Flapper Facts

Newsletter of the Ornithopter Modelers' Society

Issue #9 Winter 1995

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How to Join OMS: If you are reading someone else's copy of Flapper Facts and want your own membership, you can join now by sending $9 ($14 outside the US) to the address above. Payment should be made to "Nathan Chronister."

OMS Postal Contest Update

The current OMS postal contest is an attempt to encourage development of ornithopters which fold their wings on the upstroke as do birds. As many of you know, the contest includes two categories, one for proven, flying models, and one for untested design ideas.

In the first category, there are still no entries, presenting a wonderful opportunity for anyone who can build a folding-wing ornithopter. The winner will be determined by flight duration and amount of wing folding, but if you are the only one to enter you will certainly win.

The second category is much easier to enter and has produced a number of very interesting ideas. All you have to do is neatly draw a design for a folding-wing ornithopter with an adequate description of how it works. Your entry should be presented in an 8.5 x 11" format **with margins**, ready to be printed in Flapper Facts. The entries will appear in the next issue of Flapper Facts, and a winner will be chosen by your votes.

There is obviously a lot of room for experimentation with this type of ornithopter, and I hope that many of you will give it some thought and write down your ideas sometime between now and the March 31 deadline.

Due to the generous support of Indoor Model Supply and Roy Clough, prizes include 2 autographed copies of Indoor Flying Models by Lew Gitlow, 2 copies of the Flapper Facts backissues, a Flapping Flyer kit from Indoor Model Supply, and free OMS membership renewals.

Write to the editor for a copy of the rules.
The entry deadline is March 31st.

Member News

Plunge Wing

In the last issue, I proposed a plunging-wing ornithopter. Such a model would move it's entire wing straight up and down rather than having the wings hinged near the centerline of the model. Roy Clough has informed me that he once built such a model. He says it did not fly well enough to warrant further work, but maybe another attempt could make it successful. It would be an efficient approach if one could overcome the obvious mechanical difficulties.

Spencer Seagulls

Don Bender wrote to me asking for drawings of the mechanism which powered the P.H. Spencer seagull models. I am sorry to say that none are available. Even the people who have the surviving seagull models don't know what's inside the sealed gearbox. There's nothing special about the visible portions of the mechanism. It seems his only trick was being able to build gearboxes (with flywheels, clutches, cooling fans?) for Cox engines.

Plans and Publications

A major goal of OMS is to provide information on ornithopters to those who don't have it. If you have been wanting to give ornithopters a try, but didn't know how to build one, you can get plans for a simple ornithopter by sending an SASE. Also helpful is the Ornithopter Design Manual. Please send $3 for a copy of this very informative booklet.

Other OMS publications include the Vast Ornithopter Information Directory ($1.50) and 192 pages of Flapper Facts backissues ($19 in the USA, $24 elsewhere).

Electric Ornithopter Discovery

Despite my best efforts, there are still a lot of people, throughout the world, building ornithopters without knowing of others who are working on the problem as well. Sometimes I learn about such people, and sometimes I am amazed to see that they have gotten even farther than the rest of us. One such person is Horst Rabiger of Germany. His 3m span, 4.5 kg electric ornithopter, first flown in 1989, is among the most advanced of modern experimental ornithopters. While his machine cannot take off from the ground, as could P.H. Spencer's radio-controlled ornithopter, it is able to alternate between flapping and gliding flight and may be the first ornithopter to do so. The wing design is highly efficient, using an elastic wing covering to allow wrinkle-free twisting of a thick (Clark Y, 11.7%) airfoil. This technique is an alternative to the shearflexing used by Harris and DeLaurier. The elastic covering is very thin, so a large number of ribs is required. Each wing is supported by two internal spars, and the structure is designed for torsional flexibility. The following letter from Rabiger (31 March 1994) tells more about his ornithopter.

Unfortunately my English is not the best. My daughter must assist me in writing these letters. Therefore I am able to give you merely a rough description.

The models are radio controlled. I can choose among gliding and powered flight as often as I like.

A cycle of the flapping wing takes about 0.6 seconds.

As the wings flap no vertical movement of the body is to be seen.

I have started working on the ornithopter problem some 25 years ago. 1989 I have achieved a maximal flight duration (with flapping wings) of about one minute (flying a circle), followed by one or two minutes gliding flight. The flights usually come to an end after 10 to 20 seconds. The ornithopters always descend steeply because of the aero modeller intending the model to reach altitude flying too slow (stalling speed).

I am using 14 nickel-cadmium cells in series, RED Amp, Panasonic, capacity 1.2 Ah. They provide sufficient energy for a flight lasting about 5 minutes. More than 150 to 200W are not permissible because of the slight torsion of the airfoil and the profile data.

The total transmission ratio of the model EV7 (1992) I am using is about 120 to 160:1 and the transmission consists of gear-wheels only. Sometimes I am using planetary gears (?).

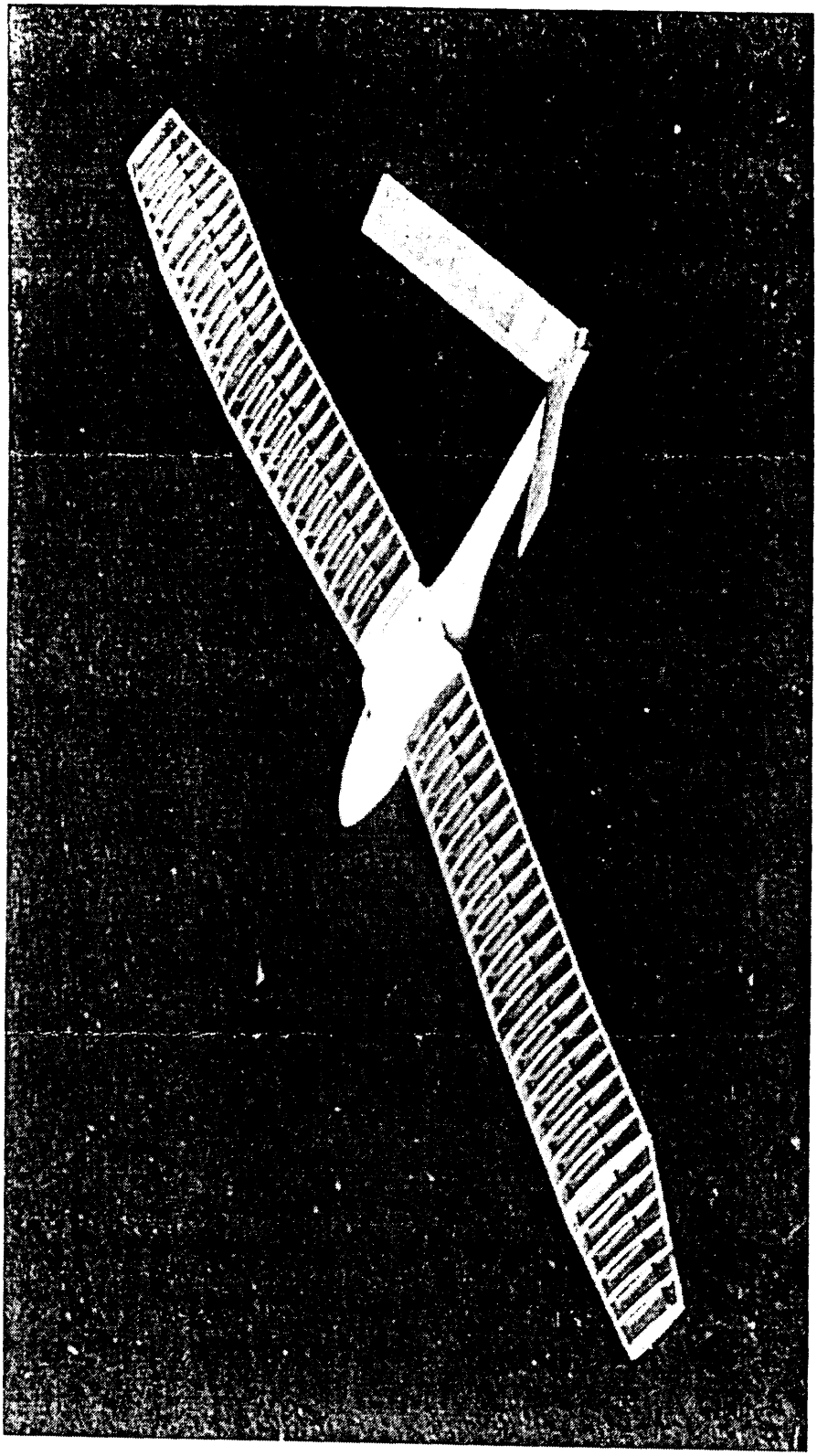
The angle of incidence of the airfoil to the body is constant. The theoretical wing twist is shown on the picture "Abb. 48" of the enclosed data. I am using an elastic foil. It is fixed with a small adhesive splicing. The wing twist is exclusively caused by aerodynamic forces "working" against a spring and not by the energy. I am afraid I cannot give you any further information about my flexible wing design since I have not applied for a patent so far.

A Cautionary Tale Bill Foshag

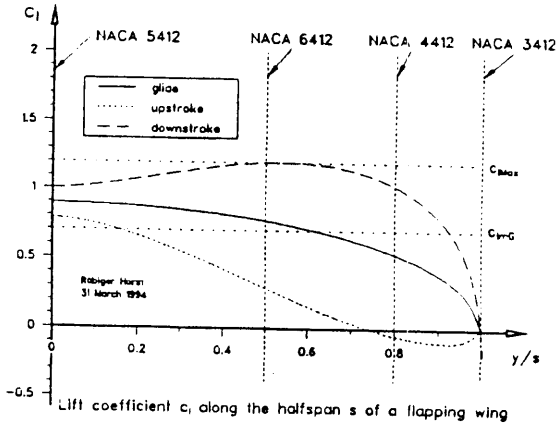
The ornithopter devotees still persisted in designing the unsuccessful flapping wings that they believed would make man a master of the sky. Through the centuries these designs had been proven dangerous, inefficient, and doomed to failure. Had they been successful, a certain Joseph Addison predicted in 1713, they would have changed the history of mankind. In his words:

"It would fill the world with innumerable immoralities and give such occasion for intrigues as people cannot meet with, who have nothing but legs to carry them. You should have a couple of lovers make a midnight assignation upon the top of a monument, and see the cupola of St. Paul covered with both sexes like the outside of a pigeon house. Nothing would be more common than to see a beau flying in a garret window, or a gallant giving chase to his mistress like a hawk after a lark."

His misgivings were unrealized, of course, but the ornithopter style of flying was a popular speculation for centuries. Most theories utilized sheer muscle power for versions which seldom progressed beyond the planning stage, but other methods were introduced which incorporated steam and other available power.



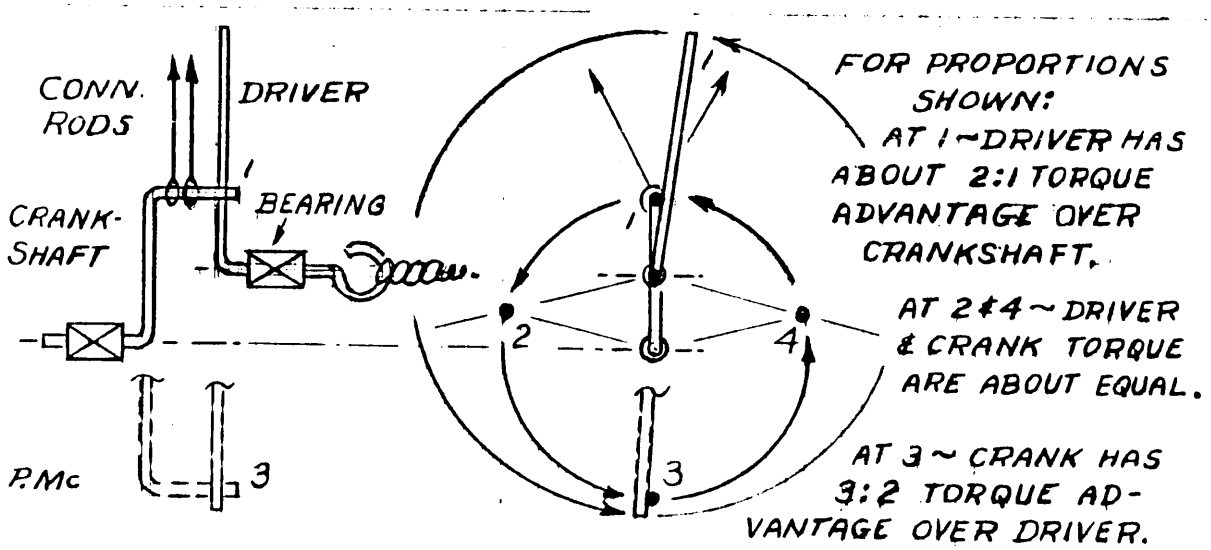
Below: This later version of Rabiger's ornithopter (November 1992) incorporates slotted wingtips, each apparently consisting of a series of small membrane wings. Notice that during the upstroke, the tips of the wings operate at a negative lift coefficient. The membranes provide the large amount of torsional flexibility necessary during the upstroke, and they do not become limp streamers because at the wingtip the air comes from above the wing. The use of a completely membranous wing would be inappropriate, however, because a membrane cannot produce lift during the upstroke. If the inner portion of the wing consisted of a membrane, it would become limp during the upstroke because the air would be coming from almost straight ahead, not from below as is required for a membrane to produce lift. Generally, membrane ornithopters produce thrust on the upstroke, but it is more efficient to produce thrust on the downstroke as in Rabiger's machine and other semi-rigid-wing ornithopters.

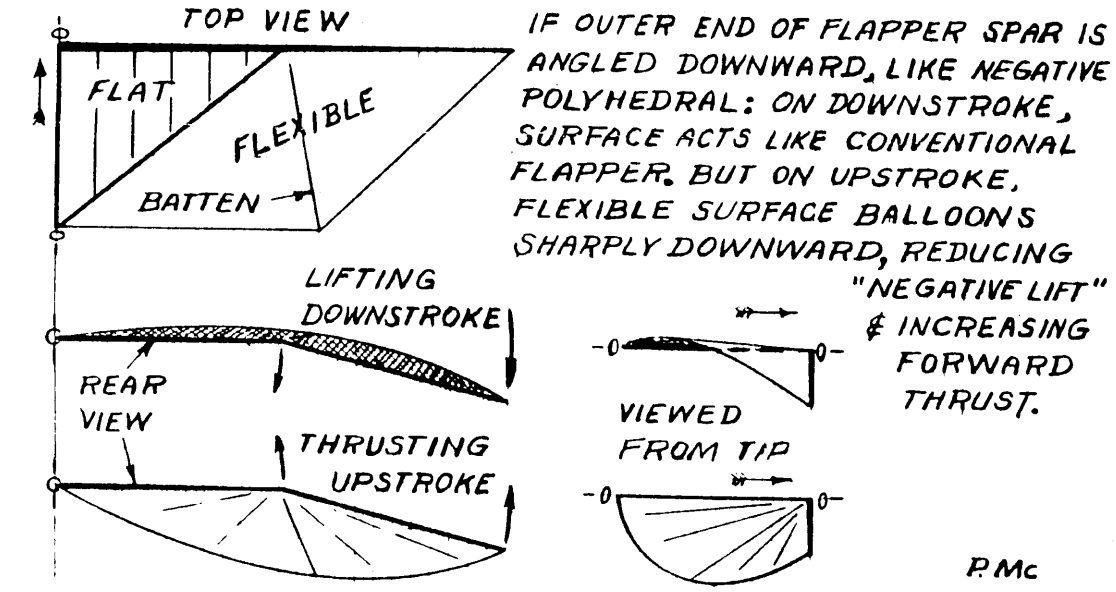


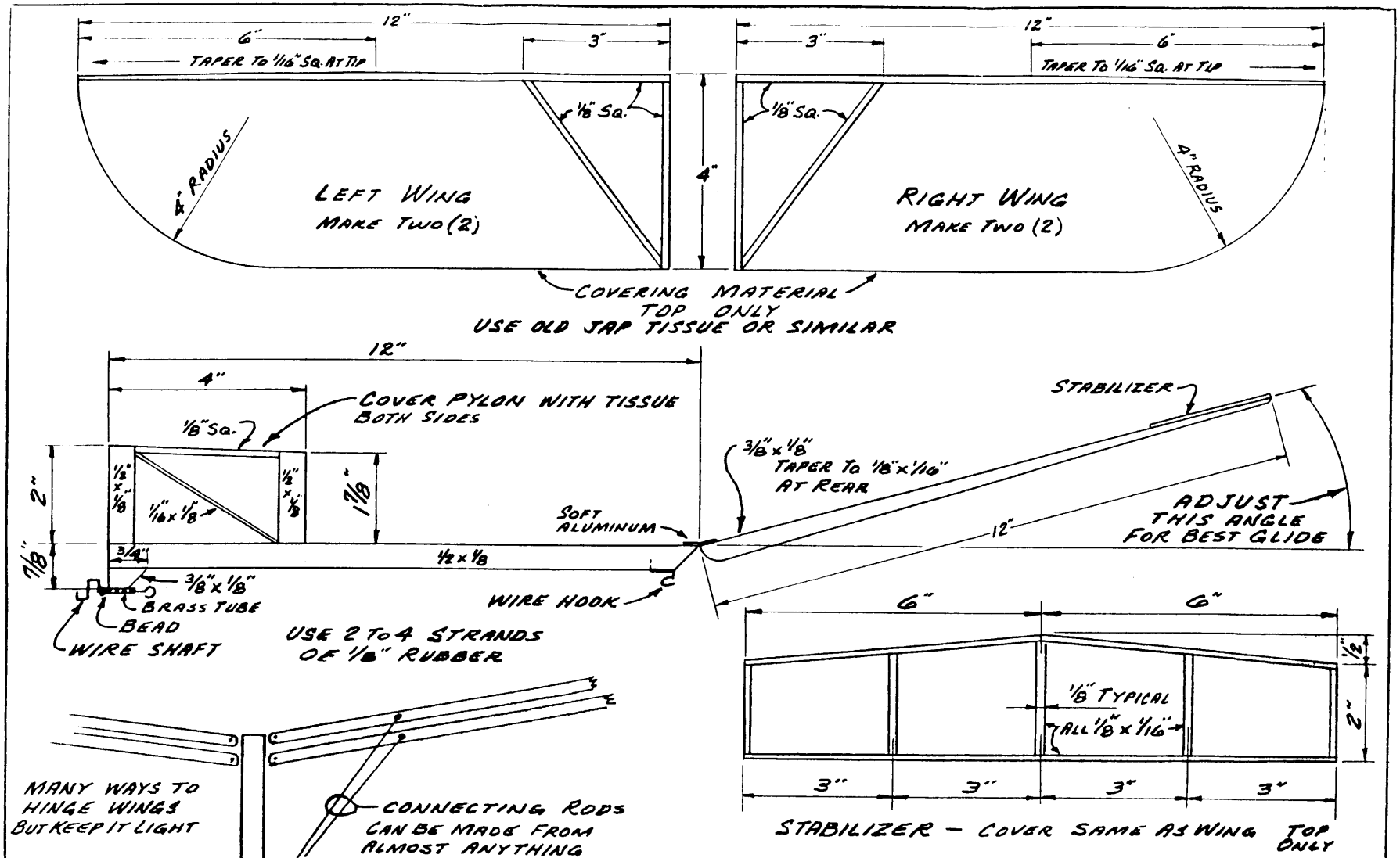
Lift coefficient c_l along the halfspan s of a flapping wing

Design Ideas Paul McIlrath

Two untested ideas that someone might want to try out on a bird-style flapper: The first is a drive arrangement that provides an output torque that varies during the cycle of the crankshaft. The second is a variation on the conventional flapping surface which produces a large change in the angle of attack on the upstroke. It appears that it might increase the forward thrust and reduce downward "lift." I've built mockups that work but haven't used [these ideas] on a model.







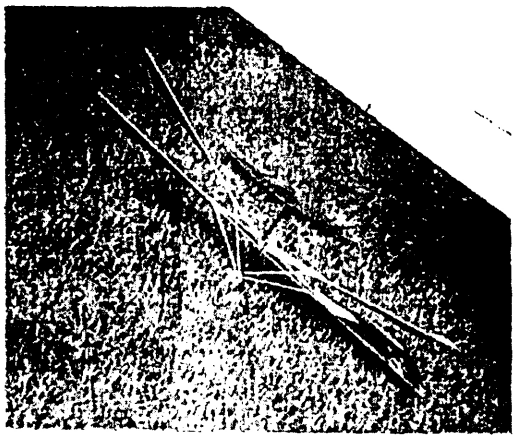
DAN GARFINKEL
PO BOX 835
LA PORTE TX 77572

D-ORNY-ONE-III

JULY 1993

DESIGNED & DRAWN BY DAN GARFINKEL

New .049 Ornithopter Dan Garfinkel



I gave it a few short glide tosses in the back yard, started up the engine, the wings flapped OK, packed the whole mess up and took off for the AMA Nats. Well, every time I had the chance to try, the winds were about 40 MPH. So I just had a beer instead. When we got back we were kind of busy. And since then I seem to have lost all enthusiasm for the project. So there it sits in the garage, all 66" wingspan of it. I'm sure I'll get back to it fairly soon.

It's mostly fiberglass tubing that I bought from a kite company. The friction drive to gears and the screw adjustment (clutch) work just fine.

CO_2 Ornithopter Update

In a previous issue, you read about Joss Levy's successful and innovative CO_2 powered ornithopter. Since the first flights last year, Joss has been working on the model in order to increase its flight duration. His experimentation with gear ratios, wing stiffness, and other variables is informative for would-be engine-powered ornithopter builders. The following letters from Levy describe the process.

7 August 94

I thought I'd give you an update on developments with my CO_2 model. You may recall my mentioning that the wings were flapping faster than expected, possibly due to inadequate wing torsional stiffness, resulting in the gas being exhausted excessively fast. Well, I tried stiffening the wings, by both stiffening the spars and reattaching the ribs to the spars at three quarters of their original distance out from the wing roots. Incidentally, there was no problem with the spars' bending stiffness, despite their thin section, thanks to the carbon fibres. When I tried flying the model again, however, I found no noticeable difference in either flapping frequency or flying performance.

I therefore concluded that I had seriously underestimated the optimum flapping frequency, and that a smaller gear ratio was needed. But first, I tried flying the model with a larger tank fitted. I didn't time these flights, but would estimate the duration at 50-60 seconds (flown outdoors).

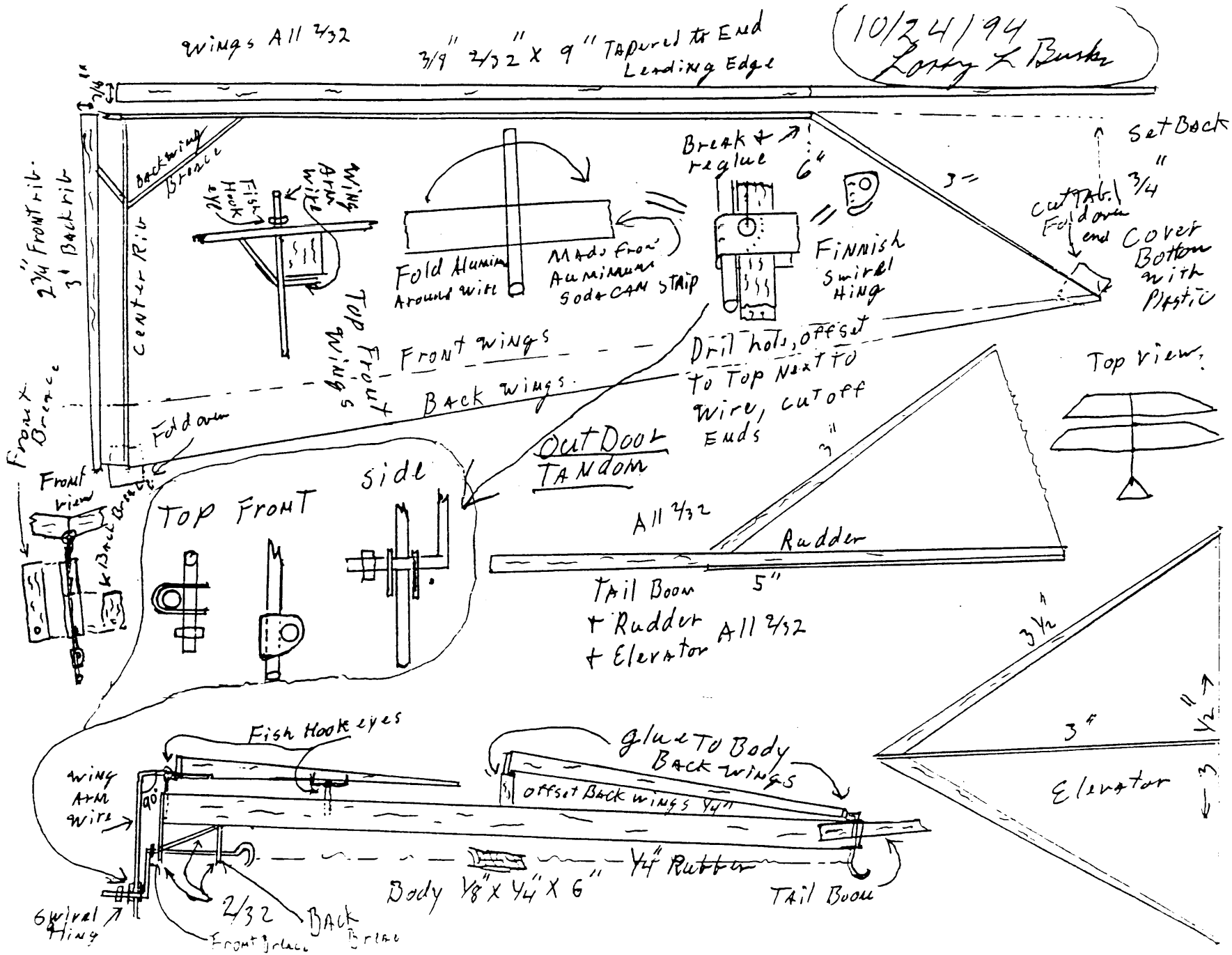
I found some gear wheels to give a new ratio of 10.8:1 which would reduce the motor's speed by 38%, and installed them in the model. I then tested the operation of the motor & transmission and was pleased to find that the motor ran beautifully and the wings were beating away as vigorously as ever, suggesting that there was still plenty of power getting through to wings at this reduced motor speed.

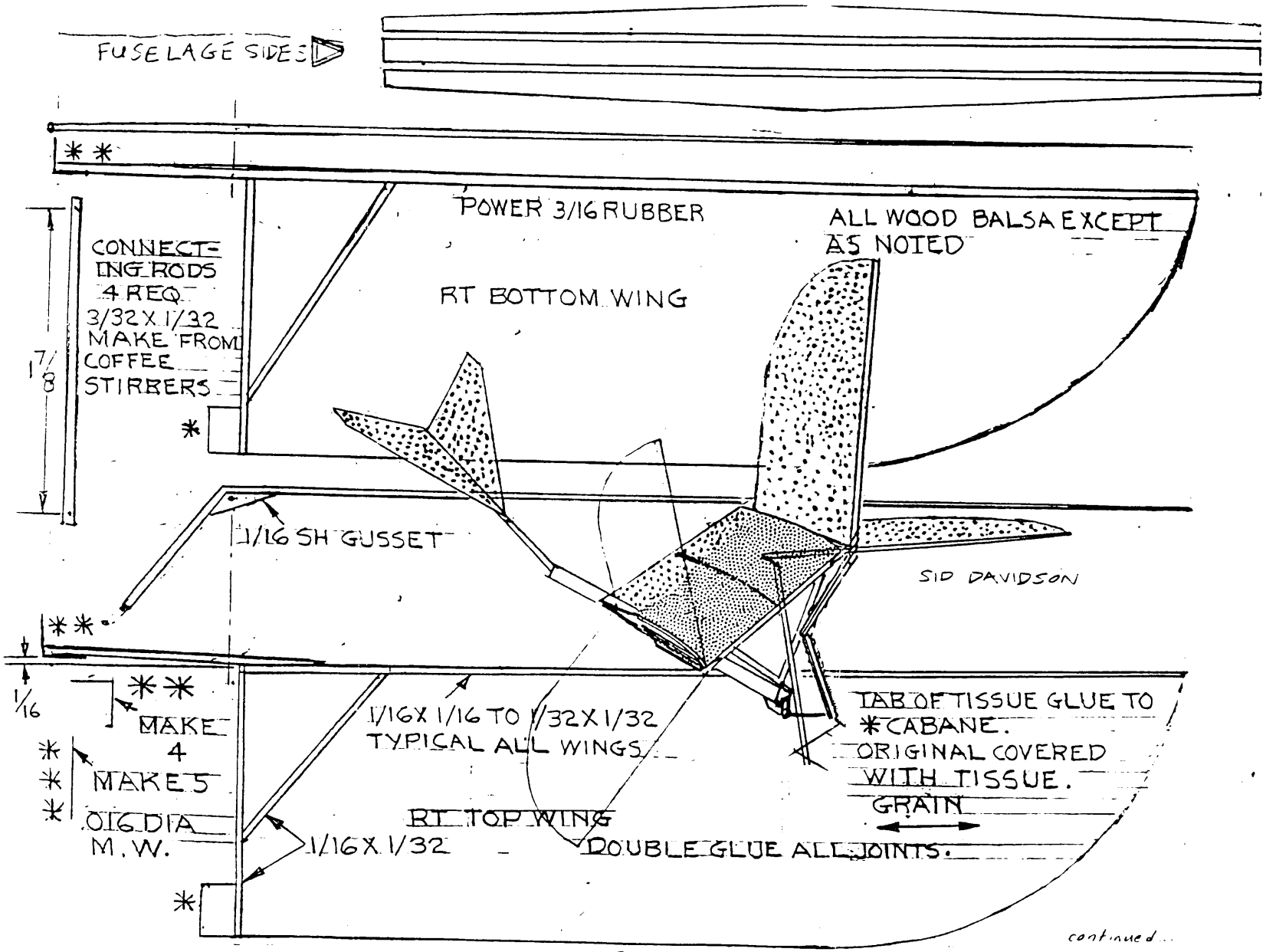
Unfortunately, when it came to flight testing, the wings stopped flapping a few seconds after launch and the motor could be heard whizzing away at an astronomical speed. One of the new gear wheels had shed some teeth (most frustrating when I was hoping for a two minute flight). This gear wheel was a little thinner than the corresponding wheel in the old gear train which was still in perfect condition after a hundred or so flights.

I will, of course, put together another gear assembly, but for now I'm putting this model aside to make a start on a new, larger ornithopter.

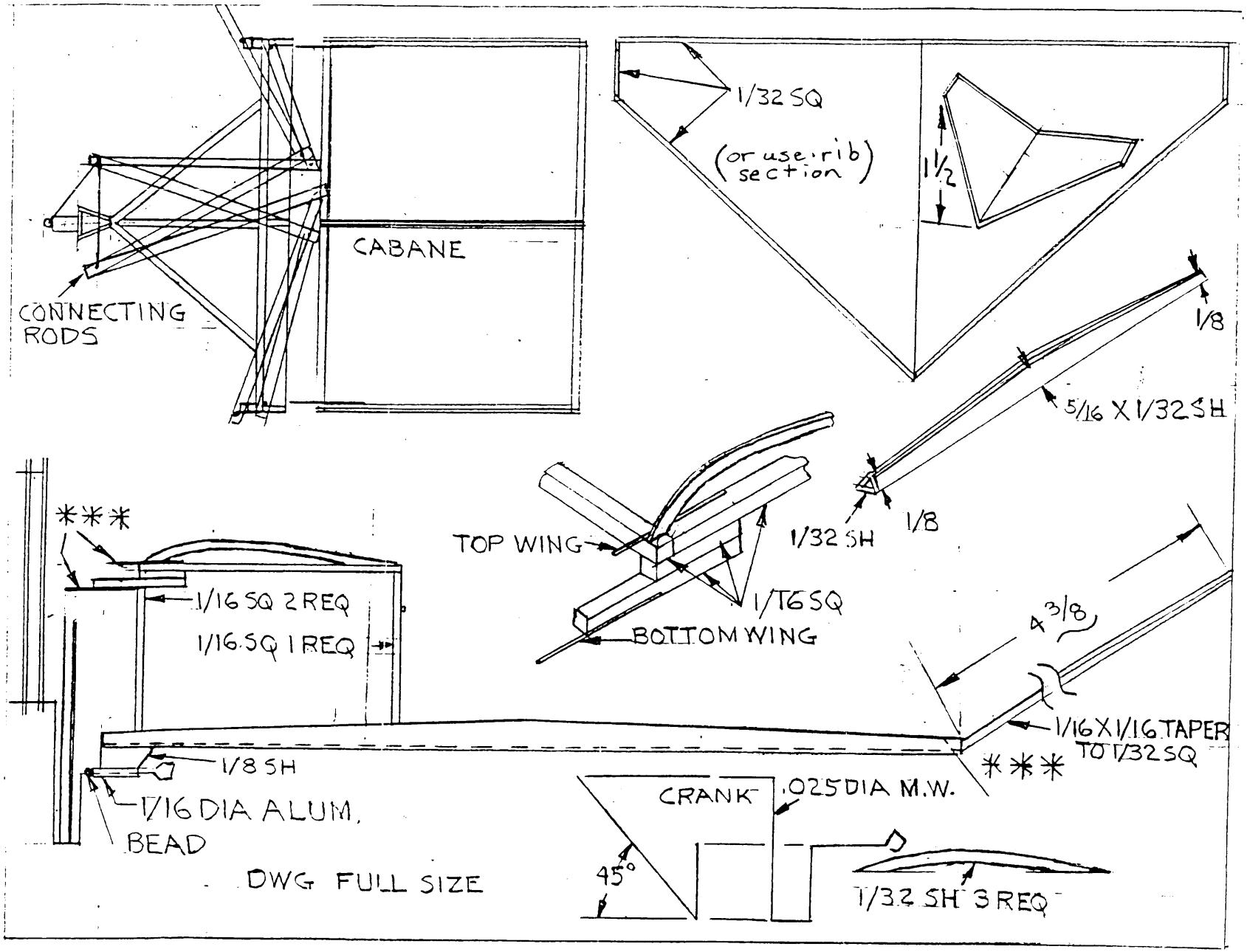
12 December 1994

I have now repaired the CO2 model, ready for the forthcoming Model Engineering Exhibition. The new gear ratio is 9:1, but the now reduced motor speed requires an extra heavy fly-wheel. This and the extra large tank have increased the weight 40%. I am confident that it will still fly nicely, but whether it will still survive the collisions with the pillars around the flying site remains to be seen.


wings All 2/32
3/8" 2/32" X 9" Tapered to End
Leading Edge
10/24/94
Larry L Burke
2¾" Front rib.
3" Back rib
Center Rib
Backwing Brace
Fish Hook eye
Wing Arm wire
Fold Alumin Around wire
Made from Aluminum Soda CAN STRIP
Break + reglue
6"
Finnish Swivel Hing
3"
Set Back
3/4"
Cut tab. Fold down and Cover Bottom with Plastic
Top Front wings
Front wings
Back wings
Drill holes, offset to Top Next TO wire, cut off Ends
Front X Brace
Fold down
Front view
Back Brace
Top Front
side
OUT DOOR TANDOM
All 2/32
Rudder
5"
Tail Boom + Rudder + Elevator
All 2/32
Top view
3½"
3"
½"
Elevator
3"
Fish Hook eyes
glue TO Body Back wings
wing Arm wire
90°
offset Back wings ¼"
¼" Rubber
Body ⅛" X ¼" X 6"
Tail Boom
6 wire Hing
2/32 Front brace
Back Brace


FUSELAGE SIDES
POWER 3/16 RUBBER
ALL WOOD BALSA EXCEPT AS NOTED
CONNECTING RODS 4 REQ. 3/32 X 1/32 MAKE FROM COFFEE STIRRERS
1 7/8
RT BOTTOM WING
1/16 SH GUSSET
SID DAVIDSON
1/16
MAKE 4
MAKE 5
.016 DIA M.W.
1/16 X 1/16 TO 1/32 X 1/32 TYPICAL ALL WINGS
TAB OF TISSUE GLUE TO * CABANE. ORIGINAL COVERED WITH TISSUE. GRAIN
RT TOP WING
1/16 X 1/32
DOUBLE GLUE ALL JOINTS.

continued...


CONNECTING RODS
CABANE
1/32 SQ
(or use rib section)
1½
1/8
5/16 X 1/32 SH
TOP WING
1/32 SH
1/8
1/16 SQ
BOTTOM WING
***
1/16 SQ 2 REQ
1/16 SQ 1 REQ
A 3/8
1/16 X 1/16 TAPER TO 1/32 SQ
1/8 SH
1/16 DIA ALUM. BEAD
CRANK
.025 DIA M.W.
45°
1/32 SH 3 REQ
DWG FULL SIZE