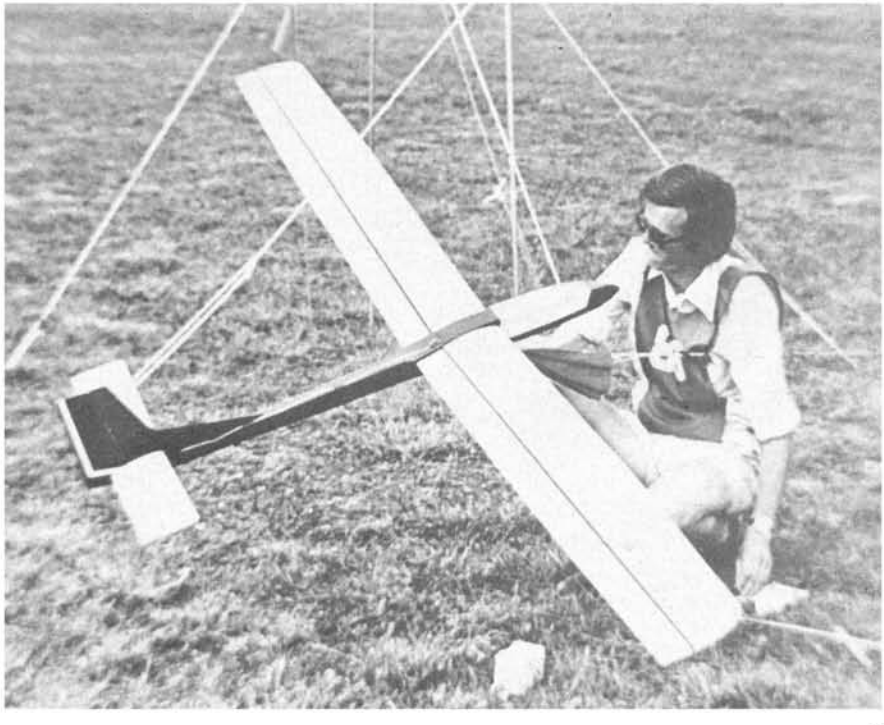
"Bommel"

by Peter Keim

A beautiful 114" FAI thermal soarer from the Netherlands for multi-task competition. An Eppler 387 airfoil section.

At the AerOlympics, Lakehurst. Peter eyes ferocious storm, just made it into Don't care in time. **Below:** Full span flap action alters the airfoil on hi-start line or soaring flight upon command.



The special feature of the "Bommel" is its enormous flaps. Flaps have been the focal point of my interest for a long time, since I worked for a school in an airplane repair shop. I studied the flap system of a "Beaver" and so became interested in applying their advantages to a model.

The most interesting point for me as a soaring enthusiast was that it is more difficult to get a plane to fly slower than faster. I like designing and constructing model aircraft and my interests lead me to designing with flap surfaces. The first such model was a small one, a 79" motor glider with a Cox .049. Its 15" flaps were only adjustable on the ground. The model flew well, but when it came to the point of experimenting with the flap settings it crashed.

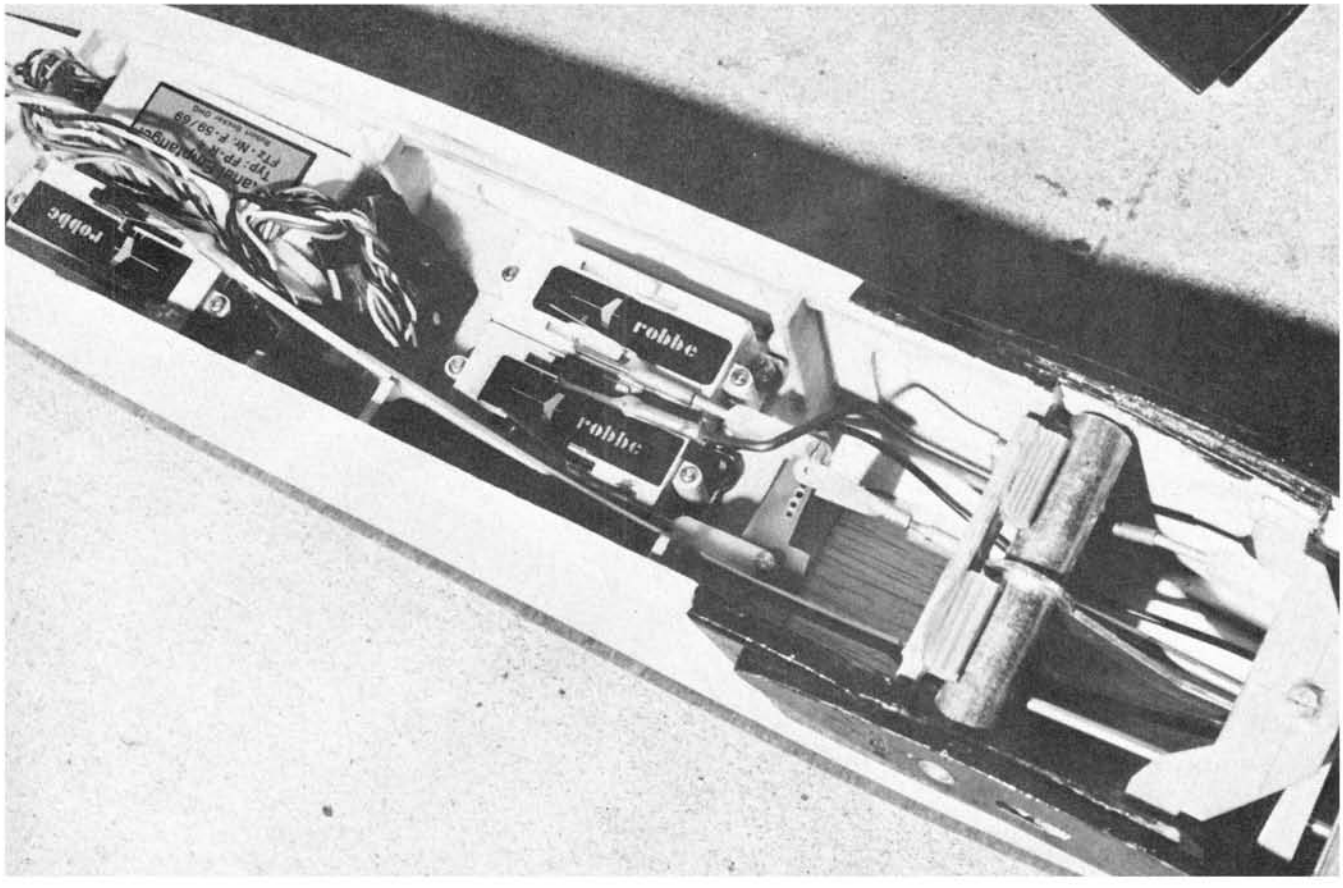
The new International FAI rules for gliding competition came along, wherein Duration, Distance and Speed flights should be made with the same model. In fact, you should have three aircraft: one with a low sink rate; one with a big gliding angle; and a strong one with less drag. The mentioned performance aims could probably also be achieved within certain limits, by changing the wing section.

The same general problems appear in the Free-Flight Power class. The first part of the flight is a fast-as-possible climb rate, followed by a glide with a low sinking speed. Sections are flat, and rather thin. The flap-wing was designed, a development by Thomas Koster from Denmark. During climb, his section was flat, in the glide the flap hung down to give a little more camber and a lower sinking speed. These models fly very well and this gave me the idea to make an R/C soaring model with flaps which could be activated during flight.

The Design

In question was the basic section. I chose the Eppler 387, specially designed for all-round R/C Gliders. This section is almost flat at the bottom side and is rather thin.

Photos by the Author / Berry Aarts



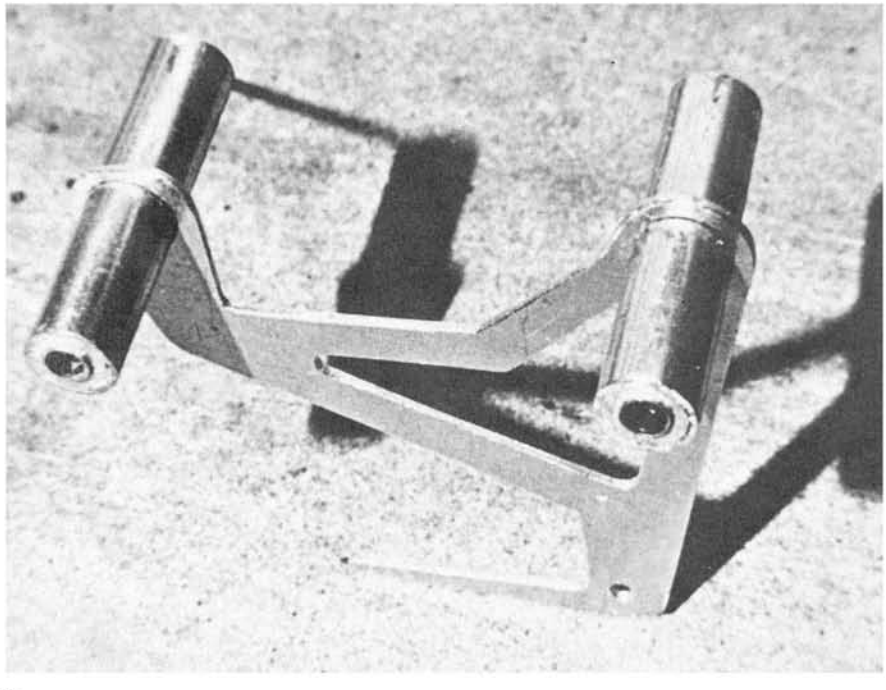
Gliders only look simple. Servos for every subtle function, each bit of mechanism must have an end result in efficiency. The neat radio system.

Below: Ah, now we understand! As the wings fight the hi-start tension, why attach a towhook to the fuselage? The tubing accepts the wing pins.

The wing form is rectangular in the middle, becoming narrower in chord toward the tip, also approaching elliptical lift distribution and giving less difference in the Reynolds number. I believe this tip form offers less drag. A relatively big tip chord and rather thin section create big forces on the wing root, which is why the aspect ratio chosen should not be too high. For values around 14-15, (the "Bommel" is 14.3) it is not so serious.

The turning point of the flap lies at 67% of the chord. There was no special reason to select this point, though ease of building entered the equation, the upper surface of the flap is straight. Distortion of the airfoil is 5 degrees up-flap and 11 degrees down. At the tip this is 75% of these values.

The stabilizer surface I chose is not too small, 15.8% of the wing surface, because longitudinal stability decreases with the flaps in the lowered position. When you move the flaps, the incidence of the stabilizer changes (e.g. flaps down has an effect of lessening the incidence).

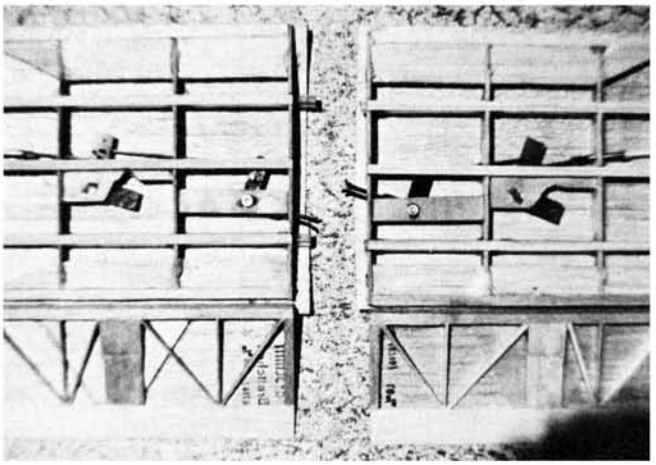


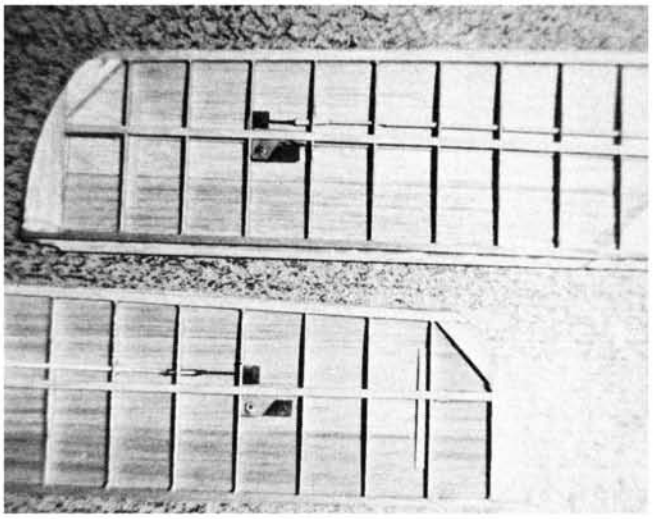
The Wing Construction

The relatively thin section and small chord makes a big main spar necessary. I chose two, with constant dimensions in the middle and four smaller 3/32 "x 3/16" spars of spruce by the pins, strength where you need it. The top of the wing is all planked, the bottom, only the forward part. With webs it creates a stiff torsion box. Flaps have diagonal ribs also for stiffness.

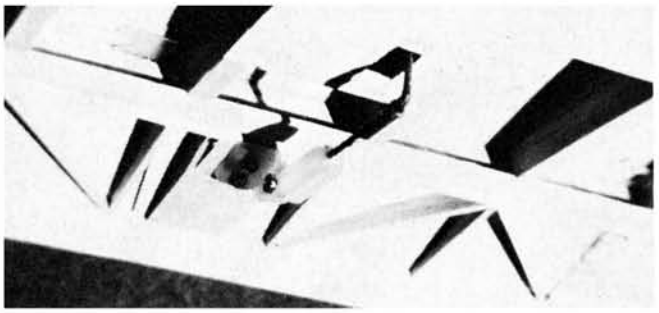
For cutting the ribs you need three templates; two with notches for the auxiliary spars for the rectangular part and one for the tip portion. Holes are required for the pushrod. The ply ribs have the same form as the big templates, except for holes for the flap movement. Be sure the front spar stands a little above your building board.

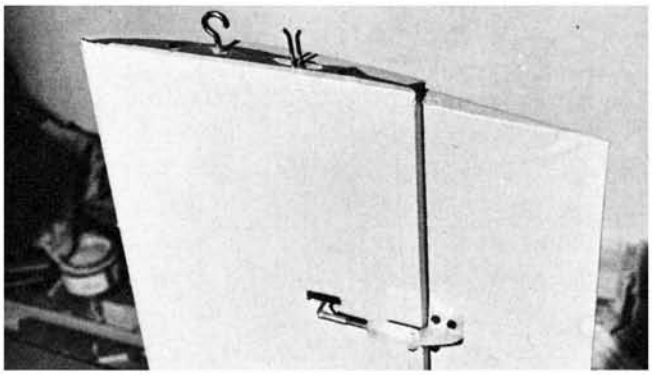
After assembling the ribs, position the spars and reinforcements, then mount and adjust the flap movement system. Glue the planking together; medium balsa at the center and front and soft at the tip after the main spar. Adhere it to the frame, followed by the bottom planking (soft). Finish the bottom surface with the strip on the trailing edge, the capstrips and spruce





Flap structure visible, flap horn mounts, bellcranks to actuate in wing. **Right:** Double-horn system and linked bellcranks actuate flaps over span.

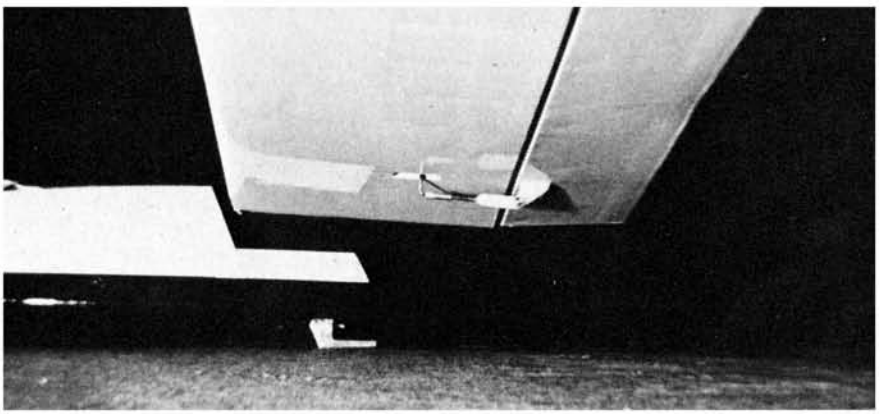




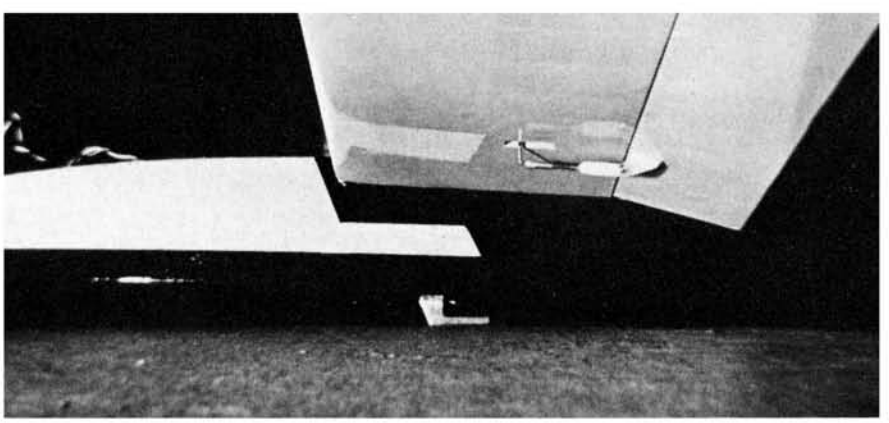
The linkage to the flaps seen here in this view from beneath wing panel. **Right:** Eye hook retains panel. Aileron linkage visible, neat hinge line.

cap on the forward L.E. A negative template is used to check the forward airfoil and an end rib should be glued on at the root position.

Build the flap upside down. Pin the trailing edge tapered planking to your building surface and then position the front spar properly. To prevent any splitting of the trailing edge I glued a strip of silk beneath this trailing edge. Next, place the ribs and diagonals, allowing them a little more height than necessary. Now sand the entire bottom flat, making sure the back edge of the wing is equal to the flap's height. Wash-in is achieved by cutting the flap on the bottom as per the plans and bending it upward, creating a triangular raised portion. Position hinges so the flap is at the correct height. Glue them only in the flap so that it can always be removed. I used Solarfilm to cover the wing and flap. Keep the two parts together with thin tape. Now you can finish the flap system.



Two extremes of flap motion, raised for speed tasks, depressed when additional lift and thermal turns dictate, as photos above and below illustrate. Takes time to evaluate possible advantages.

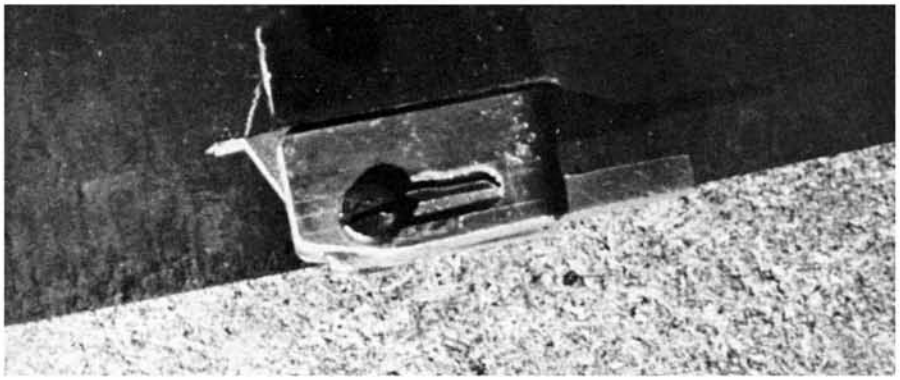


The Stabilizer

You will note the holes in the ply ribs are not all in the same position so you get the dihedral. Epoxy the pins in one part, and place oversived pvc fuel tubing in the other. File the hole so that the pins go stiffly into the tubing.

The Fuselage

For simplicity, I chose a rather square fuselage section with a flat bottom, not the best aerodynamic solution. The rear portion is of balsa, the forward end balsa



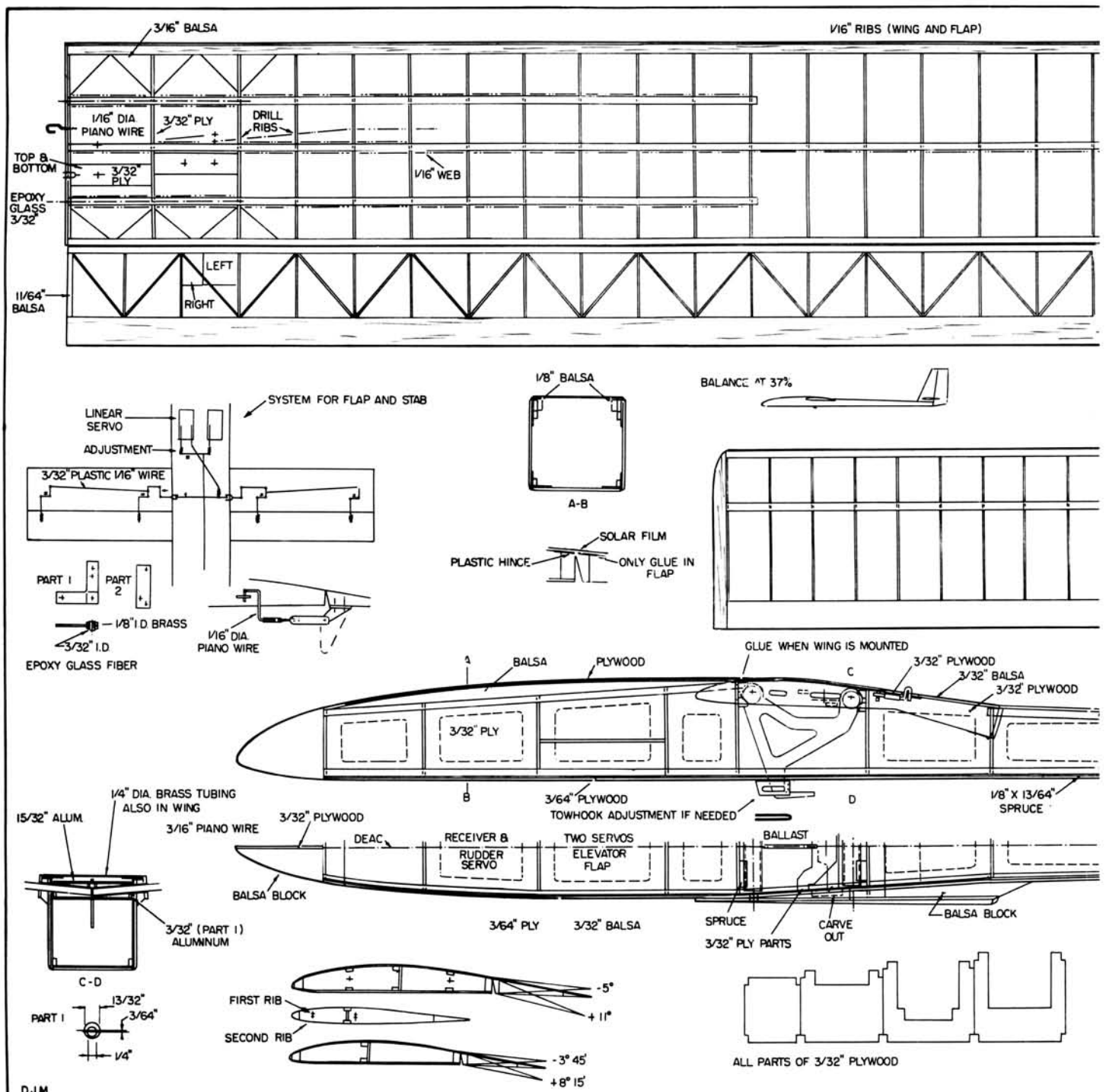
The towhook, all important, but often considered almost an afterthought to the design. Peter's attaches to the wing pins, to distribute the load. A sliding adjustable plate. Ship tows well.

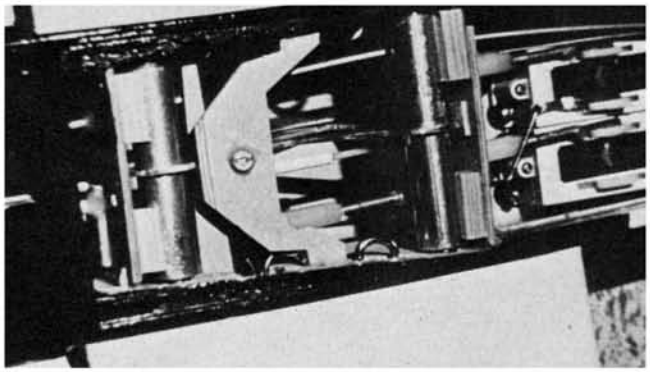
with ply inside to resist splitting etc. It also offers a better connection between fuselage siding and the formers.

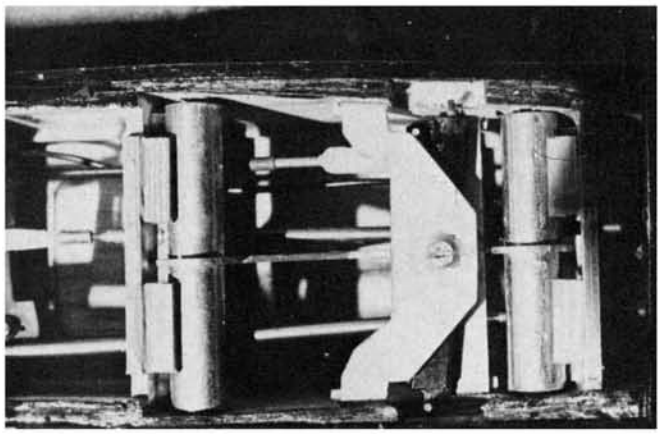
The construction of the wing fastening offers no forces upon the fuselage, for a lighter fuselage design. Two big aluminum tubes with eccentric formers provide the dihedral. The towhook is affixed to these tubes.

Start by gluing the plywood part to the bottom plate. Add the formers and longerons, then the plywood sides and balsa planking. After the top sheeting, make the wing fillet and cement the rib. Be sure both are in a position equal to each other. Now work on the tail, rudder and canopy.

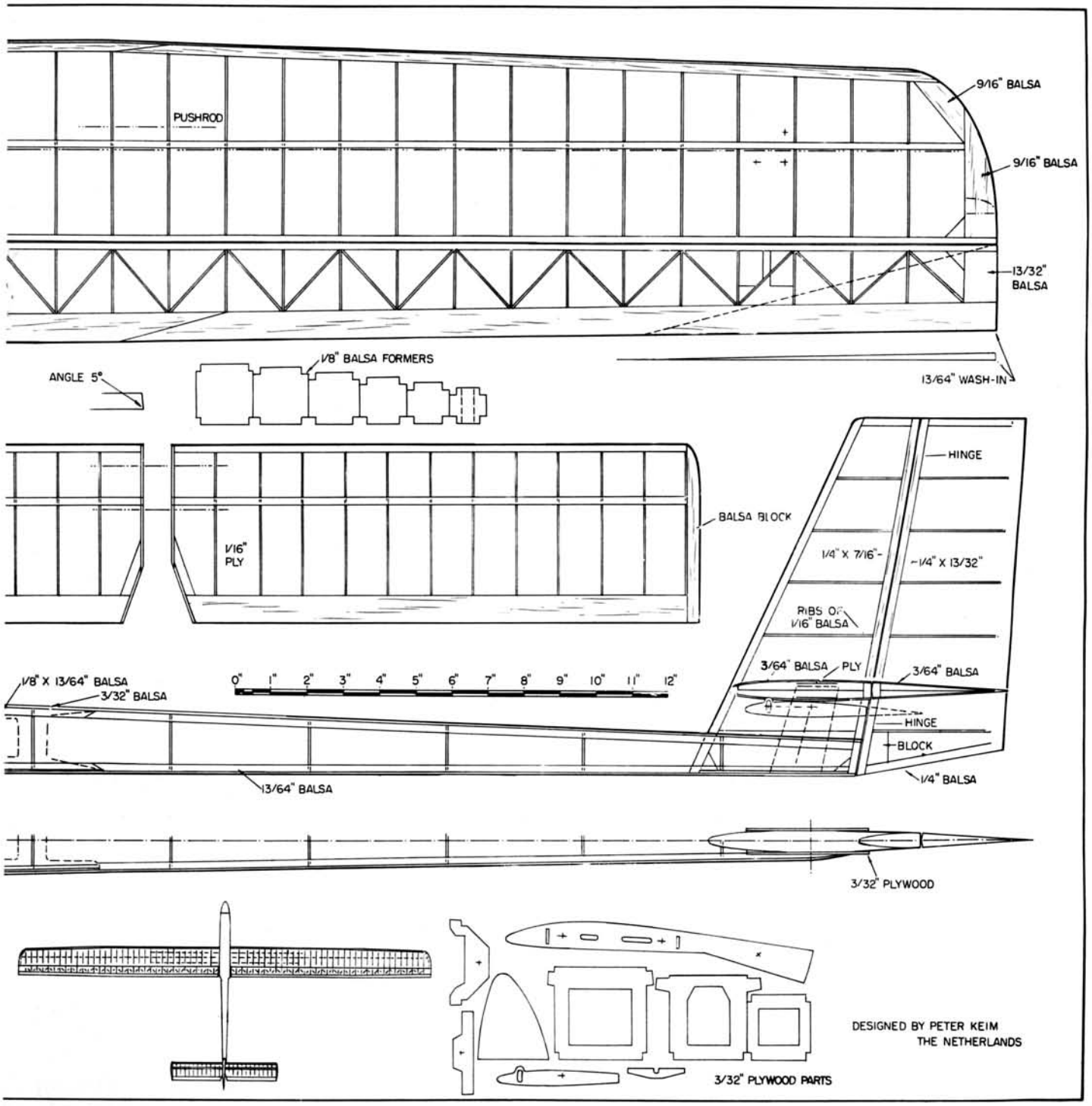
Install the servos and set the flap and elevator movements. Be sure each is in the







Hatch off: servos up forward, for C.G. considerations. Compact and neat.
At right: Sturdy wing tubes form solid foundation for the towhook plate.



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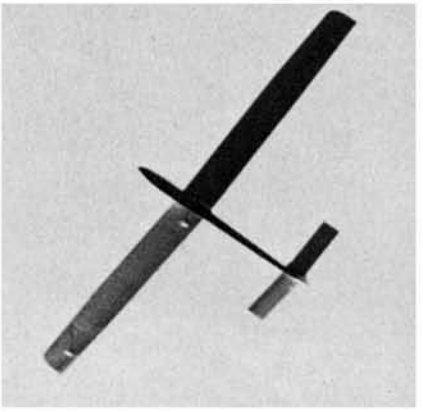
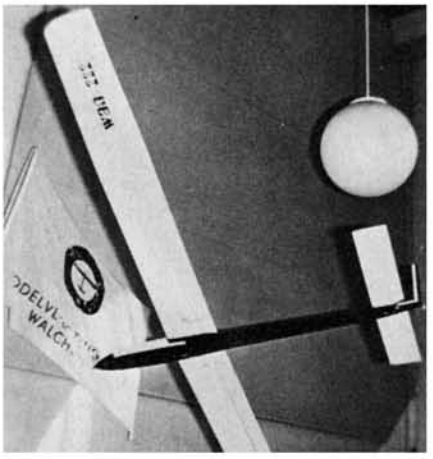


Drifting overhead, a silent hunt for currents. **Left:** Wings flex to the power of the hi-start. **Below:** "Bommel" overhead at European show.



right position with good connections. For flap control I use the throttle stick. Adjust it so that "stick-up" and "trim-down" is in the original airfoil section (almost flat). "Stick-down" is "flap-down," "trim-up" is "flap-up." Check this with a template. I finished the fuselage by covering with jap tissue, dope, light sanding and enamel.

Flying Experiences

The "Bommel" had a hard youth! There were some improvements necessary; e.g. thicker pins are used now. Again, I paid too much attention to the flaps. Also, a crash caused by radio failure occurred, so I had to make a new fuselage, but happily, there was no trouble with the flap system at all. It worked well and gave no flutter, turns by distortions or other trouble, even at higher speeds and with flaps down. Strange, but the model flies best with flaps in the normal position.

The wing loading is a little bit too much for light air. If ballast is necessary, place it at the C.G. (Up to 10 ounces). It appeared necessary to make the towhook adjustable. It is why the wash-in is not so effective as in the normal way the towhook must be in the right position for a stable hi-start.

I had the opportunity to come to the Lakehurst Aerolympics last year. It was a wonderful experience. Although I am not such a good competitor, I took my "Bommel" with me. My results were disappointing, and also the model was not fully developed at the time.

While I started this article with the idea of flaps for the speed task in multiple task competition, I would not claim this to be the right solution. More experiments and improvements of the design are indicated. For comparison I built a new "Bommel" this winter with the same form and sections on the wing and stabilizer, only lacking the flaps. Time will tell. I wish those who built the "Bommel" good luck.

Classic shot of hopes upon a slender line. FAI Soaring in AerOlympics. **Left:** Body-english is wishful thinking Peter. Winter tests in Holland.