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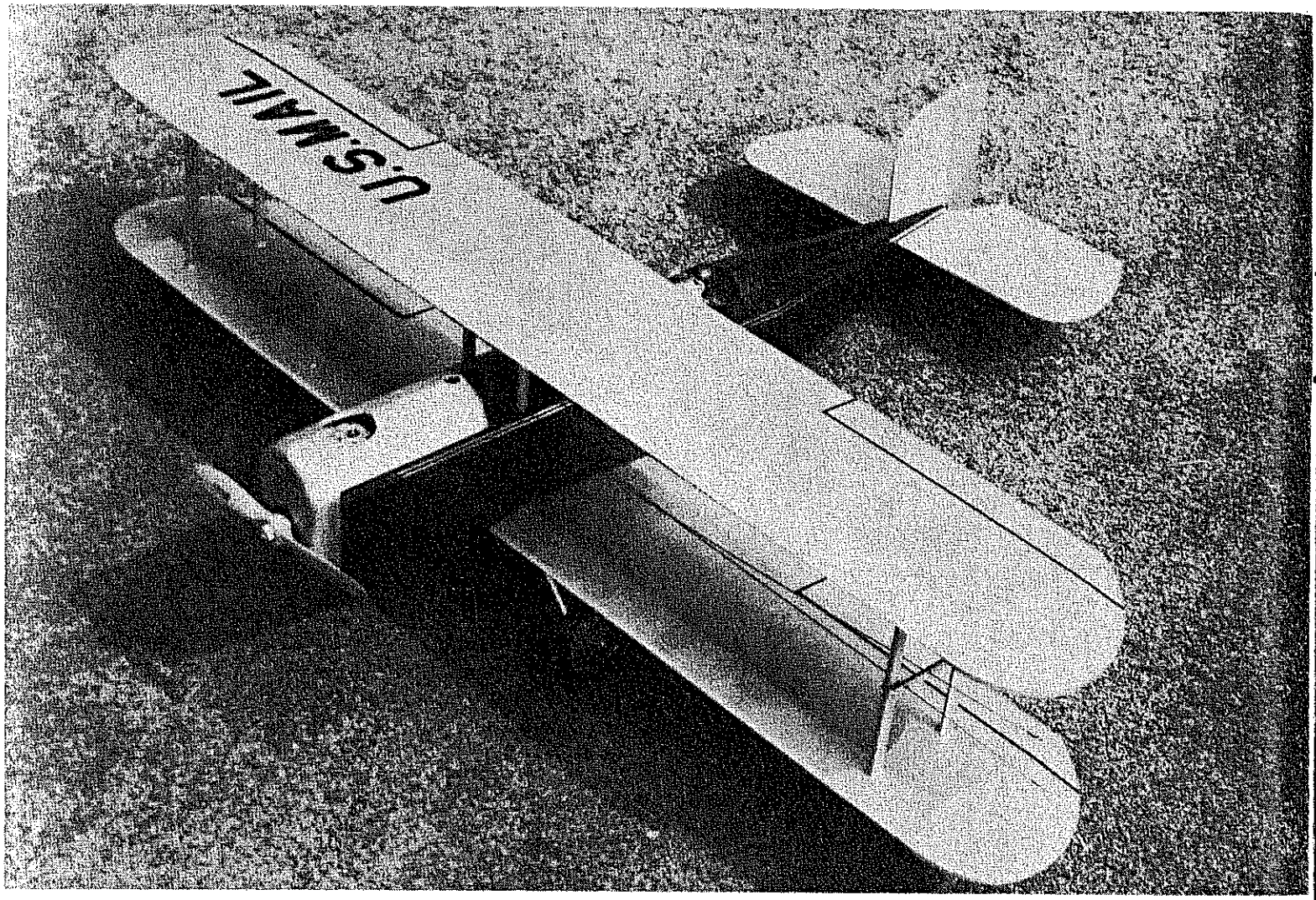
U.S. MAIL cardboard



WHAT WOULD you say if I told you it was possible to build a semi-scale control-line model biplane with a 50-in. wingspan for less than $10 in material costs? Well, before you say it can't be done, take a look at the pictures of the Douglas M-2 biplane model presented in this article, because it was built for less than $10 in material costs.

Sound interesting? You bet it is! But what can this new wonder material be? I'll give you a few hints. It's something you see everyday and you probably have enough of it around your house, garage or attic right now to build a large-sized model airplane. Well, before you become a candidate for a straitjacket, I'll tell you. It's cardboard, plain old ⅛-in. corrugated cardboard.

I can hear you now. "Cardboard! What can you do with cardboard?" Well, the M-2 biplane is just one example of the potential cardboard possesses as a building material. Honestly, could you tell the M-2 was constructed of cardboard by looking at the photos of the finished model? Don't feel bad if you couldn't, because many experienced modelers have stood five feet away from the M-2 without realizing it was cardboard. Which illustrates the point that cardboard models look every bit as good as balsa models.

But what about strength? Is cardboard strong enough to absorb the beating that most model airplanes are subjected to? And are there any other reasons for using cardboard? Well, by way of an answer, let me ask you a question. Why are shipping containers made from corrugated cardboard and not balsa wood? The answer is obvious. A cardboard box costs less. It can be cut out in one piece and folded together into a single strong unit, while a balsa box would be made from separate pieces glued together. The cardboard box would take only a fraction of the time required to build a balsa box. Now, subject both boxes to a hard impact and see what happens. The cardboard box may crease, tear or wind up with a hole which could easily be repaired with a cardboard insert or patch. What happens to the balsa box? It splinters and cracks because balsa is brittle. Cardboard, on the other hand, is a non-brittle crushable material which is shock absorbing. Impacts are absorbed locally and not transmitted throughout the entire structure. The balsa box would be heavier if it were built strong enough to absorb as much impact as the cardboard box. Also, the cardboard box is ready for painting as soon as it is glued together. The balsa box must be sanded and sealed before painting. So the advantages of cardboard are many.

I used the example of a cardboard and a balsa box because it is something we all can understand and compare intuitively. But the same comparison still applies when comparing the two as model airplane construction materials. Cardboard costs less, cuts easily with no cracking or splitting and large sections may be formed in one continuous piece. It is as strong, or stronger, than balsa wood, light weight, resists damage and requires no preparation for painting.

The ease of cutting, combined with the large shapes which may be formed from a

douglas m-2

Holding the red-and-silver model of the Douglas M-2 Mailplane flown by Western Air Express, Chuck asks if you can tell it was not made from balsa. From five feet off, he found experienced modelers didn't note difference.

This scale-type control-liner is quickly and easily built. It's as sturdy as can be and requires less than $10 in material costs.
Chuck Felton

single piece of cardboard, have resulted in simplified design techniques and reduce building time to an absolute minimum. As an example, each wing of the M-2 is constructed from two pieces of cardboard and a single spar. In two hours time, both wings can be built ready for painting. The fuselage and empennage have also been designed for easy, fast building.

Now a few words about cardboard. The technical term for cardboard is corrugated fiberboard and is specified by test strength, facing weight and flute style. In its usual form, it consists of an outer facing paper, an inner flute paper and an inner facing paper. Test strengths are dependent on the weight of the three components specified in pounds per thousand square feet. Flute sizes are B, C or A which result in an approximate thickness of ⅛, 3/16 and ¼ inches, respectively. The material used for the M-2 model is ⅛-in., 125-lb. test-B flute, which is the lightest weight of standard cardboard this thickness. However, the flying qualities of the model do not suffer with the use of heavier cardboards, including 200-lb. test board. Sources of cardboard are virtually unlimited, including department and appliance stores.

Naturally, cardboard cannot be used for all models. However, the M-2 clearly demonstrates that cardboard can be used in a wide variety of applications for both scale and sport models. Monoplanes, biplanes and triplanes are equally easy to build with almost no additional cost.

The model is built to a scale of 1¼ in. = 1 ft. which gives a wingspan of 50 inches and a wing area of 750 square inches. With a weight of 3½ pounds, the wing loading is light which results in a very shallow and stable landing glide. Slow realistic flight speeds are attainable. The flat-bottom semi-diamond airfoil section results in high lift at low speeds and enhances the model's stability and handling qualities. Engines from .29 to .40 size can be used.

The model is designed for throttle control operation. A G-S Products 3-line bellcrank was used, specifically the C22 version, in conjunction with the G-S handle. The system proved to be an excellent choice. The handle's enlarged mechanism provides one-third more power throttle control range which results in better speed control. The smooth action of the system also increases speed control. In addition, the bellcrank is designed to use clevis-type linkages. The clevis-type linkages were used in the M-2, which greatly simplified the 3-line bellcrank installation. I highly recommend the G-S Products system.

The M-2 model is just one example of what can be achieved with cardboard. I hope the possibilities will stir your interest enough for you to try your hand at building the M-2 or a cardboard airplane of your own design. I would welcome the opportunity to answer your comments or questions on this technique. Just write me at the following address: Chuck Felton, 10459 Artesia Blvd. #72C, Bellflower, CA 90706.

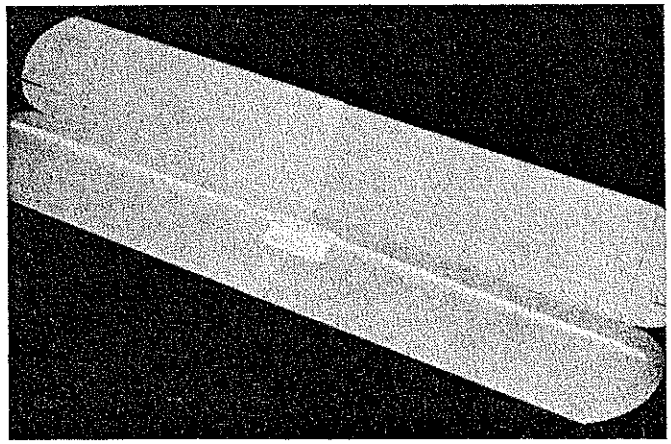
Construction Hints

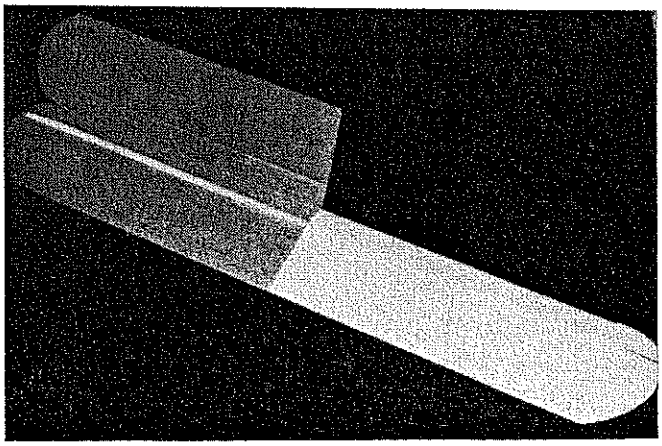
Glue: Water-base glue, such as white glue or Titebond, is recommended. Contact cement is not recommended since parts cannot be shifted when gluing surfaces.

Folding: The scoring of the fold lines is done with a screening tool available at any hardware store. It consists of a handle with a 1½ in. radiused wheel at one end which is run along a straight edge on the fold line.

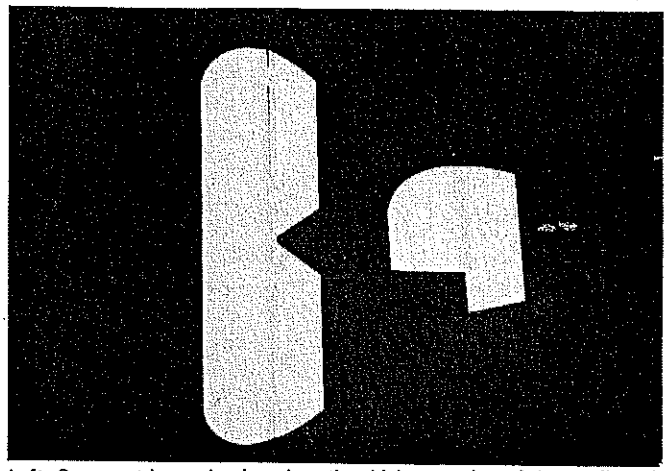
Finishing: Cardboard gives a solid surface with no open areas to cover and is non-porous. The easiest method is to give three coats of color dope and two coats of clear dope. However, a wide variety of finishing material can be used on cardboard. Coverings such as Solarfilm, Monokote and vinyl paper can be used. With any of these, it is recommended that the surface not be doped, which will result in a better bond.

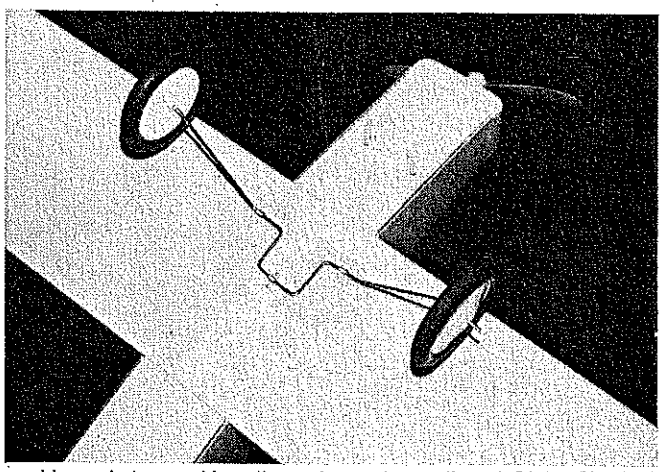
Water Proofing: Waterproofing of cardboard is quite simple and can be done to



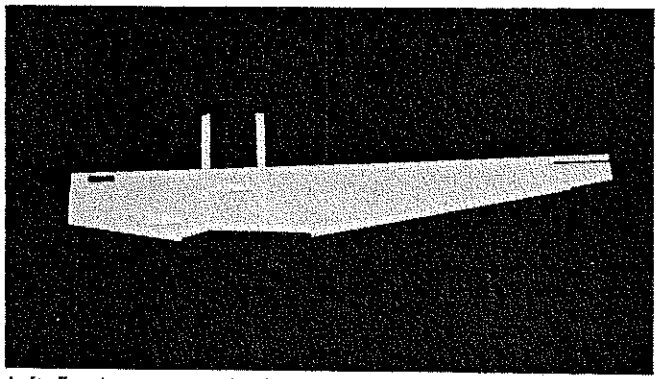


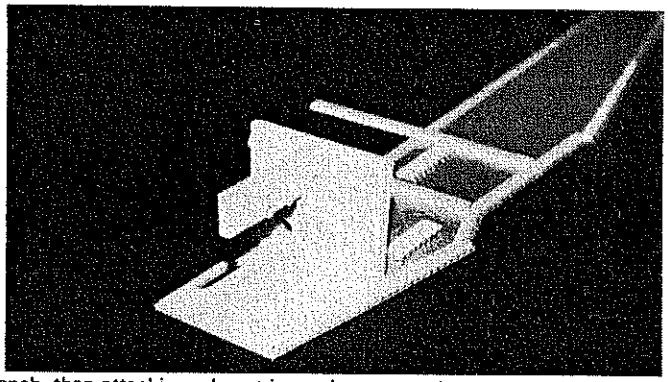
Left: Wing spar and ply landing gear mount glued in place on bottom piece of lower wing; mount fits into cutout in cardboard, spar crossing over it. Right: Right wing top covering here is folded down and glued in place. Fold lines are accomplished with a screening tool with a 1-1/2 in. radius wheel. Tool found at hardware stores. It is run along a straightedge placed along the fold lines.



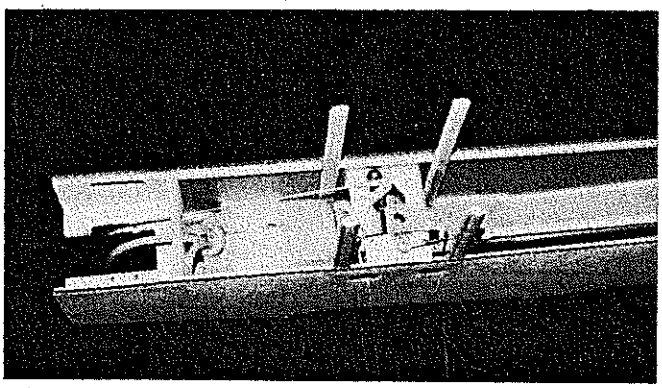


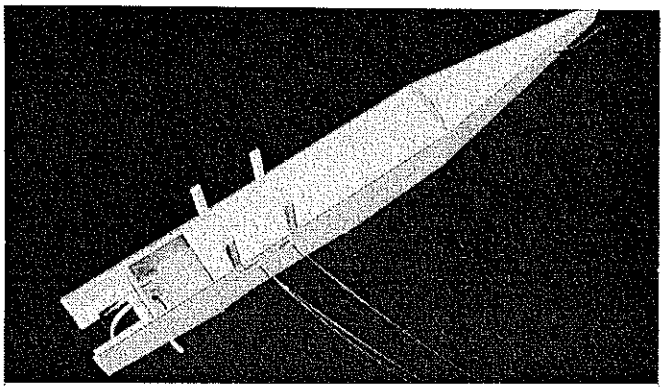
Left: Spruce strips—glued against the thickness edge of the cardboard at the rudder and elevator hinge lines—brace the cardboard. Right: Shock absorbing landing gear is held to ply mounting plate by typical metal strap fittings. Note drain tubes under nose.



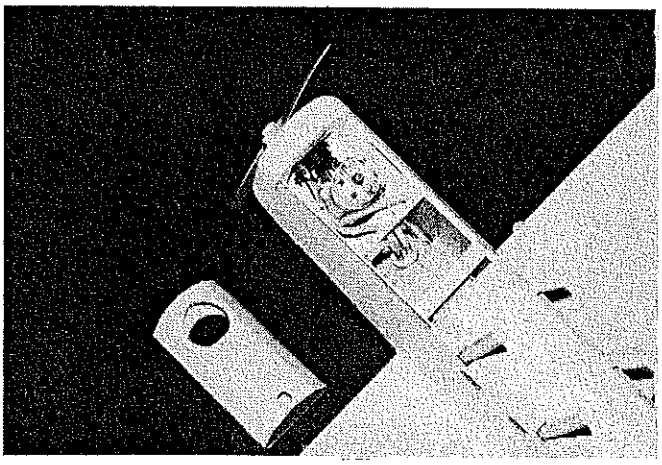


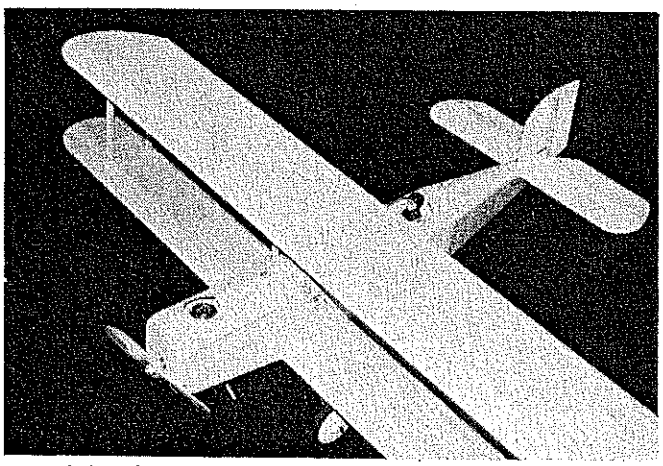
Left: Fuselage construction is begun by laying pre-cut cardboard on workbench, then attaching edge strips and centersection struts with white glue or Titebond. Right: Firewall, ply motor mount, doublers, lock into an almost indestructible unit. Use blind nuts for engine.





Left: G-S Products 3-line bellcrank (C22 version) is mounted on ply anchored beneath fuselage top rails. A 4-oz. clunk tank is fastened to ply floor with rubberbands over paperclip hooks. Engine compartment is coated with epoxy for fuel-proofing. A compact arrangement. Right: Top pieces fit on fuselage top rails, flush with top edges of the sides. Note one former in place toward rear of fuselage.





Left: Construction of the removable engine compartment hatch is evident here, consisting of floor, formers, and creased top piece. At right is completed ship ready for painting. Three coats of colored dope and two of clear will suffice, but Solarfilm, Monokote or vinyl paper can be used, in which case the surface should not be doped. Before parts are cut, raw material can be waterproofed with a mix of 25% polyurethane and 75% paint thinner. Just brush on and allow to dry for 48 hours. Cardboard then cuts crisply—like wood.

the raw material before you cut out the parts for your aircraft. Simply mix 25% clear polyurethane with 75% paint thinner. The latter can be the cheapest hardware store variety which is thoroughly mixed with any clear polyurethane. Brush the mixture on liberally to the cardboard sheet that you are going to use in the construction of your aircraft. Allow this to soak through the cardboard and dry for 48 hours. This adds no appreciable weight to the material and renders the cardboard completely waterproofed. In addition, when you start to cut the treated cardboard, you will find that it is crisp as wood and cuts sharply and cleanly.

Construction

Cut out all cardboard and wood parts using the template outlines. Be sure to note the direction of the corrugations. Score and fold cardboard parts as indicated on the plans.

Stabilizer and Fin: Glue ⅛ × ¼" spruce strips to the stabilizer trailing edge and elevator leading edge. Round off the edges of these spruce pieces for smooth control surface movement. Hinge elevator to stabilizer with cloth hinges at four places. Fill raw edges of cardboard with glue.

Glue ⅛ × ¼" spruce strips to fin trailing edge and rudder leading edge. Rudder is then glued to fin with rudder trailing edge offset ½" to outside of flying circle. Fill raw edges of cardboard with glue.

Wing: Begin wings by making two wing spars. Spars are a ⅛ × ⅜" balsa strip, capped with ⅛ × ⅜" spruce strips top and bottom. The bottom wing is made from a left- and right-hand wing panel with a cut-out on the centerline for the ⅛" plywood gear support. Glue the two panels together along the bottom centerline. Glue the ⅛" ply gear mount in the cutout. Glue the wing spar in place. The tip of the spar is ⅜" sq. balsa cut to a triangular shape. Scrap cardboard doublers are glued to the ply gear mount so that they overlap the surrounding cardboard by ½ inch.

Glue 1 oz. weight to right wing tip. Apply glue to top of wing spar and wing trailing edge. Fold the wing over and weigh down until dry. Seal wing trailing edge and centerline joint with gummed paper tape. Fill wing tip raw edges with glue. Top wing

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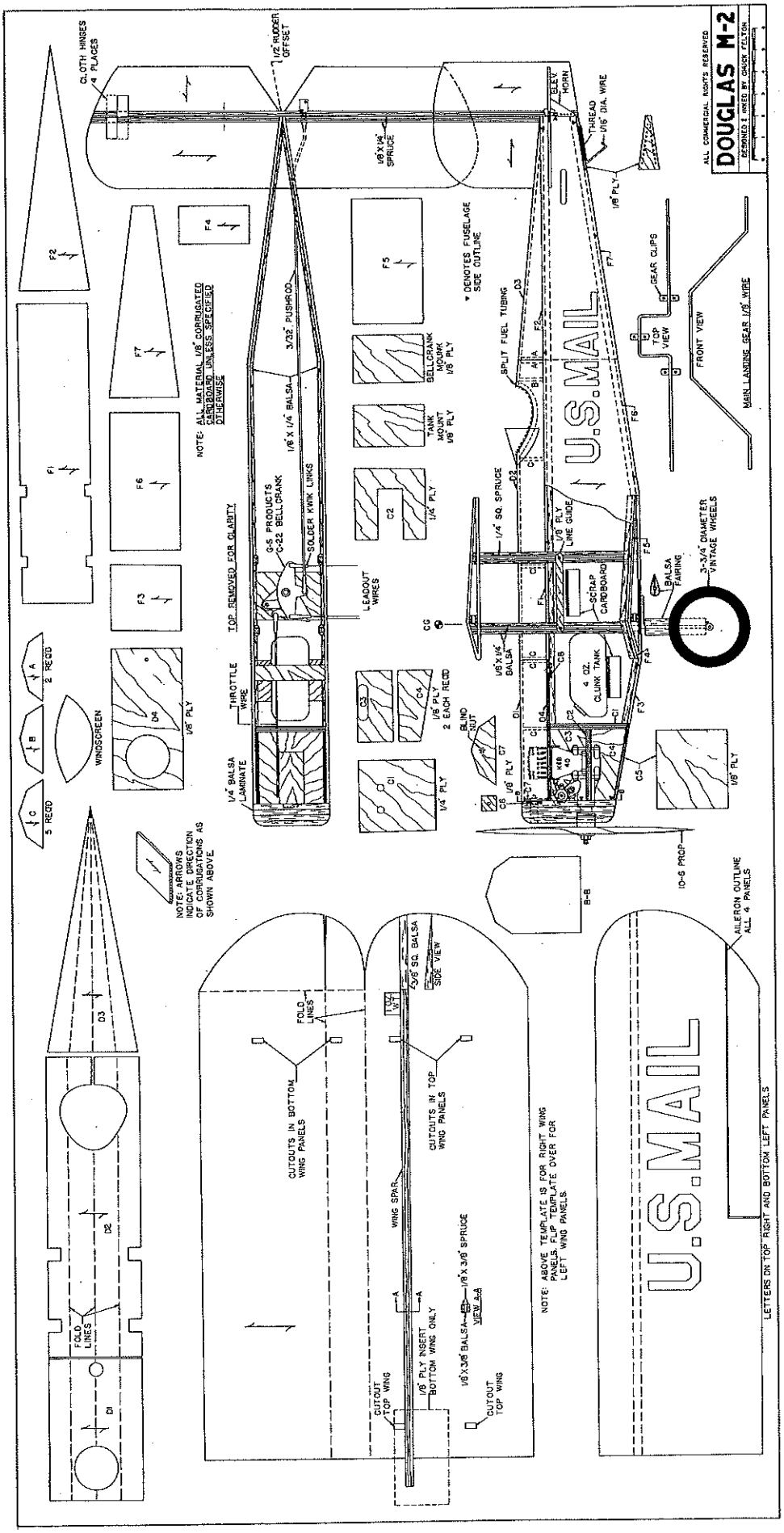
EDITOR'S NOTE: Because of the increasing interest in corrugated cardboard as a building material, this article is recommended reading for RC people, as well as CL builders. The article transcends the construction of the M-2—interesting in itself, by including an informative briefing on the material, and valuable construction hints prior to the how-to-build portion of the article: glue, folding, finishing and water-proofing.



FULL-SIZE PLANS AVAILABLE . . . . . SEE PAGE 96

Anyone having this problem will have to make inquiry with the manufacturer of his brand of equipment.

Cardboard M-2/Felton

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is made in similar fashion but does not contain ⅛" ply insert.

Fuselage: Before starting, be sure the following cutouts have been made in the fuselage sides. Slot in both sides for stabilizer, leadout holes and pushrod exit in left side, and engine exhaust in right side. A ½-in. engine shaft extension is used, so keep this in mind when locating mounting holes, exhaust ports, etc.

Make four wing center struts from ¼" sq. spruce capped with ⅛ × ¼" balsa strips. Round off balsa strips to streamlined shapes. Glue two struts to each side of fuselage. Line the upper and lower edges of each fuselage side with ⅛ × ¼" balsa strips. The strips are recessed ⅛ in. from the fuselage edges. Add scrap cardboard supports to each fuselage side. Drill holes in C1 for fuel tubing and throttle pushrod exit. Glue C1 to right fuselage side, making sure it is perpendicular to fuselage side. Cut engine exhaust hole in side doubler C3 and glue in place.

Drill holes in motor mount C2 and install 4-40 blind nuts in bottom side. Glue motor mount C2 in place and add lower doubler C4. The left fuselage side is then glued to C1 and C2. Add doublers C3 and C4 to left fuselage side, and add bottom piece C5. Give the engine compartment a coat of epoxy for fuel-proofing.

The fuel tank and bellcrank are installed next. Attach fuel tubing to a 4-oz. clunk tank and secure tank to ⅛" ply support with rubberbands, using a paper clip to secure the rubberbands. Glue assembly to the cardboard supports. Attach 3/32" wire pushrod, 1/16" wire throttle wire, and leadout wires to bellcrank. Bolt bellcrank to ⅛" ply support and glue to the cardboard supports. Solder Kwik Links were used for all bellcrank connections and resulted in very smooth operation of the control system.

The fuselage top and bottom now are closed up. Glue F1 and F2 to top fuselage. Glue F3, F4, F5, F6 and F7 to bottom fuselage. Make two holes in F3 for fuel tank fill and overflow tubing exits. Top decking is formed by gluing formers A, B and C to fuselage top and adding top decking pieces D2 and D3.

The cowl block and removable decking are next. Make laminated cowl block from four pieces of ¼" sheet balsa to shape shown in section B-B. Cut out hole for engine shaft and cowl hold-down bolt near top of cowl. Recess piece C6 into back face of cowl block. Removable decking starts with base piece D4. Add formers C7 and C to D4. C7 is ⅛" ply and has a blind nut mounted on the back side. The hole in C7 must align with the hole in C6. Add top deck piece D1. The aft deck mount, C8, is

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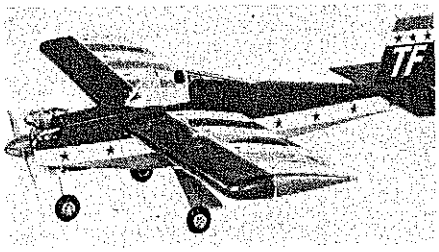

Freshman Trainer: Created by Top Flite Models, Inc., Chicago, this model is simple to build, yet smart looking. Slow and stable, it is an easily-manageable plane for beginners. The all-balsa wood kit contains machine-finished and precision die-cut parts, and a separate, fully-illustrated instruction booklet that explains assembly in step-by-step fashion. Flying hints are detailed. Kit contains shaped leading and trailing edges, ailerons, stab and elevator, solid wood wing tips, formed landing gear and steerable nose gear, ¼ in. 5-ply firewall, shaped maple engine mounts and all required hardware. For 3- or 4-channel radios. Wing span is 48 in., with a 504 sq. in. area. Takes 29 to 40 engines with appropriate ready-to-fly weight of 3 lbs. $44.95 at hobby shops. **Top Flite Models, Inc., 1901 N. Narragansett Ave., Chicago, IL 60639.**

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recessed flush into the ⅛ × ¼" balsa strips on the fuselage sides. Cowl is attached by 4-40 bolt through C6 and C7 and small wood screw through D4 into C8. At this point, seal all raw edges of fuselage with gummed paper tape.

Make ⅛" wire main landing gear, add balsa fairings and sand to shape. Make tail skid form 1/16" wire. Attach to ⅛" ply support by wrapping with thread and glue in place. Make four outboard wing struts, which you will notice are slightly longer than the inboard struts.

Finishing: Now is the time to paint and trim the model before final assembly. The color scheme is silver and red which was the same as that used by Western Air Express in 1926 on their mail routes. The wings, empennage, nose block, removable cowl, struts and gear fairings are silver. The fuselage is red. Lettering and trim is made from black and silver Monokote. Use split fuel tubing for cockpit combing and paint black. Make windscreen for thin plastic and glue to fuselage.

Final Assembly: Glue bottom wing to fuselage. Glue the outboard struts into position in the bottom wing. To make sure that the outboard wing struts stay aligned, slip the top wing over the struts, without gluing, while the struts are drying in place in the bottom wing. When dry, turn the airplane upside down and glue struts in place in the top wing. Make fillets of glue around each strut where it enters the wing surface for increased strength.

Glue stabilizer in place, attach a nylon control horn and hook up the pushrod. Glue fin in place. Attach main landing gear with gear clips and wood screws. Add 3¼-in.-diameter vintage wheels.

Bolt motor to motor mount and attach fuel line, throttle linkage and a 10-6 propeller. Bolt on removable decking. Make ⅛" ply line guide and attach to left outboard struts with 4-40 bolts. Pass the lead-out wires through the line guide and tie off. Your ship is now complete. Be sure to balance the airplane as shown on the plans.

Records/Whitten

continued from page 35

contest, but, since Mike's Pennyplane was the Novice version of Bob Meuser's excellent "No Nonsence" design, it also set a new Junior Novice Pennyplane record as well. Two records!

Richard Whitten repeated his double win of last year, this time setting new Senior "A" Stick ROG and Pennyplane times. That made four new records!

The most outstanding record established was, of course, Bucky Servaites' superb 35:08.5 flight that established a new AMA HL Stick time. What's more, the same flight borke the old FAI *World* Unlimited record for FAI Category III sites. Bucky was really gunning for this one, and he came fully prepared with all the necessary sanction papers for such a world record attempt. His model was an FAI design that weighed *less* than the minimum one gram FAI competition class requirement. Nice going, Bucky, and congratulations! We like to see those world records on this side of the pond. Six records!

There were contests for other types, too. Easy "B" was, perhaps, most hotly contested, and Stan Chilton's time must surely be about tops for Category II. Take a look at the best four:

Stan Chilton	16:42.6
Bob Mullins	15:34.0
Dick Obarski	14:58.0
Al Rohrbaugh	14:15.0

Manhattan Formula was very popular, and times were much improved over last year. Flying to the same M.I.A.M.A. rules, the first five places were all higher then Servaites' last year's winning West Baden time of 4:52.8. Cincinnati's Jim Miller took top honors with 8:14.5, establishing a new Category II contest high time for this unofficial cabin event. All models had been built close to the minimum 4.0 airframe weight allowance, except two at 5 grams which had been the requirement at a recent Indianapolis contest. It should be noted that the

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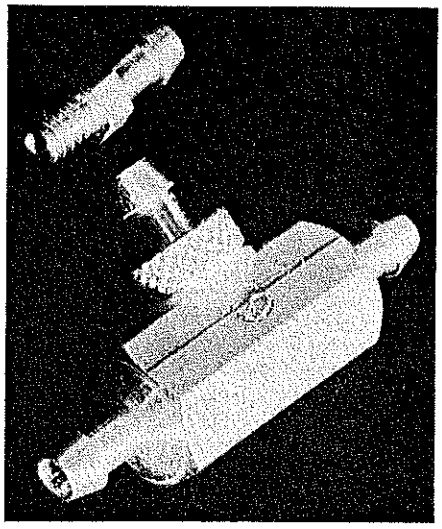

Super Pumper: Compatible with all engines, mountings and tank locations this pump comes adjusted to put out 1.5 psi with one ounce of fuel per minute—drops to 1/8 to ½ psi on idle depending on engines. The adjustment affects pressure more at the low end than at high rpm, because the carburetor is not designed to handle high pressure at both idle and wide open—prolonged idle is possible with no hesitation in response to throttle. Unit is no larger than a filter. The need for a pumper, of course, is to insure a steady engine run under all flight conditions—from full tank to empty—without variations, such as running rich or lean, or breaks in power, hesitant response to throttle changes, etc. The engine does require tapping for the pressure feed, but that is no problem, and well worth the superior engine performance. **Robart Mfg., Co., P.O. Box 122, Wheaton, IL 60187.**

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