AN AUTOMATIC, ADJUSTABLE NOSE WHEEL BRAKE FOR SAILPLANES

by Victor M. Saudek

SUMMARY:

The nose skid is a vestige of the skid-only gliders of the 1920s and '30s which has persisted because it is a reliable and effective braking device. In some modern designs it is being replaced by a nose wheel which is lighter, has less drag and, properly installed, is quite trouble free. But without brakes, it does not have the ability to reduce the landing run by ten to twenty (or more) percent that generations of soaring pilots have enjoyed by using nose skids.

This paper offers a solution to the brake problem. It will be shown that a nose wheel can be braked 'automatically' in a manner that is equivalent to the use of the steel-shod nose skid that it replaces and which allows the benefits of reduced weight and drag while making it easier to position the glider for takeoff. By permitting the center of gravity of the aircraft to be somewhat forward of the main landing gear wheel, it provides inherent directional stability, especially in conditions of side winds during takeoffs and landings (as compared to gliders having their main wheel ahead of the center of gravity).

OPERATION:

The Three View drawing, Figure 1, shows the nose wheel assembly with a bolt at the forward end acting as a hinge which allows the wheel, -1, in its support frame, -6, to pivot upwardly when a load is applied to the wheel as, for example, when the glider's crew is on board. This is resisted by the rather stiff rubber block (spring), -12, so that the weight of the crew is NOT sufficient to cause the interior braking surface of the -1 wheel (see FIG. 2) to contact the fixed brake shoe, -10 in Figure 1. In this configuration the nose wheel rotates freely for positioning the glider as for takeoff and for its ground run as the tow starts.

When the pilot applies the brake to the main landing wheel additional downward force is automatically applied to the nose wheel. This is now sufficient to further compress the -12 rubber spring and to cause the fixed brake shoes to contact the -1 wheel braking surfaces, see Figure 2, and thus to contribute to slowing the glider. The braking effect of the nose wheel is proportional to that of the main wheel. Additional braking force can be applied by pushing the elevator control stick forward. Conversely, the stick, when pulled back while facing the wind, can be used to lift the nose wheel from the ground to steer the craft by use of the rudder. Accordingly, it is not useful for gliders to have a steerable nose wheel

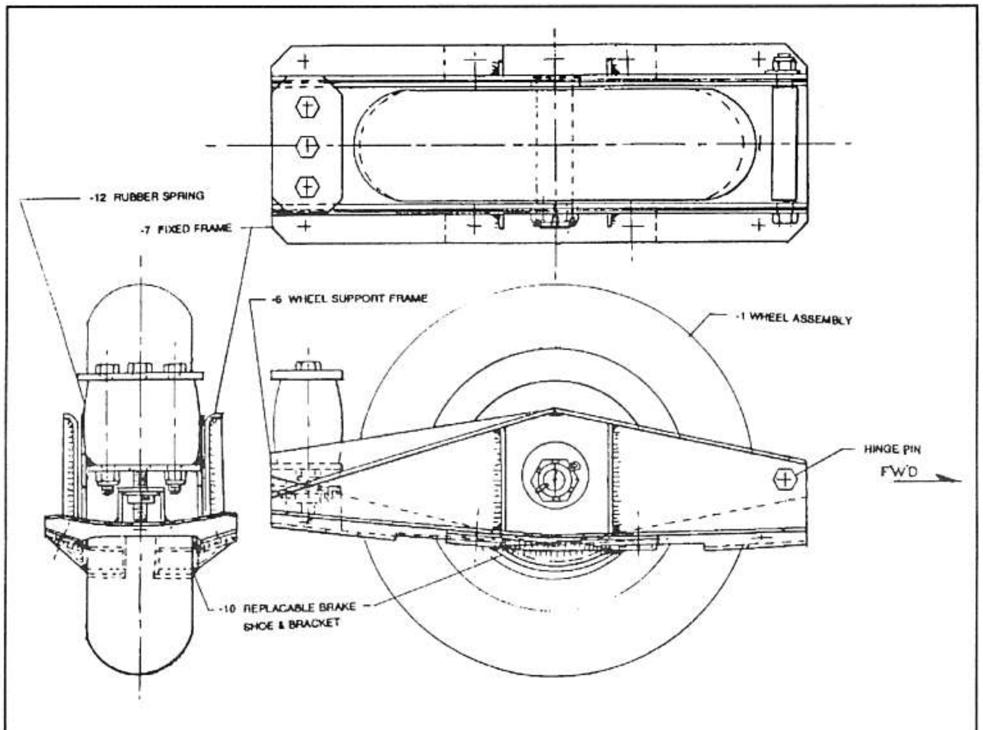

Figure 1. Three view Glider Nose Wheel with Brake, Scale: none; Drawn 11/29/96, Designed by V.M. Saudek.

(nose skids are not steerable !). It is seen that operation of the braked nose wheel is essentially identical to that of the nose skid.

It should be noted that nose wheel equipped sailplanes may have a small, lightweight full swiveling tail wheel since a tail dolly is not needed for ground handling when no one is on board.

DESIGN FEATURES:

The design described here strives for simplicity, long, trouble free life, ease of maintenance, inspection, adjustments to accommodate wear and replacement of worn out elements: The figures shown are generic, not dimensioned, but the proportions, if made of high strength steel for the structural elements, depict a unit that should perform adequately. It is understood that when the concept is applied to an actual aircraft the specific design will be modified to match the requirements of each type of sailplane.

The drawing, Figure 1, shows close fits of welded items (perhaps too much so). The tire shown is solid but resilient. A pneumatic tire would expand at altitude and as it aged and probably would then not be free running within the close fits shown.

The assembly is designed to be inserted upwardly into a suitable opening in the reinforced, lower, forward portion of the sailplane's nose. It is fastened by screws to the nose skin. Ground clearance to the nose skin should be essentially the same as that provided by a nose skid. The contoured mounting flanges of the -7 frame will thus be outside of the skin of the glider to give access to the screws that mount the - 10 brake shoes in this configuration. (No attempt to taper the edges of these -7 flanges was made for the figures drawn.)

To prevent dust and other material from being fed into the cockpit, a cover of clear lexan type plastic, Figure 3, secured by quickly removable wing nuts or the like will allow the operator to observe the wheel so that it is convenient to correct any unwanted condition found and to give access to the bolts in -12 rubber block if they need to be adjusted.

The surfaces of the asbestos or carbon brake shoe are visible for inspection by looking at the exposed lower arc of the nose wheel. When it is time to replace worn shoes the removal of two screws will allow each shoe support bracket, -10, to be freed from the flange of the -7 fixed nose wheel frame. It may well be possible to remove, at a work bench, all worn out brake shoe residue from the brackets to which they were glued and to refit the brackets with new brake shoes. Hopefully that need not be done for intervals less than a year or

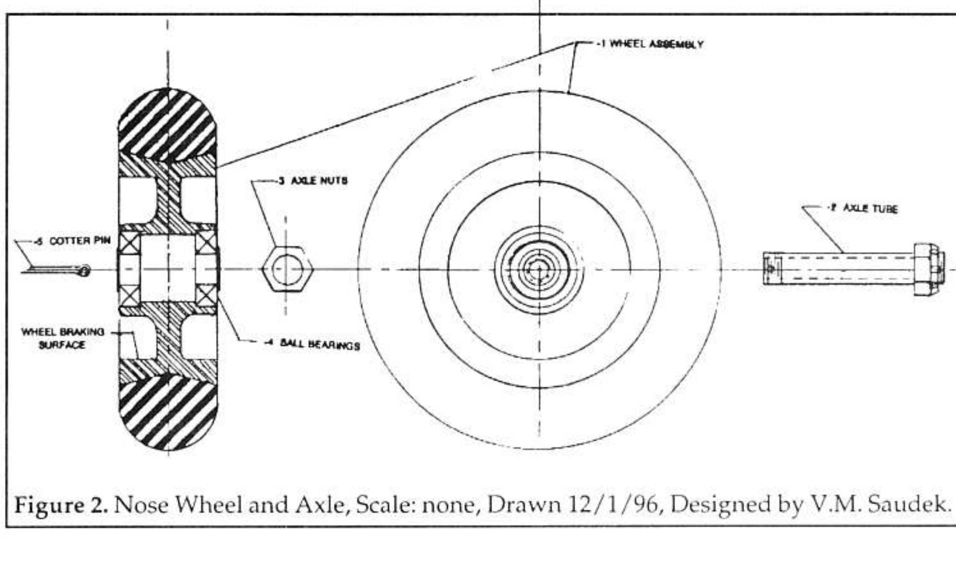

Figure 2. Nose Wheel and Axle, Scale: none, Drawn 12/1/96, Designed by V.M. Saudek.

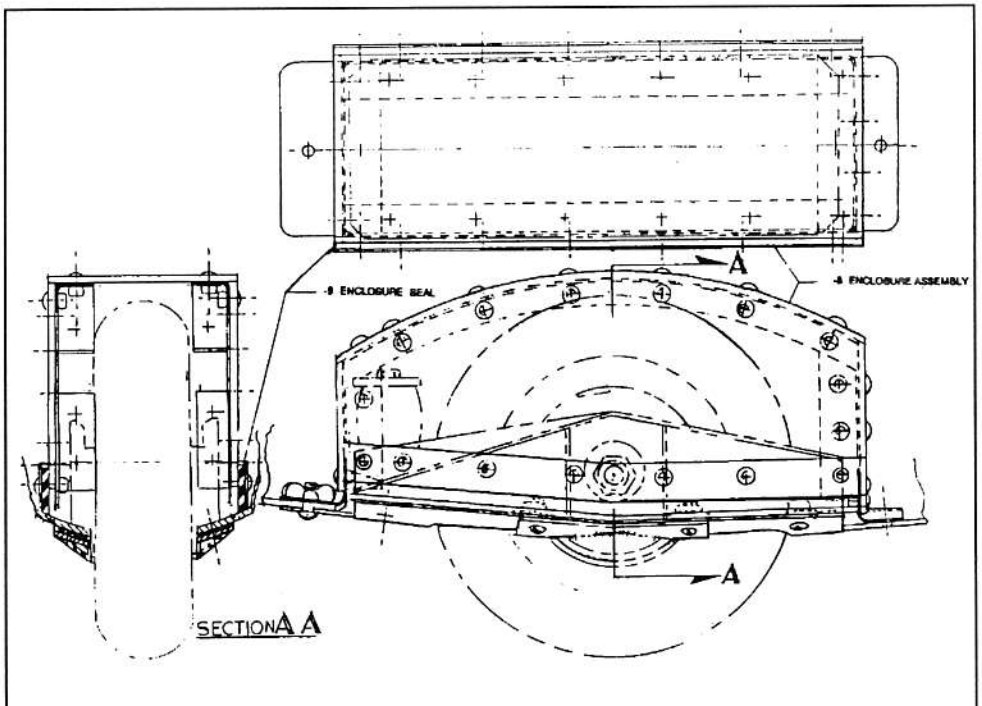

Figure 3. Nose Wheel Enclosure, Scale: none; Drawn 11/29/96, Designed by V.M. Saudek.

To remove the wheel one first removes the enclosure, Figure 3, then the -10 brake shoe brackets from the fixed frame, -7, (Figure 1) then the axle bolt, -2, (Figure 2).

It will be appreciated that the above actions are noticeably easier to accomplish than replacing a steel shod skid or removal and reinstallation for stelliting the steel of a nose skid.

CONCLUSION:

The author has had a crude model of this device made and is satisfied that an installation in a sailplane will accomplish the purpose for which it was designed. He offers to consult with anyone interested in developing it.

This device may be adapted to tricycle landing geared airplanes.

more. Reinstallation of the -10 brake shoe assembly to -7 (Figure 1) is accomplished easily, but one must also then readjust the center bolt through the rubber spring block, - 12, to achieve a proper gap for brake function. The two outboard bolts that penetrate that -12 block should be adjusted if one finds it necessary to change the spring rate of the block to ensure that the brake effect is not affected by a major weight change of the crew.

The fact that no hydraulics or cables are needed to actuate this kind of nose wheel brake should make steerable and retractable designs possible for airplanes as well as gliders.

Editor's Note: *Just as Technical Soaring was going to press, we were notified of the death of Mr. Saudek. Our condolences go out to his family and his many, many friends in soaring.*