while tension is on the line. Auto-rudders are almost universally popular for Nordic class gliders because they permit straight tows even when the model is directly overhead. Reliability is not 100 per cent however.

Twin Towhooks

When a central CG hook and an angle of attack near the stall, the large lift loads developed during a fast and efficient tow can easily break the wings at their root. However by providing two towhooks (one on each wing) the concentration of loads is greatly reduced, and steep tows may be utilized without fear of wing folding. (See Figure 2). R. H. W. Annenberg, in Low Speed Aerodynamics Association Report Number 10, "The structural Advantages of Twin Tow Hooks" (England, 1947) has calculated that twin hooks placed between 50 and 66 per cent of the semispan outboard will permit G-loadings from 5 to 13 times the limit load factor for a central hook.

Fig. 2

Typical twin towhook installation on Rose Marie Licher's "Thermic 50-X"

Were powerful enough winches available, the use of twin hooks (located near the semispan at 25 per cent chord) and very steep tows (approximately 10 g's of lift) would give over 3000 feet of altitude from a 4000 cable in full-scale applications!

One disadvantage of twin hooks for model sailplane towing is the large upsetting moment caused by a side gust or slight sideways disturbance. The tendency is present whenever the pivot point of the towline is below the CG (See Figure 3), i.e. even with a single towhook. Another objectionable feature of a simple bridle is that large asymmetrical loads can occur if one side should break or become unhooked before the other. Both of these objectionable features are alleviated by the use of a "rolling bobbin."

The Rolling Bobbin

Subsequent to their experiments with twin towhooks, N. K. Walker and R. H. W. Annenberg invented (and patented, incidentally) a compensating attachment of the towline to the bridle-line. Consisting of a nearly-frictionless sliding ring or rolling pulley ("bobbin" in the King's English!) which is attached to the towline, the rolling bobbin moves along the bridle in an elliptic locus with the twin hooks as focii (See Figure 3). Analysis of the force system following a displacement shows that the line of action of the towing force is caused to pass over the CG instead of under it, as for a rigid bridle. Hence the setup provides a stabilizing rolling moment and a destabilizing yawing moment during tow, depending on the relative steepness of the towline to centerline angle.

Calculations (LSARA pre. 17, Annenberg and Walker. "The L.S.A.R.A. Rolling Bobbin," England, 1946) and experience has indicated that for very high-lift "kited" launches, the directional effects are least important and a bridle length from 3 to 5 times the hook spacing is satisfactory. On the other hand, where long periods of shallow climb occur (such as is possible in full scale applications) the bridle length should be from 10 to 20 times the hook spacing in order to minimize directional trim difficulties.

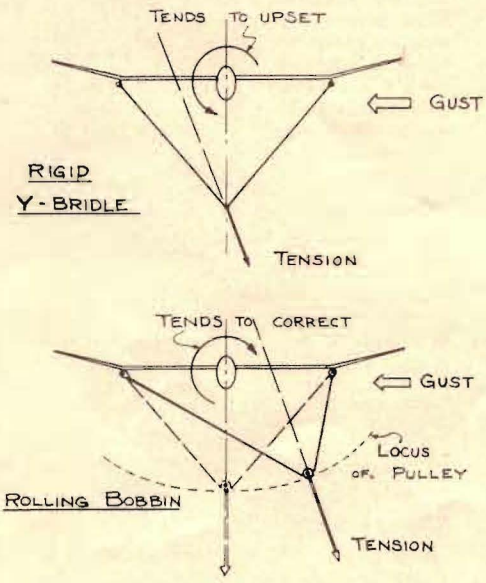

Fig. 3

Effect on stability with rigid bridle and rolling bobbin.

Besides eliminating the upsetting tendency of a bridle, the rolling bobbin makes it impossible to maintain force on one hook if the other has been disengaged or if the bridle breaks. The resulting system is thus fail-safe and may be used with confidence on man-carrying sailplanes.

If enough interest is voiced, separate articles dealing with the design of turn-hooks and rolling bobbins will be presented in SOARING.

Launching Techniques

Once a model sailplane has been trimmed for the desired circling flight and the method of towline attachment has been decided, there remains a critically important period during which the proper launching technique for maximum altitude is developed.

More important than is usually recognized is the model attitude at ground release. Forward hooks, used in windy weather or for initial testing, require gentle support under the fuselage with the nose inclined 30 degrees upward as both tow-ers and holder run forward together. On the other hand CG hooks, especially if a twin bridle is installed, require a kite type launch. The model is held just behind the wing from the top, with the nose pointed nearly vertical. Line tension is gradually increased until the holder can bear no more (i.e. the structure is creaking!), at which time the model is pitched upwards as fast as possible.

After the glider becomes airborne, TAKE IT EASY. An inherently stable model will waggle its way through gusty air if the towline is slackened slightly during each disturbance. Even with a very free-running rolling bobbin, an occasional releasing of some tension will enhance its corrective action. During windy weather, especially with a CG hook and steep tow, the person towing may have to walk or run downwind, (towards the glider) to prevent line breakage. If a crash becomes inevitable, throw the towline towards the model to release it and to provide a slack line in case the hook catches.

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