

Project "Banzai Machine"

by Mike Atwood

It helps to scream. Is it an A/2 Nordic? Our glue encrusted finger in the rulebook says it is. Needless to say it will spark further debate, but until that's settled, let loose!



For years we have lived with the spectre of the 180 second calm air flight time Nordic as a seeming impossibility. Although some claims have been made for this type of performance in calm or near indoor conditions, doing this on a contest day has been close to impossible. Enter the "Banzai Machine!" At the sight of it, grown men quake, the sun gods recede into the clouds, and the wax pops out of contest directors' ears.

Envision a Nordic glider climbing 500' and flying nearly four minutes in dead air. You may think it is impossible, but the "Banzai Machine" is getting close! In fact, flights approaching this have been made even without the use of the blue cape with the red "S" on it. As you may have guessed, the B.M. is no garden variety Nordic. Some will say it sprung from the valley and a green giant flies Handlaunch with it.

In actual fact, this airplane borrows

heavily from hand glider technology. Even the launch is scaled up hlg, using surgical tubing or shock cord for an "arm." Stretch the rubber "arm" to 80+ lbs. tension and let fly with it. The speed of departure is impressive.

All seriousness aside, let's look at the history and theory behind this development. The first thing that had to be settled was the legality of this procedure. In the opinion of AMA Technical Director Frank Ehling, FF contest Board Member Buz Averill, and FAI FF Program Administrator Dave Linstrum, this airplane and its launching technique are legal under present AMA and FAI rules. The trick set up is having a towline that does not exceed 164' under a pull-test of 4.41 lbs. as specified in the FAI rules. The important thing to note is that there are no restrictions on towline length at greater tensions.

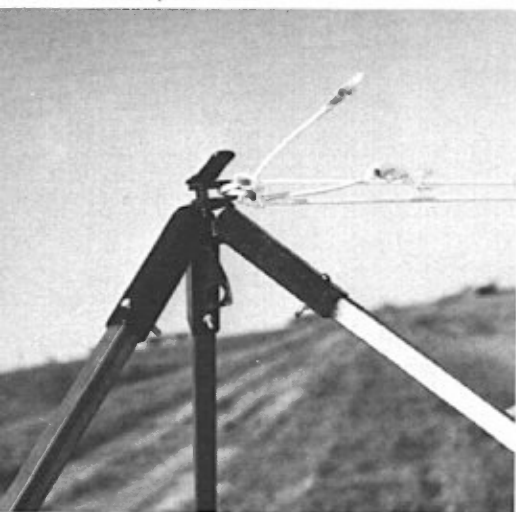
This small step that may result in a giant leap (literally) for the airplane is a pro-

jection to the logical extreme of present flying trends. For several years the Europeans have been catapulting their A-2's from the towline with various devices. The difference with the "Banzai" concept is only a matter of degree.

The history of "Project Banzai" began some months ago when I studied tension release towhook designs, looking for the best combinations. In looking for ways to gain a few extra feet of altitude, I considered changing aircraft design to allow a more severe toss off the towline. Then that weird and wonderful thing that resides between my ears began to run amuck! A thorough reading of the rule book convinced me a super-stretchy towline launch was legal and possible. I talked over the possibilities with Frank Perkins and Dick Mathis. It was in a conversation with Dick that the project finally gelled.

Within a couple of days, a crude experimental ship was strapped together using a

Photos by Dick Mathis



A tripod staked into Texas dust. Head swivels 360 degrees for shifting wind. Must be sturdy!



80 pounds of power on the line. Mike chooses not to think of that too much as he waits for good air to come along. Everybody out of the way! Be safety conscious. The climb rate is quite phenomenal.

foam wing from my FAI power plane, a *Starduster 350* stab, and what amounted to a pine log for the fuselage. Five flights were made with 15 lbs. tension on 16 strands of $\frac{3}{16}$ " contest rubber 15 feet long, with the best flight going over 120' high. Then, giving in to Fast Richard's coaxing from the side lines, I tried a full bore run (50 lbs.). Have you ever seen a goose hit by a 12 gauge at close range? The airplane began to explode immediately on launch. One wing did a beautiful pirouette around my head, pieces of stab were strained through wing spars like so much soup, while the fuselage convulsed into a perfect Lomecevak. I started crying softly, and after all the pieces were laid to rest (and the hysterical laughter from Fast Richard subsided), it became obvious that a stronger craft with more rubber should perform exceedingly well.

Planning on the "*Banzai Machine*" commenced... theory being at that point that a brick will fly three minutes if it has enough altitude; sinking speed would be traded for height. As all airplanes represent a design compromise, so does the "*Banzai Machine*." The gliding ability is limited by the strength built in to survive the launch. The compromise point was reached in a practical way. Wing and fuselage length were limited by 48" wood.

Using this method, I arrived at a 399 s.i.a. (square inches of area) projected wing and a 125 s.i.a. stab. A parabolic development was used for all the flying surface contours to add structural integrity. Airfoil selected was a 5% thick, 30% high point, flat back style. The flat back airfoil is the easiest to carve since it can be checked with a straight edge. The tail moment was kept short to make balance easier. For the same reason, the nose could belong to Jimmy Durante!

The number 1 airplane weighed 22 oz. because I built in too much strength. This is a good time to remind you to select your wood carefully.

The wing was bolted to the fuselage and the stab glued on solidly. A word about these attachments... anything less than rigid mounting may allow movement of wing and stab at launch, resulting in a spectacular but short flight. The front

wing bolt goes through the fuselage and threads into the towhook, thus transferring the launch load directly to the wing. The C.G. location was found to be critical and had to be moved rearward to prevent looping as power was increased.

Some Army surplus shock (Bungee) cord, thanks to Bernie's Hobby House, was used for the launch. The first days' flights really settled the issue. Performance was staggering, with 300' high climbs and I still hadn't learned how to trim it! Later tests indicated that enough rubber would punch the thing up to over 400', with witnesses estimating a capability well over three minutes. That's when the *Banzai Machine* earned its name.

The shock cord used was $\frac{3}{16}$ " diameter and had an elongation of 300% at 30 lbs. The first flights were made on a single 100' strand, graduating to four strands at 25'. Incidentally, lengths are measured unstretched. More experimentation is the order of the day. It was also found that too much rubber cut the altitude due to its weight.

Work on the number 2 "*Banzai*" started with a swift run to M&P Enterprises' balsa emporium. Here I gleaned some superfast wood from a bin marked "indoor wood". All this while Fast Richard was occupied with my three year old son who had been trained to bite him on the ankle as a distraction.

The evil deed accomplished, I retired to my lair to build *B.M. #2*. This is basically the same airplane as #1, except for much thinner airfoils and lighter wood. The thin, $\frac{3}{16}$ " wing and stab airfoils also help to reduce weight to a respectable 14.7oz.

Select light straight grained wood for the fuselage. A $\frac{1}{2}$ "x3"x48" board weighing about 5 oz. will be close. As a suggestion, purchase a small postage scale (\$2-\$4) and check its accuracy at the nearest drug or grocery store. Then take it with you when you shop for wood. (Hobby shop owners will love me for this.) For the wing wood, any width combination to get $\frac{3}{8}$ "x12"x48" should weigh 12 oz. Use the same weight wood for the stab.

The first step is to laminate the boards together to form wing and stab blanks. I use Elmers or Titebond for all joints except

wing dihedral and metal to wood, thus easing repair work.

If you're like me and don't have any furniture clamps, drive nails in your work bench or kitchen table and hold boards together with rubber bands stretched between nails.

Be sure and use some plastic wrapping between wing boards and the bench or you will have a winged work bench. Maybe there should be a class for "unlimited catapult workbench"?

When laying out the wing pattern on the wood blank, put the airfoil high point on one of the lamination lines. This makes an easy reference while carving.

Carve the rear portion of the wing first. Note the shaded line on the plans across the wing. A straight line from there to the trailing edge will give the proper airfoil and spanwise taper and shape. Then round off the leading edge section by cutting from the high point line forward.

I used a razor plane for all the carving and finished with 100 grit and 240 grit sandpaper. Carving a wing and a stab should take three to four hours. Picking up all the shavings takes about the same.

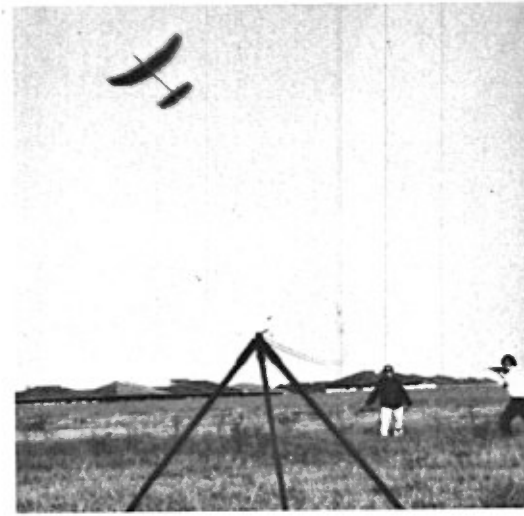
Before cutting the wing apart for dihedral breaks, note the outer breaks are not square with the wing. This gives slight washout without destroying airfoil curvature. Picked up that little tidbit from Alan Coppock in Australia and was reminded of it again by Lee Hines at the Caddo Mills Finals. The washout seems to allow a tighter glide circle without spinning in. This at very little cost to performance. Cut out the openings for the hardwood dihedral braces in the center panels before joining, unless you have a table saw. Also, ice-picking the face of the dihedral joints allows the epoxy to penetrate further into the panel, thus making additional braces unnecessary. Now would be a good time to make the fin and sand to a streamlined shape.

Cut the fuselage to shape and trim out for the hardwood inserts. Note that the rear block is drilled $\frac{1}{8}$ " and tapped with $\frac{1}{4}$ -20 thread. Drilling and tapping should be done before installation—you could split the wood!

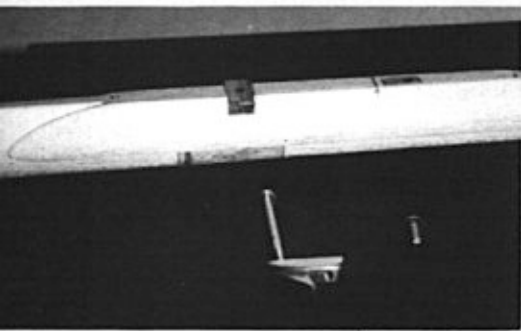
After installing the blocks, adding side doublers and subrudder, round all the



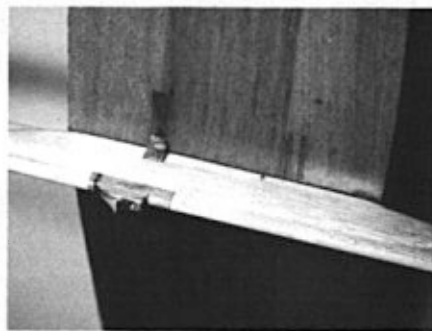
Banzai! It departs in a howling climb as Mike tries to make himself a smaller target in case it comes back. Note sag in the line due to weight of the rubber. Technique puts it all the higher.



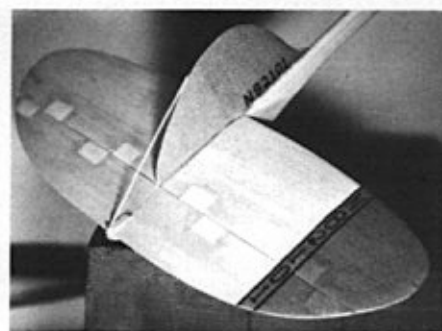
Off hook already, research is needed in optimum length and diameter rubber. 150 mph or better.



Well integrated light and strong wing mounting and tow hook. The maple inserts mean business.



Streamlining is important at "Banzai" speed. No crude pegs or lashed rubber is visible on ship.



Aft end of stab is hinged for dethermalizing, a strong mount forward to withstand launch force.

edges. Remember, the subrudder is your handle. You can use very light wood, but keep it $\frac{1}{2}$ " thick for a good grip.

Assuming the stab has been shaped, cut it in two as shown for the DT elevator. Use cloth hinges. Now glue the stab solidly to fuselage with tilt as shown. When dry, glue on fin using a long straight edge for alignment. No offset is used.

Carefully drill mounting holes in the wing. Install rear bolt in a drilled and tapped hole. Then square wing, mark the front hole location, and drill.

The entire airplane can be covered with jap tissue. Use enough clear dope to seal the surfaces and come out to a gloss finish. Sherwin-Williams clear brushing lacquer will cover and seal faster if you can get it. I haven't tried it yet, but a coat of wax may speed up the launch. Remember we may be flying as fast as 150 mph, so make it slick!

Make the towhook from aluminum as shown on the plans. Bolt all the parts together and balance. Epoxy lead in the nose until the C.G. is at $6\frac{3}{8}$ " from the leading edge, measured at the center of the wing. Ball point pen marks on the fuselage will make rechecking easy after any repairs have been made.

Flying

Trim it out just like a hand launch glider. Bank to the right on launch and use rudder tab if necessary to achieve the right climb. Slight extra wash-in may be used to hold the wing up. If more stab tilt is



necessary, shim the wing for tilt instead.

Hand glide to check for a stall or dive and correct with adjusting screw on stab. Glide turn to the left should be evident.

First flights should be made at about 15 lbs. tension. A small fisherman's scale will be very good for this. If the plane does not climb steeply, but the glide looks good, try moving the C.G. forward (more nose-weight) about $\frac{1}{8}$ " at a time. Then add stab incidence.

When a 15 lb. pull flight looks safe, go all out for a "Banzai" run! Need I remind you to use a strong anchor stake for the towline? Four or five feet from the ground is about right for attaching the towline. Refer to the plans on how to arrange the stakes. Be sure to test the stake before stretching the towline. The sight of 2x4's being catapulted toward you is horrendous.

So that's it! We now have a new set of

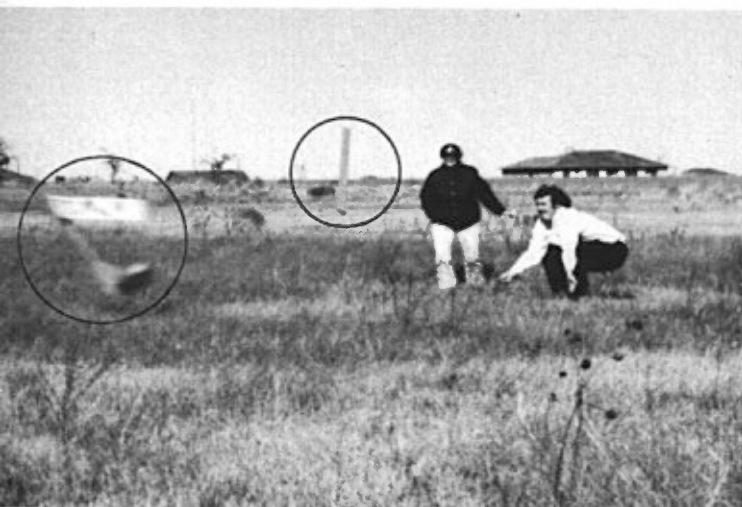
design parameters to work with. Allowing for future development, A/2 and even A/1 Nordic could be an even more exciting event for the next few years. So far, we've been lucky, but much development work will be needed before reaching the ultimate.

The design compromise point can probably be moved in both directions, i.e. more glide or more altitude. The 22 oz. #1 plane with the 5% thick wing seems to work just about as well as the light, thin wing #2 model. Experiment with more and different rubber. Surgical tubing gives a more constant pull as compared to shock cord which has a brutal initial burst then falls off rapidly. Also, try moving the towhook forward. This may keep the plane on the line longer, allowing a higher speed.

Well, start carving... the progress is there for the making. Already, two others are working along the same tangent. May all your air be lift.

Author's Note on Safety

For safety's sake, remember that with the "Banzai" launch there is a good bit of energy expended. Always launch upwind of spectator areas. Fly untrimmed planes away from people, houses, roads and cars. With some experience you will be able to judge what to expect. My personal opinion is that the Banzai launch Nordic is at least as safe to surroundings as the flying of FAI power ships. Both should be respected and flown with reasonable caution! ☐



Hoop toss? No of course not, just Dick's compass circling the loose parts unparting. Early test design succumbed to a thrilling amount of rubber.



It was as strong as an F.A.I. they estimate. Mike smiling over remnants, what else to do? Do not get in front of these gliders, they really move.