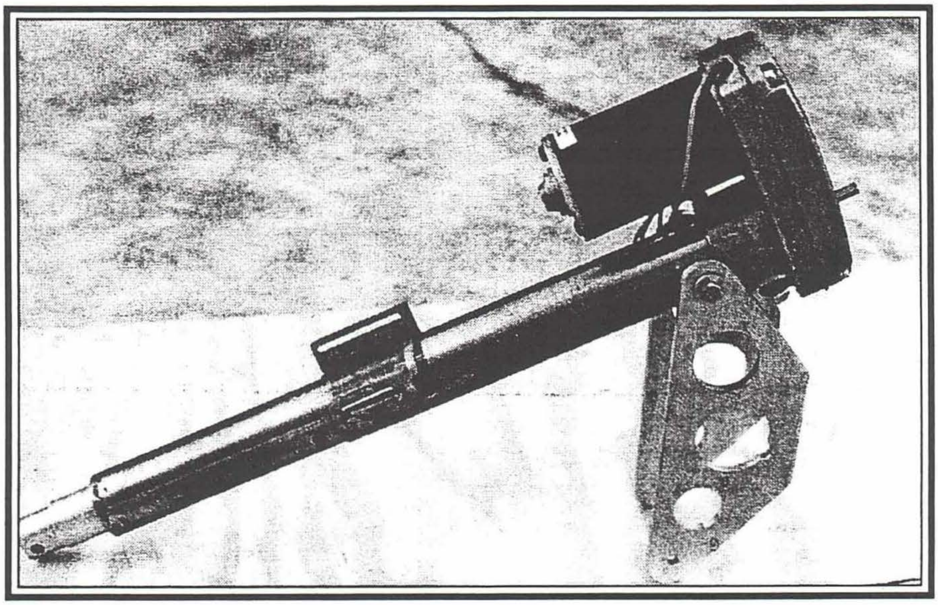
Vari-Eze Materials

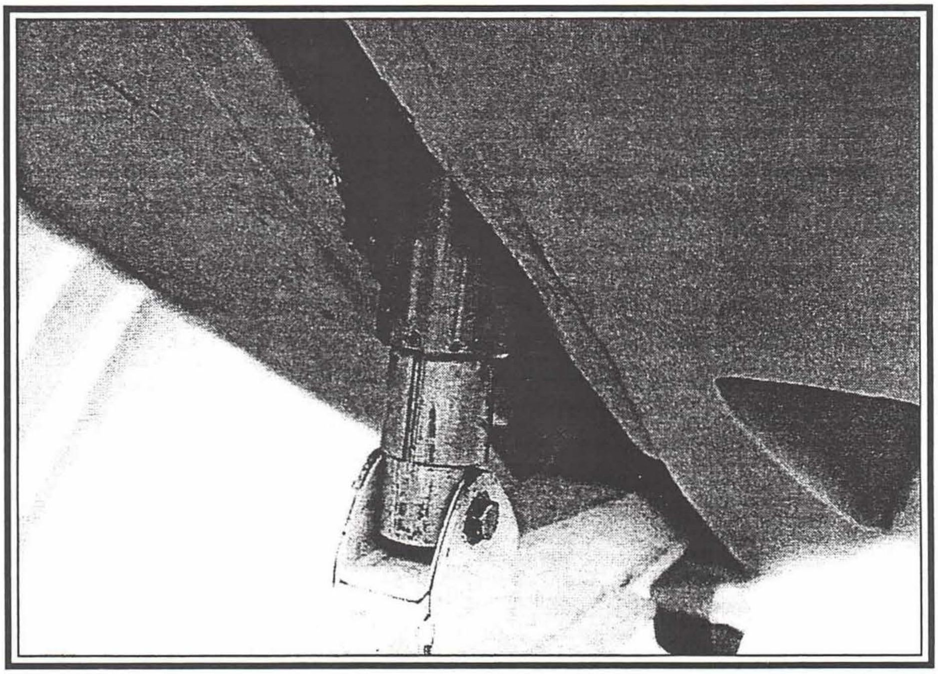
Main landing gear, Rosenhan brakes, axles, wheels and tires 340-300-5, Nose gear assembly, nose gear fork and two 280-250-2 tires, Interior cushions, headrests suit cases, Seat belts, Canopy (in box) with protective wrap. Upper & lower cowl halves, Engine mount (conical), Wing tanks & fuel caps, Two large rolls of glass cloth Wheel pants, Large boxes of white & brown foam, Nine foot long wooden crate containing aluminum angle hinges & tubing, Bell cranks, Box of fiberglass molded parts, Stainless firewall, Bulkheads, Volt meter, Electronic clock, Other parts not identified

The project is basically untouched. I can send e-mail photographs for those who e-mail me with the request. Limerick EAA Chapter 1250 will accept the highest reasonable offer for the whole project or can split up for several builders who wish to go together on a offer.

Email: tailwinds@ptd.net or call A.M. EST (610)-326-3894 Gary Novack, Chapter 1250 Treasurer



Shock spring is hidden inside



The Evolution of the Nose Gear Retraction System For Experimental Canard Pusher Aircraft

Jack Wilhelmson (SC) - The canard pusher experimental aircraft designed by Burt Rutan was both revolutionary and evolutionary. It has been said that Burt never expected to sell more than fifty sets of plans for his Vari-Eze. Probably because he knew some of the lack of creature comfort features of the design would appeal only to the real aerodynamic efficiency proponents and individuals who fully appreciate engineering excellence.

As innovative as his designs were they all suffered the need to park them with the nose on the ground. This required the nose be lifted manually before boarding the aircraft which made the aircraft unusable by anyone with back problems and rather difficult to board. All subsequent derivations of the design also had this requirement. One derivation of the design, Velocity, escaped from this requirement, but only by extreme modification and compromise of the very efficient aerodynamics and light weight construction.

In recent years, general purpose 12 volt linear actuators came into use for actuation of the nose gear with the airplane loaded. The addition of the standard spring to absorb shock from bumps and hard landings completed this evolutionary step. With the linear actuator, the airplane can be parked nose down for stability, boarded (in the nose down position) and raised by the push of a button. Other features are, a linear actuator mechanism which can hold the airplane at any amount of partial retraction for ease of moving the aircraft on the ground, and there is no possibility that the gear is not locked in the down position and therefore will collapse on landing. The linear actuator mechanism can hold the airplane at any amount of partial retraction. In addition a method of manual extension, if the electrical power fails, is available. The drawbacks to this innovation are added weight, decreased space, installation modifications (in finished aircraft), and cost.

In some cases (Vari-Eze, Long-EZ, Cozy) installation modifications were the biggest problem. My Cozy, with radio stack in the center of the panel and the trim system on the left side, presented a major problem to install this new desirable device. After nearly a year of discussing this with Nick Ugolini and planning how to install the available retraction system. We decided it might be easier to design a new retraction system for my airplane than it was to change the airplane to fit the available retraction system. The linear actuator using a 90% efficient ball screw seemed to be the best feature of the available system, so that is where we started. The length of the linear actuator after addition of the 4" shock spring caused most of the problem. It interfered with radio trays and trim system and required cutting away and reinforcing the F22 bulkhead. Engineering analysis of the forces during the various positions of the gear under static load revealed that the system was at a severe leverage disadvantage during the first 18"of lift from the full nose down position. These forces range as high as 2500 lbs. axial force in the ball screw during the initial lifting of a fully loaded 2000 lb. gross wt. canard aircraft.

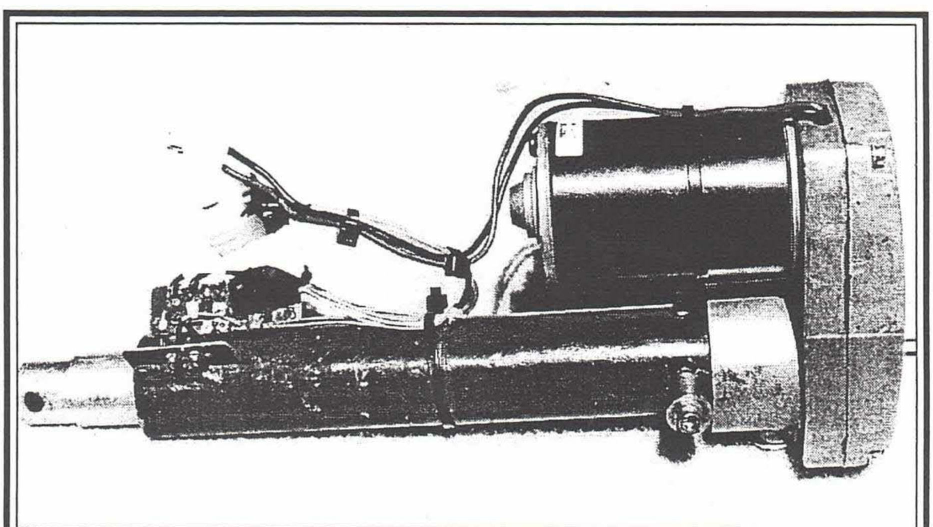
The leverage disadvantage was made worse by the need to keep the actuator unit low under the instrument panel so as not to interfere with the elevator torque tube. Also there is considerable dynamic shock loading from hard landings and the inevitable bounces that occur with botched landings etc. This reaffirmed the need for a shock control system and consideration of the dynamic forces created when the stored spring energy is suddenly released. The present shock control system (consisting of a preloaded spring retained by high strength steel center rod with a .25 diam. bolt in double shear at each end has served well in most cases. So this system was analyzed to determine it's ultimate strength and use that as the design criteria (plus 50% to allow for the heavier aircraft being built today) for the new system.

Another goal was to eliminate all welded joints in the main load carrying part of the system. The desire to eliminate welding came primarily from the quality control problems (stress relieving, x-ray etc.) with welding. Analyzing the force path through the linear actuator revealed that, if the forces can be transferred from the bolt in NG3 to the spring, then directly to the ball nut, through the ball screw to the thrust bearings, and then to the mounting pins, the outside housings only act as braces to keep everything in line and mount the components. Therefore the outside housing can be made much lighter than the stock linear actuator system especially if they are made of high strength 4130 steel. After discussing this with Nick, we agreed the thing had to be shortened so that it could be contained ahead of F22, if we were to gain any advantage from the work. He pushed: "we need to put the spring inside the tube". I laughed and reminded him that the ball screw and nut had to be inside. But, after a couple of days it dawned on me that the spring had a hole in it that the ballscrew could fit through

We reduced the travel of the unit to only the required amount and by using high strength steel and aluminum we were able to reduce overall weight of the complete assembly to ten pounds. This brings the added weight penalty to only five pounds over the standard manual retraction system. The completed system requires no modification of the existing structure (except to drill one" hole in F22 for the manual extension shaft). It is a "drop in installation". The illustration and pictures included are self explanatory.

The system is more capable of lifting the load due to better leverage. The system can be completely removed by removing three accessible bolts and lifting it upward through the nose access door. The electrical control system used with the new actuator has a electronic system that extends the gear if the pilot forgets. The system uses an airspeed sensing feature that extends the gear automatically at 90mph (adjustable) airspeed (no delay). If the airspeed increases above 90 mph a 20 sec delay is provided in the automatic retraction of the gear with gear switch in the up position. This is designed to allow time for the gear to be fully extended even if the airspeed is increased above the set point. A momentary switch is used so that the pilot can defeat the automatic feature instantly at any time. (for: slow flight, high pucker factor takeoffs over an obstacle and parking on the ground with the nose down.)

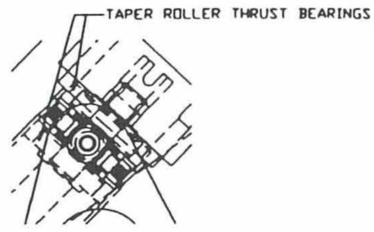
This system is new and does not have extensive worst case testing yet. To date the system has been flying on my airplane for three months with no problems. Three more systems have been built and are in the process of being installed in other aircraft. After we have a large number of hours and landings on this design we plan to make it available to other builders. The cost of this system has not been carefully calculated, however, it can be made in small quantities at comparable cost to systems that are now available.



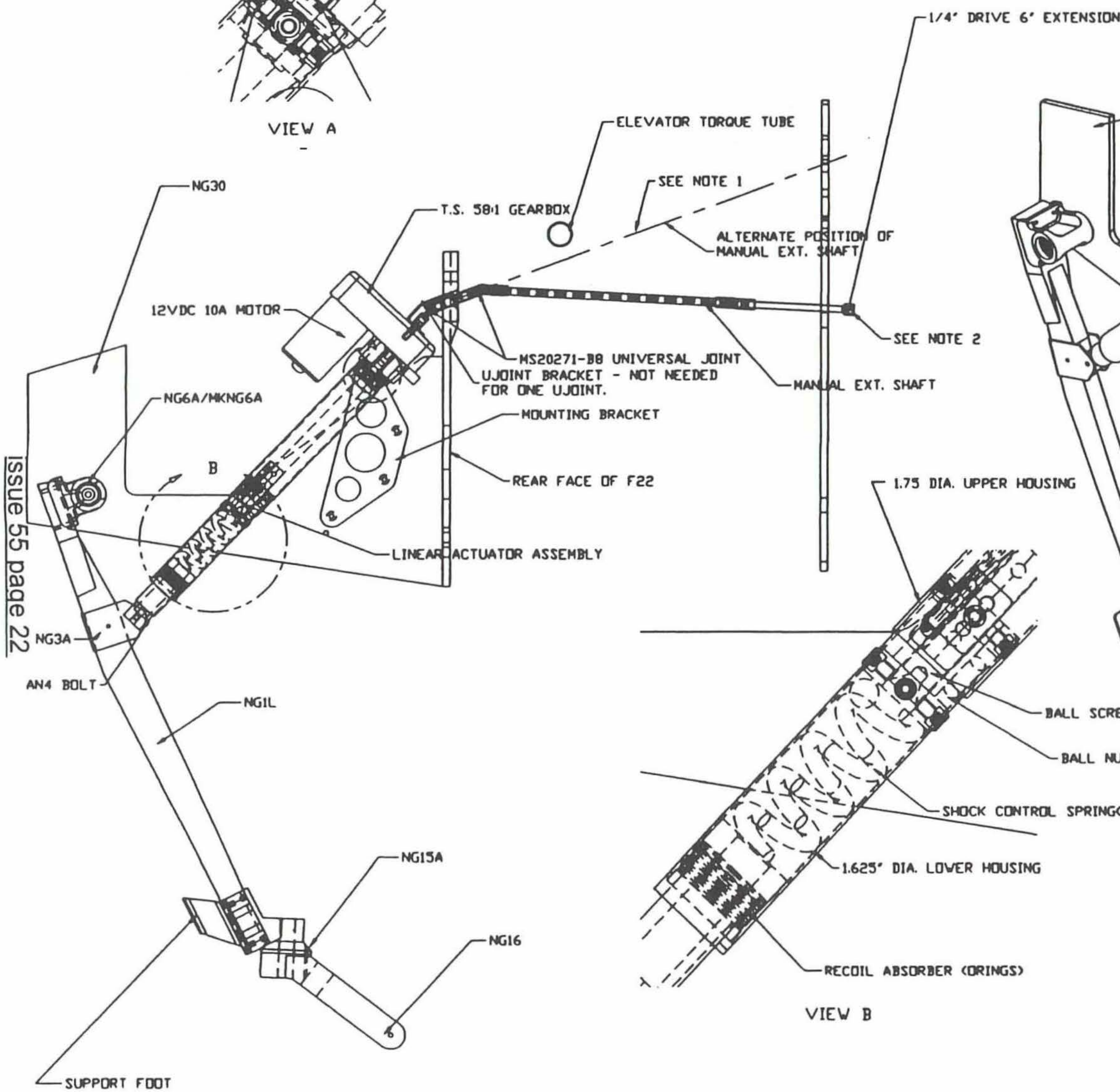
complete assembly with limit switches

NOTES:
1. THIS POSITION OF THE MANUAL EXT. SHAFT REQUIRES ONE UJOINT.
2. THIS POSITION OF THE MANUAL EXTENSION SHAFT REQUIRES TWO UJOINTS AND A SUPPORT BRACKET TO SUPPORT THE UJOINT AT THE ACTUATOR.

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

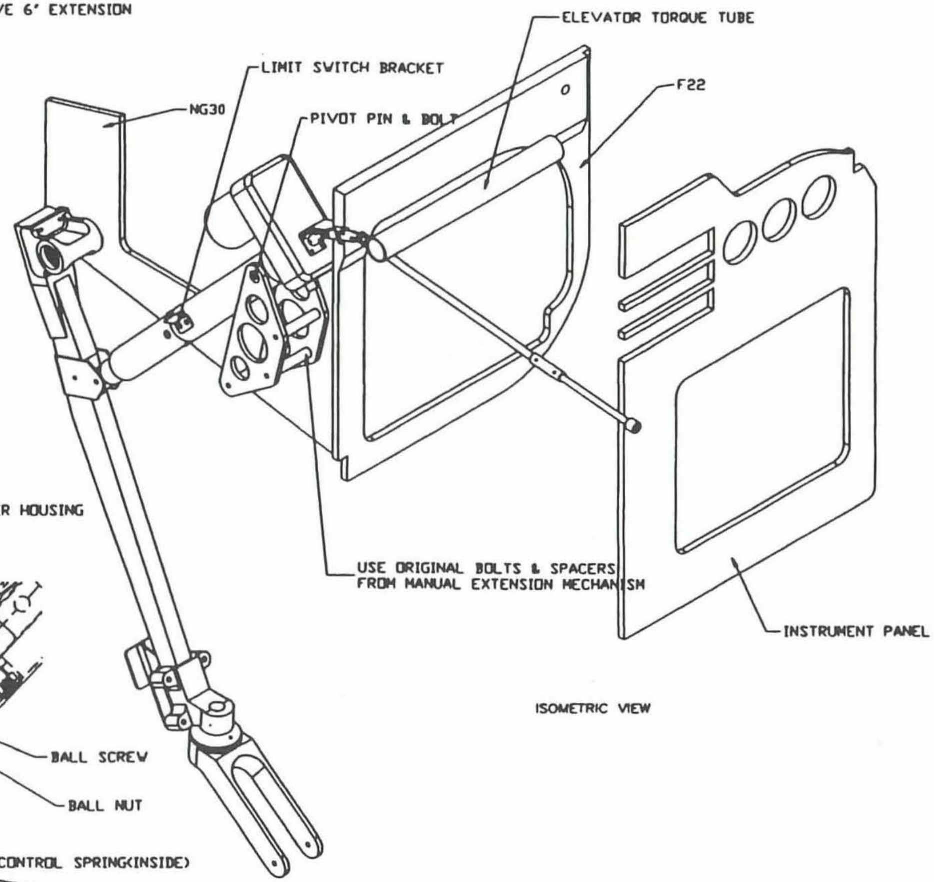


VIEW A



SIDE VIEW

VIEW B



ISOMETRIC VIEW

RETRACTION SYSTEM SPECIFICATIONS:

TOTAL WEIGHT: 10 LBS 3 OZ (INCLUDING CONTROL ELECTRONICS)
MAX EXTENSION TRAVEL LOCK TO LOCK: 7.3"
RATED LOAD FOR 10000 RETRACTION CYLES: 300 LBS AT THE WHEEL WHEN LIFTING FROM FULL RETRACTION.
MAX. LOAD: 500 LBS AT THE WHEEL WHEN LIFTING FROM FULL RETRACTION.
SPRING MAX LOAD SOLID 1700 LBS (340 LBS AT THE WHEEL RETRACTED OR 800 LBS AT THE WHEEL EXTENDED).
MOTOR CURRENT AT RATED LOAD 9 AMPS.
NORMAL EXTENSION TIME@14V: 20 SEC MAX
MANUAL EXTENSION TORQUE AT 90K 60 IN LBS.
MANUAL EXTENSION TURNS: 35

CUSTOM PRODUCT DESIGN.
606 Pelzer DR.
Mt. Pleasant SC 29464

NOSE GEAR RETRACT ASSY-DOWN