

4-40

Dr. D. B. Mathews

PLEASE DO NOT glance at this construction article and just mentally write it off as just another lightweight sport trainer! The 4-40 is comfortable with sustained inverted flight, consecutive outside loops, vertical eights, and all the

more usual aerobatics. Its looks are deceiving!

Our design objective was to develop a model to best utilize the potentials in four-cycle power plants. These remarkable engines produce outstanding pulling power

er rather than high speeds. For that reason we felt that a relatively low wing loading and generous moments would produce outstanding flight qualities. Fortunately, we were right on target. Models of this design have been a pure delight.

Those who have witnessed the 4-40 in flight are nearly universal in their reaction: the sound is that of an underpowered model, yet it is incredibly agile. Our favorite quote was made at a Fun Fly by someone who drove up during a flight. He said, "How can he be doing that in low throttle?"

The four-cycle engine seemingly shifts gears to maintain a steady rpm through any aerobatic maneuver. The 4-40 doesn't go screaming around the sky; it just

The clean and functional lines of this model, plus its light weight and flying qualities make for a concept that is frequently sought, seldom achieved.



Have you gotten your feet wet yet with a plane powered by a four-stroke engine? Proponents have a lot of good things to say about them, not the least of which is the more pleasing sound of the engine. This plane is designed for a .40 four-stroke and four-channel controls. It's a docile flier yet amazingly aerobatic.

sort of chugs away in a delightful manner.

We are struck by the similarity of the 4-40 and Marion Cole's clipped-wing T-Craft. For those who have never seen Cole's air show act, he flies the entire schedule in a very small "box," always at slow speeds and with tremendous skill in using the plane's wing rather than its en-

gine. His is an aerial ballet as compared with those who fly the Pitts, etc., which is more like NBA basketball.

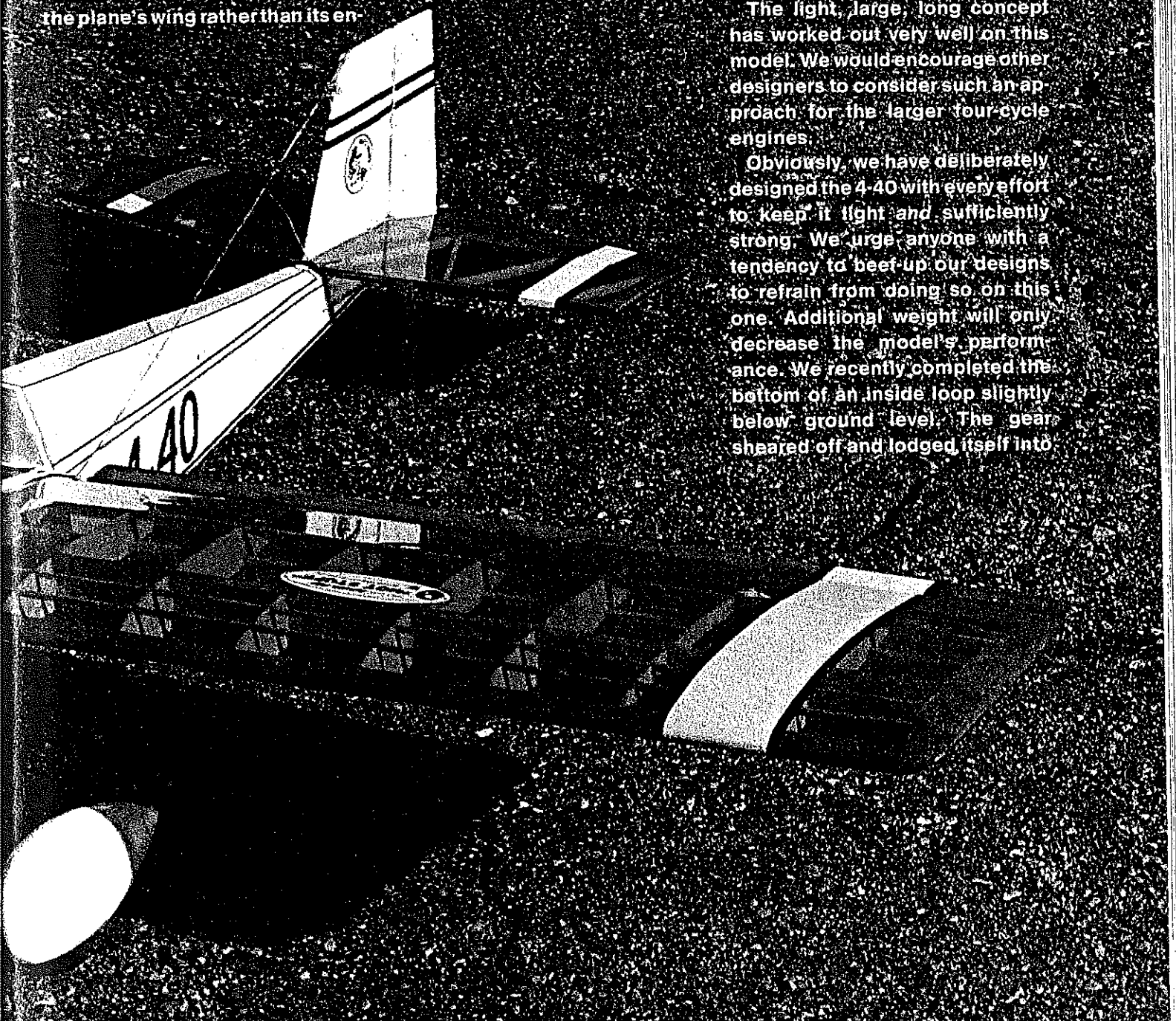
Those who enjoy large, slow, beautifully symmetrical aerobatics will find the 4-40 concept to their liking. Perhaps we should have named the model Ballerina,

as that comparison is certainly present.

We have also flown a 4-40 with a Schnuerle .25. With that engine, so much was lost in "style" that we quickly removed it. With a two-cycle engine, the 4-40 is just ordinary. With a four-cycle .40, it is extraordinary.

The light, large, long concept has worked out very well on this model. We would encourage other designers to consider such an approach for the larger four-cycle engines.

Obviously, we have deliberately designed the 4-40 with every effort to keep it light and sufficiently strong. We urge anyone with a tendency to beef up our designs to refrain from doing so on this one. Additional weight will only decrease the model's performance. We recently completed the bottom of an inside loop slightly below ground level. The gear sheared off and lodged itself into





Sixteen-year-old Sandy Skelton shows off the 4-40 with a 115-year-old cavalry provision wagon in the background. Scene is the old Fort Larned in Kansas. All photos by the author.

one side of the stabilizer. New bolts and a repaired stab were the only repairs we had to make. As designed, the 4-40 is sufficiently strong.

Construction. Read the text and study the plans until everything is clear. Then, and

only then, cut out a "kit" of parts by transferring the shapes from the drawings to the wood with the aid of carbon paper. All holes should be drilled as the parts are shaped.

This model is very easy to construct and to keep in alignment. Use a good, *flat*

building surface, and follow sound principles of craftsmanship to assure good flight performance.

All wood sizes are standard, such as found in hobby shops. Lite Ply is also known as poplar ply or door skins. Some large building supply stores sell it, but it is also a Sig product available at many hobby shops.

The landing gear and wheel pants can be ordered direct from Sig Mfg. Co., as they are replacement parts for Sig kits. The Hayes AL-40 engine mount is a perfect fit for the O.S. .40FS; if using a Saito or Enya four-stroke, some other engine mount may be needed.

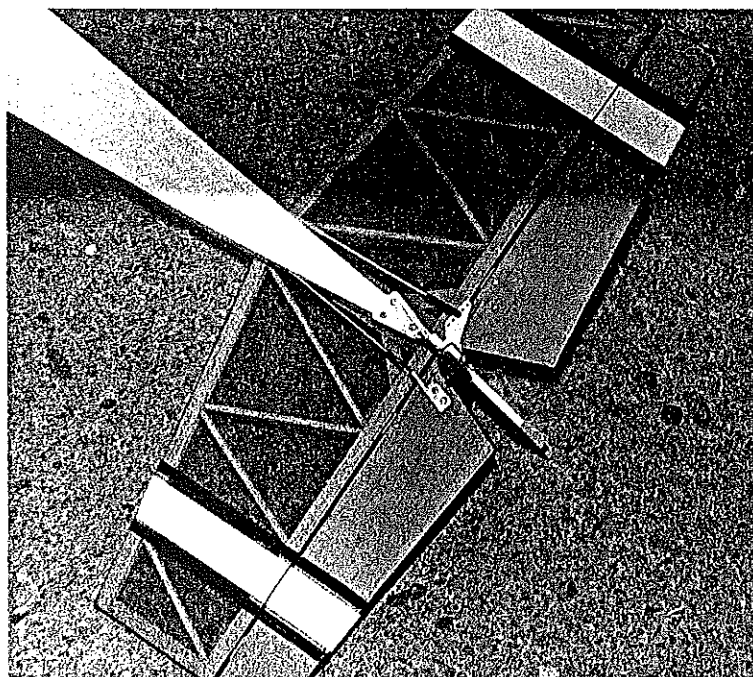
Our prototypes were constructed almost entirely with thick cyanoacrylate (CyA) glue, with the exception of the firewall and wing joints. The 4-40 is designed for using MonoKote covering on the wings for the rigidity it provides.

Fuselage. Develop a right side by tracing over carbon paper onto Lite Ply. Mark the bulkhead and other locations at this time. Once cut out, it is used as a pattern for the left side.

The nose blocks, ½-in. triangular stock, and wing saddle all serve as locators for the bulkheads. They should be adhered to the sides with thick CyA (or 5-min. epoxy), making sure the bulkheads fit well.

The basic box can be assembled over the top view of the plans, with the fuselage top surface flat on the drawing. Make certain that the sides are parallel and at right angles to the building board. Slip the bulkheads into place, and align everything before flowing the CyA glue into the joints. Once this section is planked and set, the tail post is pulled together and the cross braces added.

Remove the assembly from the work surface, and add the turtledeck formers and

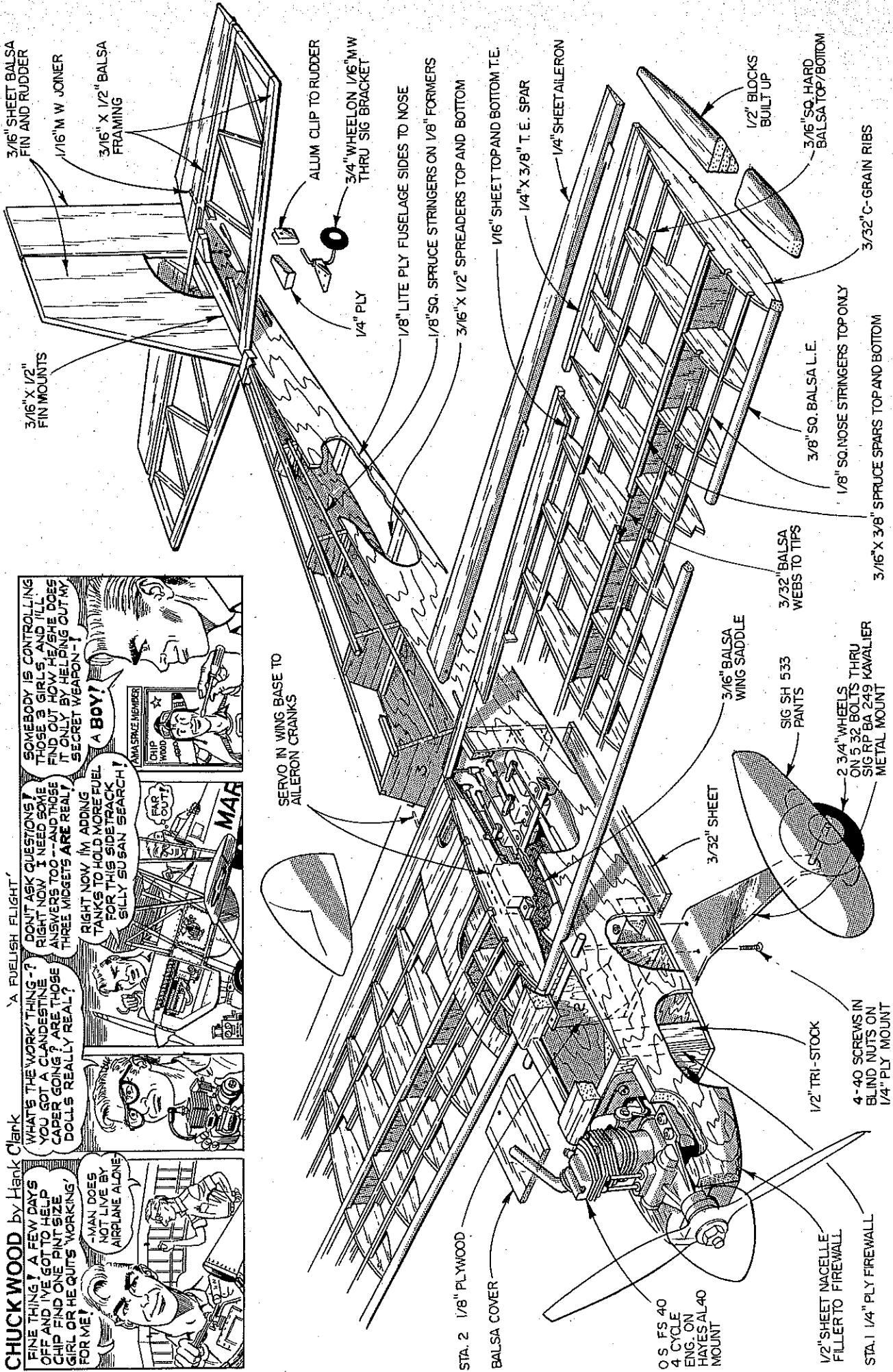


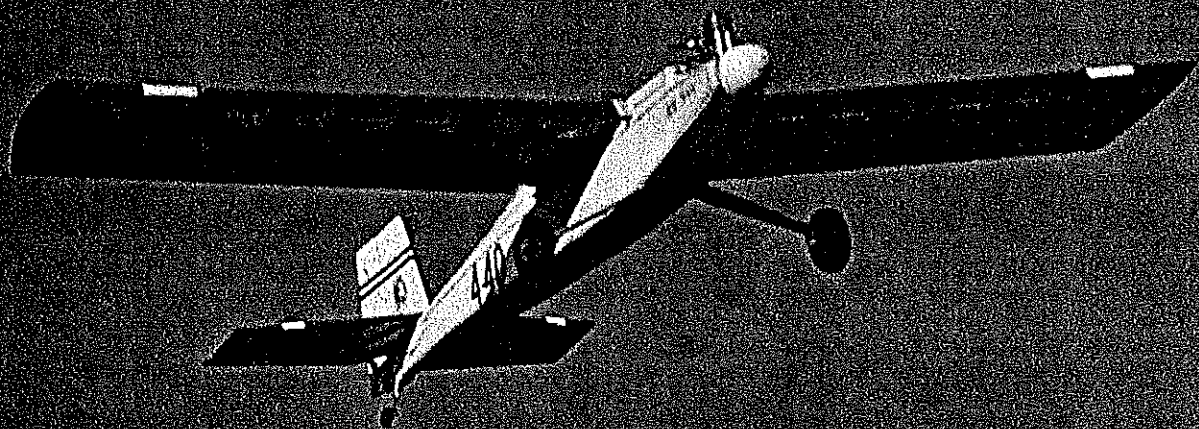
Left: Simple hookups are a virtue of this model. Note use of toothpick sections to lock in the hinges. Right: This is Don Kazmier and his second RC model, a 4-40 built from preliminary plans. He now has over 150 flights on it and has mastered a number of aerobatic maneuvers.



CHUCK WOOD by Hank Clank

'A FUELLISH FLIGHT'





Flying so slow and quiet, late-arrivers to the flying field have been heard to wonder out loud, "How can he be doing outside loops in low throttle?" Depending upon control throw settings and balance, the ship's gentle enough for a beginner yet aerobatic for the experienced.

stringers. Note that the top spruce stringers are inset into the balsa formers, but the side units are not; they terminate against a section of 3/16-in. scrap balsa and are sanded to fair in.

A removable top hatch is easily constructed by tack-gluing the block to the top, then cutting it with a razor saw. A section of 1/2 ply is CyA-glued to the bottom of the rear stub and drilled for 4-40 blind nuts. The front ply stub is CyA-glued to the removable part; it slides under the front attached section for a hold-down.

The aluminum main gear unit is supplied with the mounting holes pre-drilled; use these holes as a guide to locate the gear on the bottom of the 1/4 ply mount. The gear could be held with #4 sheet metal screws, but 4-40 bolts and blind nuts are better. The wheels should be mounted with 5/32-in. bolts and nuts. Use wheel collars to position them to clear the pants. The Sig or Fiberglass Master wheel pants are held on with 4-40 bolts and blind nuts set into a scrap of ply epoxied inside the pants.

The steerable tail wheel is screwed into a section of 1/4 ply inset in the tail. A wire tiller is moved with a small strip of tin bolted to the rudder. We prefer this approach to burying the wire in the rudder, since much less damage is done if it is twisted.

Complete the fuselage by contour-sanding the nose and hatch. Smooth everything with 380-grit paper in preparation for covering and painting (but don't cover the fuselage until the radio gear is installed).

Tail surfaces. Select firm but light balsa for these. The stabilizer builds directly over the plans, and the other units are cut from sheet. The fin fits into an alignment slot in the stab.

I prefer the pinned type of hinges for free movement. A hinge slotting tool is very useful. After the model is covered and painted, the control surfaces should then be hinged; CyA-glue small segments of toothpicks into the surfaces, through the hinges, to lock them in.

Wing. The ribs are cut in stacks using master plywood patterns. Carefully cut the spar notches, as they must be a reasonably tight fit with the spar for the thick CyA glue to work properly.

The wing panels are mirror images of one another. The right wing panel can be built on the back of the left wing drawing after first moistening that area of the plan with Wesson or other cooking oil to obtain a degree of transparency.

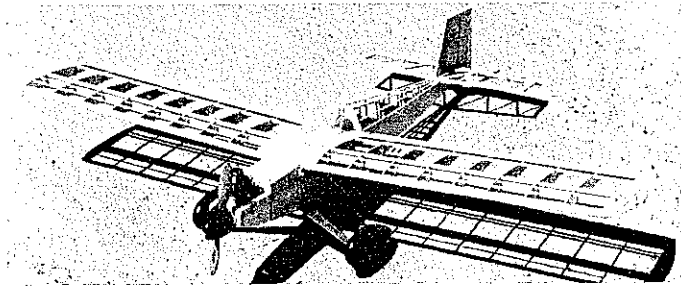
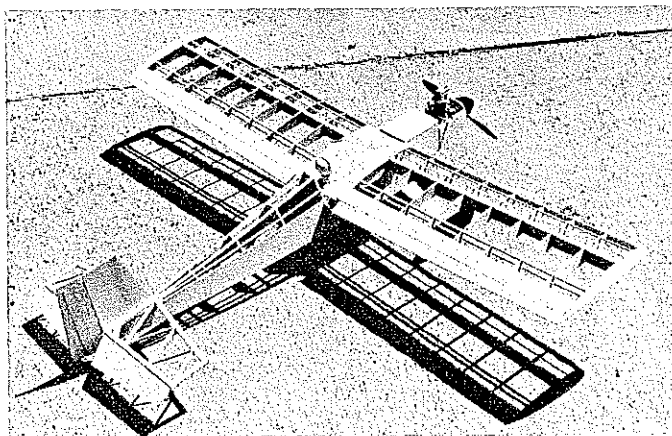
Construction is from the bottom up. Pin the sheet trailing edge down flat, position the bottom spar, use pre-cut shear webs to position the ribs, then CyA-glue the joints. Add the top trailing edge sheet and spars, followed by the leading edge and trailing edge.

Remove the panel from the plans, and add the center section sheeting. Repeat for the opposite panel, making sure the center ribs have been angled with the jig.

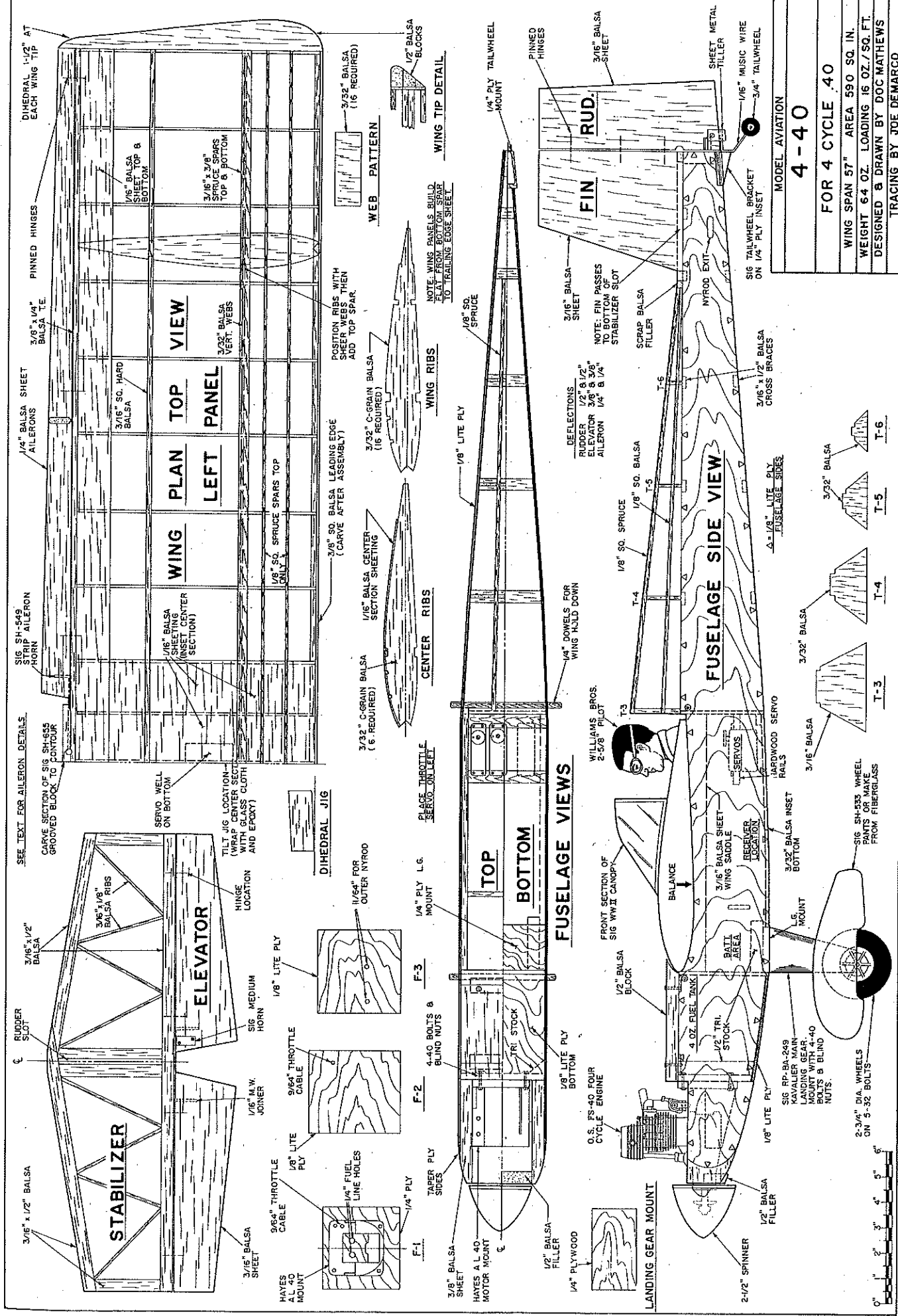
Block up each tip 1 1/2 in., and sand in the bevel. With one panel flat on the board, block up the other a full 3 in., and epoxy the center sections together. The wing being flat from the front bottom spar to the trailing edge greatly simplifies building and jiggling.

Cut a well in the center section for the aileron servo, and line it with scrap balsa. A small section of 3/16 or 1/4-in. basswood makes an ideal screw retainer. Wrap the center section, top and bottom, with fiberglass cloth and 5-min. epoxy. This provides plenty of strength without needing ply dihedral braces.

Cut the ailerons from C-grain balsa sheet. Trial-fit the hinges and horns, then remove. The horns are fitted into segments of Sig 1/8-in. grooved landing gear blocks. Use thick CyA to adhere the brass bearing to the slots; be sure a clearance groove has



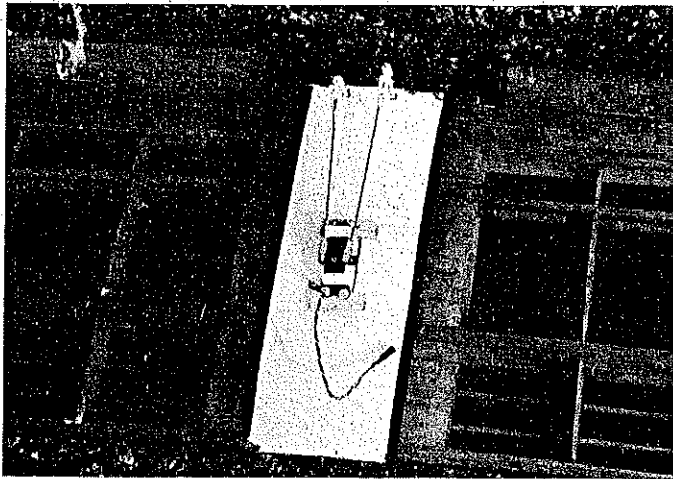
With the best of RC Sailplane and Old-Timer construction techniques, the airframe is well-stressed yet lightweight. Lite Ply sides, a few bulkheads, simple tail surfaces, and multi-spar wing turn an otherwise plain-Jane box into a rather attractive model. Use of the classic Goldberg Falcon wing airfoil at this model's weight proved to be an ideal match for the .40-size four-stroke engine.



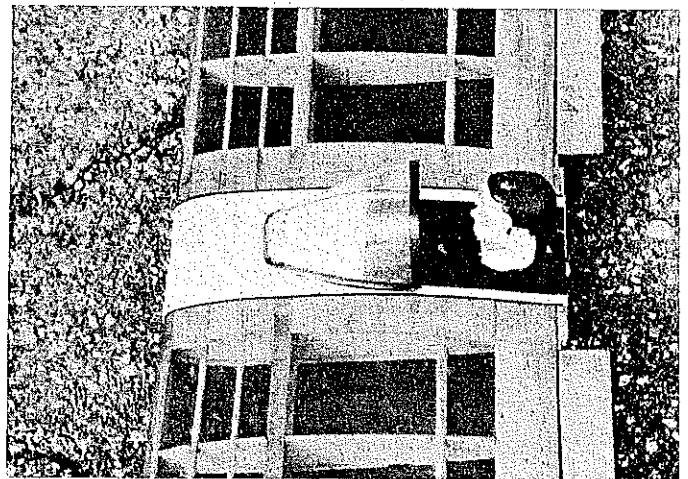
MODEL AVIATION
4-40
FOR 4 CYCLE .40
WING SPAN 57" AREA 590 SQ. IN.
WEIGHT 64 OZ. LOADING 16 OZ./SQ. FT.
DESIGNED & DRAWN BY DOC MATHEWS
TRACING BY JOE DEMARCO

Full-Size Plans Available ... See Page 180





Left: Aileron installation can't get any easier than this. Right: Uncomplicated decorations add much to the pleasing appearance of this model. Pilot is a Williams Bros. figure cut off at the neck. Windscreen is the front section of a Sig canopy trimmed with Stripe Rite tape.



been but for the tiller.

Use 5-min. epoxy to hold the block-horn unit to the trailing edge, then carve and sand the basswood to match.

Carefully sand the tip blocks to shape, then sand the entire wing in preparation for covering.

Radio installation. Our 4-40s tend to be nose-heavy; therefore, we found it best to mount the flight battery behind the #2 bulkhead with a scrap of hard wood between it and the receiver. The servos are best mounted three abreast, but watch out for the throttle servo. On the O.S. .40 FS, the link is on the engine's left.

We have shown holes for nylon rods in Bulkhead #3. The rods criss-cross midway back in the fuselage in order to reduce the angle of the cutout in the tail. Anti-sway reinforcement for the rods should be installed about half-way back.

Our preference is for threaded rod screwed into the nylon inner section with clevises on the horn ends and solder links on the servo ends. Use whatever you are comfortable with. The aileron hookup should use threaded rods and solder links. In all instances, be sure the surfaces will move without binds or stiffness. The flight

battery will give several additional flights per charge if all the controls are really free.

Finishing. We covered all the open frame areas with MonoKote, including the fuselage turtledeck and bottom. While one of the fabrics would certainly work well on the fuselage and likely be easier to finish, MonoKote can be successfully painted if all the finger oils are washed off with thinner before applying the paint.

We seal all the exposed wood with two thin coats of K&B Super Poxo clear, sanding it smooth after the second coat. Two coats of Super Poxo primer are then applied to the wood and MonoKote, again sanding after the second coat. Colored Super Poxo is then sprayed on. This gives a very attractive finish with a minimum of effort.

The 4-40 just doesn't look right without a pilot and canopy. The 2 $\frac{3}{8}$ -in. Williams Bros. unit must be cut off at the neck to look right; epoxy a scrap of balsa into the "amputation." The pilot figure is then colored with paint for plastics and epoxied onto the wing.

Wheel pants add a nice touch, though they are a nuisance on grass runways. Our early flights were made without wheel pants as a result of being more eager to fly than to

fly. Super Poxo was used to finish the pants.

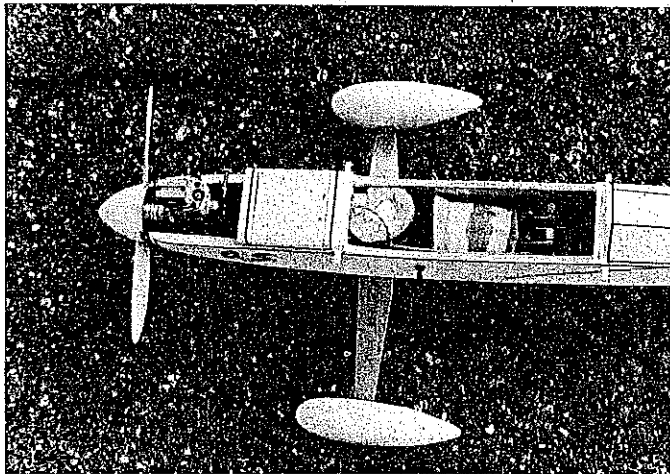
Flying. With the balance point and control deflections as shown on the plans, the 4-40 is a mild pussycat to fly. With the balance point moved a half-inch rearward and increased aileron and rudder throws, the 4-40 is a wild tiger! From this, you can see that this model is an excellent aileron trainer.

Takeoffs are simply a matter of using some right-rudder as the throttle is advanced and watching the model take off by itself. For landing, just line up with the runway and chop the throttle.

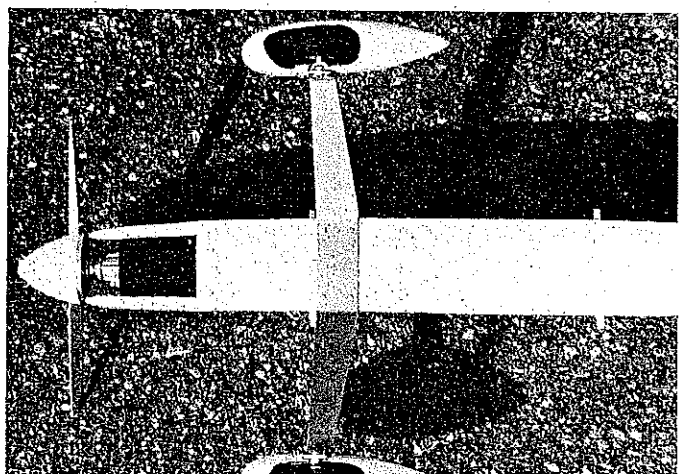
Flying a model with four-cycle power is a new experience; we have to constantly remind ourselves that even though the noise level is low, the model is at full throttle. In the outside loops, the sound is like low throttle! At least in the beginning, you can't depend on the sound as an indicator of model attitude; the engine seems to run at the same speed whether the nose of the model is up or down. A 11-5W Rev-Up prop seems to be a perfect match for this model.

For obvious reasons, four-stroke engines are extremely attractive to those with flying

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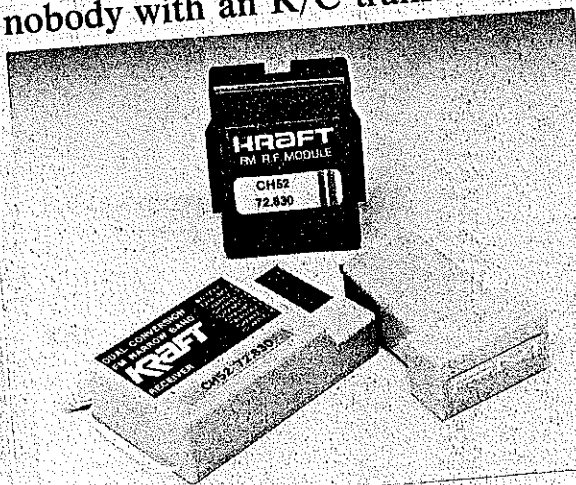


Left: There's plenty of room for all but the largest of radio equipment. Foam wraps for the battery and receiver hold them snugly in place. Removable hatch behind the engine provides access to the fuel tank. Author prefers rubberband wing mounting (rather than nylon bolts) for a model of this type. Right: The Hayes engine mount provides a "floor" beneath the engine for maximum rigidity. If some other mount is used, fill in the area with a scrap of balsa. Excellent ground handling is provided by the wide-stance pre-bent Sig gear. The wheel pants from Fiberglass Master are very attractive, though they have some drawbacks if you are flying from a runway with tall grass.



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That's what George Myers, writer of Model Aviation's Radio Technique column had to say about the performance of our KPR8FD super "1991" receiver. If you think 1991 performance isn't necessary now, listen to what Bob Aberle, technical editor of Flying Models, had to say about commercial paging systems. Bob said, referring to the the 8FD receiver, "If you happen to have a commercial paging service transmitter operating in your area only 10 KHz away from your channel you now have a chance of flying without any interference problems."

Matching transmitter modules are available in two models. The RFT-I (FM) will fit both single stick and dual stick KPT7C and Signature Series transmitters. RFT II is used with Kraft KPT6C transmitters.

The Kraft KPR8FD is available now and good for 1991 and beyond. See your favorite R/C hobby dealer or contact Kraft Systems Company, a subsidiary of Carlisle Corporation, 450 West California Avenue, P.O. Box 1268, Vista, California 92083, Telephone (619) 724-7146.

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According to an article by Chuck Furutani in the newsletter of the Soaring Union of Los Angeles (editor: Donna Gurski), we should also be careful if we handle graphite fibers (GF). Chuck writes:

"Do not play with GF, breaking small pieces, feeling surfaces, rubbing, etc. Small fibers can be imbedded in your skin. Remember, GF is as dangerous as asbestos! Wash hands and examine them carefully, looking for fine black slivers before you go to the bathroom or handle the baby.

"Do not sand, plane, or grind GF laminates—or, if you must, use a good mask. Cut to size with sharp scissors, keeping track of all cuttings and disposing of them immediately."

Chuck's reference to the danger of asbestos (an alleged carcinogen if inhaled) brings me to another newsletter article concerning lung irritants. *The Winding Stooze*, newsletter of the Nebraska Free Flyers (editor: Tom Winter), reminds us that balsa dust is not the best thing to breathe.

"What do you do with the buildup of balsa dust when you are sanding? The natural temptation is to say "phoo" to it, and blow it away.

"Don't do it! Wipe the dust off. Why? Lungs don't like balsa dust. Personally, I have a history of insomnia, and a long history of respiratory difficulties. In one of those old-fashioned mines, I could be the test-canary.

"One recent restless night, I realized I was awake because my breath was labored. "Why?" I asked myself. There was no mildew around; it was too early for pollen. Hmm. The last thing I had done before retiring was to carve a balsa prop. I had blown the dust away. Most blown

balsa dust just hangs there, and just about everything that wasn't prop was either airborne or inhaled.

"I have changed procedure and find that if you wipe off the dust, it tends to bunch up pretty neatly. You can pick up the bunches, save them, and use them for fillets and bridging CyA glue gaps. Conclusion? Don't load the air with it, load storage bins! Wipe off the sanding dust."

I believe that in a previous safety column, I stated that our bodies function best when all we breathe into our lungs is air. Whenever you start filling your workshop atmosphere with particulates, be it from sanding or spraying paint, I urge you to use a mask.

Have a safe month.

John Preston, 12235 Tildenwood Dr.,
Rockville, MD 20852.

4-40/Mathews

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field neighbors. Their markedly-reduced fuel consumption and ability to turn large props are equally attractive.

At the risk of repeating ourselves, the 4-40 may look like a trainer, but it most certainly possesses qualities that will attract even the most jaded of pilots. This project has been one that seemed to be touched by some special magic from inception to completion. We are delighted to recommend it to one and all as something to really ENJOY.

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