

Self-Sustaining Engine

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The organizers of the Houston Convention asked me to talk about new technologies and our experience with the use of carbon fiber and Kevlar in modern sailplanes. We have built about 250 carbon fiber gliders and even the new breed of Standard Class ships being developed will use these outstanding, but expensive materials in order to utilize thinner, faster airfoils. So, I'd like to talk instead about a new idea in soaring - a new type of glider we are developing for the future.

Having produced a 15 m ship with a glide angle of nearly 45, and starting the production of the Nimbus-3 (24.5 m span - 80.38'), maximum L/D over 55, with spoilers on the wing tips for best maneuverability and the ability to carry nearly 650 pounds of water, we feel we are very close to the upper limit of performance for a reasonable amount of money. Human labor is getting more and more expensive, and even a slight performance increase requires exponential higher labor. See Figure 1.

Meanwhile, pilots are attempting longer and more frequent cross countries. Along with this goes the risk of off-field landings with long expensive retrieves, due to increasing gas prices. In addition to this, we have tremendous problems, especially in Europe, with high traffic and narrow roads adding to retrieve difficulties. So, many pilots do not risk the longer flights, although they have the glider - an expensive glider - and the desire.

This reasoning led us to the development of the self-launching motor glider. Years ago we installed a retractable engine into our Nimbus-2, followed later by the Janus-C and the PIK-20-E which we distributed in Germany. Although the motor-Janus is still in production, and despite the increasing demand, we have found an alternate approach that will be more suitable for some glider pilots.

The development of this alternate approach was spurred on by the fact that the self-launching system is:

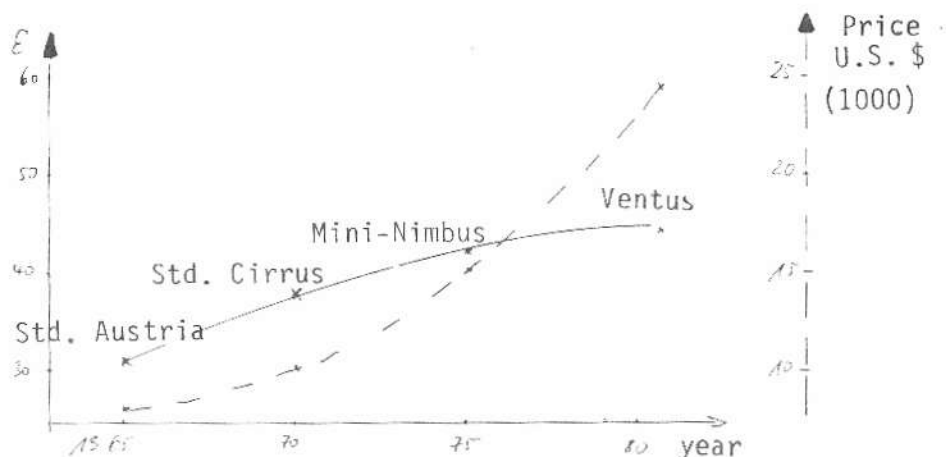


Fig. 1. Performance Increase Vs U.S. Dollars

- Too complicated and expensive, requiring an additional price in U.S. dollars of 14-18,000.
- Too heavy because of the big engine, the long propeller and resulting C.G. problems, the heavy battery for the starter, and a lot of fuel (altogether about 150-180 pounds).
- Too noisy.
- Not safe enough; pilots can make too many mistakes in a critical situation. (We've had experience repairing these motor gliders; it is expensive and the fuselage repairs are very time consuming. There are, of course, many more parts and they must be removed to make the repair, then replaced. It is a complicated procedure.)
- Last, but not least, it is just not a normal-flying glider.

With this experience in mind, we tried to solve the problems, starting from a different position. The initial idea came from a German glider pilot and aircraft professor, Claus Oehler from Berlin. He asked for a very light, uncomplicated engine-system that would produce a slight rate-of-climb only - enough for him to depart the airport early in the morning with a low tow, reach lift, fly out 100 miles or more, and yet be assured of returning safely home in the evening. This "self-sustaining" engine should eliminate the off-field landing risks completely. Claus saw no need for a "self-launching" engine; neither is it necessary for most glider pilots. Nearly all our glider ports have auto, aero or winch launching available.

So, we built Claus a Ventus-a (narrow fuselage) with a 45 pound engine system and a rate-of-climb of 70-80 fpm. Not much, we realized, but it was only for testing purposes, not for production at that stage, and it really was very successful.

During the following season, he was first to launch every day, but never had to land out. For an extra price of roughly U.S.-dollars 6,000, he got a high performing glider with a better than infinite L/D max., while still maintaining normal handling glider characteristics in all configurations, even with the engine extended but not running.

To make this "Oehler" system suitable

for a production glider, we selected the following criteria:

- The extra weight for a 15 m glider should not exceed 50-60 pounds.
- The rate of climb should be around 150 fpm.
- The system should require no extra battery, no electrical starter, no throttle, no extra instruments, just one handle (like the gear handle) to extend and retract the engine, and one switch for ignition on or off.
- The engine should run at it's best performance all the time with a fixed carburetor setting.
- The engine should start by itself as soon as it is extended, and accelerate the glider to 75-80 kts.; it should stop when close to the minimum speed of the glider and the ignition is switched off.
- Putting the engine in or out should not take more than 10 seconds, without taking care of the propeller position and without changing the C.G. position remarkably.
- Last, but not least, the cut-out in the fuselage should be much smaller than that needed for a self-launching motor glider.

All these demands are met with the Oehler system, a four or five blade self-foldable fiber glass propeller with low diameter (2¼ or 2½'), working like a windmill at high speeds (for starting the engine), and producing high drag at low speeds (for stopping the engine). This system could be used just for climbing where the efficiency of the propeller needs to be reasonably good only at a certain speed.

An additional advantage of this blade system is it's relatively low noise; even with an engine with 5000 rpm, the outer end speed of the blades reaches 2/3rd or less of the normal propeller end speed (because of the small diameter). In Europe, with the dense and more noise-conscious population, the reduced noise factor is extremely important. In the U.S., with most of the airfields far out of the towns, it might not be as important.

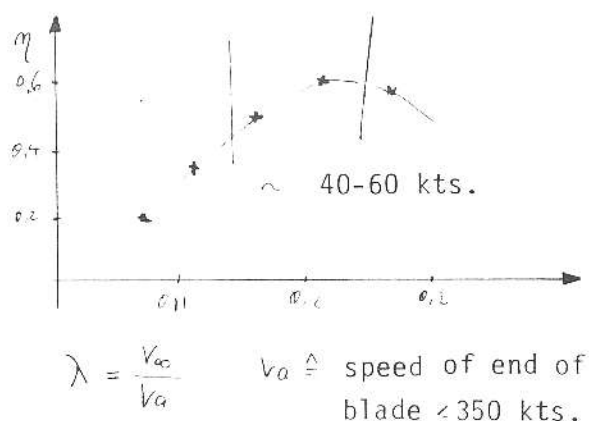


Fig. 2

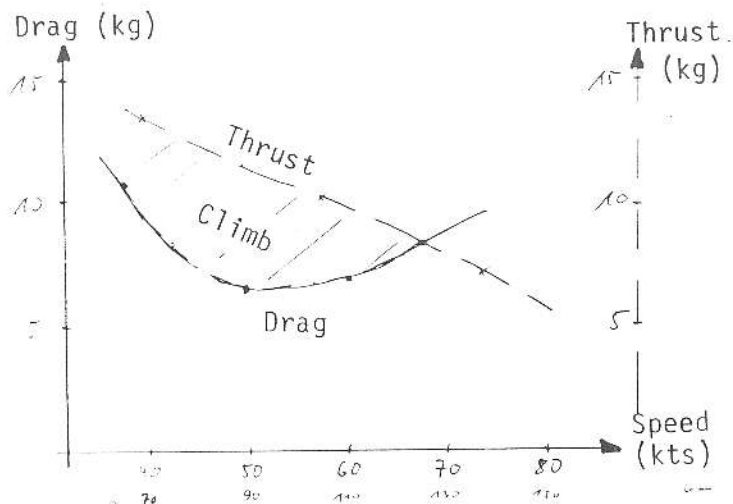


Fig. 3

To give you an example of how useful the self-launching engine can be, let me tell you about the problem I face when I want to make a very long flight. Of course, to make a long flight it is important to start with the first thermals of the day. In my area they start in the mountains about 10 miles from the field. Naturally, everyone wants to leave when they are sure that the thermals are there. On a good day, more than 20 gliders are lined up waiting to take off early in the morning. They are all waiting to see who will be the first to launch and see if thermals have started. Because time is so critical, I am usually the first one. I tow to 1000 m and then must glide to the hills. If there are no thermals, it is all over because so much altitude is lost in getting there. With a sustaining capability this is no longer a problem and I now can have much more flexibility in finding the first thermal.

We have now finished the test flights with two new engines; they have met the LBA requirement of 50 hours in operation, and we are building the first prototype for the production version of the Ventus-bT (Turbo). When in production, it will be available with removable

wing tip extensions to 16.6 m span (54.46') in order to compensate for the extra weight in weak conditions. Suitable engines for installation in the Nimbus-3 and Janus-C are in progress and will be tested in these gliders as soon as the Ventus-bT is in serial production.

The German LBA (equivalent to U.S. FAA) is going to allow the German pilots to fly this simple Turbo-glider with a normal glider pilot's license. Their own test flights with the Ventus-a convinced the LBA that:

- It would be difficult for a pilot to make a serious mistake.
- The extra weight is far below the weight from water ballast.
- The drag increase with the extended not-running engine is so low that the pilot is able to land the glider in a normal manner.

They feel that the small extra effort required of the pilot is more than compensated for by the safety factor of the system in preventing dangerous out-field landings. For U.S. pilots, who frequently fly over rough terrain, deserts and high mountains, a self-sustaining system should be very attractive.