MODEL BUILDER

WORLD'S MOST COMPLETE MODEL PUBLICATION

JULY 1989

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INSIDE:

Plans for a

RADIO CONTROL TIGERCAT MK II

Rubber Power PUSSYCAT

Control Line STINSON

MODEL BUILDER VISITS THE NUREMBERG SHOW

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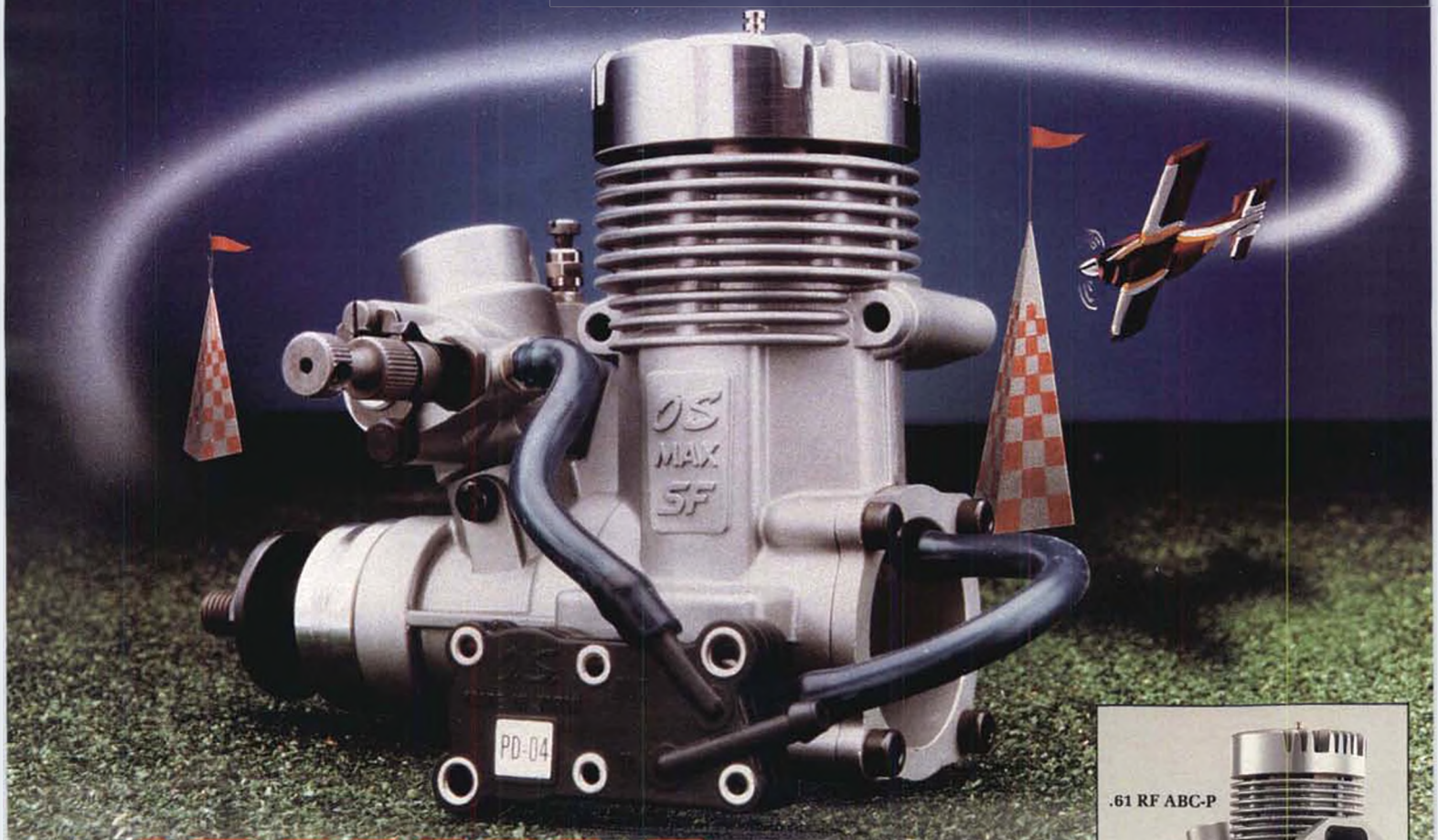

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If you fly a .40 or .46-sized plane, you can enjoy the classic features of O.S. SF engines with the bonus of a factory pre-set pump system. With Schnuerle porting, a double ball-bearing supported crankshaft, single-piece crankcase, and expansion muffler, the new **.46 SF ABC-P** is as forceful as you'd expect any O.S. engine to be. Outfitted with the newly-designed **46 Pump System**, it's the power you've asked for, and more.

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The .46 SF ABC-P's new pump and carburetor maximize fuel efficiency.

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F-8 CRUSADER, D&S #31. Kinzey. Vought's F-8 was flown by the U.S. Navy and Marines throughout the Vietnam war. Covers all fighter and reconnaissance versions. Lots of never-before-published photos of cockpit, camera bays, landing gear, engines, armament, and variable-incidence wing. Modelers section gives kit reviews, decals, etc. 223 photos, many in color, plus 3-view drawings, 72 pgs., 8½" x 11", sfbd. 1157A **$9.95**

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MODEL BUILDER

JULY 1989

volume 19, number 209

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CONTENTS

FEATURES

CONSTRUCTION

COVER: This North American SNJ-5, piloted by John Collver and his wife Donna, is being sponsored by *Model Builder* magazine during the 1989 show season. It can be seen at static and aerobatic flying shows throughout Southern California. The SNJ is in El Toro Training Command VMT-2 markings and is based at Compton Airport. John, 34, soloed on his 16th birthday, and earned his instructors rating before graduating from high school.

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EXPERT 1991-New "R.W.E.T.F." Features.

The new Expert® FM seven channel radio system is backed up with twenty-nine years of engineering, designing, manufacturing, and experience.

World Engines technicians and staff have also accumulated over 128 years of experience flying competition pattern, scale sailplanes, pylon and everyday sport flying.

This experience that combines the workbench and flight line helped us to realize that testing and accountability does not end with the test stand. Testing at World Engines starts with the lab and moves to the flying field - the ultimate test. The concept of testing continuity is called the "R.W.E.T.F." check. **Real World Environment Test Flying.**

20KHz-TX/10KHz-RX

1991

The transmitter is a lightweight, easy to hold design. Both non-slip control sticks are equipped with adjustable spring tension and stick length. Controls for aileron and rudder dual rates, retracts (ch.5), flaps with separately adjustable elevator trim (ch.7), auxiliary (ch.6), Two-way Slow Rolling, and coupled rudder mixing, are positioned at your fingertips. Other adjustments which are not needed while flying, such as servo reversing, roll rate adjustment, and all mixing adjustments are securely located under the rear panel on the back of the transmitter.

An extremely narrow crystal filter is used in our new receiver to virtually eliminate outside interference. Its small size and light weight allow it to be used in almost any application. The new Expert® FM receiver has demonstrated its ability to fly at locations that other brands are not considered flyable.

Finally, the new Expert® FM system has one feature that is hard to match, the backing of a dependable service department located here in the central United States.

Make the Expert® FM seven channel system your system for 1989. Why pay for features that you will never use and may even become serious service problems down the road.

NEW! TWO WAY SLOW ROLL SWITCH
Roll either left or right with a simple flip of the switch. Rolling rate is adjustable.

NEW! V-TAIL MIX
Allows the rudder and elevator servos to act as two separate servos or as two servos in parallel. Perfect for gliders, pylon, and models using a V-Tail.

NEW! DELTA MIX
Allows the aileron and elevator servos to act as two separate servos or as two servos in parallel. Use instead of a mechanical elevon mixer.

SERVO REVERSING
The throws for all seven channels can be individually reversed by simply throwing one of seven switches located on the rear of the transmitter.

COUPLED RUDDER MIX
Aileron and rudder mixing allow for coordinated turns in quarter scale and larger models. This mixing feature works from the rudder and the aileron sticks simultaneously.

1991 READY
This system exceeds the 1991 standards set by the AMA. Our transmitter proudly wears the AMA Gold Sticker.

EXPERT®

ENGINEERED FOR THE SERIOUS MODELER

The Expert FM seven channel system comes complete with the new full featured transmitter, our exclusive crystal filter receiver, four weather-resistant S-25 servos with mounting hardware, rechargeable batteries in both the transmitter and receiver packs, switch harness, charger, transmitter neck strap, and frequency flag.

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New! SKYRAY 35

C/L STUNT AND SPORT MODEL

Designed by *Mike Pratt*

SIG
KIT CL-25

SPECIFICATIONS:
Engines: .19 - .35 cu. in.
Wing Span: 44 in.
Wing Area: 396 sq. in.
Fuselage Length: 33 in.

KIT FEATURES:
An Easy-To-Build All-Wood Design
Top Quality Sig Balsa And Plywood
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Pre-Bent Pushrod And Landing Gear
"Easy Hinges"
Colorful Decal Markings
Highly Detailed Full-Size Plans
Complete Hardware Package (no running back and forth to the hobby shop)

$34.95

HARDWARE PACKAGE INCLUDES:
Sig 3" Nylon Bellcrank
Lead Out Cable
Wing Tip Weight
Molded Nylon L.G. Straps
Molded Nylon Control Horn
Engine Mounting Bolts
J-Bolts, Screws, Washers, And Other Small Hardware

The **SKYRAY 35** is an easy-to-build .19 - .35 size profile model that is suitable for a wide variety of control-line flying fun. This excellent all purpose design is suitable for stunt, combat, racing, or general sport flying. When equipped with a .19 engine, it makes a great control-line trainer. Bolt on a Fox .35 Stunt engine, and the **SKYRAY 35** will fly the complete AMA stunt pattern. Install a high-performance combat engine, and you'll have a real *HOT ROD* on your hands! Dyed-in-the-wool "roundy-rounders" will really appreciate the **SKYRAY'S** rugged construction and super tough wing design, which features spruce spars and die-cut Lite-Ply wing ribs.

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Dreamgirl.

With her stunning looks and sparkling performance, who could blame you for guessing that the Sophisticated Lady might be a bit of a snob?

Fact is, she isn't.

She's a high-flying beauty with a personality that couldn't be more down-to-earth.

SOPHISTICATION. NOT COMPLICATION.

All the tricks are in the engineering—not in the skills you'll need to build her. The Lady's designed to go together straight and true, with the help of plans and instructions that may be the most complete you've ever seen. There's even a section on techniques for the various forms of soaring.

So if you aren't an experienced builder, don't let her graceful lines and state-of-the-art T-tail scare you. Building the Lady is a piece of cake.

THE LADY LOVES A CHALLENGE.

The C.G. Electric Power Pod (No. 678), is perfect for the Sophisticated Lady, the Gentle Lady and lots of other 2-meter gliders.

Even if you put her up in weak air, her extraordinary L/D will reward you with impressive durations.

In more active conditions, add a bit of ballast and the Lady's slim airfoil and slender contours let her knife through turbulence and handle booming lift with ease.

And while she's built to shrug off the rigors of standard 2-meter high-starts and lift-grabbing tight turns, she won't be insulted if you prefer the more relaxed fun of powered climbs with the C.G. Electric Power Pod.

Whatever your pleasure, the Sophisticated Lady is great company.

SHE'S GOT ALL THE ESSENTIALS AND SOME EXTRAS, TOO.

As you might expect, the Lady's kit is complete in every detail. The wood is select, the cutting is precise, the hardware is like fine jewelry, and there are nice touches—like her formed canopy and cockpit detail—just to sweeten the deal.

And speaking of the deal, you don't have to be a big spender to take her out, either.

So don't keep the Lady waiting. She's at your local dealer's now, and we hear she's just dying to meet you.

CARL GOLDBERG MODELS INC.

THE SOPHISTICATED LADY (KIT 59)
SPAN: 78½"
LENGTH: 43"
WING AREA: 663 SQ."
WEIGHT: 25-29 OZ.
RADIO: 2 CHANNEL (MIN.)

The Sophisticated Lady.™
A 2-meter thriller from Carl Goldberg Models.

OVER THE COUNTER

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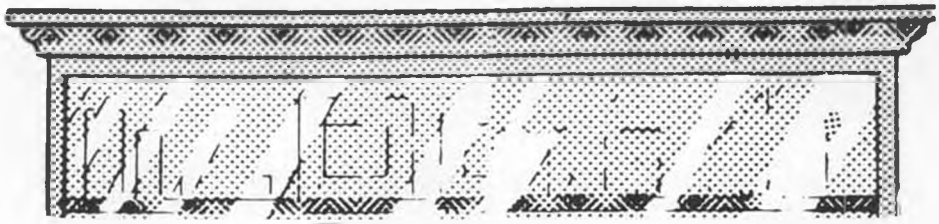


• First bit of news this month is that Great Planes Model Distributors is now offering Kyosho's Auto Cut-Off as a separate item for individual electric power installations. This device, which is included with Kyosho's ARF electrics, is a radio operated electronic on-off motor switch that runs the radio off of the on-board motor batteries (six or seven cells). The advantage, of course, is that no motor control servo and no separate radio battery are required, making for a much lighter and more compact installation. As the name implies, the Auto Cut-Off is designed to automatically shut the motor off when the battery voltage drops to a predetermined level, saving enough juice to run the radio long enough to get back down safely. Other safety features include a 30-amp inline fuse and a pushbutton arming switch to guard against premature motor start-up when the radio is first turned on. The unit plugs into the throttle channel on the receiver and is available with Futaba G, J, and Airtronics connectors.

From Great Planes Model Distributors, P.O. Box 4021, Champaign, Illinois 61820.

• • •

Sailplanes designed for the novice R/C pilot are usually two-meter span or smaller, but the new "Habicht" (German for Hawk) from Robbe is an easy flying 110-inch glider that features a molded plastic fuselage and Jedelsky type prefabricated wing panels.

Dieter Schluter's "Magic" helicopter, from Robbe Model Sport.

The "Habicht" (Hawk) from Robbe Model Sport, 110-inch R/C glider for novices.

Said to be extremely docile and requiring only a two-channel R/C system, the model can be flown as a pure sailplane (hi-start or slope) or as a motorglider using Robbe's optional power pod for .09 size engines. The kit includes sanded tail surfaces, hardware, decals, plans, and instructions.

Also new from Robbe is the "Magic" R/C helicopter, the latest from Dieter Schluter of Germany. Our "Chopper Chatter" columnist, James Wang, is planning to do a complete review of the Magic in the near future, so we'll hold off mentioning any details except to say that it's a .60 size machine that just may be the hottest competition helicopter developed so far. We'll have to wait for the review to see if this is really the case. In the meantime, if you have any questions about the Magic or any of Robbe's other products, you can get answers by calling them direct at (201) 359-0157.

From Robbe Model Sport, 180 Township Line Road, Belle Mead, New Jersey 08502.

* * *

Terry Prather advises us that his company's prop pitch gauge, which has been out of production for several years, is now back by popular demand. This is an essential tool for anyone who demands the utmost performance out of his models. Pylon racers have long known the necessity of checking and truing their props for maximum performance. The Prather Pitch Gauge allows you to easily check or even change the pitch of your propellers as you see fit. Retail price is $59.95.

From Prather Products, 1660 Ravenna Ave., Wilmington, California 90744.

* * *

The "Skyray 35" is Sig's latest kit offering, this one being a general purpose C/L sport model for .19 to .35 size engines. The airplane was designed by Mike Pratt, who is responsible for several of Sig's C/L kits, and is based largely on the layout of the all-balsa 1/2A Skyray C/L model also kitted by Sig. The Skyray 35 has been scaled up to 44-inch span and features the usual high-quality materials found in all of Sig's kits, plus a full hardware package. Asking price is $34.95.

From Sig Mfg. Co., 401-7 South Front St., Montezuma, Iowa 50171.

* * *

Three Radio Control Handbooks by Argus, from Zenith Aviation Books.

If you're one of those modelers who rightfully believe you can never have too many tools, you'll want to add Design Enterprise's "Miter Magic" to your shop. This is a small mitering tool used with your razor saw, for cutting strips and sticks at precise angles in 150 increments from 45° to 90°. it works both right and left handed; the saw remains constant in relation to the base of the tool and the material is moved through the desired angles. As a final touch, the bottom of the base is covered with an abrasive paper to keep the thing in one place while being used. Certainly seems worth the asking price of $2.98!

From Design Enterprise, Rt. 5, Box 10, New Richmond, Wisconsin 54017.

* * *

We received copies of the first three of a new series of modeling books published in England by Argus Books and distributed in the U.S. by Zenith Aviation Books. The titles are *Building From Plans*, by David Boddington; *Installing Radio Control Equipment*, by Peter Smoothy; and *Setting Up Radio Control Helicopters*, by Dave Day. We haven't had a chance to do more than give each one a brief look, but can tell you that they are all very professionally done and appear to be quite comprehensive. Each is in a 7-1/4x10 format, with 64 pages and 80 illustrations apiece. Going price is $9.95 each.

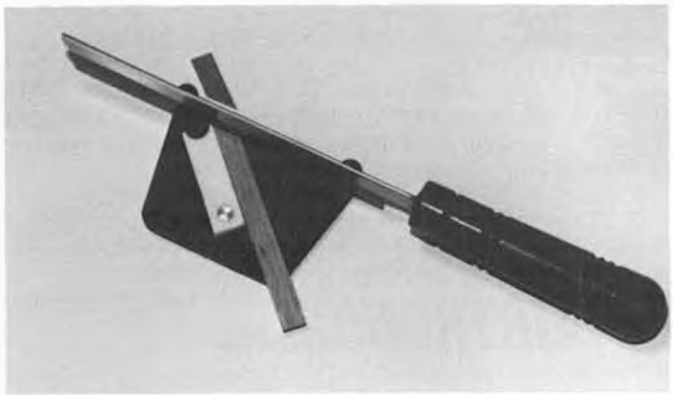
A 3-in-1 Piper Cub plan (shows clipped wing and Super Cub) in 30% scale by Hostetler.

From Zenith Aviation Books, P.O. Box 2, 729 Prospect Ave., Osceola, Wisconsin 54020.

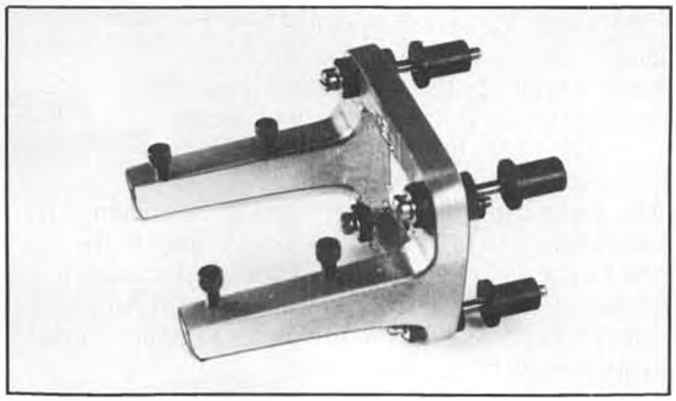
* * *

A number of vibration isolated engine mounts are now available to modelers and the newest ones to appear are the "Snuf-Vibe" mounts and mounting kits just announced by J'Tec. The Snuf-Vibe system completely encloses the engine mounting bolts with neoprene rubber, both in the engine mount itself and in the firewall, for complete vibration dampening. Snuf-Vibe *mounting kits* consist of four bolts and all the necessary neoprene grommets and bushings to adapt any brand of aluminum or glass-filled nylon mounts to the vibration isolated type. Snuf-Vibe *mounts* include all of this hardware plus a cast aluminum J'Tec engine mount, which can be supplied either drilled for a large variety of two and four-cycle engines, or undrilled.

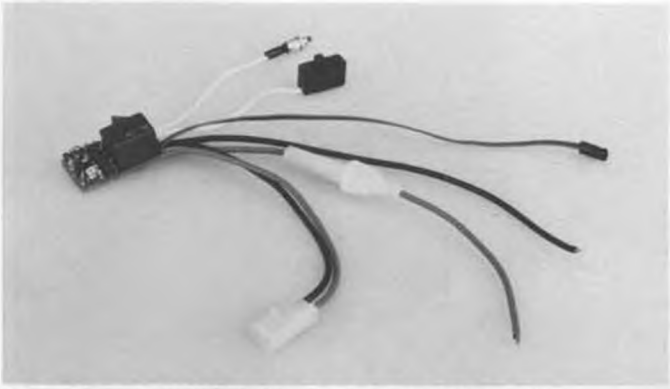
For an info sheet listing all of the drilled Snuf-Vibe engine mounts available, send an SASE to J'Tec, 164 School St., Daly City,

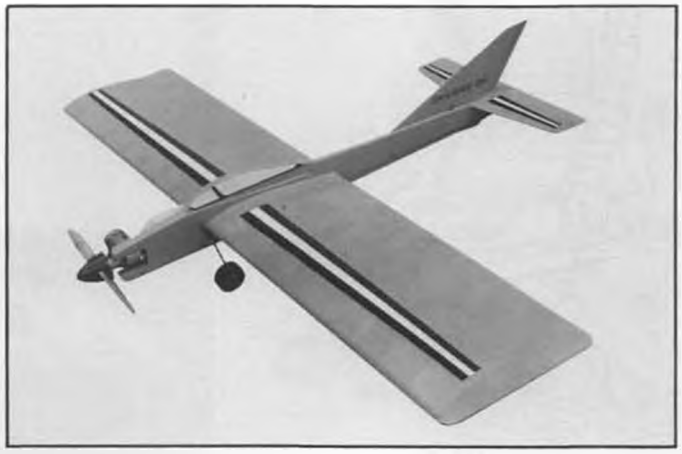


The "Miter Magic" by Design Enterprise.



"Snuf-Vibe" engine mounts by J'Tec.





Above: The Auto Cut-Off by Kyosho, from Great Planes Dist.
Right: "Skyray 35" C/L sport model from Sig Mfg. Co.

Futaba's 5UA system AM sport radio.

California 94014.

* * *

Futaba's new 5UA system is an inexpensively priced five-channel AM sport radio with such features as a plug-in transmitter RF module, ATV on four channels, dual rates on two, and servo reversing on all five. The system is supplied with Futaba's R117H AM receiver (meets 1991 specs) and four S148 servos. The new 5UA system should be available at your local hobby shop by the time you read this.

From Futaba Corp. of America, 4 Studebaker, Irvine, California 92718.

* * *

Those beautifully made functioning landing gear shock struts from Impact Engineering are now also being made available in kit form, saving the buyer up to twelve bucks over the factory assembled prices. Four different styles are offered, each in three different sizes, both with and without the optional scissor linkage. Construction is of aluminum with stainless steel strut pins. These are not exactly inexpensive items—prices for a pair of mains range from $29.95 to $89.95—but for those who want the very best, this is the way to go.

The same can be said for Impact Engineering's pneumatic retract systems. These are available in three different sizes and have such features as pneumatic drive both up and down, positive mechanical lock in the up position to keep the gear from sagging during high-G maneuvers, and a safety spring system that automatically locks the gear in the down position if air pressure is lost. System prices start at $139.95 and are complete with retracts, rotary spool valve, fill valve, tank, hoses, and all necessary fittings.

If interested, your best bet would be to send a large SASE and ask for their information and pricing brochure. Write to Impact Engineering, 2100 Stonehill Court, Arlington, Texas 76012.

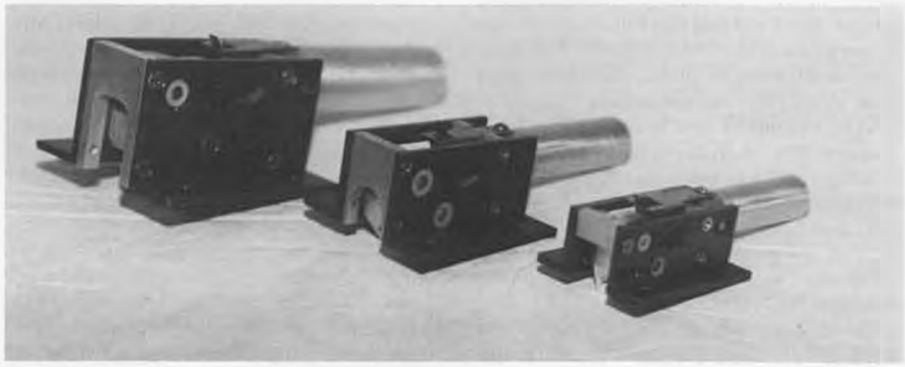
* * *

Wendell Hostetler is celebrating his tenth anniversary in the Giant Scale plans business by announcing a 3-in-1 Piper Cub plan, which includes the standard J-3 Cub, clipped-wing Cub and Super Cub. The plans are drawn at 30% scale, which makes for a span of 127 inches (102 inches for the clipped-wing), a wing area of 2280 square inches (1824 for the clipped-wing), a length of 76 inches and a flying weight of 22 to 25 pounds.

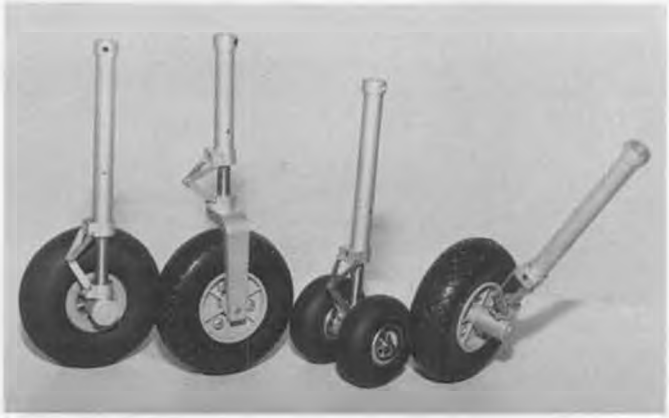
Accessories available include three different cowls, a heat treated shock absorbing landing gear, vinyl decals, and plans for a set of 60-inch Edo type floats.

The Piper Cub plans are drawn on two 42x96-inch sheets and are priced at $29.50 postpaid (U.P.S.). Float plans are $15.95.

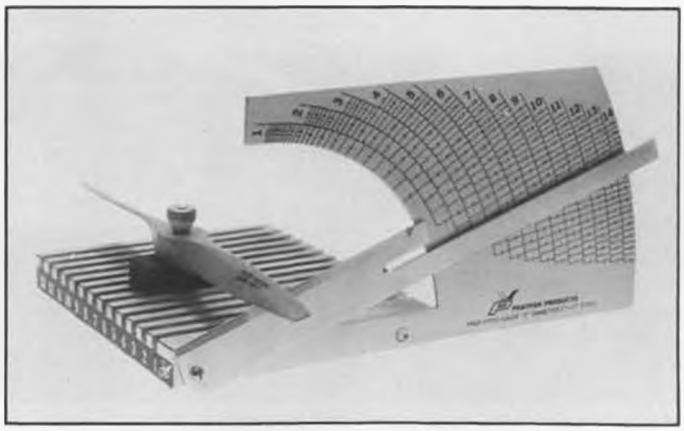
For more information on the accessories listed above as well as the other plans in the lineup, send an SASE to Wendell Hostetler's Plans, 1041 Heatherwood Lane, Orrville, Ohio 44667. •



Impact Engineering's pneumatic retract systems.



Functioning landing gear shock struts from Impact Engineering.



The Prather prop pitch gauge is back.

from Bill Northrop's workbench

Plane on the cover, with its co-owners; (l to r) Donna and John Collver (pilot), and Ron and Joannie Custer (Donna's parents). The SNJ-5, built in November 1944, is powered by a 600 hp Pratt & Whitney engine displacing 1340 cu. in. It is based at Warbirds West, Compton Airport, in Southern California. See cover story on page 2 for more information.

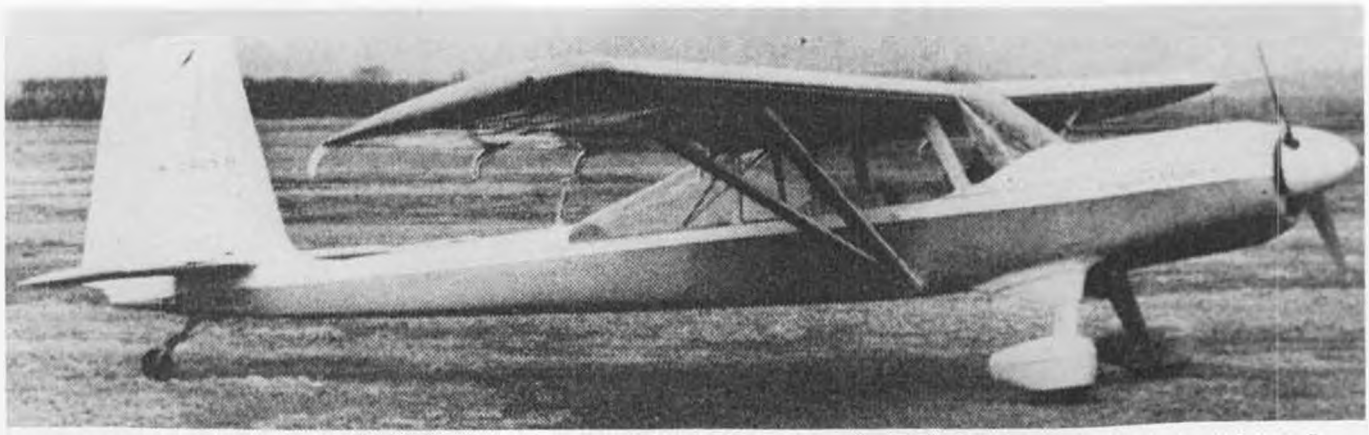
BEST LAID PLANS

We were real proud of that interesting photo on last month's cover, and made special effort to assemble all the proper information for the "Cover Story" that always appears below the Contents, on page 2. We called Mike Cioli, president of Circus Hobbies, in Champaign, Illinois, to confirm the identity of the two model helicopters and their pilots. We also called Mel Larson, Executive V.P. of Circus Circus Enterprises, to get all the specifics on his Bell Long Ranger. We then fed this information into the cover story that had already been outlined, and then took off for Atlanta to settle some details for the upcoming IMS show in May. Wouldn't you know it? The typo gremlins got in there when we weren't looking, and took Mel's chopper away from him and gave it to his boss, Bill Bennett, and not only that, threw in his wife Marilyn for good measure! Sometimes it just doesn't even pay to get out of bed!

SOMETHING NEW

The thirty-fifth edition of the oldest running R/C model show, put on by the Toledo Weak Signals R/C Club, is now history. Incidentally, it was the twenty-seventh consecutive Toledo show for this writer, who drove out from Delaware with fellow club member Graham Lomax through rain, sleet, and snow to attend the 1962 gathering at a golf course country club, under 15 inches of white stuff on the ground, somewhere south of town. I entered the static model competition with an aerobatic model that took first place in the Intermediate category. For the information of newer R/Cers, the Pattern event back in those days was divided into equipment categories, not skill levels. Rudder Only was exactly what it implies; control of the aircraft by the rudder . . . no elevator or ailerons . . . and some kind of throttle control. Don't shake your head. We could do barrel rolls, Cuban Eights, consecutive loops, etc., even hit-and-gits (touch-and-goes) with no more than rudder . . . honest!

Intermediate was the next category, in which two control surfaces were allowed . . . usually rudder and elevator, though in later years, before the system was changed, some were using aileron and elevator . . . plus throttle, of course. The catch was that, until later years, this category, like Rudder Only, was limited to the use of a single channel radio. As a result, there were some real Rube Goldberg devices . . . and some real clever ones . . . that gave rudder, elevator, and throttle off a single radio channel. I had designed, built, and test flown a streamlined version of my "Square Hare," which was dubbed the "Smooth Hare." It was equipped with a single-channel Kraft receiver, and the rudder and elevator were controlled by "Galloping Ghost," a system in which one electric motor in the plane was pulsed back and forth, causing the rudder and elevator to simultaneously pulse from side-to-side and up-and-down respectively. A stick-controlled pulse box in the hands of the operator could make the pulsed signals from the transmitter vary in rate and width, which in turn, caused the elevator to pulse more up than down or more down than up, and the rudder to pulse more to right or more to left . . . the first crude proportional control in which the model more or less . . . very often less . . . followed the movement of the control stick. You had to see it to believe it!



George Ardwin, 52 Ely, Sabina, OH 45169, is looking for 3-views, colors, photos, etc. on this Skylark SRX-1, built in Ft. Worth, Texas circa 1954. Test flown by Marion Cole, it was an STOL design. Can anyone help George on this one?

The third, and eventually only control system category for Pattern competition was called Multi, meaning, of course, that multi-channel radios could be used. In those days, the multi radios were based on vibrating reed systems. The transmitter emitted different tones, according to which toggle was pushed in one of two directions; up and down or left and right. Each tone picked up in the receiver caused a certain reed to vibrate, something like a tuning fork, thus closing a circuit to a relay, which acted as a switch to activate a servo in one direction or the other (It took two channels for each control. A ten-channel radio had the same number of controls as today's five-channel radio). Lots of things depended on lots of other things, just to get a control surface to move in a certain direction . . . like having to count on several subcontractors to do the right thing at the right time just to get one little project completed, and most of us know how often that works . . . seldom!

We have kinda wandered off the main subject, R/C model shows. In the early days, the shows were more like symposiums, where leading radio control modelers from around the nation, gathered together to compare notes and trade ideas. In fact, the gathering put on by the District of Columbia R/C Club was billed as such; the "DCRC Symposium." Toledo and Buffalo were among the first to offer space to manufacturers to show their products. The 1962 show in Toledo had about a dozen manufacturers. Carl Goldberg introduced his original Falcon at this one. These and other shows, such as put on by the clubs in Garden Grove, California (later replaced by the IMS), the RAMS in Seattle (now the Northwest Expo), the WRAMS in White Plains, NY, a multi-club group in Chicago, and several others, played a major roll in the progress of the R/C industry. In the past 15 years, the emphasis of the shows has changed to being primarily a showcase for the manufacturers, who found from bitter experience that the only strictly "Trade Show" in town, that which was put on annually by the HIA (Hobby Industries of America), did not serve their purposes as well as the private shows. Have some of them forgotten this?

So what was new at Toledo '89? There were many refinements and updates of existing products, but the one thing that struck us as being really new was what might be considered a minor category . . . covering material. Representatives of the English company, Solarfilm, which produces that well known plastic covering film, came by our booth with something that should interest all categories of aircraft modelers . . . iron on, heat shrinkable tissue! Called "LiteSpan," the material is described by Solarfilm as follows: "LiteSpan is a very light, strong, synthetic material which is airtight, waterproof, resistant to diesel and glow fuels. It is heat sealed to the model (after coating the model with [an] adhesive [called Balsaloc]). It is then shrunk by extra heat to tighten. It can be painted—so it is an excellent material to

Continued on page 108

ADVICE FOR THE PROPWORN
—By Jake

Dear Readers:

Open your minds and close your noses. It's time once again for another episode of Jake's Adventures in Glossary Land.

For those of you who may be new to this column (although I believe the last time I picked up a new reader was June '87), Jake's Glossary of Misunderstood Modeling Terms is a list of definitions and/or explanations of modeling names, phrases, and jargon that hobby writers tend to use under the assumption that everybody already knows what they mean. Well, not everybody does, so that's why the glossary is published every now and then.

I can't catch them all, so if I miss your favorite please feel free to drop me a card with any terms that you don't understand. I'll do my best to get them defined for you in a future column.

Jake

* * *

Jake's Glossary of Misunderstood Modeling Terms

Tri-Pacer: Three legged race horse.
Diode: The princess was in debt.
Steel Wool: Textile product obtained from armored sheep.
Oil Pan: Used by prospectors to sift oil from riverbeds.
Reverse Stagger: When a drunk walks backwards.
Bending Moment: Time warp.
Tuned Pipe: Plumbing that hums in C-sharp when you flush the toilet.
Toggle Switch: Device which turns your toggle on and off.
Wing Root: Part of the wing that grows underground.
Left-Hand Thread: Sewing supply for southpaws.
Hardened Axle: Tough old German.
Woodruff Key: What didn't work after Mrs. Woodruff changed the locks.
Jam Nut: Person crazy about preserves.
Tail Slide: A maneuver performed in aerobatic competition.
Landslide: A maneuver performed in California when it rains.
Operating Range: Stove that works.
Sea Fury: Black seahorse loved by a young boy.
Guy Wire: Opposite of gal wire.
Twisted Pair: What you get when guy and gal wires get together.
Turbine Inlet Temperature: Degrees Fahrenheit at which a Muslim comes in out of the sun.
Water Ballast: Wearing a weighted shoe on the leg that isn't bloated.
Vintage Aircraft: Grape crop dusters.
Flight Deck: Cards obtained from a stewardess.
Spoileron: Turn Leron into a brat.
Lift and Drag: How you get a drunk home.
Thickness Ratio: Skull measurement parameter inversely proportional to IQ.
Transonic Performance: Your radio's ability to pick up overseas stations.
Avogadro's Number: Six per pound of guacamole.
Half-Round File: Government list of people who are 50 percent overweight.
Wing Saddle: Invention which allowed Roy Rogers to teach Trigger how to hang glide.
Pylon Race: Five-yard dash to see who can be first to dive on a fallen quarterback.
Nose Wheel Strut: Proud walk characteristic of someone whose nose is so big it needs a set of wheels.
Sonic Boom: Period following World War II when many transistor radios were born.
Shrink Coverings: Psychiatrists' bedspreads.
Stall Warning: Sign in stable that says "Watch where you walk."
Stagnation Point: About 42 minutes into a Botanical Society slide show.
Spoke Wheels: Talked about tires.
Carving Blanks: Whittling bullets that don't work.
Hand-Carved Propeller: Usually happens the other way around.
Glow Plug: Old horse with a snoot full.
Fighter Pilot: Sugar Ray Yeager.
Die Casting: How old fishermen want to leave this world.
Toledo: Part of the old expression, "It's possible Toledo horse to water, but you can't make him drink."
Swap Meet: Exchange ground round.
Terrain Following: Putting (a golf ball).
Binary: Requiring two hair removal applications. •

NUREMBERG FAIR 1989

The Electric Wave

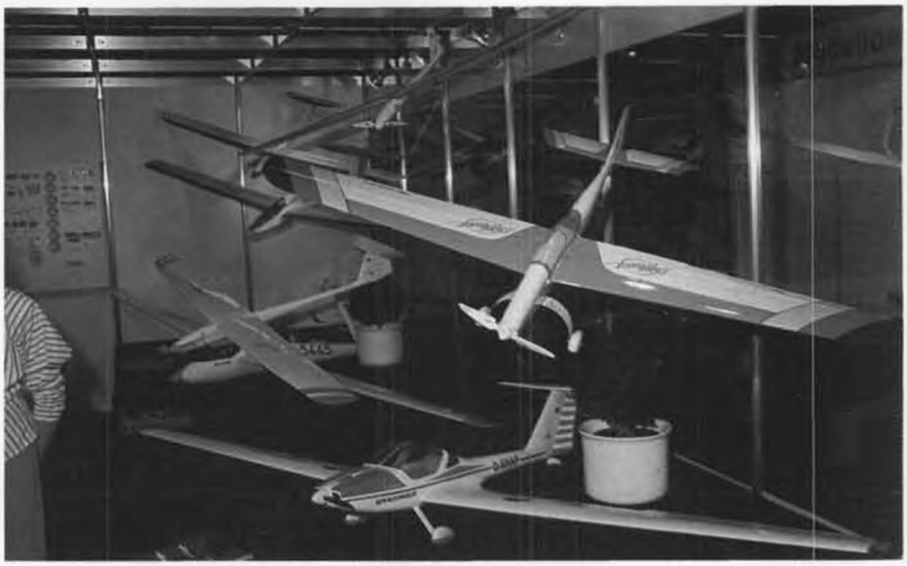
By noted European model reporter, GUY REVEL

• I came for the first time to the Nuremberg Toy and Model Fair as a youngster. The German market was then a kingdom of small manufacturers/distributors, only one (Graupner) standing well above the others. Asian companies were numerous on the toy market but simply nonexistent for our hobby and so was, also, the American model industry, which was much too comfortable at home to bother about the European market.

Things have changed since then. The Fair has moved to much larger premises and is still growing, by over 5% this year. The European model market is now the equal of the Japanese or the American ones and manufacturers like Graupner and Robbe, each employing well over 300 people, are the largest in the world in their branch. Japanese and American manufacturers now care about exhibiting in Nuremberg; they usually have to wait a few years before a space becomes available.

The German model manufacturers dominate the European scene, although this is not true any more of engines, which come mostly from Japan or Italy. Even radios have to conform to the German style and are widely accepted in Europe.

Interesting "Moseppl" by Wanitschek is a true scale model of a German motorglider. It's an electric ARF with a 150-inch span and 12-lb. flying weight.



All these models in the Aeronaut booth are electric powered. The model hanging suspended in the foreground is a 68-inch Pattern ship by current F3E World Champion, Rudi Freudenthaler.

"Tray" style transmitters are the norm, with many features unique to Europe. But more about that later.

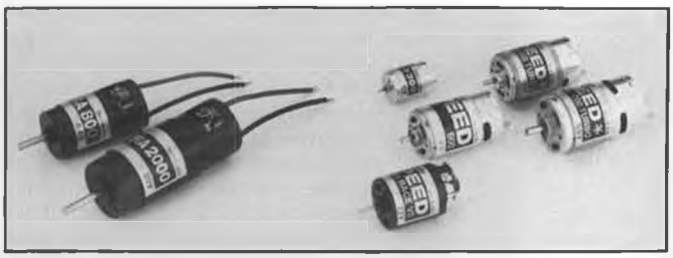
SAILPLANE ACTIVITY

European modeling is fairly evenly split between powered models and sailplanes, helicopters being only 5% of the total activity. Some countries, like Switzerland, are more heavily involved with gliders (up to 90% of the total motel activity, with four-stroke engines and electrics taking a fair percentage of the remaining). Germany has, up to now, a fairer balance, with sailplanes more and more on the lead. Fields are becoming more scarce and are subjected to strict limitations. As is the case throughout the world, noise is one of the biggest obstacles. However, this is only one reason why sailplanes are so popular and why the most renowned manufacturers like Graupner and Robbe have an impressive number of large models, usually scale or semi-scale, in their catalogs. The upper span limit seems to be around 12 feet, with sales volume usually well into the several thousands per year, while the average size is more conservative at around 100 to 120 inches. Of course, one can find a lot of smaller manufacturers producing much larger models, but then only on a small scale of a few hundred pieces a year. Actually there are dozens of such small manufacturers specializing in sailplanes, usually of quite a high standard. This reflects the strength of the model sailplane market in Europe and above all in Germany.

ELECTRIC FLIGHT

Ever since the late Fred Militky demonstrated the first practical electric powered models in 1971 during the Aerobatics World Championship in the U.S.A., European manufacturers have developed the concept. This was a true work of faith as, although a fair number of enthusiasts followed through, it was certainly not enough to justify the heavy investments. Throughout the years German manufacturers dropped from this field, one after the other. Only Aeronaut and Robbe stood against the odds, continuing to develop

High-performance scale sailplanes with ailerons are becoming increasingly popular. Graupner's AS-W22b is available in both glider and electric models. Graupner photo.



Graupner's new electric motors include samarium cobalts (left). Ultra 2000 is big enough for 15-lb. models. Graupner photo.

The Graupner "Race Rat" can be built for either gas or electric. Features a blow-molded plastic fuselage. Graupner pic.

Futaba is introducing a new line of radios aimed at the European market. Note the tray-style transmitter. This FC-18 is the middle-range model, 10 bits PCM with extension modules and menu-driven programs. The "CAMPac" memory module memorizes all the programming data for up to twelve different aircraft and can even be copied to a normal PC diskette via a simple interface. Futaba photo.

models at a loss, with the faith that the days of electric powered models had to come sometime.

Meanwhile the field and noise problem was more acute, and the development of electric motors and batteries had progressed so far that electric powered models were flying regularly all over Europe. There was now clear evidence that electric powered models were a viable proposition. Both of the largest German manufacturers introduced new electric models. in 1987 Robbe's "Arcus," derived from a pure competition model, proved an absolute best seller on the sport market: high performance at a very low price made this a good incentive for trying electrics. Thousands of kits were sold and now, two years later, sales are still ahead of production. Last year Graupner launched a completely different kind of model: the "Elektro-Uhu" is aimed at the beginner market. It is a smaller electric glider with a low-price motor; it has surprising performance with a standard six-cell battery pack, thanks to its low weight, good aerodynamics and efficient propeller. Sales are astronomical. In fact German manufacturers sold more products for electric flight in 1988 than during all the previous years combined!

The trend is now clear, and the same happens now in all other European countries. It was evident to me, remembering previous year's fair while driving to Nuremberg, that the '89 Fair was to be even more focused towards electrics. But what I saw was beyond all expectations.

NEW MODELS

There is a significant decline in the number of new powered models. This reflects the scarcity of model fields and the acuteness of the noise problems. Many fields have strict noise restrictions, engines are even totally banned from some of them. The large model (also known as "quarter scale") trend is apparently well over in Europe after having been responsible for the loss of a number of good

This delightful Pitts S-1 by Robbe is the first true-scale electric powered airplane available on the European market. Robbe photo.

Krause is one of the many German R/C glider manufacturers. All of the models shown here span between 120 and 220 inches.

The latest from Schluter, the "Magic" R/C helicopter. State-of-the-art design and mechanics make it one of the highest performance choppers available.

flying fields. Of the very few new engines we could see at Nuremberg, the new 45cc (2.8 cu. in.) by Super Tigre, was almost an oddity. Actually most of the new powered models on display were on smaller manufacturers' stands. Robbe had only one small model, and Graupner had a very nice aileron trainer and a semi-scale jet fighter for the smaller engines as well as a ready-to-fly version of one of its most successful trainers, the "Kadett 10 FP" subcontracted to OK Model in Japan. None of the other major German manufacturers had any new powered models on show.

Although it was previously felt that the market could not justify new helicopters every year, both Heim (mainly through the Graupner and Robbe channels) and Schluter were displaying new models, all of them for .60 engines. A new version, with collective pitch, of the British MFA "Sport 500" was also on show. This helicopter is the only one on the European market still sold in a fixed pitch rotor head version. The Kyosho stand was proudly displaying the very successful "Concept 30" in all of its versions and Graupner acquired the German distribution rights of the Hirobo "Shuttle" and "Shuttle XX" (renamed "Super Shuttle" by Graupner). Proper distribution will probably boost sales of small helicopters on the European market.

Gliders are still as popular as ever. Robbe had five new models, Graupner three and this is not counting the electric powered gliders! Just think that these are entirely new models from manufacturers having already a large number of gliders of all sizes and styles in their (thick) catalogs. The new models cover the spectrum from the 2-meter ready-built (traditional wooden structure) to the 15-foot scale sailplane for slope soaring or aero-towing.

RADIOS:
COMPUTER-BASED CONSOLES

Radio equipment is more and more heavily computerized. European radios are modular, the same basic transmitter being used for powered aircraft as well as for gliders or helicopters. On the upper-class radios, specialized programs are handy for flying any type of model from the same transmitter. The new program modules on show enable more than 400 basic interactive mixing functions! Simpler transmitters can use extension modules to boost their performance up to almost the same level.

For years European transmitters have been of the tray type, as opposed to the more familiar hand-held type used in the U.S. This is one of the reasons why the largest companies have sold own-designed radios made by Japanese manufacturers: Graupner radios are made by JR, Robbe by Futaba, and Simprop (at least part of the range) by Sanwa. Lately Graupner has even sold extremely successful specially-designed servos more suited to specific European needs, particularly heavy-duty miniature servos for glider wings. These servos are exclusive to Graupner and are not to be found in the other countries with JR products.

The big surprise, this year, was the presentation by Futaba of a new range of European-styled radios, directly sold in Europe under the Futaba name. Three new radios ranging from the simple four-channel (with extension modules up to eight-channel, ten-bits PCM and advanced computer-based programming) to the "FC-28," an up-to-date competition radio

Electric motors are popular with large models in Europe, as can be seen from these examples from Graupner's line of large scale gliders.

Above: Lightweight wooden structure is the main feature of Graupner's "EPS 2000," which uses the same motor/prop combo as the "Electro-UHU." Left: Prototypes of the "Electro-Pink" were flown at the F3E World Champs in St. Louis last year.

Two small electric aerobatic/racing models from Robbe are the "Micro Racer" (above) and "Speeder-E" (right). Robbe photos.

with even more possibilities than the already-known "1024." This marks the recognition by Futaba of the European market strength and the necessity to cater for the specific needs of the European modelers.

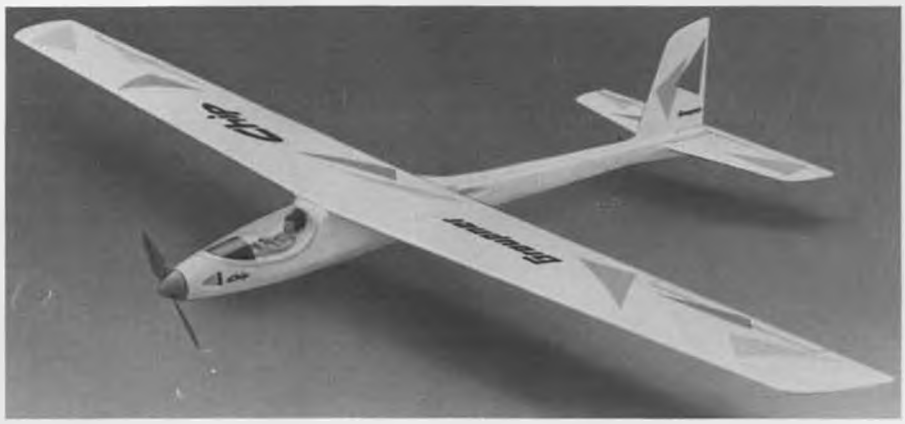
ELECTRICS

Let me tell you, the sheer quantity of new electric flying models is overwhelming. Smaller manufacturers followed the route pioneered by Robbe, Graupner and

Graupner's scale "Ventus" spans just over 12 feet with the wing tip extensions. Graupner photo.

Aeronaut and now offer a number of seven-cell gliders. Meanwhile the leading companies presented in Nuremberg many larger and heavier models designed for larger and more powerful samarium-cobalt motors. The days are gone when only models designed for small motors and seven-cell batteries had any chance to sell. The new models range from the 2-meter ready-built lightweight by Graupner to the formidable 12-foot, 13-pound scale powered sailplane by Wanitschek.

Also new is the fact that electric flight is no longer restricted to gliders. Both Graupner and Robbe had electric-powered racers designed for the international



Following the incredible success of last year's "Electro-UHU," Graupner is now producing a sportier version with ailerons, called the "Chip." Graupner photo.

7-cell class. Multiplex, Robbe and others had sport trainers, which were also on display in the American stands by Midwest and Parma, the latter being better known, up to now, in the electric car field. Aeronaut had even a true aerobatic model, spanning all of 67 inches and designed by world champion Rudi Freudenthaler. Robbe, again, exhibited a delightful scale Pitts S-1 that should prove very popular.

Apart from the quantity of new electric models, the sensation was the announcement of Robbe having taken over the Keller company, just a few days earlier. If you are interested in electric models, you probably know Heinz Keller as the world's most renowned competition motor manufacturer. His samarium-cobalt motors are used by most leading competitors throughout the world, including world champion Rudi Freudenthaler, but also by numerous sport modelers. Although Graupner has been marketing, since last year, a range of samarium-cobalt motors subcontracted to Hecktoplett, another well-known German manufacturer, the Robbe action is much more significant. Such high-quality electric motors will now

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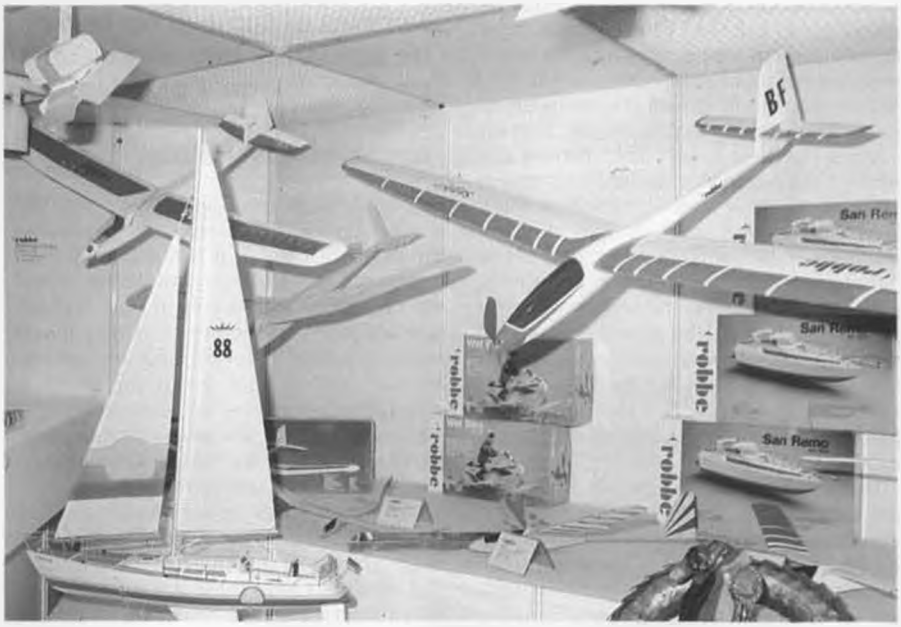


"Saphir" is the name of this ARF sailplane produced by Robbe. As with most of the current crop of European sailplanes, electric power is offered as an option.

TIGERCAT Mk. II

By BOB BENJAMIN . . . "Could-be scale" at its very best! Our author has blended the most pleasing characteristics of some of his favorite airplanes into a very appealing design. For .60 to .65 size four-strokes and experienced builder/pilots.

• The Tigercat Mark 2 is another in my series of "could-be-scale" sport aerobatic designs. I interpret this term to mean that the airplane might well be a scale model of some full-size aircraft that never quite came to be, or that it might fancifully be scaled up to full-size. The Tigercat came about as an attempt to blend some of the most appealing characteristics of the limited-displacement closed course racers of the 1930s into an appealing model. There is a strong flavor of Keith-Rider, Brown and Benny Howard in this design!

Those of you who recall my Bobcat Mark 2 (*Model Builder*, Feb. '88) may notice a similarity; in fact, this latest iteration of the Tigercat is a Bobcat in terms of moments, airfoil, and incidents. The lines have been changed to increase the appeal. The overall size has of course been reduced. The Bobcat flies well on a Saito .80; the Tigercat you see here uses a Saito .65. It also happens to fit into most cars more readily than its larger ancestor.

The Tigercat, like the bigger Bobcat, is not tricky to fly, but demands your full attention all the time. It is by no stretch of the imagination a trainer. There is a small margin of positive stability in both pitch and roll built into the design, but for practical purposes the airplane will go where it is pointed. Though by no means a real racing airplane the Tigercat is quite fast and will cover a lot of real estate in a hurry, the point being that it is not a small field airplane. On the other hand, I have tested the prototype extensively in slow flight at safe altitude and determined that it will respond safely at low speed and retains aileron control right up to the point at which the wing gives up completely and stalls out. In short, it is an exciting airplane to fly for a pilot who has some solid low-wing experience under his belt.

While laying out the structural design of this airplane I gave a great deal of thought to the demands the Tigercat will make on the modelers who build it. I've explained that it's not for novice fliers, now I'll go one better and state that it's not for novice builders, either. The whole purpose in laying out the design the way I did was to provide an airplane that would be esthetically exciting both in appearance and in flight performance. To compromise visual appeal for the sake of simplified construction seemed out of keeping with what I wanted to do in the first place. Besides, there are already plenty of easy-to-build sport planes around. My final decision was to develop this airplane as a showpiece for those of you who have learned to build well. I make no excuses for having made demands on the builder. If you like the looks of the Tigercat, but don't feel your skills are up to it, don't give up. All of us "old timers" started out just like you. Keep on practicing your flying with the models you are used to and fine-tune your building skills with a couple of good rubber powered scale kits. The excellent kits by Flyline come to mind as good examples. Believe me, the results will be worth the work. I've been flying this airplane for a year at the time of this writing and I still get turned on just looking at it hanging on the wall of my shop. It has never failed to elicit all sorts of positive comments from fliers who see it for the first time.

As has been the case with other designs I have presented in *Model Builder*, I make use of a lot of spruce and basswood in this model. While these woods exact a small

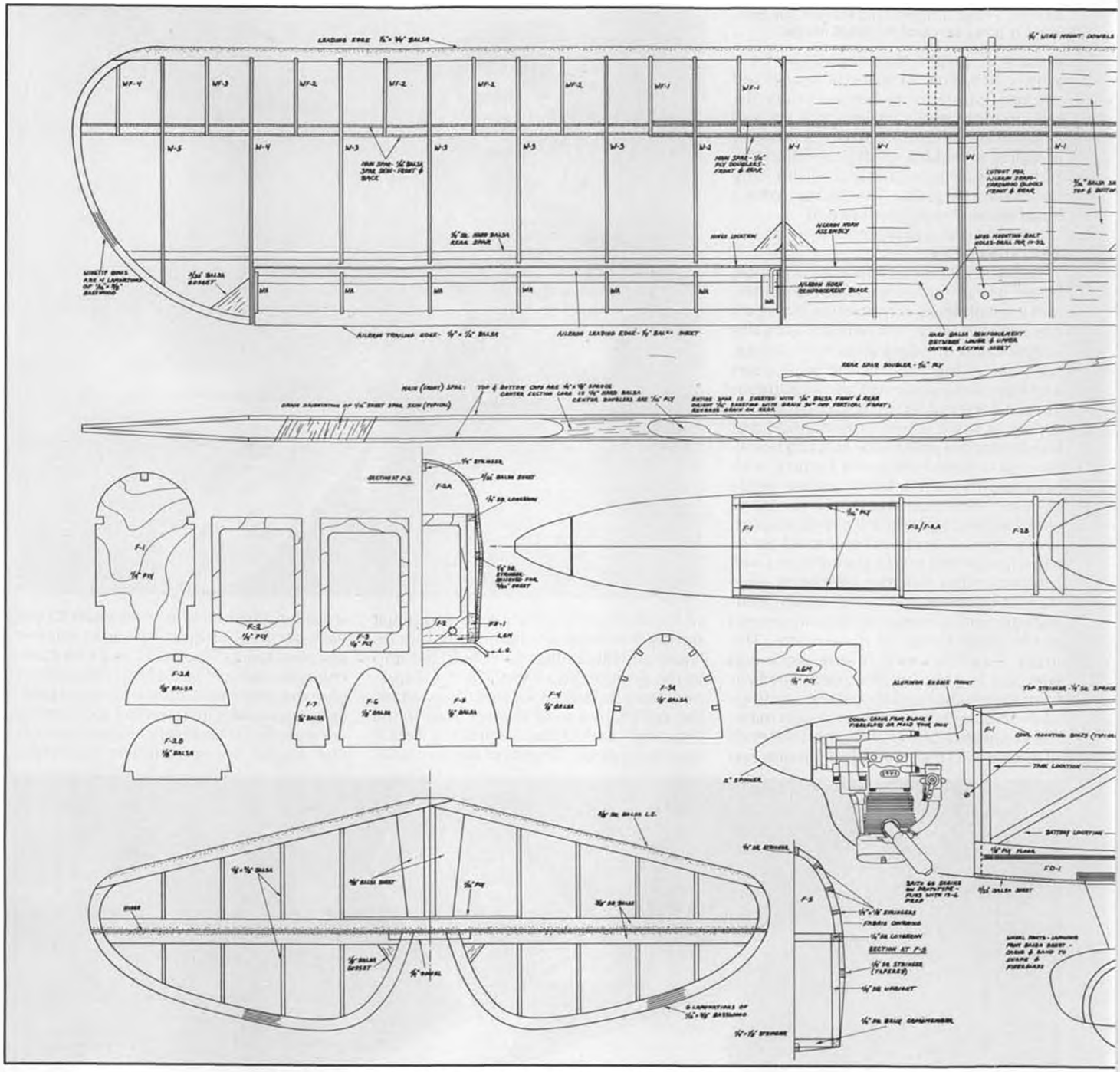
At right, expert designer and builder Bob Benjamin is justly proud of his latest model.

penalty in weight, they return the favor amply in terms of greatly increased strength, resistance to bowing under the tension of a properly applied covering, and in dent resistance. While there is no point in trying to make a crash-proof airplane, building one to withstand all the little knocks and dings that come along makes a lot of sense. Try it, you'll like it!

Let's build this airplane!

TAIL SURFACES

Both the horizontal and vertical tails are based on laminated basswood outlines, and it is with these components that you'll need to start work. I have been using this approach to building attractive, strong, scale-like flying surfaces for some years and have long since stopped making involved forming fixtures. Cut an ample supply of small blocks of firm wood that you can readily pin to your building board. Having covered the work surface with plastic, firmly pin a block on the inside edge of the horizontal tail laminate outline wherever you feel you will need a support. (Every two or three inches should do it; experiment until you find what works well for you.) Note that the laminated edge starts at the outer end of the straight leading edge and continues all the way around to the inside corner of the elevator. This entire length is made in one piece and later cut to separate the fixed stabilizer from the elevator. Lightly wet the bass strips and wipe them dry. Leaving enough material to run several inches beyond the ends of the finished piece, securely pin one end of the inner strip to the board and pull it tightly into position against the blocks. Move any blocks that don't hold the strip in the position you want. Pin the strip as necessary to keep it located. Now attach the end inch or so of the next strip to the "starting" end of the laminate. I find it easiest to stagger the ends of the successive strips by a half inch or so in order to pin each securely without having to remove any pins. Using "Special T" and Kick-It accelerator, secure the starting end and then glue the entire strip a few inches at a time, keeping it under light tension and pinning as necessary as you work around the outline. Repeat the operation for each strip,



FULL-SIZE PLANS AVAILABLE — SEE PAGE 106

removing and replacing any pins on the outside of the laminate. Repeat the sequence for the other side of the horizontal tail. You'll find that the entire surface outline can be laminated in a surprisingly short time. Leave the assembly on the board until it has had a chance to dry thoroughly, then pull it up and true up the top and bottom surfaces with a sanding block, then trim the ends to exact length. I'd suggest that while you're in the laminating business you go ahead and make up the vertical tail outlines and wingtip bows as well. Kind of neat stuff to play with, isn't it?

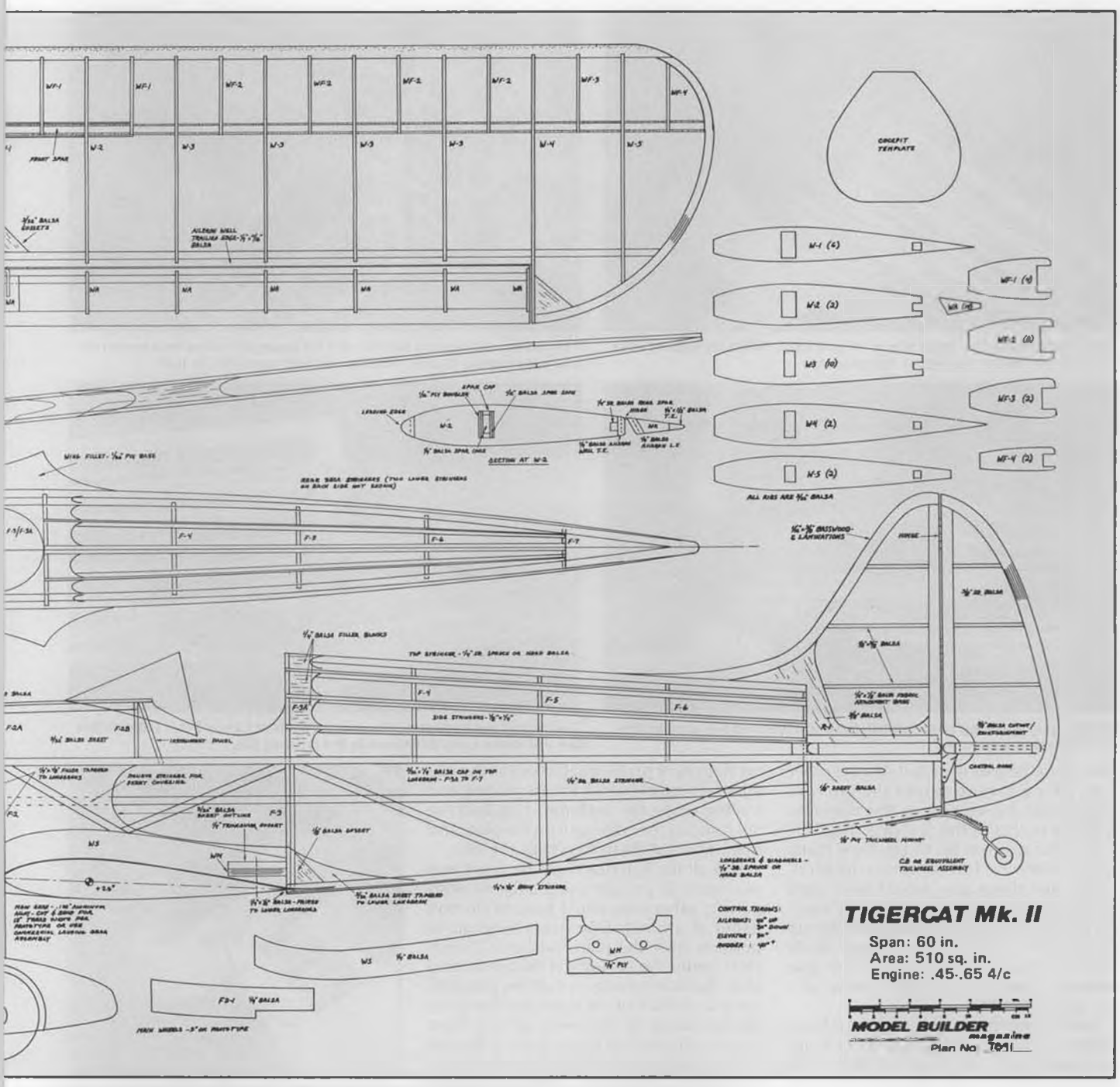
With the laminating complete, lay out the entire horizontal tail assembly. Use hard balsa for the leading edge and the hinge line edges. The 3/8 sheet fillers at the center can be lighter. Don't forget to leave a 3/8-inch opening there for R-1 to fit through later. The dowel elevator joiner is inset into the leading edges of the elevator halves. Make the trailing edge gusset on one side of the elevator full depth to provide an attachment point for the elevator horn. Block sand the entire assembly true and round all edges to a 3/16-inch radius. These tail surfaces are intended to simulate a welded steel tube and fabric structure, and are not tapered or airfoiled.

Build up the vertical tail and rudder in the same way. Notice that R-1 extends down to the lower surface of the horizontal tail. Orient the grain on R-1 as shown. Leave the finish sanding of the forward portion of the leading edge until after the vertical tail has been assembled onto the fuselage, so that you can fair it properly into the dorsal stringer.

Test fit the control horns and hinges for the tail surfaces and set the assemblies aside.

WING

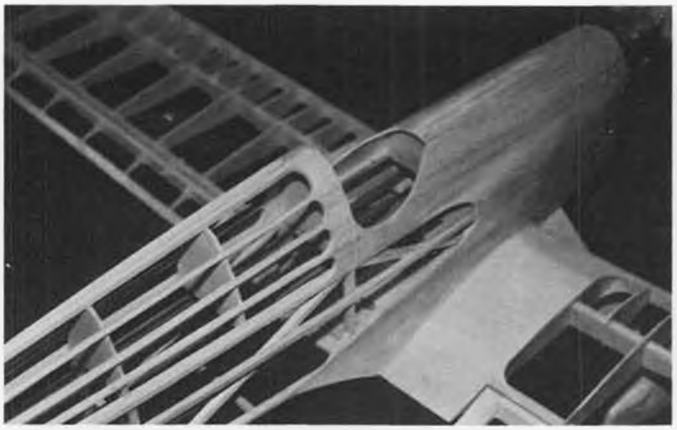
The main wing spar on this airplane is a little different from what you may be used to. Treat it as a separate construction project in its own right and take pride in doing a good job. *Don't* be tempted to substitute a chunk of hard sheet for the built-up spar. It might work, but I wouldn't want to guarantee it. The entire wing was conceived as an exercise in being different for the sake of enjoying good craftsmanship. It's in keeping with the rationale



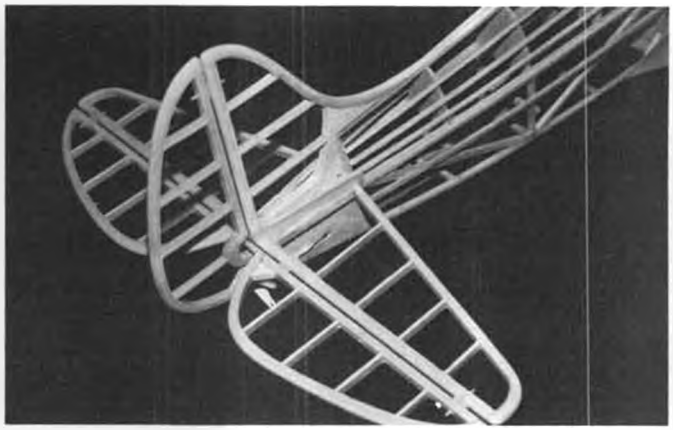
behind the entire airplane. If you're still with me at this point, we're in tune and I need say no more.

Start building the spar by cutting out the sheet balsa center core. "Split the difference" with the grain direction so the grain is at a 2 degree angle to each wing panel. Use uniform, hard wood and *do* make the cutouts at the ends of the core; the idea is to avoid any abrupt changes in the bending modulus of the spar which might provide stress foci and convenient locations for failure.

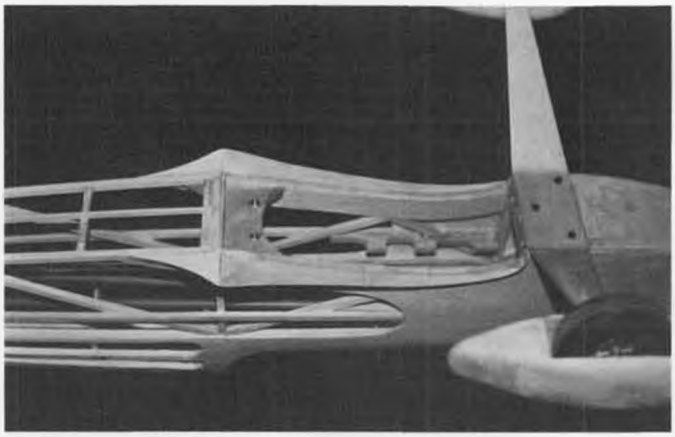
Assemble the 1/4x1/8 spruce spar caps on the core over the plan; follow this by adding the 1/16 balsa sheet spar skin to the "top" face of the spar while the assembly is accurately pinned to the plan. Note that this sheet is oriented with the grain running 30 degrees off the vertical. With the skin in



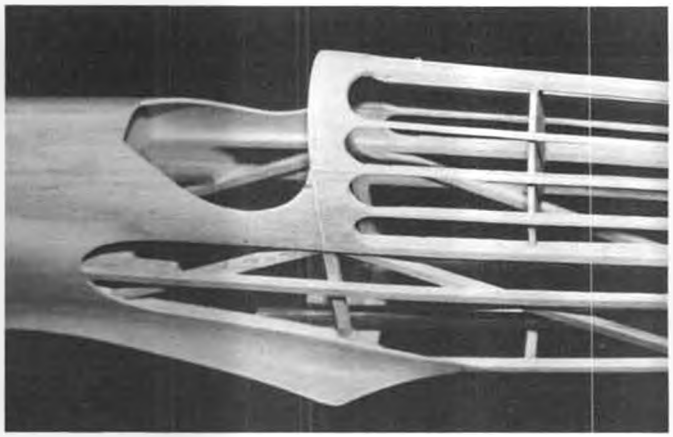
Wing fillets are Sig Epoxolite over a 1/32 ply base. Fillets are applied after the front end of the fuselage is fiberglassed.



Tail surface outlines are laminated from basswood strips for a more realistic appearance. Simple technique is fully explained in text.



Landing gear and wing saddle detail. Note also the plywood wing attachment plate and servo tray.



The cockpit area, showing the stringer fillets at former F-3A. Little details like this make a big difference in the finished job.

place, turn the spar over and skin the other side, taking care to orient the grain 30 degrees off the vertical in the direction opposite to that of the first side. The 1/16 sheet extends from tip to tip. Now make up and attach the 1/16 ply center doublers, noting that these also should have their primary grain running spanwise and "split" referent to the dihedral angle. Make up the rear spar of hard balsa and the 1/16 ply doubler. True up the edges of the spar assemblies and you're ready to get on with the wing assembly.

With a one-piece spar you will have either to build the wing on a jig or build one panel flat on the board and then rock the wing over to build the opposite panel. I used the latter method. As long as you keep the outer surface of the main spar square to the building surface you will have no alignment problems. Cut out all the ribs and the requisite stock for the leading and trailing edges for both the wing and the ailerons, lay the edges out on the plan, and mark and slot them to accept the ribs.

Slip all the full ribs over the front and rear spars (if you are using a jig, do both panels; otherwise, you'll have to do one panel at a time). Line everything up in position over the plan. Add a 3/32-inch shim under the W-1 ribs at the center and shim the trailing edges of all the ribs until the rear surface of the main spar is exactly perpendicular to the work surface. Now you can slip the half ribs in place, followed by the leading and trailing edges. Shim as necessary to insure that these are aligned correctly and glue up the structure. You

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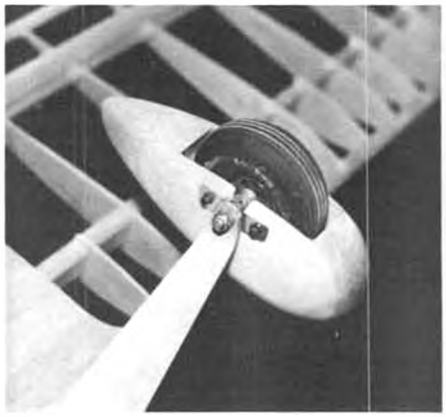
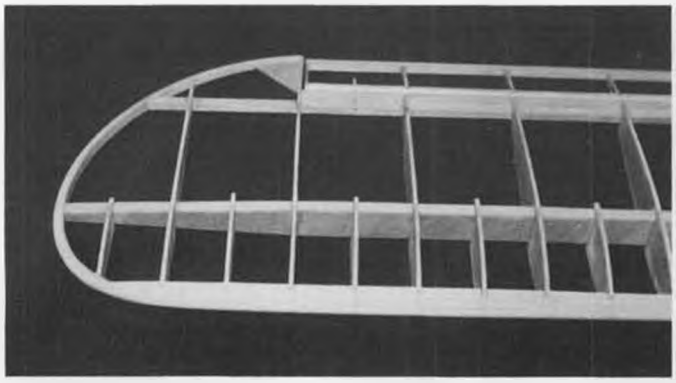
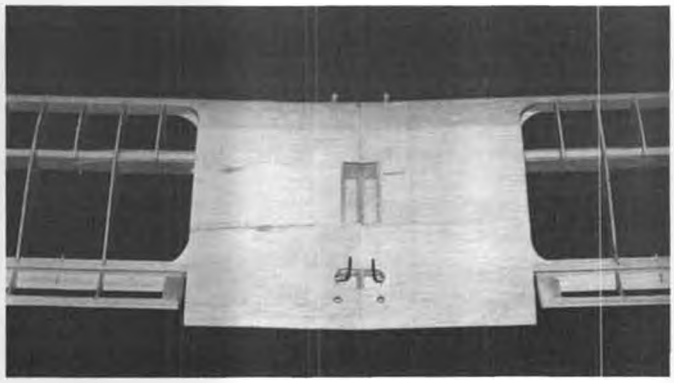


Wheel pants add a lot of class to any model. On this one, the pants are held in place by the same nut that secures the axle to the sheet aluminum landing gear.



Wingtip with all structure sanded to final shape. Note how the leading edge is notched for the ribs. Spar web grain is slanted 30° from vertical.



Finished wing center section shows the aileron servo cutout and aileron control wires. Sig Koverall was used to cover the author's model.

CHOPPER CHATTER

By JAMES WANG

• This month, rather than attacking some heavy-duty technical stuff, we will discuss the helicopters that are available for beginners and how to start flying your first R/C helicopter. Next month we will talk about helicopter stability and control. If you are a helinut, send in your subscription to *Model Builder*. You will be reading the forefront of R/C helicopter technology. A big "thank you" to all the readers who called or wrote. I'll continue to answer your letters as I receive them.

I assume you are reading this column because you are interested in R/C helicopters. If you are an absolute beginner who has never seen an R/C helicopter, what should you do? I suggest you make a trip to your nearest hobby shop that sells R/C helicopters. As a columnist, I cannot be biased and recommend which particular brand and model you should get. However, I *will* tell you how *I* got started. I talked to the local shops and the local heli fliers and read magazine reviews and advertisements. Back in 1976 I picked my first helicopter, the fixed pitch Schluter Helibaby (now discontinued). The Helibaby was very easy to fly. You couldn't loop or roll it, but it was very stable.

I suggest three different packages for different financial situations: budget, reasonable, and "sky is the limit." Table 1 is a compilation of almost all of the R/C helicopters sold in the U.S. that a beginner might try. If you are a student wanting to try an R/C helicopter without spending a lot of money, you are the budget type. Try an inexpensive machine specially designed for the beginner: the GMP Cricket, GMP Rebel, or the MFA 500. Any of these can be purchased for under $200. Either use your four-channel R/C airplane radio, or buy an inexpensive four-channel radio with four servos. Next, buy an inexpensive new engine. Add a gyro and field support equipment and you will be in business for about $500. These three helicopters are all fixed pitch. I learned on fixed pitch helicopters and found they were simple to build, easy to repair and relaxing to fly.

For those planning to spend between $600 and $1,000, I would suggest a moderately priced, collective pitch helicopter like the Hirobo Shuttle, Kyosho Concept or Kalt Cyclone. The beauty of these three helicopters is that they are mostly constructed of molded glass-fiber parts; are semi-built, requiring minimal assembly time (about ten hours); are extremely stable, and each costs between $300 and $400. The alternatives are the GMP Cobra, GMP Stork, Kalt Baron 50, Miniature Aircraft X-Cell 50, and Schluter Junior. They are of all metal construction, are medium size, use .40 to .50 size engines, and cost $400 to $500. Kalt also makes a Baron 30 which uses a .30 size engine. So does Miniature Aircraft, who will soon release an X-Cell 30. Hobby Dynamics will also soon release a Cyclone II, an upgraded version of the original Cyclone. Helicopters in the reasonable category are not only good trainers, they are very aerobatic as well. For these helicopters, I absolutely recommend you get a helicopter radio, not an airplane radio. Heli radios bring out the full potential of R/C helicopters. Airtronics, JR, and Futaba all sell inexpensive helicopter radios for $200 to $400. Add another $130 to $150 for engine and muffler. See the May issue of *Model Builder* for a comprehensive list of R/C heli radios.

For the sky-is-the-limit people, I admire your attitude! The hobby shops love you even more. The GMP Competitor, King Cobra, Legend, Kalt Baron 60, Miniature Aircraft X-Cell 60, Schluter Champion, Scout, Magic or Robbe Avant Garde each cost between $500 and $600. We are talking about toys the big league boys play with: contest quality machines. They can do any maneuver required in FAI aerobatic competition, are all .60 size, big, heavy machines that are stable and least affected by strong wind. Think of them as the Navy's F-14 Tomcat: they are fast, rock solid and mean business. They are great investments if you like this hobby and have the cash. A top-of-the-line helicopter radio can range from $500 to $1,000, although a $300 to

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Manufacturer	Kit Name	Engine	Suggested Retail
BUDGET			
GMP	Cricket	25-32	$225.00
GMP	Rebel	40-46	$225.00
MFA	Sport 500	40-46	$249.50
REASONABLE			
Hirobo/GMP	Shuttle (built)	28-32	$325.00
Hirobo/GMP	Shuttle XX (built)	28-32	$399.00
GMP	Cobra	40-50	$449.00
GMP	Stork	45-60	$525.00
Kalt	Baron 30	28-32	$399.99
Kalt	Baron 50	50-60	$399.99
Kalt	Cyclone	50	$329.99
Kalt	Cyclone II	50	Summer '89
Kyosho	Concept 30 DX	28-32	$349.95
Kyosho	Concept 30 DX (built)	28-32	$419.95
Kyosho	Concept 30 SE	28-32	$429.95
Miniature Aircraft	X-Cell 30	28-32	Summer '89
Miniature Aircraft	X-Cell 50	40-50	$599.00
Schluter	Junior	40-50	$459.95
SKY IS THE LIMIT			
GMP	King Cobra	60	$565.00
GMP	Competitor	60	$545.00
GMP	Legend (flybarless)	60	$599.00
GMP	Legend (flybared)	60	$625.00
Kalt	Baron 60	60	$699.99
Miniature Aircraft	X-Cell 60	60	$669.00
Robbe	Avant Garde	60	$699.95
Schluter	Scout	60	$659.95
Schluter	Champion	60	$629.95
Schluter	Magic	60	Summer '89

Gorham Model Products, CA (818)992-0195
Kalt (Distributed by Hobby Dynamics), IL (800)458-0241
Kyosho (Distributed by Great Planes), IL (217)398-2834
Miniature Aircraft, FL (407)422-1531
Robbe/Schluter, NJ (201)359-2115

GMP's "Legend" Helicopter and the Airtronics Quantum 8H PCM Radio

By JAMES WANG

• This month we will look at the GMP Legend, a lean and mean .60 size fully aerobatic machine that cruises at around 65 mph. The Legend is extremely fast because it has a slim profile canopy and a low-drag flybarless main rotor design. Research on full-size helicopters has shown that the main rotor head, shaft, swashplate and mixing unit can contribute up to 50% of the total drag on a helicopter. Thus, removing the flybar and seesaw assembly can significantly reduce the total drag. Furthermore, a clean rotor head improves the air flow to the rotor disk during an autorotation maneuver.

My Legend is powered by a pump equipped O.S. .61 rear exhaust with a Hirobo/GMP mini rear exhaust muffler. This very compact box-like muffler hides underneath the helicopter and is very inconspicuous, but its small chamber might constrict the exhaust and reduce the engine's power slightly. Still, my friends and I have timed my Legend through a 200 meter run, and it clocked about 65 mph. With a Hatori or Magna pipe, this thing would really take off!

A top-of-the-line aerobatic machine certainly deserves a top-of-the-line radio. I chose to install a brand new Airtronics Quantum 8 channel radio in my Legend for a few reasons. The first reason is that the Quantum is the only helicopter radio on the market, at least as of this writing, that has a capability to couple in an extra servo to vary the horizontal tail's incidence in flight. In other words, you can program the radio so that when you move the fore/aft cyclic stick, a sixth servo will change the angle of attack of the horizontal tail. Airtronics calls this a Synchronized Elevator System, or SES. Of course, you have to modify your horizontal tail to a rotatable flying surface. The Futaba 1024H and JR PCM 10 radios have general purpose mixing functions that can also couple in a sixth servo, but they are not specifically designed for SES. I am interested in this feature because many of the state-of-the-art full-size helicopters like the Apache AH-64, Sikorsky Blackhawk UH-60, etc., have this feature to improve the flight dynamics. For instance, in high speed forward flight helicopters always fly in a nose-down attitude, so you would want the horizontal tail to deflect its leading edge up and thus reduce the severe nose-up tendency that a fixed tail will produce. This reduces the stress at the main rotor hub and improves the dynamic stability of the helicopter. So for this case you want down elevator as you push the cyclic stick forward, and up elevator as you pull the stick back. For aerobatic fliers, a strong coupling of the horizontal tail and the fore/aft cyclic stick can improve helicopter longitudinal control. Now you can do a super-tiny and fast loop. For this case you want plenty of up elevator as you pull the cyclic stick back. The Quantum 8 has two trim pots for you to adjust the coupling any way you like. Of course, I had to modify the horizontal stabilizer on the Legend to a moving control surface.

The second reason I chose to install the Airtronics Quantum radio in my new Legend is the excellent 94735 servos. The Airtronics 94735 servo is specially designed for R/C helicopters. It has 75 in.-oz. of

GMP's John Gorham looks on as son Robert mows the grass. With the proper radio (such as the Airtronics Quantum) the Legend is capable of awesome performance.

All Legend kit parts come sealed in numbered plastic bags. Main rotor and wood servo trays are factory pre-built.

At only 8-1/2 pounds the Legend is one of the lightest .60 size choppers available, makes for phenomenal acceleration.

Above: Airtronics is the only manufacturer that includes five servos with all of its helicopter radios. All meet 1991 specs.
Right: a 700 mAh receiver pack is standard. Our author uses a 1200 mAh pack because he uses it to also run an Airtronics SG-1 yaw rate gyro.

torque (typical servos have 40 to 50 in.-oz.), high speed (two seconds for 60 degrees of travel), and a very quiet coreless motor. It is in the same league as JR's top-of-the-line 4000 series servos, and Futaba's S9 servos.

The third reason for installing the Quantum in the Legend is that I wanted to try out the new Airtronics SG-1 gyro system. It is an excellent unit. It has recently replaced the older Airtronics gyro. You might still be able to pick up one of the discontinued gyros. They were one of the least expensive yaw rate gyros on the market and even include inflight switchable sensitivity. They were good and very inexpensive.

Another reason for using the Quantum radio is that it has four pitch curves. This allows me to play around with the engine/collective mixing to optimize the helicopter for hover, aerobatics, and autorotation.

Usually I prefer writing technical helicopter articles instead of doing reviews. I am a little wary of writing review articles because no matter how careful he is, a reviewer might miss mentioning some features, or with one slip of the pen he might doom a manufacturer's sales. Of course, I believe the reviewer has the obligation not to lie about flaws, but my policy is to check with other fliers and the manufacturer to see if there have been other occurrences. Then if there indeed exists a problem, I will forward the manufacturer's suggestion and tell you my own remedy so you will not have to worry and stop flying. I also try to avoid exaggerating the review because that would certainly upset and be unfair to other manufacturers who also produce quality products. In the future you will see many reviews of different brand helicopters, radios and engines. I will avoid saying things like "Screw bolt A to nut B, then connect rod C to lever D." Rather, I will concentrate on the technical merits and flying qualities. Since my job is designing real helicopter rotor systems, blades, etc., building a different R/C helicopter each month actually helps me with insight into full-scale design ideas. Building and flying more helicopters gives me an opportunity to be more familiar with all the available R/C designs so I can write better technical articles for our readers.

Above and right: two views of the Legend's rotor head, the most important ingredient in any helicopter's flight dynamics. This particular one is a flybarless Delta-3 design. A flybared head is also available to first-time pilots. The two control rods from the swashplate go to a mixing arm, then to the rotor blade pitch arm to provide mechanical advantage to reduce the loads on the servos generated by the blade airfoil pitching moment. A symmetrical airfoil would have zero pitching moment.

Continued on page 101

With the canopy removed you can get a good view of the Legend's clean, businesslike mechanical layout.

The Legend does beautiful autorotations because of the 165 gram weighted blades and the clean flybarless rotor head design.

BIG BIRDS

By AL ALMAN

• We never hear much about big electric birds, so it seemed about time to air the subject. But since my hands-on experience with electrics is almost zilch, I finagled that almost legendary and verbose Norseman, Crash Evanson, into blessing us with his subtle thoughts and opinions . . . and whatever other stray poop he's run across during his unending quest for the ultimate in quiet power. Here's what Crash has to say:

"Al, I'll be happy to insert some extraneous thoughts about big E-power on the premise that my learned observations, plus my opinions, are my own and do not represent the Gospel or the demeanor of you or *MB*.

"Let me preface this blurb of mine by saying that motor driven R/C vehicles have only been with us for a relatively short period of time (when compared to free flight) so no one, especially this writer, knows it all. In fact I've been known to make mistakes and even overstate things at times.

"At the present time there are two basic (American made . . . the best!) powerplants capable of supplying adequate thrust for giant scale applications: the Astro Cobalt 40 and 60. These two large space-age motors have Samarium magnets and are capable of sustaining large amounts of voltage and amperes necessary to motivate big R/C aeromachines. They do represent a lot of bucks but will give years of dependable use; truly a one-time investment.

"These vibration-free and diminutive motors immediately impress the nitty-gritty scale set (those builders who can make mom's hair curlers look like machine guns) because these prop turners will snuggle nicely inside an Aircobra cowl and still have room left for the retractable nose gear. And extension shafts work well with electrics because of the lack of piston-pounding explosions, thereby opening the door to many applications previously thought impossible.

"Obvious is the electric motor's ability to become a pusher simply by reversing the motor leads—no special props required. Now that Dornier 335 Arrow project you've been dreaming about becomes realistic. And those two, three, four, and six-engine aircraft avoided up to now because of inherent operational problems of using either two or four-cycle engines also become a reality; exact rpm's every time, from idle to full power . . . without the vibes.

"In 1985 a buddy and I built Yardsticks (April '85 *RCM)* for just plain *fun* sport flying. After a year of comparing notes using .60 glow engines, I installed a Cobalt 60 motor system in mine. The fuselage was cavernous and easily accepted the 28-cell pack of 1200 mAH Sanyo batteries. I expected it to barely whisper around the field at treetop level, if this 13 pounds worth of yardsticks and Elmer's glue flew at all.

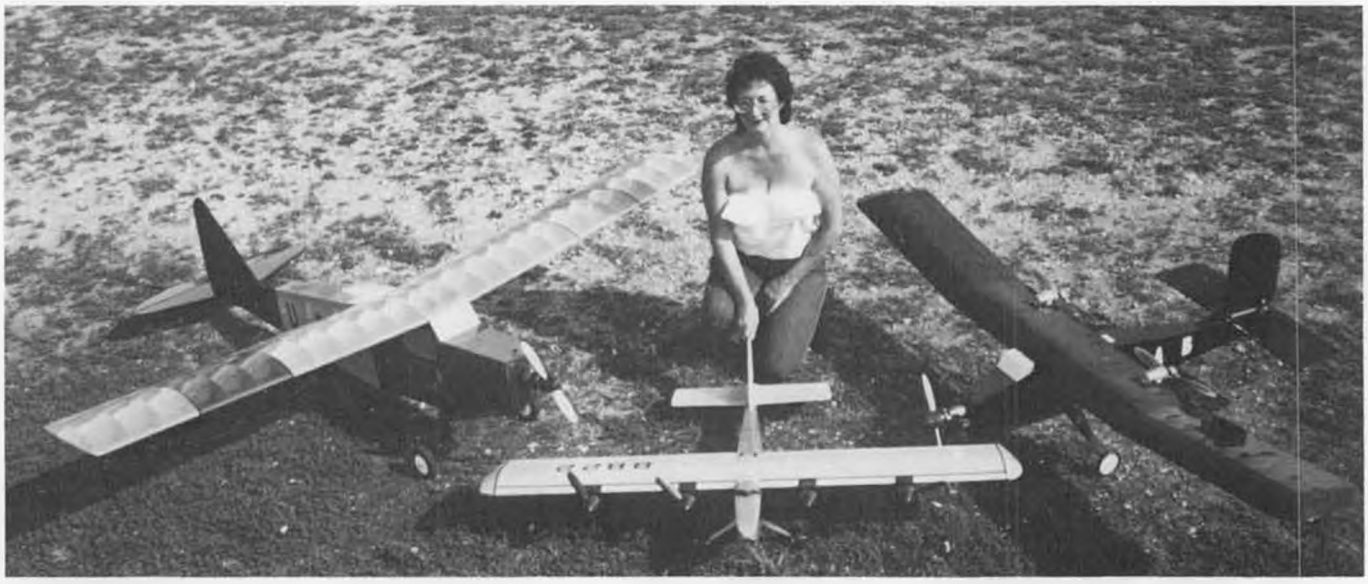
"What a surprise! She jumped off the runway in twenty feet and climbed uncomfortably high in just two minutes. The glow version was sick by comparison. My electric monster could make two or three high climbs, and flights averaged about ten minutes, which is long enough to tie up any frequency pin at a busy R/C field. I flew the E-powered Yardstick for a couple of years and when I finally did sell her the airframe was still squeaky clean (all the original glow-grease had been cleaned off by then).

"I decided to design an airplane in honor of my three 'bestest' pals, **L**es Hard, **A**l Alman and **B**umper Lyons (all IMAA members/officials), and thus emerged the LAB-13. Even the original airfoil was named LAB-13. This machine started out as a tri-motor (one tractor and two pushers) and amazed lots of people by flying well. But after having to repair the wing trailing edge for the umpteenth time, I decided to install the 'big one,' a Cobalt 60, and see if this 88-inch bird could handle the weight and power.

"I sweated unnecessarily; she climbed out briskly and became a mere flyspeck in less than a minute.

"Here in MinneSNOWta winter flying can be an absolute hassle at best, but with 10,000 flying fields (lakes), electric power really comes into its own. I usually charge three or four E-birds, toss them into the truck and silently enjoy winter's beauty while pushing the gimbals . . . and the environment loves me. Usually the thermos runs out of coffee about the same time my frozen fingers quit functioning and my dripping nose signals the end to this mad delight. Sometimes a rabid skier or demented ice fisherman will ask, 'Whatcha doin?' . . . and I've yet to figure out a good answer.

"Back to reality. There are certain guide-



Three of Crash Evanson's big E-powered birds. (l to r) Cobalt 60-powered Yardstick, an original design with four Cobalt 05s, and the LAB-13 as a tri-motor. Sorry, the prettiest model in the photo was not identified.

The LAB-13 on snow, using a skid for landing. Span is 88" and prop is a Giest 13x8 folder.

Some of Crash Evanson's gas guzzlers, proving that he really does fly all kinds of BIG Birds.

Crash's portable E-power fueling station for remote operations. Includes car battery, meter, and Astro Flight Charger that'll handle up to a 28-cell pack. Dolly makes for easy towing.

lines when messing with electrics, but remember that none of them are set in concrete.

"1) Weigh your motor system. This should be about half of your total ready-to-fly aircraft weight. The formula is adjustable, however, by using larger wings and cleaner airfoils.

"2) Mount your tailfeather servos behind the trailing edge of the wing since the space they used to occupy is now filled with your motor batteries.

"3) That large space that used to contain the fuel tank can now be used for your motor control, either of the electronic variety or a simple servo-operated on/off switch.

"4) A fuse is highly recommended to save the motor from frying due to a mishap.

"5) If you add another motor to your system, add a cell to the battery pack—which also holds true for the addition of an electronic throttle. Luckily the Super Charger marketed by Astro Flight doesn't give a hang what your cell count is.

"The FAI recently outlawed electric power for world class scale events, probably due to its absolute superiority (I'm not really too surprised considering their track record; they seem to eliminate the *fun* element in anything they get their hands on). Thank goodness we in the noncompetitive sport of Giant Scale don't have to adhere to FAI mandates, as there are few of us who can afford thousand-dollar disposable airplanes. 'Nuff said!

"Paging through some of my old dog-eared aero-mags I ran across a bunch of airplanes suitable for E-power. Lemme see . . . of German WWII vintage there was a glider tug (two JU-88's bolted together) with five engines, and a couple of giant freighters with eight mills. Of course, anytime a Hughes Spruce Goose shows up at the field it's a show-stopper.

"I've read that Tony and Addie Naccarato's B-36 flies beautifully and that Keith Shaw's twin-engined Comet has to be seen to be believed. There are countless scale aircraft of multi-engine configuration crying to be modeled, and with our current state-of-the-art electric systems the door is wide open even to average builders like myself.

"A very frequently asked question is, 'How long will the motor run?' It's not easily answered because there are so many variables. A battery pack is much like a fuel tank in respect to its capacity. You can go full bore for two to four minutes, or you can mete it out (via an electronic throttle) for four to six minutes.

"Of course, longer motor runs are within your grasp by simply using a smaller prop. In E-power every design has a 'right-sized prop' (thinning the blades helps a lot), and it takes a bit of experimenting to find the correct one. For instance, the old Yardstick would hardly fly on a 16x4-1/2, but when a 13x8 was bolted on she became a tiger.

"In regards to cooling the battery pack, I do not do this—they get hot from the inside out, anyway—but I do remove it from the bird after each flight. Never charge a hot pack as venting can occur and ruin said power supply. On the other hand, cooling air should be allowed to flow through the motor. Letting the motor hang out in the breeze is one way to accomplish this, but on tightly-cowled designs I just cut a hole in the pointy end of the spinner plus a few strategically placed holes in the spinner backplate and add an outlet somewhere unobtrusively.

Crash's B-I-G Cub. Wheel covers help anyone who might possibly not recognize the aircraft!

"Modern electric power systems are quite capable of propelling just about any gas engine model kit made (avoid anything with extensive fiberglass or foam components for openers). To the best of my knowledge there are no Giant Scale E-powered kits available; however, there are lots of sailplanes and some lightly loaded gas powered biggies like the Sig Kadet Senior, and they will convert nicely to

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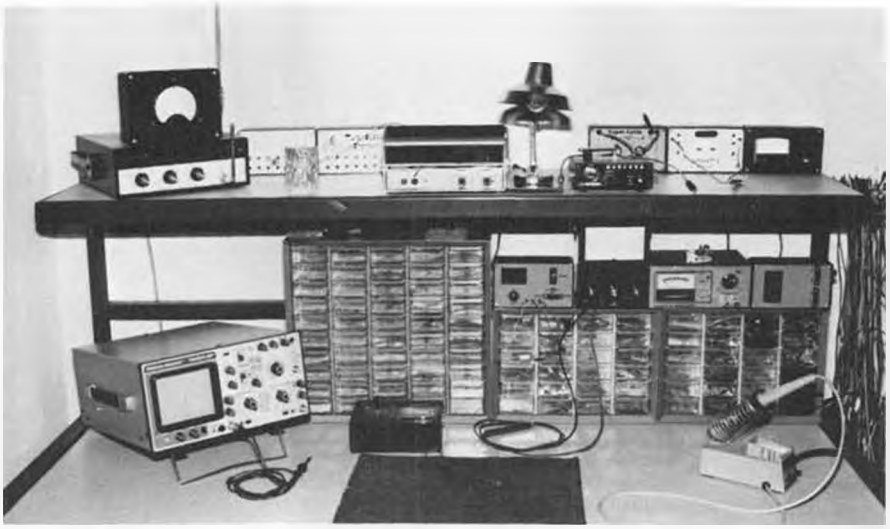

Electronics Corner

By ELOY MAREZ

DIAL 976 fOR R/C?

I just ran across an ad for an information service which claims to give you the answer to anything you need to know about anything R/C. Just like the 976 numbers, it opens its fountain of information to your MasterCard or VISA card—$3.00 per shot. I haven't tried it, so I will withhold any opinion, except to say that I can't imagine any person or persons who can honestly claim to know everything about any single subject. In short, I have enough doubts to not pass along the number. However, I do have other good numbers for you:

(619)728-0440—the new number for Authorized Radio Control Service, late of Orange, California. Don McCarthy has moved, kit and kaboodle, to 327 S. Stagecoach Lane, Fallbrook, California 92028; down towards San Diego from where he used to be. ARCS is your best West Coast service center for some of the currently available equipment as well as for the oldies but goodies (such as Kraft), and can often make mods and changes that the original manufacturer does not offer.

(714)455-9888 is another good number, at which you can expect a cheery "Good morning, Futaba!" every time you dial it. Futaba Corporation of America also has a new home: 4 Studebaker, Irvine, California 92718. For those of you in the local area, that is off Alton Parkway at Jeronimo.

Futaba's new 100,000 square foot home has got to be the largest in the hobby industry that is devoted exclusively to electronic products, and should insure that all phases of its operation will increase in efficiency. One more note for you local aficionados: should you need service, call for an appointment and ask for Kelly!

The area in which Futaba is now located is a highly restricted one, and s very close to the landing pattern for nearby El Toro Marine Air Station, which is too bad, since the building is large enough to fly off of. Maybe the next one!

PCM AND FAILSAFE

I have discussed both subjects before, on and off, but there seems to be a much greater swing to PCM (Pulse Code Modulation) now that 1991 approaches, and some confusion is coming along with it.

First of all, PCM is not really modulation as we normally speak of it, which is the modification of a radio wave for information carrying purposes. We normally use one of two methods of modulating the R/C signal, either AM (Amplitude Modulation) or FM (Frequency Modulation). Before we reach the modulating stage in the R/C transmitter we must translate the mechanical stick inputs into electronics, a job that is done by the encoder. The sequence then is the encoder first, the modulator, and lastly the RF amplifier. The PCM signal is generated in the encoder, in the same manner that the older style pulse width signals are generated in AM or FM transmitters. In the switchable transmission mode transmitters now available, a choice can be made between PCM and PPM, which stands for Pulse Position Modulation and refers to the older pulse width encoding methods.

A valuable item to have at any flying field is the "TxCheck" hand-held RF monitor by Kraft Midwest. Details in text.

Before I go any further, I would like to clarify another confusing point, in that while the transmitters are switchable, the receivers are not, and a PCM receiver *must* be used with a transmitter switched to PCM. Ditto for FM!

Now, after this encoding has taken place,

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Futaba's new home is this 100,000 square foot building in Irvine, California. Service facilities are located here also.

Pattern Flying

By DICK HANSON

• *Dear fellow modeler;*

This is an open letter to all those interested in Pattern flying, be it A.M.A., F.A.I. or any independent governing body.

I personally feel that a change in equipment rules, specifically engine rules, is in order.

An apparent conflict of interest exists in that we have an engine size rule, a maximum weight rule and a new set of noise level rules.

If our objective is to allow models of a moderate size and weight, then the weight rule is necessary. If we must reduce noise levels in order to satisfy community desires, then a noise rule is required.

Why then must we regulate the engines to be used?

Originally we all used very ordinary two cycle engines. No pipes, pumps etc. As larger engines became available, a limit was put on displacement in order to control the size of the models used. It worked very well for a number of years. The weight rule also served as a method of keeping size and I suspect safety at an acceptable level.

The issue of noise is now the controlling element in equipment used. It is also the one rule which promises to change due to community influence.

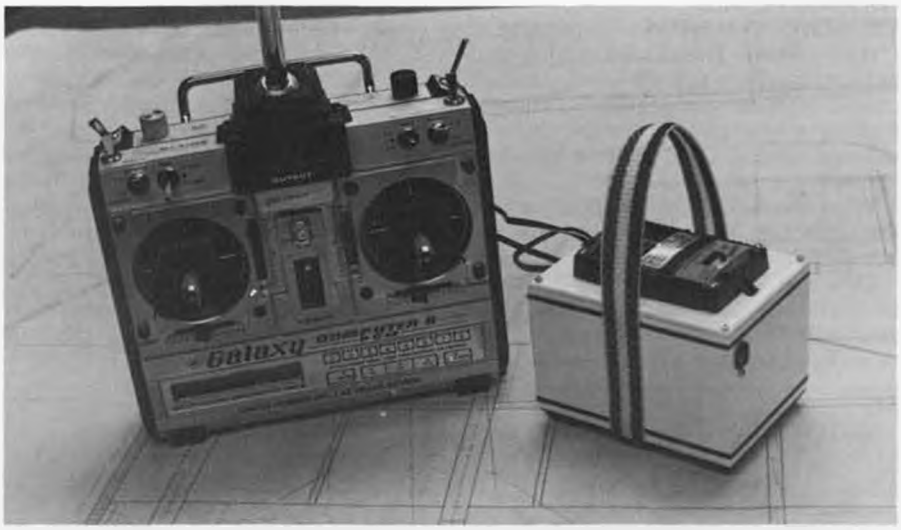
The size rule is now rather academic in that our .60 size engines just will not work competitively in an 11-lb. model.

If 11-lb. models are acceptable, why not eliminate engine rules altogether and go with a weight maximum rule and a noise rule? This would also allow much greater freedom in design work.

Would dropping the engine rules obsolete much of our present equipment? I believe it would have the opposite effect in that no particular engine would have an edge. Our present rule, it seems, has a tendency to obsolete all but a few engines.

Please give this proposal some shared thought with your friends. I will be happy to discuss it further with any interested parties.

Sincerely, Dick Hanson



Portable transmitter charger has a self-contained battery and allows one to top off the transmitter battery right on the flight line if necessary.

• • •

A few weeks have passed since I wrote the above letter. Copies were sent to a number of active pattern fliers as well as some well-placed A.M.A. people.

Feedback has been minimal—as expected.

George Manning, who is an active flier from Southern California, did offer some very interesting information. While he was attending the T.O.C. event last fall he had a talk with Hanno Prettner who expressed, according to George, an almost identical point of view.

I was surprised but after thinking it over I came up with the following assumption. The four-cycle 1.2 cu. in. engines are proving to have much more usable power than the .60 two-cycle engines. If they prove to be popular due to the larger, heavier models they will pull, the Europeans will be required to use similar powerplants. A simple rule change by the F.A.I. could change the engine rule to allow the use of *any* 1.2 engine (or perhaps a change to .90 two-cycle types), which would knock out any advantage the four-strokes may offer at the present time. I think this is a definite possibility and I base this assumption on past changes that the F.A.I. has accom-

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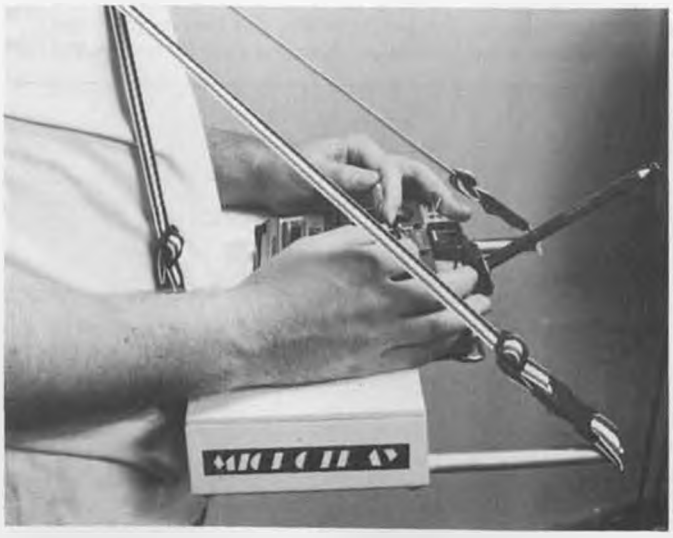
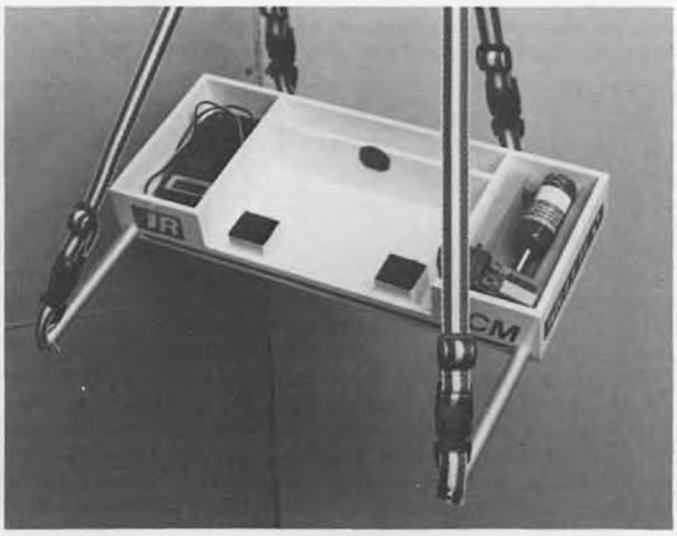




Two views of Dick Hanson's homemade "Microtray," European style transmitter tray. Transmitter itself is held in place with Velcro. Compartments on the side contain equipment that might come in handy on the flight line.

R/C SOARING

By BILL FORREY

THERMAL FLYING: THE HOWS AND WHYS

It's summer. The skies are blue and beckoning. There's a light breeze, and it's only 75 degrees. Your sailplane's radio system has a fresh charge, the lawn's been mowed, and you have a few hours to yourself.

What comes next? Loading the car with the flight box, the hi-start, and that big beautiful bird!

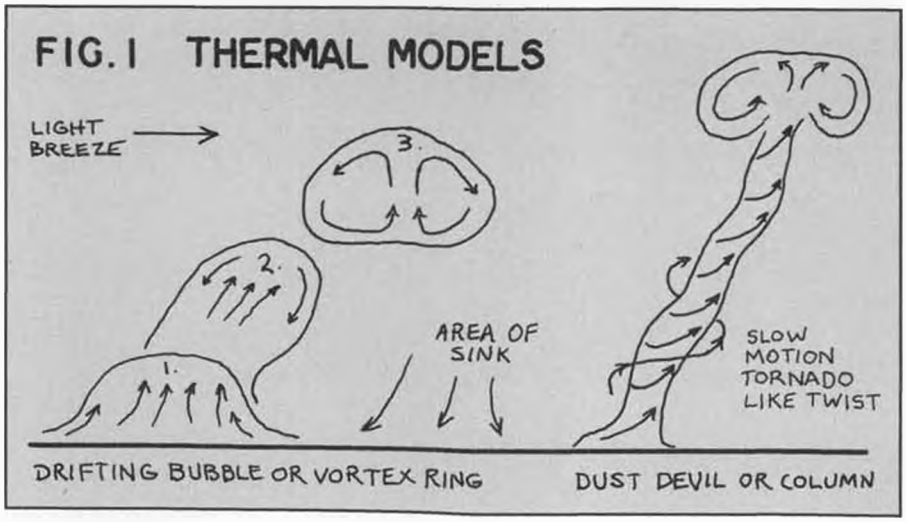
Only one problem. It's been six months since you last flew a sailplane. You know you're in need of practice because last year's flying season ended just as you were getting the hang of it.

As you pack the car, you envision an embarrassingly short flight in front of your old flying buddies. Did you imagine laughter? A little "friendly" ribbing aimed your way? The vision causes butterflies to bounce around inside your guts. Your nerves are on edge. You're light headed with excitement, anticipation, and a perhaps an occasional squeeze of adrenaline that makes your heart race.

"Get real," you say out loud, "Get a grip!" You know from experience that the fun you always have will outweigh everything else. So you pick your imagination up by the nape of its neck, reprimand it for its insubordination, and finish packing the car with the determination of a Chuck Yeager. A minute later you're headed toward the local glider field with mental pictures of flying into 300-foot-a-minute "hat suckers."

We've probably all had moments of irrational thought like this at one point or another in our flying careers. They come from the insecurity of inexperience. With time, they stop coming. What I'll attempt this month is to speed up the process for those fledglings out there who are interested.

We'll offer some ideas about what thermals are, what they look like, and how sailplanes react inside them. We'll discuss how to work a thermal, and then how to land. With all that information under your hat we'll make you an "old pro" in one season . . . all from your easy chair!



What Is A Thermal?

A thermal is a rising body of air which is warmer than its surrounding air. There are two main "models" (see Figure 1) which represent the physical appearance of thermals: the intermittent "bubble" or vortex ring which represents the most common form of thermals; and the "dust devil" (visible or invisible) which represents a rarer, more constant or even stationary form of thermal.

Thermals can do almost magical things to flying machines and soaring birds. Personally, I get a kick out of showing someone a thermal who has never seen or heard of the phenomenon before. Statements and questions like, "I can't hear any engine. What's making your airplane go up?" are common. Knowing what we do about soaring, we could all be medieval wizards if we could travel back in time with our model sailplanes.

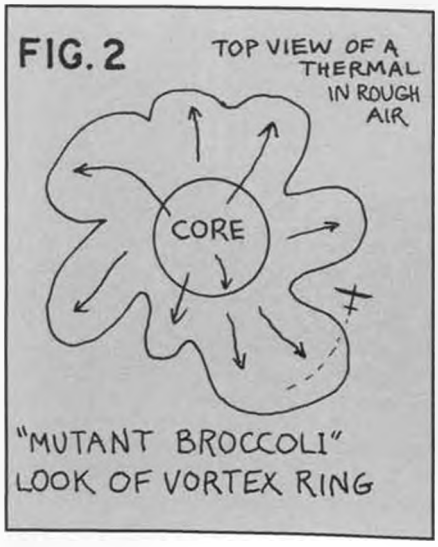
How Does A Thermal Form?

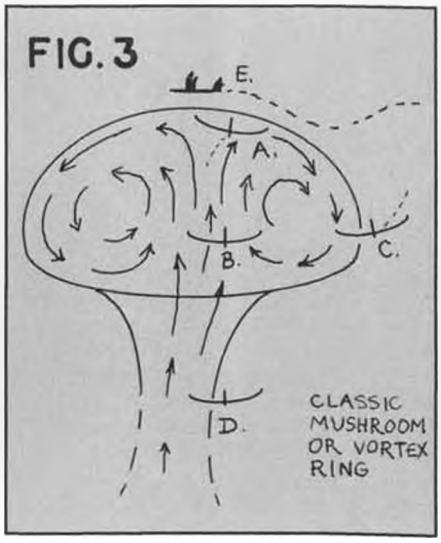
Thermals are formed when cool air passes over a source of heat and is warmed by it. Warm air, of course, rises. The thermal source can be literally any large surface which is warmer than the air that surrounds it. The surface usually absorbs heat from the sun more rapidly than its surroundings and readily gives off its heat to the air.

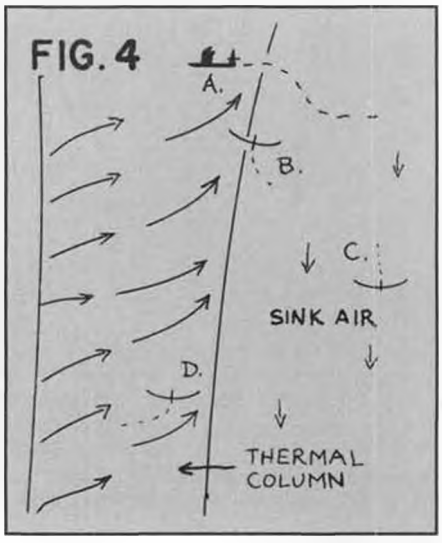
A few of the most common thermal sources are plowed earth, dry grassy areas, man-made surfaces such as a gymnasium rooftop, or a dirt or asphalt parking lot. Even unlikely sources produce thermals. I have seen vultures thermaling over a Caltrans Park and Ride lot here in Southern California at a shady, cool, 7:00 a.m.! The 50 or so hot engines produce enough heat to generate an early morning thermal.

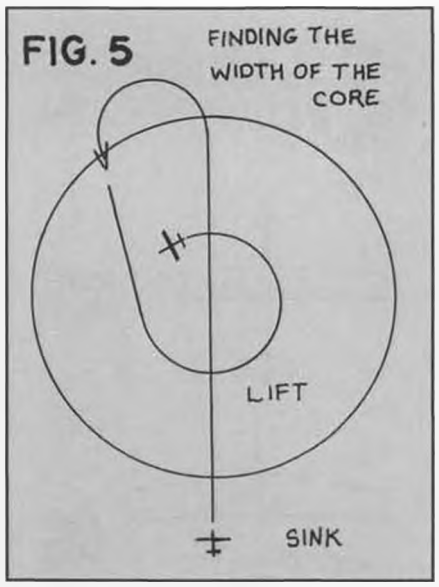
Often a line of trees will generate a stream of bubbles. What happens in this case is that the trees shelter the ground on their leeward side. The cooling wind is blocked. The relatively stagnant air gets heated by the sun-drenched ground, and then it rises in periodic bubbles.

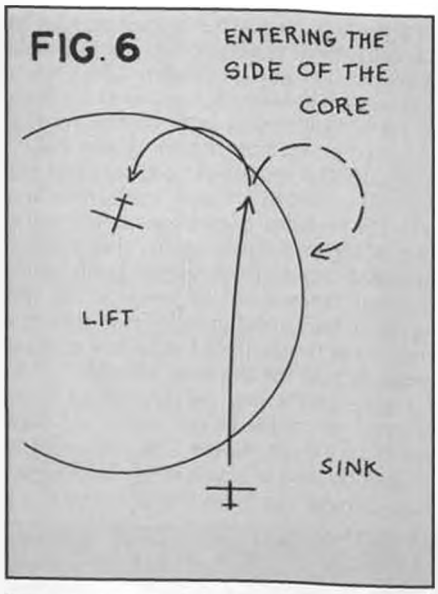
A row of trees may be solid enough to form a very efficient wind barrier. On the windward side, the breeze is forced up and over, forming wave lift on top. But I'm

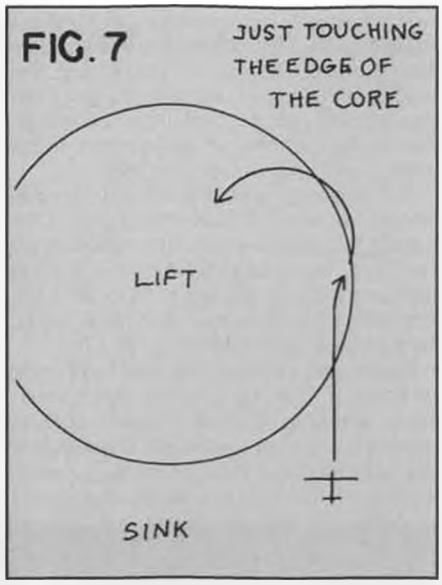












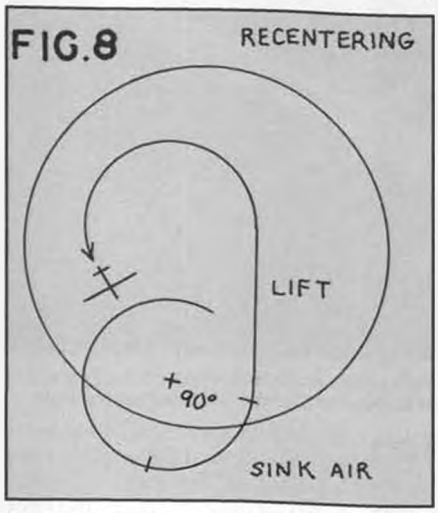
wandering away from the subject of thermals here. Perhaps in a future article we could cover wave and slope lift.

Thermals tend to be cyclic, coming in periodic intervals of time, often quite regular. Bubbles of boiling water make a good analogy. If you can imagine a puffing steam locomotive traveling down a track you have yet another picture of a periodic thermal.

It is hard to be dogmatic about the shape or size of thermals. Thermals can be as small as the tightest circle your glider can fly or as large as entire fields. Often during contests, one flight group can take off and every model will go up practically without respect to location. The next group will launch and the field's cycle will be between puffs. The models will be on the ground in two or three minutes.

Air is a gas. Breezes can be very turbulent and have many horizontal, vertical, or even spiral wind currents caused by obstructions. These could be houses, trees, passing trucks, local topography, etc. Turbulence can sometimes be mistaken for lift.

As shown in Figure 2, the "top view" of a thermal bubble may look like anything from a perfect doughnut shape or smooth mushroom, to the lumpy shape of a head of mutant broccoli! (Hey, stop laughing.



Sometimes an analogy can be very descriptive!) Turbulence and the shape of the heat source can distort the thermal radically. The stem of the broccoli could be representative of the strong core of rising air, and the irregular outer edges the unstable, turbulent "sink air." Lift proceeds up the stem, cools, flows outward, and then sinks.

What Kills Thermals?

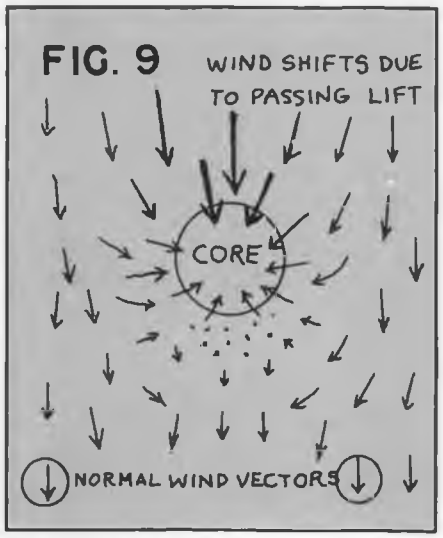
By contrast, any potential thermal source can be affected negatively by many factors. A stiff wind will keep the air mass moving so fast that it doesn't have time to get warm. Wind often is so turbulent that what little lift there may be is quickly mixed up with cool air and destroyed. Sometimes this lift is very hard to distinguish from just plain rough air. Usually you get suckered into making a circle with your sailplane. That's when you find out you're in sink!

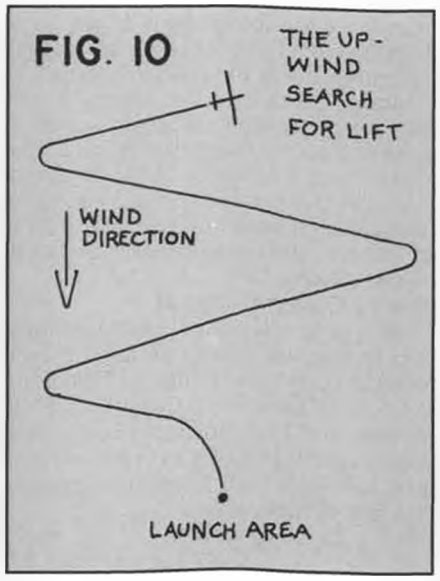
Another major factor is the position of the sun. If it drops too low in the sky, it will no longer heat the surfaces likely to produce thermals. Certain dense surfaces—concrete for example—which have high thermal mass will continue to give weak lift after sunset. However, sources like these eventually die. Mornings and evenings are poor times for strong lift. Shadows can also ruin a likely thermal source.

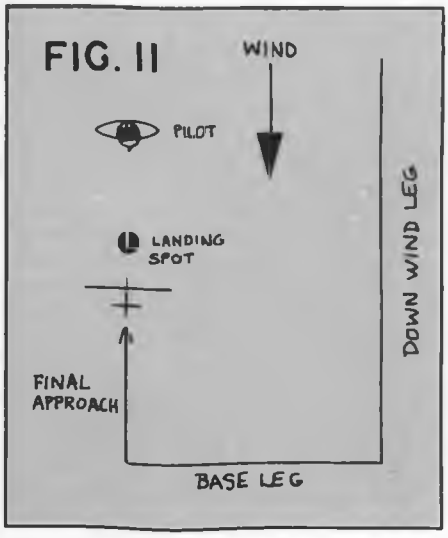
A lack of heat contrast in the surrounding area will likewise hinder strong thermal development. If you were flying over a large, dry lake bed at noon in July with no wind, you would be as likely to find thermals as snow balls!

How Do You Use Thermals?

Here we probably run into as many flying techniques as pilots. There are, how-







ever, a few widely accepted rules for thermal flying. The illustrations I've drawn show these rules of thumb. Unfortunately, the models are drawn somewhat larger than they would appear in real life in relation to the size of the thermal. Just picture them smaller and you will get the idea.

The first step is recognizing a thermal when your model encounters one. Obviously, you would expect the model to go up. True, most of the time that's what happens, but not always. Let's look at the internal structure of our thermal models, then place a few models inside each.

Figure 3 is the classic thermal bubble or vortex ring. These are practically impossible to see due to their gentle nature at ground level. They tend to pick up no dust or paper to make their presence known. However, the soaring birds and insect hunting birds find them and often mark their presence in large numbers which in many cases actually define the outer fringes of the bubble very graphically.

In Figure 3, the model sailplanes E and A are passing over a developing bubble and through the top of the bubble respectively. This case is the most obvious.

Models A and E may encounter a little sink just before they enter the thermal. They may be pushed away from the core of the thermal if they hit off center. They may even encounter a slight increase or decrease in speed if they hit head-on. However, providing they can circle centered over the core, they are soon climbing strongly.

Because the thermal bubble is cooling as it rises, the top of the thermal is rising slower and flowing outwards to make room for the heated air that is coming up from below. These two models may have trouble staying centered in the thermal. Their pilots may have to constantly recenter their birds. Each will settle down in an area near the top of the thermal which matches their sink rate (relative to the vortex). The thermal vortex will carry them upwards until it cools and loses energy.

Model B in Figure 3 will experience the strongest lift inside the thermal and soon will be up with A and E. Model B will have an easy time staying centered in the core of the thermal.

Model C will experience sink that may try to suck the model towards the core or just push it away. This model may try to bank in the direction of the core as it sinks if the outer edge is well defined. Just below this area on the outside the thermal is likely to be turbulent sink as air rushes in to fill the void created by the rising thermal.

Model D is the guy who spots a thermal and flies over to enter it, but arrives too late. His buddies' planes are rapidly going out of sight. Unfortunately, the thermal has passed through already and only a little residual "zero sink" air remains. He will need to find another ride in a different area, or if the bubble frequency is close enough, wait for the next bubble.

Figure 4 is the thermal column, or slow-motion tornado. Often called a "dust devil" or "trash mover," this thermal is frequently visible because of the insects, dust, or paper particles that get sucked up inside. Polarized sunglasses can sometimes help you see this kind of thermal. The sky has much polarized blue light. Polarized sunglasses darken this light. When this light hits the minute dust particles, it becomes a little less polarized and a little more random. The result is a lighter shade of blue in the shape of the thermal column. The necessary ingredient, of course, is dust.

Model A in Figure 4 has just hit the column head-on. Provided the pilot can center or "core" the thermal, he will have a nice, long, high, thermal ride.

Model B has just grazed the core and is experiencing a shove upwards and away from the core. This pilot needs to turn into the core, fighting the outwards shove.

Model C is outside the thermal completely. He may experience light sink air. If nobody spots the thermal for him, he may never find it. So close . . . yet so far away!

Model D is firmly entrenched in the core. He has it made! All he needs to do is adjust his center once in awhile, and he is on the elevator UP!

How To Center A Thermal

Many years ago, when I was first learning how to thermal, I had the help of such early LSF Level V and National Champions as Chris Adams, Terry Copeland, Rick Pearson, and Jerry Krainock. Each was a very accomplished flier at that time, and each had their own suggestions on the best way of thermaling.

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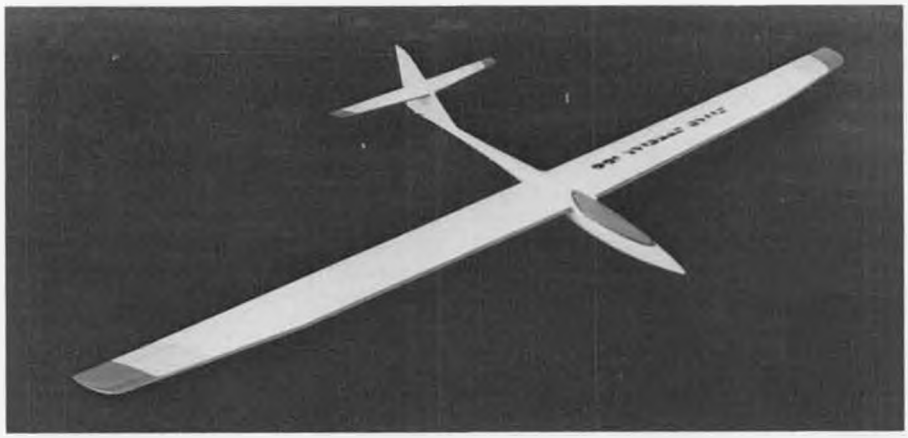
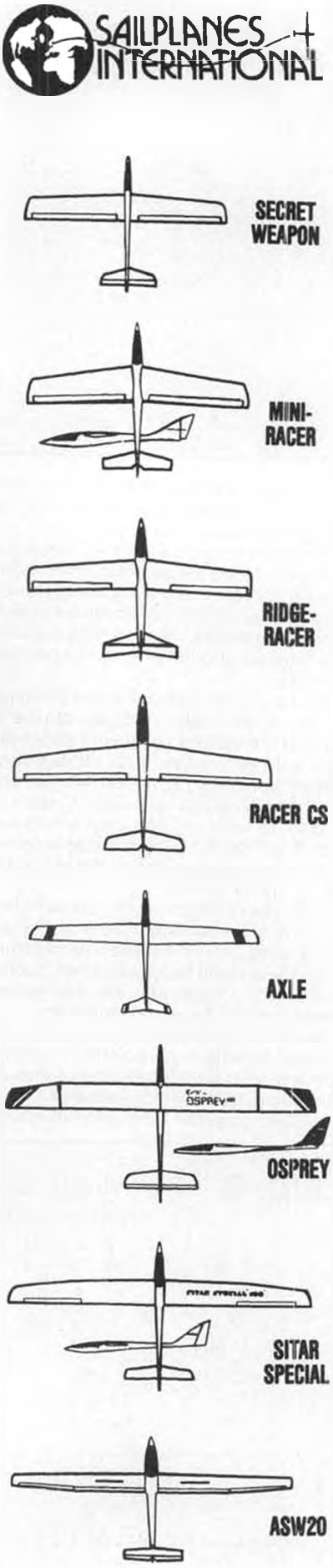


The Sitar Special 100 is one of several high-performance sailplanes being imported from England by Global Hobby Distributors. See text for more details on this and the other models shown at right.



MODEL DESIGN & TECHNICAL STUFF

By FRANCIS REYNOLDS

• To continue with the preliminary design of Sea Fli XI, the R/C flying boat that we started last month, let's get down to the seaplane part. If you just came in, see not only MD&TS for June, but also the construction article for this airplane in the same issue. Remember our code: (April '89) means, "Please reread the April 1989 column of MD&TS where we discussed this point in more detail."

Hull

This is the challenging and interesting area. Designing a conventional landing gear is very simple indeed compared to designing a hull which will float the plane, support it in the right attitude, permit it to taxi slowly under directional control, transition to the step, accelerate up to flying speed, take off at a range of planing angles compatible with required wing angles of attack, and reverse all this for landing. The hull should also be easy to build, rugged, light in weight, and have low aerodynamic drag. All this isn't too tough if we design it one step at a time.

Flotation

One cubic inch of water weighs .036 pounds, so to find out how many cubic inches of displacement we must design into our seaplane to make it float, we divide the weight of the airplane in pounds by .036. Our airplane is going to weigh 7.0 pounds. (How do I know? Just take my word for it.) Actually we have to provide quite a bit more flotation than that to keep the plane from going partially under from waves, crosswinds, etc.

Static Attitude

In addition to making the plane float level laterally, we must make it float at an acceptable pitch angle. Bow-down is not an acceptable pitch angle. No amount of up elevator or throttle can get the nose up at the start of taxiing if it is not already up. A bow-down condition is the result of having too much of the total buoyancy behind the step.

Beam Loading

One important dimension in hull or float design is the beam, or width of the planing surface. This is the hydrodynamic equivalent of the span of the wing. Designers talk about hull or float "beam loading" the same way they talk about wing loading. Andy Lennon, in his book *R/C Model Airplane Design*, shows beam loadings for R/C seaplane models ranging from a 2-1/2 ounces per inch of beam, to 25 oz./in., with the majority falling in the 10 to 20 oz./in. range. With the 6-1/2 inch beam I chose for Sea Fli XI, and its weight of seven pounds or 112 oz., we have a beam loading of 17.2, which works fine.

One thing that Lennon neglects to say is that beam loading varies with the size of the airplane, like wing loading does, only worse (Sept. '88). With wing loading we are dividing a cubic function (weight) by a square function (area). With beam loading, it is cubic weight divided by a linear dimension, so beam loading, like span loading, will vary as the square of the size of the seaplane does. We need to use beam cube loading (divide the weight by the beam cubed), but that is for another day.

The significance of beam loading, cubic or not, is that if the beam loading is too high on a particular airplane it will require excessive power to get up on the step and accelerate to flying speed. The hydrodynamic lift will be poor and the hydro drag will be high. If the beam loading is lower than it needs to be, the hull will be big, pound harder on rough water, skip on takeoff, weigh more, and have more aerodynamic drag. We want a big beam with a big wing and vice versa, to provide a smooth transition from hull support of the weight to wing support at takeoff.

The sides on older floats and flying boats were usually parallel, giving a constant beam, but there are things to be gained by starting with full beam somewhat ahead of the step and tapering it to less beam at the step. For one thing, it reduces the aerodynamic drag and improves the looks. Also, it gives a higher beam loading when the plane is fully up on the step, which reduces skipping just before takeoff and just after landing. At lower speeds, when more bottom is on the water, it provides a lower beam loading for more rapid rise-out.

Flat Bottoms

All full-scale seaplanes have vee bottoms to reduce the pounding in rough water. Modelers build them both vee and flat. I always design flat bottoms unless it is a scale model. I fly from pretty rough water sometimes, and haven't been able to identify any structural, radio, or other damage which could be attributed to flat hull or float bottoms. Flat-bottom models may experience shock levels that an on-board pilot wouldn't like, but the R/C link completely protects a remote pilot from such physical abuse. At any rate, flat bottoms on models work just fine. They are more efficient and easier to design and build than vee bottoms.

By "flat bottom" above, we mean flat laterally, but what about longitudinally? It is definite that the bottom ahead of the step needs to be straight for some distance. Curvature in that area, like that on an old row-boat bottom, would be a big mistake. The effect of a rounded bottom fore and aft is to pull the hull deeper into the water as it accelerates, and make planing difficult or impossible. Let's look at the bottom near the bow. It is traditionally curved up at the front. Paul Weston and I suspect this may retard the rise up onto the step in some seaplanes, by tending to suck the bow down when the plane is just getting started and has not yet risen significantly. I intend to do some book research and perhaps testing on the water on this question, but for now, we may be designing better than the rest of the world in this particular area, by avoiding bottom curves even at the bow. Have a look at the drawings in the construction article for Sea Fli XI last month. You will even find a small step up near the bow, to improve initial hydrodynamic lift still more.

The Hump

Stinton, in his book, *The Design of the Airplane*, states that "All (full-scale) seaplanes have had marginal performance in the vicinity of the hump." "The hump" is the point in the takeoff run where a full-scale seaplane is trying to get up on the step. At this point the nose of the plane is pitched up sharply, the drag is at its maximum, and with full power the plane slowly climbs out on top and then begins to accelerate much more rapidly. The hump can be seen on a model seaplane takeoff if the throttle is advanced very slowly, but it is certainly not a problem. Good seaplane models get up on top so fast one couldn't

Continued on page 74

PLUG SPARKS

By JOHN POND

• This month's column starts on a note of pure nostalgia as can be seen in Photo No. 1 showing Red Barrows' model of a nine-foot Shereshaw Champion.

This shot, taken 16 years ago in San Diego, was one of the first O.T. R/C models built by Pond and Barrows. We built two Champions; the twin, an all white version, is still around serving as the SAM 21 club trainer. Good thing Shereshaw designed rugged models as many a tyro has learned on it! This writer can still remember the now deceased Lee Norcross, who asked to fly the model at Taft.

Thinking that Lee had some R/C background, I allowed him to fly the Champion. After about ten minutes, Norcross brought the model in for a landing. What a landing! The model was all over the ground, sky, you name it. Upon ragging Lee about a bum landing, he replied, "What did you expect? This is the first time I've ever flown R/C!"

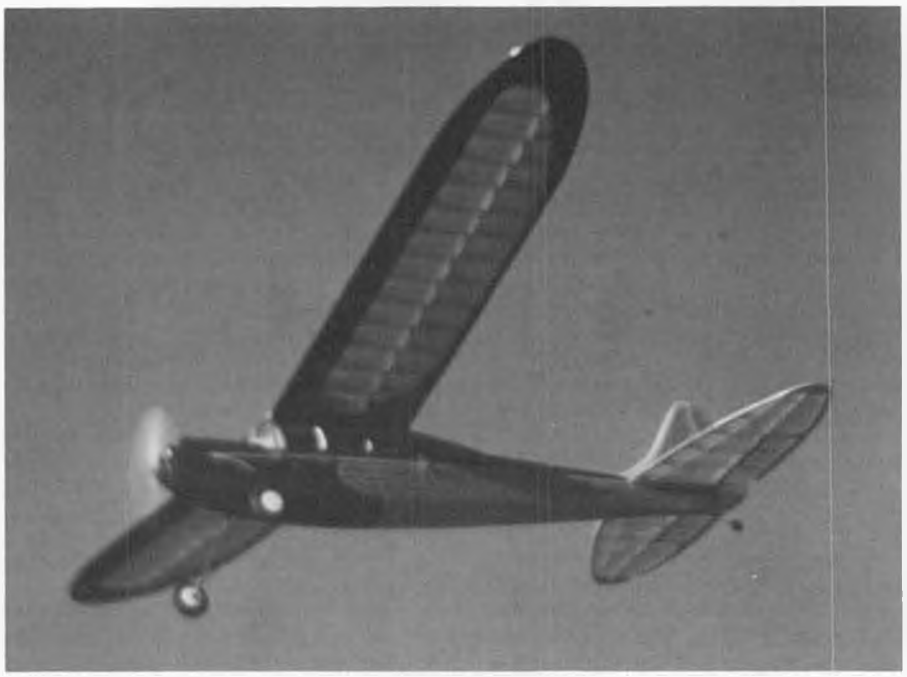
After recovering from that shock, this writer only mentions the above as it does prove that the big Old Timer models are the best trainers for learning how to fly R/C.

Recently, Pond's Champion was given to Dave Lewis, SAM 21 Prexy, to get some Texaco flying experience. As can be seen in Photo No. 2, Dave has done a complete refinishing and recovering job. Putting in a Super Tigre .60 on glow was the major change, with the result that Dave has always placed.

PLAYBOY REVISITED & SAM 39

In the last column we wrote an article featuring Joe Elgin, and were unable at the time to come up with the desired pictures. Since then, Art Grosheider, newsletter editor for SAM 1, has come up with several good photos.

Just about the same time, Bucky Walter of SAM 39 sent in a series of photos taken last year of various SAM 39 competitors and contests. This, plus excerpts from Walter's latest newsletter, should suffice for a report on SAM 39 doings.



1. Red Barrows' Shereshaw "Champion" cruises overhead. Pretty!

First off, we would like to feature a couple of photos of Joe Elgin that we promised you. Photo No. 3 is an excellent shot taken of Joe admiring Tom McCoy's version of the Cabin Playboy. McCoy's models can always be identified by the yellow covering with blue fuselage nose and black and white striping.

Inasmuch as Joe Elgin stated the cabin version was an afterthought on the original plans, there is some variance in the idea of exactly what the cabin looks like. The sketch of the model shows a tapered rear cabin that fairs to a point. My Playboy is built this way. The second version had the cabin built directly on a Playboy fuselage, thus resulting in smaller windows. Still is attractive. The third way with even more variations is the McCoy Playboy with large windows, however, not extended to the end of the wing saddle. Kinda like Erskine Caldwell, "You pays yer money and takes yer choice."

Photo No. 4 is what this writer thinks Old Timer flying is all about: FUN! Joe Elgin, seen with a 1/2A Texaco version of the Playboy Sr., is a happy and satisfied modeler with this model. You can just see the pleasure emanating from Joe. As the Australians would say, "Good on you."

This report wouldn't be complete unless we featured a photo of Robert "Bucky" Walter, 5807 Cambridge Circle, Sandusky, Ohio 44870. Bucky blames his long silence on retirement . . . can you beat that? Here's what Walter has to say:

"I read in the SAM 49 newsletter that you are having some troubles with your health. I hope and pray you are feeling better by the time you read this letter. I have been putting off writing you with news from SAM 39. No excuses.

"I made the grave error in going back to

2. New SAM 21 president Dave Lewis with his restored Shereshaw "Champion." S.T. power for Texaco.
3. (right) Joe Elgin admires cabin version of Playboy Senior by Tom McCoy.

4. Nothing but fun for Joe Elgin, with 1/2A Texaco version of his Playboy.

5. Bucky Walter releases his Class A-B Bomber for an official at the 1988 SAM Champs.

work. My good friend and modeling buddy, Jack Ross, asked me to go to work for him. Seems like his company was assigned the job of reactivating the systems required to operate the biggest vacuum chamber in the world. This chamber took 14 months to pump down to the proper operating conditions. Need I say more when I say the system had been deactivated for 13 years!

"Finally on Jan. 1, 1989 I retired again (much the wiser) and I figure it only took me 15 minutes to get back in the swing of modeling activity. You might be interested to know I even cleaned up my 57-inch wingspan Bomber you told me to clean up at the 1986 SAM Champs."

Takes time but they eventually listen to their Uncle Jack. The model can be seen in Photo No. 5 being launched at the Lawrenceville SAM Champs. Model was flown in Class B and C using Forster .29 and .35 engines.

Bucky actually sent in fourteen photos. We have selected the ones that look like they will reproduce well. Such is Photo No. 6, showing Luther Peters readying his Dallaire Sportster at a SAM 39 contest held at Northridgeville, Ohio. Of note is Thad Kusak, holding the model. Thad was the SAM 39 High Point man for the year. No mean accomplishment as the competition in this club is pretty fierce.

In his newsletter, Bucky reports that Ralph Turner made a first class boo-boo when he did not check the direction of his rudder prior to launch. His beautiful Class C Glow MG went to the left on takeoff. For correction, Ralph gave right rudder control. This was actually more left with the resulting crash breaking the fuselage in half. Bucky says he did the same thing with his Lanzo Stick. You have to say "right" and see if you actually have right rudder when you move the transmitter sticks and not just see surface movement. Moral: Watch out for those servo reversing switches!

6. Luther Peters readies his Dallaire Sportster while Thad Kusak lends a hand.

Bucky relates that Chet Lanzo told an anecdote on himself. Chet got a call from Dave Platt, who revealed plans to hold a contest marking the 50th anniversary of Dick Korda's win at Chicago. Dave wanted Chester to call Dick and ask him if he would go to the contest in his honor with all expenses paid. Chet called Dick and was refused because of health problems.

Chester, on his return call to Platt, said he would be glad to take Korda's place. Dave told Chet this would be fine *but pay your own way!*

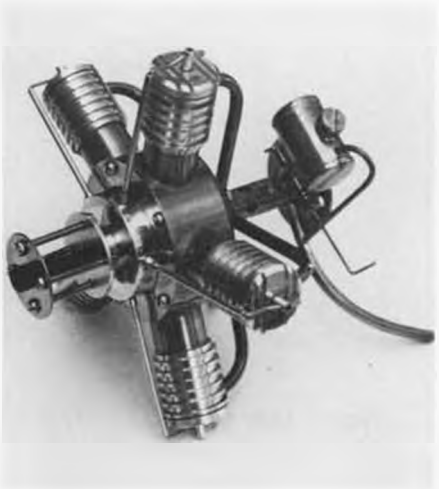
Ah, such is fleeting fame in this modeling game!

ENGINE OF THE MONTH

For this month's very rare engine, we are indebted to Wayne Cain of 3308 Pamela Drive, Lorida, Florida 33857 for making the original pencil drawing of the Nomie engine, and to George Armstead, 89 Harvest Lane, Glastonbury, Connecticut 06033 for a copy of the four-page 1912 Nomie engine Co. catalog.

Probably the neatest thing about this month's engine is the drawing. Wayne Cain was quite concerned about losing this valuable engine in the mail, so undertook to draw it himself. What a surprise! So, with some rearranging, and inking on mylar, this rotary compressed air engine is presented for your viewing pleasure.

The first item that strikes your attention in the brochure is the statement that this engine will run on carbonic acid (CO_2), compressed air, or steam. In 1912, gas engines, spring motors, and rubber strand motors were not very practical or powerful. Hence, in the Nomie brochure, claims are made for the most powerful engine made to date. As designed by J. deMartino, the Nomie could be supplied with varying numbers of cylinders, as shown in the drawing.



7. Powerful compressed air rotary engine by Walt Winberg. Swings a 20-inch prop!

The particular model we are describing is the Model B, a three-cylinder rotary. These engines came equipped with a 1-1/4 inch diameter steel tube, 12 inches long, weighing roughly 10 ounces. According to the brochure, the tube could be recharged for as little as 10¢ from any soda water vendor. One charge was suitable for operating the engine for 96 seconds at a maximum pressure of 50 pounds. Naturally, the type B and C motors required larger tubes at twice the capacity of the A tube.

The Nomie motor is quite similar to the old WWI rotary engines in that the crankshaft is stationary while the cylinders and crankcase revolve. Claims were made that this reduced vibration to a minimum, as neither the cylinders nor the pistons have any reciprocating motion, but simply revolve each about a separate center. Thus, the motions of both are continuous, much like a turbine. It is interesting to note the illustrations of the engines show the six-cylinder version running clockwise while the three-cylinder model is counter-clockwise.

The crankshaft is hollowed and machined from tool steel to form the conduit through which the gas is brought to the cylinders. After passing through the shaft, the gas enters the rotary tapered bronze distributing valve. This valve is provided with suitable openings for the gas to enter the respective cylinders. This valve also acts as an exhaust port which allows the gas to escape into the crankcase. Under this system, the moving parts disperse the spent gas without back pressure.

Oiling the engine is accomplished by putting a few drops of good oil in the hollow shaft. The pressurized gas in the shaft then forces the oil into the cylinders.

For the benefit of the technically minded, the Nomie crankcase is made from an aluminum casting divided into two bolted sections. Cylinders are made from phosphor bronze, machined and ground. Each cylinder is threaded and screwed into the crankcase. Cylinder heads are aluminum alloy and screwed into the cylinders. The engines came highly polished with nickel plated parts.

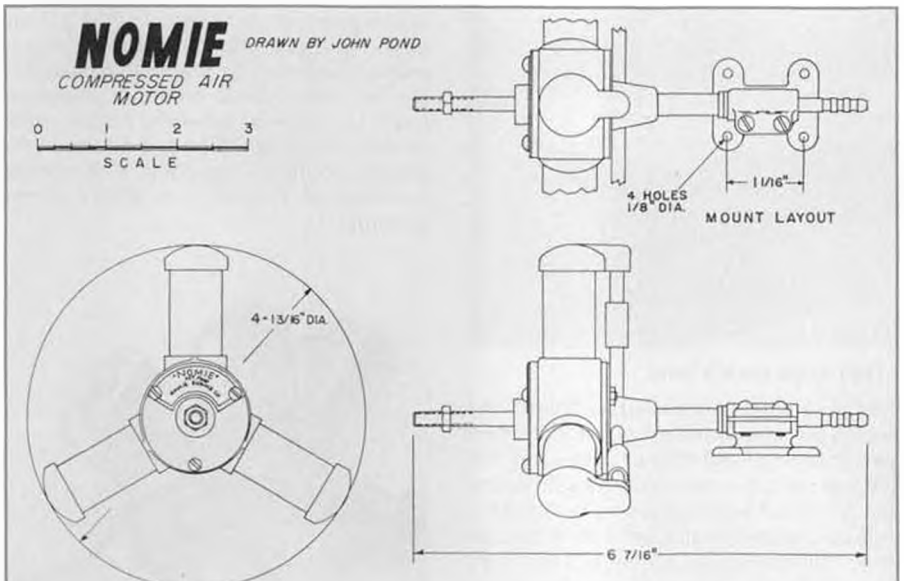
8. Gaggle of C/L biplanes taken to 1947 Nats in Minneapolis by Bob Kennedy and Brad Shepherd. First Nats after WWII.

9. Three Orwick powered "Madman" models by J.C. Yates at the '47 Nationals for the Stunt event.

Connecting rods are drop forged nickel steel fitted with bronze bearings. The pistons are made from McAdmite, a lightweight metal, ground, polished, and fitted with compression washers that absorb oil.

Finally, the main crankshaft housing is fitted with a ball thrust bearing and special collar to prevent excess wear of the rotary valve.

Made by the Nomie Engine Co., Ltd., 52nd Ave. and 22nd St., Cicero, Illinois, all engines were guaranteed to run, being tested first with steam at 50, 80, and 100 psi and finally with carbon dioxide gas. All



Type	Cylinders	RPM	Wt.	Power	Prop
A	2	1200	3 oz.	1/8 hp	10 in.
B	3	2500	6 oz.	1/4 hp	14 in.
C	6	2000	16 oz.	1/2 hp	20 in.
D	8	1900	22 oz.	3/4 hp	23 in.

10. Never saw him this happy when flying R/C Scale. Dave Platt at SAM 46 November Annual. Elfin 2.49 diesel.

horsepower ratings were guaranteed. Prices on the Nomie engines, complete with tube, ranged from $12.00 for the Type A to $42.00 for the Type D, the eight-cylinder model.

MORE COMPRESSED AIR (ANOTHER ROTARY!)

Finally found a slot for this letter dated 1976 and forwarded to this writer recently. Photo No. 7 shows the latest creation by Walt Winberg, 938 Gormond Rd., Richmond, B.C. V7E 1N5, Canada. This engine was designed to look as realistic as possible in an effort to get it out of the standard brass-tube-and-solder appearance of the usual compressed air engine.

This engine, with a bore of 15/32 inches and a 1/2-inch stroke, uses a master rod setup similar to full-size practice. Special side porting allows the pistons to come as close as possible to the top of the stroke with considerable saving in intake pipe length.

The engine features an oil tank mounted on the intake shaft. A metering valve allows oil to flow to the engine. This is turned on just before the air valve is opened, metering about 1.5cc of oil per minute; this being dependent on the weight of the oil and the temperature. Walt reports this is just like a true rotary as the engine slings a fine mist of oil while running. One soon discovers this if standing behind the engine!

This latest engine weighs 3.45 ounces and swings a 20-inch propeller. Impressive for a compressed air motor!

11. Old Timer Elmer Wassam starts up Ohlsson .60 in his Comet Sailplane. Good combination!

12. Scaled up 6-foot Bay Ridge Diamond Demon by Aussie Gordon Burford, with (natch) special Burford .21 diesel. 13. (right) Beautiful framework of Swedish "Balder" glider, by Sven-Olov Linden. Held by his wife, Violet.

DEUTSCHLAND O.T. GLIDER

Received a notice from Friedhelm Mink via Jim Adams, SAM Prexy, announcing the "Grosse Rhon" contest to be held from August 5 to 13. This soaring glider meet will be held in much the same style as took place on the Wasserkuppe in the late thirties and forties.

Also, at this time, a meeting is planned to organize the European antique modelers in an effort to found a Euro-SAM Society.

For further information, contact Friedhelm Mink, BRD-5778 Meschede 12, Im Wiessengrund 9, Germany.

40 YEARS AGO, I WAS . . .

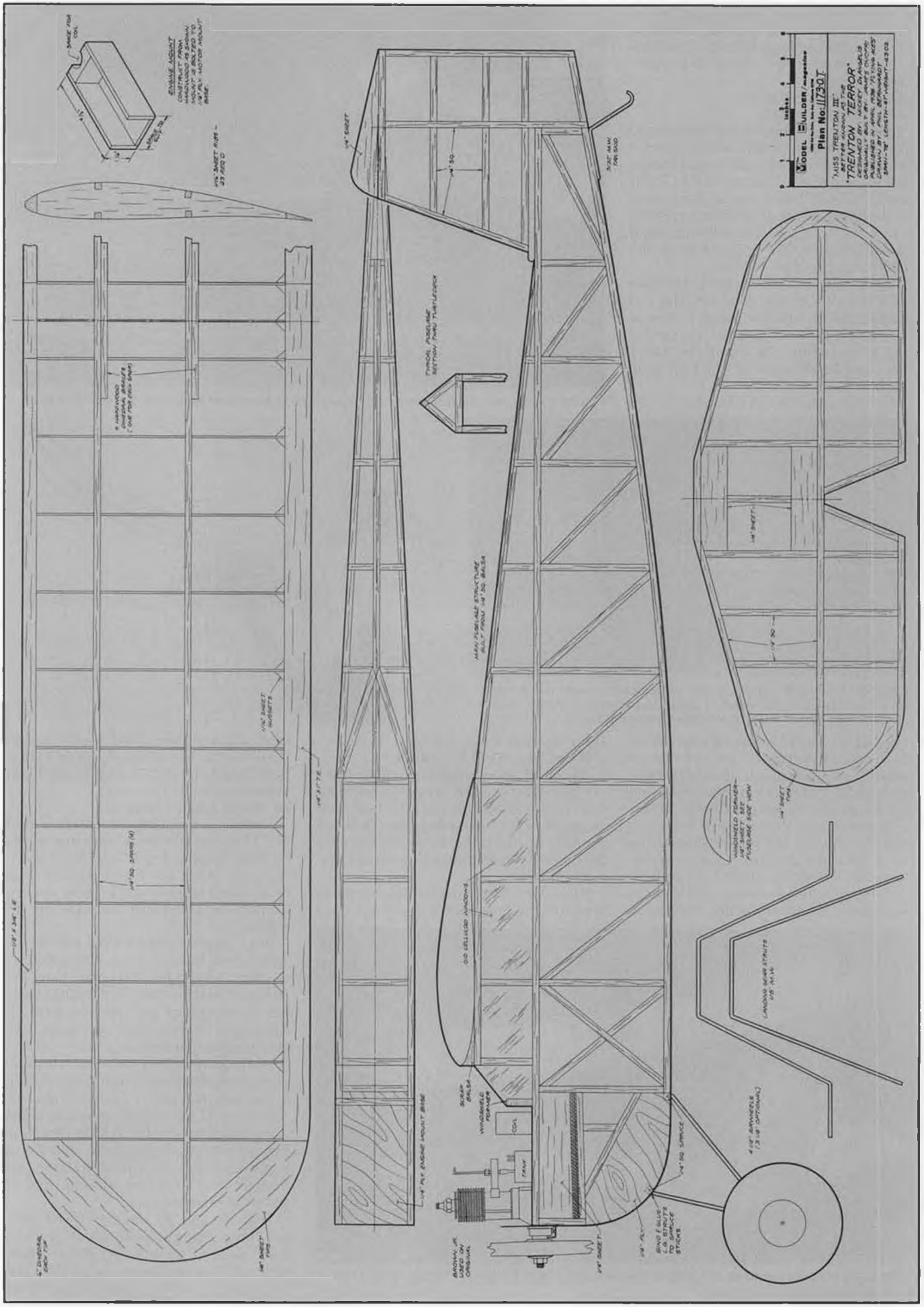
Maybe we should title this section "Back in '77," as this is when a letter was written by Brad Shepherd to Bill Northrop. Eventually his letter got forwarded (10 years later) but it still has some good remembrances in it that should tickle the old memory.

Brad Shepherd, whose last address was 1300 E. Polk, Victoria, Texas 77901, writes to say that "Seeing J.C. 'Madman' Yates in a recent *Model Builder* photo brought back the memories of the 1947 Nationals in Minnesota. I lived it all over again with very pleasant memories."

Brad submits Photo No. 8 which shows six biplanes that he and Bob Kennedy took to the Nationals from Corpus Christi. Brad continues, "I was still in the Navy and Bob was a draftsman for the O&R on the base. Believe it or not, these little 'twingers' have Super Cyclones on ignition in them. We thought they were real hot stuff until we got to Minneapolis.

Then we saw 'JC' and the Orwick powered jewel flying on 80-foot lines, the lines looking like they were bowed in a half-circle. I'll never forget watching Yates completely relaxed and wringing the

14. Mickey DeAngelis has flown this 108-inch version of his "Miss Fortune X" for past three years. Powered by an Enya .60 four-cycle.


MODEL BUILDER
Plan No. 1173-0.T.
"MISS TRENTON III"
"TRENTON TERROR"
TYPICAL FUSELAGE SECTION THRU PLANE-DECK
MAIN FUSELAGE STRUCTURE BUILT FROM 1/4" SQ. BALSA
OD DRILLED WINDOWS
WINDSHIELD FRAMER
COIL
TANK
1/4" PLY ENGINE MOUNT BASE
1/4" SHEET
1/4" SQ. SPRUCE
LANDING GEAR STRUTS
4 1/2" BANNERS (2 AR OPTIONAL)

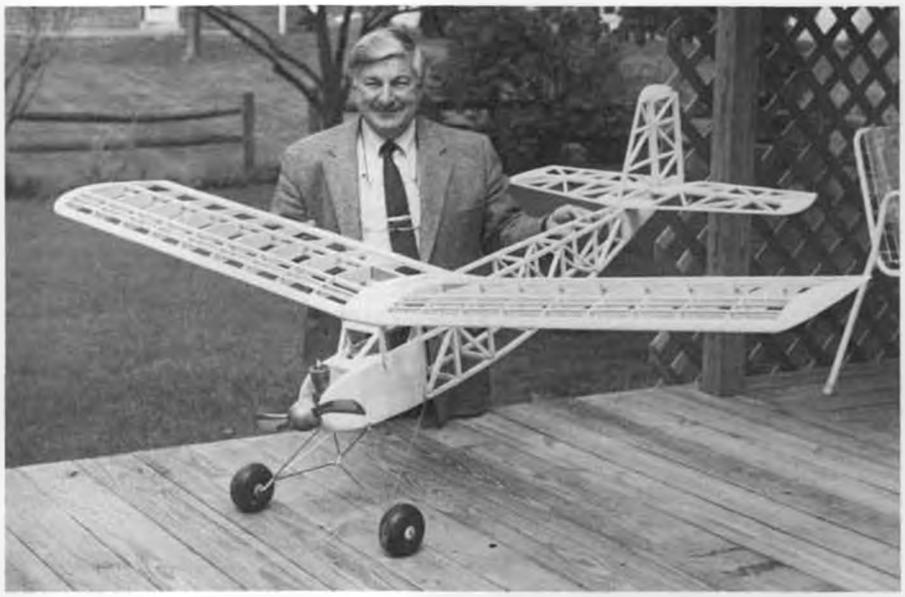
model out in the pattern series of maneuvers.

"I took a picture of his three Madman designs (Photo No. 9) just to remember this incident. Bob and I felt like putting our models back in the car after watching the 'big boys' but decided to give it a try anyway. I have a ninth place medal in Open Stunt from that meet and I am as proud of that award as I am of any other trophy won since.

"Other things that I can remember from the first postwar Nationals was how the California boys arrived in the Ohlsson & Rice DC-3, what style! Seeing Claude McCullough's free flight models; in short, things of beauty. And finally, if I am not senile, the Good brothers had their big R/C 'Guff' there. A great meet for memories."

NEW SAM CHAPTER

Nothing like a field to bring the modelers out of the woodwork! Jack Bolton (former SAM Eastern VP) announces the formation of a new SAM Chapter known as CAAMA (Capitol Area Antique Modelers Association), or SAM 10.



15. John Delagrange did a gorgeous construction job on his "Miss Fortune." This is an earlier version with lower thrust line.

16. Charles Buchanan modified and enlarged his TD Coupe to the point that he has renamed it the CB Coupe.

Jack is real excited about the free flight field they have been able to obtain; a three-quarter-mile square area with "good fallout" on all sides. Best part of all, the field is located near Culpepper, Virginia, an hour away from the Washington D.C. Beltway.

The club is very diversified in interests: SAM F/F, AMA F/F, Nostalgia, Rubber, and of course, SAM R/C Old Timers. This has resulted in a membership of 41.

To start things off right, Jack announces the First CAAMA Fun Contest on June 3 and 4, at the Club field. No lack of events as there are four SAM F/F events, five SAM R/C events, two AMA Gas, two NFFS Nostalgia, two special SAM events (Ohlsson .23 and .020 Replica), plus three rubber events. Whew!

To keep things on strictly a fun basis, there will be no entry fees, instead a one-time $2.00 registration fee will be charged.

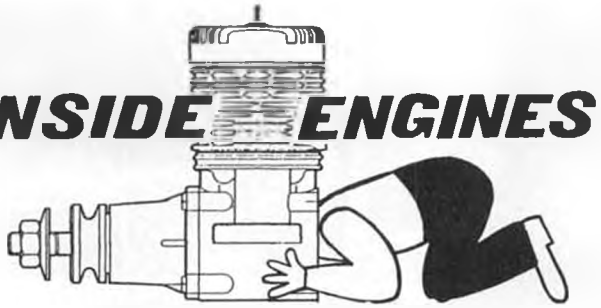
Continued on page 81

Trenton Terror

• Featuring an Old Timer plan in each issue of *Model Builder* is a tradition that was begun early in the magazine's history, and the "Trenton Terror" was one of the first. That was back in November of 1973, or 185 issues ago. Many of you readers have joined us since then, so we're reprinting the plan this month for those who missed it the first time around.

The Trenton Terror originally appeared in the April 1938 issue of *Flying Aces*. Actually that's not the model's real name; Mickey DeAngelis, who designed the ship, was a member of the Trenton Gas Model Airplane Club and was himself known as the "Trenton Terror" by his clubmates. When he designed this particular model it was Billy Giblin, who drew the four-page plan for *Flying Aces* and who has the distinction of having played one of the Munchkins in *The Wizard of Oz*, who suggested calling it by its designer's nickname.

Continued on page 84

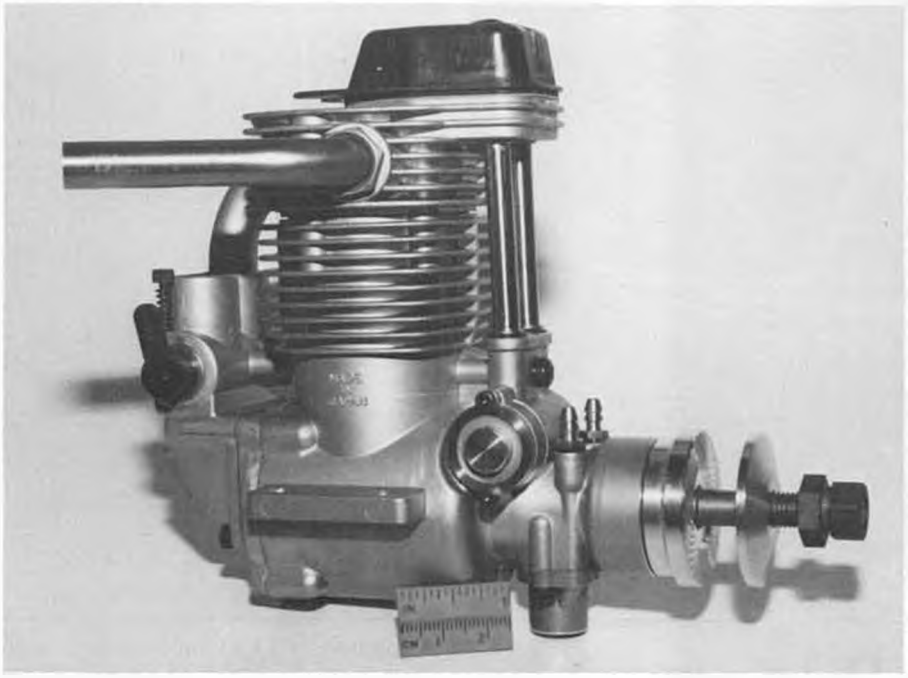


INSIDE ENGINES

WITH STU RICHMOND

SUPERCHARGED FOUR-STROKE

Futaba's YS-120



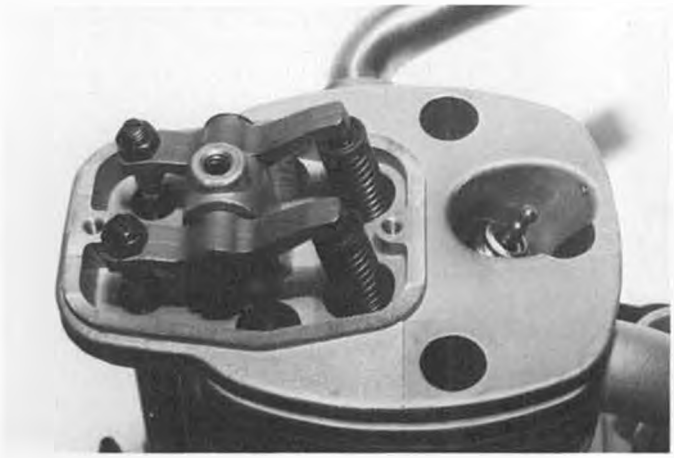
Just to the right of the one-inch ruler is the casting that houses the pressure fuel regulator system. Text explains its operation. Engine's castings and machine work are excellent.

• An engine is an air pump to which a combustible is added so that mechanical work (like turning a propeller) can be performed.

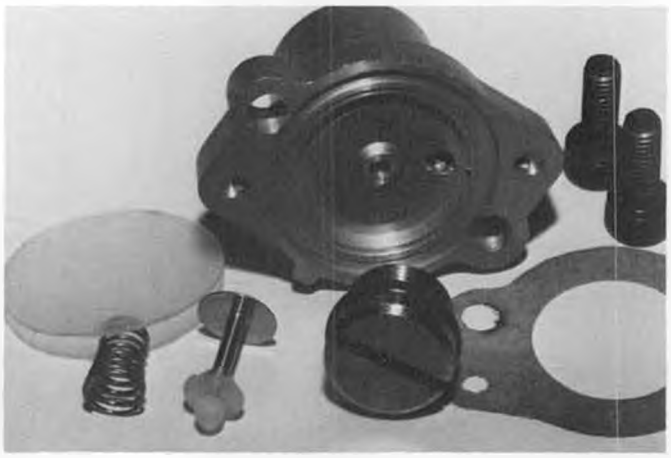
YS has perfected the "combustible is added" part to a very high level of satisfaction to R/C fliers. The only further fuel feed advancement will be true mechanical fuel injection—in which a controllable volume of fuel will be injected under extremely high pressure directly into the combustion chamber for each firing cycle. WWII's Messerschmitt Me-109 fighters had fuel injection—they could quickly dive in combat by simply pushing the stick forward. Spitfire engines had common downdraft carburetion and had to do a half roll and pull on the stick to dive or their engines would starve for fuel.

YS makes two-cycle .45s in both side and rear exhaust versions. They also make two-cycle .60s in both side and rear exhaust, in airplane and helicopter versions. All six of these engines use the unique and simple YS variable pressurization system to pressurize the model's fuel tank to a degree such that fuel is supplied to the engine combustion air with a force *above* simple normal atmospheric pressure. The increased pressure originates in the YS engine's crankcase as the piston descends toward bottom dead center (BDC). That pressure below the piston is allowed to travel forward through the crankshaft's hollow journal and out a surface hole of the journal to exert timed crankcase pressure downward on the top side of the pressure regulator's diaphragm. The regulator's spring sets the pressure level. The pressure then is released through a one-way external check valve into the fuel tank where it forces fuel to the engine at a steady pressure through a one-way check valve in the regulator—past the needle valve—and into the engine's air intake for combustion. A simplified example of this can be seen on any of the Cox TD engines, which have a small nipple molded into the plastic carburetor section on the right side; if you drill through the plastic at the bottom of the nipple it gives access to timed crankcase pressure.

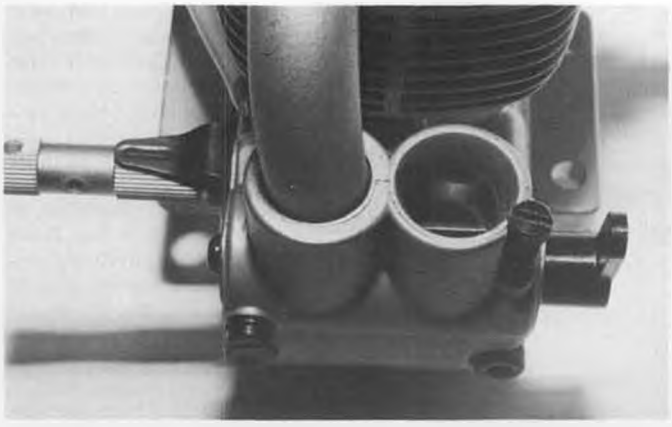
The YS pressurized fuel system works so well and gives such steady engine runs that thirteen of the top sixteen Masters Class Pattern fliers at the '88 Nats used YS en-



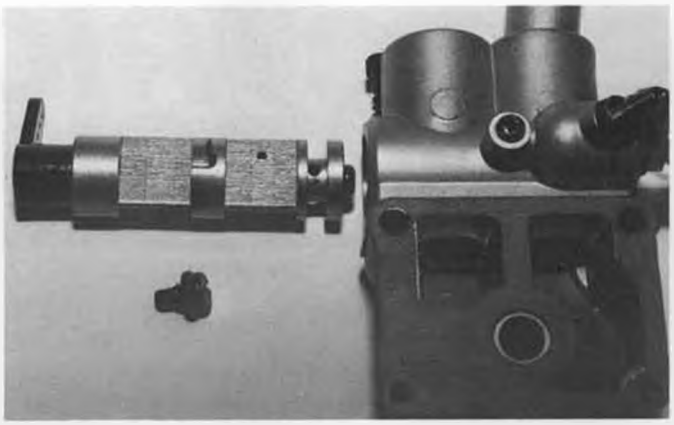
With the valve cover removed we see the straightforward mechanics for operating the valves.



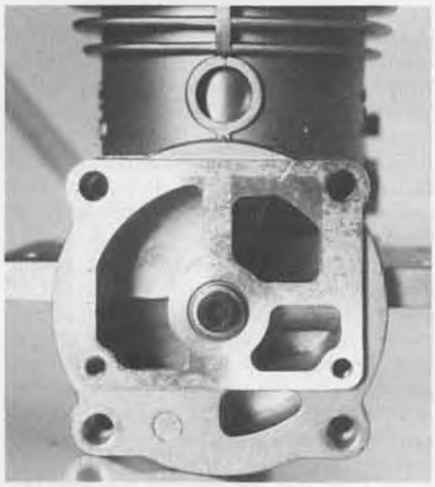
These few parts are the heart of the YS-120's pressurized fuel system. Design is simple and works beautifully.



Double-barrel carb draws combustion air down through the right hole, through the crankcase and back up through the intake pipe on the left.



The YS-120's fuel/air system works so well that the Quarter Scale Pylon Racing Association has banned its use! Text tells why.



With the carb removed you can see how combustion air flows through the crankcase to keep it purged. Fuel/air flow is completely unique among four-cycle engines. Hold just below the bottom cooling fin is for removing the wrist pin.

PROP SIZE	LOW SPEED	HIGH SPEED	SPEED RATIO
13x6	2,000	11,700	5.85:1
13x8	2,000	11,250	5.63:1
14x8	1,900	9,750	5.13:1
15x8	1,800	9,300	5.17:1
16x8	1,750	7,250	4.14:1
12.5x11.5*	2,150	8,650	4.02:1

*This is an Australian Bolly three-blade Pattern prop. All others are black Master Airscrews.
A speed ratio below 4:1 is unsatisfactory.
A speed ratio of 4:1 is barely satisfactory.
A speed ratio of 5:1 is average.
A speed ratio of 6:1 is excellent.
A speed ratio above 6:1 is superb performance.

gines! Needless to say, the rest of the engine works as well as the pressurization system does!

When YS decided to build a 120 size (1.2 cubic inch or 20 cubic centimeters displacement) four-stroke engine for F3A world class Pattern flying, for scale, and for Sunday sport flying, they cleverly devised a rear rotary valve air induction system since their highly successful timed-crankcase-pressure-fed-to-the-fuel-tank system requires a sealed crankcase in order to work. On a two-cycle engine the pressure that builds up below the piston is mostly used to pump the fuel and combustion air up the bypass ports into the combustion chamber—before the piston rises high enough to close the combustion chamber—and before compression and combustion occur.

The Futaba YS-120 uses its rear rotary intake disc to mostly seal the crankcase on the piston's "down" stroke (so the pressure system will work) and to mostly open the crankcase on the piston's "up" stroke to readily draw in fresh combustion air. But since this is a four-stroke engine there are two intake-through-the-disc air movements to each opening of the engine's intake valve. In effect, the first intake of air (and fuel) waits sealed in the intake tube and carburetor area while a second intake is made and is also released into the same waiting chamber. When the intake valve opens, both of these charges enter the combustion chamber. I don't regard these dual intakes as "supercharging" in the conventional sense. Superchargers are usually very small volume high-speed impeller type air pumps that are driven by the engine's crankshaft. The pumped, compressed air enters the combustion chamber carrying more oxygen, and more power results. Turbosuperchargers (or turbos) are air pumps driven from hot escaping exhaust gases rather than from the crankshaft, and rotational speeds are still higher, as are efficiencies. (I recently drove an older Dodge Colt Turbo through the North Alabama mountains. The car's performance was unimpressive but when you stomped down on the gas pedal hard, the exhaust was diverted to the turbine compressor—you could audibly hear it spool-up like a jet airliner at takeoff—and when the system started pumping compressed air into the Colt's carburetor and cylinders, two or three seconds later you got an exhilarating push on your backside that ac-

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Futaba's YS-120 four-stroke is normally available wherever their radios are sold. Engine comes with all of the tools shown plus a one-way check valve for the pressure line.

ELECTRIC POWER

By MITCH POLING

• Motor timing has become a hot issue in stock off-road R/C car racing. Most aircraft motors are set at zero timing, so the subject may not seem to apply to airplanes. This will not stay so! The Astro cobalt motors have adjustable timing, and now the Leisure 100 watt (05) motors do too. The Leisure motors are *very* impressive, the best 100 watt ferrite motors I have seen, and they are most surely the leading edge of what will be the standard in the future. So, let's take a look at timing.

Twin Astro 05 cobalts provide plenty of motive power for John Mountjoy's Partenavia P-68. Could this be the only scale electric twin available in kit form?

This column was inspired partly because of the Leisure motors, and partly from a postcard from Bill Baker. Bill knows his stuff; he put out an independent newsletter, the *Okie F/F News* until recently, and is now writing the Old Timer F/F column for *Model Aviation*. His question was: "Should *all* motors be run in backwards for break-in, or just car motors?"

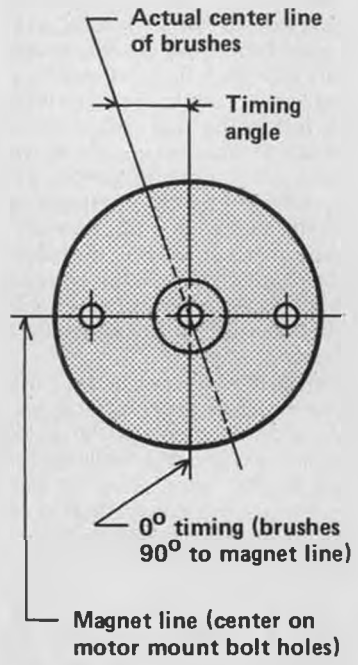
The catch here is that motors can run either way. Backwards is then just a word for "it turns the opposite way to what I am used to." I fly mostly direct drive, so to me, *forward* means the motor shaft is turning clockwise when viewing the motor from the back. This is correct for conventional propellers. If a belt drive is used, the situation is still the same. If a gear drive using a pinion and drive gear is used, the motor must turn counterclockwise as viewed from the back so the prop will be turning conventionally. So, gear drive is "backwards" for the motor as compared to direct drive.

When a motor is broken in, the brushes tend to feather in the direction of rotation. If the motor is then run in the opposite direction the edges of the feather area can and sometimes do break off, which results in some rough running for awhile until the brushes break in again. The symptoms of rough running are lots of arcing or sparking, pitting and/or discoloration of the commutator, power/rpm loss, radio interference, and heat. If the motor has removable brushes and you are changing from direct to gear drive or vice versa, just pull out the brushes, twist the pigtail so the brush turns around 180 degrees, and put it back in the same brush holder it came out of. If the motor is the "can" style, the brushes are not removable, so do a motor break-in for the new direction before you go fly.

Timing adds a new dimension. You must check the timing to see which direction the motor is timed for. This is easy to do, as shown in the sketch. Draw a line from brush to brush. Now draw a line 90 degrees (perpendicular) to it, using the motor shaft as center. This is your backplate reference line. Now draw a line from motor mounting hole to motor mounting hole in the front of the motor. Some motors have a pair of holes; draw the line between the pairs. This is the magnet reference line. It runs between the magnet pairs. Now check the relationship between the backplate and magnet reference lines. I check this by looking at the backplate, that is, looking from back to front on the motor. If the backplate is rotated counterclockwise to the magnet line, the motor is timed for direct drive. All the off-road stock car motors are timed in this direction. The general rule as viewed from the back of the motor is as follows: *the backplate is rotated opposite to the direction of the motor rotation.*

Now you can measure the timing angle. Use a protractor to measure the angle between the brush line and the magnet line; this is the *timing angle*. Timing angles up to and including 15 degrees are common. The timing angle can go as high as 20 degrees, but the motor will be drawing so much current that its life will be short. As the timing angle goes up, the rpm goes up. Past 20 degrees, the rpm drops again. If you rotate the backplate 180 degrees, the motor reverses. This is one way you can make the motor go in reverse without

HOW TIMING ANGLE IS MEASURED



HOW TIMING ANGLE AFFECTS MOTOR PERFORMANCE

LeMans 360 motor, 6x3 Graupner prop
6 cell Panasonic Eliminator 1200 mAh pack

Degrees	No Load Amp	Prop Amp	RPM	Efficiency
0	1.5	16	14,700	66.3%
5	2.5	14	14,900	79.6%
1O	2.5	17	15,300	71.2%
15	3.0	19	15,800	71.0%
17.5	4.0	23	15,900	60.4%
20	8.0	Not Run		
30	30.0	Not Run		

changing leads!

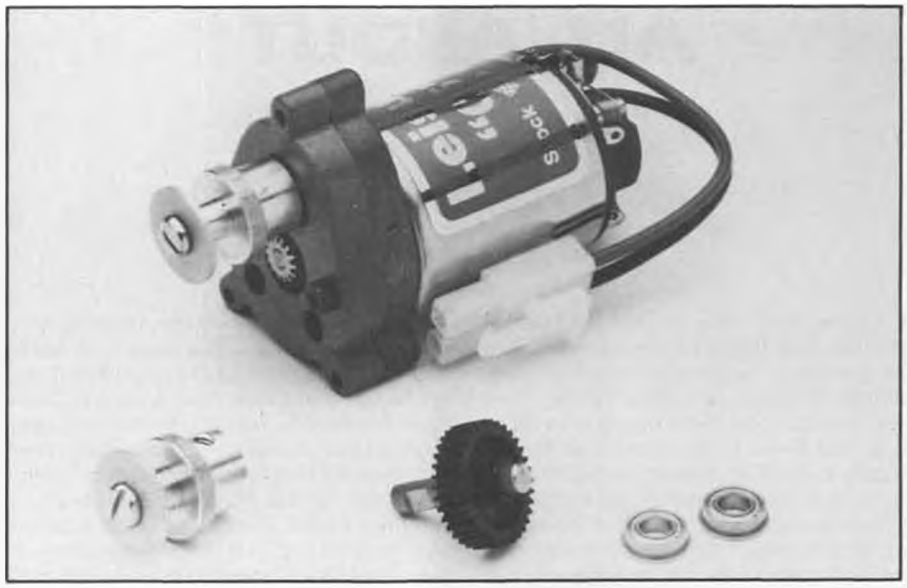
So, at last, the answer to Bill's question! Break in the motor in the direction it will be going when used in flight. Usually this will be clockwise for direct drive and counterclockwise for gear drive, as viewed from the back of the motor.

Car racers often modify stock motors that have replaceable brushes. Mabuchi style "can" motors can be modified too, but it takes more work. The Yokomo style motors (replaceable brushes) have lightweight tabs holding the backplate in place. It is easy to lift them up with a screwdriver. Some car racers just grab the motor, drive shaft pointing down, and whack it shaft-down on a hard surface; this pops the tabs open. The backplate can then be rotated. You can drill a couple of small holes in the case at the back for screws to hold the backplate on. The car racers usually replace the sintered bronze bearings with ball bearings while they are at it. These are 1/8-inch I.D. bearings, which are often available at the hobby stores that stock off-road cars, or from the off-road manufacturers.

Let's take a detailed look at the effects of timing angle on the power and efficiency of a 100 watt motor. I ran tests on a LeMans Kyosho 360 motor at a series of timing angles. The accompanying table shows the results. Efficiency was calculated using watts in equals volts times current; watts out equals pitch times diameter to the fourth power times rpm cubed times 5.33 times ten to the minus 15 power (as per the article in the July '88 *Model Aviation*).

The data shows some interesting results. Note that even though the no-load current goes up, the efficiency of the motor goes up even more. Note the incredible 13% jump in efficiency with a timing change of only five degrees! Any time you can get a gain like that, it is worth doing! If you are after power gain, the 15 degree timing angle gives an output power gain of 24% with no loss in efficiency compared to zero degrees. So, take your pick, high efficiency at 5 degrees or high power at 15 degrees.

I have seen many off-road motors labeled as 20 to 30 degree timing. When measured with a protractor, I get half that. Perhaps the manufacturers are adding the degrees for each brush. Why they would do that is mystifying to me. So, be aware that motors that measure 15 degrees may be advertised as thirty degrees, and so on. Note that the LeMans 360 motor was drawing 30 amps with *no load* at an actual 30 degrees!



The standard speed reduction gearbox from Leisure Electronics has been improved by going to a larger diameter shaft, bigger bearings and a tougher material for the big gear.

Also from Leisure is the new extended gearbox designed specifically for electric sailplanes. Available with three different gear ratios and with three different motors. Details in text.

Now for the other item that inspired this column. Leisure Electronics sent me a sample of their new sailplane motor and gearbox, and I am very impressed. I have not had a chance to go out and fly it yet (it is March and there is six inches of snow on the ground!), but technically it is better than any 100 watt ferrite aircraft motor I have seen, and the gearbox is better than any I have seen with plastic housings. There are two gearbox styles available, long and short. The photo shows the long housing. This is for sailplanes, and it allows a longer nose to accommodate folding props. The housing looks like it is the same type of glass filled nylon that is used for gas engine mounts—very tough indeed. The output shaft is a hefty 3/16-inch diameter. This shaft is unlikely to break or bend. Ball bearings are used front and rear. The drive gear is nylon, the pinion gear is brass. It all looks very sturdy. I have only two things I would like to see. One is a removable pin-

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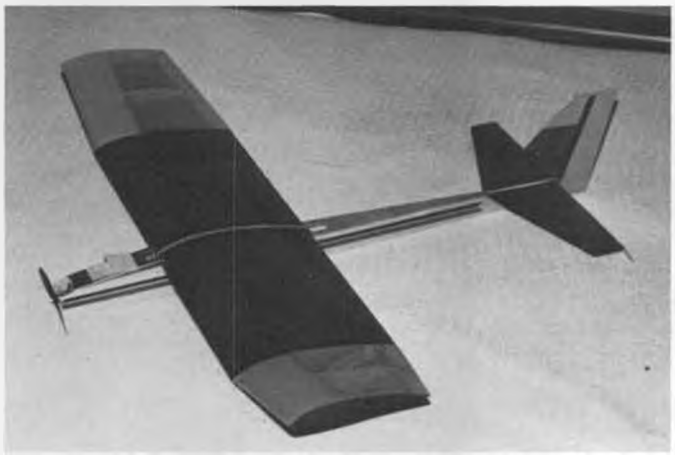


Two 020/035 size electrics belonging to Jack Dobbins are a converted R/C hand-launch glider (left) from RCM plans, and a scaled down Ken Willard "Showmaster." Both use a Kyosho AP29R power system.

ALL ABOUT ARFS

By ART STEINBERG

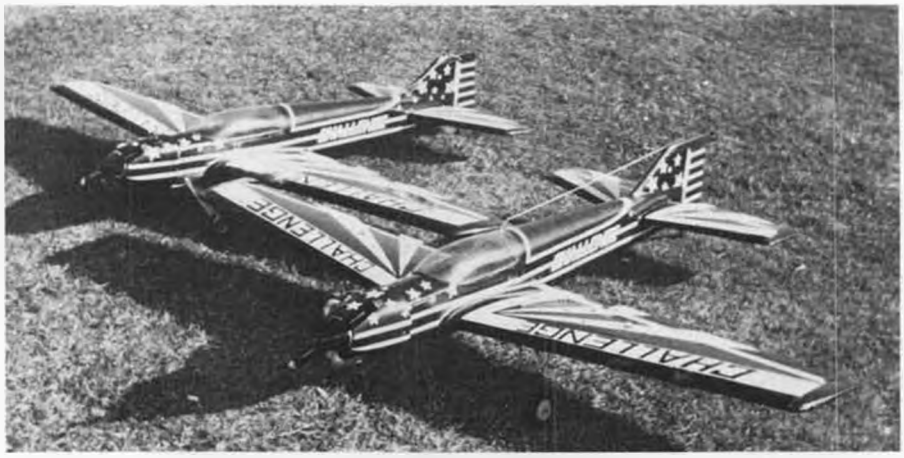
• A great deal of the enjoyment I derive from my R/C flying activities comes from the privilege of writing this column each month. By doing so I get to handle many new products and those of you who regularly read these pages know that we are usually examining, testing, and discussing some new innovation brought out by the ARF industry. I wish I were at liberty to mention some of the specific things that are in the works for future columns, but for the time being I am obligated to keep mum about what we have in store for our loyal readers. Suffice it to say that one or two of our forthcoming product reports will really move you! And besides getting in on the ground floor of so many fascinating R/C ARF developments, another one of my invaluable benefits is that I get to make so many good friends along the way.

It's difficult to believe that this column is halfway through its second year of publication. From the voluminous mail I've been receiving, interest in ARFs is absolutely exploding. Much of this correspondence is of great general interest, and this month I will share some of it with you. From Springfield, Massachusetts we hear from Derek Buckmaster, an Aussie who is presently residing in the States. Derek is an old hand at writing for R/C publications, as he has authored a couple of kit reviews for *Airborne*, the model magazine published "down under," and he's had one of his own designs published too. His letter is in the form of an ARF kit review and he writes:

"I have been following the ARFs column with interest for a while now, but until recently I had not had the opportunity to try out one of these new-fangled Meccano-set models. You see, two months ago I moved from Melbourne, Australia, to the U.S. for work (I'm a computer-aided design engineer for GE Plastics). Back home, building model aircraft can be an expensive hobby if you let it. Anything imported from the U.S. or Japan has its price inflated by one or two middlemen, then import duties, sales tax, and finally the conversion between the Aussie dollar and the yen or the U.S. dollar. Thus any ARF kits are generally very pricey. A couple of examples: the Kyosho Flash electric kit which can be found in the U.S. for around $150 is selling for AUS$305 or U.S.$386 when you allow for the conversion, and EZ's Dago Red was supposedly a bargain in Australia for a mere AUS$395, or U.S.$500 at the time. In the U.S. Dago Reds go for around $230! So you can see that kits and accessories (radios, too) are around two or three times more expensive in Australia than they are here.

"So after arriving in the U.S., I started looking around for a model to start flying. The new England winter was almost upon us when we arrived late in October so an ARF made sense as the quickest way to get into the air. The other factor that came into play was that we are here temporarily, and therefore we are living in an apartment without the 'model room' I was used to at home and without a garage or backyard for breaking in and running an oily and noisy piston engine. So an electric ARF would be ideal. I ended up choosing Kyosho's Express for the above reasons, and I thought you may be interested in my impressions. I'm also trying to find some info about the model, but more on that later.

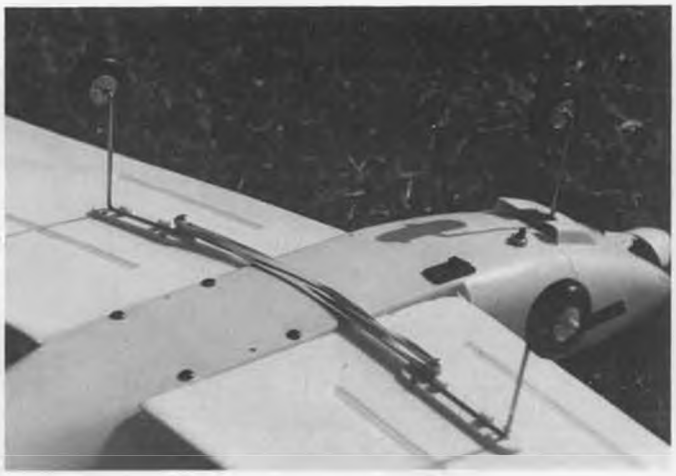
"The Express is Kyosho's most recent ARF motorized glider. A number of magazine writers have already noted its resem-



A handsome pair of Challenge II ARFs originally marketed by World Engines—check with W.E. for availability. Rick Radcliffe's, on the left, flies with an Enya 120R, while Sal Luciania uses an O.S. .90 in his.

The Kyosho "Express" ARF is actually a semi-scale model of the Taifun 17-E motorglider built in Germany. This is an electric powered model using Kyosho's AP29R motor on six cells. Ship comes equipped with the Auto Cut-Off described in "Over the Counter" this month.

This month's column contains a review of the Express by Derek Buckmaster, an Aussie modeler temporarily living in the U.S.



Underside view of the Express shows the landing gear attachment and wing rudder bands.

blance to the Valencia kit, even suggesting that it is simply a smaller, tricycle-geared version of the Valencia. Somehow I like to think that it is a little more than that. In several places on the box and in Kyosho's advertising, the Express is described as being 1/11 scale, but nowhere is the identity of the full-scale craft made clear. A little research shows that the Express is fashioned after the German Taifun 17-E motorglider. Cox also has a larger kit of the Taifun on the market. This also explains the German registration letters D-KONO on the fuselage of the Express. This is where my plea for information comes in. I am looking for some more documentation on the Taifun. I brought no books across from home at all, and my references on motorgliders are rather sparse in any case. So I would really appreciate it if you or a reader may know of any Taifun details or where to find them. One source I intend to try is the scale documentation mail-order type places, but often they do not feature rarer or European types.

"On to some details of the kit. The model features Kyosho's latest materials technology. The fuselage is a one-piece blow molded affair, which I understand is molded from a polyolefin resin, resulting in a waxy surface. Of course nothing at all will stick to this material, so everything is fastened mechanically; screws or bolts are the order of the day. The fuselage is very tough, but also a little flexible. Whenever you pick up the model, the fuselage squashes in by half an inch or so on each side. This takes a little while to get used to! However, the fuselage molding is very rigid in torsion and resists any lengthwise bending.

Here's a hot combination: Royal's Telstar and a pumped S.T. .45 with MAC tuned pipe. This one by Ben McMichael is a lively performer.

"All of the tail surfaces are molded in higher than normal density expanded polystyrene foam, featuring a hard, shiny surface. The rudder and fin are one piece, with a thin integrally-molded hinge in between. Elevator and tailplane treatment is the same. These hinges are quite stiff when taken out of the box and must be 'exercised' to free them up and reduce servo loads. I found that the easiest way to do this was to sandwich the elevator between the edge of a table and a steel straightedge with the hinge line directly over the edge of the table. The tailplane is connected to the top of the rudder with two plastic brackets which allow the tailplane to be removed for transport. Two long bolts protrude from the bottom of the rudder, and these hold the whole empennage onto the fuselage, fixed with plastic nuts on the underside of the fuselage. The elevator is actuated by a Bowden cable which runs inside the tail fin, and the rudder is actuated by a wire pushrod.

"The wings are made from a top and bottom layer of styrofoam, with a core which extends for about a quarter of the span out each wing from the root. This

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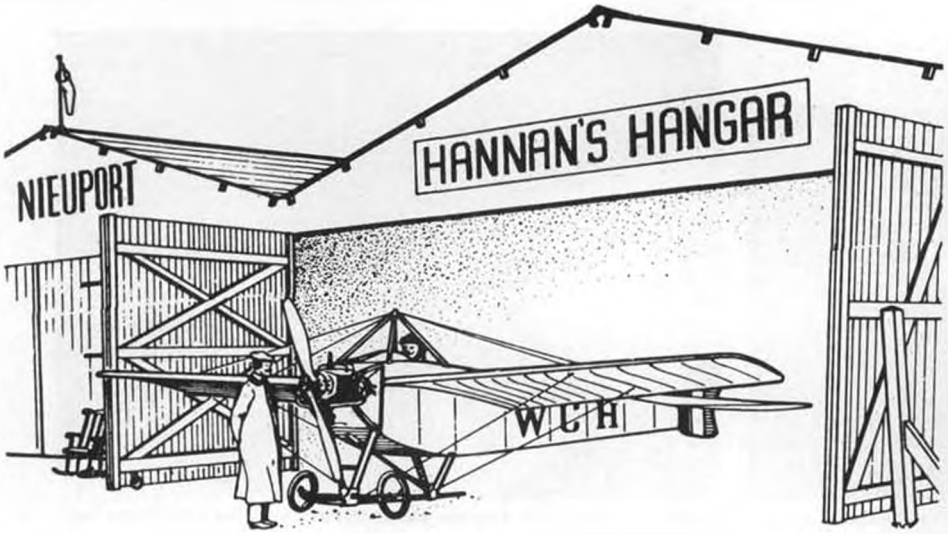
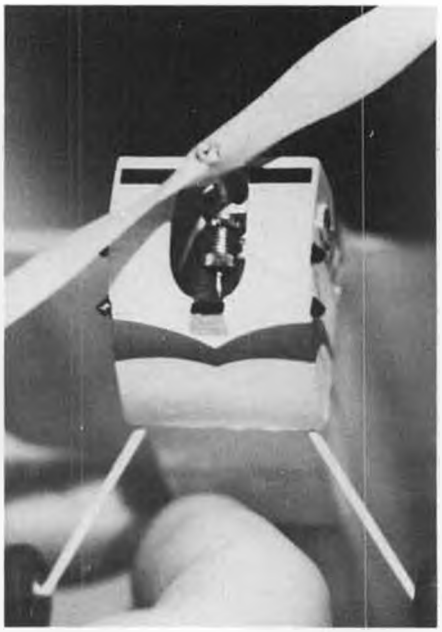
Above: not commonly seen in the U.S., the Striker is a 62-inch ARF produced in England. This one by Sal Luciania flies well with an O.S. .61 SF ABC.
Left: a .60 two-stroke in a Royal Chipmunk 40 is a real handful! George Wright goes for spectacular performance in his models.



"Those of us who learned the old simple ways have stuck with aeromodeling all these years because we found that the basics have transcended and outlasted all the new and changing fads."
John Worth



Close-up of custom-made CO_2 engine by Stefan Gasparin, mounted in Lacey built by Frantisek Barta. Photo by M. Gasparin.

RELIABLE RUBBER POWER

Rubber is the oldest and simplest form of model power, other than gravity. Even in the "High-tech Eighties" it remains efficient and popular for models as small as Pistachios and as large as Jumbos.

The Don Ross book, *Rubber Powered Model Airplanes* is selling briskly, and not only to beginners, but also to many experienced builders. Is this a sign of yearning for "days of yore" nostalgia? Or do rubber-powered models offer a relaxing change-of-pace from long-term complicated projects? Whatever the reasons, we congratulate author Don Ross and artist Jim Kaman on their winning combination!

RUBBER-POWERED JETS?

Among the advantages of "rubber jobs" is the ease with which experiments may be conducted. A case-in-point concerns model jet planes. Ducted fans are hot items in R/C, of course, however they are now gaining fresh attention among free flighters. Emmanuel Fillon's rubber-driven squirrel-cage-blower powered models have appeared in this column previously, and we well recall Jon Hoshisaki's Mig-like sport model flown many years ago at Sepulveda Basin. Now modelers in California and Virginia are experimenting with the jets, and thanks to Tom Arnold, Hewitt Phillips and Bill Hadden we have a few tantalizing details. On the West Coast, Barnaby Wainfan has a delta-winged model propelled by a Sleek Streak plastic prop running inside a 15-inch long duct, making circuits inside a gymnasium. In San Diego, Roy Hood has constructed an all-balsa, rubber-driven, seven-stage axial-flow turbine. Although unsuccessful thus far, it may inspire additional exploration.

In the east, Reid Hull and Hewitt Phillips, partially inspired by Jurgen Korteback's A-10 Peanut, have developed the ducted-fan sport models shown in our photos. Their Virginia Brainbusters model club proposed simple rules: 3-inch maximum impeller diameter, 6-inch minimum duct length, and 18-inch maximum wing span. The model must climb under its own power after launch to register an official flight. No limit on attempts. Best duration wins. What could be simpler?

During the first meeting, four models appeared. Bill Hadden's two semi-scale entries (one with twin ducts) proved too heavy to achieve official flights, however were inspirational anyhow.

Next to try was Reid Hull, who employed a carved two-blade impeller running in front of an oppositely-pitched stator in a stick-and-tissue duct with a styrofoam inlet. On the first attempt the model climbed away and flew well while the audience cheered! It soon hit a wall, but it had gained several feet of altitude, showing unexpected promise.

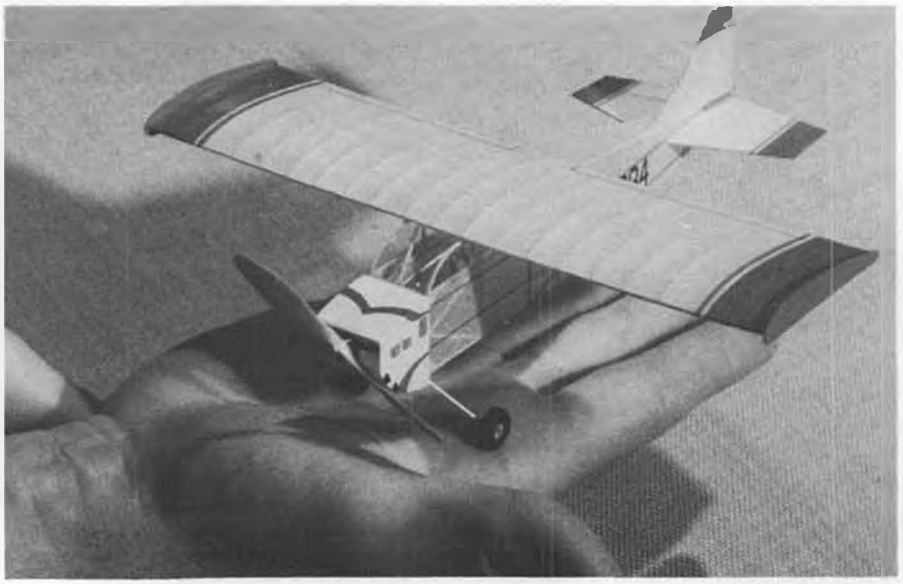
Then Hewitt Phillips' model, featuring an impeller at each end of its duct, amazed the crowd by performing a takeoff, and being "the slowest jet plane you will ever see," according to its builder. (How about the Harrier, Hewitt?)

By the end of the flying session, Phillips' model had attained 24.1 seconds duration, and Reid Hull's had managed a respectable 17.1 seconds.

Phillips also flew a semi-scalish Boeing 727-200 with a propeller, unconventional in having transparent blades which became nearly invisible in flight. Spanning 16 inches, the 22-inch long model has also flown with the prop mounted in the pusher position. If any of our readers are looking for a fresh challenge, try rubber-powered jets!

RUBBER-POWERED B-36

Dr. Bill Harris has been developing multi-engine models employing lightweight gears of his own manufacture. Beginning with a simple non-scale twin-prop "test bed," he progressed through a Northrop P-61 Black Widow, and eventually a six-prop Convair B-36. We enjoyed his description of the testing difficulties: "The B-36 flew before I painted it and



World's smallest CO_2 powered free flight, a Pistachio Scale Lacey M-10 by Frantisek Barta, Czechoslovakia. Photo by Michal Gasparin.

A tidy Tipsy Junior Peanut by Clarence Mather, Bishop, California. As you might expect from Clarence, it's an outstanding flyer.

added 25 grams of details. Since the only flying field is 20 miles away, and since the wind only quits on alternate leap-years, it may be some time before the feasibility of six props running off one rubber motor can be demonstrated."

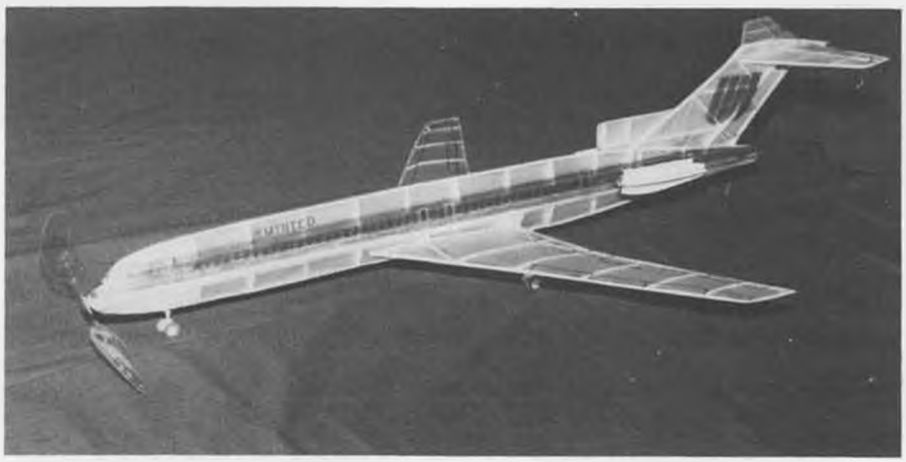
FLYING HAT?

During last year's Pasadena IMS show, Doug Gardner, of Covina, California, attracted a great deal of attention with his Pistachio-sized Hergt monoplane mounted atop his hat. He related that dozens of curious people stopped him to ask if it really flew. (Yes, up to 45 seconds . . . without the hat, of course.) Among those who talked to Doug was a gentleman who wanted to purchase it, offering two fifty-dollar bills right then and there! No, Doug didn't sell, and he explained the reason for wearing the unusual chapeau: "I feel I must actively promote our hobby, and although sewing a model plane to your hat might seem silly, it just might help save us a flying-field somewhere down the road."

PEANUTS ON PARADE

During late 1988, the Japanese Shonai Peanut Powers Club organized a most successful model display in the Nagoya Ueda Dome Plaza. Sponsors were enlisted and lavish full-color posters promoting the event were published. Hundreds of models were displayed in a gallery-like atmosphere, and we were pleased to note *Model Builder* magazine prominently on view in one showcase! Modelers Shoichi Uchida, "Kaz" Suzuki and Jiro Sugimoto were interviewed on local television and did some Peanut flying for the cameras as well.

The Nagoya club will again sponsor an international Peanut Postal Proxy contest, and mailed-in entries are invited. Based upon previous events, entries from at least six different countries may be expected. Scheduled for August 13, 14 and 15th, entries must be received no later than July 30, 1989. For entry forms and rules, send four International Reply Coupons (from your post office) to: Shoichi Uchida, 3-24 Asanaka, Ogaki-shi, Gifu-ken, 503 JAPAN.



An "almost profile" Boeing 727-200 with transparent propeller, as described in article. Photo by Hewitt Phillips.

AND IN BELGIUM

The 13th Annual Club de Petite Aviation indoor championships features many prize categories, and also solicits Peanut and Pistachio proxy entries for those unable to attend in person. The dates are August 25, 26 and 27, and complete rules and entry forms are available by sending four International Reply Coupons to: F.L. Van Hauwaert, Grand Place I - Box 52, 4110 Flemalle, BELGIUM.

AND IN THE U.S.

The 1989 contest calendar is unusually enticing. The National Free Flight Society U.S. Indoor Championships in the Johnson City, Tennessee Mini-Dome (116 feet high!) is scheduled for June 1, 2, 3 and 4, with over 20 separate events, including the MIAMA Peanut Gran Prix. For more information send a stamped self-addressed return envelope to: USIC, 1655 Revere Drive, Brookfield, Wisconsin 53005.

Reid Hull's ducted-fan rubber model (yes, ducted-fan) approaches rafters during Brainbusters' indoor meet. Bill Hadden pic.

Then on June 19 through 23, the NFFS Outdoor Championships takes place in Lawrenceville, Illinois, with practically every free flight event one can imagine. Entry forms may be obtained by sending a stamped, self-addressed return envelope to: R. Smith, 7552 Redondo Ct., Cincinnati, Ohio 45243. The AMA Nationals in the Washington Tri-Cities area plus Moscow,

Hewitt Phillips (left) and Reid Hull with their successful indoor ducted-fan models at Brainbusters' meet. Photo by Bill Hadden.

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STINSON MODEL "U"

By MIKE KEVILLE . . . Half-A Profile Scale is an event that is rapidly gaining in popularity. Our author's three-engine 1930s airliner offers a good introduction to the event and to multi-engine C/L models in general.

• Stinson's Model "U", produced from 1931 to 1933, was the last in their series of tri-motored, high-wing airliners. Spanning 66 feet 2 inches, and powered by three 240-hp Lycomings, the "U" featured many advanced items for its day, and sold new for $27,000 . . . about the cost of an R/C Giant Scale ship today, we'd reckon. Flown by American Airways, forerunner of today's American Airlines, most model versions seem to be trimmed in that livery, and this one's no exception.

Longtime readers may recall Don Butman's Peanut Scale version in the April '74 issue of *Model Builder*. Dave Shipton, of Delavan, Illinois, had a gorgeous C/L "U" at the '66 Glenview Nats. An .010-powered free flight rendition was once built and flown (!) by Bill Stroman. And now . . . for what it's worth, the Half-A Profile Scale version.

Several members of our club, Southern California's "Knights of the Round Circle," suggested we try to get this thing published. We immediately chose *MB* with its much-appreciated equal billing of C/L and F/F. The Editor/Publisher has been a friend through the years, offering us a sincere "welcome back" after a long absence from modeling. The guy is down-to-earth; despite being an AMA Hall-of-Famer and all-around big-timer, he's managed to maintain the same hat size, if you know what we mean.

For scale data and 3-views, we contacted Dave Shipton. To our delight, he responded by sending his 22-year-old Nats presentation booklet, containing Wylam drawings and copies from the pages of an old issue of *Popular Aviation*. We then enlarged the Wylams four times, which yielded a wingspan of 50 inches and an overall length of 33.75 inches. This works out to a scale of 3/4 inch = 1 foot, or 1/16th full size.

A word about power. You could modify things and use beam-mounted engines, such as Cox Medallions, WenMacs or OK Cubs. (If you have Cubs for sale, we need to talk.) Or, with some changes, center the Babe Bees. Being basically lazy, and in view of the vertical needle valves required, we mounted them off-center. Up close, we'll admit it looks sort of tacky—but in flight it's no big deal. Ample, but not outrageous, power is provided by 6x3 props and 25% nitro fuel.

Construction of this little airliner is fairly standard, so we'll just try to highlight any unusual features. It's helpful to "kit" and prefabricate as much as possible, as this seems to speed assembly somewhat and allows plenty of time for the fun (?) of painting and decorating.

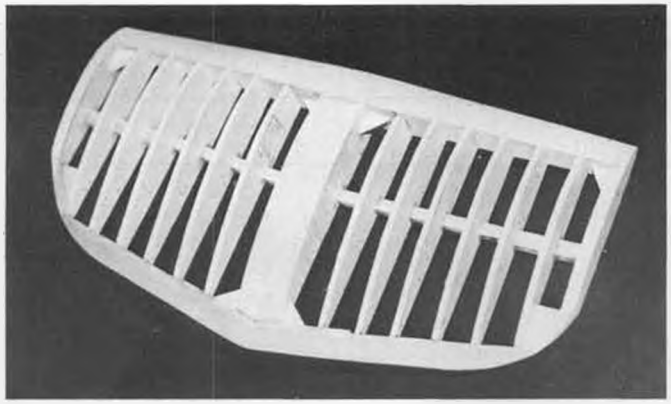
Mike did a fine job on the model Stinson but it still looks pretty sick compared to his daughter, Michele. At 13 years of age, she is already a competent C/L flier. Mike says Michele can land a C/L model better than he can. We think so too—we've seen him fly!

Gorgeous full-fuselage C/L Stinson built by Hobby Hideaway's Dave Shipton over 20 years ago. Dave originally flew it with three Arden .09s, now has three dummy Lycomings for static display.

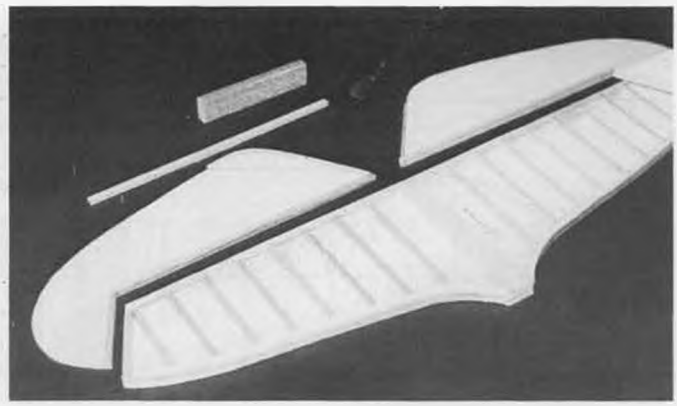
MAIN WING

Sliced ribs (64 of 'em) were used for lightness and to avoid having to cut all those holes for the buried spars. You'll also save a bundle of bucks on balsa this way. Use a template of 1/16 ply for the top rib pieces, and go to it. Rib bottoms are lengths of 1/8 sq. stock.

If you can't readily locate any light-but-firm 3/4x1 balsa for the L.E., trim some one-inch square on a scroll saw, which will also help ensure straightness. Note the slight dihedral in the panels, and allow for



Sesquiplane structure needs to be strong to withstand landing shocks. Leading edge is carved from a solid balsa block.



Horizontal stab is a 1/16 balsa core with 1/8 balsa outlines and ribs top and bottom. A quick and easy way to simulate a built-up structure.

Rib tops are sliced from 1/8 sheet, bottoms are 1/8 sq. Not as difficult as it looks.

that when installing the center ribs.

Spar height and locations aren't critical; just be certain they're strong enough to do the job, and that they contact every rib. Do be sure to install the ply spar joiners and balsa gussets.

Wingtips on the original were cut from 3/16 sheet as shown on the plans. While these don't look too bad, an alternate method would be to laminate them for a more realistic appearance using four thicknesses of 1/32x1/8 basswood soaked in ammonia/water and glued around a form of the inside dimension of the tip. (For more information on laminated wingtips, refer to past "F/F Scale" columns by Fernando Ramos.)

On rib spacing, note that while most ribs are 3/4-inch apart, those toward the center of each panel are spaced at only 5/8-inch. This follows the scale spacing per the Wylam drawings and allows for a somewhat stronger strut support area—probably Eddie Stinson's intent in the first place.

The four center ribs (two of 1/8, two of 1/4-inch balsa) are solid, and require spar openings to be cut, including space for the spar joiners. Note that each of these ribs is undercut by 1/16 inch, top and bottom, to accept the center-section sheeting. Dihedral is 3/8-inch at each tip. Carefully block-sand to this angle and join the panels with your favorite adhesive, then secure the previously-inserted spar doublers and slide the solid ribs into place. Install about 3/4 ounce of outboard tip weight. Fill in all the dings, carve and sand everything to final shape and cover as desired.

(Editor's note: As shown in the photos and on the plan, Mike originally mounted all three engines on the inboard side of the nose and nacelles, in an effort to direct the thrust toward the outside of the circle. However, flight tests have since shown a very definite need for increased outboard tip weight, at least twice the 3/4 ounce specified above. Mike recommends either relocating the engines to the outboard side and sticking with the 3/4-ounce weight, or building the model as per the original and installing at least 1-1/2 ounces of outboard tip weight.)

We found it helpful to cover and finish the wing prior to its installation. If you agree, remember to leave about 3/8-inch of bare wood at the center for adhesive penetration. You may want to reinforce the wing/fuselage junction with lengths of 1/8-inch dowel.

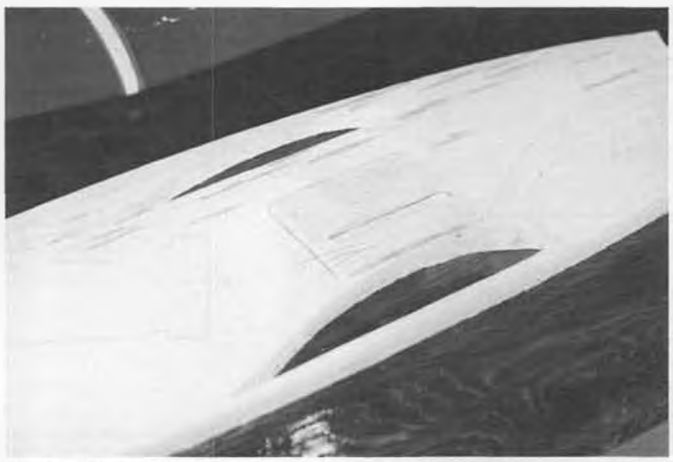
SESQUIPLANE (Lower Wing)

This unit absorbs a lot of stress. It supports the two outboard engines and takes the landing shock. Although light weight is important, think strength here. Don't omit the dowels, gussets or ply joiners. Select a length of firm 1x1-1/8 inch balsa, mark the center and taper it to 3/4-inch square at each tip, with the "sweep" being on both the L.E. and the bottom surface. Ribs are solid. Note the "vee" dihedral on the under surface and taper the SP-1 rib bottoms to blend in with this.

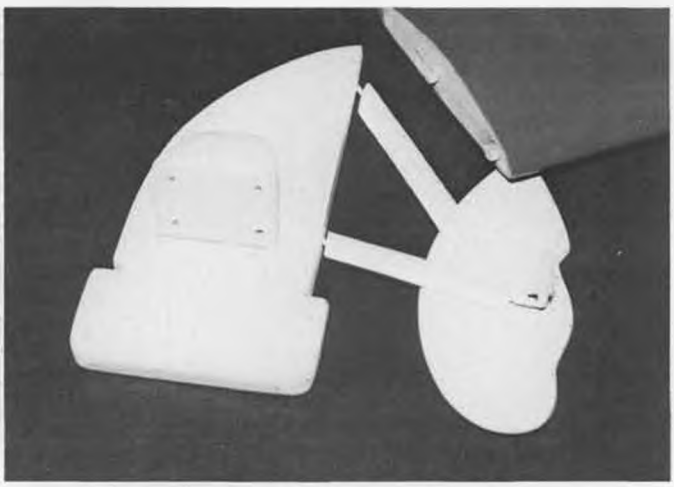
Among other things this author can't do is plot rib patterns. Ribs SP-2 through SP-8 were eyeballed and trimmed to shape as things went along—based on SP-1. As such, the sesquiplane ribs on the plan are approximate shapes; you'll have to judge as you go along . . . or perhaps you know how to plot tapered ribs properly?

The 1/4-inch tip ribs (SP-8) are added after the L.E. and T.E. are carved and sanded

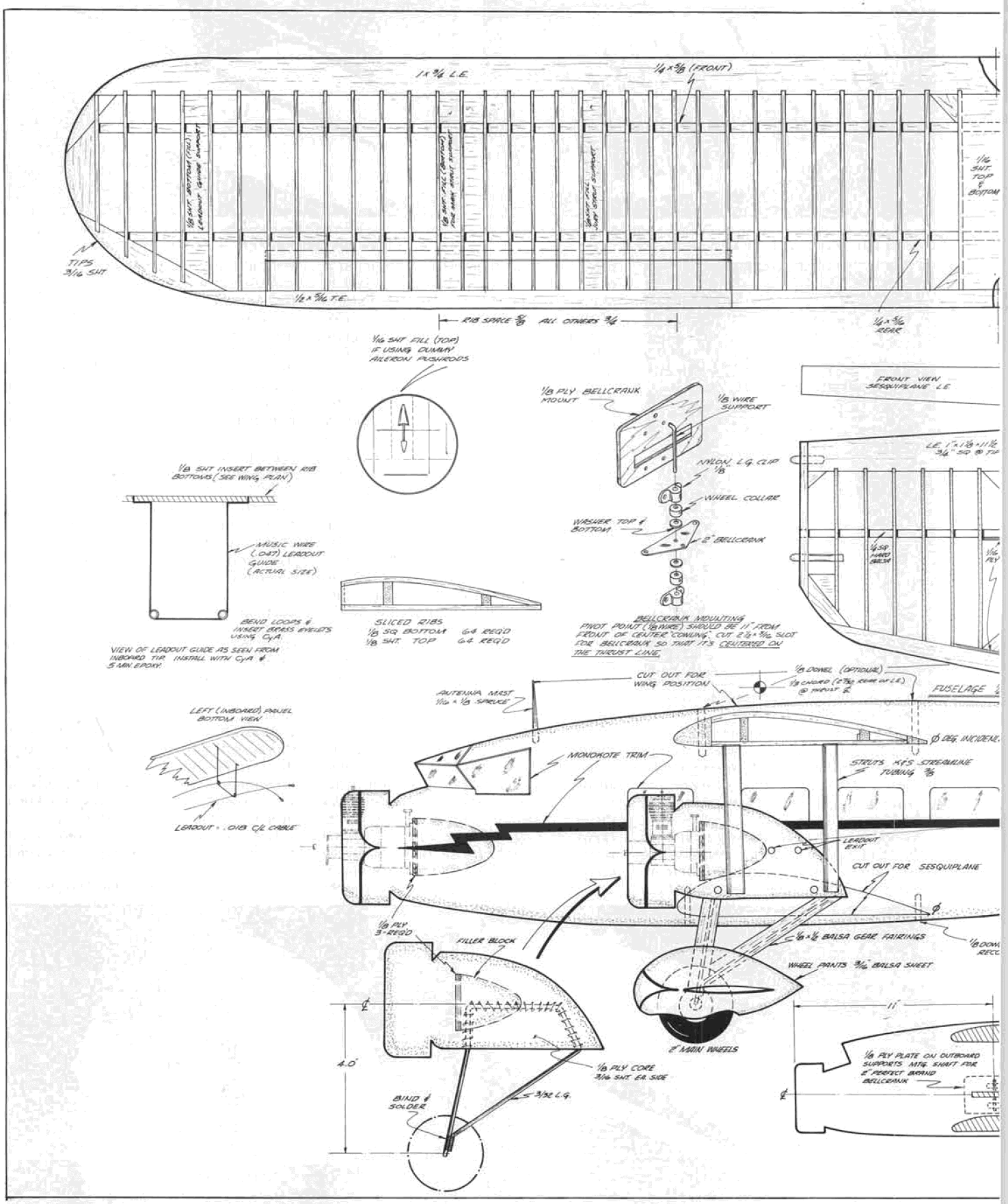
Continued on page 79

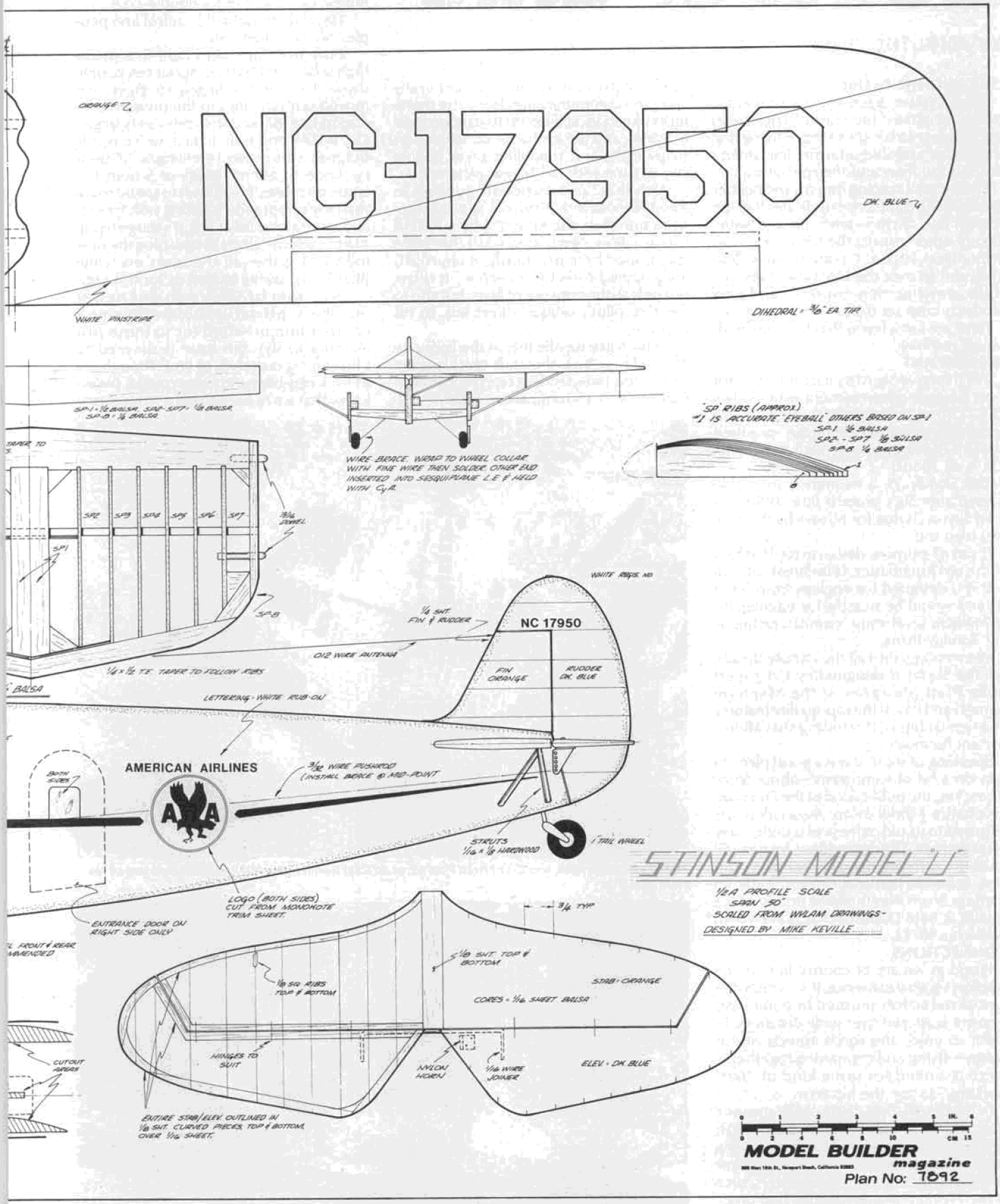


Outboard side of the fuselage shows the 1/8 ply bellcrank mounting plate. Fuselage is completely painted and trimmed before final assembly—makes things a lot easier all around.



The outboard nacelle, engine mount, landing gear strut, and wheel pant, all ready for painting.


1 x 3/16 L.E.
1/4 x 5/8 (FRONT)
1/16 SHT. TOP & BOTTOM
TIPS 3/16 SHT
1/2 x 3/16 T.E.
RIB SPACE 5/8 ALL OTHERS 3/4
1/4 x 5/16 REAR
1/16 SHT FILL (TOP) IF USING DUMMY AILERON PUSHRODS
1/8 PLY BELLCRANK MOUNT
1/8 WIRE SUPPORT
FRONT VIEW SESQUIPLANE L.E.
NYLON L.G. CLIP 1/8
WHEEL COLLAR
WASHER TOP & BOTTOM
2" BELLCRANK
1/8 SHT INSERT BETWEEN RIB BOTTOMS (SEE WING PLAN)
MUSIC WIRE (.047) LEADOUT GUIDE (ACTUAL SIZE)
BEND LOOPS & INSERT BRASS EYELETS USING C/A.
VIEW OF LEADOUT GUIDE AS SEEN FROM INBOARD TIP INSTALL WITH C/A & 5 MIN. EPOXY.
SLICED RIBS
1/8 SQ BOTTOM 64 REQD
1/8 SHT. TOP 64 REQD
BELLCRANK MOUNTING
PIVOT POINT (1/8 WIRE) SHOULD BE 11" FROM FRONT OF CENTER "COWLING". CUT 2 1/2 x 3/16 SLOT FOR BELLCRANK SO THAT IT'S CENTERED ON THE THRUST LINE.
1/8 DOWEL (OPTIONAL)
CUT OUT FOR WING POSITION
1/8 CHORD (2 3/16 REAR OF L.E.) @ THRUST ℄
FUSELAGE
ANTENNA MAST 1/16 x 1/8 SPRUCE
LEFT (INBOARD) PANEL BOTTOM VIEW
LEADOUT = .018 C/L CABLE
MONOKOTE TRIM
STRUTS K&S STREAMLINE TUBING 3/8
LEADOUT EXIT
CUT OUT FOR SESQUIPLANE
1/8 PLY 3-REQD
FILLER BLOCK
1/8 x 1/8 BALSA GEAR FAIRINGS
WHEEL PANTS 3/16" BALSA SHEET
2" MAIN WHEELS
4.0"
1/8 PLY CORE 3/16 SHT. EA. SIDE
BIND & SOLDER
3/32 L.G.
1/8 PLY PLATE ON OUTBOARD SUPPORTS MTG. SHAFT FOR 2" PERFECT BRAND BELLCRANK



FULL-SIZE PLANS AVAILABLE — SEE PAGE 106

Control Line

BY JOHN THOMPSON

CIRCLING THE GLOBE

There's never been any doubt that for modeling action, the control line circles are the place to be. It's a kind of flying that is often fast and always fascinating, and it's close to the fliers and the spectators.

Recent mail coming into *Model Builder* control line headquarters indicates that the control line circle extends far and wide. Recent news crossing the *MB* desk comes from places such as Germany, New Zealand, and all over the U.S. New clubs, old clubs growing, new contests, and new products crop up daily.

Here are just a few tidbits from the midwinter mailbag:

SIG-NIFICANT

We'll forgive Sig Manufacturing Co. for their advance advertisement which refers to C/L fliers as "roundy-rounders." We know they were just kidding, because their new kit is evidence that Sig knows what C/L is all about.

The Skyray 35, a 44-inch span profile named after Sig's popular little .049-powered Skyray, is due for release by the time you read this.

It's an all-purpose design in the tradition of the old Ringmaster, Flite-Streak, etc., in that it is designed for engines from .19 to .35 and would be suitable for training, intermediate level stunt, combat, racing or just Sunday flying.

We won't go into all the minute details, but the Skyray is designed by C/L expert Mike Pratt (designer of the Magnum stunter) and has all the top-quality features of a typical big kit, including that all-important hardware.

Speaking of stunt, this is a good place to pass on a bit of stunt news—about *Stunt News*. Yes, the publication of the Precision Aerobatics Model Pilots Association has returned to its old name and is under new management. The new address for general PAMPA correspondence is 221 N.W. 2nd Ave., Suite 300, Portland, Oregon 97209. To contact *Stunt News*, write editor Mike Keville at 6618 Dashwood St., Lakewood, California 90713.

CONNECTIONS

Proud as we are of control line model aviation's global existence, it's a somewhat specialized activity pursued by enthusiasts who are scattered over wide distances. In order to enjoy the social aspects of our hobby—flying and competing together—there is a need for some kind of "networking," to use the hip term.

In model aviation, that usually means a club and/or a newsletter. Indeed, most newsletters are produced by clubs, serving their cities or regions. Some areas have developed independent newsletters, such as the *Flying Lines* newsletter that originated in the Northwest for eight years and had nationwide circulation. Newsletters tend to come and go with the availability of energetic editors, but they generally carry the communication load. The newsletters keep local fliers up to date on local activities, and the exchange of newsletters helps clubs and modeling press people stay in tune with the bigger picture.

With that "connectional" concept in mind, we come to a current success story from one club, the Knights of the Round Circle, whose newsletter, which has been mentioned here previously, is appropriately named *Direct Connection*. It refers not only to the network of fliers, but also to the C/L pilot's unique direct link to his airplane.

Editor Mike Keville tells in the February 1989 edition how the club quickly grew from a few independent fliers in Southern California to a strong, active club:

"Back in early '87, Mike Fox and Don Repp began local efforts to form a control line club. Several of us saw notices in area hobby shops and did a double-take.

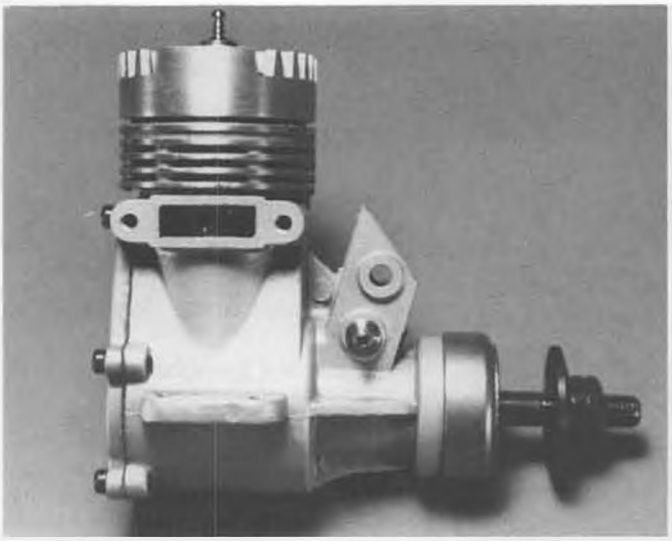
"Hey, we thought. " 'Control line people.' So we called 'em. . . .

"Early meetings were held in a junior high school in Orange. About ten people showed up and it began to grow. We moved our meetings to the present location in late '87, and the roster gets larger. C/L is alive and well. In fact, we've nearly outgrown the present meeting site. Guests continue to attend, many of whom become members. It's difficult to spend more than a few moments chatting with friends and associates at meetings. It's tough trying to get a minute alone to welcome the new folks and gather all the news everyone (thankfully) wants to give us for this rag.

"As a special service to our newer members, primarily those who aren't competition oriented (or to those just learning to fly), this issue is devoted to introducing ourselves to you. Though we all look very busy and preoccupied, please know that we're here to help. Your mem-

Piotr Zawada (arrow), top C/Ler from Poland, at an East Berlin meet. *MB* has published two of his stunt designs.

Group of young stunt fliers from Poznan, Poland, at a Warsaw meet.



The Fox Combat Special Mk VI.

It pays to bring lots of ammunition for Combat. Carload of fast combat ships belonging to Larry Driskill, Texas.

bership is valued, so be sure to ask if you need assistance or info on anything."

Mike then goes on to list the names and a bit of information about each club member—some 40 strong.

If you happen to be a resident of the area and would like to drop in, the Knights of the Round Circle meet at the Anaheim Public Library. For information about meeting dates, contact Mike at (213) 804-4056.

As if designed to fit right in with the above item, the mailbag also contains the excellent *Orbiting Eagles* newsletter from Omaha, Nebraska, with some information about that national "networking" of C/L newsletters mentioned above.

Robert Furr, newsletter editor, notes that the *AMA National Newsletter* is working to set up a newsletter exchange between clubs. The clubs are to be listed in the *National Newsletter*, and the local editors can choose from that who they wish to exchange with.

Former *MB* columnist Dan Rutherford returns to combat. Note pad says, "Duke, I'm back. Send parts. Thanks. Dirty Dan."

The *National Newsletter*, by the way, is a publication put together by Academy of Model Aeronautics mover and shaker, Jim McNeill, and is mailed to newsletter editors. It contains clippings from many newsletters, intended for reproduction by any editor who finds the material useful.

Bob Furr also mentioned the Omaha club's display in a local public library, which showed model airplanes to some 20,000 library users over the month that it was in place. This could be an inexpensive and effective way to attract local attention to the hobby.

(By the way, did you know that most public and school libraries would happily welcome a donated subscription to your favorite model magazines? For several years, I have donated magazine subscriptions to the local library in Cottage Grove, Oregon. The library director tells me it is one of the best-read magazines in the collection.)

In other news from Omaha, we discover yet another version of sport racing, called Omaha Sport Race, which integrates several unique concepts. It's a bit more complex than the typical simple sport race, but appealing to modelers interested in that "like the real thing" feel.

Somewhat like the AMA Goodyear class, the event requires airplanes that look like full-size racing planes. In the case of planes that don't come from semi-scale kits (such as the Goldberg P-40, Shoestring, Buster, etc.), the event requires some documentation. Dimensions are somewhat similar to many sport race classes—390 square inches of wing, for example. Landing gear must approximate that of the original plane.

The event allows Schnuerle ported engines up to .21 displacement and plain-bearing, loop-scavenged engines up to .36. Mufflers and tuned pipes are allowed; models with mufflers get a 20-second time advantage in a 140-lap race (two pit stops required).

Props must be commercially available,

Gene Pape fuels bladder tank in his "Undertaker," typical fast combat ship.

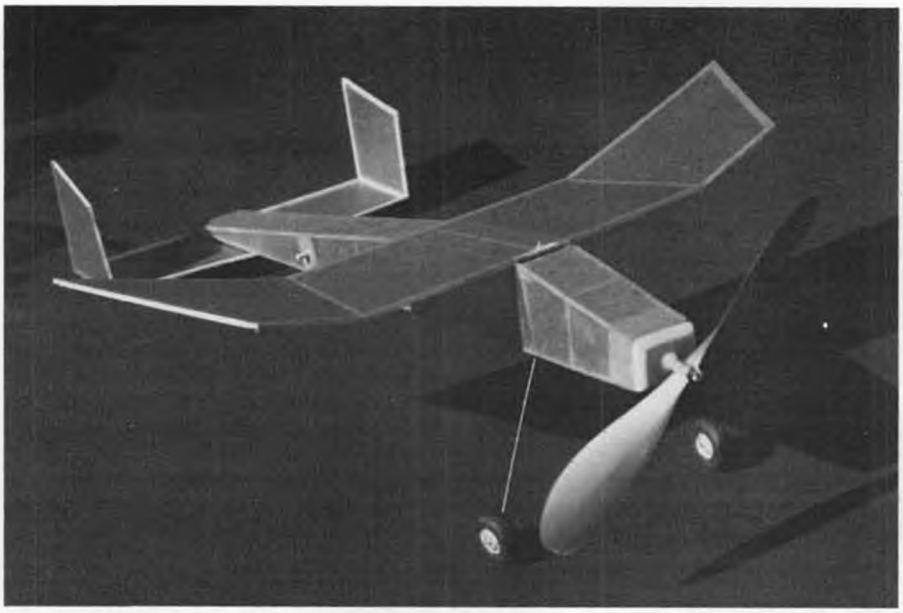
the tank is limited to two-ounce suction, and fuel shut-offs are allowed but not hot gloves or quick-fills.

It would be interesting to hear how the event has succeeded. A well-designed sport race can become a popular and enduring local or regional activity; the poorly conceived ones tend to fall by the wayside in time. We've discussed in this column before the success of some of these events, such as Northwest Sport Race, which has endured with only a few changes since 1976, and continues to be among the most popular events in the region. It also has been adopted by some areas in California, Utah and some other places in the West. (By the way, Northwest Sport Race and its companion, Northwest Super Sport Race, are on the AMA National Championships unofficial events schedule.)

STANDING TALL

Returning to the subject of newsletters, here's an idea that could be adopted by local or regional newsletters to add interest

Continued on page 84



Pussycat

Designed by DICK BAXTER
Text by WALT MOONEY

This month we take a break from our usual Peanut feature and present instead a simple rubber model originally designed for a junior high school Aerospace class. Anyone can build this one!

• This is more a report on a successful project involving several people and organizations (more even than the heading would indicate), but if you decide to build the model presented you will be rewarded with a superb flying model even if you are a rank beginner at constructing model airplanes.

This project is one that can be emulated anywhere there is a teacher who would like to introduce his or her pupils to aerospace technology in a way that is fun, as well as developmental in hand/eye coordination and instructive in terms of basic aircraft configuration and terminology, stability, controls and flight in general.

Dick Baxter's design and Bob Nutt's motivation to give his students a bit more than they might otherwise get from an aerospace class might not have got so far had it not been for Dick's employer. The following is a statement from Vicki L. Boatman, Manager for Civic and Community Affairs, McDonnell Douglas Space Systems Company: "McDonnell Space Systems Company feels it should support local educational systems and so formed a 'school partnership' with the Huntington Beach School District in 1987. Since then, company employees have been putting their skills to work with students in a variety of aerospace disciplines. The Dwyer Middle School model flying class is one result of this policy." As a consequence, Dick was encouraged to support the effort and allowed time to do so.

The Aerospace class presented to 7th and 8th grade students is divided into three six-week units:

I. Lighter and Heavier-than-Air Flight
II. Rocketry and Space Exploration
III. Astronomy

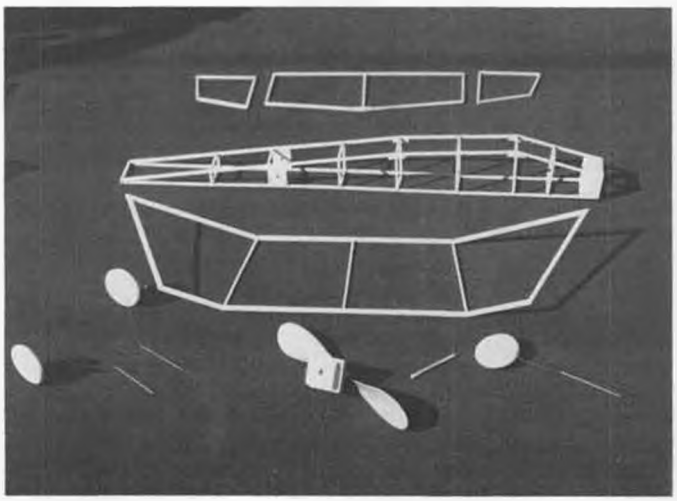
Each student is required to write a research paper for each of the three units, and all are given an opportunity to participate in various activities. One of the activities is the chance to build a stick-and-tissue rubber powered model. The following was obtained from Bob Nutt, and is directly from his letter:

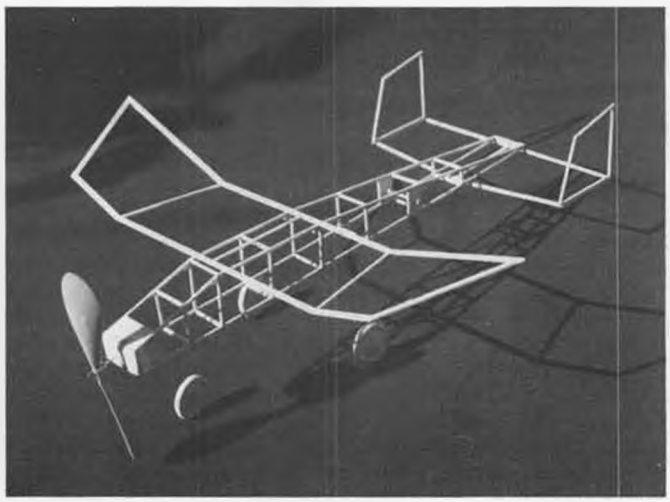
"I met Dick Baxter through a joint program that had just been started up between my school district and his company. I was teaching an aerospace class at that time made up of 7th and 8th grade students. We both agreed that an ideal 'hands-on' project would be to have the students make and fly rubber band powered model airplanes.

"Dick's first meeting with my class was basically to arouse the students' interest in the project. To do this Dick flew a number of his own small planes in the classroom and the students were 'hooked' immediately. They all wanted to go to work on their own at once. They were given the option of building either a flying wing of Dick's design or his 'Pussycat.' The materials were purchased, kits assembled and distributed to the students and work began.

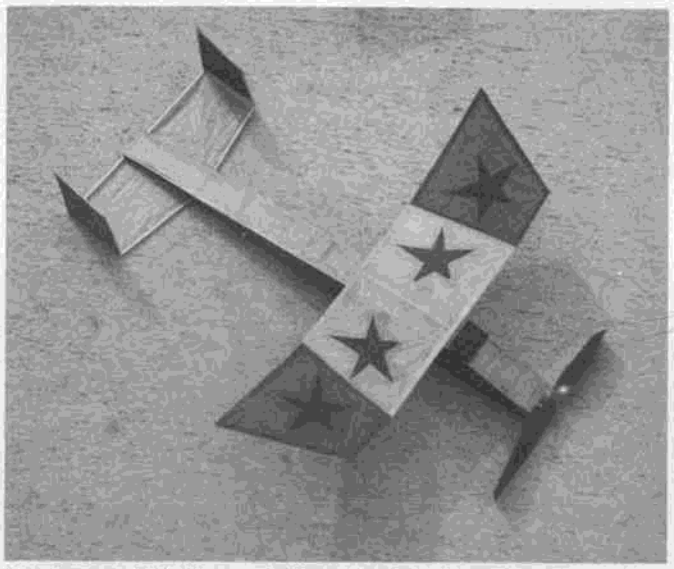
"The students built their models at home but construction techniques were given in class by Dick and myself. We had started this project rather late in the course so there was quite a bit of pressure to squeeze everything in before we ran out of time.

"We could see there was a time problem when the students started bringing in their airplanes. There were many construction

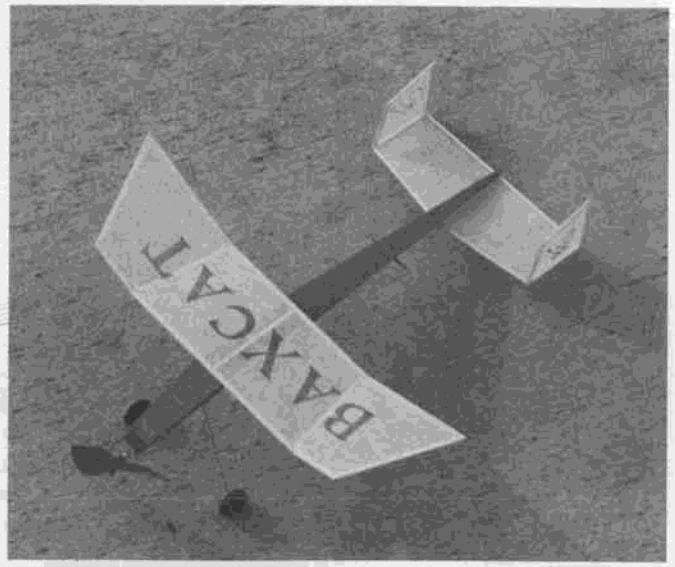




The major components, ready for covering (left) and lightly tacked together to show the general configuration. This is Walt Mooney's model and was built with the trike gear shown on the plan. Could also be built as a taildragger or with no landing gear at all—it's your choice.



Dick Baxter built his Pussycat without wheels for long flights. The angled dihedral break ribs automatically provide the necessary washout when the tips are angled up.



Eight-inch Pistachio size version by Bill Hannan is a fine flier too. Who will be the first to build a Jumbo (36-inch) version? Or a 36-incher with a Pee Wee .020? The possibilities are endless.

mistakes and models which had been slapped together.

"Dick was a lot less worried about this than I was and, sure enough, when we went to a local gym, even these horrible looking Pussycats flew quite well. It took a lot of breaking and regluing, balancing with balls of clay, etc., but they all flew and the kids loved it.

"In addition to the obvious learning that went along with this project, I was also pleased that some of my students were following through by buying more difficult models in hobby stores. I knew I had added an activity to the aerospace class that would be valuable and fun for years to come.

"The students were given a week to complete the model and the next week was spent with three days of flying sessions and two days for discussion of problems and repairs.

"The students were graded in participation, not success in the air. Twenty-seven of twenty-nine students actually tried to fly something and in spite of less than perfect looks and construction errors, by the end of the week most were flying. Myself, Mike Case, and Dick spent a lot of time with individual planes correcting errors. It was rewarding to see the students fly and make adjustments on their own planes."

Some problems that the students had were:

- Building a top and bottom frame as well as two side frames and then trying to make a fuselage by gluing it together. The proper way, of course, is to make just two side frames and use the top view to get cross-piece length and location.
- Putting the wing on backwards so the required washout, which is automatic with the proper dihedral, becomes washin. Read the plans so you know which is the trailing edge and understand that it goes toward the tail.
- They really crumpled up the tissue covering so that the airplane was really too soggy. The paper is wrinkled so that with age it will not get too tight and pull the flying surfaces into warps. Dick says, "Wrinkle the tissue and then smooth it by hand but do not iron it or shrink it."

Now we come to some other individuals contributing to this report.

Three members of the Thermal Thumbers, Dick Peterson, Gary Buddenbohm and Stan Buddenbohm, decided to honor Dick with a one-design fun-fly at Mile Square and selected the Pussycat as the design. Sixteen pilots flew and a total of 83 official flights were recorded, for which the average flight time was 77 seconds. The longest time was recorded by Mike Mulligan at 165 seconds. The lowest flight time was 32 seconds. Thirteen contestants recorded best flight times of 68 seconds or more. This success is what actually inspired this article.

If you build your model exactly according to the plans you can expect this kind of flight capability. Read the plans and follow the instructions on them. I built my first model with tricycle gear according to the plans. It flew right off the workboard without a single adjustment. It has now been flown hundreds of times and consistently exceeds a minute; it often does almost two and no adjustments have ever been needed. I'm really impressed and a lot of experienced modelers who have seen mine fly have built one too.

Not following the plans can give unexpected problems. My son, Curtiss Ryan Mooney, decided to "improve" the model by covering the top of the horizontal tail, instead of the bottom, as called out on the plans, and as a consequence his model dove into the ground in the mass fly-off that the Thermal Thumbers had, while all the other models were climbing up into the blue.

The model can be built with tricycle landing gear, with two wheel conventional landing gear, or with no landing gear at all. The weight and aerodynamic drag of the wheels and wire decreases the flight time capability of the model. With the landing gear, a loop of 1/8-inch rubber about 18 inches long is about right for outdoor flying. Without the landing gear a loop of 3/32-inch rubber the same length will give flight times about 50% longer.

Build a Pussycat by all means and you will surely have fun flying it. Hopefully there are a lot of people who will read this report and be motivated to do what Bob Nutt, Dick Baxter, et al, have done in their local area. Dick's design is the key to the program. •

Group shot showing most of the Thermal Thumbers who participated in the Pussycat one-design contest at Mile Square Park, in Southern California. Do these people look like they're having fun, or what?

PIN PARTS DOWN BEFORE ASSEMBLY REMOVE EXTRA WOOD AFTERWARDS

A JIG IS SIMPLY A SUPPORT TO HOLD UP THE WING TIP WHILE THE DIHEDRAL JOINT IS DRYING

DIHEDRAL BREAK IS JUST OUTBOARD OF RIB

LEFT WING TIP

DIHEDRAL JIG LOCATION JIG IS 5/8 HIGH

DIHEDRAL IS 1.10 AT EACH TIP

WING OUTLINE 1/16 x 1/8

THERE ARE THREE RIBS, ON THE CENTERLINE

WING

COVER TOP OF WING ONLY

SKEWED RIB GIVES THE REQUIRED WASHOUT

TRAILING EDGE

LEADING EDGE

RIBS 1/16 SQ.

TOP VIEW

COVER FLYING SURFACES ONE SIDE AS NOTED:
a. WRINKLE PAPER
b. DON'T SHRINK
c. DON'T DOPE

USE A 5 OR 6 INCH DIA. NORTH PACIFIC PROP. OR EQUIVALENT

RIGHT WING TIP

RUB PLANS WITH WAX OR COVER WITH WAXPAPER TO PREVENT PARTS STICKING TO THE PLAN

ALL PARTS ARE BALSA UNLESS OTHERWISE NOTED

MODEL CAN BE MADE WITH THREE WHEELS, TWO WHEELS, OR NO LANDING GEAR AT ALL.

THREE WAYS OF RETAINING THE WHEELS ARE SHOWN: BENT UP WIRE END, GLUED ON WASHER, AND A SIMPLE BLOB OF GLUE.

TISSUE COVERING CAN BE ATTACHED WITH THINNED WHITE GLUE AND A BRUSH , OR WITH A PASTE STICK

THE WOOD GRAIN DIRECTION SHOULD RUN THE LONG DIRECTION IN ALL WOOD PIECES

MAIN LANDING GEAR PATTERN MAKE FROM .015 WIRE

.020 WIRE WILL BE STIFFER BUT ALSO, HEAVIER.

FIN

COVER FINS ON OUTSIDE ONLY

NOTE ASYMETRY FOR TURN

STABILIZER

FIN AND STABILIZER OUTLINES ARE 1/16 SQ.

TRAILING EDGE

NOTE GUSSET

LEADING EDGE

TOP VIEW

COVER BOTTOM OF STABILIZER ONLY

MAKE SURE THAT THE CENTERLINE ℄ OF BOTH THE WING AND TAIL ARE LOCATED ON THE BODY CENTERLINE.

FIN

GLUE FIN ON TOP OF STAB. RIB, MAKE SURE THEY ARE VERTICAL

MODEL PERSPECTIVE DRAWING

NOSE BLOCK TO BE A SNUG FIT IN FRONT END OF FUSELAGE, NOSEBLOCK PIECES 3/16TH. ALUMINUM 3/32 DIA. REAR MOTOR PEG.

1/16TH SHEET

FUSELAGE TOP VIEW

DON'T BUILD A TOP VIEW, JUST USE IT TO GET THE LOCATION AND LENGTH OF THE

1/16 SQUARE CROSS PIECES

MAKE A FUSELAGE BOX BY USING THE CROSSPIECES CEMENTED BETWEEN THE TWO SIDE FRAMES AT TOP AND BOTTOM LONGERONS.

1/16 x 1/8 TAIL POST

PECK POLYMERS PLASTIC THRUST BEARING

3/16 SHEET NOSE BLOCKS

DO NOT COVER FUSELAGE UNDER THE WING

THE WING IS GLUED TO THE TOP OF THE BODY (FUSELAGE)WITH THE TRAILING EDGE AFT.

NOSEGEAR WIRE PATTERN, MAKE FROM .015 DIAMETER WIRE

FUSELAGE LONGERONS AND UPRIGHTS ARE 1/16 SQ.

THE HORIZONTAL TAIL IS GLUED TO THE BOTTOM OF THE BODY WITH THE FINS ON EACH END

1/16TH SHEET

NOTE GUSSETS

MAKE TWO SIDES DIRECTLY OVER THIS PLAN, WHEN DRY REMOVE AND SEPARATE FROM EACH OTHER

AN 18 INCH LONG LOOP OF 1/8 WIDE RUBBER BAND MAKES A GOOD MOTOR

1/16TH SHEET

USE A WASHER OR A BEAD BETWEEN THE PROP

LANDING GEAR LOCATIONS AND THRUST BEARING

Pussycat ***Designed by Dick Baxter, 1988***

WEM 12-12-88

Free Flight

By BOB STALICK

• The free flight fraternity is full of advice that is useful and useable. Some of the newsletters have special features each month with these helpful tidbits to assist you with your building and/or flying activities. My favorite is the *Satellite* newsletter from the San Valeers. It seems that not an issue goes by without someone providing helpful advice. Since I know that many of the readers of this column do not receive the *Satellite* or many of the other fine newsletters from the F/F press, I thought I would devote part of this column of *Model Builder* Free Flight to some of the latest building and flying hints. But first, the usual features.

Periodically, some of the loyal readers come up with copies of potential mystery models or three-views. The Martian Space Ship, which has piqued the curiosity of a number of readers, was such a mystery model. Well, this month's feature comes from Dan Ciesla (also Sandy, Eric, Cathy, and Tricia). The Ciesla family hails from Thonotosassa, Florida. I have been holding on to Dan's letter for more time than I care to admit, but finally, this month we're presenting his suggestion for the Mystery Model.

The design appeared in an American model magazine just after the Nostalgia period, although the accompanying article claims it was designed in 1954. It shows a Webra .09 diesel in the diamond-shaped nose. The designer lived in Sweden at the time the article appeared in the magazine, and he was well known for his free flight designs including F/F scale.

Here's what you do to win the free one-year subscription to *Model Builder*. Guess the name of the model design, write it on a sheet of paper along with your name and address, and send it to Bill Northrop, *Model Builder* magazine. Two winners are awarded each month; one from the U.S.A. and another from outside the borders of the U.S.A. If yours is the first correct answer, you win! Simple, huh?

And thanks to Dan Ciesla for the help with this month's Mystery Model. Sorry, Dan, that your kids have now gotten so much older since you first sent your letter to me.

JULY DARNED GOOD AIRFOIL—SCHWARTZBACH 1968

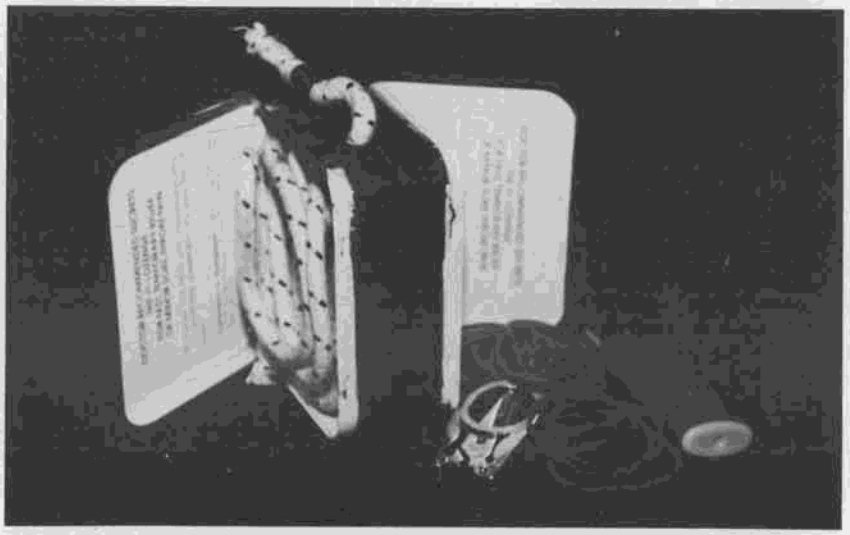
Christian Schwartzbach has been one of the leading international experimenters of the Wakefield class of free flight models. Although much of his study has focused upon the propeller system, he did some work on Wakefield wing sections. This one, developed in 1968, was one such effort. Notable in this airfoil section is the sharply pointed leading edge with no Phillips entry. The purpose of this design feature is to induce turbulation without using added turbulator spars or other triggering devices. The remainder of the airfoil is quite straightforward.

One recommendation if you intend to use this airfoil is that you build a thin flat-bottomed stabilizer with a rounded leading edge in order to add stability to the model. The sharp leading edge of the Schwartzbach 1968 airfoil might be a bit on the hard-to-trim side unless the stabilizer section was designed as stated above.

Jean Villanave launches her One-Night-28, a P-30 model. She took first place in the Fresno Annual Powder Puff event with this model. Photo by Leland Schroeder.

JULY THREE-VIEW
—Bill Hale's "Basic Yeller"

This three-view and the following text were borrowed from the *CIA Informer*



Handy D.T. kit made from two Sucrets boxes fastened back to back; fuse in one side; rubber bands, lighter, and folding scissors in the other. Ply attached to outside assists in measuring 3 or 5-minute fuse lengths. Bright orange color makes it easy to spot if dropped.

newsletter.

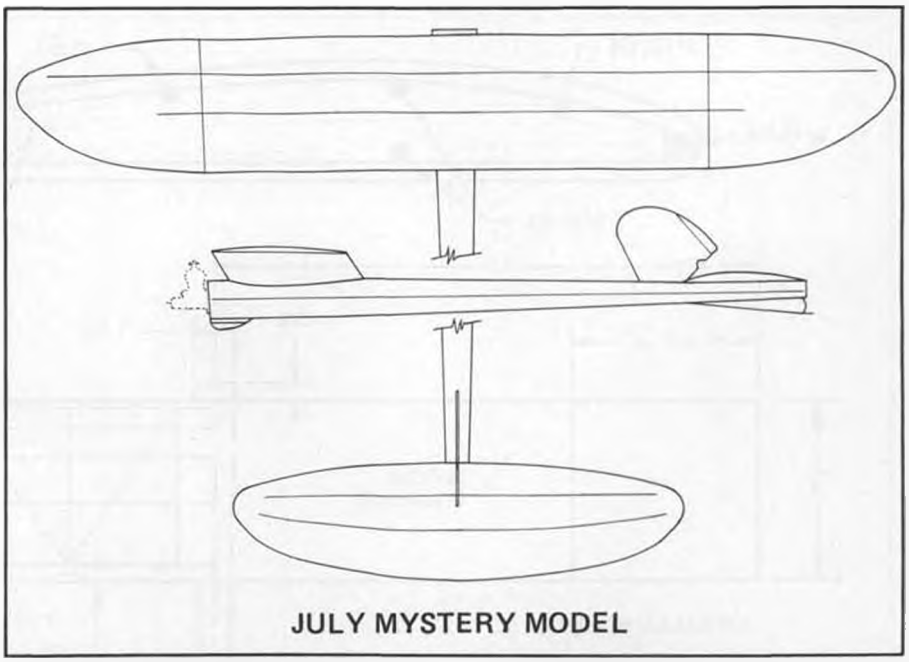
"Wright Field's Model Of The Year for 1987 was Bill 'Ole Yeller' Hale's Pee Wee 30 creation that we shall dub 'Basic Yeller' for all of the obvious reasons. It was the only Pee Wee 30 combatant to log a 3 max tally in the event all year long!"

What I like about Bill Hale's model is that it is very simple. It is a standard model for the Pee Wee 30 class, except that it has a rather long tail moment arm, and it obviously flies very well. Additionally, it should be a snap to build. Bill doesn't give any indications of the flight pattern, but I would suggest that the model be trimmed to fly right power with a right glide. Get a good running Pee Wee and build yourself a Basic Yeller this weekend.

CORRECTION TO THE 1/2A VEE THREE-VIEW

If you were intrigued by the 1/2A Vee design featured in the March/April '89 issue of *Model Builder* Free Flight, I would like to make a couple of corrections to the sketch. First off, if you studied the three-view closely, you noticed that the root wing rib was identified as the root stab rib, and vice-versa. This error is easily corrected. The second error was the omission of the tip chord on the wing. Although the tip rib shows a chord of 4.5 inches, the actual tip chord is 4.0 inches. In truth, either of these measurements could be used. I would recommend the 4.5-inch tip chord.

The most serious error on this three-view was mine. Note that the tiplet is indicated to be "toed out" at the t.e. This is incorrect. The tiplet should be "toed in" at the t.e. This means that the trailing edge of the tiplet should be 4 degrees (about 3/16 inch) closer toward the fuselage than the leading edge. Whew! I think that does it.



JULY MYSTERY MODEL

Bill Cranford, retired and living in Salem, Oregon, has rejuvenated his old Premier Manufacturing Company, that produced the Zeek. Still an active builder/flier, Bill is shown here with his Pee Wee 30 version of the Zeek.

TAIL VOLUME COEFFICIENT— FIND THE CORRECT CG

In the last issue of *Model Builder* Free Flight, I quoted some design recommendations by Terry Thorkildsen. In that quote, Terry suggested that the reader should take a good look at the Tail Volume Coefficient article in the 1959-61 Zaic Yearbook. With the idea that many of you may not have this article, I decided that it would be worthwhile to present some of the salient points for your edification. There are some general rules of thumb for you to consider as you design your own gas model. It might also be worthwhile to reread the design notes by Sal Taibi carried in recent issues of *Model Builder* Free Flight. If you didn't, here are the more important ones:

1. The stabilizer airfoil should be as thin as possible to assist with trimming and consistency of climb and glide. The old theory was that the stab airfoil should have at least 1% less thickness than the wing airfoil. Stab airfoils should be flat-bottomed.

2. The longer the tail moment, the less stab area is needed. Conversely, the shorter the tail moment, the larger the stab area should be. Usually, on fixed geometry models (not VIT equipped), the stab area will tend to be 25% to 33% of the wing area.

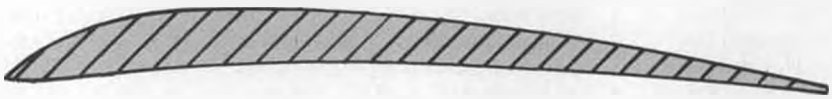
3. The angular difference (sometimes called decalage) between the wing and the stabilizer is typically in the 2 to 3 degree range, dependent upon the location of the center of gravity. The farther forward the CG, the more incidence is needed.

Now, with all of this in mind, one of the difficult items to determine is the location of the center of gravity. The Tail Volume Coefficient is the tool you need to find the CG. Elsewhere in this column, you will find a chart that shows a number of Nostalgia era models and a computation that includes this month's three-view—"Basic Yeller." Here is how it all works.

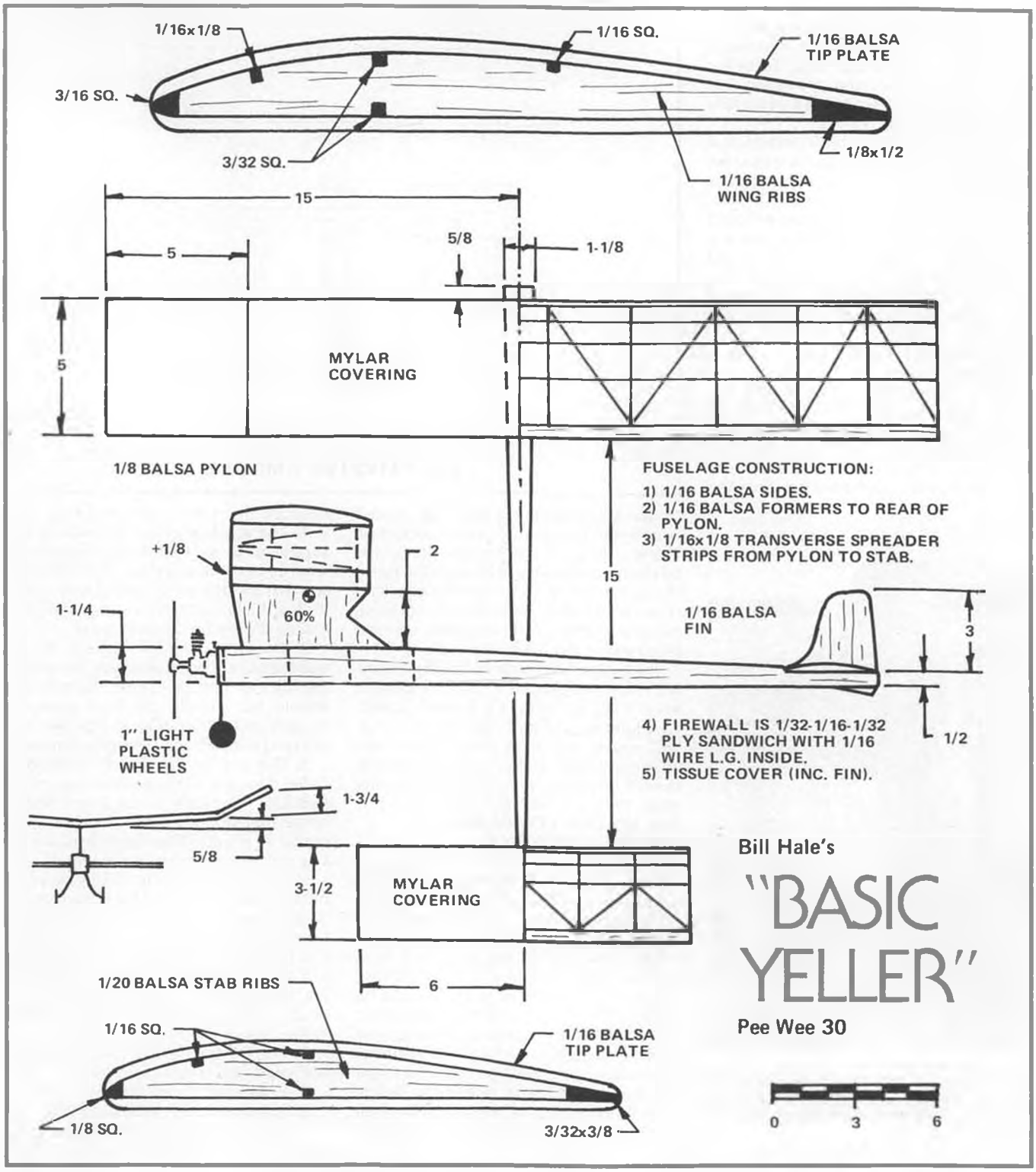
To find the Tail Volume Coefficient, you will need four measurements:

1. Wing area, designated SW.
2. Stabilizer area, designated SH.
3. Mean aerodynamic wing chord, de-

DARNED GOOD AIRFOIL — SCHWARTZBACH 1968



STA.	0	1.25	2.5	.5	7.5	10	15	20	25	30	40	50	60	70	80	90	100
UPR.	0	1.55	2.70	4.30	5.50	6.50	7.75	8.50	8.70	9.05	8.75	8.00	6.95	5.65	4.20	2.50	0.75
LWR.	0	0.05	0.10	0.25	0.50	0.80	1.35	1.80	2.15	2.45	2.65	2.60	2.35	1.90	1.40	0.75	0



signated E.

4. Tail length (the distance from the leading edge of the wing to the 25% chord location on the stabilizer), designated Lto.

The Formula is: (SH times Lto) divided by (SW times E). This gives a number usually somewhere between .6 and 2.0. Using this number, look at the chart and determine where to the left of the line your model should balance. The further left of the line, the more stable the model will be. The closer to the line, the more unstable the model will be. Remember that you don't want your model so stable that it won't be sensitive to lift.

Using this month's three-view, the following information can be obtained:

1. Wing area (SW) is 150 square inches.
2. Stabilizer area (SH) is 42 square inches.
3. Mean wing chord (E) is 5.0 inches.
4. Tail length (Lto) is 20.875 inches.

Multiplying 42 times 20.875 = 876.75
Multiplying 150 times 5 = 750.0

The result of this math is a factor of 1.17. This is the Tail Volume Coefficient. Now, look at the chart, and find 1.17 on the vertical axis. Note that this is about the TVo of the Sailplane (Basic Yeller is in good company). In order to find the CG, look down to the horizontal scale. Basic Yeller should balance no further aft than about 75% of the mean chord, according to the chart. To be more stable, the ship should actually balance closer to 60 to 65%. Now, look where Bill Hale balances his model—at 60%! Good and stable.

So, now when you want to locate your CG, consider using the Tail Volume Coefficient chart. It provides a good starting point for your testing. It is safe to say that the model's CG might be moved slightly forward or aft of this starting point after some actual flight testing.

The original article for the Zaic Yearbook was submitted by Bill Bogart and Bud

Rhodes.

HINTS, KINKS, AND TIPS

The following tips were submitted by Terry Thorkildsen.

1. A fishing line clip makes a perfect clip to which to hook your D.T. bands. You can select different sizes to fit your model. The slick part about this is you can load the clip up with about ten #8 rubber bands and only stretch out two or three for each flight. You can load up the clip again when it gets low after a few flights. A small piece of 1/64 plywood can be glued on the fuselage behind the clip location to protect against dings caused by the clip vibrating against the model.

2. Have trouble with the rear mounted fin being knocked off? Well, a butt joint is not the way to go to attach that fin. The solution is simple; just put the rudder through the fuselage and wrap the fuselage sides on either side of the fin. Terry notes that he hasn't used this system yet, but I have used it on all of my models. It works.

Darrell Chafin looks cold as he poses with his P-30 model at a recent Hart Lakes Prairie contest. Darrell is a competitive rubber flier from the Northwest.

3. Got an older T.D. that runs well but has a small crack at the plastic carb body where the intake screws in? Fix it with thread and epoxy. Just wrap the thread around the carb body and pull it tight so that the crack is closed up. Then put some 30 minute epoxy on the thread. Don't use Hot Stuff for this fix since it won't stand up to high nitro fuels. The epoxy will also work well to seal up the side pressure tap if someone drilled it out.

4. Weak pacifier? If it isn't totally shot, you might just want to use it to test run your engine. If it breaks, the result is not a disaster.

5. Got some wood that is too heavy to put into a model? If it is 1/16 sheet, it can be used for rib templates. If you back it up with 1/64 ply, you will have a permanent template.

6. Cox gray props fit a little loose on the prop shaft. To insure that you get the correct balance, I usually put a little Hot Stuff in the center hole before I balance the prop. This way you will get a snug fit on the shaft and the same balance each time you bolt it to the engine.

7. To insure that your newest engine is really better than your others, you should always run them on the same prop. I use the same Cox gray 5x3 for all my 1/2A engines. That way, I know what I really have for comparison. I also paint the center of the hub with white paint to insure I don't get it mixed up with my other props.

8. If you wrap rubber bands around the fuselage at the stab location on models larger than 1/2As, then it is a good idea to use 1/64 ply at the bottom of your fuselage and wrap it around the corners to distribute the load. You can sand the ply down in the areas where it bends around the corners so it will fold around easier. The ply will distribute the load and keep the bands from digging into the fuselage.

9. In the art and stationery stores (also at Polk's Hobbies and fabric stores), you can buy a self-healing matt pad that measures about 8.5x12 inches for about $11.75. This works great for cutting ribs, and it doesn't dull the knife blades as quickly. It also has

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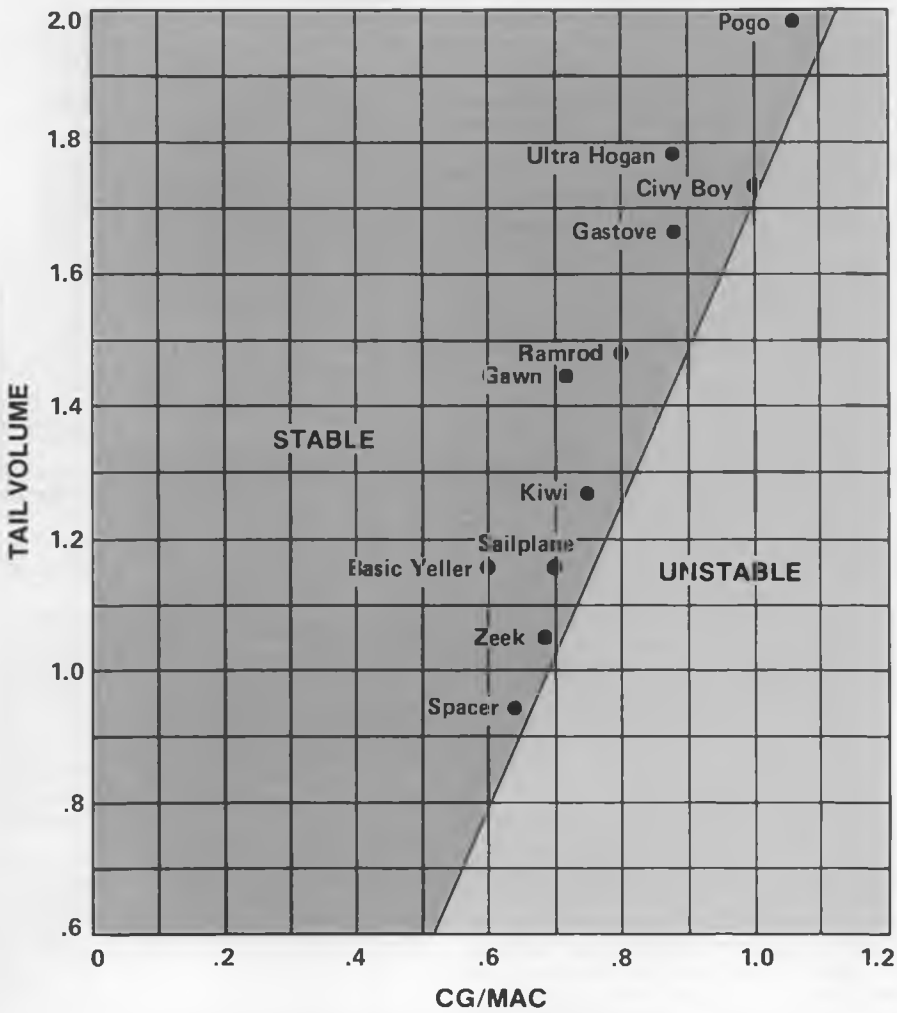
TAIL VOLUME VS. CG LOCATION



EXAMPLES OF BALANCE POINT CALCULATIONS USING THE TAIL VOLUME COEFFICIENT METHOD

		WING				HORIZ. STAB					
MODEL	CLASS	AREA	SPAN	A/R	MAC	AREA	SPAN	A/R	T_L LEN.	T_L VOL.	CG/MAC
ZEEK	A	381	51	6.6	7.5	120	25	5.1	25.2	1.05	.69
GAWN	A	434	62	9	7	143	26	4.7	30.8	1.45	.715
SPACER	B	590	64	7.0	9.2	175	26	3.8	29.0	.94	.64
KIWI	1/2A	186	35	6.6	5.3	59	15.3	4.0	21.3	1.27	.75
SAILPLANE	C	880	77.5	6.8	11.4	282	36	4.6	41.6	1.16	.70
RAMROD	C	770	69	6.9	11.2	332	40	4.8	38.6	1.48	80
GASTOVE	A	380	52.5	7.2	7.2	153	28	5.1	29.3	1.67	.88
CIVY BOY	B	575	61.2	6.6	9.4	265	33	4.0	35.4	1.73	1.00
UL. HOGAN	B	504	59	6.9	8.5	256	32	4.0	29.8	1.78	88
POGO	1/2A	170	34.5	7.0	5.0	85	18	3.8	19.8	1.98	1.06
B. YELLER	PW 30	150	30	6.0	5.0	42	12	3.5	20.9	1.17	.60

the INSIDERS

INDOOR FLYING REPORT

By DAVE "VTO" LINSTRUM

• One of the most frustrating aspects of being a model magazine columnist or newsletter editor is the lack of reader feedback in the form of usable or interesting contributions. Your "Insiders" scribe has been doing monthly columns since 1967 (that's 22 years!) and believe me, it never changes! The reader looks for a full column of interesting, topical, useful information, but he seldom contributes any of the above for future columns.

We would like to again ask our readers to submit candidates for "Obscure Aircraft" (this has been very popular), "Insider's Workshops" (most guys think they need to clean theirs before photographing—not so! Show it like it is.) and "How The Indoor Bug Bit Me." The latter requires a little narrative, but should be easy for most of you. Simply tell us, in a few words, what turned you on to indoor aeromodeling. Handwritten letters are acceptable, though we prefer it if the narrative can be typed (double-space on 8-1/2x11).

So if you would like to share you favorite little-known (obscure) full-scale design with readers, or let us peek into your workshop (we are not the Health Dept., so no need to sweep up the debris), or even learn why you love indoor modeling—get in touch! Other readers will certainly enjoy your contribution. Send the three-views, photos, and letters to "Insiders" c/o Dave Linstrum, 4057 San Luis Dr., Sarasota, Florida 34235.

HINT OF THE MONTH

Our hint this month is for endurance fliers who want to maximize their potential flight times, yet easily assemble their fragile indoor model. The trick is simple—just stick it in a pigtail! No, this is not an ad for pork nor a risque remark. It is merely a suggestion that you use Harlan Pigtail Bearings for your prop shafts. These are tiny aluminum prop shaft hangers with a hole in the front and a hole split by a saw cut in the rear. It is this last bit that gets the twist; the two split legs are twisted like a pigtail so that the shaft can be easily inserted and removed. The locking of the shaft is positive. For your pigtails, in F1D, EZB, or Pennyplane sizes (please specify), send $1.50 each to Ray Harlan Indoor, 15 Happy Hollow, Wayland, Massachusetts 01778. Two or more are postpaid in the USA.

VICARIOUS VIDEO

If you are unable to travel to the U.S. Indoor Champs in Johnson City, Tennessee this month, or if you simply want to relive the excitement from the 1988 USIC, Mike Arak of the MIAMA Club has just the ticket

The latest from Bill Hannan, volume 4 of "Peanuts & Pistachios." Great reading!

for your vicarious indoor fun (not to be confused with "hangar flying" as practiced by "hangar pilots").

Mike has professionally produced and edited a 72-minute video that includes lots of variety in models, interviews with fliers, and a good sense of the meet. It should be the "Top Gun" of model videos; we recommend it highly. To get your copy, send a $25 check or M.O. to: USIC Video, Mike Arak, 10900 S.W. 61 Ct., Miami, Florida 33156. Orders for this VHS tape

Stanford University student Dave Aronstein with indoor scale Messerschmitt BFW-20.

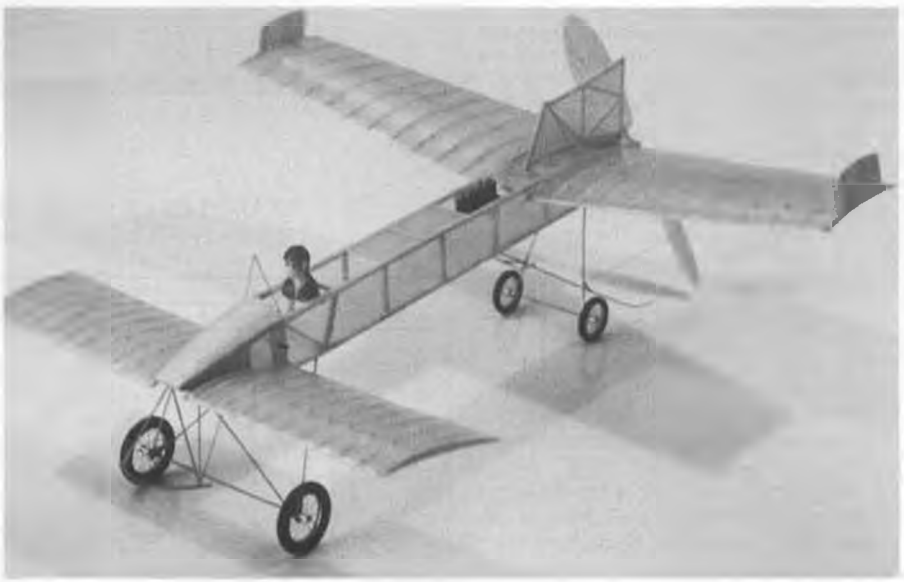
cannot be accepted from the U.K. or Europe, as their video system is not compatible. However, your U.S.A. VHS VCR will provide you with lots of indoor views.

LIBERTY BELLE ROG

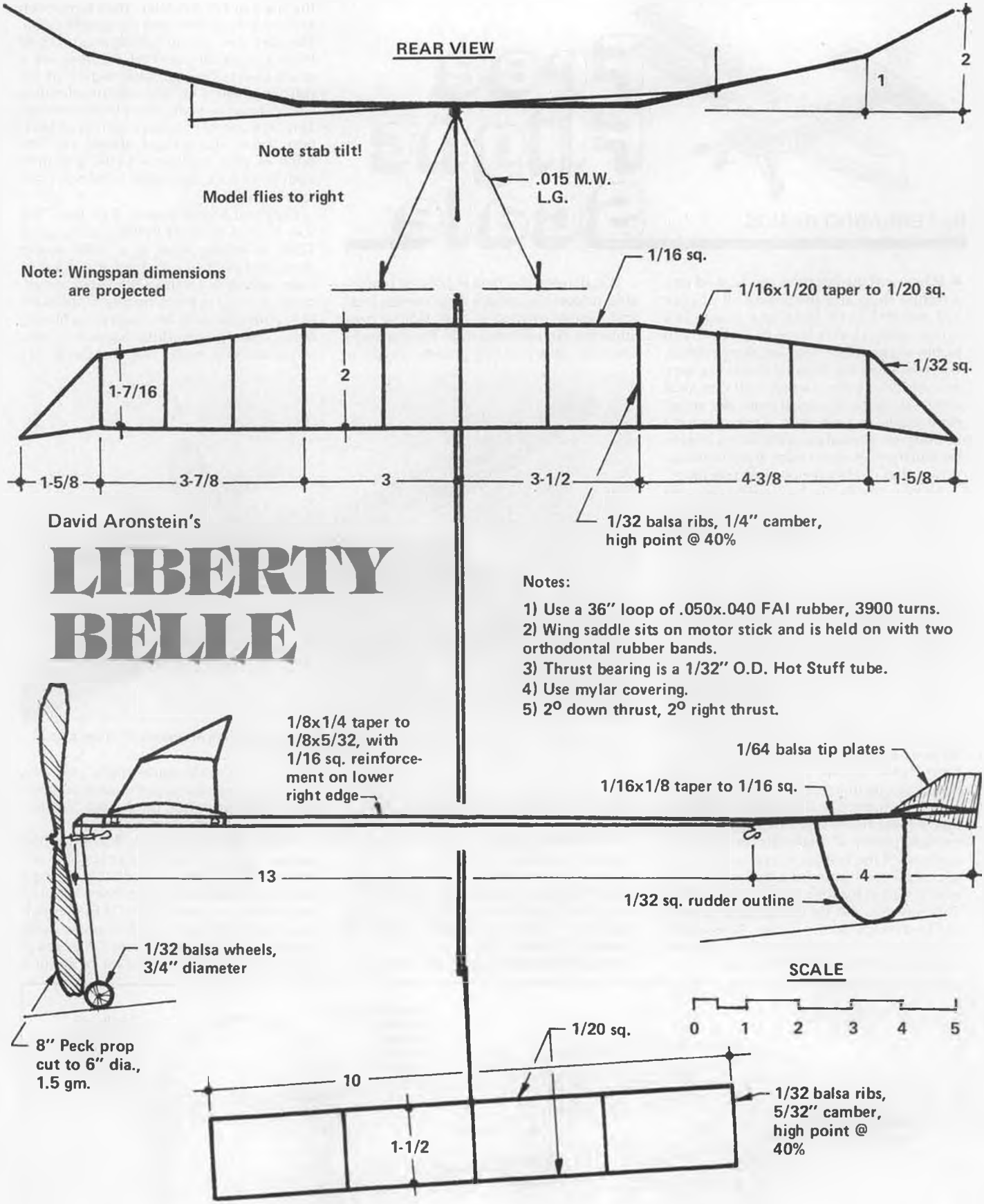
Over the New Year's weekend, Dave Aronstein came to the Delta Airlines Hangar at Tampa International Airport to fly in the King Orange/MIAMA contest. He brought along his Liberty Belle ROG, a plastic-propped indoor endurance design. Despite this being the first time out with the design, his "magic touch" resulted in a new world record of 5 minutes 7 seconds on New Year's Day. This performance blew away the competition, who could barely do 4 minutes.

Our drawing this month, based on the 3-view Dave did for Doc Martin and the MIAMA newsletter *Hangar Pilot,* shows all the pertinent details. The scale will help you enlarge the parts to full size. Construction is fairly orthodox, but you will have to scrape the prop blades until they are ultra thin to get it to 1.50 grams. Note the removable wing is not necessary unless you pack the model in a small box for jet

Continued on page 78



One of the full-size plans in P&P vol. 4 is for this Polish Pistachio, the 1912 Drzewiecki Canard as designed by Antonin Alfery of Czechoslovakia. Placed 3rd at 1988 Flemalle, Belgium event.



David Aronstein's

LIBERTY BELLE

Notes:

1) Use a 36" loop of .050x.040 FAI rubber, 3900 turns.
2) Wing saddle sits on motor stick and is held on with two orthodontal rubber bands.
3) Thrust bearing is a 1/32" O.D. Hot Stuff tube.
4) Use mylar covering.
5) 2° down thrust, 2° right thrust.

Indoor ROG Record Holder - 5:07
Set at Tampa, Florida, January 1, 1989

Free Flight Scale

By FERNANDO RAMOS

• When was the last time you walked into a hobby shop and purchased all of your F/F needs? Even Japanese tissue is a commodity that is hard to come by in hobby shops these days, let alone rubber, winders, lube, ball bearing thrust washers, etc., etc. I've been trading with one local model shop for at least 30 years. Recently I have made several stops wanting what I considered normal everyday items, only to be told they were on order. It is almost like saying that money is not welcome here!

As you probably have experienced yourself, had I wanted any R/C paraphernalia, I could have walked out a happy man. Granted, we F/F Scale types are a tiny minority, and it is obvious that the local hobby shop is not going to go out of their way to cater to our needs. There is no real money in it for them, so in a sense, I can see their point of view . . . I think!

If you have to rely on mail order houses, they also are 100% R/C. If you take a chance and order some balsa from them it is usually dense enough to build anything but light F/F models. Another problem is that not all scale F/F modelers are scratch builders. Where can they get good quality scale kits? Even Flyline kits are not carried by many hobby shops unless it is one of their R/C kits. So, what is this all leading to? Simply this. I have made a list of suppliers that provide plenty of materials we need for our end of the hobby. I recommend that you send each of them a dollar (or more where stated) for their price list or catalog. This way you will be doing business with the best people in the hobby. Believe me, they are not in it for the money . . . they are modelers helping other modelers.

We all need the best in balsa at reasonable prices. My model shop carries crud, and expensive crud at that. Not so from Superior Aircraft Materials. Their wood is first-rate, and you can get any weight or size you want. The sticks are cut square and you can order any length you want as well. Their spruce is beautiful, as is their plywood.

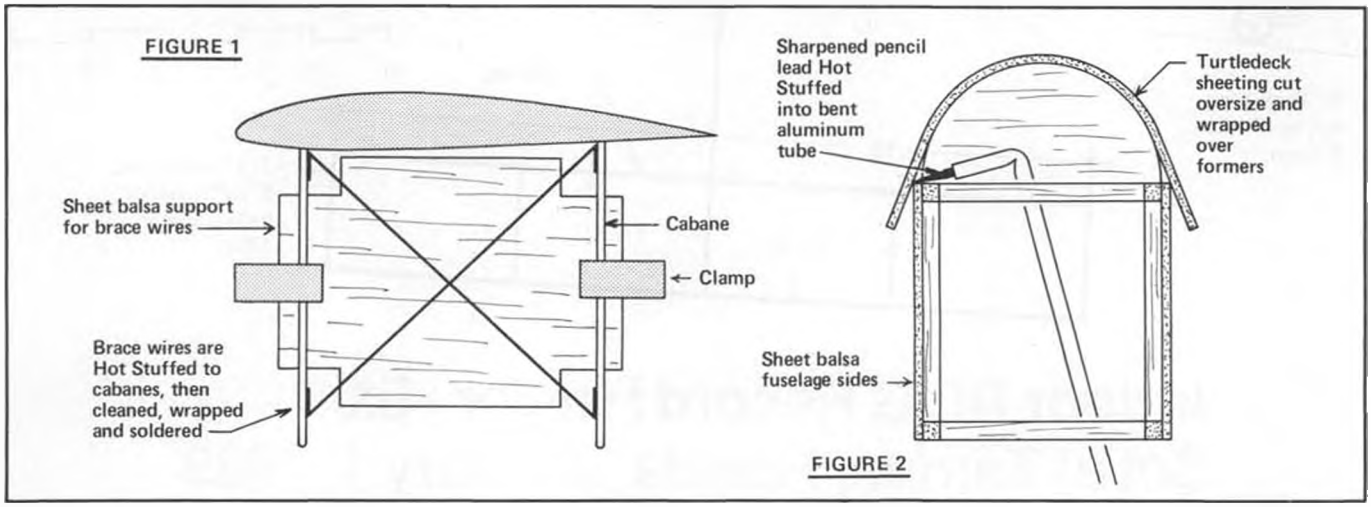
All modelers need quality wood, and Superior is the best at providing same. This company was started by the incomparable Sal Taibi, and is presently being run by his son Mike. The address for Superior Aircraft Materials is 12020-G Centralia, Hawaiian Gardens, California 90716.

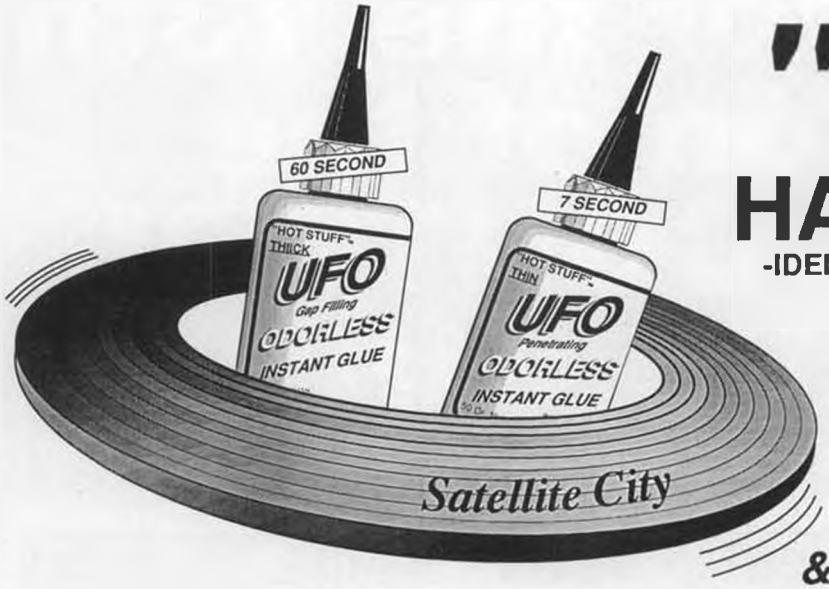
Peck-Polymers needs no introduction to the scale or F/F modeler. They have been around a long time and for good reason. They are one of the very few sources of Peanut scale kits, and all of them are a work of art. They provide materials for rubber power, CO_2, and electric, plus they have numerous plans, many from overseas. They are one of the main sources of Japanese tissue, Hungerford wheels, etc. The price of their catalog is $2.00, and their address is P.O. Box 2498, La Mesa, California 92044.

Oldtimer Model Supply, P.O. Box 7334, Van Nuys, California 91409, catalog price $2.00, advertises itself as a 1930s model shop, and rightfully so. Even though they cater primarily to the Old Timer movement, they carry many quality supplies for the rubber modeler like balsa prop blanks, balsa wheels (including balloon types), thrust washers, most if not all of Earl Stahl's super rubber scale model plans, plus a lot more. Ken Sykora runs this unique business; I've known Ken for at least 25 years. Great service with a smile.

FAI Model Supply, P.O. Box 3957, Torrance, California 90610 has a catalog available for $1.50. They are probably the best source of rubber anywhere in the country. You can buy rubber from 1/16 to 1/4-inch and in between x .042 thick in one-pound quantities. They also carry the great Crocket hooks and have a list of about a

Pretty Jumbo Scale Cessna Airmaster is the latest plans offering from Al Lidberg. Text has a list of suppliers of kits, materials and plans for F/F Scale enthusiasts.





"UFO"™

HAS LANDED

-IDENTIFICATION HAS BEEN MADE -

MODELERS WORLD WIDE KNOW THAT "UFO"™ IS THE ONLY

User-Friendly Odorless

INSTANT GLUE.

"UFO"™
- *WILL NOT FUME*
- *HAS NO ODOR*
- *DOESN'T FOG PLASTIC*
- *FOR ALL MODELING USES*

& "UFO"™
- *BONDS WHITE FOAM WITHOUT PRIMER*

IS THIS REALLY TRUE ???

Out of the thousands of calls and letters we've received about "UFO"™, many of you asked "Is this really true?", or "Will it really bond foam"?. Although we understand that a product that is User-Friendly, Oderless and Bonds White Foam is revolutionary, the "Is it really true"? questions, opened our eyes to the fact that many of you didn't believe the ad. And, if this was the case how many of Satellite City's other ads, over the years, have some of you seen as just so much hype? **Let's set the record straight.**

When Satellite City advertises:

"HOT STUFF"™-Is the Original Hobby Instant glue"

"HOT STUFF"™-products are the only Instant glues used on the *"Voyager"*

"SPECIAL'T™ was tested by Scale R/C Modeler and found to be TWICE AS STRONG as the next best hobby Instant"

""HOT STUFF"™ products are the BEST INDUSTRIAL GRADE"

"UFO"™
- *WILL NOT FUME*
- *HAS NO ODOR*
- *DOESN'T FOG PLASTIC*
- *FOR ALL MODELING USES*
- *BONDS WHITE FOAM - WITHOUT PRIMER*

"All "HOT STUFF"™ products are GUARANTEED 100% for ability to bond"

"HOT STUFF"™ products are AMERICAN products"

- IT'S TRUE! -

NO HYPE

NO BALONEY

You might very well ask HOW we do it. But you'll never have to wonder IF

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hundred F/F kits.

What about kits? You certainly aren't going to find any at your local hobby shop, that's for sure! Dave Diels has provided the scale modeler with a terrific source of kits and plans for many years now. He has several that are Peanut size and several that are considerably larger. As expected, the kits have the best of balsa and other materials, and the decal sheet in each kit is unbelievable! The address is Diels Engineering, Inc., P.O. Box 101, Woodville, Ohio 43469.

Flying T Model Company, 134 N. Edgemont #204, Los Angeles, California, is another source of kits and plans. I've never seen any of their kits, but I do have several of their plans, and they are excellent. They like to specialize in the very early airplanes. I recently received a plan for the Caproni CA-8 designed especially for CO_2. However, it could easily be converted to rubber.

They also have some interesting photo-etched fittings that you have to see to believe. Great for aiding in the rigging of biplanes.

For those of you in the Southeast, there is a supplier called Campbell's Custom Kits. Their address is P.O. Box 5996, Lake Worth, Florida 33466-5996; catalog price is $2.00. They have a long list of scale kits that are designed for CO_2 and power. They also have a large inventory of goodies that all of us are always looking for, like Trexler tires, etc. Their 24-page catalog is jammed with all kinds of supplies. They also have non-scale F/F kits as well.

Now, for those who can supply us with fantastic plans. Again, this gentleman needs no introduction to this column. For years, Al Lidberg has provided some outstanding plans. Recently, he came out with a jumbo Cessna Airmaster. This beauty has all of the earmarks of consistently being in the winner's circle. Along with a good variety of subjects, Al likes to design No-Cal Scale models. These are profile models that are easy to build and fly. Certainly a good place for the novice to begin his rubber scale flying. Al's address is A.A. Lidberg Model Plan Service, 614 E. Fordham Dr., Tempe, Arizona 85283.

Another source for outstanding plans designed especially for rubber scale is Flying Scale Inc., 1905 Colony Rd., Metairie, Louisiana 70003. They have numerous plans which include Thompson Racers, some pre-WWII airplanes, as well as several WWII. Their work has to be seen to be appreciated.

For those of you who like to build powered scale models like I do, and want to power these with a diesel, then Eric Clutton is the man to see. Eric is originally from England, and as you know, England is the place where a lot of diesels are used, especially for F/F Scale work. Eric has a lot of expertise and years of experience dealing with diesels. He handles several different types including P.A.W. (Progress Aero Works) and Davies-Charleton. Eric's address is 913 Cedar Lane, Tullahoma, Tennessee 37388.

Bill Hannan certainly doesn't need any introduction either, but Hannan's Runway is a good source of books needed for scale documentation. Bill has quite a few volumes that will be very useful in building that next scale subject. His address is P.O. Box A, Escondido, California 92025.

Aircraft Spruce and Specialty, P.O. Box 424, Fullerton, California 92632, has a catalog available for $5.00. Five dollars! Yes, but it has 290 pages. Since this is primarily a source of parts for full-size aircraft, why mention it here? Well, have you ever tried going into a hobby shop and asking for non-tautening nitrate or butyrate dope? If you can find it, it will be in a four or six-ounce bottle at a price you won't believe. Aircraft Spruce sells either of the above in gallons or larger at very reasonable prices, plus it is nice and thick, not runny like the kind in hobby shops!

They also carry Super Seam glue, which is ideal for both building and covering models. A great source for spruce and birch plywood, among other items. Many tools that can be used for modeling are also offered by this company. I am sure that after thumbing through those near 300 pages you can find a whole list of things you cannot do without!

With the exception of Campbell's Custom Kits, I have done business with all of the others listed. Each cares about their customers, and you can't say that about too many businesses these days. I realize that many of you like to see what you are buying before laying out that hard earned dollar; however, with these businesses, you

will get exactly what you order, and you will get it post haste. I remind you again that these are modelers helping other modelers.

* * *

Since Solartex is my covering of choice for all of my powered scale models, I have made every effort to get the best possible covering job. Once in awhile I screw up and wind up teaching myself another lesson, one that I will pass on to you, hopefully making your job easier from the start.

I have found that Solartex does not always adhere as well as I would like over hardwood such as plywood. Naturally, I found this out after I had trimmed the material and heat shrunk it. It would pull away from the plywood, leaving no choice but to re-cover. The solution is an easy one. I took Super Seam glue (this glue is used to cover full-size aircraft) and thinned it out so that it can be brushed. I apply several coats, sanding between coats. I do this over the entire structure where the Solartex is going to be adhered to the structure, not only to plywood areas. This is similar to the way you would prepare for covering with Japanese tissue.

I have found that the material really sticks much better, eliminating the possibility of no adhesion. I know that there is a product on the market that supposedly is designed especially to do the same thing. Well, I have tried it, and I prefer to use Super Seam for two reasons. One, it does not discolor the fabric, and two, it is much cheaper to buy!

While on the subject of Super Seam, for those of you who dope your surfaces prior to covering, try this stuff. It saves time and grief. I can't remember how long it has been since I have used dope to cover a model with Japanese tissue. For years I have expounded the virtues of thinned-out white glue, but since the discovery of Super Seam, my covering is made a whole lot easier and neater. Simply brush several thinned coats of SS with a little sanding in between coats just like dope. But when you attach the tissue using lacquer thinner, the paper stays put, unlike dope. Try it, you will like it.

Have you ever encountered problems soldering wire bracing to cabanes or landing gears? They slip from their position so easily that it can be a pain getting things lined up. Well, I have found an easy way to do this chore with little effort. See Figure 1. After the wires have been cut and bent correctly, I take a piece of balsa about 3/32-inch thick and cut it to the shape shown on the drawing. I then clamp it to the cabanes using little metal pinch clamps that X-Acto makes.

The diagonals are put in place using a drop of CA glue at either end. The balsa is temporarily removed and the joint where the soldering will take place is carefully sanded or filed for good solder adhesion. These joints are then wrapped with fine copper wire. The balsa sheet is once again clamped in place, and each joint soldered. The same is done for the other side. When you finish your parts will be in perfect alignment!

Sheeting a model can sometimes be a pain, especially when trying to get good tight joints. I discovered a method that works quite well and is very easy to do. Take a look at Figure 2. Naturally, the two sides are easy to sheet. I prefer to frame two fuselage sides and sheet these, rather than cut two sides from balsa sheet. Where the fitting can be a bit trying is over the turtledeck and the front cowling. I'll take balsa sheet (usually 1/16) and wet it and wrap it over the formers using tape to hold it down until it dries.

While the parts are drying, I will sharpen a piece of pencil lead and CA it into a piece of aluminum tubing. Then I bend the tubing at right angles as shown in the drawing. After the sheeting has dried, I will mark *from the inside* using this simple little tool. Remove the sheeting and trim the excess using a sharp knife. Just a bit of sanding to get the correct angle will be all that is required for a neat fit.

* * *

I want to remind you of the Flightmasters Flying Aces Contest scheduled for August 12th and 13th at Mile Square Park in Fountain Valley, California. The judging will be at my home with a great catered picnic and lots of story-telling on the 12th. For further

information write to Byron Calomiris, 3406 Fela Ave., Long Beach, California 90808.

We want this to be a very special event that takes place every two years. Please plan to be there with several models! •

Hannan . . . . . . *Continued from page 45*

Idaho for the indoor events, occupy July 15 through 22, which brings us to August and the next contest, the Flightmasters Flying Aces meet, slated for the 12th and 13th. Free flight scale rubber, electric, diesel, gas and CO_2 events as well as the popular mass-launched categories . . . and even a catered picnic! Judging, flying and eating sites are all in Southern California. For additional details, send a pre-addressed stamped return envelope to Byron Calomiris, 3406 Fela Ave., Long Beach, California 90808.

EVERYBODY WINS?

Georges Chaulet, of France, comments about the bewildering variety of events in model airplane competitions and concludes: "I suppose eventually there will be universal contest rules:

"Any model may be entered, whatever the size, the weight and the power. They may fly or not, be built to scale or otherwise, decorated or plain. Any materials are admitted.

"The winner will receive a prize of ten million dollars or he will be hanged."

COMMERCIAL CORNER

New products are arriving in profusion this month! So here's a brief preview by categories:

3-Views: C.L. Neely has added half-inch-to-the-foot size Cierva C.6c Autogiro drawings to his other offerings, which include P-51 Mustangs, a Monocoupe, a Monosport, Taylor Chummy, and a Canadian version of the famous Curtiss Jenny. A stamped pre-addressed return envelope will bring his illustrated price list: C.L. Neely, Box 3963, Visalia, California 93278.

Plans: Al Lidberg must be chained to his drawing board at the rate he turns out new construction drawings! His profile fliers have proven particularly popular, and his recent releases include a MIG-3, a Polish PZL, a racing F8F Bearcat and a Maule M5, all accompanied by truly informative instruction sheets. For only a dollar, you can receive an illustrated catalog of these and many other types of model plans: A.A. Lidberg, 614 E. Fordham, Tempe, Arizona 85283.

Videos: Extensive coverage of the 1988 U.S. Indoor Championships filmed inside the gigantic Tennessee Mini-Dome is offered by Mike Arak. We had not fully appreciated how magnificent that site is until seeing this presentation. Featured are all types of indoor models up-close, being prepared, and in action, plus short interviews with many of the participants. See for yourself how the experts attain their results! VHS Format, 72 minutes running time, $25 postpaid from: Mike Arak, 4200 Aurora St., Suite D, Coral Gables, Florida 33156.

If you want to see outdoor contest action, Dean McGinnes offers two different versions of the famed Flying Aces Nationals which took place in Geneseo, New York, attracting more flying scale models than any other event in history. All sizes, shapes and power forms are captured by the camera, at rest and performing, including Dennis Norman's magnificent rubber-powered Avro Lancaster and Don Srull's fantastic electric Dornier Do-X. Even the awards banquet is featured in Cassette #1. Cassette #2, called the "FAC Promotional," is edited in a different manner, more suited to club presentations. Featured are the highlights of the FAC contest flying, and in-depth interviews with such Flying Aces Club spark plugs as Dave Stott, Bob Thompson, Dave Smith and Allan Schanzle. Each cassette is priced at $19.95 plus $3 postage from: Swamp Squadron, 1503 Clairdale Lane, Lakeland, Florida 33801.

Publications: Argus Books, of England, has released three more handbooks. *Flying Scale Gliders*, by Charles Gardiner, explores silent scale flight. Included are not only scale models of traditional sailplanes, but also scale models of powered aircraft, which are flown as gliders. Picture, for example, such diverse types as an SE-5a, Boeing B-52, Curtiss P-40 and a Convair B-36 being flown as R/C slope gliders! Photos of such models along with more conventional sailplanes illustrate the wide range of possibilities open to R/C glider enthusiasts. Examined are research, documentation, construction techniques, color and markings, airfoils, competitions, and even a section entitled "If I only had time. . ." with which we can closely identify. Another in the Argus series is *Basics of*

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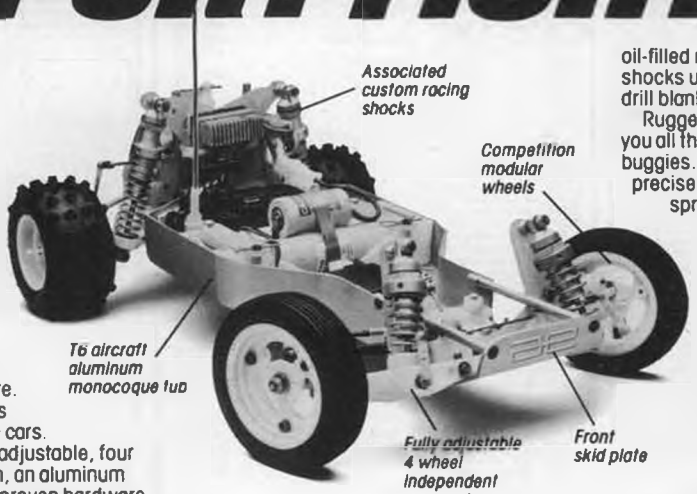

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Pratt. A must for anyone thinking of getting started in the hobby. Completely details *everything* the novice needs to know about building from scratch or kits. Covers building & flying trainer planes, perf planes, gliders, scale models, giant scale models, ducted fans (jets) & helicopters. 144 pgs., 80 ill.
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Radio Control Flying, by David Boddington, which is rather outside the boundaries of this column, but obviously measures up to the unusually high standards established in this series.

The third new offering, *Operating R/C Engines*, is by David Boddington, Editor of *Radio Control Models & Electronics*, of England, and Brian Winch, Mr. "Engine-ear" for Australia's *Airborne* magazine. An amazing amount of vital information has been sandwiched into this volume, including internal combustion theory, installation of engines, troubleshooting, maintenance, fuels, and a survey of types including two-stroke (diesels too) and four-stroke engines. Easy to understand and even entertaining (for instance, crashes are described as "unscheduled arrivals"), the text is accompanied by crystal-clear line drawings and numerous photographs. In spite of the "R/C" in the title, this offering should also be extremely useful to free flight and control line engine enthusiasts. Ordering information for these and other fine Argus Books is available directly from the publishers at Wolsey House, Wolsey Road, Hemel Hempstead, Herts, HP2 4SS, ENGLAND.

SPEAKING OF AIRBORNE

We continue to enjoy the fine Australian magazine *Airborne*, which, like *Model Builder*, caters to many tastes in modeling. Orchestrated by Editor Merv Buckmaster, the publication presents construction articles, product news, aerodynamic theory (the clearest we've ever encountered), contest reports, and inspiring front covers. Even a bit of philosophy may be found therein, such as this quotation from Bruce Abell's "On Silent Wings" column: "One explanation or another may reduce the mysteries of how a wing produces lift, which is nice. But it is even nicer if a little of the mystery, and the magic, remains!"

Airborne is available by subscription from P.O. Box 30, Tullamarine, Vic. 3043, Australia. Why not send two International Reply Coupons for ordering information?

When responding to any of the above mentions, we would greatly appreciate you telling the firms you heard about them within the pages of *Model Builder* magazine. Thank you!

COLD LITTLE LACEY

While Giant Scale models continue to grow larger, the opposite end of the size spectrum continues to shrink. Two of our photos show a Pistachio Scale Lacey M-10 powered by an actual reciprocating CO_2 engine displacing less than 4 cubic millimeters! The model is the collaborative effort of Stefan Gasparin (engine) and Frantisek Barta (airframe), and has a total weight of less than 5 grams. The entire CO_2 power system weighs under 3 grams, yet can turn two to three thousand rpm for 90 seconds, putting one-minute flights within easy reach. Incidentally, Stefan has been recognized by the Guinness Book of World Records for having produced the world's smallest engine, with one of his 6 cubic millimeter displacement productions. Looks as if they'll have to revise the book again!

WEE R/C

While on the subject of mini-models, we have it on good authority that a truly miniature servo has been constructed, suitable for indoor Peanut Scale application. More information should be available in a later column.

GUILLOW MODELS MILLION WILLED TO UNIVERSITY

The will of the late Gertrude H. Guillow, widow of company founder Paul K. Guillow, allotted one million dollars to the Carnegie Mellon University, according to an article from Carlin Hulick sent by Harry Geyer.

Mrs. Guillow remained active in the model airplane business until her passing at age 82, and had long been honored for her community service.The grant is expected to be applied to University expansion, and should insure perpetuation of the family name. Incidentally, Harry Geyer confirmed that the name correctly pronounced is "gw-illow," with the "gw" as in Gwinn, and the word rhyming with "willow" as in the tree.

SIGN-OFF

When asked how he manages to build so many models, Bob Jones of England replied: "After 37 years in military aviation, I have retired to model building, running the local club and helping out at all the competitions I can get to. Don't leave it too long to try it for yourself." •

ARFs ..... *Continued from page 43*

core also contains a plywood plate for mounting a plastic bracket for the undercarriage. The wheels are only 1-1/4 inches in diameter, so hand launches are needed at my local club's grass field (Berkshire R/C Flying Club).

"The two servos are mounted on a plywood servo tray under the pilot figure supplied for the cockpit. The tray is pre-cut for micro servos but I only have mini servos, so the cutouts were extended. The ply servo tray also includes a battery mount section. Instead, I screwed another piece of ply to the floor of the fuselage, and rubber banded my battery onto this plate. This allows me to use larger batteries than would fit in the standard battery tray.

"The motor supplied in the kit is a Le-Mans AP29R. The name doesn't reveal much, but it's an 035 sized motor with a reduction drive, turning a 7x6 prop. The instructions call for a six-cell 600 mAh battery pack but I installed a pack of six 800 mAh Sanyo SCRs for longer motor runs. The kit includes a regulator and cut-off unit, powering the receiver from the motor batteries and turning the motor off as the voltage drops. There was no provision for adjusting the cut-off voltage, so a ground test checked the factory setting. The batteries had enough power left in them for just over six minutes of continual control movement on both channels after the motor had cut. This would result in a much longer time in the air, as control inputs during the glide only really amount to a number of trim changes!

"The Express has a span of 64-1/2 inches and is 29-1/2 inches long, and my model's weight of 32 ounces gives a wing loading of 14.9 oz./sq. ft.

"We had a little snow before Christmas, so I had to wait for suitable weather for a test flight. The best day we had was probably a little breezy in hindsight, but I headed down to the field during my lunch hour on the Thursday before Christmas. Enough of the snow had melted to recognize the strip, so after a quick radio check, off she went. The first launch resulted in a quick dive into the ground. OK, how about a little up-trim? Second throw was fine, and we were airborne. The climb was brisk in the breeze, and the Express was very controllable. The motor ran for about three or four minutes and finally cut out at around 400 feet. This was a good climb, and included two loops under power on the way up. The glide was one long vertical descent into the breeze. Unfortunately a gust tipped it up on a wing tip at about three feet altitude during the landing, and the nose took a beating from the ground. But a new cowl and gearbox will have this little plane in the air once again. The first flight was a lot of fun, but next time I'll wait for calmer weather!

"The instructions were clear, and this would make the model suitable as a primary trainer (with some guidance, of course). No control throws were given in the instructions but I found that 1/4 inch each way for the elevator and 1/2 inch each way for the rudder were plenty. It served as a great introduction to the world of ARFs!

Derek J. Buckmaster
251 Fenn St., Apt. #6
Pittsfield, Massachusetts 01201"

And that, dear readers, is a kit review Australian style! I hope you all enjoyed it as much as I did. Derek's full address has been included in case anyone has information on the Taifun to send him.

If the foregoing report didn't sufficiently impress you with the intelligence of our readers, let me introduce you to another of our East Coast ARF experts, Sal Lucania of Trenton, New Jersey. Sal has been in modeling for forty years, and at the time of this writing has just completed his twelfth ARF. He belongs to three R/C clubs in his area and from time to time provides me with evaluations on various ARFs, many of which are of interest to our readers. Sal writes:

"I'm enclosing pictures of a Royal Chipmunk 40-45 (59-inch wingspan and 573.5 sq. in. area) as built by George Wright of the West Windsor Flying Club (New Jersey). This is the second Royal ARF I've seen at the WWFC. Although a good .45 would fly this model quite well, George chose a .60 for some really spectacular accelerated aerobatic performance. A nice combination, George says it is not difficult to fly. I must admit it looks rock steady in the air. Takeoffs are fast and straight and landings are smooth."

Sal next reports on the Royal Telstar 40,

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owned and operated by Ben McMichael, another member of the WWFC. This ARF has a 58-inch wingspan with an area of 593 sq. in. Ben's Telstar came out at 5.75 pounds equipped with a Super Tigre .45 with a Perry pump and MAC muffled tuned pipe and header. Ben found that the wing incidence was slightly positive and corrected it to zero degrees. He thought that the engine cowling as designed in three pieces was somewhat difficult to handle, and that a one-piece fiberglass cowling would have been preferable. Another small improvement he felt was indicated was to secure the motor mount to the firewall with the addition of blind nuts. This would make it easier to replace and/or tighten the motor mount. Also, Ben reminds us to seal all joints in the covering with thin CA to prevent fuel seepage. Ben, a conservative gentleman, says, "It flies real good."

Sal adds, "I've seen his Telstar 40 fly and I'll say a bit more. It doesn't lack for power. His plane weighed in at four ounces less than the advertised six-pound weight. It is a smooth flying machine that tracks well. Perhaps when he gets a few more flights in I'll get a chance to check the roll rate for myself. The takeoffs and landings are beautiful."

Another photo from Sal depicts the Striker, a 62-inch ARF from RTF models in the U.K. He describes it as follows:

"I made a few changes that I thought necessary to the model before the first flight. First, I threw away the tank they furnished and installed a Goldberg tank. Next, I converted the fixed nose wheel to a steerable configuration and installed dihedral braces in the wing. Also, I held the wing to the fuselage with the dowel-and-bolt method rather than the elastic band way. The remainder of the construction was straightforward. I installed an O.S. SF ABC .61, and Airtronics radio, charged up, and went out to fly. I ran two tanks of fuel through the new engine, then put it in the air. Beautiful! Great! Love it! The roll rate was a bit slow, but that was easy to fix. Flights two, three, and four were also uneventful. Then another fault turned up. While taxiing back to the flight line the engine *fell out*. The motor mount they provided couldn't hold up under the torque of the engine, as both beams of the mount broke. The beams of the mount were only about half the cross sectional area of that of the Great Planes mount that I finally used. Fortunately this happened while on the ground and only minor repairs were necessary. A word of caution here—always check the accessories provided and if they do not come up to your standards, throw them away! Also, as I don't know how strong the stab is on the Striker, I would back off the throttle during the back end of a loop, a split-S dive, or any diving maneuver. All in all, with a little work, this is a good looking, great flying, pattern ARF!"

It sounds as though Sal really likes to wring out his ARFs, judging from his letter! He goes on to close out his report with one more evaluation:

"My Challenge II is now two years old. I have seen two others and they all fly very well. I don't believe they are advertised any longer (originally Hobby Barn/World Engines, Inc.) but you still may find some around. The first one pictured is mine, powered by an O.S. .90, and the second is Rick Radcliffe's, powered by an Enya 120R. Both aircraft required structural changes to make them safe to fly. These changes involved strengthening the wing hold-down blocks, landing gear supports, and wing servo boxes. Since these modifications both aircraft have had many flights and are really fun flying models. They are relatively large at 70-1/2 inch wingspan; this makes for good visibility, lighter wing loading, and smooth maneuvers."

OK, that does it for this month. I hope the rest of you ARF enthusiasts will write in and tell us about your latest model. Photos are especially welcome. Please direct your correspondence to 2267 Alta Vista Drive, Vista, California 92084, (619)726-6636. •

Big Birds . . . . . *Continued from page 25*

E-power. Avoid draggy designs at first—no bipes, struts, radial cowls, etc. Pick a simple, clean machine.

"Of course we'd have to add a couple of fat wing tips to the Kadet Senior to make her IMAA legal (80 inches for a monoplane and 60 inches for a bipe) and possibly beef up the wing centersection to handle the extra weight of the batteries. This bird should perform beautifully with the 40 system and give years of enjoyment.

"I use primitive scratch-building as my technique. I lay out the components on my workbench and just build an airplane around them. This is fun building as you're really not too sure what will transpire. Naturally it's best to use conventional planforms to insure success . . . and let's be honest, it's good for the old ego to show up at the field with your very own original.

"Comparing E-power to gas engine power is like comparing apples to oranges; they're just too different. Each has its own place in R/C, and it goes without saying that piston-pounders definitely have the performance edge. But E-power really comes into its own in scale applications, and for many of us who are just plain sport fliers it can't be beat. When I arrive at the field with my electric-powered birds I'm all ready to go, so I head right for the frequency pin. In addition to the fuel being free, my airplanes stay CLEAN.

"And by the way, I'm not one of those narrow-minded guys who flies only one

kind of aircraft. I do enjoy big gas guzzlers. My 148-inch Cub still flies majestically with a 10-hp Sachs engine up front, and my other two, a Nosen P-51 and an original called Bubbles, are too big and heavy for any current electric systems.

"Try E-Power, you'll like it!"

CURE OF THE MONTH

Nino Campana offers this cure for constipation: Have a nurse bring you a piece of cheese, sit on it, and then swallow a mouse. It never fails!

We're all pretty well into the flying season by now so think *safety*. And why not take a youngster with you next time you go out to fly? Let's share our enjoyment; it's a great way to "pay our dues."

Al Alman, 16501 4th Avenue Court East, Spanaway, Washington 98387, (206) 535-1549. ●

Electric . . . . . . *Continued from page 41*

ion gear (this one is a press fit). You would have to destroy the gear to get it off, as it is pressed on so far that a gear puller cannot reach underneath it. The shaft and housing could easily accommodate a set screw type pinion. It appears to use 48 pitch gears, which are readily available at any hobby store that has off-road car parts. I would also like to see some way of mounting the gear unit to a firewall. None is provided, however, most gearboxes don't have this feature anyway, and most are mounted with the motor in a cradle or motor mount. Three gear ratios are available: 2.5, 3.0, and 3.8 to 1. These are stock numbers 6005A, 6005, and 6005B respectively at $19.95 for the short shaft gearbox. They are 6015A, 6015, and 6015B respectively at $25 for the long shaft gearbox.

As said, the motor is a beauty, with a black aluminum front bell, replaceable brushes, and adjustable timing. It is available in 24 turn (black label) or 19 turn (gold label) versions. The 19 turn is hot! The motors are $40 with no gearbox, $60 with the short gearbox, and $65 with the long gearbox. Put this together with a six or seven-cell Sanyo SCR pack, and watch out! You will get very close to cobalt performance! The Leisure stock motor (red label) is also very good. It is $22 direct drive, and $40 with either the short or long gearbox, a real bargain!

Now for news from readers! John Mountjoy has contributed many photos and handy items to this column and now he and his friend Charlie Spear will be the co-editors for the electric column in *R/C Report*. *R/C Report* is sold in many hobby stores, it is a tabloid format magazine which features very good product reports and columns. The price has been $1.25 per issue, or $10 a year, but I think this has gone up. The address is R/C Report, P.O. Box 1706, Huntsville, Alabama 35807. Anyhow, the photo is of John's Astro Flight Partenavia P-68. This kit has been in production for many years and is the only electric twin scale kit that I know of. John powered his with twin Astro cobalt 05 motors, 8x4.5 props, 14 Sanyo 900 SCRs, and a Robart 500 speed controller. Flying weight is 4 lbs., 2 oz, which is very good. He used a Cannon Super Micro four-channel radio. John recommends the plane for advanced fliers, as it is very fast and aerobatic. It will not take off from grass but does good takeoffs from pavement. John's description is typical of many fliers who have the P-68. It is a very hot plane. You can tame it down by adding wingspan; I have seen this done quite often. If I were building one, I would build two wings, one with the stock airfoil (which is quite thin), and one with a 12% thick airfoil. I think the 12% airfoil would tame it down quite a bit and give more lift. John is using small wheels on his; I think larger wheels would make it capable of grass takeoffs. There is certainly no power problem, twin cobalts are potent! Thanks, John, for the info and welcome to the

ranks of magazine columnists. Those monthly deadlines always seem to be two days ago!

Jack Dobbins sent a lot of info on his small electrics, enough to be the topic of a separate column. The photos show his mini Showmaster, a scaled-down Ken Willard design, and his electric powered hand launch size glider. Small airplanes are a blast, and his letter came just at the right time. I have designed many small electrics, and I was about to publish some of them when Astro discontinued the 020! That put everything on hold. However, now there are some very good replacements for the Astro 020, including the Kyosho AP-29, the Silver Streak motor from Peck-Polymers, and the smallest of the lot, the IMP 30 from HiLine (P.O. Box 341283, Bethesda, Maryland 20817). In keeping with the idea that wattage tells you more, I rate the old 020 motors as nominal 40 watts. This usually means three to six cells at 12 to 6 amps range. Anyhow, I dusted off my Electro Flea design (first flew in 1976) and installed the HiLine IMP 30 motor in it, with a 5-¼x3 Top Flite nylon prop. Flying weight was 12 ounces, and to say the least, I was very pleased with the performance. Flights are 4 to 5 minutes long with a very good climb. The plane has to dive to do loops, and spins are very good. I recommend the IMP 30, it is only $10.95 plus $2 postage from HiLine. There will be more in the column about small planes next time.

The Puget Sound Electric Model Fliers and the Boeing Hawks will have their seventh annual Electric Fly-In this June 24 and 25, at the Hawks flying field in Kent, Washington. There will be a prize for the best multi-motor plane flown each day, and a Class A battery allotment sailplane event (three flights on one charge). There will be prizes for most aerobatic, best scale, longest flight, most impressive, and others! AMA membership is required. Write to Bernard Cawley, 29838 48th Ave S., Auburn, Washington 98001, phone (206) 839-9157 for more information.

The Burlington County Club in New Jersey will have their first annual Electric Fly July 8, 1989. Flying will be at the Northern Burlington County Regional High School. Call Bob Afflerback at (609)871-8777 or write him at 123 Harrington Circle, Willingboro, New Jersey 08046 for further information. Till next time, have a good time with electrics! •

Free Flight . . . *Continued from page 59*

no grain, so cutting accurately is easy.

U.S. OUTDOOR F/F CHAMPIONSHIPS

I just received a press release from Tony Italiano to publicize the upcoming NFFS sponsored U.S. Outdoor F/F Championships which are scheduled to be held June 19-23, 1989 at Lawrenceville, Illinois at the Mid American Air Center.

Sixty-one events are on the schedule, including AMA, Nostalgia, SAM, and Flying Aces Scale. Dorms are available and two banquets are on the schedule. The event is intended for families, not just the F/F freaks. For more information, contact Tony Italiano at 1655 Revere Dr., Brookfield, Wisconsin 53005.

THAT'S IT DEPT.

Well, that kind of wraps it up for another month. Thanks for reading along again. Let me know how your free flight experiences are treating you. Send me pictures, and if you are at the Nats, I will be there competing with my models and my camera. Look me up.

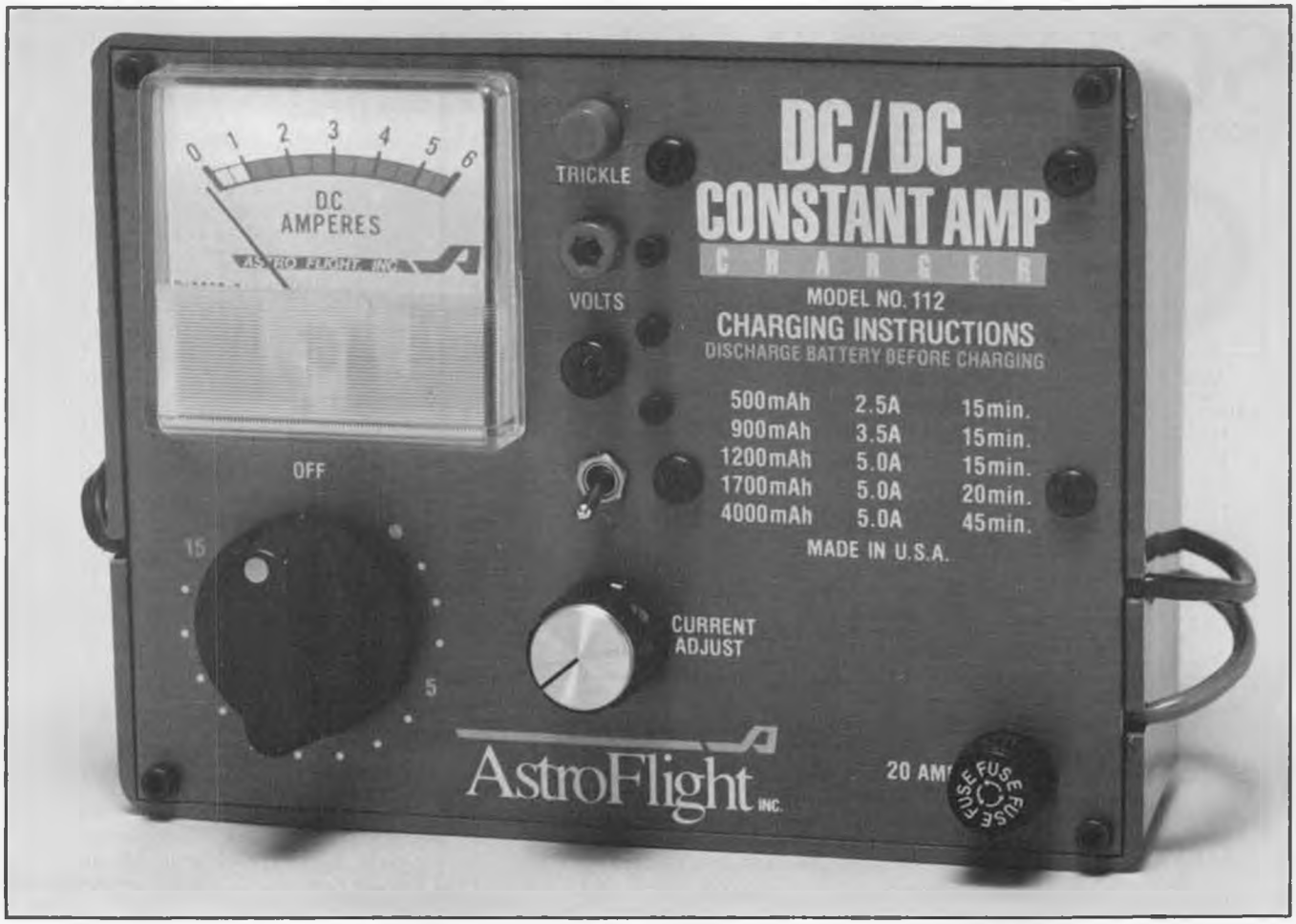
So, until next month, catch a thermal for me. •

Tech Stuff . . . *Continued from page 31*

wish for anything more. Full-scale seaplane designers have to worry about something called Froude Number, which has to do with wave-making drag, and velocity squared divided by hull length; but we usually have a better power-to-weight ratio than the big guys. Some of you never heard of the hump, so why did I tell you what it was and then tell you don't have to worry about it?

The Step

The step is of course what permits our displacement boat to climb out and become a planing boat, and in turn lift off and become a flying boat. Just before liftoff or just after landing, the plane is partly supported by hydrodynamic lift and balanced on a very small area of bottom just ahead of the step. Therefore it is evident that the step must be close to the CG. Normally the step is placed at or just behind the CG. If the step is too far forward the plane will bounce and porpoise. If the step



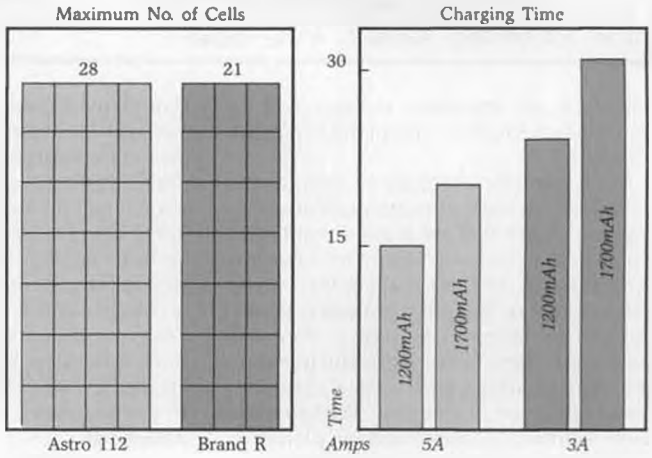
Charge the Big Ones Fast

The Astro Model 112 DC/DC charger is specially designed to charge BIG ELECTRIC SYSTEMS FAST. No more waiting around for hours trying to charge the twenty eight cells in your Quarter Scale Cub. No more removing the wing to take out the four battery packs so you can charge them one at a time. Now you can charge all twenty eight cells (44 volts) at the same time. Just plug the astro Model 112 into the charging jack on the side of your model, set the timer for fifteen minutes and relax. Our high power precision electronics will do the work.

For versatility the Astro Model 112 can't be beat. It can charge any nicad battery with as few as one cell or as many as twenty eight cells. And the Constant Amp Charging Circuit is adjustable from one to five amps, so you can safely charge 250 and 500ma receiver packs, 900 and 1200ma airplane packs, and 4000ma boat and truck packs. The Astro Model 112 charges them all faster and more efficiently. The reason is simple, our super heavy duty DC/DC inverter puts out more juice. The proof is right there on the meter.

You will appreciate another little feature. The input cord is both fused and diode protected so if in haste you were to inadvertantly hook up the alligator cord backwards nothing would get fried. Just pop in a new 20 amp fuse and you're back in business. Also, voltage jacks are provided on the front panel, so you can monitor the charging process with your digital voltmeter.

DC/DC CHARGER COMPARISON



AstroFlight INC.
13311 Beach Avenue/Marina del Rey, CA 90292 (213) 821-6242

is too far aft, excessive elevator will be required for liftoff, or the plane can't take off at all.

In conventional seaplane design, the step must be high enough and/or ventilated, to assure that the water breaks away from the after bottom cleanly, for low-drag pure planing. We are making the rear of the fuselage or the after bottom rounded in cross section so our step is very well ventilated. The simplest steps and transoms are straight across and vertical, but they have high aerodynamic drag. We can make them elliptical or vee-shaped in planform, to reduce the drag without losing much if anything hydrodynamically.

Hull Aerodynamic Lift

In a landplane the fuselage normally has little effect on the center of lift of the airplane, but in flying boats things may be different. A large wide hull sticking way ahead of the center of gravity will have lift! I originally didn't take hull lift into account in balancing Sea Fli XI. On the first test flight it was obviously too tail heavy even though the CG was at 29%. After Paul Weston and I realized that hull aerodynamic lift was the source of the problem, I moved the CG forward to 19 or 20% of mean wing chord, and it now flies beautifully. Traditional flying boats usually balance normally, because they are as wide behind the step as they are in front of it, so the hull lift is roughly at the CG. This rather unusual design is much wider forward than it is behind the step, however, putting the hull lift well ahead of the wing lift. Watch for it in any seaplanes you design or fly.

Afterbody

Most floatplanes and flying boats have a flat or vee bottom aft of the main step, and a rear step at the intersection of this aft bottom and the aft fuselage. We have demonstrated, at least on models, that an after bottom as such is completely unnecessary. We do need some buoyancy behind the main step, as we have already discussed, but a normal rounded cross-section aft fuselage can provide that with less weight, less drag and less design effort than a true bottom. As long as this aft buoyant area has straight longitudinal lines, there is little or no suction to retard getting up on the step.

Pointed Bows

Most floats and hulls have a fairly blunt bow. For model seaplanes a moderately sharp or pointed bow makes more sense. Four reasons: less aerodynamic drag; less hydrodynamic drag in very rough water; the forward deck can be made lower permitting the prop and the thrust line to be lower; and, in a crash the sharp bow can penetrate the water at a lower force, decreasing the water impact Gs and thereby reducing potential crash damage. Which will enter the water with less drag, a javelin or a basketball? You may also like the looks of sharper bows. I do.

With regard to a low forward deck, the depth of the hull at the prop on XI is only 2.5 inches. On a typical design flying boat of this size the depth is about 4.8 inches, nearly twice as much. This flat nose may look strange because we are not used to it, but it allows the thrust line to be 2.3 inches lower, for better performance and aerobatics.

Rotation

Rotation, for the younger members of the class, is the elevator-commanded rotation of the plane about the pitch axis, after flying speed is reached, to bring the wing to a sufficiently positive angle of attack so the wing lift will support the weight of the airplane for takeoff. The amount of rotation required depends on the speed at which we want to take off. When the angle of attack rises to the point where the lift at the existing velocity equals the weight, up it goes. The maximum possible rotation angle for a given seaplane design is approximately the angle between the main bottom of the hull or floats and a line from the tip of the main step to the tip of the rear step, tail float, or fuselage. This is often called the "sternpost angle." It needs to be at least six degrees. If it is more than ten degrees or so, the plane will still operate fine, but it will be possible to horse the plane off at excessive angles of attack, which may invite a stall. In other words, limiting the rotation angle in the design of the airplane prevents inexperienced or careless pilots from snap rolling on takeoff.

The sternpost angle also affects landings. When this angle is too low, in a well-flared landing the aft buoyant area will touch the water first, pitching the plane abruptly down onto the main bottom. If the sternpost angle is high enough, it will be possible to completely stall the plane yet touch down simultaneously fore and aft for a "three-point" landing.

Wing Incidence vs. Bottom Angle

When a seaplane first passes the hump, its weight is supported by the hydrodynamic lift on the planing bottom. As it accelerates, less and less bottom area is required to support the weight, and the plane rises further out of the water until it is supported only by a small area next to the step. We want the wing lift during this time to be zero or close to it, because the drag is least at zero lift, and also there will be no danger of taking off half stalled. The

most efficient planing angle for a flat surface is plus three or four degrees, therefore the wing incidence should be such that the planing bottom is around four degrees when the wing is developing little or no lift either up or down. Since this is an aerobatic model with a symmetrical section, I'm using zero decalage. The stab angle is therefore also zero degrees when the bottom is at plus four, and no elevator deflection is required to keep the ship at optimum planing angle (provided we put the step in the right place with respect to the CG).

As soon as we have plenty of flying speed, a touch of up elevator rotates the plane enough to smoothly transfer the weight from the step to the wing. In actual practice, if we have the elevator trimmed for a slight climb hands off, no elevator input is necessary at liftoff. The wing will gradually lift the load and it will take off unaided when the speed gets high enough. Only if we wish to take off at a lower velocity do we need some elevator. If a seaplane needs up elevator to get it unstuck from the water, something is wrong with the design. And it doesn't take more power to get seaplanes off; if the design is right they lift off easily. It's enough to warm the cockles of me heart.

Wing Floats

We will have to provide wing floats, sponsons, or some other form of lateral buoyancy to keep the wings out of the water at all times. If you haven't thought about it or experienced it, if a wing touches the water while it is moving or starting to move, the rounded lower surface will cause downward "lift" in the water which will tend to suck the wing down. We could put a step all along the underside of the wing and solve that problem, but the loss in aerodynamic lift and the increase in drag would be completely unacceptable. How much wing float volume do we need? Too little and we will catch a wing in the water sometimes. Too much and we will be carrying unnecessary weight and drag, but since we aren't smart enough to know exactly, we should err on the high side. A little loss in flying performance isn't as bad as tricky habits on the water.

Also, there is the question of where to put the wing floats. Too far in toward the center (short moment arm, Nov. '88) and the wing floats will have to be large, but the farther out we put them on the wing, the stronger and therefore heavier the wing must be built to withstand the twisting loads the wing floats will impose on it. Also, wing floats that are way out may have a tendency to cause ground looping (sea looping?).

There is much that we have not covered in configuring this airplane, but again I've used up my allotted space. Next month we will finish up the design of Sea Fli XI by discussing the materials, processes, and structural aspects of the model. Also I will try to put composite construction into perspective. Meanwhile, if you don't make waves, you are not under way. Designers and seaplanes make waves.

Francis Reynolds, 3060 W. Lake Sammamish Parkway N., Redmond, Washington 98052, SASE please. (206)885-2647. •

Pattern . . . . . . *Continued from page 27*

plished.

You may or may not agree. I hope you don't think I am simply trying to stir up a change for my own interest. I simply see this change as all but inevitable. If not now, in the very near future.

If it does occur, what would be the effect on safety? On noise? The size of the "box" we fly prevents very fast models from being effective. Also, the weight limit, which is still 11 lbs. dry, keeps inertia to reasonable limits. The noise rules are the most likely rules to govern preferred engines. I say this because I expect these rules to change as community needs dictate.

Simply put, I see nothing to stop this change except for the personal interests of some fliers.

Larger engines are presently available which could fill the bill. For instance, the S.T. .90, Webra .80, Rossi .80 and .90, O.S. .90 and 1.08, O.S. 1.6 twin four-cycle and others of similar size and types.

Swell! Now we all have a fortune tied up in super pumper .60 engines and Son of Godzilla models! What do we do with them?

Fly them. They are expendable if you are an active competitor and if they were really any good in the first place, they may still be entirely competitive for years to come.

Let's face it, change is a normal part of

today's world. In some businesses your thoughts are obsolete as soon as you speak them!

Enough of that. I have included some photos of a new transmitter tray I call the "Microtray." It is intended to allow access to the top of the transmitter as well as provide storage for your personal items you may need to keep with you. We have found it to be quite handy and we simply drop the transmitter onto the Velcro points and away we go.

The little charger shown by our Galaxy radio is a McDaniel unit hooked up to ten 1200 mAh Ni-Cds. This gives us a couple of refills at the flight line if we are really burning up the fuel. The digital meter in the transmitter tray monitors any of the battery packs to .01 volts. •

Insiders . . . . . . *Continued from page 60*

travel, as Aronstein did when he returned to Washington after his victory.

By the way, we built one and it flies great, even though ours came out heavier than the original.

PEANUTS & PISTACHIOS VOL. 4

When we asked P&P author Bill Hannan how he got all the way to Volume 4 with his great series of booklets about tiny and ultra-tiny stick 'n' tissue flying models, here was his profound reply:

"P&P Vol. 1 was originated as an effort to consolidate the activities of a small-in-number but large-in-enthusiasm group of geographically wide-spaced modelers. Most were individuals who were constructing and flying tiny scale models, unaware that their rather odd interests were shared by many others in other parts of the world. As a result of my *Model Builder* column, 'Hannan's Hangar,' and my previous 'Peanut Power' publication, I got letters from all over the world expressing fascination with the fine art of producing realistic fliers in miniature. Because of space limits in the magazine, photos were arriving in quantities greater than I could publish. Further, the high cost of producing comprehensive books such as 'Peanut Power,' which could feature large numbers of photos, placed them beyond the reach of a one-man, part time publishing venture. Further, the time investment required made the concept impractical.

"Thus, 'Peanuts & Pistachios,' a concise booklet, was envisioned as a practical solution to an apparent need that could be filled within reasonable time and financing constraints. Volume 1 (1986) was launched as a sort of 'test balloon' to sound out potential reception. Produced at relatively low cost in small quantity, it quickly established that there were modelers out there willing to contribute to and help support such a publication. However, it also confirmed that this was a very special area of interest, and initial market response was small.

"Still, letters from those who bought this booklet were encouraging, and about a year later, Volume 2 (1987) appeared. Another vital factor was the boost provided by the model magazine editors and columnists, who were so generous in praising P&P. With almost no paid advertising, these writers managed to spread the news of P&P to a remarkably wide audience. Similarly, model club newsletters picked up the ball and ran with it, further expanding the network of contributors and readers. The eventual result was Volume 3 (1988), which showcased work from model builders in Australia, Belgium, Canada, Czechoslovakia, England, France, Germany, Greece, Japan and Uruguay, as well as the United States. This underlines the truly international aspects of this tiny spectrum of our hobby!"

By way of review, Vol. 1 featured five Pistachio-sized drawings; Vol. 2 had four 3-views plus two actual construction plans; Vol. 3 incorporated one 3-view, data on three racers, one Pistachio plan and two Peanut plans. Now Vol. 4 (Feb. 1989) presents one Peanut and two Pistachio plans, and five different 3-views. It also has features such as Peanut & Pistachio People, Peanut Gallery, Pistachio Presentation, P&P Props, and much more.

To get your copy of Volume 4 of *Peanuts & Pistachios,* send a check or M.O. for $5.50 plus $1.50 for postage to: Hannan's Runway, Box A, Escondido, California 92025. •

Nuremberg . . . *Continued from page 15*

be available in the average retail shop and not exclusively through specialist retailers. This will further boost the interest for high-quality electric flight products. The first production batch, started early February, is of 2,000 pieces for most types and sizes. Much more than the previous series!

As if that is not all, the new Robbe/Keller range includes many motors with neodyme magnets. This is a new and very promising technology. The recently developed iron-boron-neodyme magnets are significantly more powerful than samarium-cobalt ones, but the technology is still very new and difficult to master, due to temperature limitations. Although other manufacturers like Geist and Hecktoplett are already experimenting with neodyme motors, Keller is the first to start full-scale production in the model field. Very exciting!

WHAT FUTURE?

After four days spent inside the exhibition halls, and with little time to search through more halls for small or new model exhibitors lost amidst toy specialities, I left Nuremberg with the feeling that European modeling had just taken one of its most significant turns. There is little doubt that the days of free and wide flying fields are things of the past. Modeling can only keep growing if one can fly models within a reasonable distance from town, where the activity can be seen by the general public. Not only do large distances deter people from flying regularly, but our activity becomes hidden from anybody but the most determined modelers. Electrics may be the clue for a better public acceptance, away from the usual nuisances.

I do not mean that modeling will be totally electric. Certainly not, and the combustion engines retain the same ap-

peal as before to many modelers. But when the need arises to fly silent models, electric power is now a viable alternative and many discover that it is, also, most enjoyable. •

Stinson . . . . . . *Continued from page 47*

to shape. Reinforcing dowels help secure the two nacelles to this assembly after it's been installed in the fuselage.

INBOARD/OUTBOARD NACELLES

Cut the cores from 1/8 ply, bend the landing gear struts to shape and lash them to the cores with copper wire. The cores are faced on both sides with 3/16 balsa sheet for a total thickness of 1/2 inch. Drill recesses for the joiner dowels, then make and add the firewall/fairing units if you choose the off-center engine mounting. Add the L.G. strut fairings and profile wheel pants.

FUSELAGE

Trace the pattern and cut from a plank of 1/2-inch medium balsa. The bellcrank installation is about the only item here that isn't straightforward. The method isn't original, and for that reason works very well. It's easier to refer you to the drawing than to try explaining the assembly.

As with the wing, personal preference was to apply the finish prior to assembly. Yes, there's some touch-up required after installing the flying surfaces, but try to imagine applying those "windows" and all that striping while reaching through, over, and around everything else.

TAIL SURFACES

The fin/rudder is 1/4-inch balsa sheet, with simulated ribs from thin strips of MonoKote under the paint. The stab and elevators are built up, using a core of 1/16 sheet cut to outline and faced on both sides with 1/8 squares and 1/8 sheet curved outlines. These surfaces were purposely built to 5/16-inch thickness so that after sanding they'd be 1/4-inch thick at the hinge line. Block-sand to final shape; tapered at the tips and a slight symmetrical airfoil. The horizontal tail surfaces were covered with Japanese tissue and lightly shrunk with a fine mist of rubbing alcohol. Thin (50/50) dope is applied until the surfaces are sealed and shiny. We used ten coats of Sig nitrate. Why nitrate? With epoxy as a final finish (ours is), the base must be nitrate. We're not sure what happens if you use butyrate under epoxy . . . although we've heard that the appearance will resemble a soggy pizza. Stab struts are 1/16x1/8 spruce, bass, pine, or whatever.

The main wing struts are 3/8-inch K&S streamlined aluminum tubing. Cut these to length, insert plugs of balsa/wire for attachments and apply the finish before installing. Jury struts are 1/16-inch aluminum tubing.

FINISHING

We nearly went with a 1930s era cream and green scheme for a fictitious "Fubar Airlines," but wound up following the herd and applied the AA scheme. Colors are dark blue and international orange with white pinstriping. The original's wing and sesquiplane were covered with Black Baron film. These were then sprayed with Black Baron epoxy, as were the tissue covered tail surfaces. Fuselage and nacelles received three coats of Sig nitrate, followed by two sprayed coats of Black Baron primer and two coats of color. Fuselage decorations are from MonoKote trim: windows are light blue, while the stripes were masked off on a white trim sheet (sticky-back), sprayed with orange epoxy, then cut out leaving about a 1/32-inch border all around. The same method was used on the nacelles and wheel pants. The front end of all three "cowlings" are painted and outlined with striping tape; only the horizontal stripes are MonoKote.

The AA logos were made by carefully cutting them from MonoKote. This is sort of tedious, but rewarding. Use a new #11 blade for this. Dry transfer (rub-on) white letters were used for the wording above the logos and for the registration numbers on the rudder. We used Letratype 30 pt. Helvetica Fine. These should be available at any good art supply house. Wing registration numbers and AA markings are 3-inch press-ons from Major Decals.

Following assembly of all components, small fillets of 5-min. epoxy were added and touched-up with paint and brush, then the entire model received a brushed-on coat of clear gloss polyurethane. Install controls, remembering to add a pushrod guide/support. Add details as desired. We installed dummy nav lights, aileron pushrods, exhaust pipes, antenna wire and stab brace wires. It's easy to get carried away here, but it's well worth it.

FLYING

As C/L Scale judges are seldom impressed by Hammerhead Stalls on takeoff, be sure to balance the model where shown. The original was flown on 40 feet of .010 solid wires. Engine starting sequence is: outboard, inboard, center. For reasons that should be obvious, you don't want the outboard engine running in flight when the others have stopped. This isn't a three-engine Mouse Racer, so let it have a long takeoff roll to gain flying speed, then ease it off. The sound of multi-engines is like music. On landing, don't let it balloon, but do allow it to glide down to a tail-high touchdown—gently. We think you'll be hooked on Multi-Engine Profile Scalers.

Much thanks to Dave Shipton for his

help and advice on this project. For anyone wanting to discuss this design further, we're at 6618 Dashwood St., Lakewood, California 90713. •

Inside Engines . . . . *Cont. from page 39*

tually made the car fun to drive!) Yamada has cleverly engineered a way to slightly increase (about a third of an atmosphere) the pressure of air going past this engine's intake valve and they want to call it "supercharging." I think we should accept their term.

I described fuel injection earlier. The YS-120 doesn't have fuel injection in the normal sense. The pressurized fuel system does deliver fuel to the carburetor under pressure above atmospheric due to the positive air pressure inside the fuel tank. The needle valve sets the rate of fuel flow. The throttle servo operates a dual vane or blade that passes through the dual carburetor throats. Like true fuel injection, there is no venturi in the fuel feed system. The dual blade sets the engine's speed; idle mixture is set by minor turning of the slotted brass adjuster which varies compression on the spring in the regulator. The needle valve sets the mixture above idle and is very insensitive. This isn't fuel injection, but the system works flawlessly, so if Yamada wants to call it "fuel injection," again I think we should accept their term.

The dual throats in the carburetor are a whopping big .430-inch diameter and the intake pipe necks down to .390-inch probably to accelerate the mixture a bit. Such large I.D.s would never satisfactorily draw fuel from the tank by normal venturi action. The variable pressurization system allows steady engine running regardless of the dynamics and flight attitude of the model. Raising and lowering the fuel tank a foot from center does *not* affect the engine performance! Our models can now have working tip tanks for R/C scale!

I doubt this engine design will ever have premature failure of the shaft's ball bearings due to nitrous oxide from combustion joining with moisture to form nitric acid which just loves to eat steel. With all the intake fuel/air passing through the crankcase (just like a rear intake two-cycle engine) that section runs both cleaner and cooler than any other four-stroke model engine. This feature alone virtually nullifies the price differential between the YS-120 and other four-cycle engines.

Since I'm a firm believer in castor oil's superior lubricating properties, I chose to break in and run the YS-120 on Don Nix's Powermaster Plus commercial fuel (whose oil is 30% castor and 70% synthetic) with 15% nitro. Powermaster Plus meets the YS specs nicely. Steve Helms at Futaba suggests staying away from "four-cycle fuels," since they normally have lower total oil contents.

YS recommends either an O.S. "F" glow plug or an Enya #3 plug, but neither is supplied. Although this engine comes with four Allen wrenches, two prop wrenches, and a tappet adjusting wrench, I do feel it should come with a proper glow plug. The Fox Miracle plug worked just fine through break-in and all testing. When I later decided to purposely run the engine too lean on the 16x8 prop (lean runs advance timing) to see if the prop would kick off, the prop did kick off and the plug also failed—as expected.

The complete fuel flow sequence is:

1. Fuel flows from the tank, past a filter, to the regulator.
2. Fuel enters the regulator's lower chamber, below the soft silicone diaphragm.
3. Fuel collects at/around the spring, plunger, and the internal one-way check valve that the plunger operates.
4. As the crankshaft turns, it momentarily releases timed crankcase pressure (maybe as much as 8 to 10 pounds per square inch at peak rpm) into the regulator's upper chamber and onto the top surface of the diaphragm.
5. This pressure escapes by a one-way check valve into the fuel tank where it rises above atmospheric to force out fuel. Before the pressure escapes it pushes down on the diaphragm and on the plunger below the diaphragm. The plunger releases fuel from the bottom of the regulator by opening an internal one-way check valve. The fuel flows to the needle valve for metering.
6. The fuel is fed under pressure past the restriction caused by the needle valve's setting and into a tiny hole in the carb casting, into a bathtub shaped milled entry on the surface of the rotating blade/vane, and simply dumps into the incoming airstream at full throttle. There is no spray bar, no venturi, and no injector nozzle—fuel just dumps into the incoming airstream.
7. At less than full throttle the fuel flows into a continually narrowing width/depth metering channel so that less fuel flows at lower rpm. There's even an auxiliary fuel flow path leading to the throat nearest the needle valve.

I'm sure that a massive volume of Oriental patience, some trial and error, and much clever and ingenious engineering was required to perfect the fuel feed system.

This YS-120 uses a nickel plated brass cylinder. The aluminum piston has one compression ring. The intake valve (14mm) is slightly larger than the exhaust valve (12mm) and the glow plug is offset towards the hotter exhaust side of the combustion chamber. The one-piece valve guide and seat is phosphor bronze. Mechanically

advantaged rocker arms give .120 inch (almost 1/8 inch) valve travel. A double set of metric prop nuts with a peculiar off-center shoulder between them side-loads the crankshaft's threads to help prevent the prop from kicking off. It's too bad stop nuts (those with nylon inserts) aren't made in metric sizes since they work so well to keep the prop in place.

It is a bit difficult to describe how nice handling this engine proved to be. As you study the all-important speed ratio figures (nothing is worse than an engine whose idle speed is so fast that touch-and-go maneuvers and landings are crashes looking to happen) you'll see the best performance was on the smaller props. This is a function of the exhaust timing favoring smaller props turning at higher rpm—yet the idle speeds varied considerably less than I expected from the smallest to the largest test props. The 13x6 prop idled beautifully at 2,000 rpm and when I added a Davis Diesel SM-4 muffler it dropped to a reliable 1750 low and the speed range exceeded by far a 6:1 speed ratio. I was totally delighted. Only the initial start was made with the Sullivan starter—all others were mostly one flip and two flip hot/cold starts with a rubber hose chicken stick. The fuel delivery system's value is in the completely smooth acceleration and non-miss running that is so noticeable compared to some other engines in this size. You should expect to pay about $75 more for the YS-120 over other brands—this engine is in a class all by itself. The YS-120 is such a fine performer that the Quarter Scale Pylon Racing Association (four-stroke 120 racing centered around Ohio) has banned it since it would obsolete all other current 120s at this time!

I feel certain the YS-120's two one-way check valves in the fuel feed system are floating open at high speeds and fuel is being fed to the combustion air with straight crankcase pressure—just like on Formula 1 R/C pylon racers. The engine runs just as great as a properly set Formula 1 engine on a winning flight. If you want a superb engine for quiet F3A pattern—if you want reliable and scale-like power/sound in your next scale model—if you simply want the best running four-stroker for Sunday flying, try the Futaba YS-120. Mine is going in an Ugly Stik first—and I expect unflappable performance.

Imported and serviced in the USA by Futaba Corporation of America and available where Futaba products are sold. Manufacturer's suggested list price is $529.95. Made by Yamada Manufacturing Co. Ltd., in Japan. •

Plug Sparks . . *Continued from page 37*

No awards of any particular value are planned right now, but you never know what can happen with a go-getter like Bolton. Call Jack at (703)356-5008 for details.

SAM 46

Bob Nolan, spark plug of SAM 46, writes to say it has been quite some time since he submitted any photos of their activities. Bob points out that SAM 46 holds two annuals a year, in April and November, in central west Florida.

We don't run pictures of Nostalgia era models very often, but Photo No. 10 showing Dave Platt with a 1955-56 version of Dave Posner's "Dream Weaver" proves that Platt flies all forms of models, not just R/C Scale for which he is best known.

Of course, it is history now how Platt came to America to work for Top Flite. Some years later, he moved to Florida and set up his own business under the name of Pica. He has remained ever since in Florida.

Some fellows never seem to wear out or get old. Case in point: Photo No. 11 showing Elmer Wassam cranking on an Ohlsson

.60 in his Comet Sailplane. A good combination in 1940 and still a good combo for O.T. events nowadays. Elmer is a mere 70 years old and still enthusiastic about Old Timers. Way to go!

AUSTRALIA

While attending the MAAA Nationals at Amberly AFB, Brisbane, Queensland, I was taken to the home of Gordon Burford at the close of the meet.

After visiting sundry friends and points of interest, I found Gordon was interested in the Diamond Demon, a Bay Ridge plan that was put out by Ben Buckle and later published in *Aeromodeller* magazine. He was looking for something to scale to suit his new .21 Burford diesel.

Looking over the small magazine drawing, we decided to make a Demon to 1.4x scale of the original size. In my enthusiasm, I offered to draw it up before leaving. Talk about shades of the old days! Gordon had nothing but the old brown paper to draw on, plus one straightedge and a triangle. I had forgotten how we used to "rough it."

After arriving home, I received a letter dated February 19 enclosing Photo No. 12 showing the completed Diamond Demon. Needless to say, Burford was quite enthusiastic about the drawing (a two-day special!) and promptly set to work on it. Burford is eagerly looking forward to the SAM Champs at Canowindra in April.

SWEDEN

Just about the time we had run out of interesting photos, Sven-Olov Linden kindly sent a new batch that we will feature each month or as space allows.

What better way to start off than with Photo No. 13 of Sven-Olov's six-foot glider known as "Balder." This 1944 design by Rune Anderson is being held by Olov's wife, Violet. The framework shows the resemblance to the successful Wakefield designs of 1937-38, where a long straight wing is employed with small sharply upturned tips.

As a sidelight, this replica is the second model of the Balder, the first having been built by the original designer, Rune Anderson, another member of the Vingarna M.A.C.

NORTHWEST TRIVIA

Latest item from Bob Stalick, newsletter editor of the Willamette MAC is an interesting and little-known fact from Pete Sotich. Pete works for K&S, which is owned and operated by Wally Simmers, who designed the Gollywock and other early Midwest kits.

When shown (by Pete) the drawings of the Gollywock, Wally said it was accurate but noted the propeller size should be 13-1/2 inches in diameter. The reason for the 12-inch kit prop was that their saw used to cut prop blanks could not handle anything larger than a 12-inch length. How about that?

READERS WRITE

Old buddy, Mickey (Emilio to you) DeAngelis writes to say he has been having a ball with the new SAM 100 Club. He is particularly pleased to see quite a few of his old 1934-38 designs being built these days.

This columnist has no quarrel with that as he used a Cloud Queen at the MAAA Nationals, Amberly AFB, in the Texaco event. Powered by an O.S. .40, the model flew well, and glided exceptionally flat with a Clark Y airfoil. The reason this columnist didn't win or place higher was that, without a chair to fly from, he gets vertigo looking straight up. After falling on his face and looking for the transmitter, the model had lost an excessive amount of altitude. One bummer and you are through!

Mickey sent in Photo No. 14 showing his latest scaled-up Miss Fortune X. This 90-inch blue and yellow model is powered by an Enya .60 four-stroke. The model has been flown steadily for the past three years.

The second photo (No. 15) is of the SAM 100 newsletter editor, John Delagrange, with the framework of an excellently built 1936 Miss Fortune X. As can be seen, this line of models, the Miss Trenton, Trenton Terror, Kloud King and Queen, and Miss Fortune, have all the same basic outlines and flight characteristics.

MORE READERS

Charles L. Buchanan, 404 Edgehill Ave., Kinston, North Carolina 28501, writes to say that he has scaled the T.D. Coupe plans purchased from Pond Plans to 90-inch wingspan. The model is now employed to take aerial photographs.

We received three photos: one barebones structure, one view taken from the model, and one of the finished model. We picked out Photo No. 16 to show what Charles has done.

The model is completely silked and doped (lightweight Sig orange silk) and trimmed in Miami blue dope with scallops on all the leading edges.

Charles sez he hopes we forgive him as he added ailerons for better control in shooting pictures. This, and several other small changes, have led him to call the model the C.B. Coupe rather than the T.D., which derived its name from the initials of Theodore Dykzeul.

This writer observes that initials have been used for a long time to identify or name designs such as K-G, MG, PB, etc.

50TH ANNIVERSARY JIMMY ALLEN "POSTAL AIR RACES."

The latest information received from Peter Mann, 36 Sydenham St., Guelph, Ontario N1H 2W4, Canada, consists of the announcement of a postal contest for Jimmy Allen designs. However, in reading the rules, this turns out to be a single design event for only the Easybuilt Model kit FF-68, which was originally kitted by Ontario Model Aircraft Co. in Toronto.

Models shall be built according to plan using the materials in the kit. The only structural changes allowed will be provision for a D-T tail and use of a dowel instead of rear rubber hook. Any color of tissue can be used.

Classes will consist of Junior (up to 16 years of age) and Senior (17 and over). The original age limit rule of 21 for the original Jimmy Allen Races is waived. Awards will consist of one for the longest single official flight regardless of class, an award for the longest single official flight in each class, and an award for the best total time of three consecutive flights.

Flying is to be conducted at any sanctioned model meet between March 1 and September 30. All results should be in the hands of the Event Director by October 31, 1989.

This is strictly for fun as there are no entry fees. A complete entry shall have the entrant's name, address, and class, along with the times of not more than three official flights. Date, place, and name of the contest shall be indicated by the Contest Director, with a statement verifying the flights.

The 1939 Jimmy Allen Rules in 1939 were (and still are) as follows:

1. Minimum weight: 42.5 grams.
2. Hand launch permissible.
3. Flights of less than 20 seconds may be classed as delayed flights. Three of these in consecutive order will constitute an official flight.

Other than that, the balance of the rules are pretty much like standard free flight rules regarding timing, obstructions, disappearances, etc.

Before we forget it, kits are available from Easybuilt Models, Box 1059, Beamsville, Ontario L0R 1B0, Canada. As noted in the first paragraph, to get full info on this fun meet, write to Peter Mann.

OBIT NOTICE

This columnist was caught napping regarding the demise of Allen Shivley of Las Vegas, Nevada, until Jim Gerrard contacted the widow to confirm his passing on August 13, 1988.

Allen will be remembered by most of the original founders of MECA with Shivley taking No. 1 (this writer is No. 14) when the group of engine collectors gathered rather informally and started signing up members. Since then, many people have devoted much unselfish time to further the cause of the engine collectors. Names that readily come to mind are Karl Carlson, Dick Dwyer, Bob Cowles, Bob McClelland and a host of others without whom the MECA organization would not have gotten to be worldwide.

We will miss Shivley, who specialized in the collection of Elf engines. He would put one complete collection together, then sell it and promptly started on another. I, personally, will miss his table at the Collectos where he chained all his expensive engines together. Makes it a little difficult to remove!

ANOTHER OBIT

Just received a newspaper clipping from my good friend John Carlson of Stockton, California, wherein an obituary on Tom Sopwith was included noting his death at the age of 101. Tom Sopwith was one of the early English pioneers in aviation. He won numerous races including several in the United States in 1910.

He founded Sopwith Aviation Co. in 1912 originally to build flying boats, his original love. During the war years (1914-18) the name of Sopwith was emblazoned on the skies with such names as Camel, Triplane, Snipe, 1-1/2 Strutter, Dolphin, and numerous other models.

After the war, because of excess profits, taxes, and the lack of orders for aircraft, the Sopwith Co. went into insolvency and was reorganized as the Hawker Aircraft Co., the Hawker part named after his close friend and test pilot, Harry Hawker. The latter company became famous for their Hawker Fury series of biplanes and then the successful Hurricane and Typhoon WWII models. After the war a huge amalgamation was formed, known as the Hawker-Siddley Corp.

Sopwith was knighted in 1953. •

Old Timer . . . *Continued from page 37*

It's been called the Trenton Terror ever since, even though the name "Miss Trenton III" appeared on the original magazine plan.

Barney Onofri, another member of the Trenton club, built the prototype Terror, which proved to be such a good performer that soon a dozen or more were built by fellow club members. The only hitch was that there were only a couple of Brown Jr. engines within the entire club's ownership, so they devised a novel interchangeable power package that gave everyone a chance to fly. Engine and ignition system were mounted on a common base, the whole thing being fastened to the nose of each model by a single bolt. After you made a flight, a minute's work with a screwdriver was all that was needed to get the power unit out of your airplane and into your buddy's. Our plans show this same type of engine mount setup. Today's builders will probably want to modify this though, either by raising the existing 1/4-inch plywood plate to just under the upper longeron, making a cutout for the engine and mounting it directly to the plate; or by doing away with the plate altogether and installing hardwood beam mounts.

By the way, both Mickey DeAngelis and Barney Onofri are still active modelers, Mickey being involved in the SAM 100 club—see this month's "Plug Sparks" column for a report on that club's doings. We'd like to thank Carl Hatrak, a longtime friend of Mickey DeAngelis and another former member of the Trenton Gas Model Airplane Club, for providing us with much of the preceding information about the original model and its designer.

The Trenton Terror in the photo was built as a F/F ship by Marge Bernhardt some twenty years ago and featured the same trim scheme as the original. Power was an Ohlsson .60 sideport converted to a front rotor, which was really more power than the model could handle safely. The gadget on the side of the fuselage below the windows is a specially modified clockwork timer, good for up to an hour, that would open a trap door and release a DT parachute, which made for a much gentler (if not quite as positive) descent than the normal pop-up stab.

The airplane is still active today, being flown as an R/C model by Ed Houston, past president of SAM 49, the Los Angeles area O.T. R/C club. Ed flies it in Texaco with a Saito .30 four-stroke. For R/C, the flat tail surfaces and the fact that the horizontal stab already has a V cutout for the rudder, make installation of control surfaces as easy as you could want. Just lay in an extra ¼ sq. spar parallel to and aft of the existing spar in the horizontal, and forward of the one in the fin. No balance point is indicated on either ours or the original plans, but a good starting point would be about halfway between the fore and aft wing spars. •

C/L . . . . . . *Continued from page 51*

to local competitions.

During the years of its existence, the *Flying Lines* staff compiled regional standings and competition records. Since *FL* has fallen into an uncertain status, the standings have been maintained by their last *FL* statistician, Dick McConnell of Seattle, Washington, and published periodically in the *Skywriter*, the publication of the Seattle Skyraiders.

The standings cover all events, including AMA events and those with regional rules. As during the *FL* days, the standings cover contests in all of AMA District XI and British Columbia. Fliers who place in the top four of any event are awarded points corresponding to the number of entries. If you win an event with 20 entries, you get 20 points. Second place is worth the number of entries minus 1, third is minus 2, and fourth is minus 3. Fliers must reside in the district mentioned above to be counted.

Not long after the system was started in 1979, fliers became interested in not only how they did in an individual contest, but also in their regional rankings—kind of like the tennis computer rankings. It helped bolster contest attendance. The standings changed somewhat about five years ago when many racing fliers began working together under team names, so that their names appear twice as individuals in some events and as a team in others, but the general standings interest has continued.

The Northwest records also became a matter of quite a bit of interest. *FL* kept records for all the events for which there were empirical measurements—speed, racing, and carrier. Any flier residing in the district was eligible to be listed for record performances at any contest. *FL* also sent out certificates to people who set or broke records. After any good flight, it became common to hear, "What's the record?"

The standings and records could be a model for other areas as a way of increasing interest in competition.

The *Skywriter* recently published the 1988 standings. As it happens, Dick McConnell was "Mr. Competition" with 157 points scored in a variety of competition categories. Here are the top competitors in the individual classes:

Junior balloon bust: Wesley Mullens. Balloon bust: Dick McConnell. Profile carrier: John Hall. Class I carrier: David Shrum. Class II carrier: Bob Parker. Overall carrier: John Hall. Speed (all events combined): Marty Higgs (formula 40). Profile scale: Dave Mullens. Overall scale: Dave Mullens. Slow combat: Glenn Salter. 1/2A combat: Chuck Matheny. FoxDoo combat: Mel Lyne. AMA combat: Phil Granderson. Overall combat: Spencer Sheldrew. Northwest Sport Race: Dave Green. Northwest Super Sport Race: Wayne Drake. Junior Class I Mouse Race: Wesley Mullens. Class I Mouse Race: Nitroholics Racing Team. Class II Mouse Race: Jim Cameron. Overall Junior Racing: Wesley Mullens. Overall racing: Wayne Drake. Precision aerobatics: Jack Pitcher. Old time stunt: Randy Schultz.

The *Skywriter* also lists a partial schedule of upcoming Northwest contests:

May 27-28: Northwest Regional Control Line Championships, Eugene, Oregon.

June 17-18: Northwest Control Line Speed Championships, Richmond, B.C.

July 15-23: AMA National Model Airplane Championships, Richland, Washington.

Sept. 2-3: Internats, Richmond, B.C.

Sept. 16-17: Raider Roundup '89, the Washington State Control Line Championships, Kent, Washington.

October: Stuntathon, Portland, Oregon.

Speaking of schedules, we now have in hand the Nationals schedule, including the unofficial events.

Sunday, July 16: 1/2A speed, 1/2A profile proto speed.

Monday, July 17: A speed, FAI speed, junior slow combat, senior slow combat, open slow combat, .21 sport speed (unofficial).

Tuesday, July 18: B speed, Formula 40 speed, open slow combat finals, Northwest Sport Race (unofficial), Northwest Super Sport Race (unofficial).

Wednesday, July 19: D speed, jet speed, FAI combat, open and advanced precision aerobatics.

Thursday, July 20: 1/2A combat, open and advanced aerobatics, profile Navy carrier, scale racing.

Friday, July 21: Junior combat, senior combat, open combat, open precision aerobatics, advanced aerobatics finals, junior aerobatics, senior aerobatics, Class I and II Navy carrier, Mouse Race (Class I), FAI Team Race.

Saturday, July 22: Open combat finals, open precision aerobatics finals, rat race, 15 and sportsman Navy carrier.

Sunday, July 23: Slow rat race.

OUT OF RETIREMENT

Neil Simpson of Leicester, Massachusetts, tells a tale that's quite common on the C/L flying site in recent years:

"I am writing, asking for help. I was once an avid control line combat competitor. This was in the mid-60s when we flew VooDoos with silk covered wings, Johnson motors and Veco four-ounce tanks. Recently my son started building control line models and he has involved me to the point where my interest in the sport has been completely rekindled and I am now extremely enthused about flying combat competitively again.

"I am outdated in terms of personal knowledge. I have sent for an AMA membership and have been reading *Model Builder, Flying Models,* etc., in a quest for knowledge. Can you help me get up to speed in any of the following areas:

"1. Info regarding different combat designs being flown today.

"2. Membership info for the Miniature Aircraft Combat Association.

"3. Today's hot engines and where to buy same.

"4. The hot setup as far as wing covering material.

"5. Pen bladder tanks and other alternative fuel systems being used and where to get same.

"6. Groups, clubs, individuals, etc., particularly in the Northeast, involved with control line combat."

People like Neil are greeted with enthusiasm by the current crop of modelers—they're "newcomers" to the current scene but they have a good background in the hobby and can jump in and become active and competent in a short time. And they're likely to run across people they flew with years ago. One of the joys of competition is the network of friends that fliers make with people all across the nation.

Much has changed in combat since Neil dropped out, but the important things still are the same—the object still is to cut the string!

One thing that has happened since Neil's earlier era is that combat has fragmented into a half-dozen different categories. For purposes of answering some of Neil's questions, we'll assume that he plans to make his return to the same event that he flew in the '60s, which we now know as AMA combat, or "fast combat," or, in the rule book, just "combat." All the other events have their attributes, but for most serious fliers, fast combat is the one true calling.

For general information about combat, readers may want to refer to the "how to get started in combat" column in the March/April 1989 issue of *Model Builder.* Some of the following will review that

general combat primer.

Most of the competitive fast combat designs today are variations on the tapered foam wing design. Wingspans typically vary from 45 to 48 inches, with a root of about 10 or 11 inches and at tip of 7 or 8 inches, with a fairly long single tailboom and a big elevator with not much travel. These planes are very stable in level flight but very quick in the turns, excellent for eyes-off flying. Kits are available from such cottage manufacturers as Bear Model Products, Dox Generix and The Core House, and others that are listed periodically in the MACA Newsletter.

If you want to build from scratch, I suggest getting plans for the Undertaker from *Model Aviation*. It's a 1984 design by this writer and an excellent one for somebody returning to the activity after a layoff. It is excellent for eyes-off flying, upwind, etc., and is extremely easy to build (four to five hours each, for a slow builder like me). My own current plane is the Underdog, a Gene Pape design with basically the Undertaker construction but a faster airfoil. For the Undertaker, ask the AMA for plan No. 489, published in October, 1985. There are many other good designs, only a few of which have been published; a visit to a combat contest will give you a tremendous field to choose from. Most of the top fliers insist on flying their own designs because, considering that the combat flier must fly a plane at 120 mph in wild maneuvers, chasing a moving target, without looking at his own plane, choosing just the right design is a very personal matter.

To join the Miniature Aircraft Combat Association, send $15 dues to MACA in care of Mike Urban, 316 Spring Ave., Glen Ellyn, Illinois 60137. The newsletter is edited by Pete Plunkett.

The most common engine and the best buy is the Fox Combat Special Mk VI, available only from the factory, at $80 each. This is an ABC setup (aluminum piston in a chromed brass liner). If you can find older Combat Special Mk III or IV engines, you can use them competitively as well—they may be available from combat fliers in your area who have switched to the newer version. The Mk VI design is still gradually approaching its full potential, and does require some rework for best results. Retiming the crankshaft is one essential for fast combat. The Mk VI comes from the factory with a timing that's better for slow combat. The crankshaft's opening is relatively unimportant, but it should close between 58 and 65 degrees after top dead center.

Other engine choices include the Cipolla .36 (very light but of questionable availability), the K&B 5.8 (too heavy, but powerful, again of questionable availability), the TWA .36 (a homebuilt that's expensive and difficult to get) and the Hoffelt .36 (a destroked K&B 40 that's real fast but—gulp—$250 each. This information tends to make the Fox the choice of most fliers. The Combat Special is a labor of love made by Duke Fox especially for combat fliers; it is not sold in stores. Contact Fox Manufacturing Co., 5305 Towson Ave., Fort Smith, Arkansas 72901.

Most fliers nowadays cover their planes with FasCal, a product of a company called Fasson, which is available through paper supply wholesalers. It comes in 50-yard rolls, and they're cheaper if you buy two rolls (about $90 a roll where I get it). I usually try to find somebody to buy one roll and I use the other. It's a couple of years' supply. An alternative is to use the colorful plastic coatings such as MonoKote, EconoKote, Solar Film, etc., though they come in smaller quantities and tend to be more expensive.

FasCal, a mylar, has its own pressure-sensitive adhesive. You peel off the backing, position and smooth it on, then iron it or use a heat gun to shrink, tighten and seal. The other plastics don't stick until you heat them. Plastics take a little practice to learn, but they're much quicker once you get used to them than the old silk/dope method, though not as strong. You can't use dope on foam, by the way. FasCal can be used at either high or low heat; if you use a hobby shop plastic, use a high-heat type (MonoKote, for example) for balsa planes and a low-heat type (EconoKote, Quickcote, Solarfilm) for covering foam.

The almost universal fuel system in modern times is the bladder tank, though what is most commonly used is evolved from the "pen bladder" system. It employs heavy surgical tubing, such as the material that R/C glider high-starts are made of, which is available at hobby shops. About $20 will buy a lifetime supply (keep it in the dark—sunlight destroys the rubber used to make surgical tubing). To make a bladder, tie a knot in one end of the tubing and cut it off about four inches long. Insert a 1/2-inch length of brass tube into a piece of neoprene tubing, and insert that end of the tubing into the open end of the bladder. Wrap with copper wire, or, better yet, a tiny nylon electrical tie (available in auto parts shops). "Train" the bladder to blow up from the front toward the back. Pinch the bladder in the middle and use a syringe to inflate it with air several times; after that it will automatically blow up starting from that end. The bladder is inserted into a tube or some other fuel-proof opening in the outboard wing. Some new designs are using an external bladder, but I'm not convinced yet that this is the way to go.

Fill the bladder with fuel using a two-ounce plastic syringe, available at some drug stores. Use a hemostat or some other device to pinch the lead tubing off when the bladder is full.

Bladders take some getting used to, but they're the only way to fly. The procedure is to use a syringe to put fuel in the bladder, then pinch off. Attach the fuel line to the engine (I use a filter as a connection point). Set the needle so that fuel drips out of the venturi at a steady but not too fast pace when the plane's tipped on its nose. Give the engine a small exhaust prime. Release your hemostat and hold the pinch with your fingers. Apply the battery and flip the prop. When the engine starts, release the pinch and fuel will come through. If you don't have access to a pressure regulator

(rare but nice to have), make sure to set your engine rich before takeoff—it will lean out as it unloads in the air.

Anyone looking for combat contest information in their area, whether it is the Northeast or elsewhere, can find out about much of it by reading the MACA newsletter and the contest calendar in *Model Aviation* magazine. Anyone who would like to get in touch with Neil Simpson for some flying in the Massachusetts area can contact him at 87 Lake View Drive, Box 22, Leicester, Massachusetts 01524.

Bonus: You didn't ask, but remember that modern Schnuerle engines like to turn high rpm's. As a starting point for propping, get some 8-1/2x6-1/2 Top Flite pylon racing props (you'll probably have to special order them) and cut them to 8 inches. They'll let your motor wind but still have power through the turns.

A final mailbag item: Two of the photos this month come to us via Stuart Richmond, of Apopka, Florida, who is in touch with many C/L fliers around the world. The group shot of adult fliers is from a contest in East Berlin on Oct. 24, 1988. Second from right in the back row is Piotr Zawada of Poland, Stuart's correspondent and the contest winner. The group shot of the young fliers and their airplanes is a group Piotr teaches, seen at a contest in Warsaw on Oct. 9, 1988. These C/L airplanes of ours sure do get around!

Questions, comments, and photos always are welcomed. Send to John Thompson, 1520 Anthony Ave., Cottage Grove, Oregon 97424. •

Choppers . . . . . *Continued from page 21*

$400 heli radio will also do the job. Engine and muffler will run you another $200. With any R/C helicopter, I suggest you *always* buy an electronic yaw rate gyro. It costs between $70 and $150 but really makes a helicopter easy to fly.

Whichever helicopter you buy, make sure you also build a training skid to prevent the helicopter from tipping over and breaking the rotor blades. Expect to make at least 20 to 30 flights before you can hover your helicopter fairly well. Add another 30 to 40 flights before you start flying around in the sky. It takes work but it is well worth it. Soon you will be able to go to any empty lot, pop out your favorite helicopter, put it in a hover and fly circles around lamp posts. For more information, call the R/C helicopter manufacturers listed in Table 1, they have technical people on hand to answer your questions.

Once you finish building your helicopter, you will want to get started on the flight training. All beginners should seek the help of someone who already knows how to fly. Ask your local hobby shop for the names of local fliers or clubs. Why monkey around and risk hurting yourself! R/C helicopters can be dangerous if not treated properly. A 1/4-pound main rotor blade, spinning at 1500 rpm, has a blade tip speed of 200 mph and can easily chop you up. Learn the fundamental ideas first. Nothing makes a teacher happier than discovering his student has done his homework. While building my GMP Legend in January, I came across the "Learn To Fly" pamphlet enclosed in the Legend's instruction manual. I don't think I could have done better in explaining how to begin flying, therefore, with the manufacturer's permission, I have enclosed a portion of what GMP has to say about starting flying. This applies to any brand of helicopter you learn on, it does not have to be a Legend.

* * *

TRIMMING AND FLYING

Try and find a quiet spot, certainly away from pets and children, and a smooth surface such as concrete or asphalt. Have somebody with you when you are testing a helicopter in case there is an accident and you need immediate assistance.

Now, follow the engine manufacturer's instructions to set the idle and the top end carburetor adjustments of your engine. With a new, non-ringed engine, it is advisable to have at least half an hour of bench running. This will also help you to familiarize yourself with the carburetor settings of your engine.

Use a fuel with about 12% nitro in it and, if you wish to ensure a slow "break in," use some castor oil in your fuel. Start the engine with the main throttle lever at its lowest setting and with the transmitter idle trim at full. The engine should run at a "fast idle." The clutch will engage at around 1,500 rpm. It cannot be stressed too highly that when starting the engine, and until you are actually ready to hover the helicopter, the rotor head should be held firmly in one hand. If you watch any expert flying his machine, you'll see that he does this and it is simply to cover the possible cases of the engine being started at full throttle by accident, or your radio not being switched on, or somebody else's radio interfering with yours, or a link is missing from your helicopter, etc. Any one of a number of things could cause the engine to start at high speed and, if you are not holding the rotor head firmly, then the helicopter, at best, could start off violently and hurt you or anybody near. At the worst, it could take off, out of control, and unless

you were able to regain control quickly, you would lose your helicopter and possibly hazard other people's property or even life. So please observe the "Golden Rule" for all good helicopter fliers: *Hold the rotor head firmly with your hand all the while the helicopter is not actually in position for flying! And, as soon as the helicopter has landed and the blades have come to rest, hold the head again firmly before you do your shutting-down of the engine! And never air-taxi out from the pits or near people or property!*

So now on to the first phase of learning to fly.

There certainly are some fliers who are so well coordinated that they can hover a helicopter successfully after a very few attempts. These people fall in the same category, we believe, as those fixed wing fliers who can take off, fly around and land fixed-wing planes with little or no effort and in a very short time. This section of the Legend manual, however, is intended for the "average modeler" who eventually has a heck of a lot of fun flying model aircraft, but takes a little time (and effort) to achieve this result. So, unless you possess more than average coordination, or you have a lot of money and time, we offer the following method of simplifying the process and learning to fly with little or no damage to your machine and your ego.

Now, learning just one function at a time is really impractical unless a training rig to tether the helicopter is used. Learning the functions two at a time, however, is quite easy and many people have learned (with no damage to the helicopter) in this way.

So why not try the one hand (two function) at a time method?

One prerequisite to learning, in any event, is to have a well trimmed helicopter. Even an experienced flier, if the helicopter is not trimmed, can find it difficult to maintain a stable hover, and you will normally find that the experienced flier will land the machine again, several times, after very short experimental liftoffs, if necessary, to get the trim right. So, before you learn to hover, it is extremely important to seek the help of an expert or a reasonably accomplished flier, if one is available in your vicinity, to hover your helicopter for you and to make sure that it is properly and accurately trimmed. The helicopter blade angle setting in pitch (main and tail) must be correct. The "tracking" of the blades must be right, the helicopter drive elements and engine must be running smoothly and well, and the helicopter should have very little "shake" on the tail boom or the landing gear. If all of these things are not correct, then don't continue. Once the helicopter is in trim and running smoothly then, and only then, should you commence your learning to hover. If the drive elements are not operating properly, recheck all the clearances and settings. If the blades are "out of track" and you do not have any expert help available, then you should proceed as follows:

First we must stress that you should not, repeat not, track your main blades by holding your helicopter by the tail boom while lifting it into the air. This is an extremely dangerous practice and is strongly discouraged by GMP.

However, tracking the blades is certainly a difficult procedure for the beginner since it requires the actual hovering of the helicopter for a short period in order to be able to observe which blade is higher than the other. We will, however, describe this procedure for you and, even if you cannot observe the blades yourself, you should try to lift the helicopter to a hover just for a second or two while a friend or somebody else kneels down, at a safe distance of course, and observes the "tracking." If your Legend spins sharply in one direction or the other, please check that your gyro sense is correct. A reverse sense gyro can cause serious problems to the machine and those around you. So, if there is any doubt about this, stop your engine and check that the gyro causes the tail blades to move in a direction to oppose the "yawing" of your helicopter.

"Tracking" is a measure of the lift of each of the blades, which should be equal. If the lift of one blade is greater than the other, then the tracking is wrong and there will be vibration and loss of control. The tip of one blade must be marked with a piece of colored vinyl or MonoKote during the building phase and the idea behind this will become apparent now. If you look at the edge of the blades while they are running and the helicopter is just lifting off the ground, you will notice that if the blades are tracking you will see only one blade at the tip, but if they are not tracking you will be able to clearly see one blade higher

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PROFESSOR SPECIFICATIONS	
Length	35.04" (890mm)
Wingspan	48.82" (1240mm)
Area	446.5 sq. in
Weight (w/rec. system)	39 oz.
Motor	RS540SH w/3:1 reduction gearbox
Recommended system	Futaba 4NBL/MCR
REQUIRES: 7.2v/1200mAH NiCd battery pack and charger, 2-4 Channel radio control system (electronic speed control optional).	

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than the other. Because the blades are marked individually you should then be able to judge which of the blades is the higher. Now, to correct the tracking, you must change the pitch of one of the blades.

Before we do, however, we should also note one other factor and that is that the main blade speed of Legend should be around 1,700 rpm at liftoff with a throttle setting of around half. If the speed is higher than this, then in order to adjust the tracking, we should increase the blade pitch angle that is the lower of the two. If the Legend's blade speed is lower than 1,700 rpm, then we should lower the pitch of the blade which was higher. This means that by adjusting the pitch of one of the main blades we can make one blade run higher than the other, or by adjusting both together we can lower the rotor speed of the helicopter.

Because the Legend has collective pitch you may also change the rotor speed by increasing or decreasing the collective pitch setting after tracking the blades as described above.

Finally, please note that your high end throttle adjustment (needle valve) should be set so that the engine is on the verge of running rich (occasional four-cycling or "burbling") until the helicopter has lifted off. Even in the hover your engine should still "burble" occasionally.

If you find that you need much more tail blade pitch angle than has been suggested in the instructions and the helicopter's nose is always trying to turn to the left, then you are probably running with too much pitch on the main blades. If, however, you find the helicopter blades are running very fast and the nose always appears to be wanting to go to the right, then you are probably running with too little pitch on the main blades at liftoff. You will soon become accustomed to being able to adjust both the speed of the main rotor blades and the tracking of the blades by adjusting one of them.

Place the helicopter on a smooth and level surface and start the engine. Stand back and to one side, about six to ten feet away from the machine. The reason for this is that you will now have the best view of the fore-and-aft and side-to-side movements of the helicopter if you are looking at it from 45 degrees. For instance, if you stand directly behind the helicopter, then the fore-and-aft movements are harder to detect. The secret of accurate hovering is to make control inputs at the instant that the helicopter starts to move, and maximum anticipation is helped by the best and earliest visual information.

Now, take a deep breath and try to relax. Run up the engine with the throttle lever until the helicopter is light on its skids, so that it apparently weighs perhaps only a pound or less instead of its normal weight. Under these conditions it is then quite easy, by using the transmitter tail control lever, to move the nose of the helicopter to the right and to the left, back to the center again, to the left, to the right, back to the center again. All the while you are doing this you will make small adjustments in throttle in order to keep that one pound of weight constant.

Soon your reflexes will learn how to coordinate the sideways movements of your left hand with the movements of the helicopter rotating to the left and to the right with the up and down movement of the left hand to vary the "lift" of the helicopter. Do not make any right hand or cyclic movements when practicing this exercise.

It's hard to say how long you should keep up this practice, but certainly you should continue until you can do it without feeling strained during and after each session. When your left hand has been trained to keep the tail straight and the altitude constant, you can now commence to learn coordination of the helicopter's lateral movements with your movement of the right hand stick. So now the next step is to open the throttle so that the helicopter rises in a positive manner to a position between three and five feet off the ground. It's hard to believe this when you first begin to learn, but if a hovering helicopter is well trimmed and adjusted, there really is plenty of time to maintain, or to correct, the helicopter's movements sideways, backwards and forwards.

An analogy which reflects this argument and one that beginners seem to understand is that you can regard the helicopter as a large balloon floating a few feet off the ground. The balloon can wander around as a result of small gusts of wind from different directions. We can keep the balloon stationary in front of us by "patting" it at the right place and at the right time. If it moves away from us and we pat it towards us it may need another pat to stop it coming and position it where we want it. Except, of course, it will drift off again after a short while and we will have a continuous task of providing the right control inputs to keep the balloon stationary in front of us.

Once you have learned to fly the helicopter, then the "pulsing" will blend into smooth, but still very small control commands. However, at the early stages, remember to think of the helicopter as a balloon which, let's say, is drifting towards you. You "pulse" the stick towards it, you pat it back. As it starts to drift back, you'll need a small input in the opposite direction to pat it and stop its motion so that it settles in the spot that you want it. Don't forget that you can start a helicopter moving in one direction with the force produced by the right hand stick but you will probably, unless you have given exactly the right force at the right time, have to give an opposite force in order to slow it down and to settle it in the position required. Please remember that the foregoing applies only when the helicopter is well designed and, most importantly, well trimmed.

So, try these hovering techniques and

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see if it doesn't help to speed up and ease up the learning process. Make each "flight" only a few seconds and then land. Each successful "flight," however short, will place you higher up the learning curve. We have seen people learn by this method and be hovering confidently for five to ten seconds at a time in less than a single morning. So, don't give up—you can fly an R/C helicopter if you really want to. Good luck with your hovering sessions.

* * *

Well folks, see you next month. We will discuss R/C helicopter stability and control theory. There will also be pictures of some of the helicopters seen at the Toledo show. •

Elec. Corner . . *Continued from page 26*

the actual modulation to be used must be determined. In all cases that I know of, PCM encoded signals are being transmitted on FM. This is only because FM has other desirable features, and not for any technical reasons, as the PCM encoded signal could just as easily be transmitted on AM if desired.

So now we have a choice of pulse width encoded AM or FM, or PCM encoded FM. We can make this choice either at the time of purchase, or in some cases, by switching PPM-FM or PCM-FM at the transmitter. Let's examine the basic differences between them. In actual operation, there is very little that most of us will discern in flying one encoded/modulated method from another. However, the better pilots flying highly developed machines all claim they can tell the difference between the original first generation PCM systems and second generation equipment like the Futaba 1024 series. A better servo resolution (accuracy) is the reason. Other than that, there is one decided advantage of PCM equipment over AM or FM, and one which is important to understand and appreciate: it is the system's reaction to interference, which no matter what the claims, costs us more airplanes than do radio failures. And the picture will get worse before it gets better, so the facts that follow are important. In a non-PCM system, any interference will drive the servos; the airplane will maneuver violently. There comes the rub! If you experience interference for even a few seconds, you will lose orientation completely, and even if the interference disappears, you may not be able to recover and fly the airplane to safety.

Now, a PCM system does not respond to outside interference. That is, there is no servo movement and thus no airplane tumbling through the sky, getting completely away from you both visually and electronically. Luck comes into the picture, true, but if the lady smiles on you and the interference dies, your airplane won't because you will still be in step with it and can continue to control it as if nothing had happened. Which brings us to:

FAILSAFE

What is it, and what can it do for you? Well, first off, failsafe of any kind is available only on PCM systems. Not in an effort to make you spend more money for a more expensive system, but simply because PCM systems are the only ones in which a microprocessor is used. The microprocessor, an electronic brain of the type which make computers possible, can be programmed to sample, to remember, and to react, none of which can be done without it. In the case of the R/C receiver, the microprocessor is adjusted to react to the loss of a clean signal and to react in various ways.

Failsafe comes in a variety of modes, depending (like a lot of other system features) on the complexity of the system. The simplest failsafe though, the one I consider the most valuable, is *battery failsafe*. This all takes place in the receiver, which is able to determine when the airborne battery has reached a critical low. At such time, the failsafe pulls the throttle back to idle, the exact point being full low on some systems and adjustable on others. In any event, you get a warning, and in most systems, you can override it by cycling the throttle stick, which will give you a set amount of time of throttle control again, long enough to allow you to set up for a landing. In the battery failsafe mode, all other controls are fully operational.

Next we encounter failsafe as triggered by interference, or by the loss or drastic reduction of the transmitted signal. The simplest such failsafe will maintain the last control input, in some cases retarding the throttle as with battery failsafe. In other systems, all controls can be made to travel to a preset position and maintain it until the interference disappears and/or the signal returns. With some, one has the a choice of which failsafe to use. The one which might be most helpful is determined somewhat by the type of airplane you have and the type of flying you are doing. For example, a trainer type airplane might be saved if commanded into a slow turn at low throttle, which it might maintain until control is regained. In all cases, luck takes a big hand in the eventual results, but failsafe does increase the odds in your favor by a wide margin.

Now, for a part of all this invented not by the R/C equipment manufacturers, but by unknowing fliers, the same ones who blame all in-flight problems on the R/C systems. It is called "failsafe lockout," in which the system is claimed to have gone into this mythical condition all on its own. Those with this belief firmly entrenched are always looking for a way to completely inhibit or turn off the entire failsafe system. What is reported is the in-flight action of either of the failsafe functions described.

Well, if the system is going into failsafe, it is only doing what it is supposed to, and is doing so not because it hates you but because it is no longer receiving the proper transmitter signal, because of interference; because of spark ignition noise if such an engine is being used; because of signal

blockage by long servo leads or metal control cables—all of the above, and more. The failsafe cannot do this on its own, only when the conditions as sensed by the receiver warrant it. Turning off the failsafe is not a cure, as the next time the airplane experiences the cause of the problem it will be out of control—this time with all servos at extreme positions or moving wildly back and forth.

Failsafe systems vary somewhat from system to system and from manufacturer to manufacturer. I recommend that you study the instructions for yours until you understand it thoroughly—it might save your airplane sometime. I will admit that I had some reservations on the value of any of the available failsafe systems, until one of my friends saved a helicopter, which is easily the most unstable and unforgiving flying machine of all, with the failsafe in a Futaba 8-channel PCM.

* * *

An out-of control airplane is not an unheard-of thing, and nobody, but nobody, no matter how great a flier, how experienced, or what his position might be in the R/C world, is able to diagnose what happened or at what point. Yes, radios do fail, but so do pilots, airframes, and then there is also that old devil interference, a situation which seems to get worse with time. On that subject, not everyone will accept that interference comes not only from other R/Cers at the same field but can come from anywhere on the globe. And outer space now! Nor can one definitely place the blame on the radio just because it isn't working after the crash, as the shock of hitting the ground has got to have a detrimental affect on it.

Conversely, if the radio is working after the crash, we can't positively say it quit in the air. I will never accept that a piece of electronic equipment will die completely and be revived by hitting the ground at the speeds at which most R/C models fly.

Anyway, we all feel better if we know *why* something happened, at least with a view towards preventing the same thing from happening again. Though still not pinpointing the cause of an in-flight out-of-control situation, there might be a clue, a short-lived one but nonetheless valid, that will sometimes tell us the difference between a radio failure and interference or some of the other failure modes. The behavior of the model prior to its demise can be that clue; sometimes there will be definite difference. For example, an airplane that all of a sudden maintains the original flight path without any deviation until it hits the ground does indicate a dead radio. Not necessarily a radio *failure* now, as an improperly secured battery that pulls its connectors apart can cause a radio to go dead. But for whatever reason, such airplane reaction generally indicates a lifeless control system.

Now on the other hand, an out-of-control airplane that constantly changes direction can and often is being influenced by outside interference. An uncontrollable roll or down elevator can be a servo failure. It can also be a loose hinge or control device. We see entirely too many successful R/C flights to brand R/C systems in general as totally unreliable. Look closely at some of the system installations and the general condition of a lot of airplanes at any field, and being completely honest, evaluate the chances of many of them surviving to be senior citizens, and not to be done in by other than the R/C system.

* * *

The Kraft Midwest TxCheck has recently come my way and I'd like to share it with you. The TxCheck is a small hand-held RF monitor that generates an audible noise anytime it is in the presence of a strong radio signal. It can be an easy way to locate a transmitter that has been inadvertently left on in a service shop or in a transmitter impound.

The TxCheck covers 27 to 75 MHz; AM, FM or PCM, which includes all of the modeling bands and transmission modes. It is small and light and operates from a single 9-volt alkaline battery. Its sensitivity and volume can be varied by adjusting the length of the collapsible whip antenna. Note that this is not a highly sensitive band or channel monitor that can be used to test for incoming interference, but a limited range device intended to locate an operating transmitter in close proximity. It will help to locate a transmitter when one is known to be "on" in the area, and a single sweep with it over the impound area will certainly save someone's airplane from a forgetful or careless fellow flier.

The TxCheck is priced at $59.95, and is available only from Kraft Midwest, 117 E. Main St. - Upper Level, Northville, Michigan 48167. Incidentally, Kraft Midwest is in a completely different part of the country from the center previously mentioned, and might be more convenient to some of you. It is a total service center, in spite of the Kraft name, which is held over from the days of Mr. Phil and his gold boxes. Try 'em, you'll like 'em!

Eloy Marez, 311 Mesa Dr #10, Costa Mesa, California 92627. •

Soaring . . . . . *Continued from page 30*

One of the best rules I ever heard was: if the model rises in lift, find out how big the thermal is. This helps one determine where the core should be, i.e. halfway through the lift. Figure 5 shows how this idea works. Continue flying straight when lift is encountered. When the lift turns to sink, note how far you've come and turn around 180 degrees. Begin circling at the center.

Figure 6 shows how this is done if the thermal is entered off center. Again, see how wide the lift is. Toward the end of the area of lift you may notice the model has

veered slightly to the right. This is your tip-off that the main core is to the left. Make a 180-degree turn back to the left and start circling halfway across the area of lift.

In Figure 6 the dashed line shows a right turn mostly in sink. Turn more than 180 degrees to get back to the center.

Figure 7 shows the model just grazing the outer edge of the thermal. In this case the left wingtip would rise faster than the right, pushing the model into sink immediately. Make a quick turn to the left toward the tip that came up. See how wide the core is and center it.

Figure 8 shows how to recenter if part of your circle is in sink. Note the midpoint of the circle's arc which in sink. Ninety degrees later straighten out the model and reenter the core. Wait a few seconds and start circling the same direction as before.

Where To Find Thermals

From our earlier discussion, we know what kinds of things generate thermal lift. It follows that if you go where they hang out, you'll see them, right? Very true. However, thermals don't always cooperate when you want them to, so it's best to have a backup plan.

When I fly at a new field, or a field that I have very little stick time over, I sometimes ask the regulars where the most likely hot spots are. They know, and they are generally more than happy to share their knowledge with you.

If I want a challenge, I go out and look for thermals. I find there are a couple of ways to go about this. First, I look at the sky for thermaling aircraft or birds. They've already found the lift for you.

Second, I'll look for signs at ground level for nearby thermals. Shifts of wind direction or speed can sometimes be indicators of lift nearby. These are detected by feeling, or are visible as unusual wind in nearby trees and grass. Thermal columns are like big invisible vacuum cleaner hoses. They suck in air from all sides and take it up.

Here's what to look for. There is a brief lull in the wind just before a thermal passes directly over a spot, then there is a big increase in wind just as it passes. A thermal passing by will feel like a 90-degree shift of wind, as shown in Figure 9. Please note that these are observations made from a stationary viewpoint as the lift drifts by, not from the moving wind.

Third, if there are no indicators, I go where I think the likelihood of lift is high. I look for thermal generators, then send the sailplane over to check them out.

Fourth, if I haven't a clue, I'll fly a large, cross-field zigzag pattern upwind (see Figure 10), like a sailboat tacking upwind. I find that I see the plane rise in lift much better from the side. Also, in the zigzag pattern, I never cross the same dead air twice (a *big* no-no!).

Finding thermals takes practice. There is no substitute for a trained eye and an experienced thumb. Give yourself time to learn!

Landing The Model

Okay, so your neck is tired and you want to come down. What's next? Landing. Terra firma. The moment of truth! Will the glider re-kit itself? Will the landing be sloppy and embarrassing?

Like thermaling, there is a preferred method of approaching the landing target area. Most pilots feel comfortable with the classic rectangular pattern shown in Figure 11. This can be adjusted to suit the field conditions easily. If it's windy, the downwind leg is kept short. If the field is small, the pattern is reduced in size to suit.

If the breeze is gentle, start the pattern with about 30 seconds worth of sink time left in your glide. Judge this by present altitude and current sink rate. Fly down wind from yourself for ten seconds and turn to your base leg. If the wind is blowing hard you can cut this time down dramatically. Fly down the base leg for five to eight seconds, depending on the wind you encountered on your downwind leg, until you are almost directly down wind from the spot. The base leg can be adjusted for altitude and speed using spoilers or flaps to assure a precise final approach. Turn up wind, allowing enough time to get back to the spot. It will take longer to come up wind than it did to go down wind.

Shooting landings over and over is the only way to get good at judging the three legs of the landing pattern.

This completes today's armchair flying talk. I hope that you found something profitable in it. Sorry I bored you if you didn't. If you have any thoughts, tips, or observations in this area, please send them in! I'll be glad to air them so that we can all benefit!

* * *

RIP-STOP PARACHUTES

Time to replace that old rag that used to look like a parachute? Michael L. Schultz of Airmen's Supply Co., P.O. Box 1593, Norfolk, Nebraska 68701 has a nice one for you!

Airmen's Supply Co. is offering two sizes suitable for winch or hi-start. The large one is 15 inches across in the shape of a first-aid cross or Red Cross logo. Each arm of the cross is 5 inches wide for a total of 125 square inches of surface.

The color is a dark red. According to Schultz, these parachutes have proven themselves to be quite durable over the past seven flying seasons. The rip-stop nylon chute has eight lines of 50 pound test twisted nylon sewn onto the surface in zigzag stitch fashion. A one-inch chrome plated steel key ring slides over the glider's towhook, and a similar 1.25-inch ring attaches to the winch line.

Pricing of these chutes is quite reasonable. It is hardly worth the effort to make one yourself when you consider the price. The small chute is $7.50 plus $1.00 shipping and handling, the large one is $8.50 plus a buck.

Send for your parachute and when you do, ask for their catalog. Tell Michael that *Model Builder* sent you!

SAILPLANES INTERNATIONAL

From time to time new gliders come along, make headlines, gain acceptance, and even popularity. But it isn't very often that an entire line of sailplanes comes along

as is the case with Sailplanes International.

For the first time, a major U.S. importer is bringing into the states most of the sailplanes from this internationally known British company. That importer is Global Hobby Distributors and its mail order affiliate, Hobby Shack. The models range from small slope ships to competition models, scale models, and thermal ships. They may be purchased through your local hobby dealer.

Very quickly, I will give a brief description of each model.

The Secret Weapon is a state-of-the-art, sport aerobatic slope soarer. Its slim fuselage is of wooden construction. Its foam core wings are presheeted at the factory with obechi wood. The Secret Weapon is capable of flying in a wide range of wind strengths with or without ballast.

The design features a slim fuselage with large side area to aid in knife-edge performance. The Secret Weapon's wing transitions from a semi-symmetrical airfoil at the root to a fully symmetrical airfoil at the tip. This provides good soaring ability and excellent axial rolls.

The Secret Weapon's specifications are: 61-inch span, 44.5-inch length, 490 sq. in. area, all-up weight of 2 lb. 12 oz., and wing loading of 13 oz./sq. ft. Controls are ailerons, optional rudder, and elevator. It sells for about $79.99 at most outlets.

The Mini-Racer makes a great transitional model from basic trainers to the more aerobatic and responsive aileron models. The kit comes with a molded white gelcoated fiberglass fuselage, and factory presheeted obechi veneer foam core wings. The fuselage has plenty of room for any radio system you may own. It requires two or three functions: ailerons, elevator, and optional rudder.

The Mini-Racer is a small, low-drag design which produces sparkling performance on the slope. It can even be put away in your car without disassembly. Specifications for the Mini-Racer are: 60-in. span, 40-in. length, 424 sq. in. area, 10 oz./sq. ft. wing loading, and the all-up weight is 3 pounds. It sells for about $139.99.

The Ridge-Racer is, as the name implies, a slope racer. It's six-foot span makes it suitable for short to medium courses. It is a fast, low-drag design.

The Ridge-Racer is also very good at aerobatics. It has inversely tapered ailerons for crisp, instant roll response. This makes it an ideal multipurpose slope ship. Over six years of development and refinement have made this model near optimum for its type.

The Ridge-Racer comes with a white molded fiberglass fuselage, blue tinted canopy, foam wings presheeted with obechi veneer, and full hardware. Specifications are: 72-in. span, 650 sq. in. area, 42-in. length, 2 lb. 14 oz. average flying weight, and 10-12 oz./sq. ft. wing loading. The model can be ballasted for racing up to 7-11 lbs. It sells for about $169.99.

The Racer CS is a 2-meter slope ship that is unique among ARF gliders. It features foam core wings which are fiberglass reinforced, then obechi sheeted. The airfoil used is the Quabeck HQ 1.5/12 modified. This airfoil section lends itself very well to flaperons, and the Racer CS can be set up this way.

The Racer CS can be flown in a wide range of wind strengths. It is aerobatic and fast. Specifications are: 78.7-in. span, 670 sq. in. area, 49.5-in. length, flying weight of 58 oz., 12.5 oz./sq. ft. wing loading, and functions consisting of ailerons/flaperons, rudder, and elevator. It sells for about $169.99.

The Axle is a pivot wing slope racer or aerobatic sport plane. Its wing actually rotates to achieve roll control. There are no ailerons. The Axle is very efficient and "clean" as it cuts through the wind. Drag savings in the wing, fuselage and T-tail pay off with high speed. This same low drag property gives the Axle the ability to stay up even when the wind is only a slight breeze.

The Axle features a molded white fiberglass fuselage, presheeted obechi veneer foam core wings, precision cut balsa parts, and complete control linkages. Specs are: 76-in. span, 374 sq. in. area, 28-32 oz. flying weight, aspect ratio of 14.5 to 1, 10.8-12 oz./sq. ft. wing loading, and functions consisting of rudder, elevator, and wingerons. It sells for about $139.99.

The Osprey 100 is the model which will have the broadest appeal because it is very well suited for thermal flying as well as slope flying. It is also one of the most affordable in the line. In England, the Osprey

is a popular 100-inch Standard Class (100S) contest model. These rules allow for only rudder/elevator control, 100-inch maximum span, and 799 square inches maximum area.

The Osprey is a precision cut wood kit. It has a thin, modified Eppler 176 airfoil for excellent wind penetration. Because its wing loading is light, it can thermal quite well, or stay up in light slope lift.

The Osprey 100's specs are: 100-in. span, 799 sq. in. area, 51-in. length, 2 lb. 12 oz. flying weight, 8 oz./sq. ft. wing loading, 12.5:1 aspect ratio, and rudder/elevator and optional spoiler controls. It sells for about $74.99.

The Sitar Special 100 is a highly evolved slope FAI-F3F slope racer. It can be flown in any weather over any slope, or even as a thermal ship with exhilarating performance. It is designed for aileron, rudder, and elevator controls, but the instructions show how to fit ballast tubes or spoilers if these are required.

The Sitar Special 100's wing is a fiberglass reinforced, obechi sheeted foam core. It has the famous Eppler 193 as its root airfoil, then it transitions to a lower camber E180 at the tip. This gives increased soaring performance, improved L/D, and lower drag at high speeds. The Schuemann-inspired wingtip shape is used for efficiency at high and low speed as it cuts induced drag and minimizes adverse low speed stall behavior.

The Sitar Special features a white molded fiberglass fuselage, molded blue canopy, and complete hardware and control linkage. Specs are: 100-in. span, 700 sq. in. area, 50-in. length, 4 lb. flying weight, 13 oz./sq. ft. wing loading, and 14.8:1 aspect ratio. It sells for about $279.99.

The ASW-20 is a 1/5 scale replica of the 15-meter Racing Class full-size sailplane manufactured by Alexander Schleicher of West Germany. Its outstanding achievements and elegant form make this one of the best loved gliders of all time. Only a few very small changes have been made to the wing form to improve flight performance and handling characteristics as a model. The overall appearance of the model is unaffected.

This is a highly prefabricated model. It includes a molded white gelcoated fiberglass fuselage, fiberglass reinforced obechi veneered foam core wings with full-depth plywood spars, ailerons, provision for airbrakes, and control cables already installed. All wood parts are pre-cut and wing joiners and control linkages are provided.

There is plenty of room in the fuselage for retract and/or aerotow mechanisms, plus a full-length pilot. Specs are: 118-in. span, 54.3-in. length, 763 sq. in. area, 84 oz. flying weight, 15.75 oz./sq. ft. wing loading, and 18.3:1 aspect ratio. It sells for about $339.99.

Ask your local dealer to order you anything you like from the above selection. He can get these models from Global Hobby Distributors for you. If you wish to order directly from a mail order company, Hobby Shack carries the complete selection.

TIME TO GO!

I'm way over my space budget! I have to cut myself off at this point or risk the editor's Uber Skiver knife on my column! There's more for next month, but send in your photos and ideas too, we can all benefit from your ideas. Bill Forrey, 3610 Amberwood Ct., Lake Elsinore, California 92330, (714)245-1702 after 6:30 p.m. PDST. Thermals! •

Tigercat ..... *Continued from page 20*

can build the ailerons flat on the board, being careful to insure that their rib spacing matches that of the wing. Trim the spar ends as necessary and fit the wingtip bows, centering on the leading edge and the rear end of W-4. The leading edge will taper to match the tip bow and the bow will taper to fair into W-4. Now add the 3/32 gussets at the tips and at the inner end of the aileron wells. If you are building one panel at a time, now is the time to rock the assembly over and repeat what you just did on the first half. When both panels are framed up, remove the wing from the board and add the lower 3/32 sheet center section skin. This is an "in your lap" job, so be careful to maintain alignment. With the lower sheet in place, replace the wing on

the board, add the hard balsa filler at the trailing edge where the wing bolts will go through, build up and install the aileron horn assemblies from music wire and brass tube, add the wing attach dowels at the leading edge, then go ahead and close up the center section by adding the top 3/32 sheet. Don't forget the little 1/4-circle gussets at the outside corners; these will make your wing look much more finished after the covering is on.

Get out the sanding block and cut everything down to final shape. The leading edge will have to be brought down to the correct airfoil contour and blended into the tip bows, which in turn need to be sanded to a radius and faired into the W-4s. Make sure that the rear edges of the nose ribs are rounded off to prevent unnecessary bumps in the covering, and be compulsive about block sanding the entire outer wing surface to insure that all the outer edges of the various structural components are in line. A single rib protruding above its fellows will ruin the appearance of the entire wing.

Make the cutout in the center section for the aileron servo and install hardwood servo mounting blocks. Sand the ailerons to a final fit, test fit the aileron hinges, and check the entire aileron assembly for freedom of movement.

FUSELAGE

The fuselage construction is easily what we might call traditional. The two side frames, which include FD-1 and WS, are built up of hard balsa or spruce. Block sand the side frames true after assembly, then add the 1/16 ply doublers ahead of F-2, being certain to make both a left and a right side. The sides can now be joined over the top plan view, placing them on the plan upside down to allow them to rest securely on the board. Join first at F-2 and F-3, then draw the sides together at the tail, joining at the tail post and at the F-4 through F-7 locations with 1/4-inch sq. crossmembers only on the bottom. Now remove the assembly from the board and join the sides at F-1. Add formers F-2A through F-7, followed by the 1/4-inch sq. top stringers at both the nose and tail. Make and install the 1/8 ply tailwheel mounting plate, then LG-M and WM. Don't forget the triangular gusset blocks above WM.

Now comes the fun part. Cut the wing root fillet bases from 1/32 ply, taking care that the primary grain on these runs spanwise to allow easy bending around the wing saddle. Note that these bases extend to the inside edge of the WS pieces. Lightly glue the bases in place only at the very front end of the wing saddle, so that you will be free to make incidence adjustments at the trailing edge if necessary. Line up the wing as accurately as possible, measuring in from the tips to establish an accurate centerline, and make guide lines to align the wing with the inside edges of the WS pieces. Mark and drill the 1/4-inch holes in F-2 to accept the mounting dowels, then install the wing in the fuselage, pinning it in place temporarily. Trammel from the top center of F-7 to an appropriate point at each tip; insure that you have proper alignment and mark the wing accordingly. Now block the fuselage on the bench with the top longerons at 0 degrees incidence and use an incidence meter to establish the wing incidence at 2-1/2 degrees positive, measured using the chord line shown on the plan; this is where the "V" guides of a Robart or similar incidence meter will center themselves on the airfoil. Cut away or build up the WS saddles at the trailing edge as necessary, then align the plywood fillet bases and Hot Stuff the entire wing saddle assembly in position. Recheck incidence and alignment, then drill through the trailing edge into WM for the wing mounting bolts. I opened up the holes in WM to accept DuBro 10-32 threaded inserts and used 10-32 nylon bolts through the wing.

When you are satisfied with the wing installation, fix the airplane back in place over the top plan view and use a line drawn at right angles to the fuselage centerline to

establish a square mounting for the horizontal stabilizer. Measure the tip distance off the plan to insure lateral alignment and satisfy yourself that the stab rests securely on the top longeron; horizontal tail incidence relative to the longeron should be 0 degrees. When the stab is securely in place, follow it with the vertical tail, aligned square with no offsets. Trim the vertical tail leading edge laminate as necessary to allow it to fair smoothly into the top stringer. At this point it starts to look kind of exciting, doesn't it?

Line up your engine mount on F-1 and drill the necessary mounting holes. Install blind nuts on the back of F-1. No downthrust is used on this airplane, but you should make provision for one degree of right thrust. Mount the landing gear, setting blind nuts into WM for the mains and into the tailwheel mounting plate for the tailwheel assembly.

Remove the wing and set it out of the way while you finish closing up the fuselage. Install the 1/8 ply battery compartment floor. Add the turtledeck stringers, followed by the 1/4-inch sheet filler blocks at F-3A. Rough cut these on your jigsaw and make a couple of round sanding blocks from various size dowels to finish sand the inside curves. Add the 1/4x1/8 fabric attach strip along the top surface of the horizontal tail on each side of the vertical fin; these will be essential to complete the covering job. Add the side stringers, noting that these are relieved where the 3/32 nose sheet covering lies over them. Follow these with the 1/8 sheet balsa fillers under the horizontal tail. Add the belly stringer and fair it into the bottom of F-3 with scrap balsa. Sheet the top of the nose with 3/32 balsa. The top sheets extend to the lower edge of the upper longeron, and will have to be cut at the low point of the cockpit opening to allow you to align the rear edge flush with F-3A and wrap the forward portion around F-2B. Light wetting on the outside and a little patience should get these in place for you. Edge-join narrow sheets if necessary to get wide enough pieces of 3/32 sheet to cover the entire forward fuselage sides from the top longeron to the bottom of LG-M. Mark and cut the outlines of the wing saddle and the rounded cutout at F-2B, noting that you will have to add filler blocks of 1/4x1/8 balsa on the outside edges of F-2 and taper them into the upper and lower longerons to give the side sheet a secure base for attachment. The side sheets are installed flush with the top cowl sheet and with the bottom edge of the lower longeron and LG-M. Don't forget the tapered extension of the side sheet behind F-3 which allows you to blend the sheet area smoothly into the lower longeron. Finish closing the nose by adding the 3/32 sheet under the nose; install this cross-grain and terminate it where the front edge of the landing gear will rest on LG-M. Now trim the cockpit opening to final shape and go over the entire fuselage with your sanding block and blend all the edges, keeping in mind the lines the covering will follow. On my airplane the wing root fillets were added after the nose was fiberglassed, a detail I'll explain shortly.

Since those of you building this airplane are not beginners, I'm not going to hold your hands on the cowl and wheel pants. There are no plastic or fiberglass units available for this design, although if someone out there likes it well enough to want to make them available, I'd like to hear from you. The pants are built up of several laminations of light 3/8 balsa sheet with 1/4-inch sheet outer faces. Add copious amounts of carving, sanding and fiberglassing and the results will be beautiful wheel pants. I inset 4-40 fiberlock nuts in the inner edge of each pant, liberally reinforcing the entire area with Hot Stuff. The nuts are matched to a 1/16-inch aluminum plate slipped over the axle and held in place on the gear by the same nut that locks the axle in place. Check the photos for a good look at this.

The cowl is carved and hollowed. If you want to make a mold and do it in fiberglass, have at it! I mounted my engine, removed the exhaust and needle valve, wrapped the engine securely in masking tape and with the spinner mounted, built up the cowl around it. Starting with a block about one inch thick and opened up to fit over the front of the engine, I roughly built up enough wood around the engine and spinner to give me material to carve and sand. When everything was smoothly shaped and blended I removed the cowl

and cut the air intake, exhaust, and other openings and gave the outside surface a coat of 2-ounce fiberglass cloth attached with resin. When this had cured I opened up the inside of the cowl with a rotary file, several sanding blocks and a lot of patience, then added another coat of resin inside and out, followed as you might guess by a lot of sanding. The wheel pants got the same treatment, using 3/4-ounce cloth. While working with the resin, I covered the entire fuselage back to the stringer fillets behind F-3A, as well as the entire wing center section, with 3/4-ounce cloth. The trick to doing good, light fiberglass work is to control the amount of resin that stays on the airplane by using an appropriately light grade of cloth, and by removing any resin that lies above the cloth weave. A good alternative is the attachment of the fiberglass using Hot Stuff; this is quicker, lighter and just as strong. I used resin on this job to get a little more material buildup on which to sand out a really slick base finish.

If you want to try a different system on the cowl and pants, have at it! What I have described has worked well for me on a whole succession of airplanes, and at the expense of being a bit labor-intensive, produces beautiful, durable accessories that fit perfectly.

As I mentioned earlier, the wing root fairings were added after the entire nose was fiberglassed. In the case of my airplane this was done because I used Sig's Epoxolite to form the fillets, and the polyester resin used with the glass cloth won't cure in the presence of most epoxies. Different materials may allow you to avoid this problem, but the sequence didn't cause me any trouble. Having the area around the fillets glassed allowed me to work the Epoxolite into a nearly finished shape with copious amounts of water and the end of my finger. The cured material could subsequently be wet sanded to a final finish without having to worry about unprotected balsa getting wet.

Now is the time to do a temporary installation of your tank and route all fuel system plumbing. Do a preliminary installation of your radio system and make sure everything fits now, so you won't have to cut up a finished covering later to get it to work. I permanently installed two plywood rails at appropriate locations on the inside of the radio compartment, then screwed a plywood servo tray to them. My switch and charging plug are mounted on a bracket in the cockpit. Put the entire airplane together to insure that the spinner doesn't bind on the cowl, that the landing gear tracks properly, and to eliminate any other nasty little gremlins that will be tougher to fix later. When you have everything the way you want it, it's time to cover and finish.

There are so many methods available to model builders these days for covering and finishing airplanes, many of which work very well, that I won't attempt to specify a "best" method for this airplane. I will mention one important reservation: this wing structure was designed to be a little more flexible than some of the wings you may be familiar with. As there is no leading edge "D" tube to absorb vertical flexing loads, the wing becomes dependent on the covering for some of its strength. My prototype has been well tested with a covering of dacron polyester (Sig Koverall) applied with a heat-activated adhesive and tightened with two coats of nitrate clear dope before being primed and color finished. Any of the synthetic fabric coverings (Coverite, Worldtex, etc.) will work as well if given a coat or two of nitrate clear dope before final finishing; this will prevent the sagging long after application that sometimes affects these coverings. I specify nitrate dope because it bonds far better to dacron than does butyrate dope, and also

because all the enamel or epoxy type finishes I'm aware of bond better to it than to butyrate. I cannot guarantee that the airplane will have sufficient structural strength if you insist on using an iron-on plastic film covering. In spite of various manufacturer's claims, many years of experience have left me convinced that these materials add little or no structural strength to an airplane.

A final note to you real "old time" builders out there; clear doped, dyed silk would work very well on this airplane; in fact, I nearly went that route myself instead of doing the multicolored paint job you see in the photos. I'd like to see photos of a clear doped, silked Tigercat if you build one.

There is one aspect of the covering job that I must explain in detail. This airplane demands that you make what is referred to as a faired fabric fillet between the top rear of the fuselage (the turtledeck) and the vertical fin. This is nearly universal practice on fabric covered full-scale airplanes and adds tremendously to the appearance of models where it is used. Regardless of the covering you choose, the method of doing a faired fabric fillet is the same. Cover the fuselage bottom and sides separately. Cut two pieces of covering material large enough to cover each side of the top rear fuselage and vertical fin, with enough extra to give you something to hang on to and to allow for some adjustments. The pieces you will work with will be attached along the upper longeron and to the fabric attach strip that runs along the top of the horizontal stab center section (now you know why I put those there!), to the edge of F-3A and to the dorsal stringer, and to the leading and trailing edges of the vertical tail. Start by attaching the fabric to the upper longeron and the fabric attach strip, then to the trailing edge of the fin. Keep it stretched out pretty tight. Now start working around the fin leading edge and into the curve between the fin and the dorsal stringer. Take your time, think about what is going on, and be ready to *pull* and *stretch* the fabric. The heat-activated fabric adhesives work well here, as you don't have to wait for anything to dry. You may have to heat your fabric "in the air" as you pull it to get a smooth job over the center of the fin-dorsal junction. Finish up by completing attachment along the dorsal stringer and F-3A. Wrap a little extra covering around and over the edge of the leading edge and dorsal stringer to get a good bond. Don't shrink the covering until you have both sides covered! Small wrinkles will pull out, but you can't tolerate any deep puckers or creases along the edges. When you do the second side, you will have to pre-trim the overlapping edge to prevent your trim job from cutting through the lower layer of fabric and allowing everything to slip loose. When it's all in place, go at it with the heat and shrink it up tight. Beautiful, isn't it? The trick to this thing is to take your time. It really does work; look at the photos of my airplane for proof. The system works just fine with plastic, too. If you are using silk and dope, be aware that the first coat of dope used to seal the silk will probably loosen the dorsal-leading edge seam badly and spoil the job. The fix is to make a series of closely spaced pinholes along the seam and lock it down with a shot of Hot Stuff before that first coat of dope goes on. Heat-activated adhesives won't give you this problem.

For final setup and preflight of the airplane you might want to use my specifications as a guide. The balance location shown on the plan gives me sharp maneuvers and a clean spin entry, yet allows some "drawing" of the airplane for a slow final approach. The control throws shown are sufficient for very fast angular accelerations. If you have a dual-rate equipped radio you might want to make the first flights on low rate; otherwise it might be a good idea to make the first few flights with the throws set at about half of what is shown.

My engine, as I have mentioned, is one of my well-loved Saito .65s. I run it, as I do all my four-strokes, on 10% nitro Red Max four-stroke fuel which I order mixed on a castor oil base. This engine flies the airplane with vast power to spare on a Rev-Up 13x6 wood prop. The airplane will doubtless go faster than the way I have it set up; if you want to experiment, you might start with a 12x8. The one degree right thrust I have specified appears quite sufficient to handle any tendency to yaw in flight when power is added, but as with any high-powered

taildragger, you'd better be ready to add lots of right rudder on takeoff.

The radio is one of my Airtronics Championship 7 FM systems, with which I have had nothing but good experiences. You don't need big servos in this airplane, but I would caution against using "minis" to save a few ounces unless they are designed to stand a workout; although this isn't a heavy airplane, it is going to move along pretty fast and will impose considerable control loads.

A thought on engines: my airplane has a three-color-plus "show finish" and weighs in at well over six pounds. A serious attempt at building a light Tigercat should yield a five-pound machine, perhaps lighter. The new Saito .5O, which I have flown, would be more than enough power if your airplane comes in at the lower end of the weight range. There are several other four-strokes in the same size range that should, of course, work well.

Take your time setting this airplane up, don't turn her loose until you are sure everything is ready to go, stay sharp while you have her in the air, and you will be rewarded with a satisfying, esthetically different airplane that will attract attention wherever you fly. •

Legend . . . . . *Continued from page 23*

OK, now let's check out the awesome Legend and the Quantum radio. First things first: how much do they cost? The prices for the helicopter and radio vary at different shops. If you put down five one hundred dollar bills, you should be able to get the new Legend helicopter kit. Add another six one hundred dollar bills and you will be taking the Airtronics radio home. Are they worth it? Yes! Your wife will see you beaming from ear to ear. Also, all Airtronics helicopter radios come with five servos. Five 94735 servos at $69.95 each are worth $350. So, paying five or six hundred for a top-of-the-line Airtronics system is not bad. (I remember back in 1974, when my first Kraft five-channel radio with only four servos cost $300. It had no bells and whistles at all. The sticks were nowhere near the smoothness of today's open gimbal sticks. The servos had less torque. And that was 1974 dollars, when gasoline cost a third as much as today. Back in 1974 you could buy a new car for under $2000.)

The 94735 is Airtronics ultimate heli servo. Not only is it powerful, it is very dependable. I have used the Airtronics 735 with my older Module 7H radio and Futaba radio. They still work flawlessly even after a few crashes. The 735 servos sometimes make a humming noise during idle. That's normal; the servos are just trying to maintain a given position. I hear that noise on my JR 4001 coreless motor servos, too. The biggest reason I am impressed with my 735 servo is its dependability. A year ago, while I was changing the wires on a gyro, I shorted some wires and suddenly smoke came out of one of the 735 servos. I thought, oh &$%, there goes $60. After the smoke cleared, that little servo still worked! I was impressed. To give you another example, some of my flying is done in the winter. While I am working, the helicopter is usually left in the car trunk. When I take the helicopter out in the afternoon for a flight the machine feels ice cold, but those five little servos come to life as soon as I turn on the switch. No sluggishness whatsoever.

Now throw in an extra bill, and you will have the brand new Airtronics SC-1 gyro, too. I hope you have an unused .60 engine sitting at home; otherwise, chip in another two bills for a Schnuerle .60 with pipe or muffler. One of the best .60 heli engine buys on the market is the Super Tigre .60H helicopter engine. It is the most inexpensive Schnuerle .60 helicopter engine on the market. The beauty is that it comes with a muffler! I am presently flying my GMP Stork with a Super Tigre .60H. The Super Tigre .60H does not pull my Stork as fast as the O.S. .61 RF ABC with pump, but for the big difference in price, the S.T. .60H puts out more horsepower per dollar. The S.T. .60H also has a growling high-pitched sound as you come up to full throttle. A friend described the sound as powerful and intimidating. The drawback of installing the S.T. .60H on the Legend is that you will have to spend 20 extra minutes grinding down the prop backplate washer and drilling out the flywheel slightly so the flywheel and cooling fan assembly will all fit together.

Before I make any comment on the Legend's flying qualities, let's go over some of the outstanding design features that led me to build it:

1. It is extremely light. With a 1200 mAh receiver battery pack, the gross weight is less than nine pounds. (Most .60 machines are around nine to ten pounds.)

2. It has triple ball bearings in the tail rotor blade holders: two radial bearings and one thrust bearing. This provides absolutely minimal slop in tail feathering action. I don't think there is any other helicopter kit under $1000 having this feature.

3. The Delta-3 flybarless main rotor head also has triple ball bearings: two radial bearing and one thrust bearing. The main rotor yoke is machined from a solid piece of aluminum. GMP says the two surfaces where the thrust bearings are attached have been carefully checked to ensure that both blades are feathering on the same axis.

4. The Legend is the only helicopter kit on the market with a thrust bearing to support the 10mm main rotor shaft. In aerobatics, model helicopters may experience up to four or five G's. The thrust bearing relieves the loads on the main rotor shaft radial bearing.

5. The autorotation bearing employs three roller bearings instead of a single bearing as on less expensive machines.

6. Excellent steel clutch. It is the legendary design used on GMP Cobras and Competitors.

7. Many interchangeable parts with the

Cobra and Competitor.

8. The sturdy .080-inch thick aluminum side frames are pre-drilled and designed for either a belt driven or shaft driven tail rotor. The kit comes with belt drive, but the Cobra/Competitor gear drive unit will fit, too.

9. The toothed belt tail rotor drive system is very light and efficient.

10. The tail rotor is a pusher design. It is located on the right side of the helicopter, which is aerodynamically more efficient and provides better heading control.

11. I prefer the sliding tail rotor pitch control (also used by Heim, X-Cell, Kalt Omega, and Concept) over the classical sliding wire method.

12. Like the Schluter Champion, the Legend kit comes with a special tool to hold the flywheel/fan assembly as you torque down the engine prop nut.

13. Hirobo/GMP is well known for excellent machined parts in all of its helicopter kits. The slopless inline swashplate is an example.

14. A simple main rotor blade pitch gauge is included in the kit.

15. All the control arms and bellcranks are fitted with ball bearings for ultra-smooth operation.

16. Simple slide-off canopy like the one used on the Shuttle.

17. Cone start feature on the engine.

18. Rear facing engine cylinder for easy access to the glow plug.

19. The horizontal and vertical fins are made from Magnalite composite material to reduce weight.

20. Special metal straps to support the tail rotor control guide tube.

21. There are probably some other design features I haven't discovered.

Putting the Legend together was a simple job because I have built quite a few GMP Cobras and Competitors. Their layouts are similar. The instruction set is good. It comes in four volumes: Basic Assembly Manual, Control Setup Manual, Rotor Blade Manual, and How to Fly Manual. There is no excuse not to build the kit properly.

The Legend has heavy duty .080-inch thick aluminum side frames. My GMP Special Edition Stork also has the .080-inch thick side frames. Even after many crashes, my Stork still has the original side frames. When the Cobra first came out in 1984 it had .062-inch thick side frames, which usually bent in a crash, which meant pulling the engine out and tediously straightening the engine starting shaft until the dial indicator showed a shaft runout of less than .003-inch. For the last two years all the Cobra kits have come with the thicker .080-inch side frames. The Legend side frames may actually be even better than the Cobra side frames because the Legend uses 5052-H32 aluminum for these instead of the Cobra's 6061-T4 aluminum. 5052-H32 is the more ductile of the two, thus you are less likely to get stress cracks near the landing gear area.

The Legend is extremely robust. I have tumbled mine on the ground a few times with no harm done. The octagonal-shaped tail boom seems to be tougher than the round tail boom on the Cobra or the Competitor. I give the Legend an A for structural integrity. The only weak link is the landing gear retention strap. The four steel straps that hold the landing skids to the landing struts only use one bolt on each strap, which allows the skids to rotate after a few bounces. The Legend instructions tell you to drill and install a screw through the strap and the skid to prevent the skid from turning, which is satisfactory. Since the Legend only weighs 8.5 pounds, the landing struts and skids have survived very well. However, I would prefer the double-bolt retention strap as used on the GMP Competitor.

The pictures and the instructions show the Legend struts raked forward. Recently, I started raking mine backward. I think that looks even better. Furthermore, raking the struts backward makes the helicopter sit more solidly on the ground because the vehicle's CG will now sit in between the two landing gear straps.

How does the helicopter look? Quite pretty. Especially on a nose-high flare in an autorotation. All the parts on the Legend are anodized metallic grey—quite an interesting color change from the familiar black color as used on the Competitor and Stork. It's nice to see a manufacturer try something to deviate from the norm. So far I have seen quite a few other Legends, but most of them have color schemes similar to mine. Well, mine is a copy of the scheme on the box cover. You will see other Legends painted just like mine.

Unlike a full-fuselage model helicopter, a pod-and-boom chopper doesn't take much time to get it flying. I only put in about 20 hours, which translates to one week of evening work. Some will be able to build it in one weekend. Finishing the main rotor blades took over an hour because I made sure that the lead weights were well epoxied in the slot. Nothing would be scarier than seeing a two-ounce lead weight shooting out at a bystander with the rotor turning at 1700 rpm. I was told that many years ago, one flier was hit by a lead weight and it put a hole in his lower leg. Before epoxying the weight in, I take a flat screwdriver and scribe about 40 cross-cut grooves all around the soft lead. This helps the epoxy to grip the lead weight. You should use slow cure 30-minute epoxy (not 5-minute epoxy) so the epoxy has time to settle around the lead weight.

If you would like to speed up your construction time, try the new GMP helicopter tool kit. I started using one last month and I love it. With a retail price of $49.95, it is a collection of German-crafted chrome vanadium metal Allen drivers, nut drivers, and screwdrivers. There is also a needle-nose plier, a ball link plier, Locktite, and a pitch gauge. All of these fit in a compact black leather case.

As usual, 40% of my time was spent installing the radio and adjusting the control linkages. I spend a lot of time on control setup so I can be confident that a new ship will be ready to rock and roll from the first flight. On the first flight the tracking looked perfect, with no vibration. If there is vibration, try lowering the collective pitch setting and/or lean out the engine slightly, that should alleviate the vibration. Nowadays the quality of any brand of model rotor blades is very good, and each blade in a pair usually is never more than one gram away from the other blade. If you are fortunate enough to buy a set of the expensive but high quality fiberglass blades made by Sitar, Vario, Peka or Miniature Aircraft, then you have no balancing act to juggle. With a new set of wood blades, I usually just epoxy in the weight, put on the covering material, then lay out the two blades end to end and put a 4mm bolt through both blades and tighten them with a 4mm locknut. Then I use my thumb and index finger to hold the bolt and let the

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two blades teeter, adding trim tape until the blades teeter level. Most of the time my helicopter will not vibrate. If upon flight test, there is vibration, then arbitrarily add a two-inch square piece of trim tape to one of the blades. If the vibration gets worse, peel it off and stick it to the other blade. Bingo.

Now, let's talk about flight performance and the Quantum radio. On the first flight, with a few clicks on the trims here and there, the Legend was in a stable hover. To check the trim, I usually take both hands off the sticks. Well-trimmed and well-designed helicopters should maintain a hands-off hover for three to four seconds. The Airtronics SG-1 gyro was functioning superbly. It guided the Legend on a set heading and held it there. The SG-1 gyro has an in-flight selectable sensitivity feature. I set my high end sensitivity at 40%. The low end setting on the gyro was at 25%. For hover I usually switch the gyro to high sensitivity; for forward flight and aerobatics I switch it to low. Next, I rocked the cyclic stick fore-and-aft and side-to-side to check the control sensitivity. The Legend was very responsive. I was using the exponential feature on the radio so the control feel was excellent at hover; no sign of overcontrol. If you have this exponential feature on your radio, then you should try it. Exponential control may improve your precision hovering.

Next, I checked the ATS tail rotor mixing. Increasing the collective from middle stick to 3/4, the Legend climbed rapidly and the nose yawed to the left a little. No sweat. Cranked up the ATS on the Quantum two clicks. Now the ship climbed straight up. One elegant touch on all Airtronics helicopter radios is that they all come with a miniature plastic screwdriver that can clip onto the transmitter carrying handle. This facilitates flight testing because on most high-tech programmable heli radios you need a small screwdriver to adjust the trim pots on the transmitter to fine tune the helicopter.

A top heli radio like the Quantum can truly enhance a helicopter and make the pilot look really great. The smooth sticks add finesse in flying. The Quantum transmitter's stick tension can be adjusted by opening the back of the transmitter cover. The high and low end collective pitch trim is conveniently located on either side of the transmitter. For the discriminating flier, the radio has four separate pitch curves: one for auto, two for the two high-idles, and one for normal flying. Each pitch curve has its own high and low pitch adjustment trim pots. Most heli radios come with only one high-idle. Top radios like the JR PCM 10 and Futaba 1024 have two high-idles; idle-up 1 may be used for general flying to maintain a healthy rotor rpm at low collective stick, while idle-up 2 is switched on for aerobatics such as loops and rolls, where negative collective pitch is fed in at the upside down portion of the maneuvers, or to fly upside down without hitting the invert switch. Since the Quantum is designed for F3C level contest fliers where there is no requirement for inverted flight, the Quantum does not have an invert switch.

The transmitter has two rev mix switches. Turning them on allows the pilot to disengage the tail rotor mixing as the idle-up switch is flipped for aerobatics. This is necessary for roll because you don't want the tail to yaw left as you feed in negative pitch. There is also a rudder preset switch which will kick the tail rotor into a preset position when you hit the throttle hold switch for practicing autorotation. This feature might be useless on most helicopters because the tail rotor stops turning during autos, but rudder preset is useful for many specialized contest machines where pilots use a "driven tail rotor" system, in which the tail rotor is still engaged in an auto to achieve heading control. (Full-sized helicopters all have driven tail rotors.) The rudder preset trim is used to dial in sufficient tail rotor pitch to null out the torque due to friction in the bearings and tail rotor drive system. Like I said, the Quantum is a top-of-the-line heli radio with awesome servos designed to do the job. The rudder preset may also be engaged to kick in a preset amount of tail rotor when idle-up 2 is switched on. The rationale is that you can trim the tail rotor for hover; when you are ready to fly forward, switching on idle-up 2 which will give you not only the forward flight pitch curve and forward flight engine curve, but also a forward flight tail rotor trim. Thus, you do not have to hold left tail rotor as you normally would. Isn't that nice?

Throttle, elevator, aileron, and rudder channels all have travel volume adjust (TRV). This feature facilitates setting up the control sensitivity of any helicopter. Yes, I know there is no elevator, ailerons, or rudder on a helicopter. They only exist on airplanes, but all the radio instruction

manuals use these terms—probably because they are easier to say than fore/aft longitudinal cyclic, lateral cyclic, and tail rotor yaw control. The throttle travel adjust is especially useful to ensure that the carburetor opens exactly 100% at full stick, and shuts tight at low stick and full low throttle trim. The rudder, elevator, and aileron channel each has dual rate and exponential control. The pilot has three choices when he hits the dual rate switches on the outside of the transmitter:

1. Traditional dual rate (linear high rate and linear low rate).
2. Selection of linear stick control or exponential stick control.
3. Fancy exponential dual rate (exponential high rate and exponential low rate). I chose the third option because exponential control gives a very soft control feel when the sticks are near neutral. This helps prevent P.I.O., or pilot induced oscillation, which is due to the pilot overcorrecting the helicopter.

Like all Airtronics helicopter radios, the PCM 8H comes with a removable plug-in transmitter battery pack. On a normal flying session I always put in at least six flights. The receiver battery pack can be quick-charged very well at the field, but the transmitter battery is 9.6 volts, and the 12-volt car battery usually cannot charge it at high enough current. Therefore, I bring an extra fully charged transmitter battery along.

The Quantum radio has a memory hold feature that allows you to set the hovering throttle stick position by simply pushing a button at the back of the transmitter. Since this is done electronically, there is actually a small Ni-Cd battery hidden inside the transmitter to remember the setting even when you disconnect the 9.6-volt main battery pack. Fancy! The hovering memory is useful because it defines where your throttle stick is when you are hovering. This way the tail rotor "up" mixing adjusts tail rotor mixing for throttle stick above the hovering setting, and "down" mixing for below the hovering setting. On most other heli radios, the hovering point is set by turning a knob. The advantage of the Airtronics hovering memory button is that you don't need to look at the transmitter when you are concentrating on hover. Just popping into a hover and simply touching the memory button will set the hovering point.

Of course, the Quantum is the only radio with the synchronized elevator feature which can significantly alter a helicopter's flight dynamics. This interesting topic deserves a column by itself, so stay tuned for a future "Chopper Chatter" column. Besides the essential features that help fine tune the helicopter, the Quantum has an LCD timer and an LCD RF power display. The LCD timer can be activated and stopped by touching a button conveniently located at the back of the transmitter case. Other convenient features include a flashing LED to warn you if the throttle hold is on, or idle-up is on. The count-up/ countdown timer features a very useful audio beep at every one-minute interval, and beeps every second during the final ten seconds. Like all PCM radios, the Quantum PCM 8H has a failsafe mode which automatically sets the servos into a pre-programmed setting, or you can choose to let the servos maintain their last positions when there is a loss of signal. So far I have not had the need to use this feature. Or maybe the radio has already kicked in the failsafe mode a few times, and saved my helicopter without letting me know.

What's more important than features? Reliability! I have flown Airtronics heli radios for the past two years, and none of them have failed, even after some very nasty crashes. The radios have been through very hot summers and freezing winters and they still function flawlessly. The Airtronics receiver is of the dual conversion, narrow band design which has excellent noise rejection ratio, and complies fully with AMA's 1991 requirement. The dual conversion receiver design has a much better noise rejection capability than the balanced mixer type receiver as used by less expensive radios. This is an important consideration when you buy a helicopter radio. In fact, every new radio in Airtronics' line meets the 1991 20 khz narrow bandwidth requirement. So, get ready for 1991 and get your own Quantum. Yes, I know the extra couple hundred dollars is not a small amount, but the value is there.

OK, ready for the big time? Let's hit full collective and see what the Legend is made of. Full collective response is out of sight! In the March/April issue I explained that acceleration is dependent on the vehicle weight. At 8.5 pounds gross weight, this must be the lightest of any .60 size R/C helicopter. Hit full throttle and this baby takes off like a rocket. Maybe I ought to measure its vertical 0 to 60 time. Do you need all that power and speed? Well, I am glad there is no traffic law that says model helicopters must fly under 55 mph. So why not enjoy life to the fullest?

How is the aerobatic capability? My flybarless Legend does very nice three-second axial rolls. Loops and stall turns are effortless. Venturous pilots might want to try the full "Kelvin" snap roll: hit full right aileron, full up elevator, full left rudder and zero collective pitch and pray that you have checked all your ball links. My friend Kelvin claims it under his name because he says he is the first one to try it. I do this maneuver frequently on my Cobra, but once I pushed it beyond its flying envelope. A link must have popped because I saw the blade pitch go to 90 degrees after a three-and-a-half snap roll and a high-G, full elevator, full collective pull-out. The blades stopped in the air and the Cobra tumbled to the ground from 100 feet. The only damage was a chewed-up main gear. The frames and landing gear were straightened and ready to fly in an hour. Amazingly, the Yale blades did not even break. Those Yale blades can survive almost anything. They are so hard they once chopped my friend's helicopter tail boom clean off in a tail boom strike. Just make sure they don't hit you. The moral of this story is to check all your controls before flight. I must have had a loose link or bind somewhere because the throws were maxed out and set up for inverted flight, too. The Kelvin snap roll is a very violent but spectacular maneuver.

Any intermediate flier would not have a problem performing aerobatics with the Delta-3 flybarless head. What is the Delta-3 flybarless head, and how does it handle, compared to a flybared helicopter? Delta-3 is a technique derived from full-size helicopter rotor design. The main rotor head pitch link is simply displaced slightly from the rotor teetering or flapping axis, thus when the blades flap up due to disturbance the blade pitch will change automatically to help stabilize the blade. Proper Delta-3 angle can improve a helicopter's stability slightly.

For years, there existed a myth that flybarless helicopters are unflyable. I guess this myth has been broken. The smoothness and stability of the Legend have surprised me. I think it would impress other finicky pilots, too. Even novice pilots would have no problems handling the flybarless Legend. At one point I handed the transmitter over to one of my novice students. He hovered it solid as a rock. I asked him how does it feel? He says it's just like hovering his Champion.

To better judge the Legend, let's study the physics of the flybar. Most modelers are used to seeing a stabilizer bar atop R/C helicopters. The stabilizer bar is nowadays only used on model helicopters. The full-size Bell Jet Ranger, Bell 222 and Robinson R-22 do not have them. The stabilizer bar is used on model helicopters to help stabilize

them. The principle is that it can teeter *freely* atop the rotor head so it acts like an inertial reference for the main rotor system. If a gust suddenly tilts the fuselage and the main rotor disk, the stabilizer bar will *not* tilt with them because it can teeter freely. It's like a toy top; it will stay upright and level by itself. By linking the main rotor blade pitch arms to the stabilizer bar, the bar can act as a mechanical feedback system to provide inputs to the blades to help stabilize the main rotor disk and thus the entire vehicle. By removing the stabilizer bar, you are removing a nice assistance. So why remove the stabilizer bar? One major reason is for scale effect. You don't see a flybar on the real Jet Ranger, so why should a model helicopter have one? I think scale contest judges should award extra points for realistic looking main rotor heads, such as a flybarless head. The other reason you might want to try a flybarless Legend is that it's unique and different from all the other helicopter kits on the market. It provides a different control feel. Not necessarily more difficult, just different. I have seen novices flying around with flybarless Legends. My friend, who is a novice flier, flew mine and loved every minute. Through careful engineering, such as proper rotor stiffness, blade weight, blade weight distribution, airfoil shape, vehicle inertia, etc., flybarless helicopters can be engineered to fly very well. My Legend loops and rolls with ease. There are no nasty traits that will keep you on your toes. The only noticeable difference between the flybarless Legend and the flybared Prohead Legend is that when you chop the throttle suddenly, or during a quick stop maneuver, the nose tends to pitch up slightly more. But do not be alarmed, it is very mild and you will become accustomed to it very rapidly. If a novice can enjoy the flybarless Legend after one flight, then think how much fun the intermediates and experts will have. This nose-up phenomenon is due to angle-of-attack instability and speed stability which all helicopters possess. The trait is less noticeable on a flybared helicopter because the stabilizer bar masks it slightly. The physics of this will have to be dealt with in my "Chopper Chatter" column.

To check out the Legend's full potential, I paid a visit to Robert Gorham while I was in California to see him fly. Boy, can he fly! His normal routine is to start the engine, pop the machine into a hover, then peel out vertically, flip it over on its back and do a split-S, followed by lots of high-G maneuvers. I wouldn't want to be sitting inside that model. Of course, as shown in the photo, inverted flight on the flybarless Legend is a breeze for him. I would suggest you follow the Legend instructions and build it accordingly and you will be rewarded with a fine flying machine. The key to the Legend's nice flying qualities is the rotor blades, so you ought to stick with the stock Legend blades for a while before you adventure into more exotic blades. The side benefit of the 165 gram weighted blades is there is plenty of stored inertia for autorotation. You can practically hover the model for a couple of seconds after the flare. I think this is a bit unfair to my friend who practices autos on his Junior with 110-gram blades. He has almost no reserve energy at the bottom of an auto, so if he miscalculates his timing for the flare, then he has bought the farm. In contrast, I can auto in my Legend, hover for a second and nudge it over to the targeted landing spot. I have seen X-Cells with heavily weighted blades do beautiful autos, too. Just make sure you epoxy the weights in securely.

The other reason that a flybarless helicopter might be preferred over a flybared helicopter is that flybarless helicopters are more agile. This has to do with the stability of the system. For example, the Grumman X-29 forward swept wing experimental jet fighter is designed purposely to be inherently unstable. This is called "relaxed static stability." An inherently unstable vehicle is much more maneuverable than a stable vehicle, however, it is difficult to control. It might not even be controllable. For example, try to balance a pencil vertically in your palm. I bet you can't do it. It is such an unstable system that you just can't react fast enough to do it. But you can balance a tall broomstick in your palm even though it is also an unstable system. The reason is that balancing the pencil requires a quicker "reaction time." This is the reason why R/C helicopters are more difficult to fly than real helicopters. But, at the same time, R/C helicopters are much more maneuverable. You don't see a full-size Jet Ranger doing a 540° stall turn. By making the Grumman X-29 fighter aircraft inherently unstable, aircraft engineers have made the vehicle very maneuverable. However, the pilot can't cope with that, so a fly-by-wire computer controlled autopilot system is necessary to make the X-29 flyable. The result is an agile fighter, yet it can be tailored by the computer to make it as easy to fly as the pilot desires, even hands-off for some time. Now, think of the flybarless Legend as the X-29. It is very agile due to the removal of the stabilizer bar, but through careful engineering in the rotor system, rotor blades, and the vehicle itself, it has been tailored to be very stable. Well, I guess the best proof is for you to build one and try it yourself. I think you will be pleasantly surprised about how nice a flybarless machine can fly. Then your buddy will want to borrow yours.

The flybarless Legend retails for $599,

the flybared Legend for $625. Both helicopters come with precision bearings on all the moving parts. I have flown both versions. The flybarless version is extremely stable due to the special rotor blades. It definitely has a slightly different trait than the flybared version, but you will grow accustomed to it quickly. Anyone who can hover a helicopter can handle the flybarless head confidently. For beginners, I suggest you purchase the flybared version. You can remove the flybar at a later stage.

Any questions? Airtronics will be glad to answer your radio questions regarding the products I have mentioned. Call them at (714)830-8767. Have a question on building or flying your Legend? You can get free technical help from GMP at (818)992-0195. Of course, you can always call me at (301) 589-0855 or (301)454-8601 on any helicopter related question. •

Workbench . . *Continued from page 11*

use as a paintable surface on balsa and other solid surfaces." It sure looks and feels like tissue; smooth and shiny on one side, duller on the other side. It has a definite grain pattern and will tear easily, like tissue, with the grain. But trying to tear *across* the tissue will raise your eyebrows. It will eventually tear if you pull hard enough, but prior to that, it stretches and distorts, but refuses to let go! Out of the package it is not as light as good quality Japanese tissue . . . but the real tissue is not doped either. By the time you've put on enough dope to waterproof and fuelproof the tissue, the weights are going to be more equal. Solarfilm states that in the translucent tissue colors; yellow, orange, red, and blue, the material weighs slightly less than an ounce per square yard. In scale colors; antique cream, WW I dark green, black, and silver, it weighs an ounce per square yard. The sheets come approximately 20 inches wide by 36 inches long, with the grain going the long way. The lightness and toughness of this material will make it attractive to free flight, control line, and R/C modelers. Our impression, when first seeing and handling LiteSpan, was similar to the reaction we had when first seeing and using Super MonoKote . . . a revolutionary model building product. Solarfilm has an agreement with a California company that will soon announce availability of LiteSpan in the United States.

SWAMP GHOST

That's the name of the only B-17 left in the world in its original combat configuration. The Papua New Guinea government has just officially given permission to bring the "Swamp Ghost" home to Travis Air Force Base. Obviously, it's not all as simple as that, and there are many requirements and obligations to be fulfilled before the project is complete. The Travis AFB Historical Society, P.O. Box 1565, Travis AFB, California 94535, is the focal point of this whole effort, and the Project Manager is Bob Gonzales, 2700 Waltrip Lane, Concord, California 94518, phone (415) 798-5100. Phone number of the Historical Society is (707)424-5598. To find out more about this project, and how you may become involved, contact any of the above. For scale buffs, there are picture sets and a VCR tape available.

WHAT IS FREE FLIGHT?

Old Timer modeler Mike Guarnieri (Remember the MG?) stopped by our booth at the WRAMS show to make a tongue-in-cheek comment about my not understanding free flight (see my January '89 column). He went on to give me a definition of the term "Free Flight," and stated that he was sure I was an expert according to this definition. "Free Flight" is going to the local R/C flying field *without* your radio, field box, and model. You then check the sky for the model that interests you the most, sidle up to the pilot and comment on what a nice looking airplane he's flying, then ask him how it handles. Nine times out of ten, he'll proudly offer you the transmitter to find out for yourself. In order to avoid risks and to make it more likely that you'll get future offers of a "free flight," don't shoot touch-and-goes or landings, and try to return the transmitter to the owner before the engine runs out of fuel and you may be forced to land dead-stick. With the proper diplomacy and careful observance of the rules, you may get in more flights than you would if you brought your own airplane, you get a variety of flying experiences, and best of all, you avoid all the messy cleanup and packing of the R/C gear in your transport. Man . . . that's *REAL* Free Flight!" •

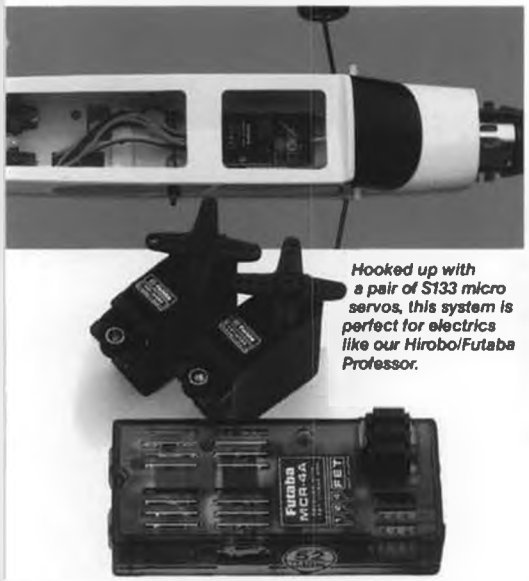
FOUR BY FOUR.

THE ATTACK 4NBL

Our newest 4 channel system has something for everyone. In fact, the Attack 4NBL is such a versatile performer we've customized it for all kinds of radio control fun.

ATTACK ELECTRIC

The 4NBL/MCR system is destined to become a favorite with electric flyers. This Attack system comes complete with our new MCR-4A integrated receiver/speed control. This remarkable device incorporated a four channel receiver and a MOSFET speed control into one very compact, very light and very efficient package. It also incorporates BEC to eliminate the need for, and extra weight of, a receiver battery.



Hooked up with a pair of S133 micro servos, this system is perfect for electrics like our Hirobo/Futaba Professor.

The MCR-4A four channel receiver/MOSFET speed control weighs just 1.5 oz. and can easily handle 280 to 540 size electric motors. 1.24" x 2.92" x 0.63".

SILENT ATTACK

There's a 4NBL system for sailplane flyers, too. With the Attack glider package you get a pair of S133 servos, R114H four channel receiver and a 250mAh NiCd pack. Again, when size and weight of the airborne package is critical, Attack is the answer.

Transmitter/T4NBL				
RECEIVER	SERVOS	BATTERY	FREQUENCY	TYPE
MCR-4A	S133(2)	BEC	72MHz	Electrics
R114H	S133(2)	NR-4K	72MHz	Sailplanes
R114H	S148(3)	Dry Case	72MHz	Aircraft
R114H	S148(3)	Dry Case	75MHz	Truck/Boat

ARF ATTACK

Looking for the perfect system for ARF and conventional sport aircraft? Once again, it's Attack to the rescue with a high value package including R114H receiver and three S148 servos.

4X4 ATTACK

There's even a surface Attack 4NBL system on 75MHz. Supplied with three S148 servos and R114H receiver, this ground and sea outfit has what it takes for gearbox-equipped 4x4's and RC boats.

The ergonomically designed T4NBL transmitter features comfort contoured case and adjustable length control sticks.

No matter which 4NBL system you choose, you'll also get our new four channel Attack transmitter.

Loaded with extras like adjustable stick gimbals, servo reverse switches and a rechargeable NiCd pack, the T4NBL transmitter also features a comfort contoured case and neck-strap for fatigue free operation.

Futaba

Futaba Corporation of America
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Hop up your Grasshopper II, soup up your Super Sabre, get the max from your Midnight Pumpkin and boost your Blackfoot with genuine MRC-Tamiya parts.

MRC-Tamiya R/C off-road buggies are where the action is. They're exciting. They're fun.

And a big part of the fun is the available parts you can buy to coax the maximum out of your machine. There are parts for souping up the speed. Parts for modifying the looks and the performance. Parts for changing the handling from one track to another. And on the rare occasion when your buggy needs maintenance, you can do it yourself. You built it, all you need is the right part, and MRC-Tamiya makes them all available through your hobby dealer.

And because these parts are genuine Tamiya parts, you won't be taking chances. These are made by the company that created R/C off-road technology, so you'll know they're quality parts and will fit your MRC-Tamiya buggy precisely.

Here's just a sample of genuine MRC-Tamiya parts. Space age titanium screws in a variety of types and lengths, for lightweight, long lasting connections. Silicone damper oil in 3-grades — soft, medium and hard, so you can adjust the damping action of your shocks to track conditions. For the Avante and Vanquish there's a carbon graphite chassis, the ultimate in strength and weight reduction.

Ball bearings for smoother running

Ball bearings are a must for increasing the performance of your buggy by reducing friction. Ball bearings on the front axle boost cornering ability. And ball bearings on the rear allow more motor power to the drive wheels. So MRC-Tamiya offers a number of ball bearing sets that are specifically designed to make your buggy run faster, smoother, and longer.

Tires with true grip

Tires with superior tread design will enhance the cornering ability of your buggy. And on the rear, they'll help transmit more power to the track without loss of traction, giving you better acceleration.

Tamiya has engineered 20 different sets of off-road tires.

Motors for every need and speed

Perhaps the most important part of your buggy is its motor. So MRC-Tamiya offers 7 different motors from the 380 type which provides up to 30 minutes on one charge, to the competition Dynatech 01R which provides more power than just about anything else in its class.

Change bodies, add shocks, improve performance

And there's so much more you can do too. Like change the looks of your buggy by selecting from a number of body styles. Each complete with all the parts needed for assembly onto your car. Or depending on your model, you may want to add shocks for improved handling. And depending on the model you own, you could opt to replace the original equipment ball joints with rugged, low friction rod ball ends. They'll provide for less play in the steering and speed control linkages, and require less maintenance, too.

The real pros have even found that a little Tamiya Switch Lubricant can help their Tamiya buggy perform better. It coats the electrical contacts providing maximum power throughout and longer speed control life. And Tamiya's special Ceramic Grease offers tough protection for gears, shafts, axles and joints, by reducing friction, and wear, thereby allowing more power to the wheels.

The list goes on and on, from pinion gear sets that will give you more low end or high end torque, to complete chassis sets for maintenance...they're all produced with the same perfection that has made MRC-Tamiya the leader in R/C off-road.

So don't miss the added pleasure the right part can bring. Ask your hobby dealer for genuine MRC-Tamiya performance parts. Make them part of your hobby...and accept no substitutes.

MRC™ TAMIYA®

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