Beech on a Budget

SAFE • LEGAL • LOW COST

By Mike Caban

Landing Gear System Watch Outs

The landing gear system in our ABS airframes is nothing short of an engineering marvel, both mechanically and electrically. Simply considering that a DC motor a little larger than a man's fist with a gear shaft diameter smaller than a penny (**Figure 1**) is capable of lifting the unsupported weight of our wheels, brakes, and tires, and then extending the same under the air-speed loads we fly is quite impressive. This electro-mechanical system is essentially the same as engineered for the original Bonanza in 1947, and time and time again it continues to perform well.

FIGURE 1

As systems in our airplanes go, I would say that the landing gear is the second most important system for preventing airframe damage and occupant injury (the engine/propeller being the most important). It's no secret that the current ABS fleet is getting smaller each year as owners who are no longer flying their planes abandon airframes, inadvertently land gear up, or fail to stay on top of their landing gear system maintenance resulting in a gear collapse that more often than not totals the airframe.

This article will point out some of the "watch outs" in our landing gear system that might remain hidden from view without a thorough inspection and proper rigging.

Speaking of rigging, if you and your mechanic do not have the *ABS/ ASF Landing Gear Guide*, you can download it at *www.bonanza.org*. If you want a bound hard copy, order it on the ABS website or by calling 316-945-1700. I must confess that for several years of my Baron ownership the "gear swing" portion of my annuals consisted of swinging the gear on jacks, checking the free travel remaining in the hand crank and doing a manual gear extension with the hand crank. Today – I know better! Five hundred hours earlier (~4200 AFTT) we replaced all the rod ends and installed new tensioning springs. Recently, with the help of the ABS *Guide*, my IA and I did a complete step-by-step rigging. We found some very out-of-spec tolerances and made the necessary adjustments. We both ended up much more knowledgeable about the entire system. Going slowly

FIGURE 2

and methodically, it took us a full eight hours. The end result was silky smooth, quiet extension and retraction cycles and the peace of mind that comes with it.

Figure 2 shows why rod ends are so important, and how running them beyond some reasonable service life is risking the totaling of your airframe or the high-dollar and lengthy downtime of extensive engine and airframe repairs. There are several recommendations on Time-in-Service (TIS) for rod end replacement, ranging from 2,000 hours in Beechcraft service manuals, on up to 4,000 hours TIS by anecdotal references among owners knowledgeable of rod end failures. ABS strongly recommends observing the 2,000 hours TIS figure given service history and the airplane-totaling nature of rod end failure. **Figure 3** shows a failed nose gear rod end at approximately 7,000 hours TIS. Let's bite the bullet on these rod end failures, folks. Why don't we say that a rod end, that has delivered 2,000-4,000 hours TIS over multiple decades, has given an adequate service life and give the airframe that extra margin against an aging part failure?

FIGURE 3

Here is a quote from the Bonanza owner of the rod end in **Figure 3**:

… you are gambling on a failure that may result in a landing with the nose gear not extended! I was very fortunate; the aft nose gear retraction rod pushed the front nose gear retraction rod to lower the gear with the failed rod end. I felt a thump when I retracted the gear and didn't know what the problem was, so I extended the gear for the next landing, at home base, at under 100 knots and did a gentle, smooth landing and slow taxi to the hangar on smooth pavement. When we retracted the gear the next day on jacks, the nose gear did not retract. We were very lucky not to have landed the Deb with the nose gear not extended or in having it fail on the ground. Please do not neglect the nose gear retract rod ends. There are three of them.

Speaking of nose gear not retracting, I'll describe another circumstance that could cause to the same thing to happen in early model Bonanzas, as shown in **Figure 4**.

FIGURE 4

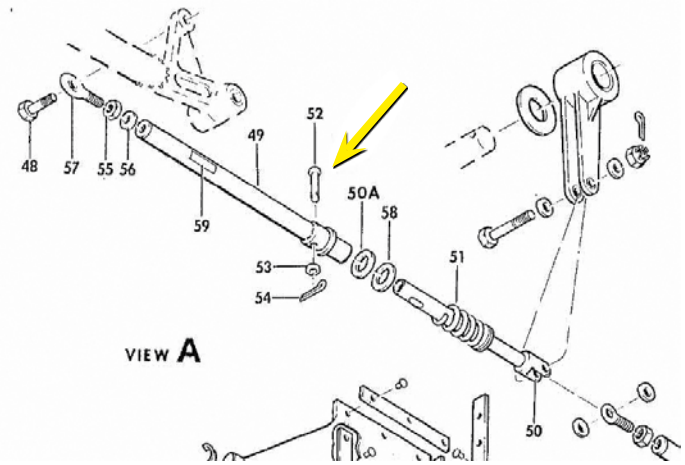

FIGURE 5

On early model Bonanzas, the rod #50 in **Figure 5** had a short nose. If/when pin #52 fails, upon gear retraction the rod slides out of its nested position in rod #49, which would pull the nose gear up. There you have the makings of a nose gear collapse on landing rollout. In February 1957, Beech issued a Service Letter announcing that a longer rod #50 and controlled-strength shear pin was used starting with Serial Number D-4547 (midway through 1956 G35 production). The Service Letter refers to retrofit kit #35-619 for earlier airframes. Read the entire Service Letter at *www.csobeech.com/files/Beech-SB-NoseGearPin.pdf*. A vintage Bonanza source recently called out the kit as P/N 35-8007-1S. The newer rod is reported to be 7.5" longer and is P/N 35-825094-4.

Figure 6 and **Figure 7** are examples of two different Bonanza owner shear pins (#52 in **Figure 5**) that were found "in the nick of time" to avert a landing gear disaster. As you can see from the assembly in **Figure 8**, without complete disassembly and inspection, the shear pin damage is impossible to detect.

FIGURE 6

FIGURE 7

FIGURE 8

Figure 8 shows the nose gear linkage assembly as installed. The pin is clearly visible but I think you'd be hard pressed to see potential mangling without complete disassembly. Come to think of it, why not just put a fresh new one in there and toss the 20-, 30-, 40-year-old

FIGURE 9

FIGURE 10

FIGURE 11

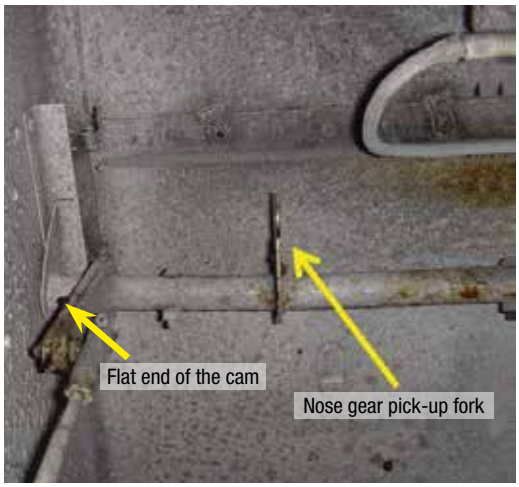

FIGURE 12

one in the trash? Also note that the tensioning spring has a reasonable amount of distance between coils. A spring that is "stacked," with the coils very near or touching each other, should also be replaced.

The nose gear spring #51 (**Figure 8**) for my B55 is P/N 35-825188 and the main gear springs (one on each main gear lifting arm in the main gear wells) is P/N 45-815091. Check your airframe parts catalog for your specific part numbers.

While we are still in the nose gear area, let's take a look at **Figure 9**, which shows a bent bolt found by a savvy IA who was involved in a thorough gear disassembly inspection. This bolt connects the two nose gear rods to an idler at #50 in **Figure 5**.

Let's look at one more nose gear watch out: nose gear door actuator pin as shown in **Figures 10** and **11** (**Figure 10** showing a pin worn nearly through). If this pin is lost the nose gear pickup fork (**Figure 12**) will not be actuated and the nose gear doors will not close. The repaired pin, done by welding, is shown in **Figure 11**. Sawing action between the pin and the pickup fork is the culprit. It helps to add a dab of grease to the pin.

Many mechanics are familiar with the practice of disconnecting the gear doors when doing gear swings and gear rigging. Here are two specific watch outs to keep from bending things when the gear doors are disconnected:

- In the nose gear (**Figure 12**), the flat end on the left side of the cam must be firmly planted on the "L" shaped piece that is on the left side (of this picture view, right side of the aircraft) of the inner wall when the gear is down and locked. If your gear door rods are ever removed it is easy to reattach them in such a way that the cam/pickup fork is slightly turned counter clockwise, and the flat part of the cam will not be flush with the "L" piece on the wall. You will then have nose gear doors that do not close properly, and also potentially bend the pickup fork by the pin on the down lock arm.

FIGURE 13

FIGURE 14

- With the airplane safely on jacks and a tail stand, *before* going full blast with an electrical retraction, check for proper inner gear door clearance. It's a two-person job. Turning the hand crank *clockwise*, begin opening the inner gear doors. You (or your observer, if you're doing the cranking) sing out if you see anything getting close enough to do damage.

After disconnecting the inner gear doors from their rods, I've found it a great help to firmly safety wire a length of rubber hose on the end of the rods that is long enough to extend out the fuselage far enough to protect the rod throughout its full travel. Leaving the ends of the rods exposed when cycling the gear leaves them vulnerable to hanging up on something during their trip in and out. **Figure 13** illustrates what you don't want to have happen to your rods.

FIGURE 15

FIGURE 16

Inner main gear door slop can be caused by any number of factors: tired gear motor, improperly adjusted uplock and downlock micro switches, poor dynamic brake function, and wear in

the arm bushing and bolt combination. **Figure 14** shows the slight wear signature in the transmission arm that indicates bushing/bolt wear in the linkage. **Figure 15** and **16** show the bolt and bushing combination.

Another older airframe weakness is the thinner nose gear arm that was fitted to early Bonanzas (and T-34s). **Figure17** shows a failed arm on the bottom of the gear transmission.

FIGURE 17

FIGURE 18

Beech has gone through three generations of these arms. The first few years it was made out of magnesium and was P/N 35-825172. Some time later Beech changed to an aluminum version, P/N 35-825172-2, used through the 1980s at which point they switched to the heavier-bodied arm, P/N 35-825172-13. **Figure 18** shows the more robust design alongside an earlier design.

I urge ABS members to participate in their landing gear maintenance, to whatever extent is possible, for economic as well as system knowledge benefits. The *ABS Landing Gear Guide* is truly a member benefit worth the cost of our annual membership in and of itself. My mechanic and I couldn't be happier with the results we got by using it in its step-by-step format. If your Beechcraft is coming up on 2,000 hours or more and has not yet had a thorough landing gear rigging check and rod end makeover, consider putting that on your to-do list with your mechanic.