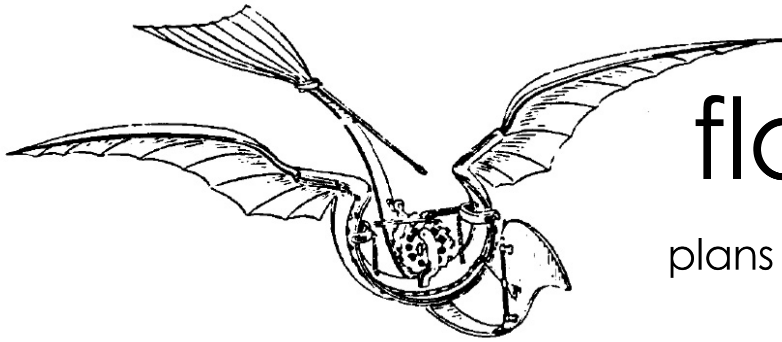


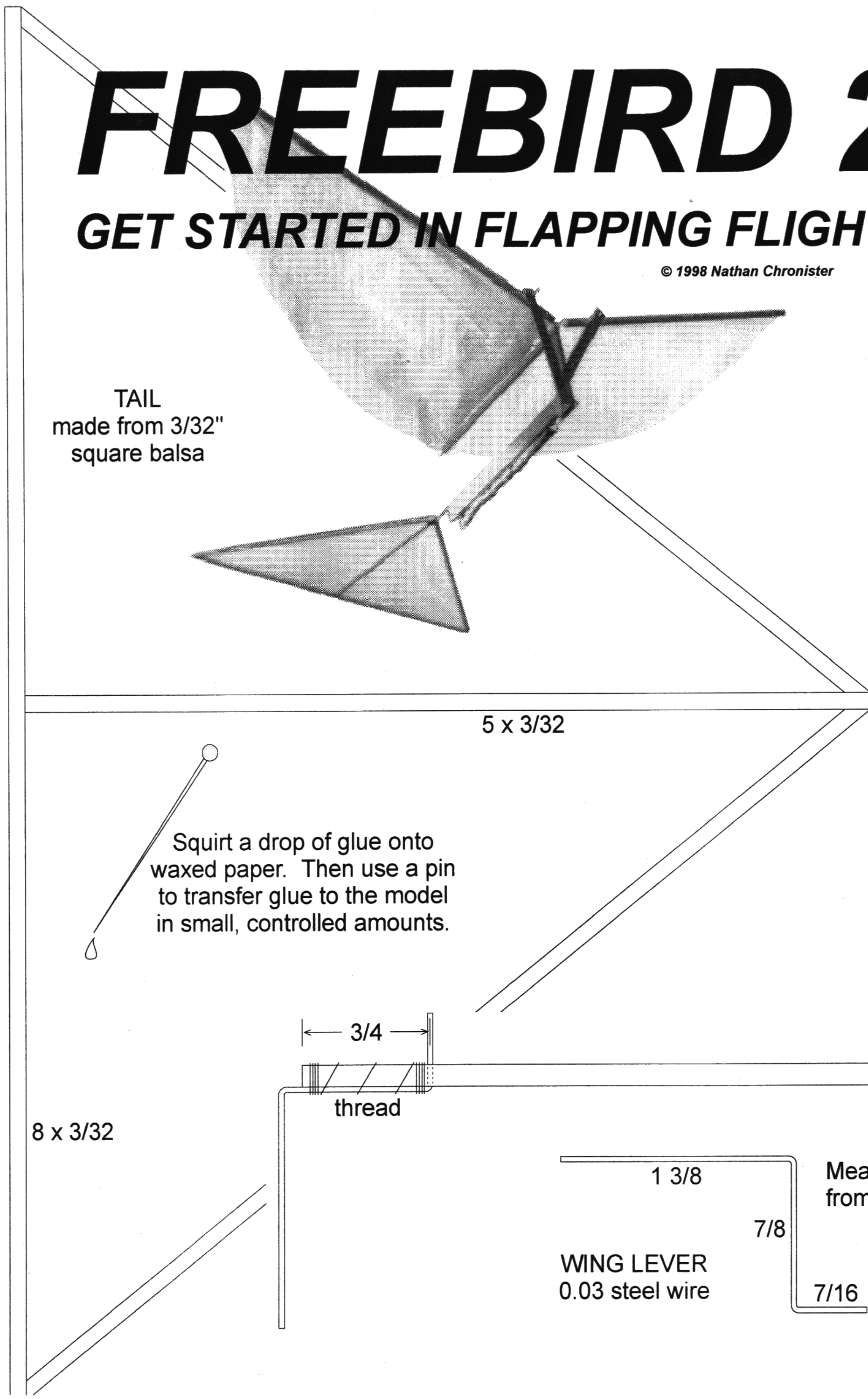
flapper plans facts

Flapper Facts (now called *Flapping Wings*) is the newsletter of the ornithopter community. Its goal is to facilitate the sharing of information about ornithopters, and to provide a lasting record in print of accomplishments in our field. Patrick Deshaye started the *Flapper Facts* newsletter in 1984. At the time, *Flapper Facts* and Deshaye's handbook called the *Ornithopter Design Manual* were virtually the only source of information on how to design and build ornithopters. In the 1990s, Nathan Chronister took over as editor and created the Ornithopter Zone web site, www.ornithopter.org, to further promote the development of flapping-wing flight.

These ornithopter plans were selected from back issues of the *Flapper Facts* newsletter. They were contributed by readers and were originally published during the period from 1984 to 1998. The designs, however, cover a much wider period and represent a variety of approaches both conventional and unique. All of these ornithopters have flown successfully.

FREEBIRD 2

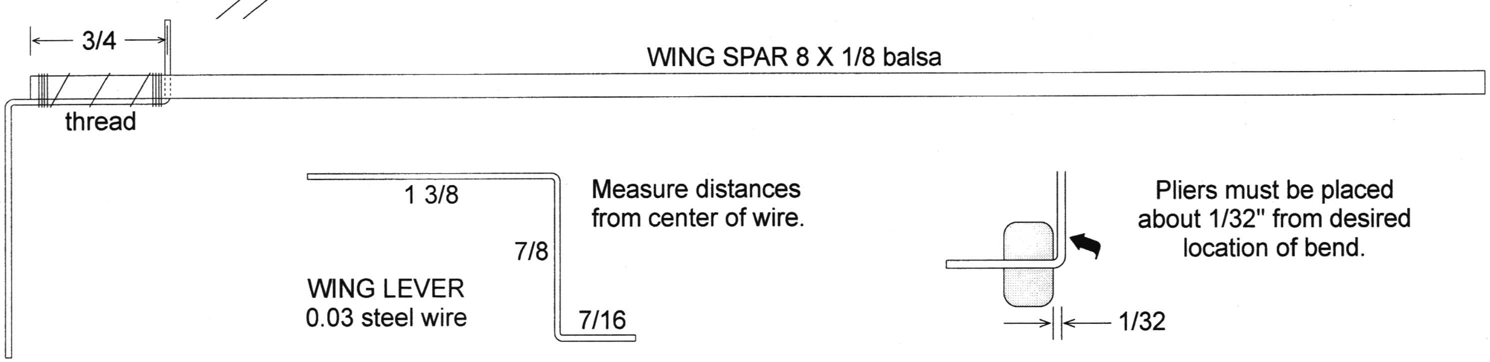
GET STARTED IN FLAPPING FLIGHT!

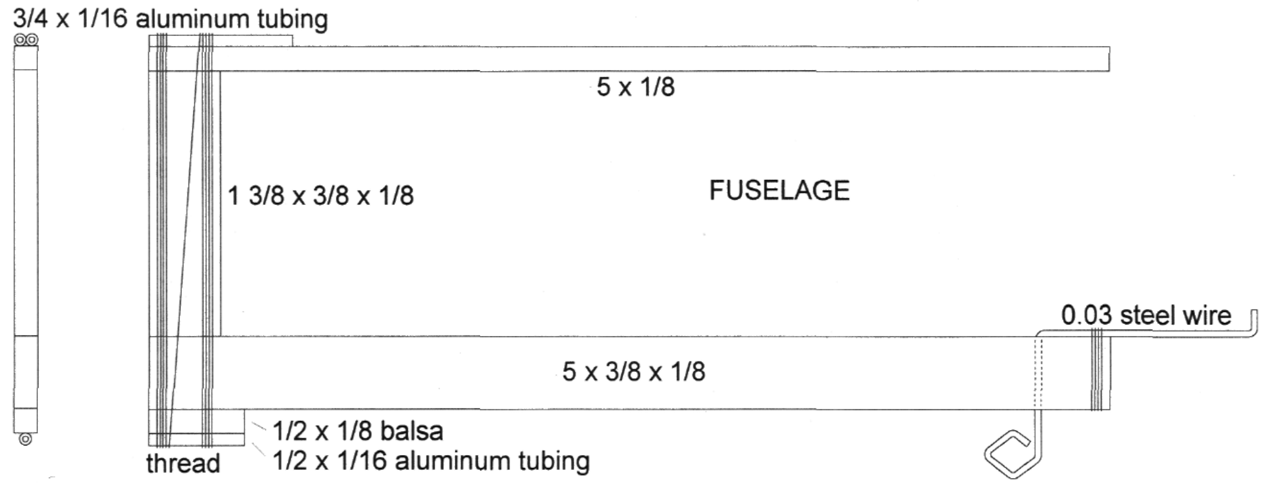


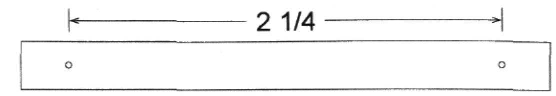
IT TOOK FOUR BILLION YEARS for flight to evolve in nature. You can build this simple flapping-wing model in a single evening! Designed specifically for first-time builders of ornithopters, Freebird 2 is just about the easiest-to-build ornithopter there is. It will give you the greatest chance of success in this challenging field. Despite its simplicity, Freebird 2 is innovative. Like real birds, it uses its wings, not tail, for directional control. Freebird 2 is also a good subject for experiments, because it is rugged and can be modified quickly. With Freebird 2, you can try more ideas in less time!

START WITH THE TAIL. Work on cardboard or another surface you can cut on. Work right on the plan, but cover it with waxed paper so the glue doesn't stick. First cut the center and trailing edge pieces to length, then glue them together on the plan. Glue is applied to the joint while holding the parts together motionless. Next cut the tail side pieces by referring to the plan. Angles at the ends must be cut accurately or the glue won't hold. Set the tail aside for later.

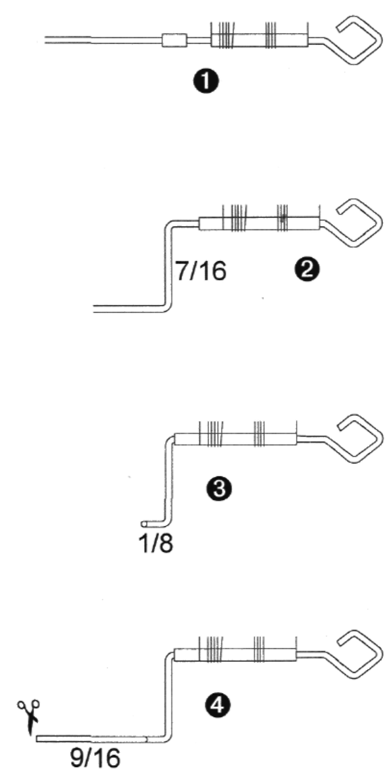
WINGS. Bend the wing lever wires as accurately as possible. Both bends are in the same plane, so the completed part should lay flat. After you cut the wing spars, make a hole in each spar for the wing lever wire. Start the hole with a pin and then drill it through by hand with a sharp piece of plier-cut wire. Make sure the hole is straight. Wrap with thread as shown; don't use too much thread. Saturate the thread with glue, just enough to do the job, and rub it in with a small piece of waxed paper.







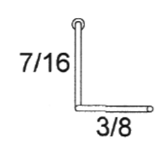
CONNECTING ROD 2 3/4 x 1/4 x 1/32 plywood

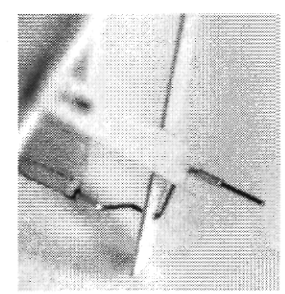


FUSELAGE. Assemble wooden parts first. Then glue aluminum tubing in place. Make sure the tubing is parallel to the fuselage and that it is not recessed behind the front of the balsa structure. Make the tail hook, which holds the rear end of the rubber motor, from a long piece of wire: Use a pin to make a hole through the fuselage, form the tail hook, and insert the remaining wire through the hole. Bend the wire 90° so it lays back along the end of the stick as shown. Finish by making an upward bend. Make sure wire is straight up and down when viewed from behind. Cut off the excess wire. Wind with thread as shown.

CRANK. The crank wire is the most difficult part of the ornithopter, but the tail hook was good practice. Even if you make a mistake, you can easily cut off the crank wire and make a new one. Begin by bending the motor hook. Then slide the wire through the bearing tube on the bottom of the fuselage. Cut a 1/8" long piece of aluminum tubing as a thrust washer and slide this onto the front end of the wire. In Figure 1, you are ready to bend the crank itself.

FINISHED CRANK front view





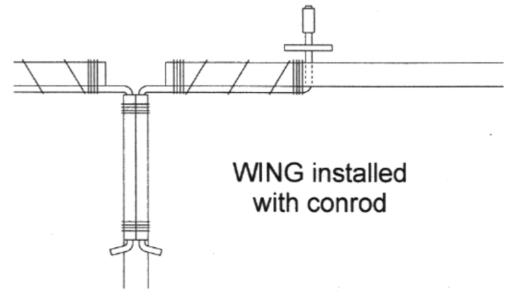
The crank consists of a series of 90° bends. Make the first bend by grasping with pliers, just ahead of the thrust washer, and bending the free end of the wire by hand. Carefully make the second bend so that it is in the same plane as the first. Notice that in Figure 2, the remaining wire is parallel to the bearing tube. The third bend rises directly "out of the page", as shown in Figure 3. The fourth and final bend leaves the wire parallel to the bearing tube once again, as shown in Figure 4 and the front view.

CONNECTING RODS. Make 2 conrods from plywood. Make holes by piercing the wood with a straight pin; enlarge with wire. Holes must be exactly 2 1/4" apart. Slide conrods onto crank, then onto wing lever wires; rear conrod goes to left wing. Turn the crank. Wing motion should be smooth and symmetrical.

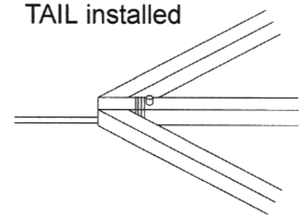
INSTALL TAIL. Make a perpendicular hole through the tail and fit the tail onto the wire extension of the tail hook. Make sure the tail is not crooked, then glue and bind with thread.

INSTALL WINGS. Insert wing lever wires through the wing hinge tubes. Bend the wires as close as possible to the hinge tubes to hold the wings on, bending more or less in the same plane as the wing lever. Cut off excess wire. Wings should swing freely and should be perpendicular to the fuselage.

APPLY TISSUE COVERING. Cover the tail first, because it is easier. First apply a thin coat of white glue (mixed with 3 parts water for best results) to the upper surface of the frame. Then apply the model tissue and smooth out wrinkles before the glue dries. Let it sit until dry, then trim off the excess with a new, sharp razor blade. Do not shrink the tissue. Do not cover the bottom of the tail.

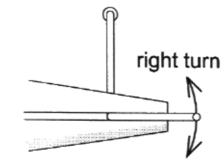


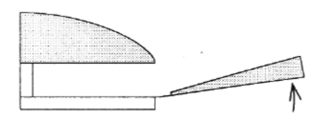
WING installed with conrod



TAIL installed

WING OUTLINE
↕ tissue grain direction





FLIGHT ADJUSTMENTS

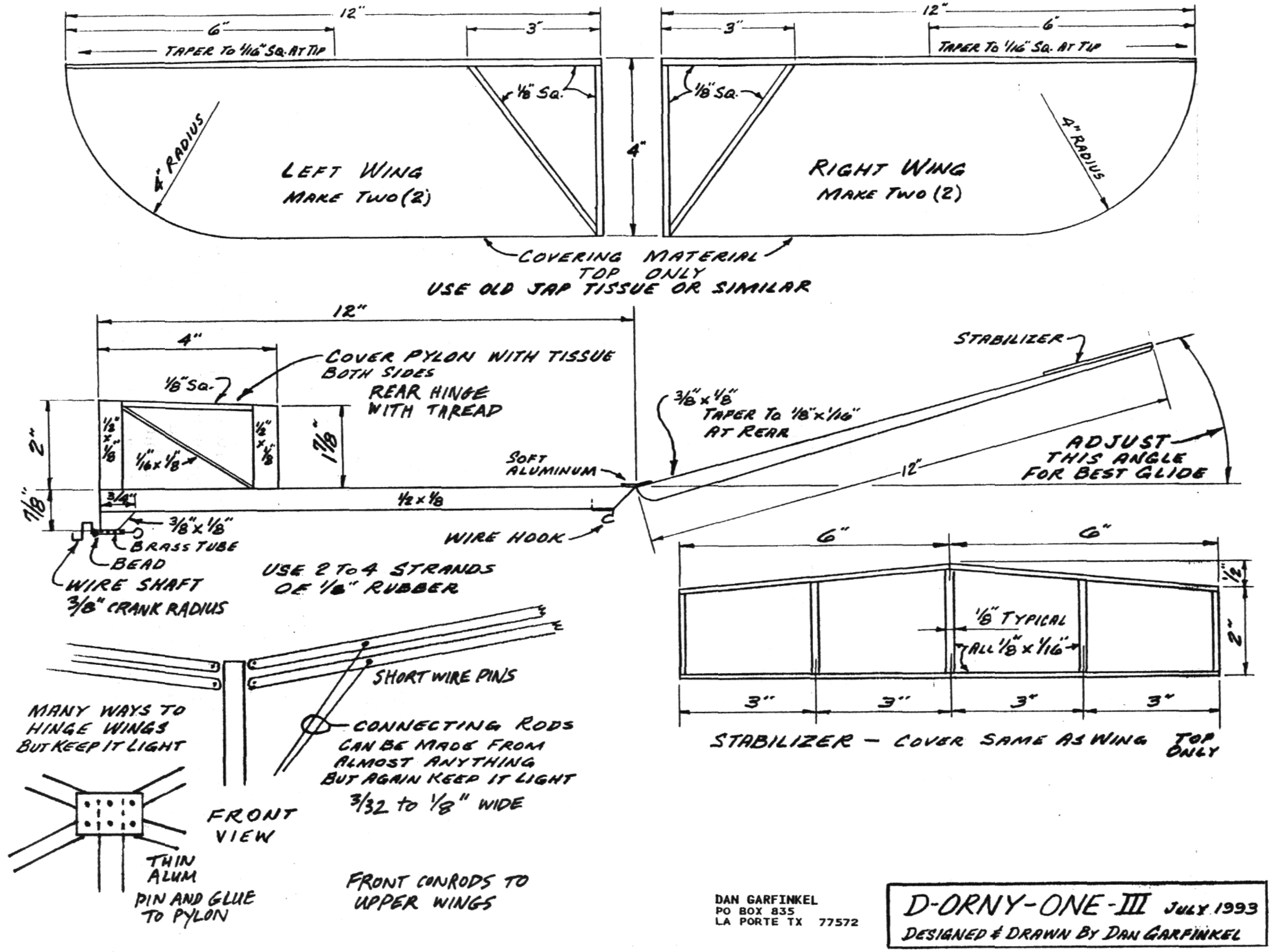
How to tie together ends of rubber band:

For the wings, spread the tissue flat on your work surface. Coat the top of the wing spars and pylon with glue and lay the structure on top of the tissue, keeping both model and tissue flat on the work surface until the glue sets. Tissue grain should be perpendicular to wing spars.

RETAINERS. Reinstall conrods. Cut two aluminum tube retainers 3/32" long and put them on the wing lever wires. Leave space between conrods and retainers. Crimp each retainer with pliers and add a small drop of glue to the outer end. As the conrods loosen up, you may need a retainer on the crank as well.

POWER UP. Cut an 18" length of 1/8" model airplane rubber. Tie as shown. For best results, lubricate the entire motor with rubber lube. Double the rubber band, and install on the front and rear motor hooks with the knot in the back.

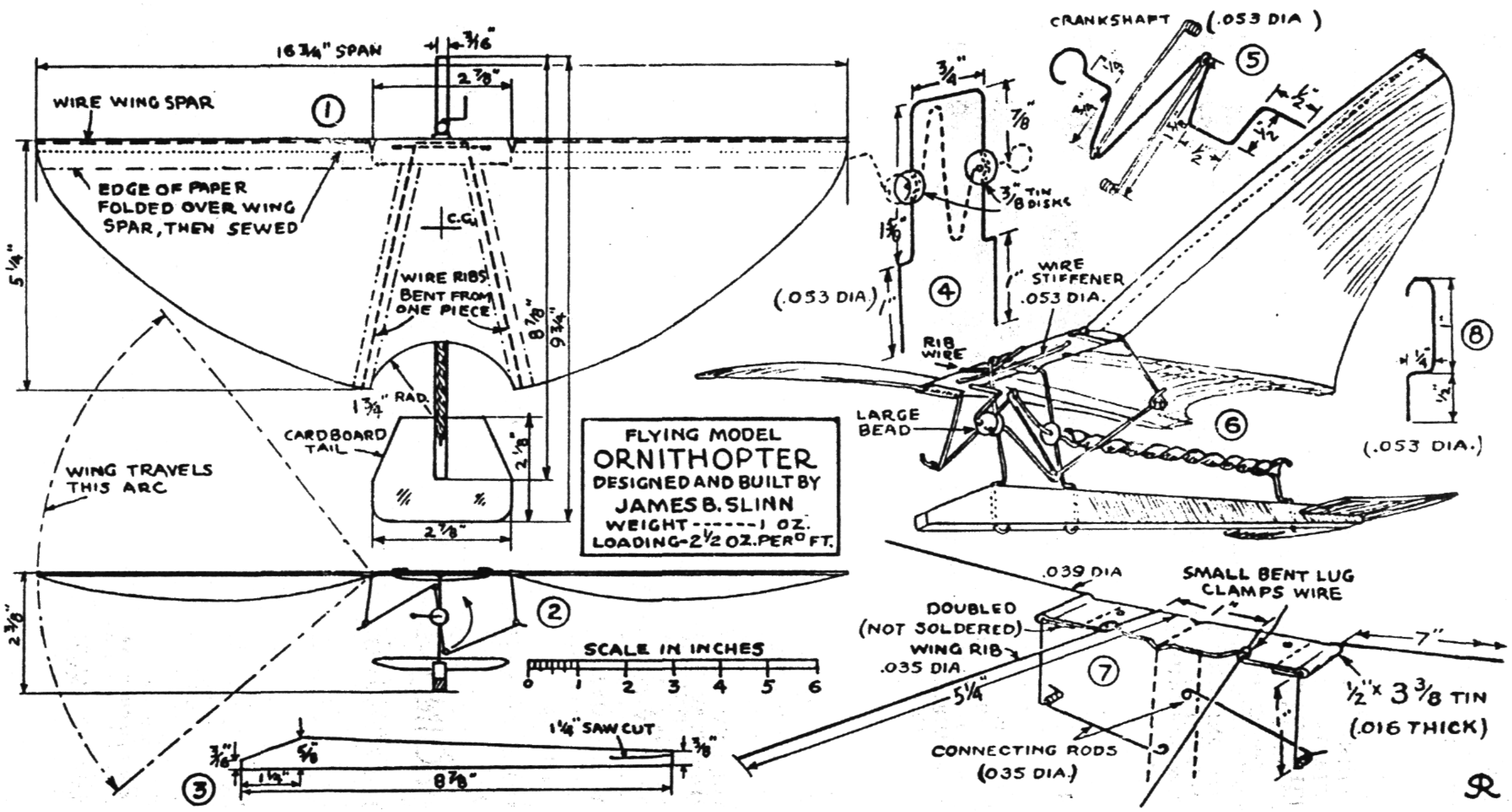
FLY IT! Before flying, bend the tail slightly upward. Start off with some lowpower indoor tests to get the model adjusted right. Wind the motor 40 times, launch gently. The ornithopter should slowly descend, weakly flapping its wings. If it makes a nose dive, bend the tail up slightly. If it stalls (tries to go up, but then drops sharply), bend the tail down a bit. Try to eliminate left or right turns. Fullpower flights (130 turns) may require further adjustments.

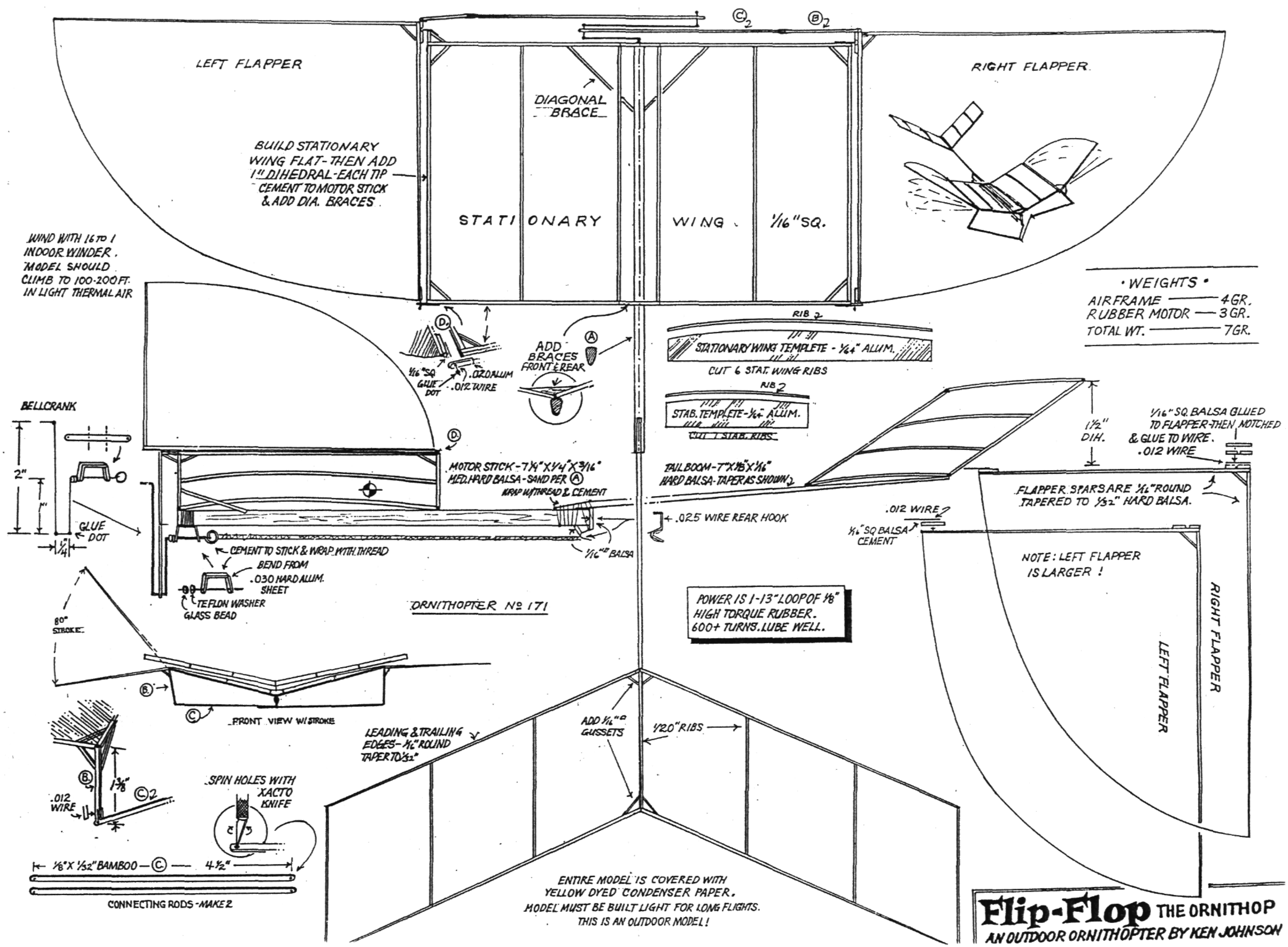


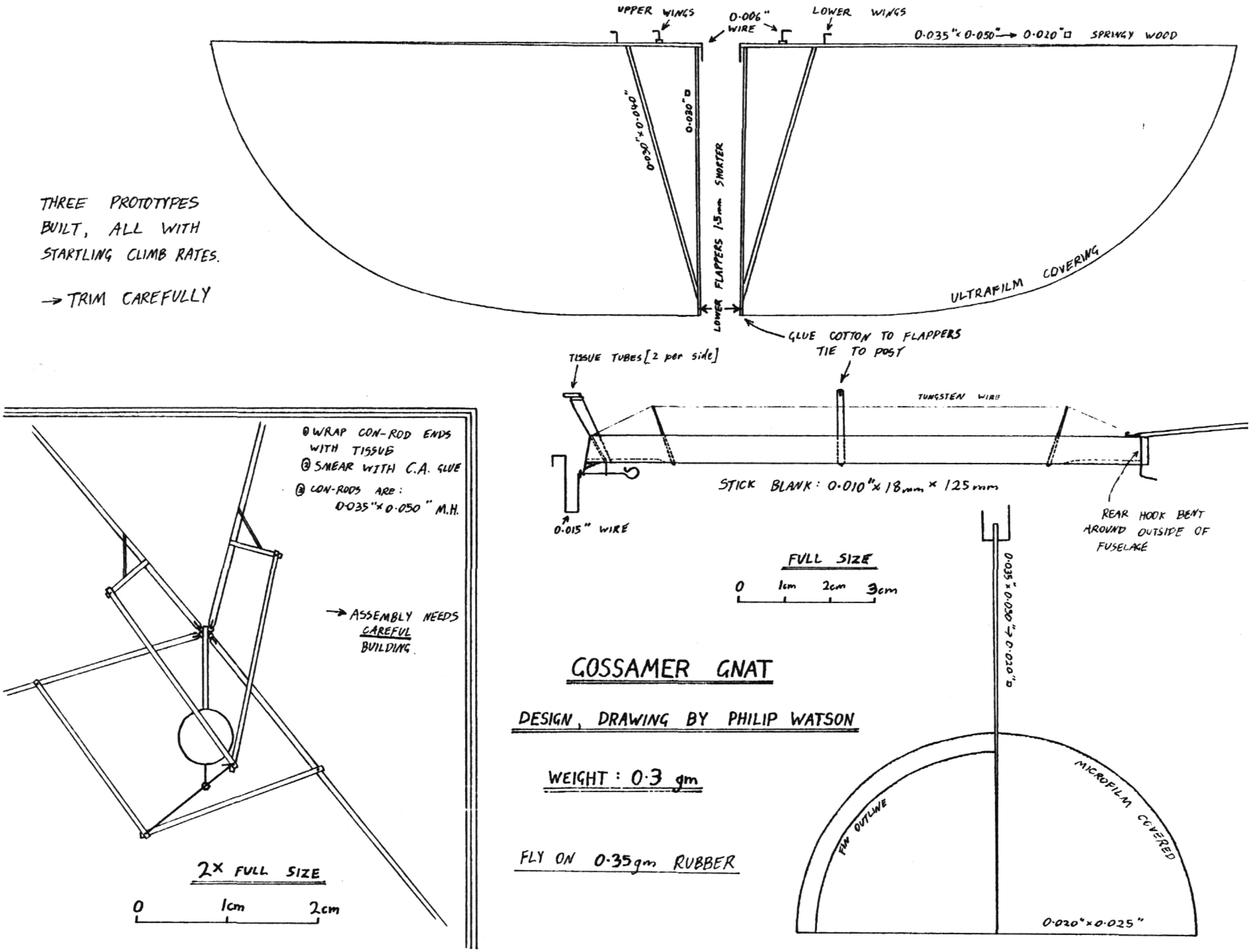
DAN GARFINKEL
PO BOX 835
LA PORTE TX 77572

D-ORNY-ONE-III JULY 1993

DESIGNED & DRAWN BY DAN GARFINKEL

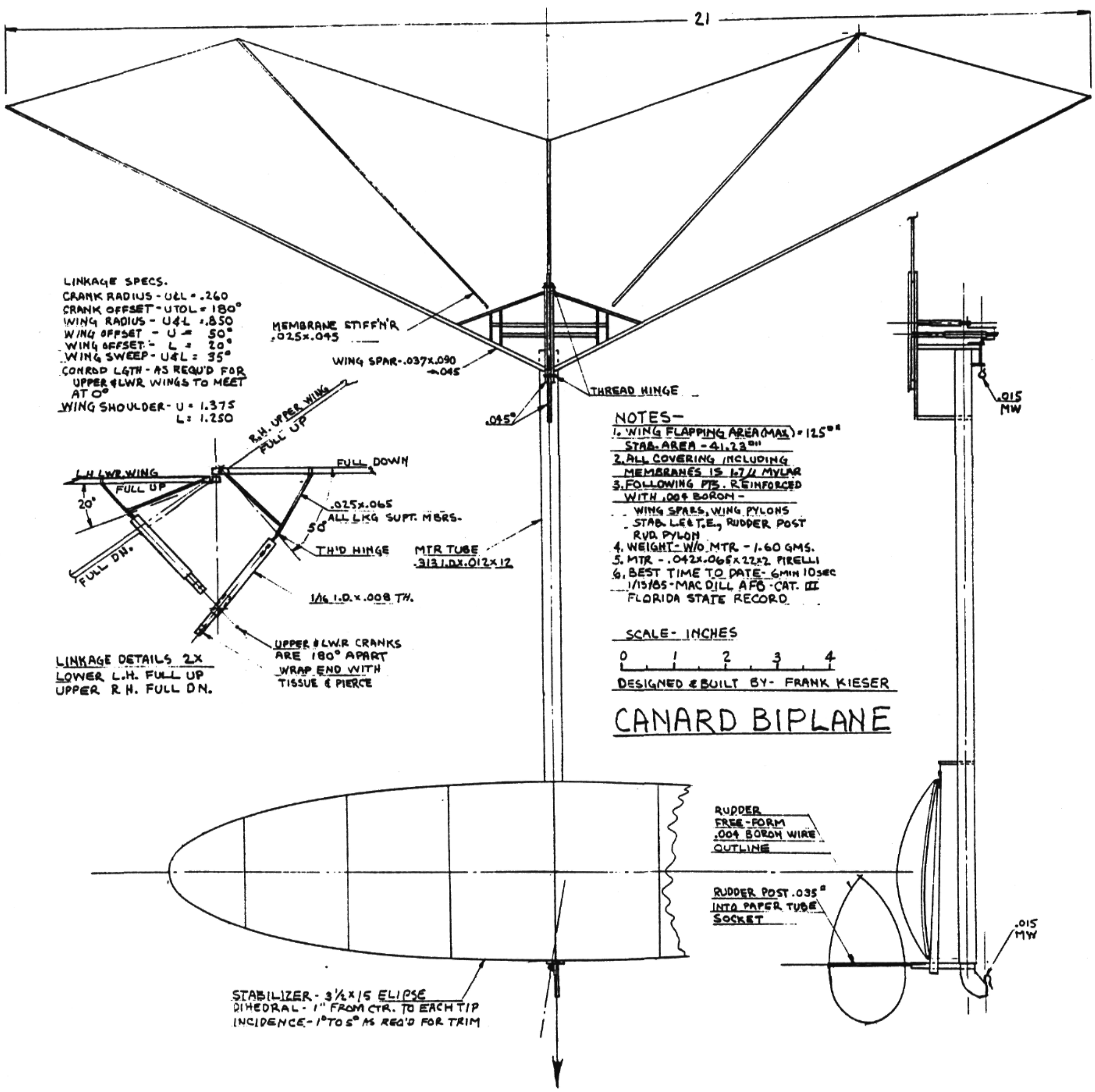

FLYING MODEL
ORNITHOPTER
DESIGNED AND BUILT BY
JAMES B. SLINN
WEIGHT------1 OZ.
LOADING-2 1/2 OZ. PER □ FT.
16 3/4" SPAN
WIRE WING SPAR
EDGE OF PAPER FOLDED OVER WING SPAR, THEN SEWED
C.G.
WIRE RIBS BENT FROM ONE PIECE
RAD.
CARDBOARD TAIL
WING TRAVELS THIS ARC
SCALE IN INCHES
1 1/4" SAW CUT
CRANKSHAFT
(.053 DIA)
3/8" TIN DISKS
WIRE STIFFENER .053 DIA.
(.053 DIA.)
RIB WIRE
LARGE BEAD
.039 DIA
SMALL BENT LUG CLAMPS WIRE
DOUBLED (NOT SOLDERED)
WING RIB .035 DIA.
1/2" x 3 3/8 TIN (.016 THICK)
CONNECTING RODS (035 DIA.)

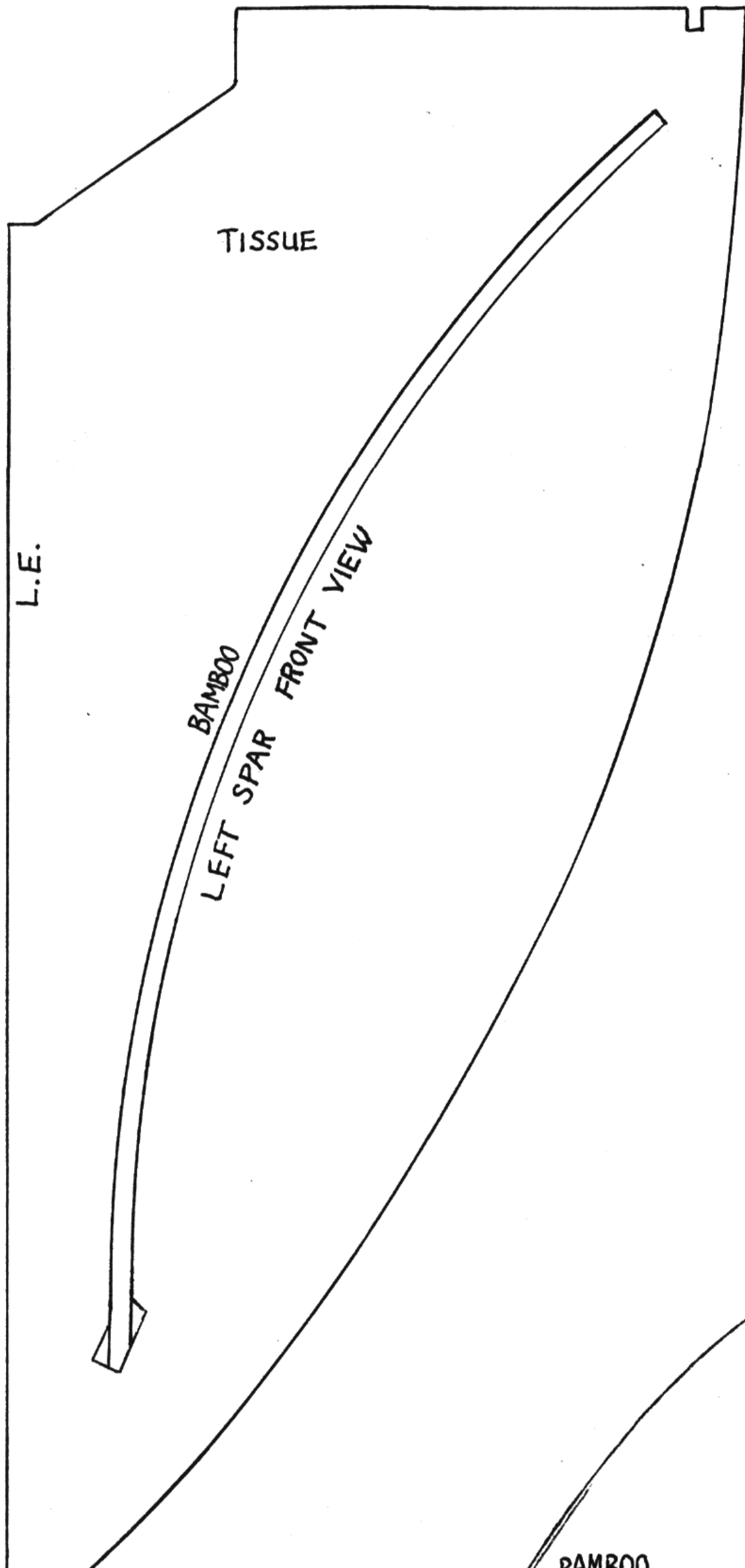

Flip-Flop THE ORNITHOP
AN OUTDOOR ORNITHOPTER BY KEN JOHNSON
LEFT FLAPPER
RIGHT FLAPPER
DIAGONAL BRACE
BUILD STATIONARY WING FLAT - THEN ADD 1" DIHEDRAL - EACH TIP CEMENT TO MOTOR STICK & ADD DIA. BRACES
STATIONARY WING 1/16"SQ.
WIND WITH 16 TO 1 INDOOR WINDER. MODEL SHOULD CLIMB TO 100-200 FT. IN LIGHT THERMAL AIR
• WEIGHTS •
AIRFRAME — 4GR.
RUBBER MOTOR — 3GR.
TOTAL WT. — 7GR.
RIB 2
STATIONARY WING TEMPLETE - 1/64" ALUM.
CUT 6 STAT. WING RIBS
STAB. TEMPLETE - 1/64" ALUM.
CUT 1 STAB. RIBS
ADD BRACES FRONT & REAR
1/16" SQ GLUE DOT
.020 ALUM
.012 WIRE
BELLCRANK
2"
1"
GLUE DOT
1/4"
MOTOR STICK - 7 1/4" X 1/4" X 3/16" MED. HARD BALSA - SAND PER (A)
WRAP W/THREAD & CEMENT
TAILBOOM - 7" X 1/8" X 1/16" HARD BALSA - TAPER AS SHOWN
.025 WIRE REAR HOOK
1/16" BALSA
CEMENT TO STICK & WRAP WITH THREAD
BEND FROM .030 HARD ALUM. SHEET
TEFLON WASHER
GLASS BEAD
ORNITHOPTER No 171
1 1/2" DIH.
1/16" SQ. BALSA GLUED TO FLAPPER - THEN NOTCHED & GLUE TO WIRE. .012 WIRE
FLAPPER SPARS ARE 1/16" ROUND TAPERED TO 1/32" HARD BALSA.
.012 WIRE
1/16" SQ BALSA CEMENT
NOTE: LEFT FLAPPER IS LARGER!
POWER IS 1-13" LOOP OF 1/8" HIGH TORQUE RUBBER. 600+ TURNS. LUBE WELL.
80° STROKE
FRONT VIEW W/ STROKE
LEADING & TRAILING EDGES - 1/16" ROUND TAPER TO 1/32"
ADD 1/16" GUSSETS
1/20" RIBS
1 3/8"
.012 WIRE
SPIN HOLES WITH XACTO KNIFE
1/8" X 1/32" BAMBOO — (C) — 4 1/2"
CONNECTING RODS - MAKE 2
ENTIRE MODEL IS COVERED WITH YELLOW DYED CONDENSER PAPER. MODEL MUST BE BUILT LIGHT FOR LONG FLIGHTS. THIS IS AN OUTDOOR MODEL!



UPPER WINGS
0·006" WIRE
LOWER WINGS
0·035" × 0·050" → 0·020" □ SPRINGY WOOD
0·030" × 0·040"
0·080" □
LOWER FLAPPERS 1·5mm SHORTER
ULTRAFILM COVERING
THREE PROTOTYPES BUILT, ALL WITH STARTLING CLIMB RATES.
→ TRIM CAREFULLY
GLUE COTTON TO FLAPPERS
TIE TO POST
TISSUE TUBES [2 per side]
TUNGSTEN WIRE
STICK BLANK : 0·010" × 18mm × 125mm
0·015" WIRE
REAR HOOK BENT AROUND OUTSIDE OF FUSELAGE
FULL SIZE
0 1cm 2cm 3cm
① WRAP CON-ROD ENDS WITH TISSUE
② SMEAR WITH C.A. GLUE
③ CON-RODS ARE : 0·035" × 0·050" M.H.
→ ASSEMBLY NEEDS CAREFUL BUILDING.
2× FULL SIZE
0 1cm 2cm
GOSSAMER GNAT
DESIGN, DRAWING BY PHILIP WATSON
WEIGHT : 0·3 gm
FLY ON 0·35gm RUBBER
0·035" × 0·030" → 0·020" □
FIN OUTLINE
MICROFILM COVERED
0·020" × 0·025"

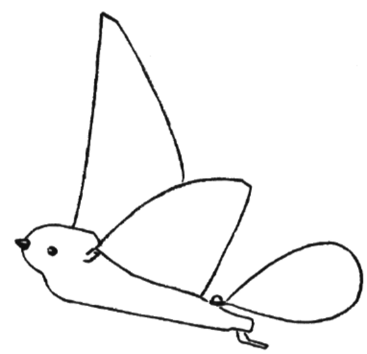
OMS FLAPPERPET #7

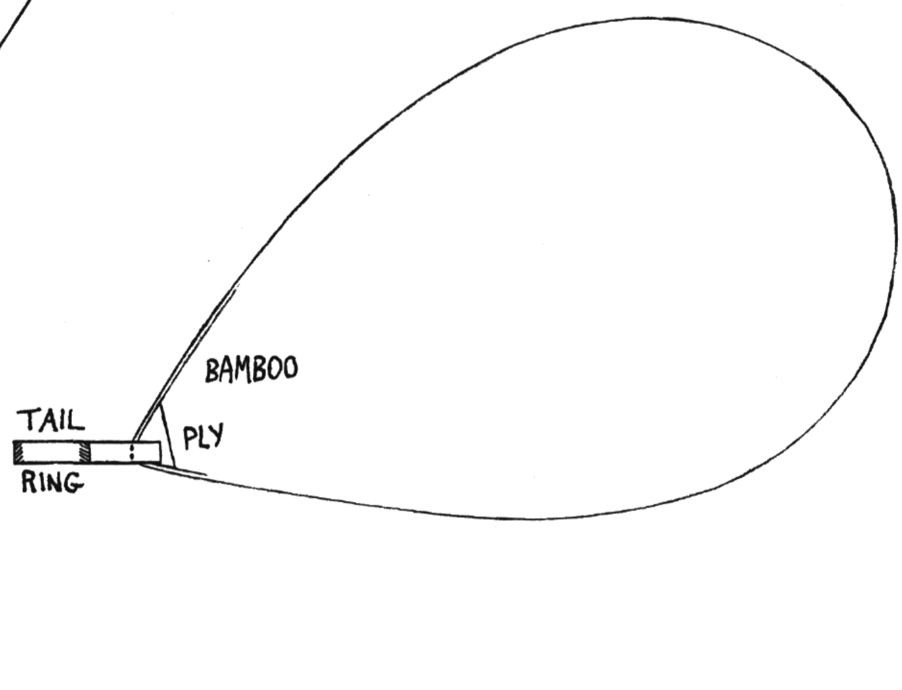




TAILLESS TIM

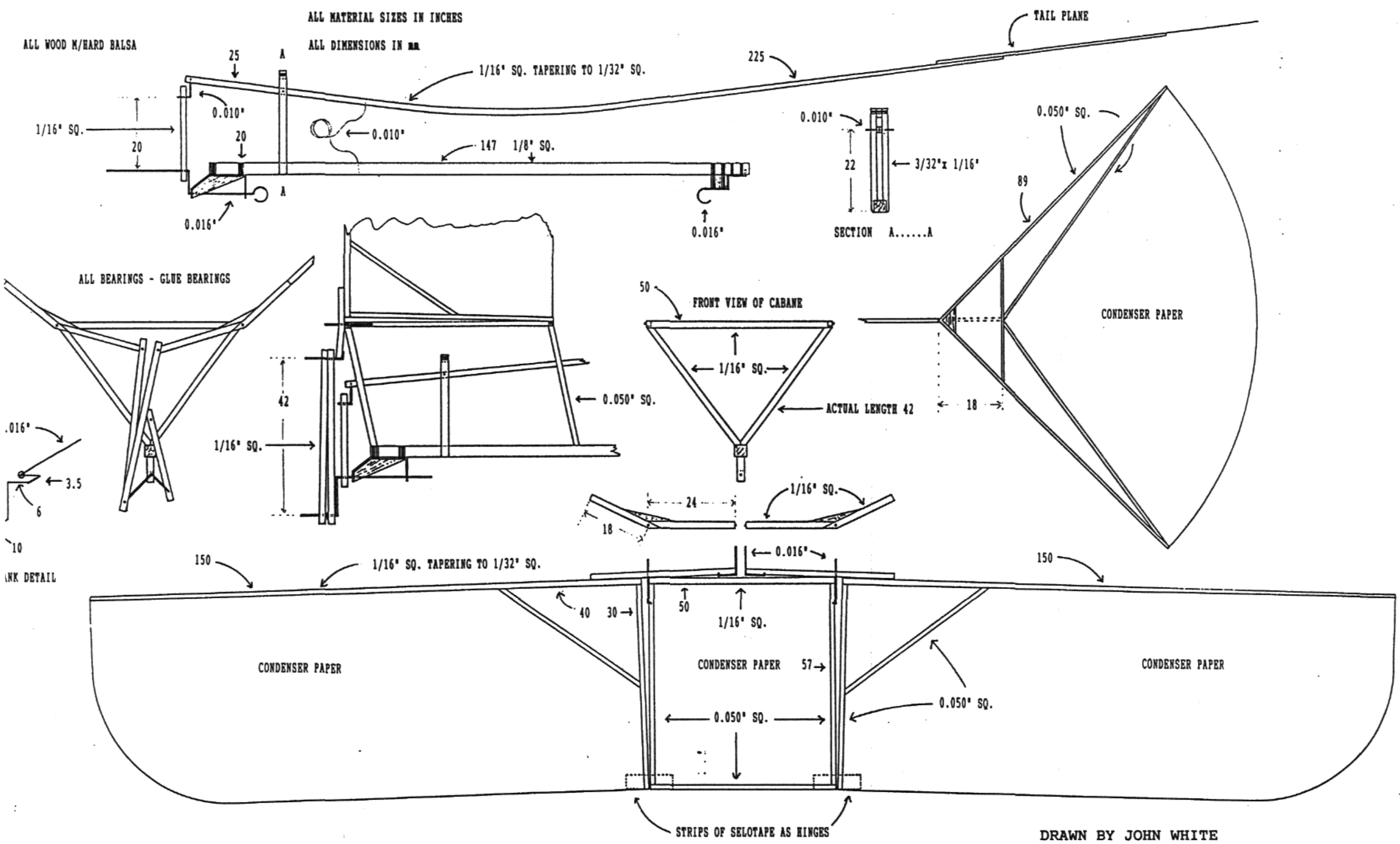
Nathan Chronister





' MOSQUITO '

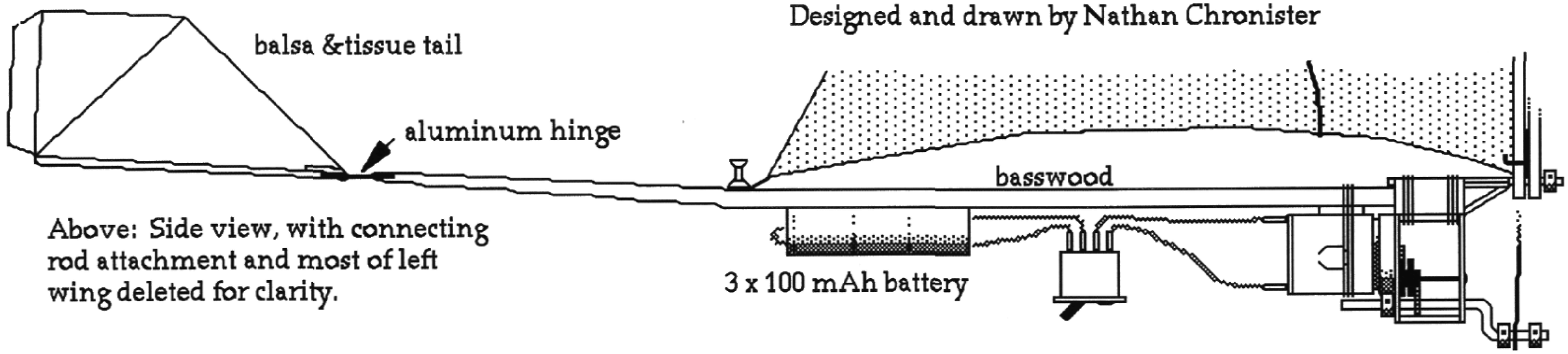
DESIGNED BY JOHN WHITE



DRAWN BY JOHN WHITE

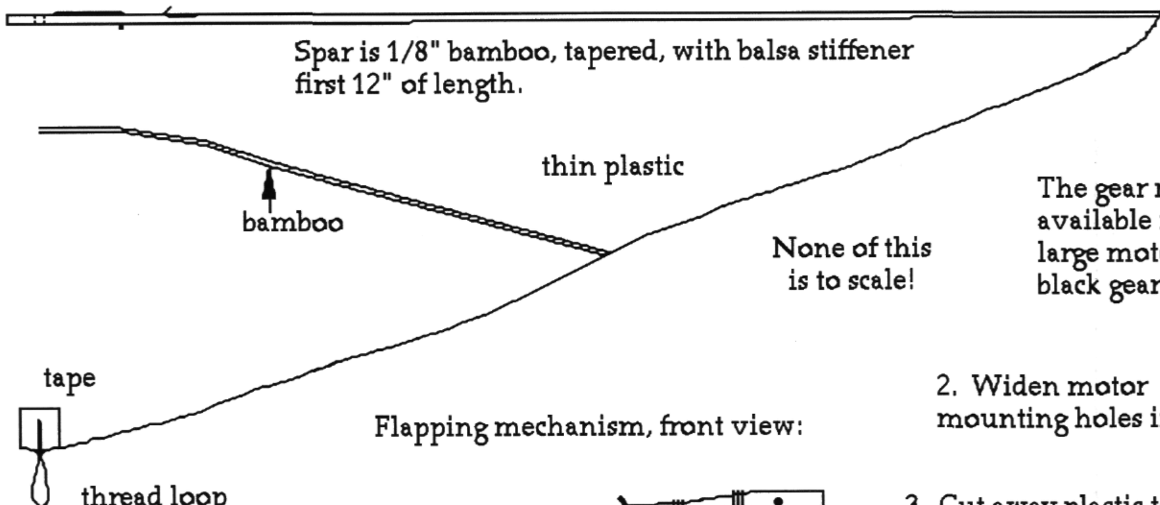
Electric Dawn ornithopter

Designed and drawn by Nathan Chronister



Above: Side view, with connecting rod attachment and most of left wing deleted for clarity.

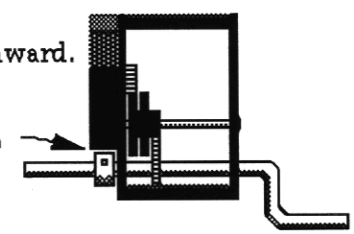
Motor: M-25 motor from VL Products. Request one without the prop adaptor (bare shaft).



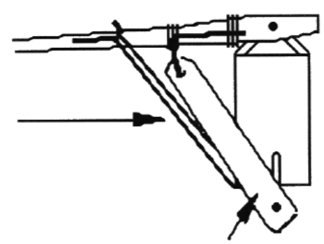
None of this is to scale!

The gear reduction unit in this model is available from Hobby Lobby: HLH731 large motor geartrain using two of the black gears, with the following changes:

1. Remove screw mounts.
2. Widen motor mounting holes inward.
3. Cut away plastic to clear the collar.
4. Cut away the integral spacer which keeps the second black gear away from the metal gear. Replace it with a new washer made from plywood.



Flapping mechanism, front view:



Rubber bands are used to balance the force of lift on the wings.

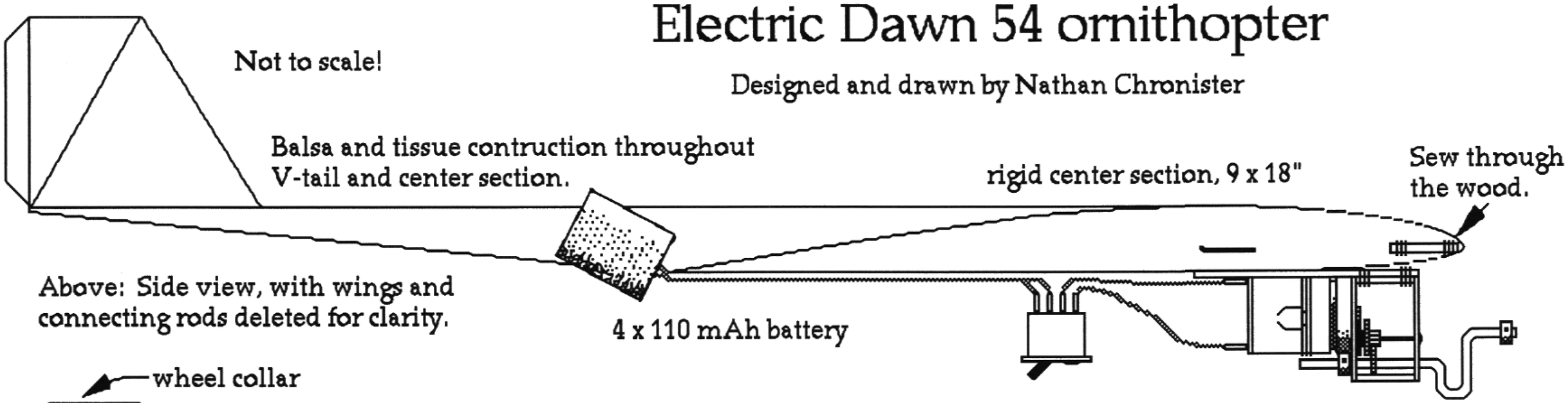
||| = thread wrapping

Electric Dawn 54 ornithopter

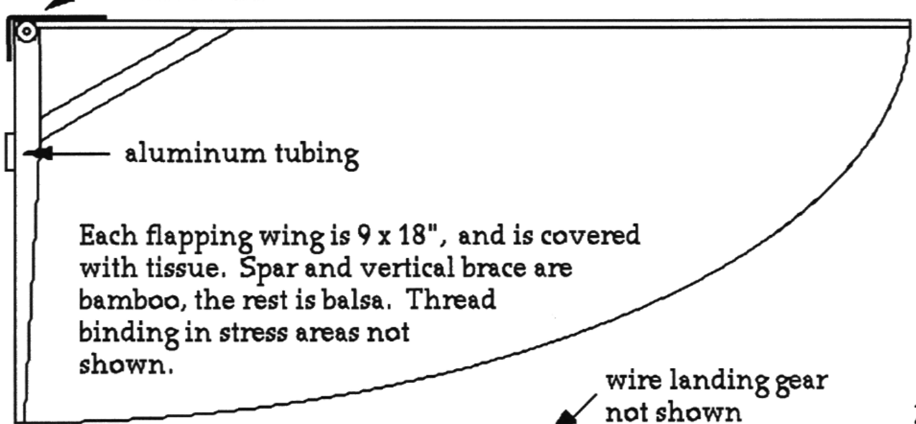
Designed and drawn by Nathan Chronister

Not to scale!

Balsa and tissue contruction throughout V-tail and center section.



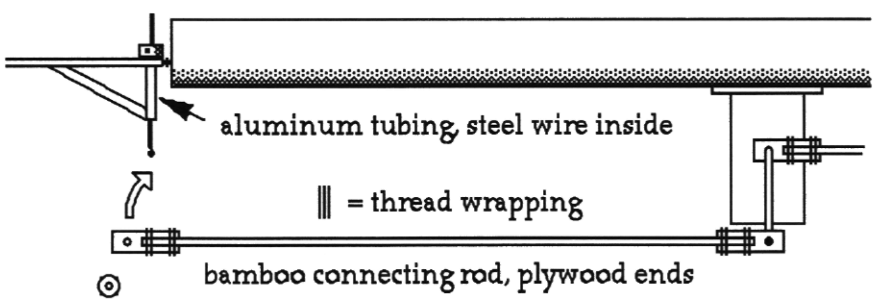
Above: Side view, with wings and connecting rods deleted for clarity.



Each flapping wing is 9 x 18", and is covered with tissue. Spar and vertical brace are bamboo, the rest is balsa. Thread binding in stress areas not shown.

wire landing gear not shown

Flapping mechanism, front view:



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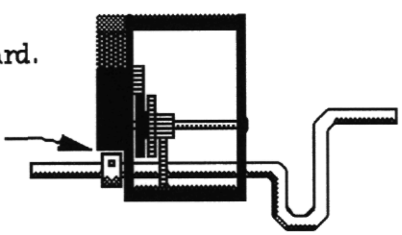
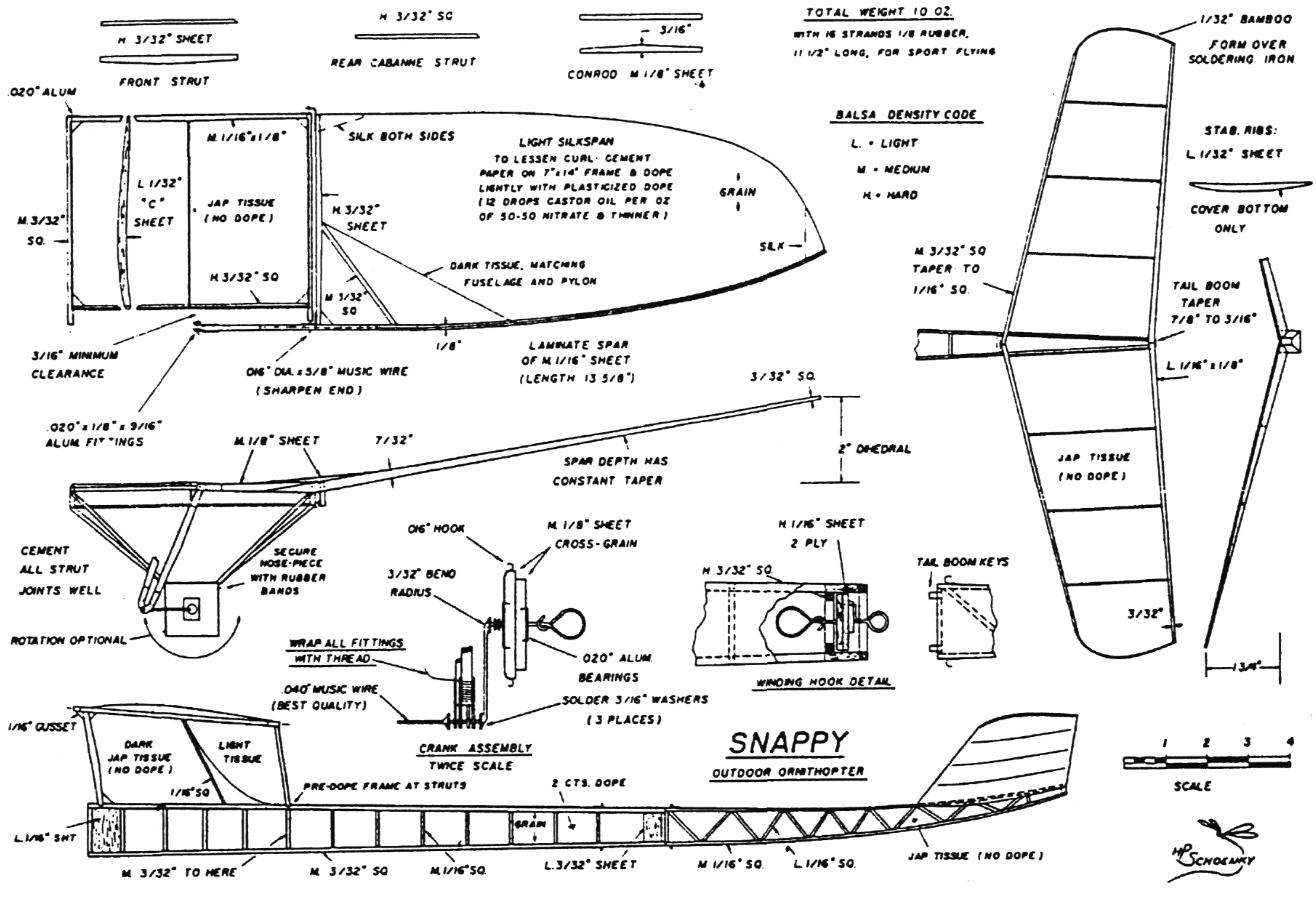
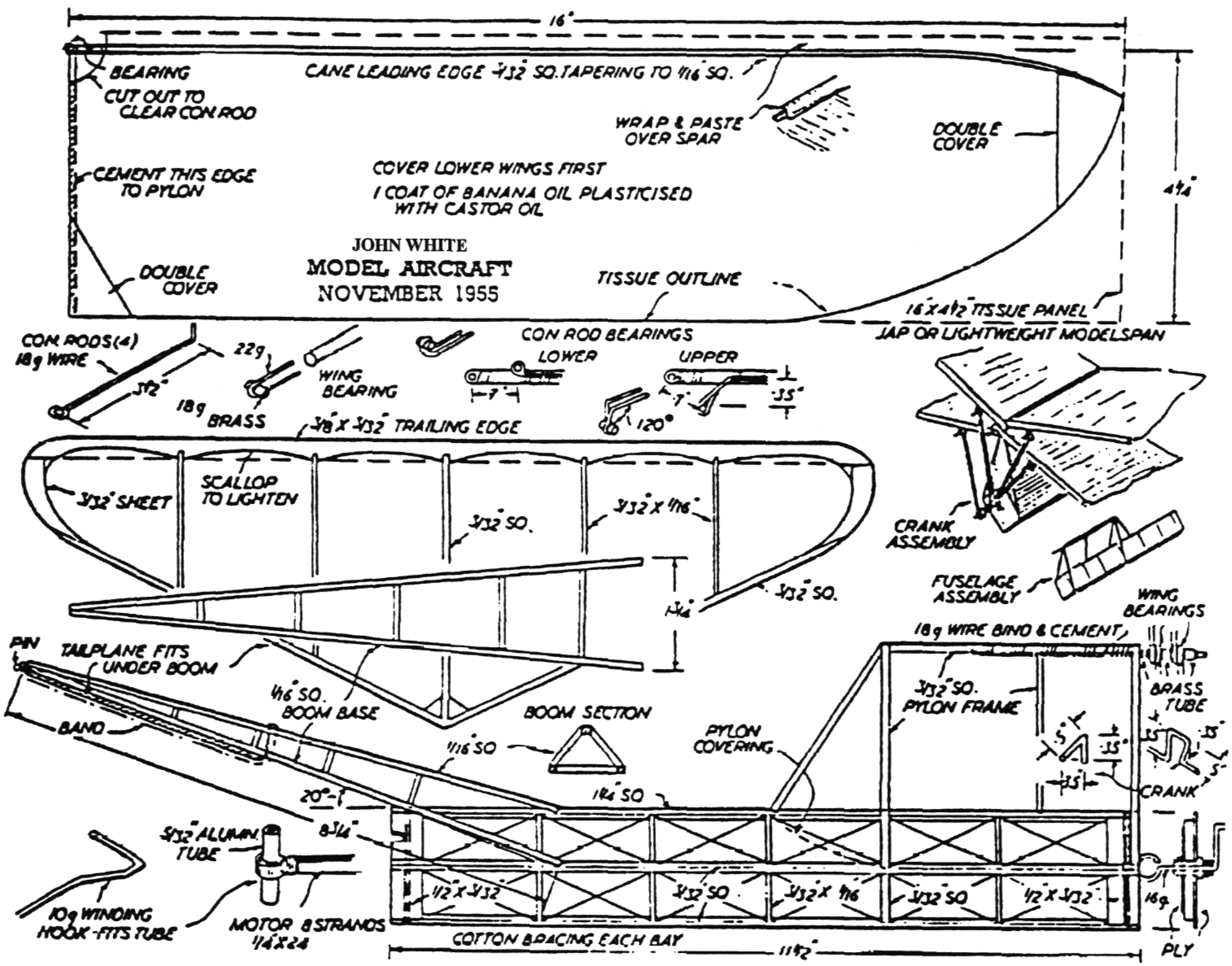


4. Replace second black gear with a stronger one.

5. Cut away the integral spacer which keeps the second black gear away from the metal gear. Replace it with a new washer made from plywood.

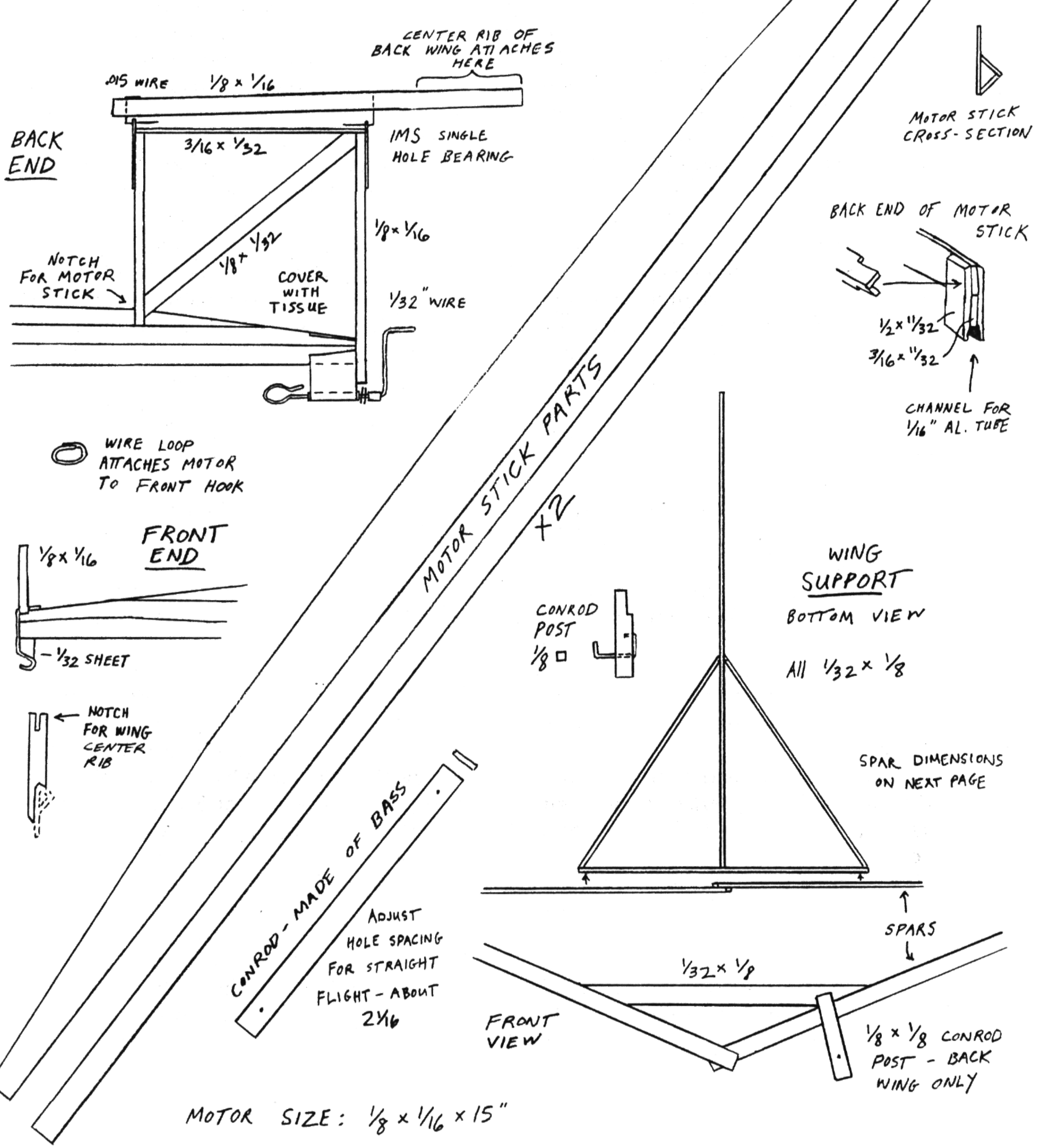

SNAPPY
OUTDOOR ORNITHOPTER
TOTAL WEIGHT 10 OZ.
WITH 16 STRANDS 1/8 RUBBER, 11 1/2" LONG, FOR SPORT FLYING
BALSA DENSITY CODE
L. = LIGHT
M = MEDIUM
H = HARD
H 3/32" SHEET
FRONT STRUT
H 3/32" SQ
REAR CABANNE STRUT
3/16"
CONROD M 1/8" SHEET
.020" ALUM
M 1/16" x 1/8"
SILK BOTH SIDES
L 1/32" "C" SHEET
JAP TISSUE (NO DOPE)
M 3/32" SQ.
H 3/32" SHEET
H 3/32" SQ
M 3/32" SQ
LIGHT SILKSPAN
TO LESSEN CURL CEMENT PAPER ON 7" x 14" FRAME & DOPE LIGHTLY WITH PLASTICIZED DOPE (12 DROPS CASTOR OIL PER OZ OF 50-50 NITRATE & THINNER)
GRAIN
SILK
DARK TISSUE, MATCHING FUSELAGE AND PYLON
1/8"
LAMINATE SPAR OF M 1/16" SHEET (LENGTH 13 5/8")
3/16" MINIMUM CLEARANCE
016" DIA. x 5/8" MUSIC WIRE (SHARPEN END)
.020" x 1/8" x 9/16" ALUM FITTINGS
M 1/8" SHEET
7/32"
SPAR DEPTH HAS CONSTANT TAPER
3/32" SQ.
2" DIHEDRAL
CEMENT ALL STRUT JOINTS WELL
SECURE NOSE-PIECE WITH RUBBER BANDS
ROTATION OPTIONAL
016" HOOK
M 1/8" SHEET CROSS-GRAIN
3/32" BEND RADIUS
.020" ALUM. BEARINGS
WRAP ALL FITTINGS WITH THREAD
.040" MUSIC WIRE (BEST QUALITY)
SOLDER 3/16" WASHERS (3 PLACES)
CRANK ASSEMBLY TWICE SCALE
H 1/16" SHEET 2 PLY
H 3/32" SQ.
WINDING HOOK DETAIL
TAIL BOOM KEYS
1/32" BAMBOO
FORM OVER SOLDERING IRON
STAB. RIBS:
L 1/32" SHEET
COVER BOTTOM ONLY
M 3/32" SQ TAPER TO 1/16" SQ.
TAIL BOOM TAPER 7/8" TO 3/16"
L 1/16" x 1/8"
JAP TISSUE (NO DOPE)
3/32"
1 3/4"
1/16" GUSSET
DARK JAP TISSUE (NO DOPE)
LIGHT TISSUE
1/16" SQ
PRE-DOPE FRAME AT STRUTS
2 CTS. DOPE
GRAIN
L 1/16" SHT
M. 3/32" TO HERE
M. 3/32" SQ
M 1/16" SQ.
L 3/32" SHEET
M 1/16" SQ.
L 1/16" SQ.
JAP TISSUE (NO DOPE)
1 2 3 4
SCALE
H. P. SCHOEANY

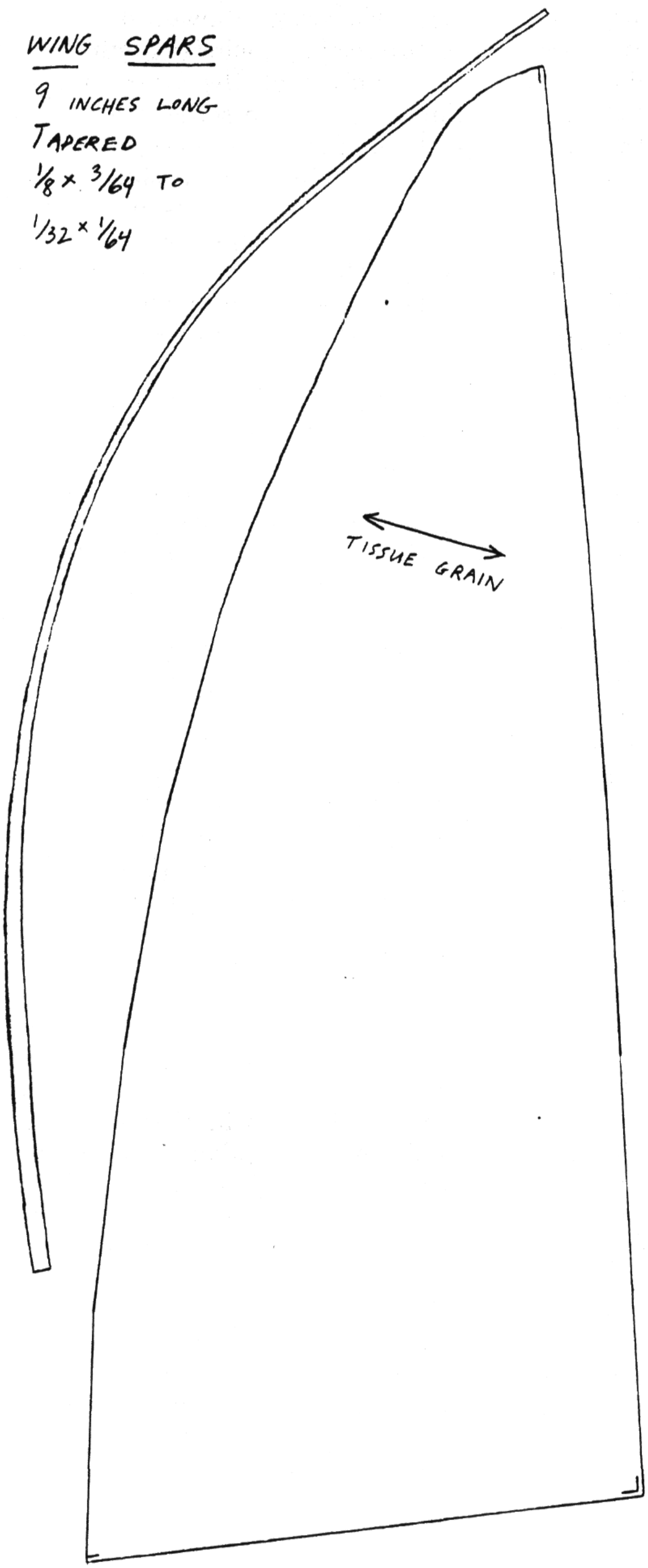


16"
BEARING
CUT OUT TO CLEAR CON. ROD
CANE LEADING EDGE 3/32" SQ. TAPERING TO 1/16" SQ.
WRAP & PASTE OVER SPAR
DOUBLE COVER
CEMENT THIS EDGE TO PYLON
COVER LOWER WINGS FIRST
1 COAT OF BANANA OIL PLASTICISED WITH CASTOR OIL
4 1/4"
JOHN WHITE
MODEL AIRCRAFT
NOVEMBER 1955
DOUBLE COVER
TISSUE OUTLINE
16" X 4 1/2" TISSUE PANEL
JAP OR LIGHTWEIGHT MODELSPAN
CON. RODS (4) 18g WIRE
3 1/2"
22g
18g
BRASS
WING BEARING
CON. ROD BEARINGS
LOWER
UPPER
.7"
.35"
120°
3/8" X 3/32" TRAILING EDGE
3/32" SHEET
SCALLOP TO LIGHTEN
3/32" SQ.
3/32" X 1/16"
3/32" SQ.
1 1/4"
CRANK ASSEMBLY
FUSELAGE ASSEMBLY
WING BEARINGS
18g WIRE BIND & CEMENT
PIN
TAILPLANE FITS UNDER BOOM
1/16" SQ.
BOOM BASE
BOOM SECTION
3/32" SQ.
PYLON FRAME
BRASS TUBE
BAND
1/16" SQ
PYLON COVERING
.5"
.35"
.35"
CRANK
20°
1/4" SQ
8 3/4"
3/32" ALUMN. TUBE
1/2" X 3/32"
3/32" SQ
3/32" X 1/16"
3/32" SQ
1/2" X 3/32"
16g
10g WINDING HOOK - FITS TUBE
MOTOR 8 STRANDS 1/4" X 24
COTTON BRACING EACH BAY
11 1/2"
PLY

AMI

AEROELASTIC MEMBRANE INDOOR





APPLYING THE MEMBRANE

The special characteristics which will allow this ornithopter to produce lift during the upstroke are not determined by the wooden structure. It is essential to apply the membrane correctly. To insure a cambered wing that is not floppy, the membrane should be applied so that it comprises a series of straight (not sagging) lines between the back end of the root rib and each point on the wing spar. The series of imaginary lines is shown in Figure 1. If you do this incorrectly, the wings will have negative camber.

Before the glue dries, you should carefully bend the spars forward and down as shown in Figure 2. Tape the wingtips to the table top with the underside of each wingtip facing straight up. This trains the spars in that direction and increases the amount of pretwist and membrane tension. You may wish to store the model in this position as well, because the twist tends to weaken over time.

FIGURE 1.

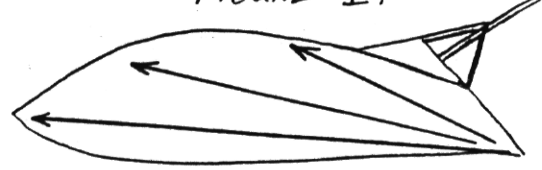
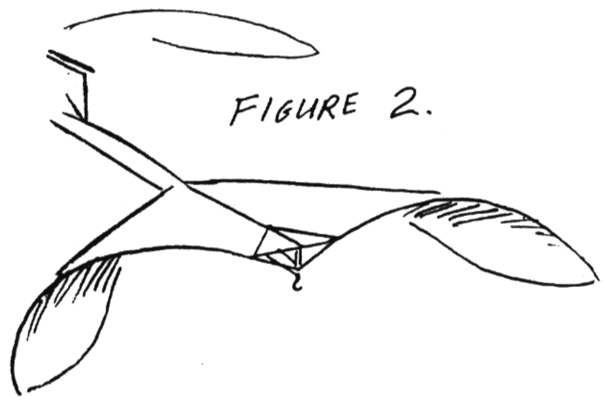
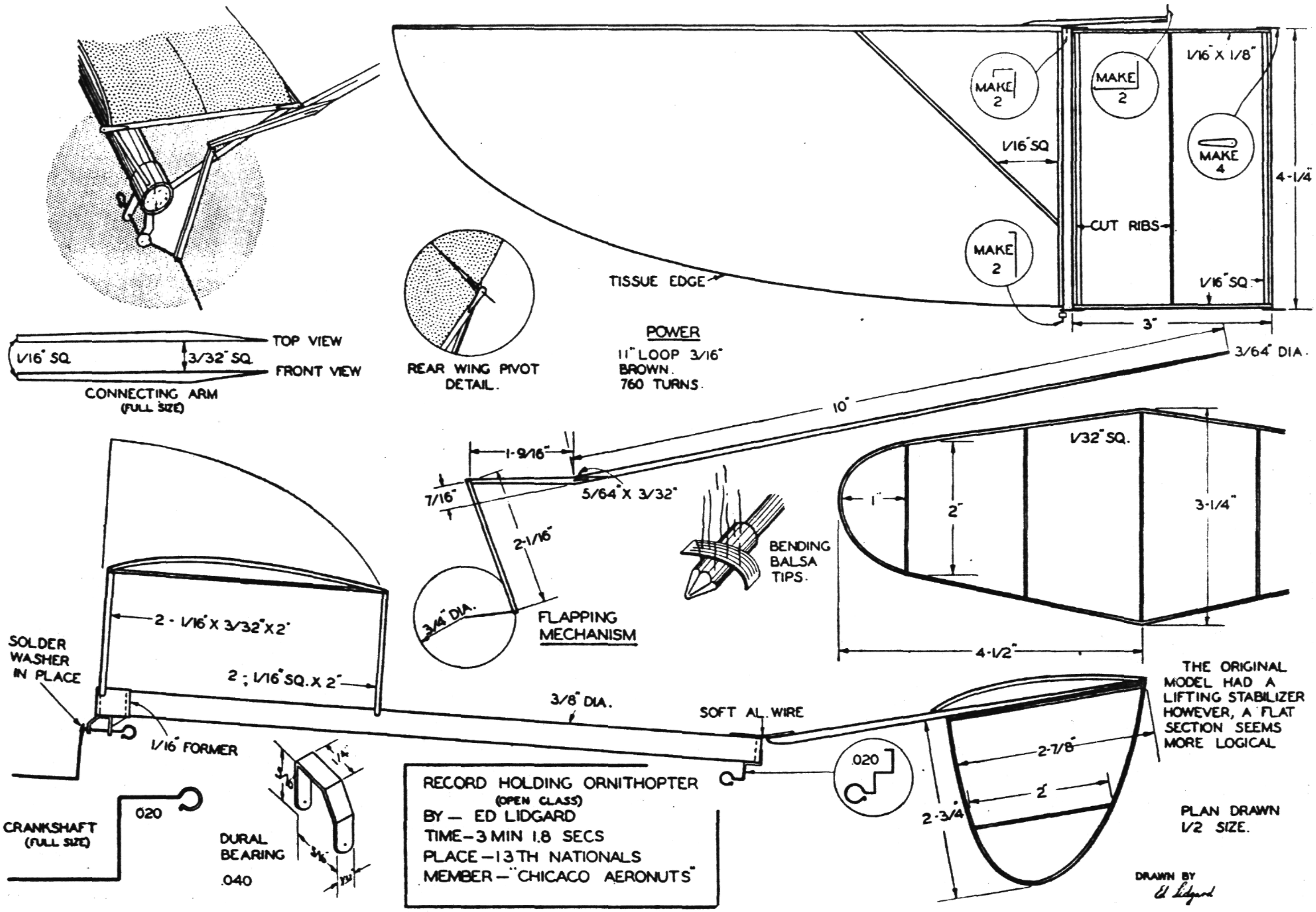


FIGURE 2.

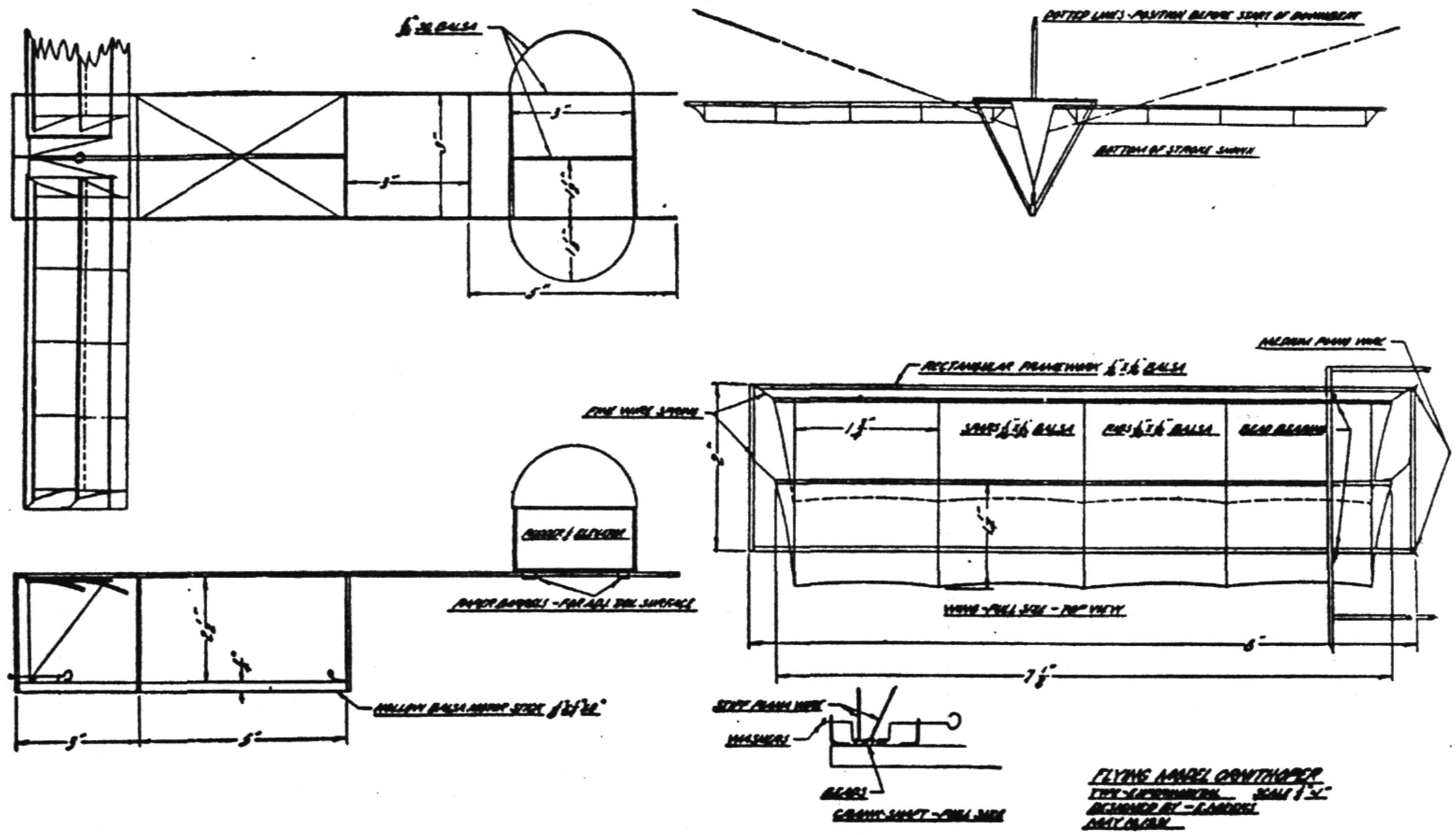


In addition to adjusting the amount of twist, you may need to vary the hardness or thickness of the spars until the right amount of flexibility is achieved. The correct pitches for upstroke and downstroke should be reached when the wings are supporting 0.5 and 1.5 times the model's weight, respectively (a rough estimate).

The model is likely to require some noseweight. The conrod hole spacing may need to be adjusted to prevent uncontrolled yaw and provide a straight flight.



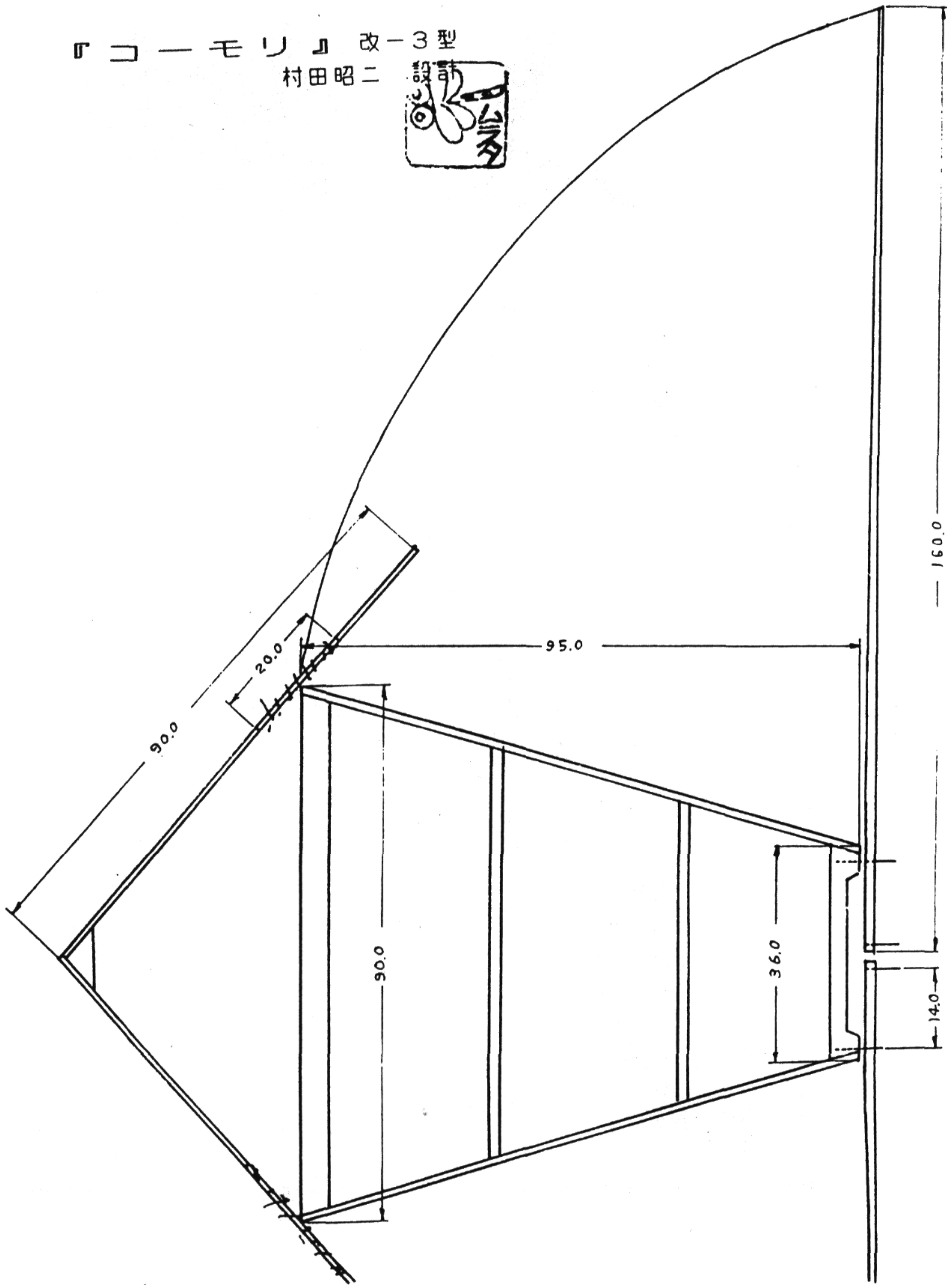
RECORD HOLDING ORNITHOPTER
(OPEN CLASS)
BY — ED LIDGARD
TIME — 3 MIN 1.8 SECS
PLACE — 13TH NATIONALS
MEMBER — "CHICACO AERONUTS"



FLYING MODEL ORNITHOPTER

"Bat" **MurataShoji**

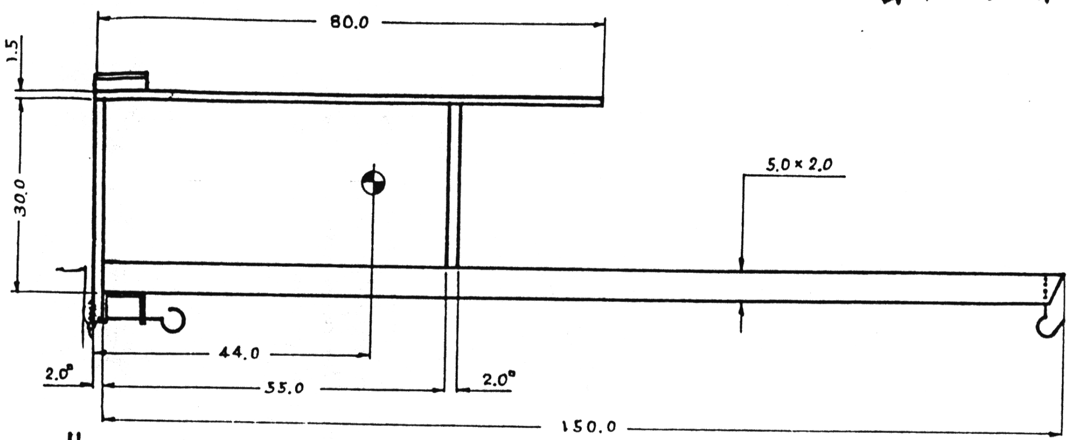
Characteristics of "Komori Bat" flapping plane: When the main wing is on an upward angle, it tends to go up, and vice versa. The tail (triangular balancing wing) counteracts. (This is determined through trial and error.) Place a metal piece on the main junction of the triangular wing.

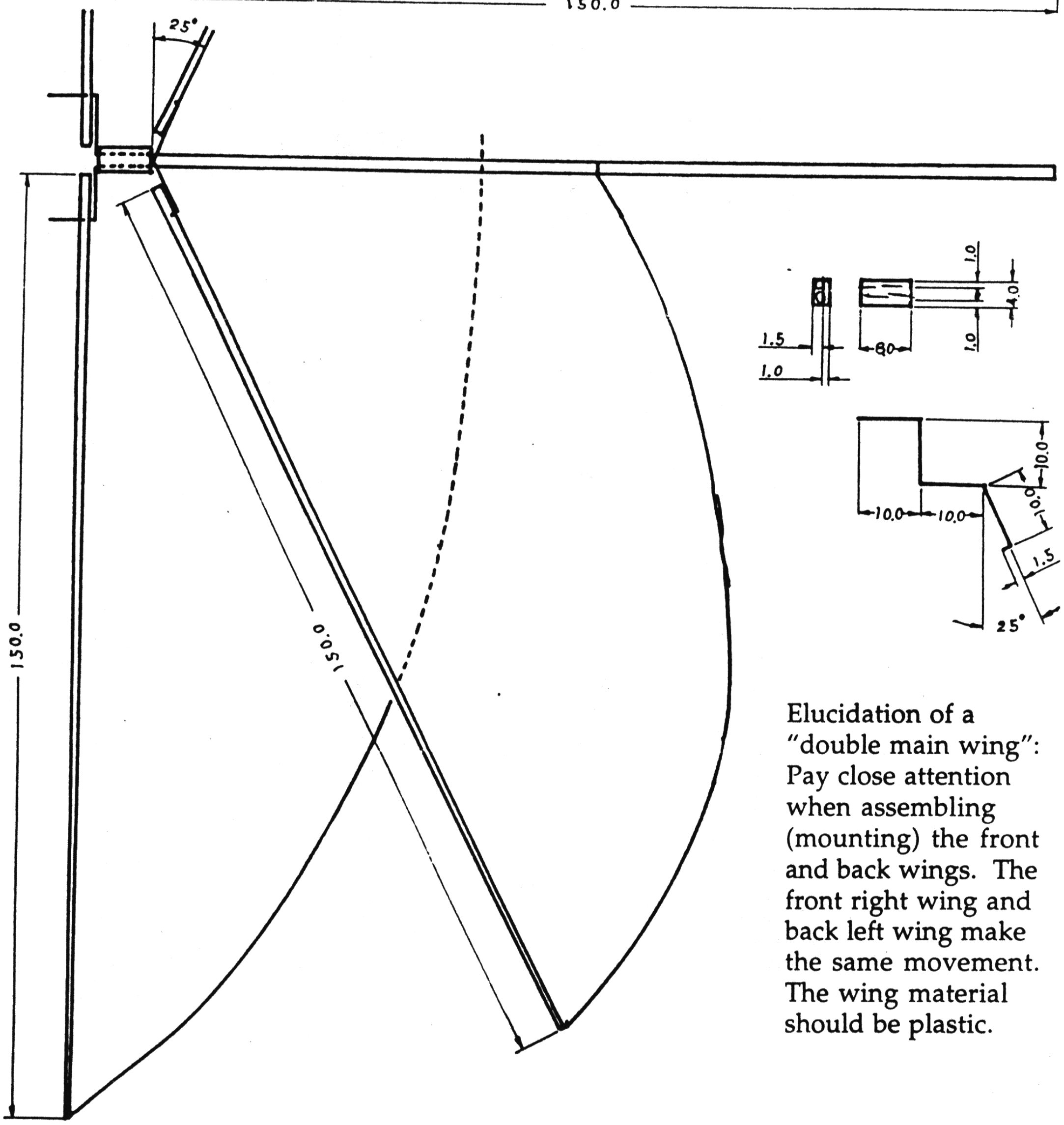


無尾翼はばたき機『かげろう』

Tailless Wing Flapping Plane "Dragonfly"

村田昭



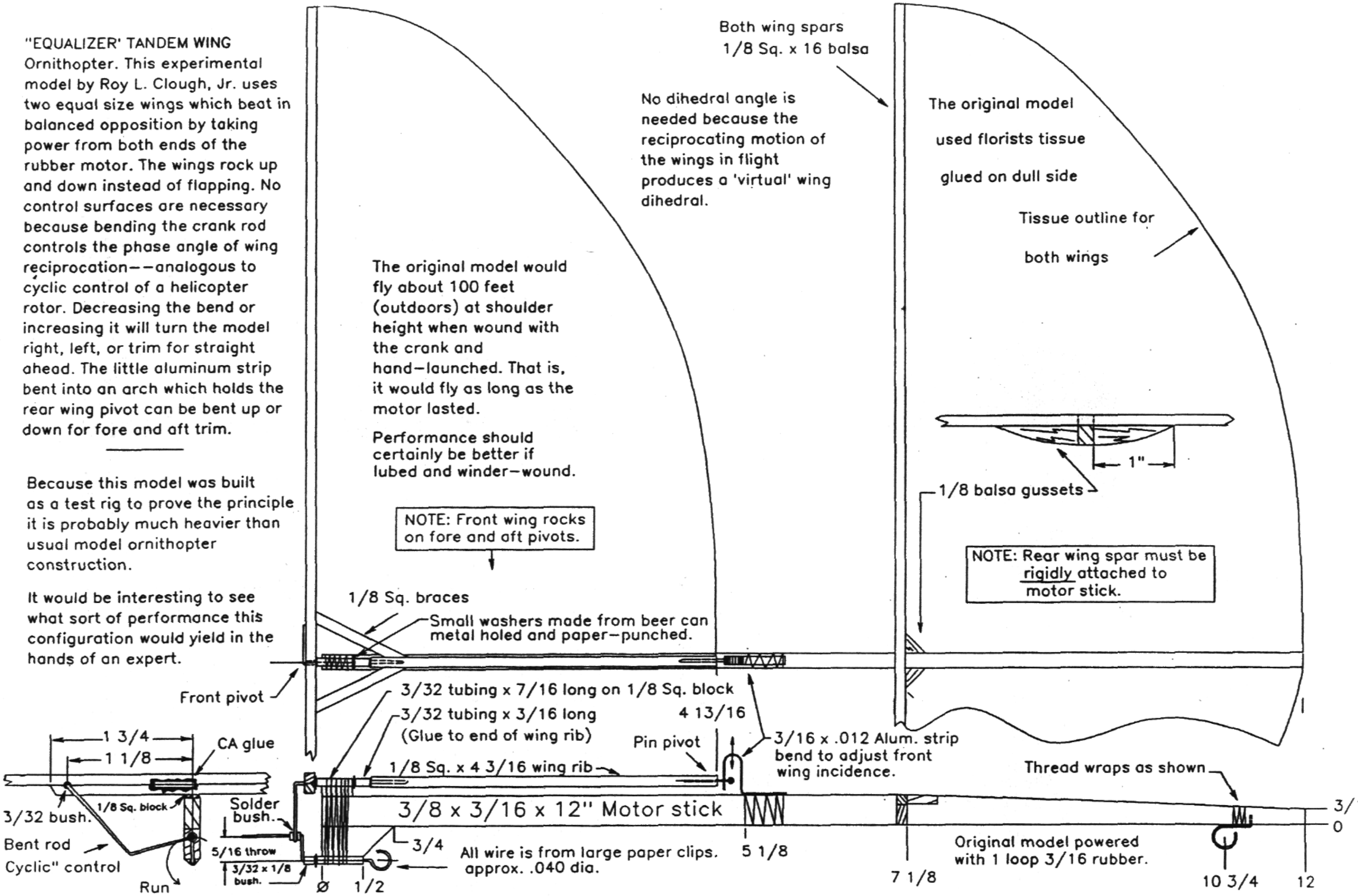


Elucidation of a "double main wing": Pay close attention when assembling (mounting) the front and back wings. The front right wing and back left wing make the same movement. The wing material should be plastic.

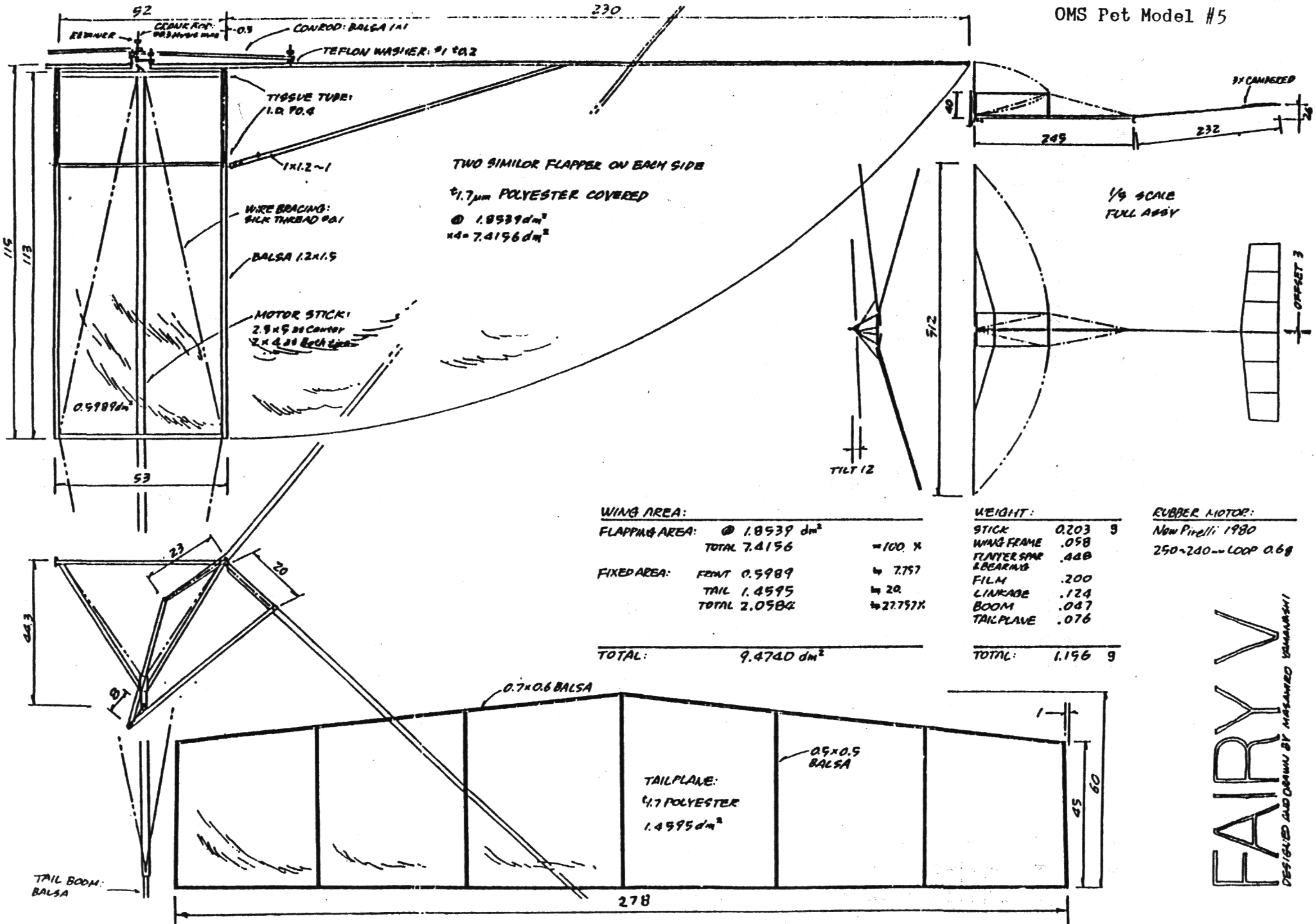
"EQUALIZER' TANDEM WING Ornithopter. This experimental model by Roy L. Clough, Jr. uses two equal size wings which beat in balanced opposition by taking power from both ends of the rubber motor. The wings rock up and down instead of flapping. No control surfaces are necessary because bending the crank rod controls the phase angle of wing reciprocation——analogous to cyclic control of a helicopter rotor. Decreasing the bend or increasing it will turn the model right, left, or trim for straight ahead. The little aluminum strip bent into an arch which holds the rear wing pivot can be bent up or down for fore and aft trim.

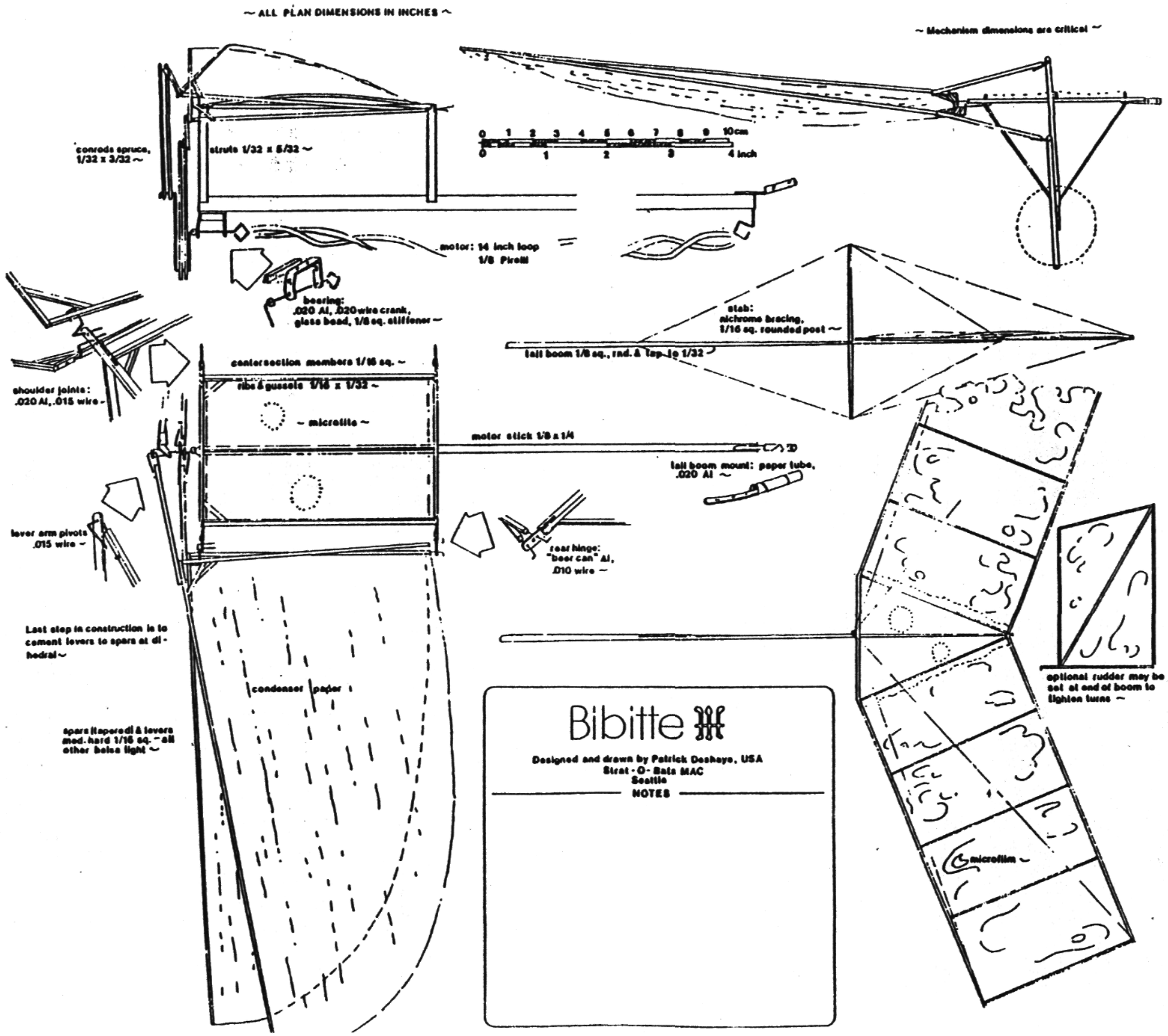
Because this model was built as a test rig to prove the principle it is probably much heavier than usual model ornithopter construction.

It would be interesting to see what sort of performance this configuration would yield in the hands of an expert.

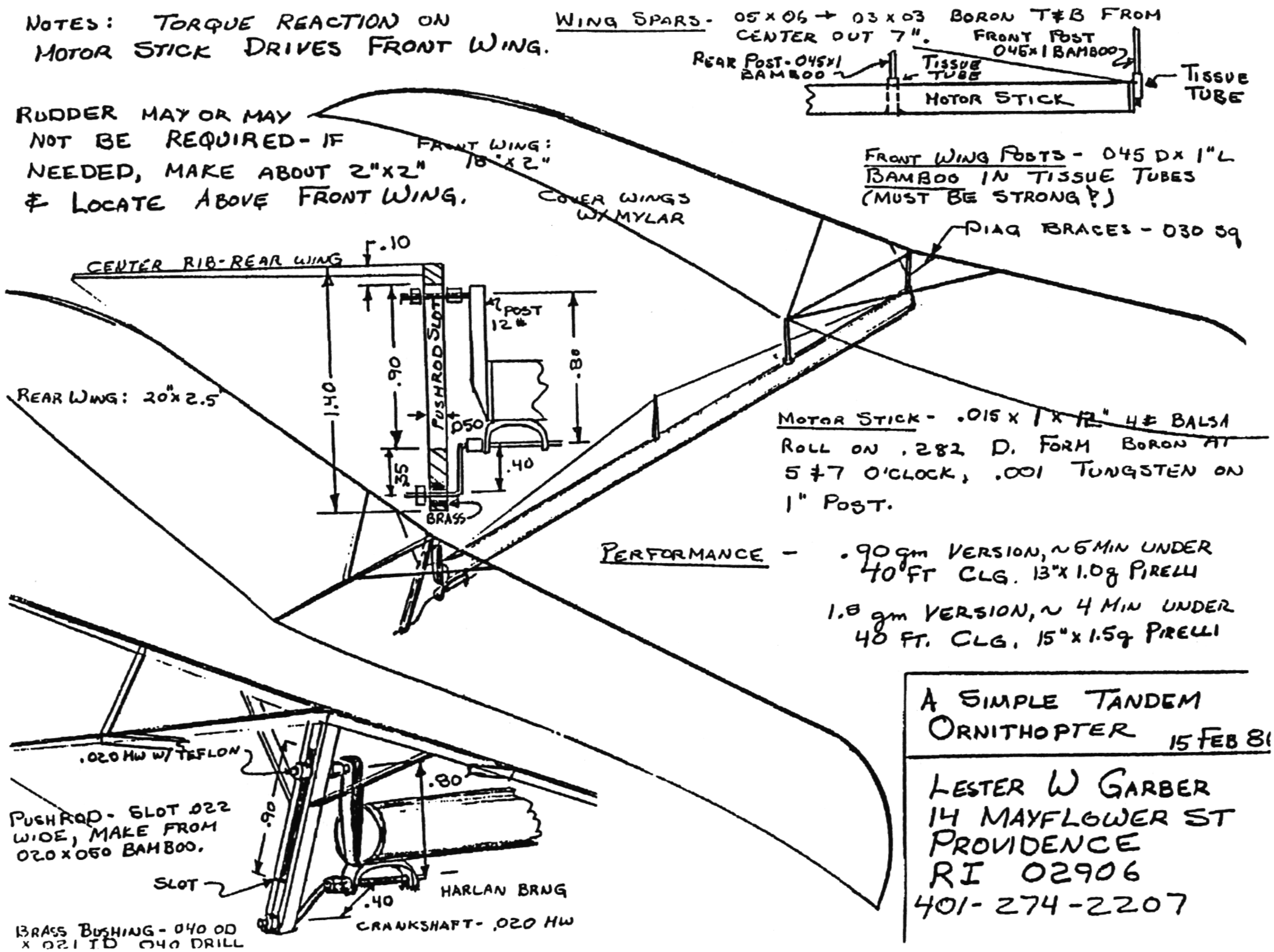


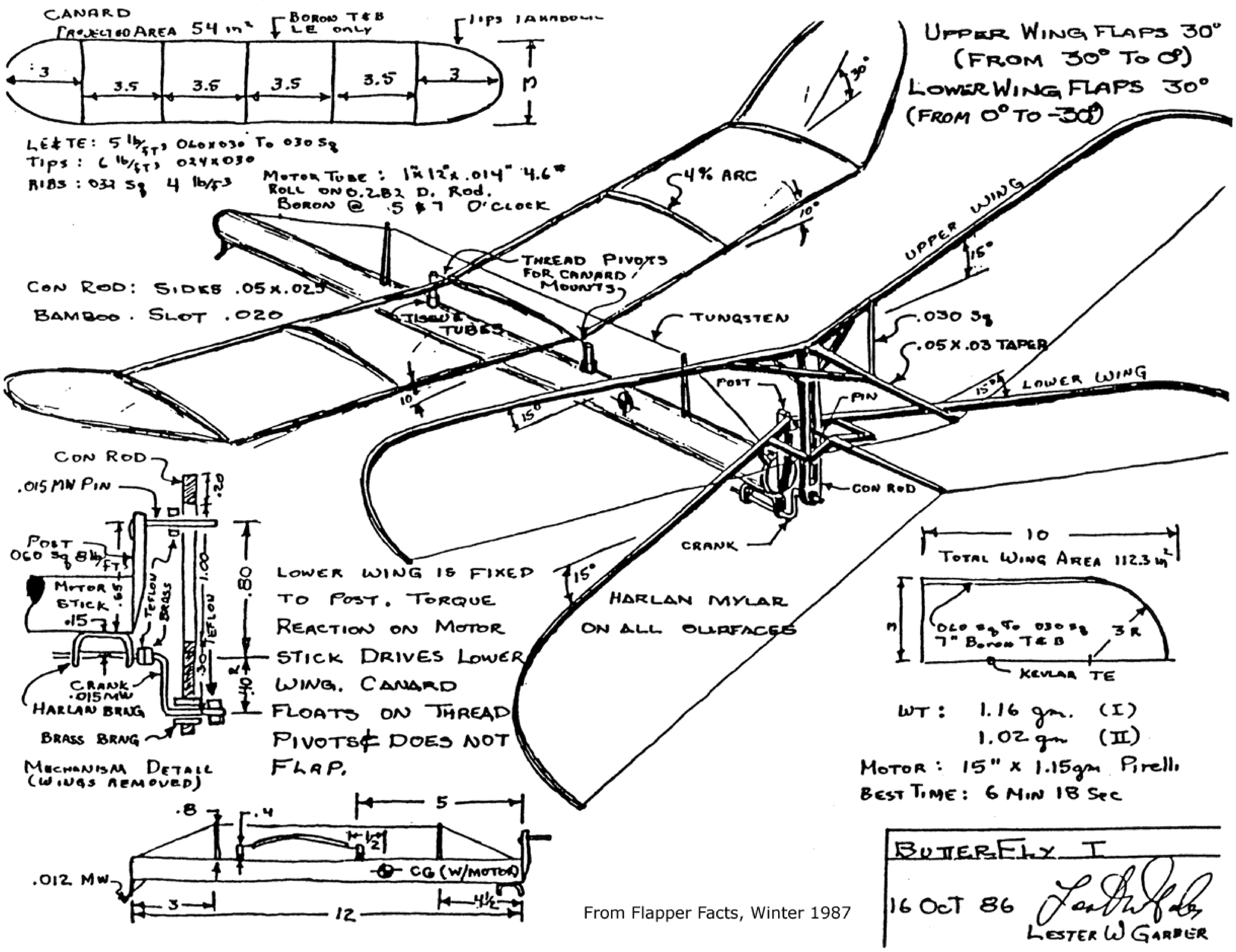
OMS Pet Model #5



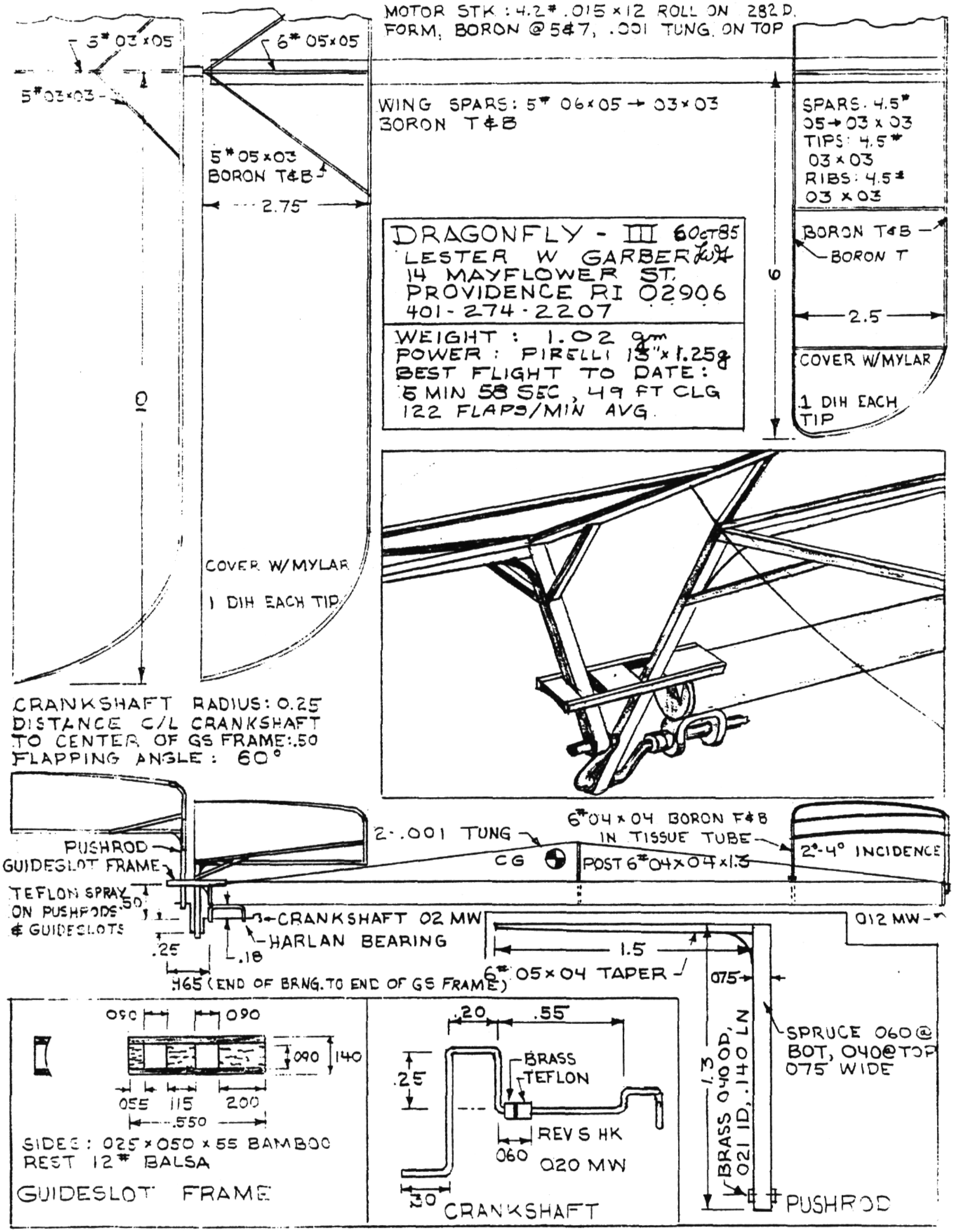


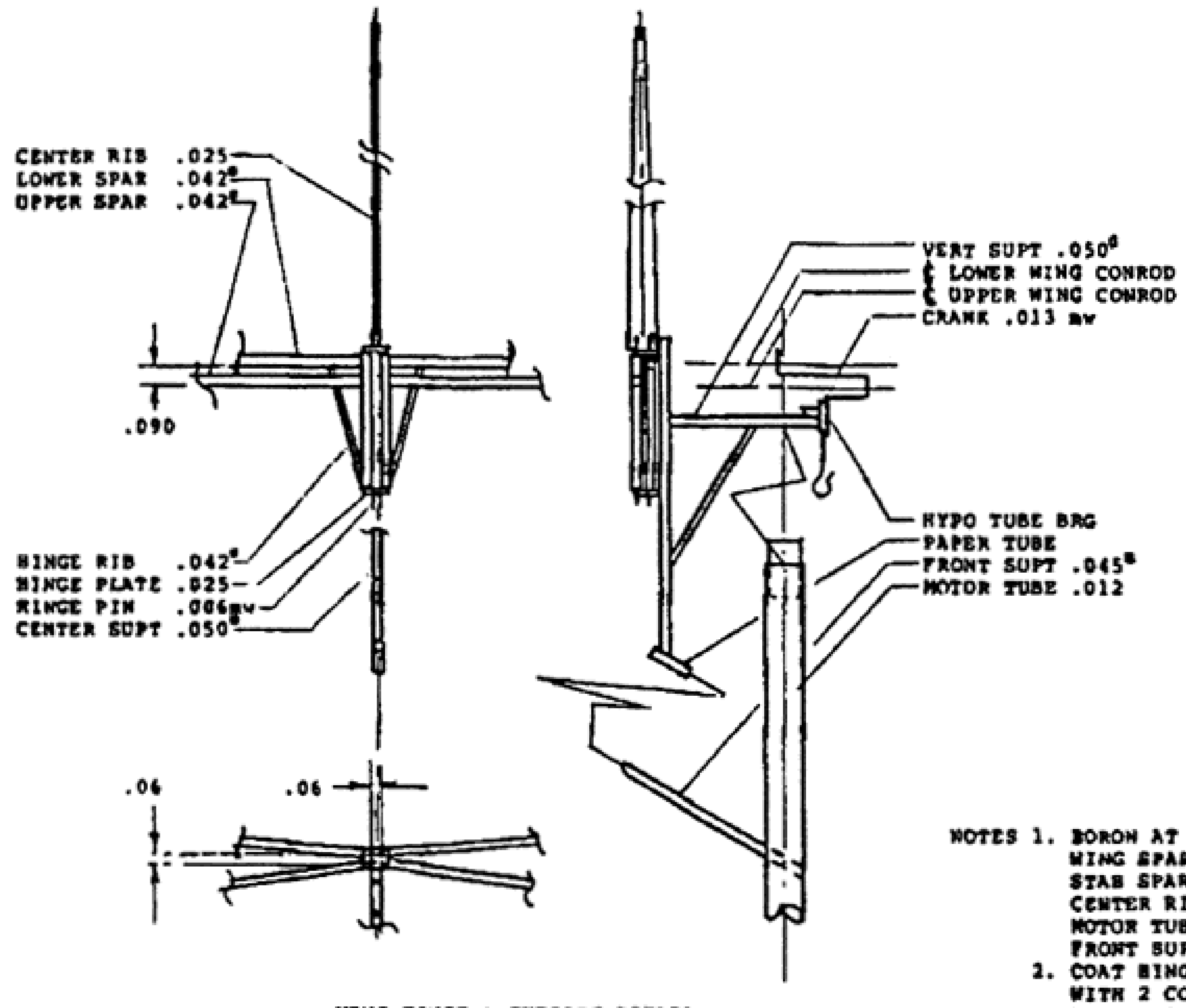
~ ALL PLAN DIMENSIONS IN INCHES ~
~ Mechanism dimensions are critical ~
conrods spruce, 1/32 x 3/32 ~
struts 1/32 x 5/32 ~
0 1 2 3 4 5 6 7 8 9 10cm
0 1 2 3 4 inch
motor: 14 inch loop 1/8 Pirelli
bearing: .020 Al, .020 wire crank, glass bead, 1/8 sq. stiffener ~
stab: nichrome bracing, 1/16 sq. rounded post ~
tail boom 1/8 sq., rnd. & tap. to 1/32 ~
shoulder joints: .020 Al, .015 wire ~
centersection members 1/16 sq. ~
ribs & gussets 1/16 x 1/32 ~
~ microlite ~
motor stick 1/8 x 1/4
tail boom mount: paper tube, .020 Al ~
lever arm pivots .015 wire ~
rear hinge: "beer can" Al, .010 wire ~
Last step in construction is to cement levers to spars at dihedral ~
condenser paper
spars (tapered) & levers med. hard 1/16 sq. ~ all other balsa light ~
optional rudder may be set at end of boom to tighten turns ~
microfilm ~
Bibitte III
Designed and drawn by Patrick Deshaye, USA
Strat - O - Bats MAC
Seattle
NOTES


NOTES: TORQUE REACTION ON MOTOR STICK DRIVES FRONT WING.
RUDDER MAY OR MAY NOT BE REQUIRED - IF NEEDED, MAKE ABOUT 2"x2" & LOCATE ABOVE FRONT WING.
WING SPARS - 05 x 06 → 03 x 03 BORON T&B FROM CENTER OUT 7".
FRONT POST 045x1 BAMBOO
REAR POST - 045x1 BAMBOO
TISSUE TUBE
TISSUE TUBE
MOTOR STICK
FRONT WING: 18" x 2"
COVER WINGS W/ MYLAR
FRONT WING POSTS - 045 D x 1"L BAMBOO IN TISSUE TUBES (MUST BE STRONG!)
DIAG BRACES - 030 SQ
CENTER RIB - REAR WING
.10
1.40
.90
.35
.050
PUSHROD SLOT
POST 12#
.80
.40
BRASS
REAR WING: 20" x 2.5
MOTOR STICK - .015 x 1 x 12" 4# BALSA ROLL ON .282 D. FORM BORON AT 5 & 7 O'CLOCK, .001 TUNGSTEN ON 1" POST.
PERFORMANCE - .90 gm VERSION, ~5 MIN UNDER 40 FT CLG. 13" x 1.0g PIRELLI
1.8 gm VERSION, ~ 4 MIN UNDER 40 FT. CLG. 15" x 1.5g PIRELLI
.020 HW W/ TEFLON
.90
.80
PUSHROD - SLOT .022 WIDE, MAKE FROM 020 x 050 BAMBOO.
SLOT
.40
HARLAN BRNG
CRANKSHAFT - .020 HW
BRASS BUSHING - 040 OD x 021 ID 040 DRILL
A SIMPLE TANDEM ORNITHOPTER
15 FEB 81
LESTER W GARBER
14 MAYFLOWER ST
PROVIDENCE
RI 02906
401-274-2207

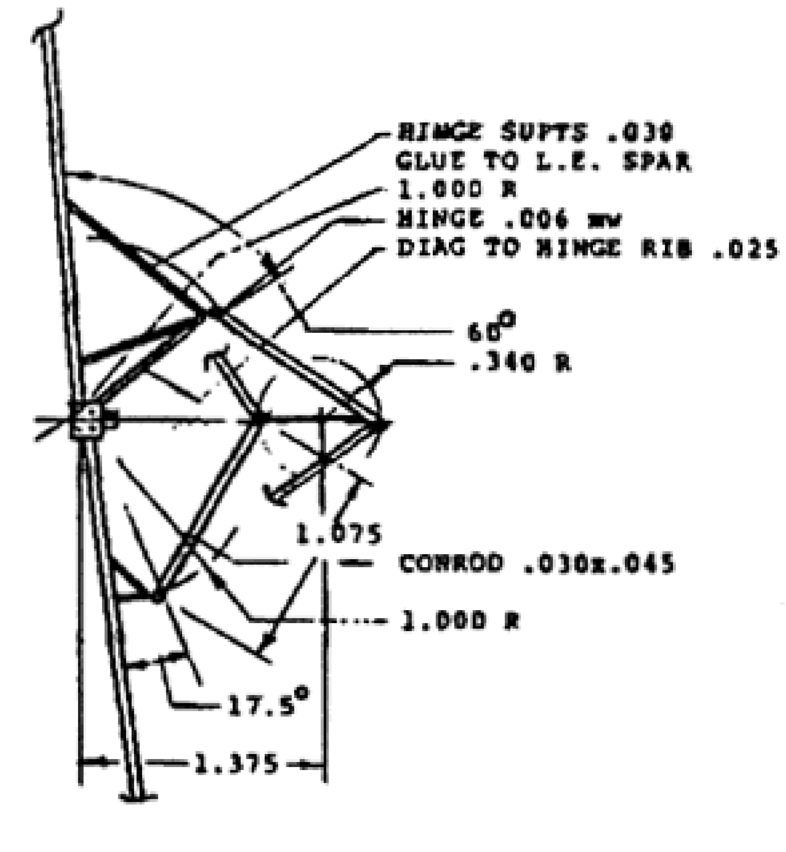


From Flapper Facts, Winter 1987


MOTOR STK : 4.2# .015 x 12 ROLL ON .282 D. FORM, BORON @ 5&7, .001 TUNG. ON TOP
5# 03 x 05
6# 05 x 05
5# 03 x 03
5# 05 x 03 BORON T&B
2.75
WING SPARS: 5# 06 x 05 → 03 x 03 BORON T&B
SPARS: 4.5# 05 → 03 x 03
TIPS: 4.5# 03 x 03
RIBS: 4.5# 03 x 03
DRAGONFLY - III 6 OCT 85
LESTER W GARBER
14 MAYFLOWER ST.
PROVIDENCE RI 02906
401-274-2207
WEIGHT : 1.02 gm
POWER : PIRELLI 13" x 1.25 g
BEST FLIGHT TO DATE :
5 MIN 58 SEC , 49 FT CLG
122 FLAPS/MIN AVG.
BORON T&B
BORON T
6
2.5
COVER W/MYLAR
1 DIH EACH TIP
10
COVER W/MYLAR
1 DIH EACH TIP
CRANKSHAFT RADIUS: 0.25
DISTANCE C/L CRANKSHAFT TO CENTER OF GS FRAME: .50
FLAPPING ANGLE : 60°
PUSHROD
GUIDESLOT FRAME
2 - .001 TUNG
6# 04 x 04 BORON F&B IN TISSUE TUBE
CG
POST 6# 04 x 04 x 1.3
2°-4° INCIDENCE
1.2
TEFLON SPRAY ON PUSHRODS & GUIDESLOTS
.50
CRANKSHAFT 02 MW
HARLAN BEARING
.25
.18
.165 (END OF BRNG. TO END OF GS FRAME)
012 MW
1.5
6# 05 x 04 TAPER
075
1.3
BRASS 040 OD, 021 ID, .140 LN
SPRUCE 060 @ BOT, 040 @ TOP 075 WIDE
PUSHROD
090
090
090
140
055
115
200
.550
SIDES : 025 x 050 x 55 BAMBOO
REST 12# BALSA
GUIDESLOT FRAME
.20
.55
.25
BRASS
TEFLON
REV S HK
060
020 MW
.30
CRANKSHAFT

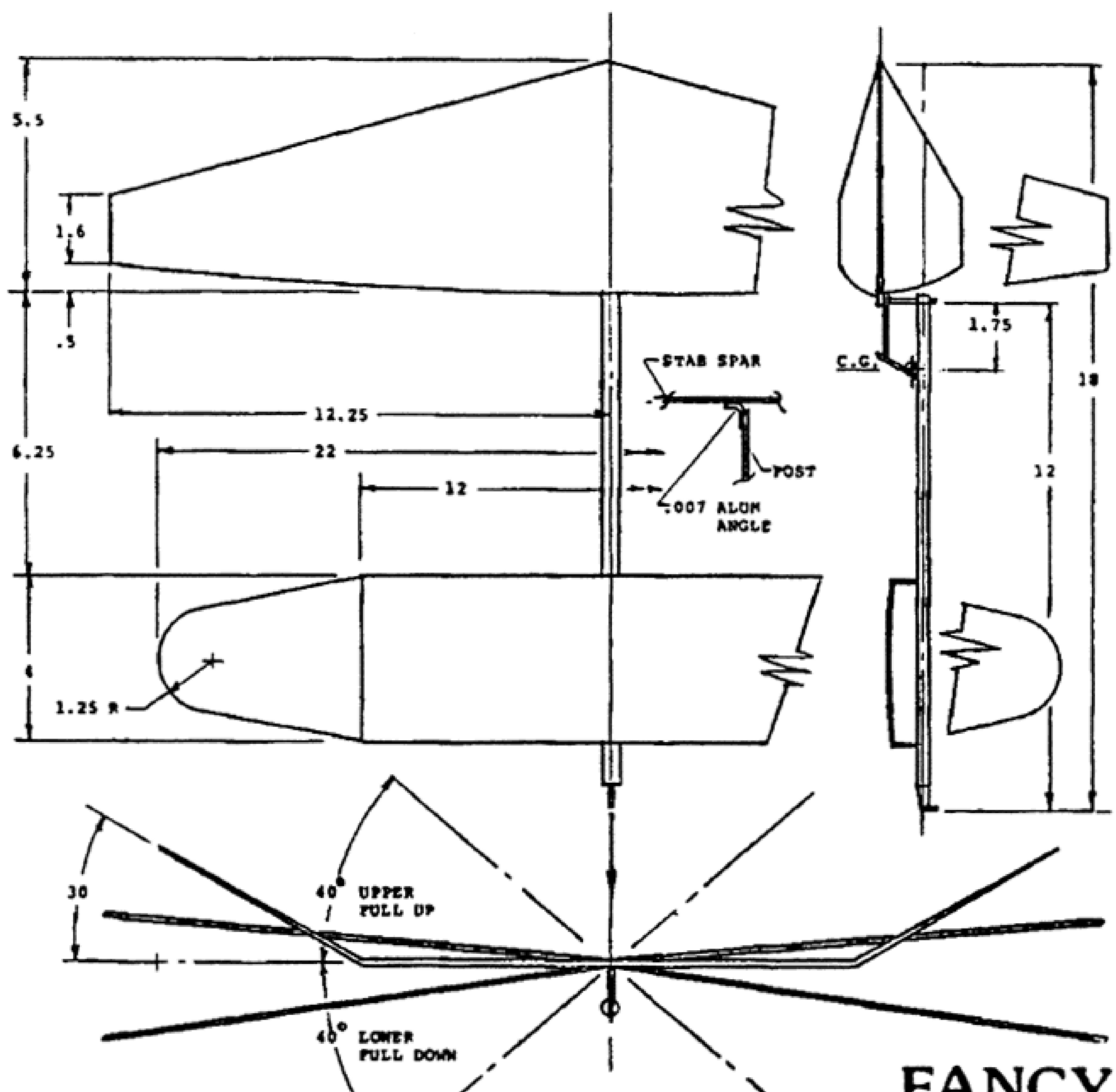


WING HINGE & SUPPORT DETAILS



LINKAGE DETAILS

NOTES 1. BORON AT FOLLOWING LOCATIONS:
WING SPARS - TOP & BOTTOM
STAB SPARS - TOP & BOTTOM
CENTER RIB - TOP & BOTTOM
MOTOR TUBE - 5,7,&12 O'CLOCK
FRONT SUPPORT - SIDES
2. COAT HINGE PLATES AND CONROD ENDS WITH 2 COATS GLUE TO REINFORCE BEARING POINTS
3. ALL COVERING IS HARLAN 'ULTRAFILM'



WEIGHTS - GRAMS

FLAPPER ASSEM	.65
BODY ASSEM	.33
STAB ASSEM	.32
TOTAL EMPTY	1.30
FLYING WEIGHT	2.60

AREAS - SQUARE INCHES

UPPER WING (FLAPPING)	87.2
LOWER WING (FLAPPING)	82.6
TOTAL WING (FLAPPING)	169.8
TOTAL WING (FIXED)	0
PROJECTED (FLAPPING) (169.8 X COS 20°)	159.6
STABILIZER	77.3
STAB/PROJ (%)	48.5

MOTOR - 1989 USIC
.058 X 20 PIRELLI
1600 TURNS

Frank Kieser

FANCY GIRL III

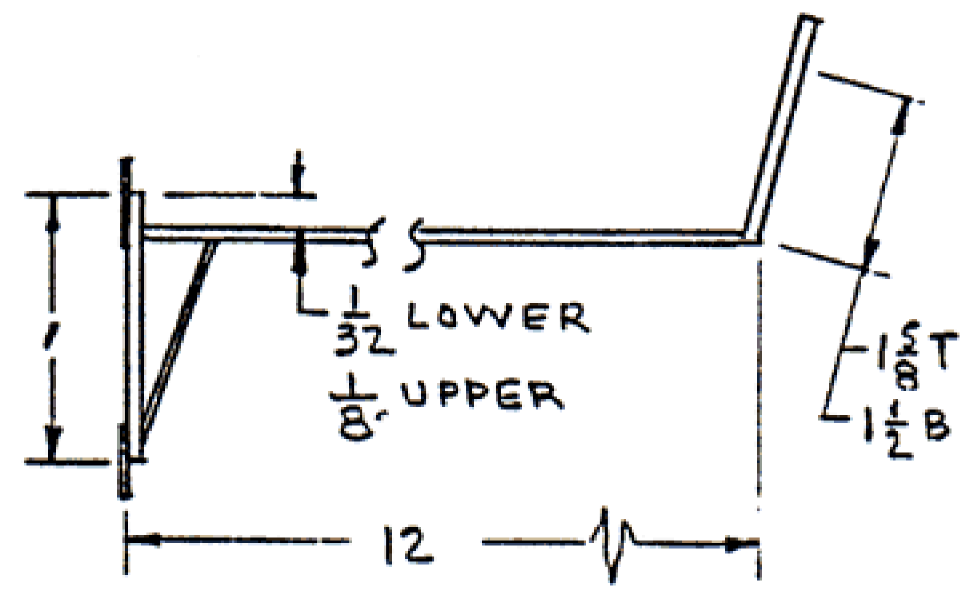
CANARD PUSHER ORNITHOPTER
DESIGNED BY FRANK KIESER - VERO BEACH, FLORIDA
USA RECORD HOLDER CAT I - 5:54, CAT II - 10:00
CAT III - 11:32
USIC WINNER 1987 - 10:33, 1989 - 11:12

FBK 1/31/90

CANARD ORNITHOPTER CONSTRUCTION by FRANK KIESER - 9/15/87

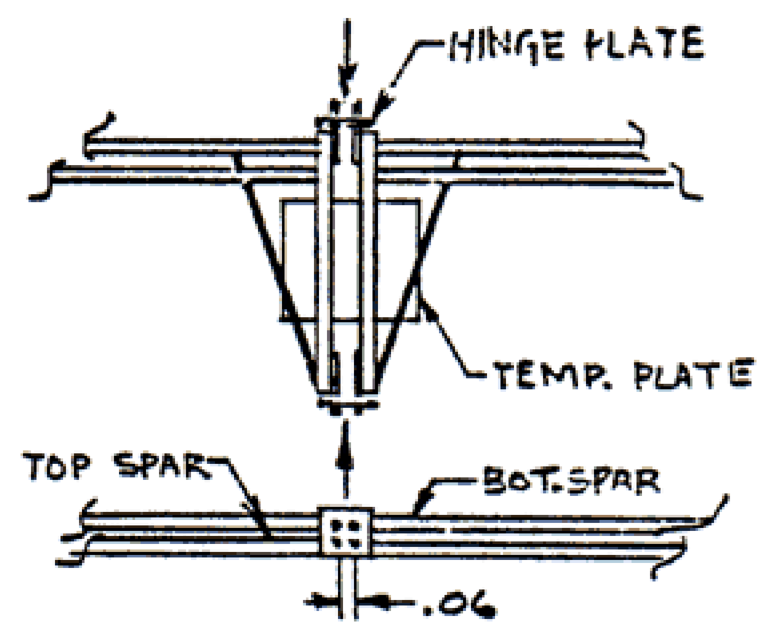
The canard biplane ornithopter has proven to be the best competitive configuration holding three of the four categories of AMA records. Many have asked about construction details of the wing and linkage for this type of model. Presented here are details of Fancy Girl III which features a wing, linkage and crank in a single assembly, demountable from the motor tube. This design is particularly attractive since it reduces considerably the box size, provides adjustment of the flapper incidence and gives interchangability of parts with practically no weight penalty. Wood sizes shown are for the competitive model weighing 1.2 grams. For those building this type model for the first time, sizes may be increased. However, too much weight in the wing assembly will have an adverse affect on the center of gravity. Details of parts not shown are conventional indoor model construction to suit the builder. For instance, my model uses an unbraced mylar covered stabilizer while Roy White uses a braced microfilm covered stabilizer.

FIG. 1 - UPPR & LWR WING SPAR ASS'Y (4)



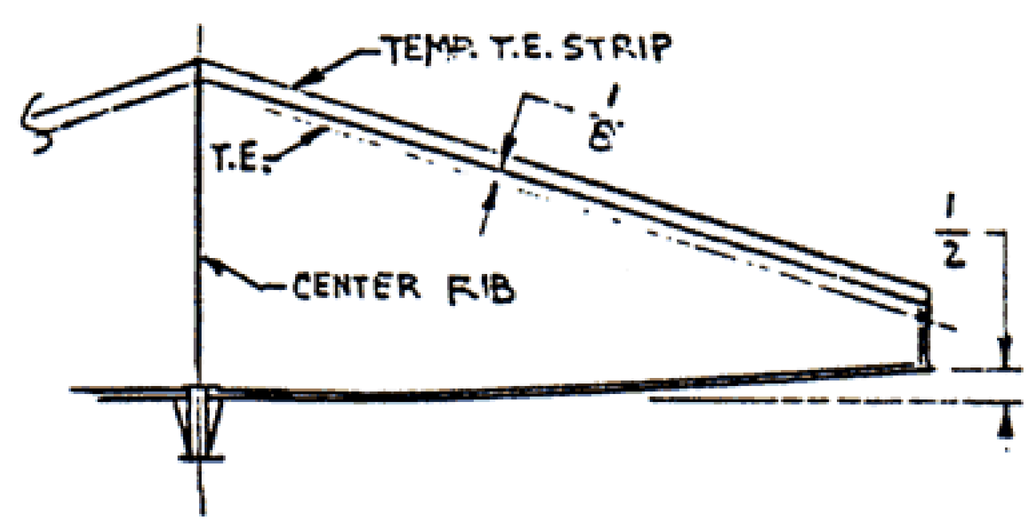
All wood parts are .045 square 5 lb. balsa. Boron is used top and bottom for the inboard 9 inches and the front inboard 4 inches. The hinge pins are .006 mw glued to the inboard side of the inboard rib. Be sure to leave extra length on the tips for glueing temporary T.E. strips in fig. 3. Lower spar diagonal member must be sufficiently inboard to clear upper wing linkage support.

FIG. 2 - HINGE PLATE ASS'Y



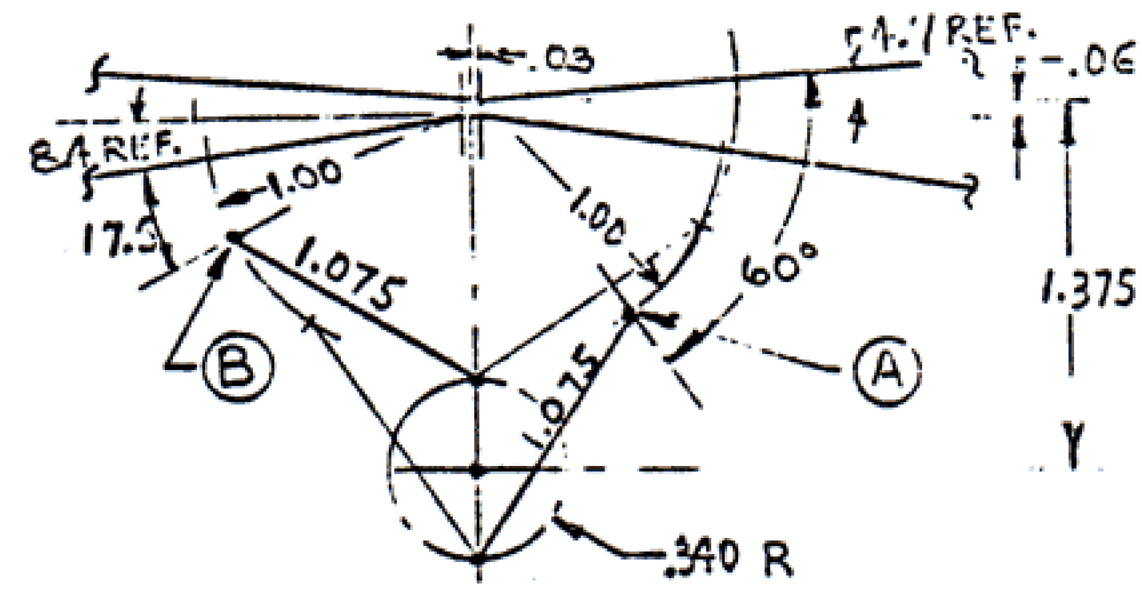
The hinge plates are .025 balsa .12 wide x .19 high. The faces are coated with glue to incease the bearing strength for the hinge pins. Tack glue the 4 spar assemblies to the .020 thick temporary plate between the upper and lower hinge ribs. Be sure the spars are in their exact relative positions. With the upper spars on a smoothe surface, push the hinge plates over hinge pins.

FIG. 3 - WING COVERING



Preparetory to covering, the center rib is made from .025 sheet balsa leaving extra length. It is cemented to the aft hinge plate. The temporary trailing edge strip is made from .05x3/8 balsa and cemented so that the trailing edge of the wing is 1/8 forward of the forward edge of the strip. The tips are bowed back 1/2 inch from the straight position. Care must be taken to keep the upper spar a uniform 3/32 ahead of the lower spar. The covering is 1.7   mylar. The covering is stretched and cemented to a frame, the lower structure surfaces, except for the inner 1 1/2 inches of the spar where the conrod hinge support will be glued, are coated with contact cement, including the temporary T.E. strip and then placed on the mylar. The mylar is cut with a hot wire. The upper surface is covered in like manner. After both surfaces are covered, the T.E. of the mylar is cut with a hot wire using the temporary strip as a guide. After all 4 T.E. cuts are made, the excess center rib and tips are cut away taking with it the temporary T.E. strip.

FIG. 4 - LINKAGE DIMENSIONS



The linkage dimensions for this design are shown for reference. Points A and B are the upper conrod hinge points and are fixed to the upper and lower wing spars respectively (see figs. 9 & 10)

FIG. 5 - FLAPPER SUPPORT ASS'Y

The vertical and horizontal members are .050 square 7 lb. balsa. Boron is glued to the sides of these members. The diagonal is .045 square 5 lb. balsa. The paper tube is .05 I.D. Jap tissue. The crank bearing is a piece of hypo needle tubing with a tab bent up from the forward end. Dim. A is sized to suit the linkage dimensions (see figs. 4&7). Dim. B is sized to suit the motor clearance. Dim. C must match the hole spacing in fig. 6.

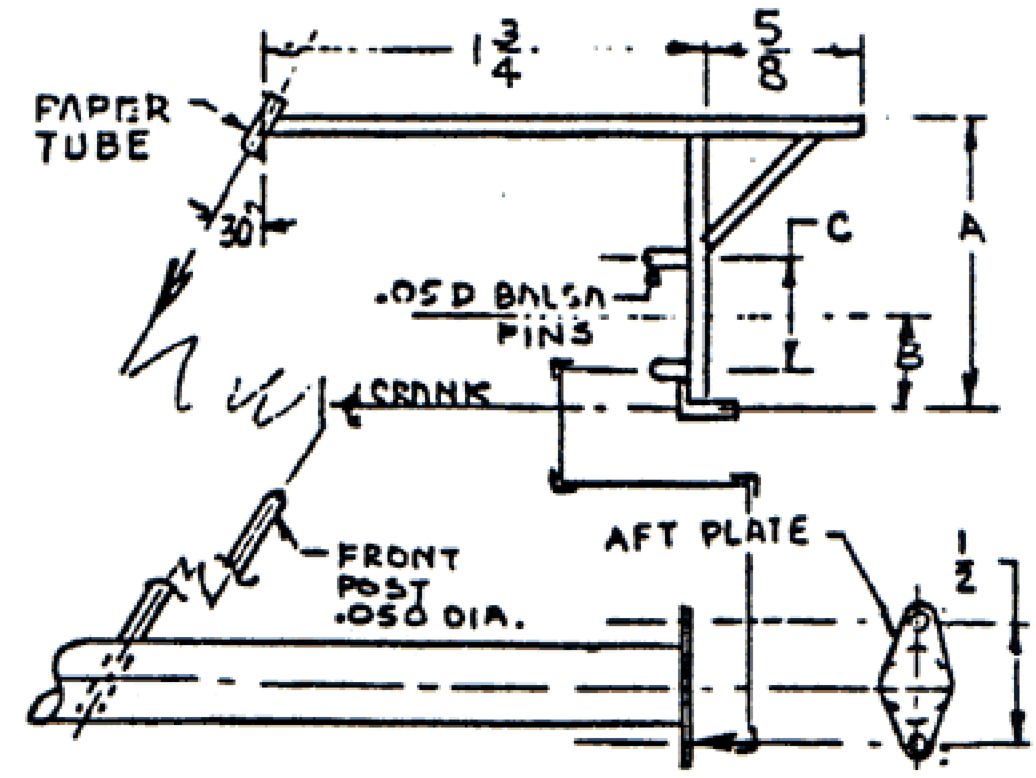


FIG. 6 - MOTOR TUBE ASS'Y

Only the aft end of the motor tube is shown. The rest is conventional indoor construction. The tube is .012 dia. x 9/32 I.D.. Three boron stiffeners, one each at 5, 7 & 12 o'clock are used. The aft plate is .025 thick. It is coated with glue around the two holes. The front post is stiffened with boron on both sides. The post must be sized and located so that it slides tightly in the paper tube.

FIG. 7 - WING & SUPPORT ASS'Y

First make the crankshaft from .015 mw. Insert in the bearing with a short length of hypo needle to act as a washer and then bend the hook. The covered wing is now assembled to the flapper support by glueing the hinge plates to the support. the location must be such that the wing spars are aligned with the crankshaft. Also check that the height of the upper hinge pin above the crank is correct. When wing assembly is firmly attached to the support, remove the temporary plate between the upper and lower hinge ribs by disolving the tack glue spots (see fig. 2). Check wings for freedom of rotation.

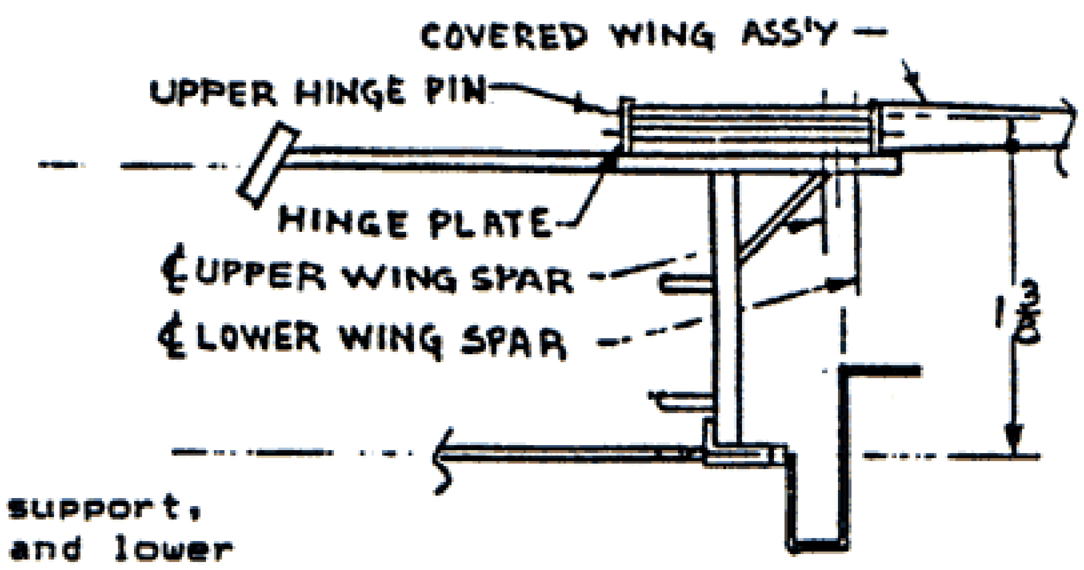


FIG. 8 - CONNECTING RODS

The linkage is designed such that all four conrods are the same length. They are made of .025x.040 balsa with the ends wrapped with 3 layers of Jap tissue. The crank end is pierced with a .015 wire and the wing end .006. I use a simple jig so that all hole spacings are accurate and identical.

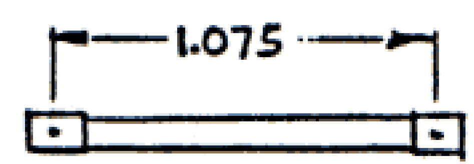


FIG. 9 - CONROD HINGE SUPPORTS

The struts for the conrod hinge supports are made of .025x.035 balsa. The hinge pin is bent from .006 mw and glued to the struts. The hinge support for the upper wing is glued to the spar with the pin at the correct radius (1.00) from the wing hinge. A diagonal brace is run from the lower end of the support to the forward end of the hinge rib to steady the conrod hinge pin. The conrods are slipped on the crank and then on the wing. With the crank in the bottom center position, both upper wings should be 5 degrees above horizontal. A small balsa washer is glued on the hinge pin to retain the rod.

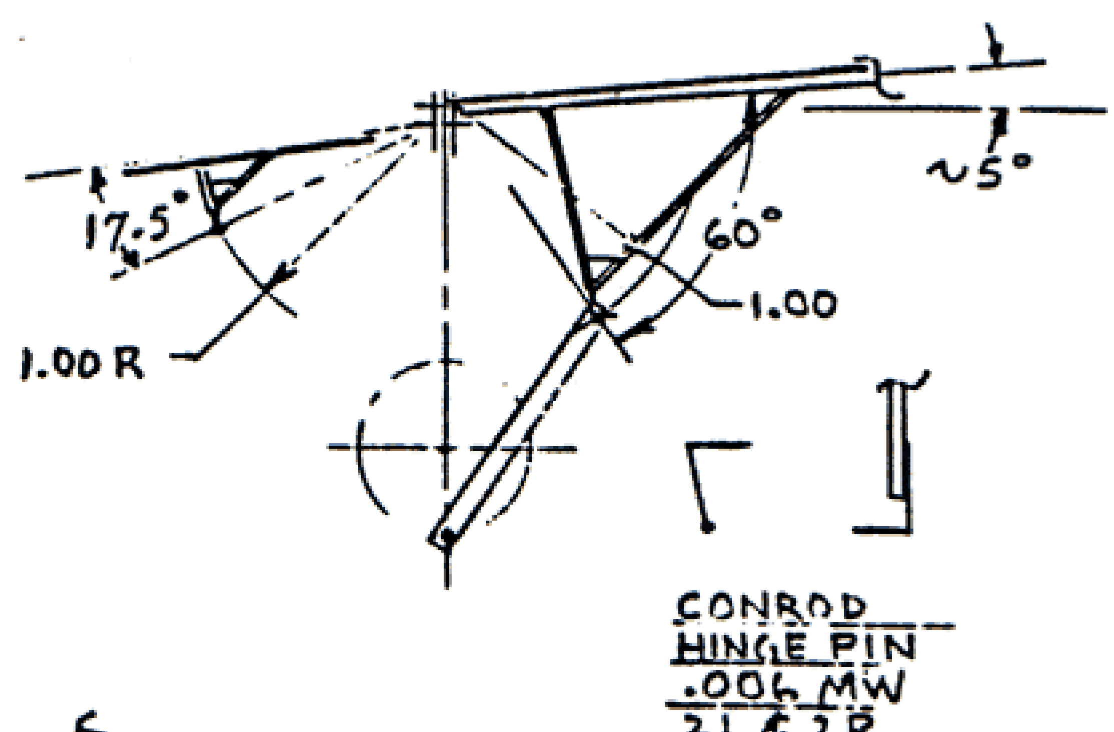
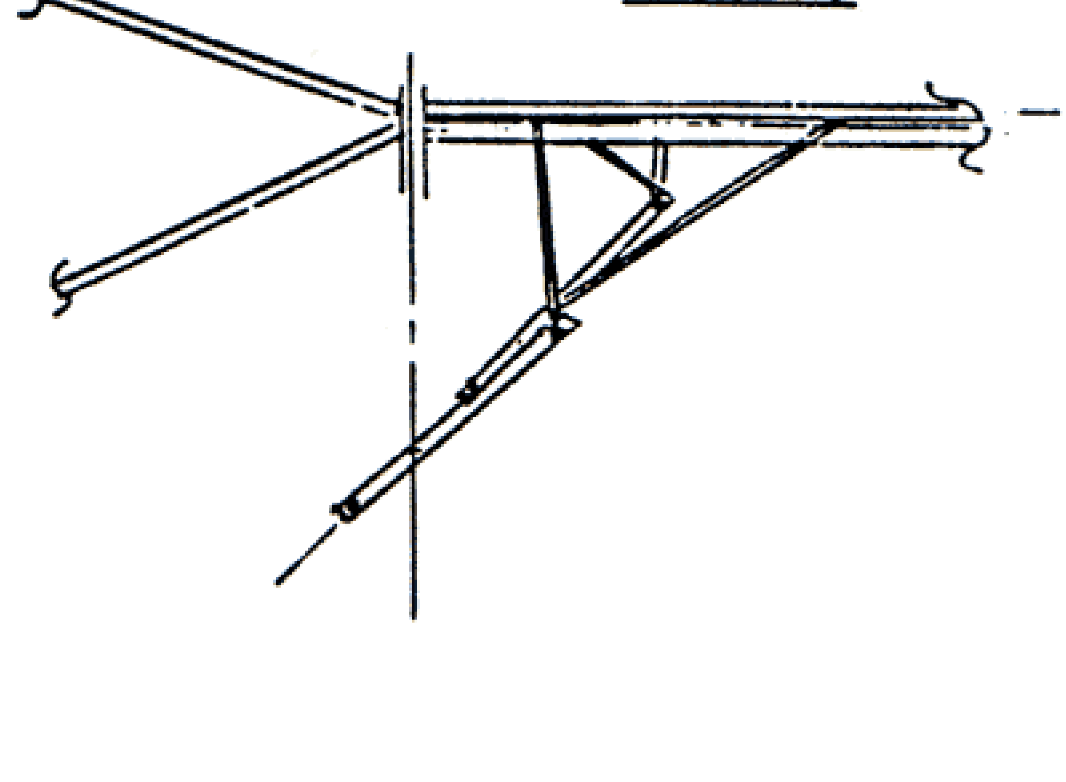
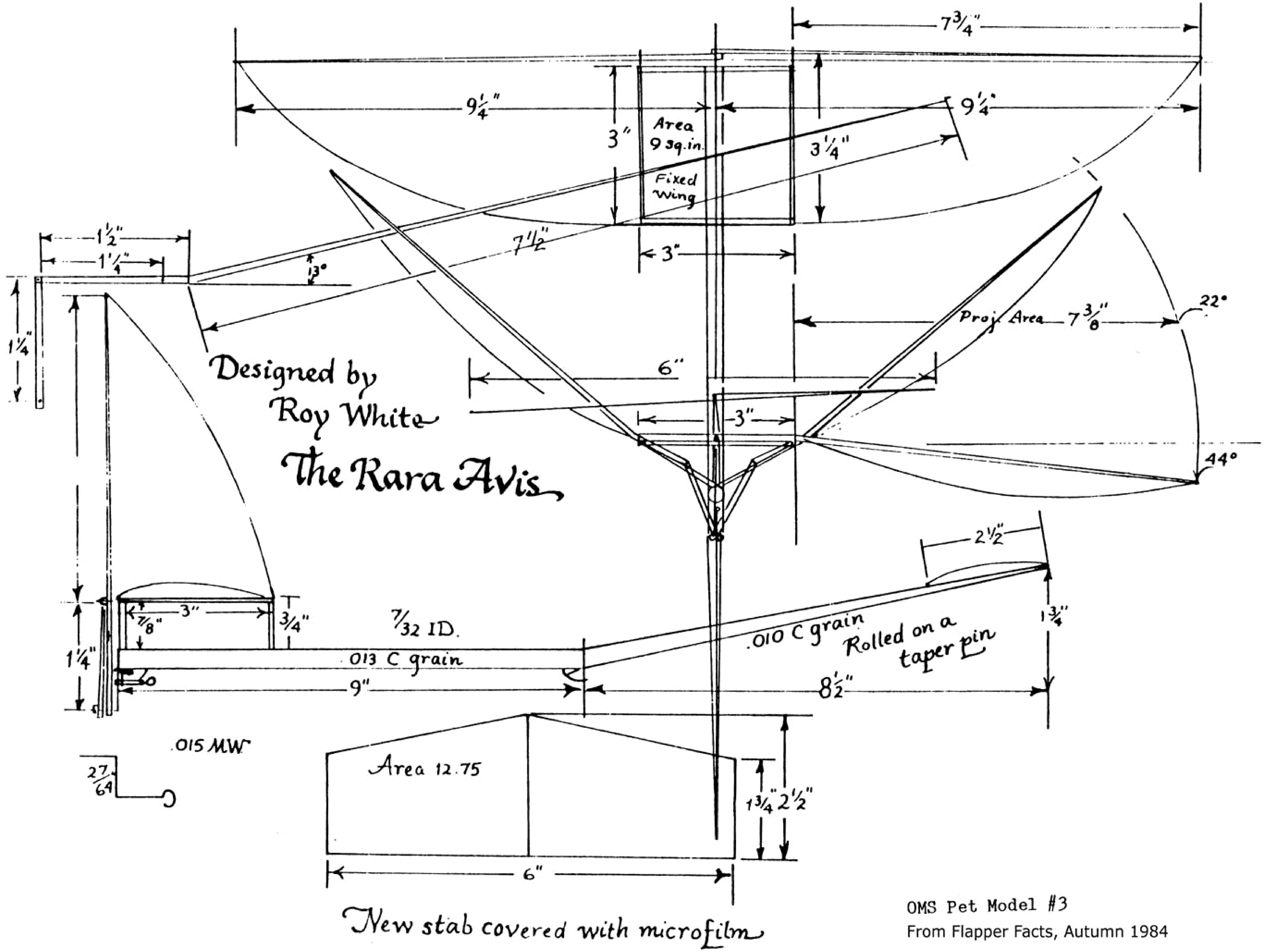


FIG. 10 - LOWER WING HINGE SUPPORT

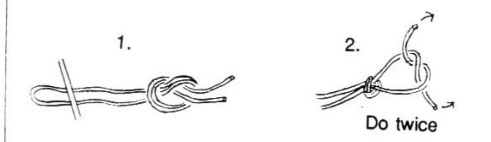
The final step is to attach the lower wing conrod and hinge support. Each wing is done separately. Slip one conrod on the crank and the hinge support on the conrod. Rotate the crank so that the upper wing is in the full down position and slide the hinge support along the lower wing spar until the upper and lower wing just come together. Glue the hinge support in this position. Repeat for the other wing. This method assures that the upper and lower wings will come together even though there are small errors in the linkage.



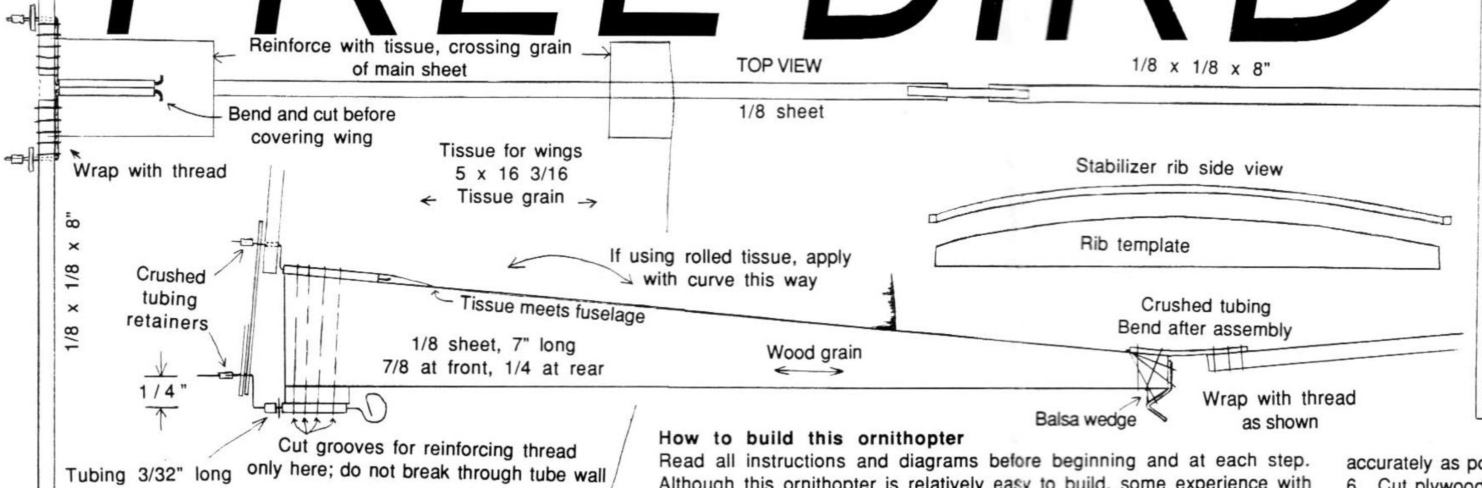


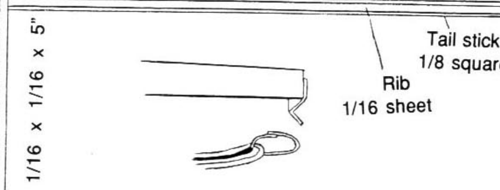
OMS Pet Model #3
From Flapper Facts, Autumn 1984

FREE BIRD

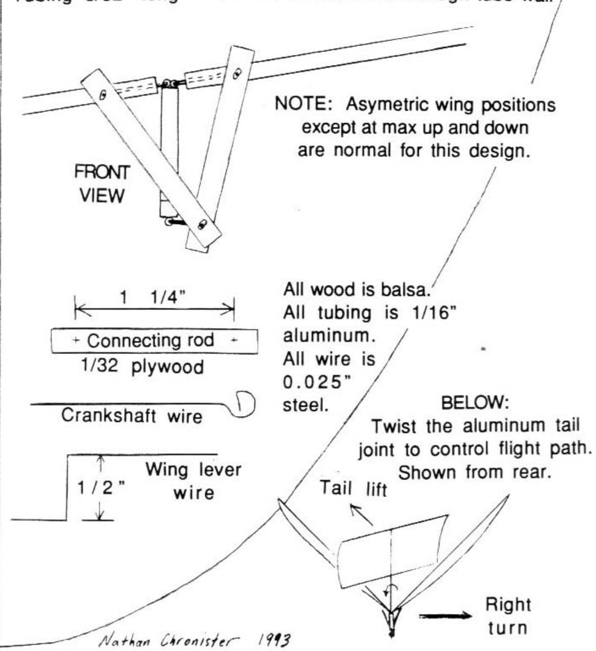


Use 26" of 1/8" model aircraft rubber. Tie as shown using saliva to prevent damage. Trim all but 1/4" of excess from knot.





Make a wire oval as shown (actual size). Form the rubber motor into a double loop before closing the wire oval. Apply rubber lube just prior to flying the model.



How to build this ornithopter

Read all instructions and diagrams before beginning and at each step. Although this ornithopter is relatively easy to build, some experience with rubber powered models will be helpful. Anything that is not clear will hopefully be resolved by studying the plans. Apply CA glues with a straight pin dipped in a drop placed on waxed paper. Using the bottle directly gives far too much glue. With thin CA, parts are held motionless in place while glue is applied. Repeat application if necessary to insure strength. All materials are readily available at hobby shops. This is the first publication of this design. If you have any problems with the model, plans, or intructions, please contact me and I'll give you a hand.

1. Assemble fuselage using thin CA. Cut aluminum tubes by rolling under razor blade. Cut grooves on both sides of crankshaft tube with hobby saw, not penetrating tube wall. These can be held in place with a thin strip of tissue, allowing them to be glued. Make sure the tubes are on straight and are not recessed behind the front of the fuselage. Replace tubes if CA gets inside them.
2. Apply a wrap of thin sewing thread as shown, catching the grooves in the tube. Coat with thick CA or epoxy and rub in with a piece of waxed paper.
3. Make the tail. Trace rib template onto 4" long balsa sheet and cut curved 1/16" ribs with new blade. Select 3 good ribs, cut other 1/16" strips, and assemble with white glue, using pins or bits of tape to hold it while drying. Add 1/8" tail boom after it dries.
4. Bend the wing lever wires as accurately as possible. Both should match eachother and the diagram. Poke through wing spars and attach with CA and thread joint as above. Insert wings into wing hinge tubes, bend excess wire as close as possible to the tube, and cut.
5. Bend hook in the crankshaft wire and insert through bearing tube. Place washers (optional) and 3/32" long tubing onto shaft, then bend shaft as accurately as possible to crank shape. Crank radius must not exceed 1/4".
6. Cut plywood connecting rod and use a cut piece of wire to make holes. Install on the crankshaft and wing levers, and check for correct operation by turning the crank. If the average of the max up and max down positions is not a slight dihedral, make new connecting rods with different hole spacing. If wings toggle into the wrong position, reduce the crank radius.
7. Secure the rods by tightly crushing short pieces of tubing on the wire ends. To make it permanent, use thick CA in the tubing, being careful not to get it near the wood.
8. Cover wings and tail with model tissue. Apply thinned white glue to the wings and fuselage (don't get too much), lay the model onto the tissue, checking tissue position as you do. Cut the shape with a new blade after gluing the tissue in place.
9. Gradually crush a piece of tubing with pliers, straighten it, and CA it to the tail boom and fuselage. Bend the tail hook and cut off excess. CA it in place. Cut a small balsa wedge to fit under it. Wrap with thread and coat.
10. Tie rubber motor as shown. Fold it to form a double loop. Bend a wire oval around it to allow easy transfer from winder to tail hook. Winding requires an assistant or a device to hold the model. The left hand is used to hold the crankshaft hook, keeping it from turning, until the moment of launch. Never use the crankshaft to wind the motor.
11. Release the model gently with a long follow-through. Bend the tail down to prevent stalls, up if the model dives. See diagram on how to cause turns, though straighter flights will go highest. If your model does not fly, this may be caused by glue in the bearing tubes, by improper alignment, or by incorrectly proportioned flapping mechanism parts. The model doesn't take too long to build, so if you have one of these problems, give it another try! Once successfully completed, this ornithopter will give you many beautiful flights.

This is the original Freebird plan from the Fall 1993 issue of Flapper Facts.