The Hebridean.

A pendulum servo wind vane for yachts.

Below some background information, and how this one works.

The vane deflects

The vane is vertical when on course with its leading edge facing into wind, but when the boat goes off course the wind hits the side causing it to be deflected about its horizontal axis on the vane base. The vane is connected via a push-rod to a pendulum which in this case is swept aft in the water at an angle of 32 degrees to the vertical. (It follows the same principal as the Sailomat 601 in this respect, which creates feed-back). When the vane is deflected it causes the pendulum to rotate about its longitudinal axis in the water (just like the way you rotate the rudder with the tiller). The frame onto which it is mounted pivots in a socket fixed at the stern of the boat, so if the boat is moving forward through the water the pendulum is pushed (swings) to one side. Lines then pull the tiller correcting course.

Rigid mount

Wind vane self-steering systems normally have a rigidly mounted vane base which cannot be moved except to change course, in which case it is rotated by hand or ropes around a vertical axis. The pendulum has to swing from side to side in the water, and to create a link from the vane to the pendulum as a result is difficult unless you are an engineer with machine tools to create interlinking cogs - generally not a job for a DIY person. That part which the engineer designed to do the job of linkage for the Sailomat 601 he patented.

Inclined axis

A vane that deflects in the wind about an axis that is inclined 20 degrees to the horizontal (which is usual) is damped because as it deflects there comes a point when the vane feathers into wind and will not deflect any more. The angle that it deflects depends on how much the boat is off-course. The tiller corrects course, and as the boat steers towards its intended heading the vane is progressively pushed upright by the wind and the pendulum swings back towards the centre line (as does the tiller). Once on-course the vane is upright and the pendulum in line, so the boat does not over-steer through its intended heading and off-course in the other direction.

Horizontal axis

A vane on a truly horizontal axis provides a powerful impulse to the push-rod rotating the pendulum when deflected, and this depends on the strength of the wind rather than the amount the boat is off-course. However it does not “feather” so the vane is not pushed back to the upright as the boat resumes its correct course. This happens only when it is on-course. It is therefore not “damped”, and the boat over-steers off-course in the other direction.

What’s different?

In this design the vane is mounted on a horizontal axis (not inclined). However it is still “feathered”. This is done by the swing of the pendulum which rotates the vane axis (and therefore the vane) into wind. This is only possible because the vane base is “floating free” rather than being held rigid. The vane is damped by
“feed-back” from the pendulum. As the boat returns to its correct heading the pendulum rotates it back as it swings towards its centre line driven by the vane as it is pushed upright by the wind. In other words the pendulum which steers the boat (via the tiller) also controls how and when the vane is damped.

This creates a whole new dimension of control, power and sensitivity into self-steering. The vane and the tiller are better “connected”. Friction is not such a “curse” because it is overcome before the vane is damped. In any case there are minimal moving parts in the system. Also, if there is any excessive looseness in the linkage between vane and pendulum, it is taken up before the vane is damped so there is no loss of efficiency. The vane is not damped at source.

The pendulum

As already stated the pendulum swept back by 32 degrees to the vertical provides feed-back from the water. As it swings to the side, there comes a point when the pendulum is in line with the direction of water flow, and will therefore be prevented from swinging any more. This limit depends on the amount it has been rotated by vane deflection, but is never more than 30 degrees as the rotation itself is limited by the frame settings.

Construction

The frame not only supports the pendulum as it rotates in the water but also the vane as it deflects in the wind, so the push-rod connection between the two is easily achieved with just one pivot. There are 30 metal pieces to drill and cut to size from a standard stainless steel sections, rods, tubes, bars, nuts and bolts. (15 different pieces.) There are no bearings and no welding is required in its assembly. The tools you need to make it are what you would find in any reasonably good workshop at home. There are some you might need to buy such as a hole cutting set worked off a drill, some taps for threading holes in metal and a good quality set of drills, size differences of 1/2mm up to 10mm. A reasonable skill in woodwork is an advantage, and the ability to saw and drill accurately is fairly important. I have written guide-lines as to how to achieve this in all cases.

In use

You balance the sails, adjust the vane base so that it is held more or less vertical by the wind and then locate the lines to the tiller. If you are sailing solo an electric auto-helm is useful to hold course while you set it up, but don't forget to disengage the auto-helm once it is. You may have to re-adjust your course slightly at the vane base once it has settled down but that's normal. In some conditions you have to lower the vane (centre of gravity) on its mount. Smaller alternative vanes can be used as an option. All you do now is enjoy the sail as it steers. Increase weather helm and it will cope, but it is better to have the sails balanced. Releasing the main-sheets to reef is also possible even although the boat is temporarily out of balance. It will also hold course for jib changes if you do not have roller furling.

As the vane axis rotates, it wobbles slightly and sways as the pendulum swings from side to side. The bigger the frame the more it sways. However this does not effect performance. It is kept to a minimum by the geometry of the frame. Because the vane base is floating free (and therefore sways), if the boat is healing as it beats into wind it is possible to set the vane base so that it is more horizontal than the boat itself, and this means greater sensitivity and impulse to the push-rod. It also means there is more line travel to cope with weather helm.