On Drag, Round Noses and Spinners

Norman G. Messinger -- N24PN

Several years ago a drag reduction engineer from the local McDonnell-Douglas Aeroplane Werks who spends most of his time working on high-powered wind suckers gave our EAA Chapter suggestions for reducing drag on a Long-EZ. He said his little tricks might add 15 to 20 knots. Several of the suggestions were relatively innocuous such as fillets where any right angles occur as where winglets meet wing and wings meet fuselage. (Phyllis just asked what I am doing. I said, "I'm writing Arnie an article on drag reduction. Didn't you know I am an expert on drag reduction?" She said she thought the only reduction I was interested in was hers!)

Anyway, for what it's worth. . . .

Wheel pants, of course are the most significant single item. A vent to allow air to escape from the cockpit rather than leak out around the seams is helpful. A couple of other suggestions require rather significant cosmetic modifications fore and aft. A pointie end on the front works best at Mach 1 plus. According to him an eight-inch parabolic nose provides the least wind resistance-- even if the EZ is powered with an O-360. The spinner on the back should have a slightly obscene look-- like N24PN and the Starship.

Some of the local builders have carved the nose parabola. I'm used to the standard shape but it doesn't look too bad. It should add two or three knots and at least it won't interfere with parking with the nose gear retracted as modifications in the other extreme have. So far N24PN seems to be the first Rutan composit with the "right" spinner shape.

What I've been leading up to is sharing with you a method for making a perfect prop spinner-- in any shape you wish. The technique was taught to me by Mr. Art Frost, master pattern maker at that wind sucker place, good friend and hangar mate with an immaculate Emaraude.

The secret of the method is in the three templates used to form the plaster-of-Paris forms used to shape the fiberglass layups. Draw a full size outline of the inside surface of the spinner, locate the center line and draw template "B" and "C" in precisely the proper position and there is no way that you can complete a spinner that will not fit the bulkheads or track true.

Template "A" is used to form a plug over which the spinner is formed. Templates "B" and "C" form the bulkheads which hold the spinner to the prop hub. I used four plies of BID for the spinner reinforced with a ply of UNI in the area through which the attachment screws pass and five plies of BID for the bulkheads. Be sure to stagger the overlaps so the spinner and bulkheads will be balanced.

Begin the plug for the spinner by placing scrap foam over a half-inch rod. When the foam is hacked to roughly the shape of the template, though smaller, dump on plaster of Paris and strike it around and around the center rod with template "A". As the plaster sets up keep adding more and rotating the template to distribute the plaster and scrape off the high places until the plug conforms perfectly with the template. Do not allow the template to raise off the rod nor let the plug dry out before this process is complete.

When the plaster is dry, seal the surface and treat it so the fiberglass will not stick to it. I taped on plastic wrap. Lay up the four plies of BID and one of UNI, knife trim the end of the plug and when cured, remove the plug. It should come out with effort. (Don't you hope!)

Make the bulkheads beginning with a round plate of .10" 2024-T3 in which a 3/16" center hole and holes for the prop attachment bolts have been drilled. The center hole must be dead center on the prop attachment holes! The size of the plate is optional but at least 1/2" smaller than the radius of the spinner at the respective points and 1 1/2" to 2" larger than the radius of the prop hub and pressure plate. Lay the plate on a scrap of plywood over a 3/16" center hole, dump on a pile of plaster of Paris, place tip extension of the appropriate template "B" or "C" in the center hole and rotate the template around and around pushing the plaster out forming a dam on the circumference of the template. Keep rotating the template and adding plaster until a perfectly smooth inside surface has been formed by the template and the round plate has been scraped clean. Do not allow the template to raise, keep it vertical.

When the plaster dam is dry, seal it, rough up the round plates outside the area which will be covered by the prop hub or pressure plate, coat with wet flox and lay up five plies of BID inside the dam and over the roughed up portion of the plate. Keep the glass outside the circumference of the prop hub or pressure plate— or trim it back later.

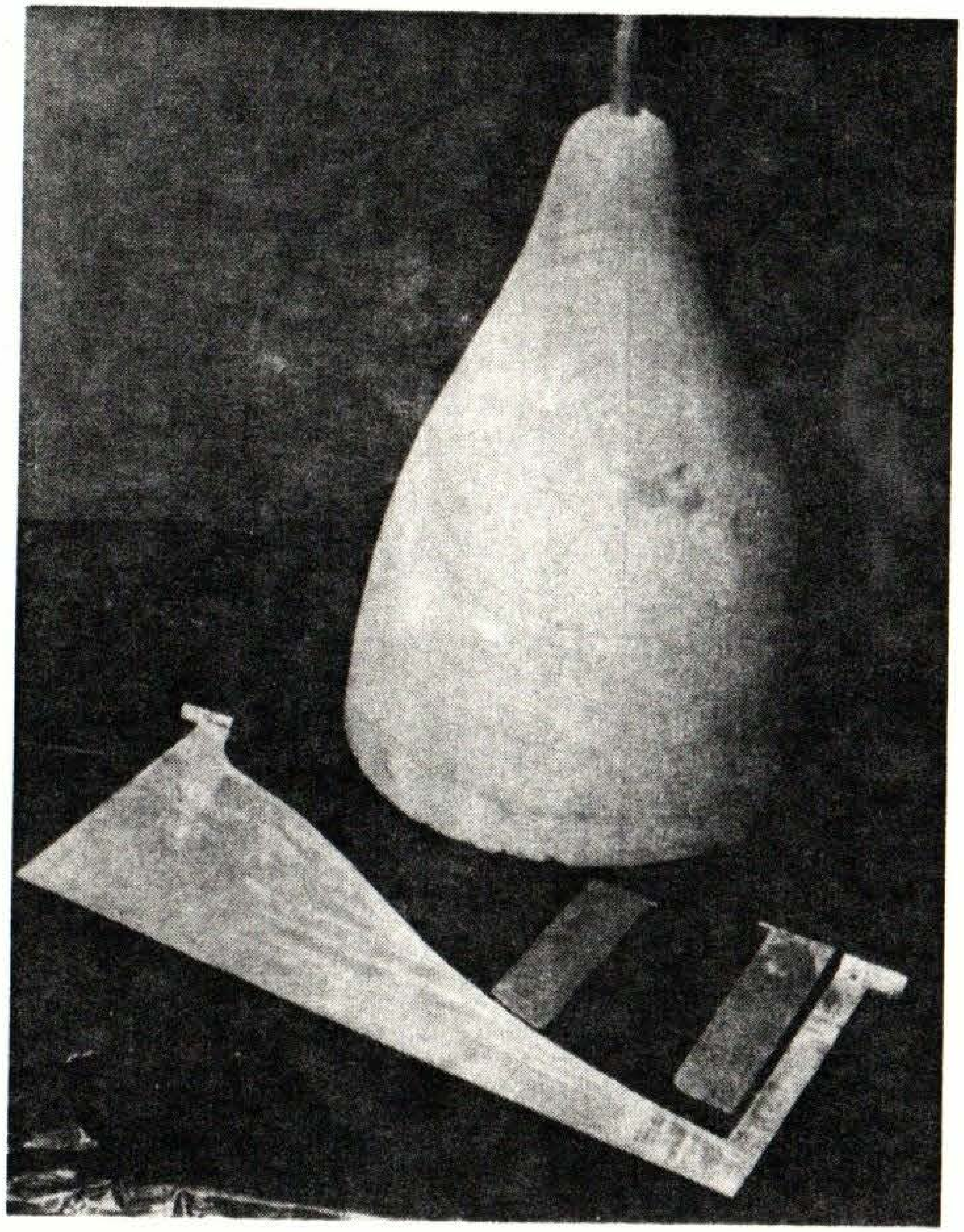
The plaster dam must be destroyed to remove the bulkhead. Clean off the plaster and rivet the glass to the aluminum plate with two rows, staggered, of rivets through washers on the glass side.

Now, if you figured the thickness of the prop right and added the thickness of the aluminum plates when you drew out the templates, all you gotta do is pull the prop, slip on the forward bulkhead, glass forward, replace the prop, install the aft bulkhead, glass aft, replace the pressure plate and torque 'em down.

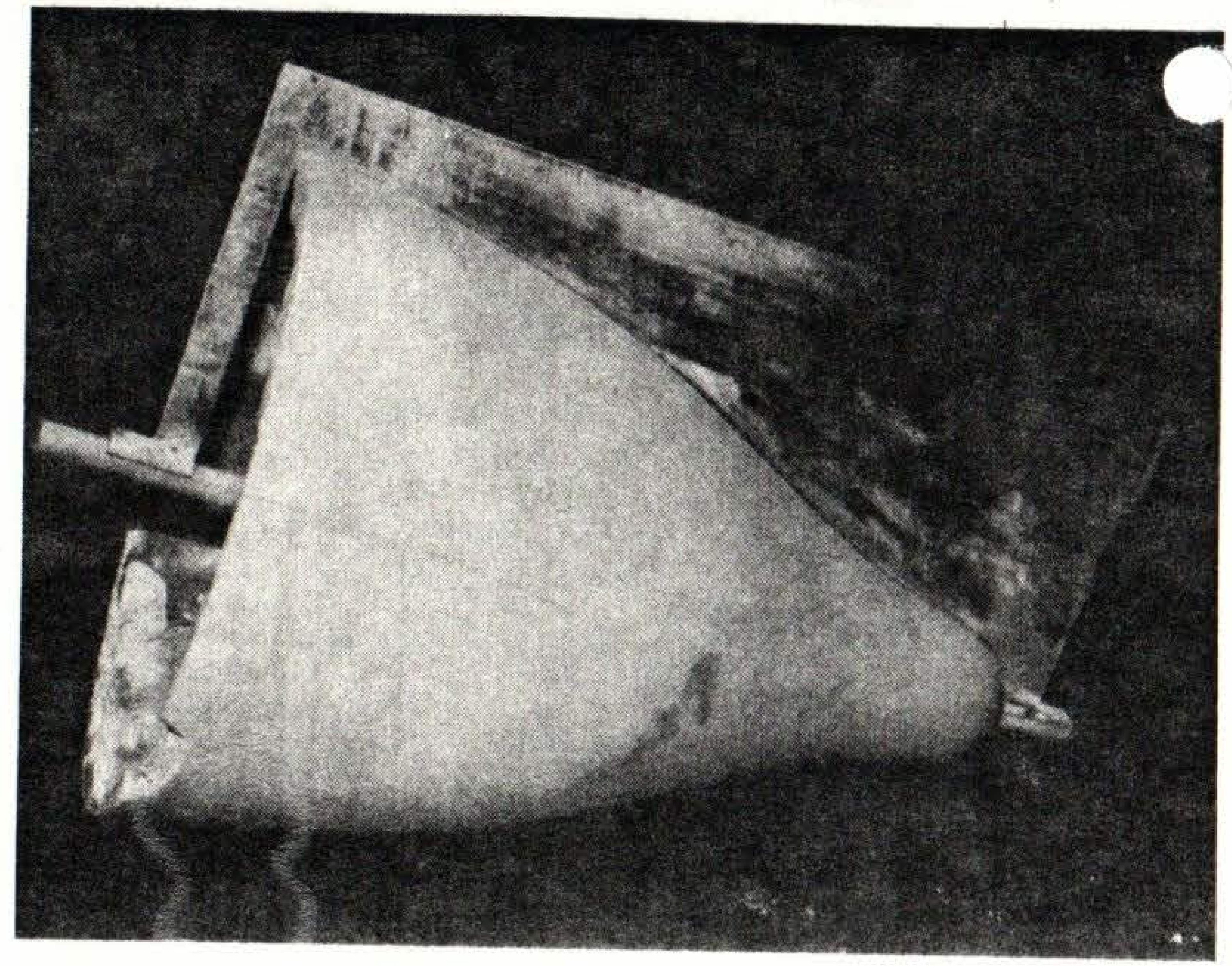
Cut out the spinner as required to allow it to slip past the prop and seat tightly on both bulkheads. Use at least eight "T" nuts pop-riveted to the forward bulkhead to attach the spinner. None is required in the aft bulkhead. If you were careful enough about making the prop cutouts, you can use them to fill in the gap in front of the prop. Otherwise, lay up five plies on the spinner plug to get a piece large enough and of the correct shape to cut two filler plates. Lay a half-inch lip on the inside of the filler plate and rivet on a "T" nut to attach the filler plate to the spinner.

Art described the above process to me in a few minutes with sketches on the back of a Wicks invoice, or maybe it was an envelope or napkin. It did seem simpler and more concise coming from him, than I've done above. Perhaps the drawings and photograph will clarify my prose, though none is complete alone. It is however why I just squeaked through high school mechanical drawing some 35 years ago. Drop me a note it you have questions that you can't figure out from the material presented.

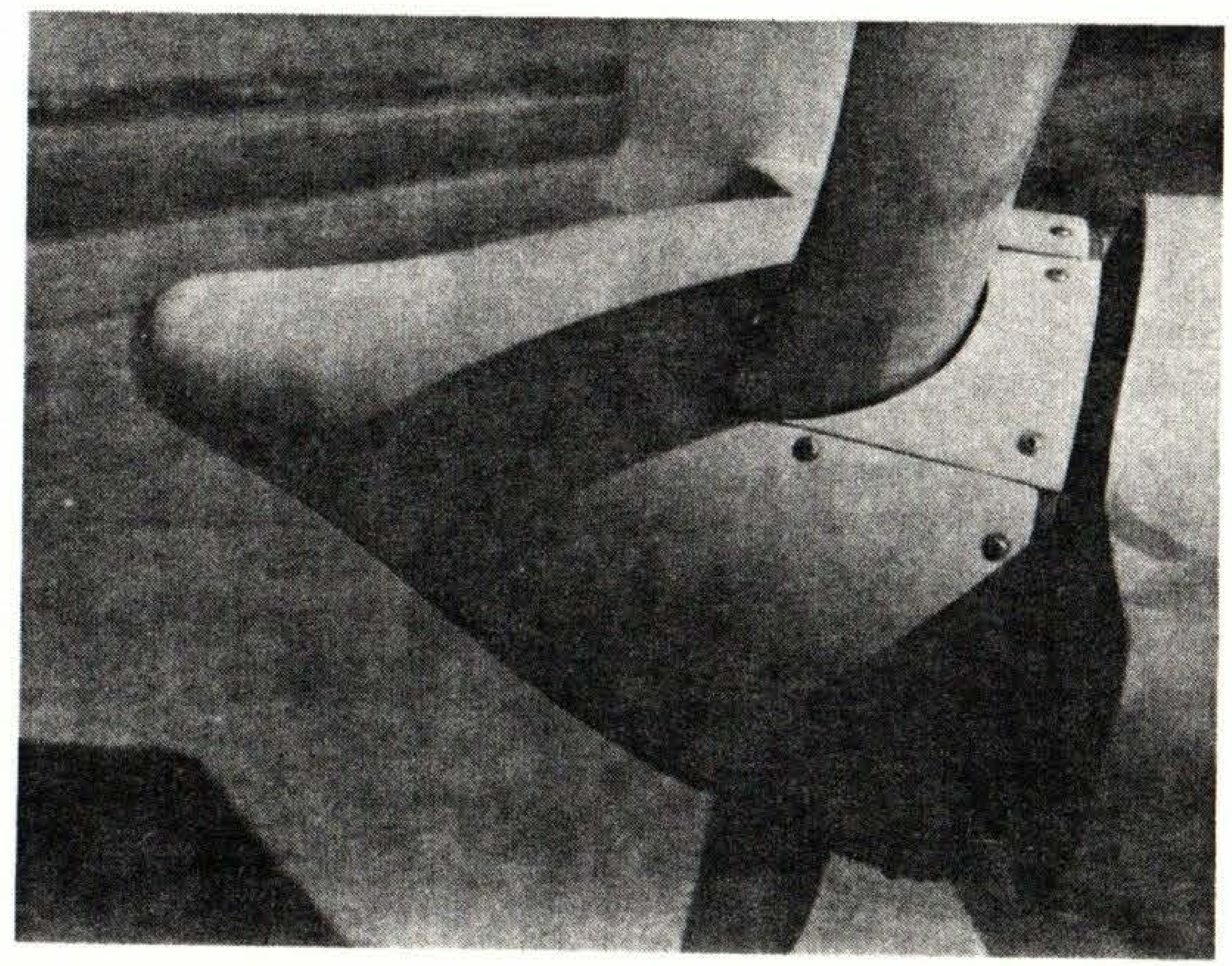
Anyway, N24PN has the nasty little spinner herein described. The drag guy said it would add a half a knot or so. I can't detect extra Gs on takeoff but cooling is better and the engine sounds different. Best of all I like having a custom spinner designed for the push-me configuration. And I wonder where the Starship got its idea. Go for it.



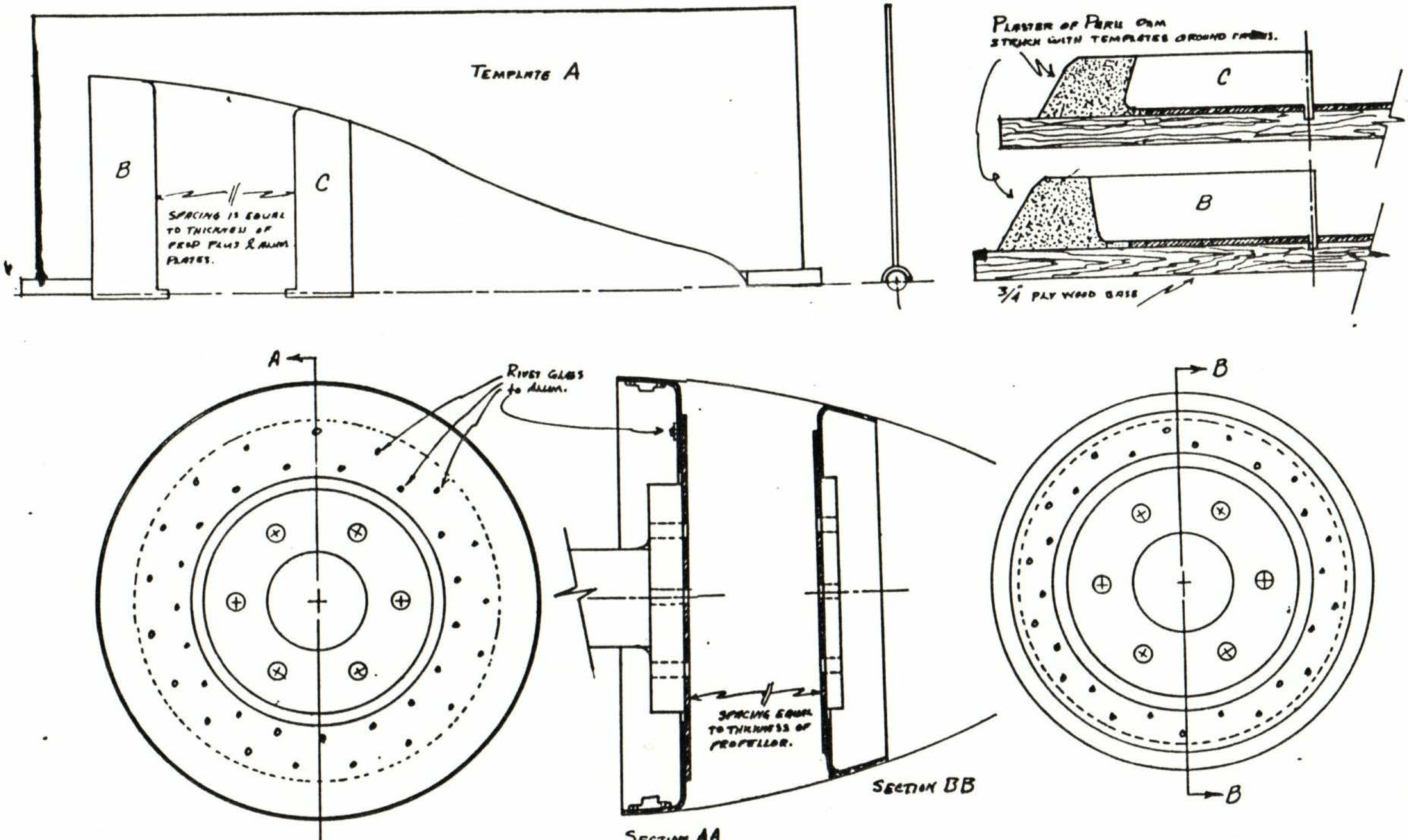
The completed spinner plug and the three templates which form the plaster-of-Paris molds for the three spinner parts. Because the lay ups are on the outside of the plug and the inside of the dams, the spinner must fit the bulkheads precisely.



Template "A" in position on a completed spinner plug. Note the half sections of a ½" i.d. tube on each end of the template which rotates on the ½" rod to form the plaster.



Spinner of N24PN. Failiar to account for the thickness of the prop bulkheads keeps spinner from covering forward bulkhead. Aft glassed bulkhead is about 0.2" out of place. A rounded insert on the forward end of the bulkhead would furthur enhance the benefits of thesspinner.


TEMPLATE A
B
C
SPACING IS EQUAL TO THICKNESS OF PROP PLUS & ALUM PLATES.
PLASTER OF PERU
STRUCK WITH TEMPLATES AROUND
C
B
3/4 PLY WOOD BASE
A
RIVET GLASS to ALUM.
SPACING EQUAL TO THICKNESS OF PROPELLOR.
SECTION BB
SECTION AA
B
B

Induction Icing

Ben Ellison (WA) - Thanks for inviting my input on carburetor icing. I have summarized what (we think) we know about the mechanism of carburetor ice formation.

Float Type Carburetors:

1. The throttle plate experiences drastic cooling due to the evaporation of fuel which is sprayed on it by the upstream fuel jet. The thermodynamic "venturi" effect, which is popularly assumed to be responsible for ice formation, is insignificant. Water vapor in the air condenses on the cold throttle plate and freezes, with ice accumulating on both sides. Engine roughness from distortions in cylinder to cylinder fuel distribution is often the first warning symptom, followed by substantial power loss as the growing ice deposit obstructs induction airflow. Final engine failure can either be a rich or lean failure depending on subtleties of ice ball geometry.

2. Another form of icing can occur in Marvel-Schebler carburetors (as well as in the Ellison TBI as explained below) when small air bleed passages in the idle system as well as the main metering circuit are occluded with one or more small particles of ice. The result is excessive rich roughness that may occur over a narrow RPM range or may be present over the full range of throttle openings. When the engine finally quits it is a rich failure.

Throttle Body Injectors:

The Ellison Throttle Body Injector (TBI), with no throttle plate downstream of the point of fuel injection, at first glance appears to be ice proof. Unfortunately, many of our customers have never gone beyond the first glance in spite of our warnings. A TBI, in any given application, may go years without accumulating any ice. Unfortunately, some of our customers feel that since the TBI ices up so infrequently, they won't be quite as dead as if it happened often. As with the Marvel-Schebler carburetor, the same two ice mechanisms are possible in the TBI. Here's how:

1. The same extreme temperature drop occurs in the TBI as with the M-S and for the same reason. With no throttle plate downstream of the fuel input there is little for the ice to adhere to. It is possible however, for ice to form on the side wall of the TBI downstream of the throttle slide. TBI owners can convince themselves of this danger by running their engine at 1500 RPM for a while on a humid day with the cowl removed; the diffusion section of their TBI will look like a Popsicle. Serious ice formation doesn't happen very often, but it only takes once to have your widow's attorney looking for my phone number. Deadly ice formation can occur in the manifold of engines with cold intake pipes such as VW conversions and Continental engines, to name a few.

2. Idle circuits of most of our TBI models include an air bleed passage that makes the fuel behave as though it had much lower viscosity. On humid days, when operating at idle for extended periods of time, the bleed orifice (located in the bottom of the slide cavity) will ice over, causing idle mixture to slowly enrich. Cycling the throttle a couple of times will sometimes clear the ice but the application of carb heat is the only sure cure. As the fuel contribution of the idle circuit diminishes as the throttle is opened, bleed circuit icing has negligible effect on power but can result in the engine quitting in a decent if the throttle is retarded far enough. This is a critical problem in Ezes because the driver, not being able to see the prop, has no good way of knowing that he's a glider pilot.

V-6 For Sale

Chevy V-6 4.3L engine with all aluminum block and heads. Oil pump and water pump driven piggy back from accessory case. Was installed on my Velocity, but I ran out of time. Includes Northwest Aero of Auburn, WA reduction drive, engine mount, custom radiator, top & bottom cowl assembled and ready to mount on Velocity. $13,000 located in Sebastian, Florida. Call:

Byron McKean,
Payson, AZ
520-474-7097

Canopy Access Door

During a recent trip, looking at EZ projects for new ideas, I came across Jim Leturgey's Long-EZ in Gasport, NY. Almost everyone, who has installed the canopy access door, has been bothered with air leaks from that flexible door. Jim's approach has been to increase the stiffness to achieve more reliable sealing and provide a more secure mounting for the door's lock. He has also changed the hinge geometry to reduce the possibility of leaks. That is important in NY's cold winters.