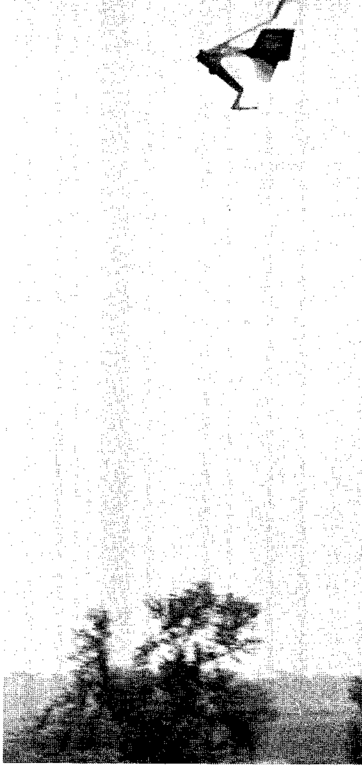
NEUTRINO



Not a delta or just an unusual design, it is a thoroughly engineered ultra performance airplane.

By DAVE YOUNGBLOOD

It takes a trained eye to tell the difference between the "new" designs and the old ones we've been flying for years. Most of the planes at the local field look alike to me and, let's face it, they all fly about the same. The standard low-wing multi is popular because it's a darn good flying machine. But let's consider some alternate layouts.

What about shoulder wings (or high wings)? Ever have the wind get under a wing on take-off? What about a pusher and/or a canard? Well, there may be hope for these but it seems like flying backwards, and besides, how does one keep the engine cool while taxiing? Or a flying wing?

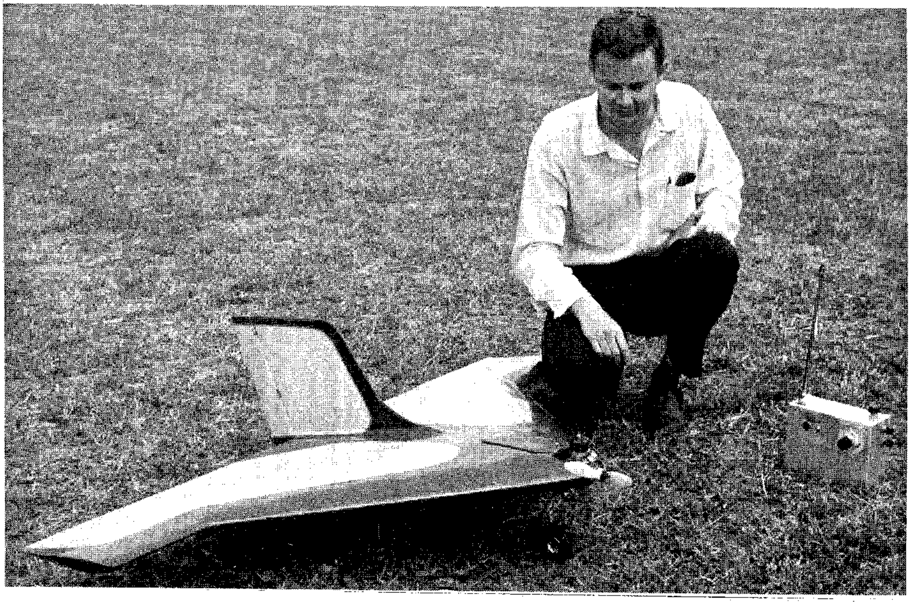
One version, the delta, is quite flyable but, in general, is known as a flighty, semi-stable, speed whiz. However, it can be tamed and turned into a machine as nice to fly as most standard ships and better than quite a few. This taming results in a delta, but with important differences. So I'm going to describe an airplane that doesn't look like the others, although it does much the way they do.

Hours were spent discussing these things during the daily meetings of the Houston RC Bull Thrower Society (five or six of us ate lunch together every working day). For experimentation I obtained a ready-to-fly Midwest Hustler. The first step was installation of a full-house proportional rig, including steerable nose wheel and throttle. This alone tamed the landings considerably, and allowed for flying at reduced power to evaluate performance. Many flights later (with Veco 45) a few conclusions were drawn. The configuration proved convenient, serviceable, and it was different. Few people fly full-house, stunt delta's.

However, several drawbacks were apparent in its flying qualities. Most serious was the matter of pitch control (you know: elevator). Balanced according to the plans the thing would hardly remain in the air—almost full up was required and the conventional elevator was completely ineffective—this at about 70 mph. When the engine died the glide resembled that of a dead pigeon. As the balance point was moved back the delta became more responsive and a place was reached where nicely flared landings could be made even dead stick (but at a rather high airspeed). The thing was surely responsive under power. All the maneuvers of a conventional ship could be performed reasonably well, but it was almost unstable.

These are not criticisms of the Hustler, really — just of

Though weird and strange, it flies with the same characteristics as conventional planes. All control responses are linear throughout its flying speed range and the planform is fantastically stable. Dave shown with his creation.



the Hustler when flown the way I wanted to fly it, two pounds overweight and a .45 up front. The pitch control problems became much less severe when you cut out 2 lbs., but I had to carry a quad prop. rig with four servos to get full-house performance.

The Hustler has as much total area as most low wings (including stab) so why does it behave that way? There are several reasons. The most important is that short tail-moment. To fly the airplane, a torque about the C.G. must be produced which will at least cancel the nose down torque inherent in a stable lifting configuration. To do this, we push down on the tail of the airplane, i.e., we carry a little up elevator (or negative incidence in the stab on a conventional ship), but on a delta the tail moment is less than half that of a conventional ship, so that, to obtain the same torque, we have to push down on the tail more than twice as hard.

But the object is to go up, and now a fair portion of our wing isn't helping to lift the 5 lbs. of dead weight, but only to counteract the force with which the tail is pushing down. In fact we are also using part of the wing to push down as well, since there is no separate stab. The obvious solution to this problem is to put a conventional tail and fuselage on the delta, which Howard Lincoln did and produced a very nice flying machine that won a contest or two. But it was for the station wagon crowd only. Try fitting an airplane 4 ft. long, 4 ft. wide and 1 ft. high in an ordinary car.

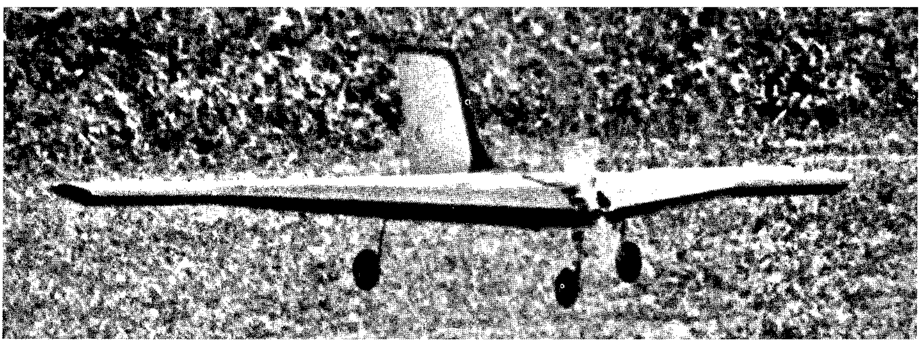
The fellow responsible for my quad. propo gear, Udo Birnbaum of Dallas, suggested using elevons instead of the standard elevator aileron hook up. By doing so we wouldn't be spoiling the lift of that big center portion of the wing by trying to use it for elevator. On the Hustler the elevator in back spoils a portion of the lift from the center section of the wing, which contains most of the lifting area of the wing. The elevons, on the other hand, act only on the small area of the tips, so by having the center section for lifting alone a large increase in performance was expected. He built a delta slightly larger than the Hustler, put elevons where the ordinary ailerons would have been and it did have much nicer characteristics. Getting rid of that big wide board (the elevators) from behind that nice thick high-lift center section had done wonders for the flying qualities.

To further improve the delta, I decided to add a stab. There are several places for it. A fuselage is too bulky. Mounting it on the rudder is a structural nightmare. So I added one on each tip. This leaves the full delta configuration free for lifting and provides a more or less conventional stab airfoil. The effective elevator action is now further back (a longer tail-moment) and the rolling moment is also longer, which should smooth out the delta's sharp roll response at high speeds. And it is different.

Conventional 45-degree slope and a configuration of about 900 sq. in. was chosen to give roughly the performance capability of a standard multi. The symmetrical airfoil (what else for a stunt ship?) has no reflex; a well placed C.G. and a tiny bit of up elevator does the job without affecting the inverted characteristics. It tapers from 15% thickness in the center to 18% at the tips, because a thicker section does stall at a higher angle of attack and we do not want the tips stalling first. Besides, 15% in the center makes a nice radio compartment and I had an 18% rib pattern which was just right for the tips.

A large conventional fin and rudder (remember the short tail moment—to keep torque the same, the force, and hence the area, must be greater) was installed. The rudder is nice for landings—hold the wings level with elevons and steer with rudder. Powerwise, a rebuilt K&B 45 seemed the logical choice. It's light, which helps the chronic noseheaviness of these delta's, and besides, why spend money on a new engine. You want a .60? At 5 lbs. you'll shake the airplane and radio apart—it'll climb almost vertically with the K&B 45 anyway.

Construction is conventional, if you ignore the 45-degree sweep. The wing construction (and that's all there is) is the familiar "Live Wire" type with a solid (3/8" x 3/8") leading edge, two 1/4" square spars running almost parallel about 3-in. back, and 3/32" leading edge sheeting. A couple of extra 1/4" spars top and bottom run straight across for about 1/3 the span. These hold the thing together, so use hard balsa and *don't* cut through the one that runs across the radio compartment hatch. A set of 3/16" spars runs full span including the tips. These can be spliced anywhere (they are 65 in. long) except at the tip joints and the center section where strength is needed. The trailing edge is 3/32 sheet top and bottom, with the elevons built in, then cut out afterwards. I attach mine with 3/32" brass tubing and 1/16" piano wire. Pretend they are regular ailerons and rig them your favorite way. Conventional aileron bellcrank linkages are used for the elevons, but each is on a



separate servo and the signals from the receiver are electrically summed to give elevon action.

Beam mounts are used for the engine, with a ⅛" aluminum adapter plate to fit the engine chosen. "Breakaway" plates are OK except that they usually vibrate more than a good firm mount; besides Neutrino is built to fly, not crash. The balsa doublers, plywood firewall and beam mounts are glued in with epoxy. This is particularly important because there is no spar running through the center section in the front; the epoxy holds it together. Epoxy glue should also be used when joining the tip sheeting onto the swept sheeting. Glue normally and fill in with plastic balsa and the tips will join nicely.

The landing gear installation is typically low wing. Plywood doublers are used on the ribs at the landing gear mounts. A Top Flite nose gear is bolted to the ⅛" thick 5-ply firewall and an extended steering arm provided to obtain good ground handling.

Three access hatches are necessary: one for the tank in the front, one for all the radio except the elevon servos, and one for the elevon servos. The latter two hatches are on the bottom of the plane to keep out fuel. The gas tank and radio hatches each have two ⅛" dowel pins at the back and a deBolt Cam Loc at the front to provide quick access. The spring tension on the Cam Loc is lessened by replacing the spring supplied with one made from 0.064" piano wire. Also to keep fuel out of the tank compartment, 1/18" brass tubing is epoxied into the firewall to act as a fuel feed for the tank. The switch, mounted inside the radio compartment, is extended into the tank compartment with a Kwik-Link attached to its arm. This keeps fuel out of the switch and the radio compartment.

The big stumbling block is the elevons—radio-wise, that is. For analog radios the solution is to use a summing circuit (to be seen in McEntee's next column) into which you plug your aileron and elevator plugs, and out of which come plugs giving the proper signals for elevon action from the two servos. There are two other solutions. One is a mechanical coupling of two servos to give elevons and the second is to hang conventional elevators on the back. I'm working on a solution along the former line, as well as a digital summing circuit. I think the performance would suffer if the latter solution were chosen, although it should still be better than a standard delta.

The mechanical linkage shown on the plan was invented by Cliff Fox. It requires an outward push on both sides for the forward pushrod to have up elevator and vice-versa for down elevator. This can be easily done with a disc output servo or with an added control-line bellcrank. The rear pushrod needs only push-pull movement for the aileron function.

Now assume the model has been built, the radio installed and juggled to get the proper balance—not over ½" behind the point on the plans or it'll be a wild machine. The further forward the C.G., the less elevator response, but I've flown it 2 in. in front of the point shown.

If it's balanced OK, put about ¼ in. up in the T. E. of the elevons at neutral, set the engine full bore, and roar down the runway. If the airplane is sitting positive as shown it'll lift off essentially of its own accord. If it's sitting negative and nose-heavy you'll probably never take off—that short tail moment again. Otherwise, flying is standard. The plane has no nasty characteristics and can be landed with full up without fear of a tip stall. Slow fly it a while—there is no better way to really become acquainted with a flying machine. If your elevon linkages are tight (flutter is fatal), all your spars are hard balsa, and the ship weighs under 5½ lbs. (mine weighed 4¾ lbs.) full power dives are permissible—but not for too long or you are almost sure to lose the elevons to flutter. (I never have, but why be foolish?)

A few variations have been built with elevons, but without the fancy tips, these by Udo Birnbaum. An inch thinner and it's too hot for ordinary flying—an inch thicker and it's too sluggish. Wing fences were found to actually increase the stalling speed. Apparently at slow speeds air spills off the elevons onto the top of the center section of the wing, helping fill the vacuum there and allowing higher angles of attack. An interesting variation would be a slot in the wing at such an angle as to spill air onto the back portion of the top of the center section of the wing at slow speeds, to further increase the allowable angle of attack.

There was one other variation. The first of the elevon equipped ships had the balance point 2 in. further back than this one—boy, that was a wild short flight! Don't make this mistake.

The name, Neutrino? That's a stable, very elusive, simple particle of zero mass, but lots of energy and spin. This plane is quite stable, the theory behind its performance is quite elusive, it's reasonably fast, and it spins nicely. It's also simple to use, no messy rubber bands, no more forgetting to bring the wing. And it does have a low mass!