ACCIDENT

Aircraft Type and Registration:	Beech B58 Baron, G-OSDI
No & Type of Engines:	2 Continental Motors Corp IO-520-CB piston engines
Year of Manufacture:	1980
Date & Time (UTC):	5 April 2008 at 1220 hrs
Location:	Leicester Airport, Runway 28
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - None
Nature of Damage:	Right propeller blades bent, engine shock-loaded, scraping on right wing tip, passenger step displaced
Commander's Licence:	Private Pilot's Licence
Commander's Age:	54 years
Commander's Flying Experience:	682 hours (of which 64 were on type) Last 90 days - 1 hour Last 28 days - 0 hours
Information Source:	AAIB Field Investigation

Synopsis

Whilst landing at Leicester Airport, the pilot was unable to obtain a green 'down and locked' indication for the right main gear, despite several reselections. During the landing roll the gear collapsed at relatively slow speed and with minimal damage. Examination of the aircraft showed that both main gear uplock rollers had seized and this has previously been recognised as a cause of main gear 'hang ups'. A similar accident in this Bulletin (Beech A36 Bonanza, G-CDJV) contains a diagram of the main landing gear system.

History of the flight

The aircraft was returning to Leicester, with just the pilot on board, after a period in Guernsey. The pilot had elected to load full fuel, giving a departure weight of 5,255 lbs. The flight was uneventful but, some 26 miles from Leicester, the pilot encountered deteriorating weather with a lowering cloudbase. Leicester Airport was reporting a cloudbase of 800 feet but he sighted the airfield at about 900 feet. He elected to use Runway 28 since the active runway, 04, was too short for his aircraft.

Normal landing checks were carried out, including selection of first stage of flap and landing gear DOWN. However, the indicator showed green lights for the left main and nose landing gears only, with the right gear not indicating and with the GEAR UNSAFE warning horn

sounding. Having requested a visual inspection by the control tower, the pilot made a reselection whilst positioning the aircraft for a fly-by. This resulted in the same indications.

The tower initially reported that the gear appeared to be down but requested a closer fly-by. Whilst positioning for this the pilot made a third selection – again with the same indications and with the same response from the tower. A fourth reselection was also unsuccessful and the pilot positioned the aircraft north-west of the airfield, whilst he considered his options. His thought processes included:

Using the manual gear extension crank. He was aware that the Pilot's Operating Handbook gave a procedure for using manual extension in the event of failure of the landing gear to extend. He was uncertain whether its use might be inappropriate for cases where only one gear was indicating unsafe. Also, because of the distraction caused by the 50 turns needed to crank the gear all the way down, he would need to be well above the 800 feet cloudbase for safety, and he was not current in IMC procedures.

Performing high-energy manoeuvres to try and force the gear down. He discounted this option for the same reason: he did not want to perform such manoeuvres at low level.

The pilot now accepted that he was going to have to land with the right gear possibly unsafe and requested the presence of a fire crew. He made his approach to Runway 28, having tried a fifth, unsuccessful, reselection. Touching down at 85 kt on the left side of the runway and on the left landing gear first, the ground roll was initially normal and he commenced gentle braking. The aircraft had slowed and completed roughly 75% of the ground roll when the right gear collapsed: the aircraft slewed about 80° and, after a very short slide, came to rest. The right engine had stopped and the left was running at higher rpm than idle (the pilot thinks he may have inadvertently moved the throttle as the right gear collapsed). He shut the aircraft down and tried to evacuate through the pilot's door on the right, but it was jammed, apparently from structural distortion due to the aircraft's unusual attitude. The fire crew wrenched it open and the pilot exited the aircraft "shaken but unhurt". He recalls that he had considered opening the pilot's door prior to landing, but discounted this for the same reasons of distraction at low level which had precluded cranking the manual gear extension mechanism or forcing the gear down with manoeuvres.

After the aircraft was jacked, the right gear actuating rod was disconnected from the actuator, and the gear dropped into full downlock position.

Description of the landing gear mechanism

The B58 Baron (and several other Hawker Beechcraft models) uses a single electric actuator for landing gear extension and retraction. In case of failure of the actuator motor, the gear can be manually cranked down. Three rods are moved by the actuator to extend and retract the left, right and nose gears and two further rods actuate the inboard main doors. Also attached to each of the latter rods is a cable which is tensioned and relaxed by rod movement. These cables move an uplock mechanism into place when the gear is fully UP and a secondary lock into place when the gear is fully DOWN.

The primary method of downlock is provided by the overcentre geometry of the two-piece folding sidestay. The extension/retraction rod rotates the upper, V-shaped, element of the sidebrace and moves the whole gear assembly. As the gear approaches the down-and-locked

condition, the rod overtravels and compresses a spring, which forms part of the rod: the downlock is thus held overcentre by this spring pressure (see Figure 1). As this occurs, cable 'B' tensions and pulls the secondary downlock into place underneath a roller on the sidebrace; this is to prevent the gear from being forced out of lock by cornering forces or yawed landings. The green indication in the cockpit is not an indication that the gear is fully locked DOWN with the secondary lock in place, but, because it is activated by a striker plate on the sidebrace, it is an indication that the leg is in a position where the sidebrace is overcentre.

Upon selecting gear UP, the rod reverses its travel, cable 'B' relaxes and the secondary lock drops clear under spring tension, allowing the sidebrace to fold and the leg to retract. As the gear reaches the fully UP position, cable 'A', which is attached to cable 'B', tensions and pulls the uplock block underneath the same roller, preventing movement towards the extended position. The actuator rod is also keeping the gear UP, so the uplock is intended to prevent the gear from sagging against the spring tension.

It will be appreciated that, if the gear is not fully

Figure 1

Gear down and locked

downlocked upon landing, the gear will start to fold and buckle the actuator rod, as it cannot backdrive the actuator. It will also damage the inboard door, which is only open during extension/retraction cycles.

Examination of the aircraft

During the accident the right main landing gear, which had clearly not been locked down, had retracted. The actuator rod had buckled the fitting connecting it to the actuator motor and there was a second, minor, kink in the tubular part of the rod. The inboard door had also been damaged.

When inspected by the AAIB, the bent actuator rod had been replaced with a new, serviceable rod and the system was tested using the manual winding handle on the actuator. All three landing gear legs were found to retract and extend into downlock normally.

Figure 2 shows the right main landing gear of G-OSDI in the up-and-locked condition (doors removed for access): cable 'A' is tensioned and pulling the uplock against its spring under the roller. Although not apparent in the photograph, there was a clearance of about 0.25 inches between the uplock and the roller. The

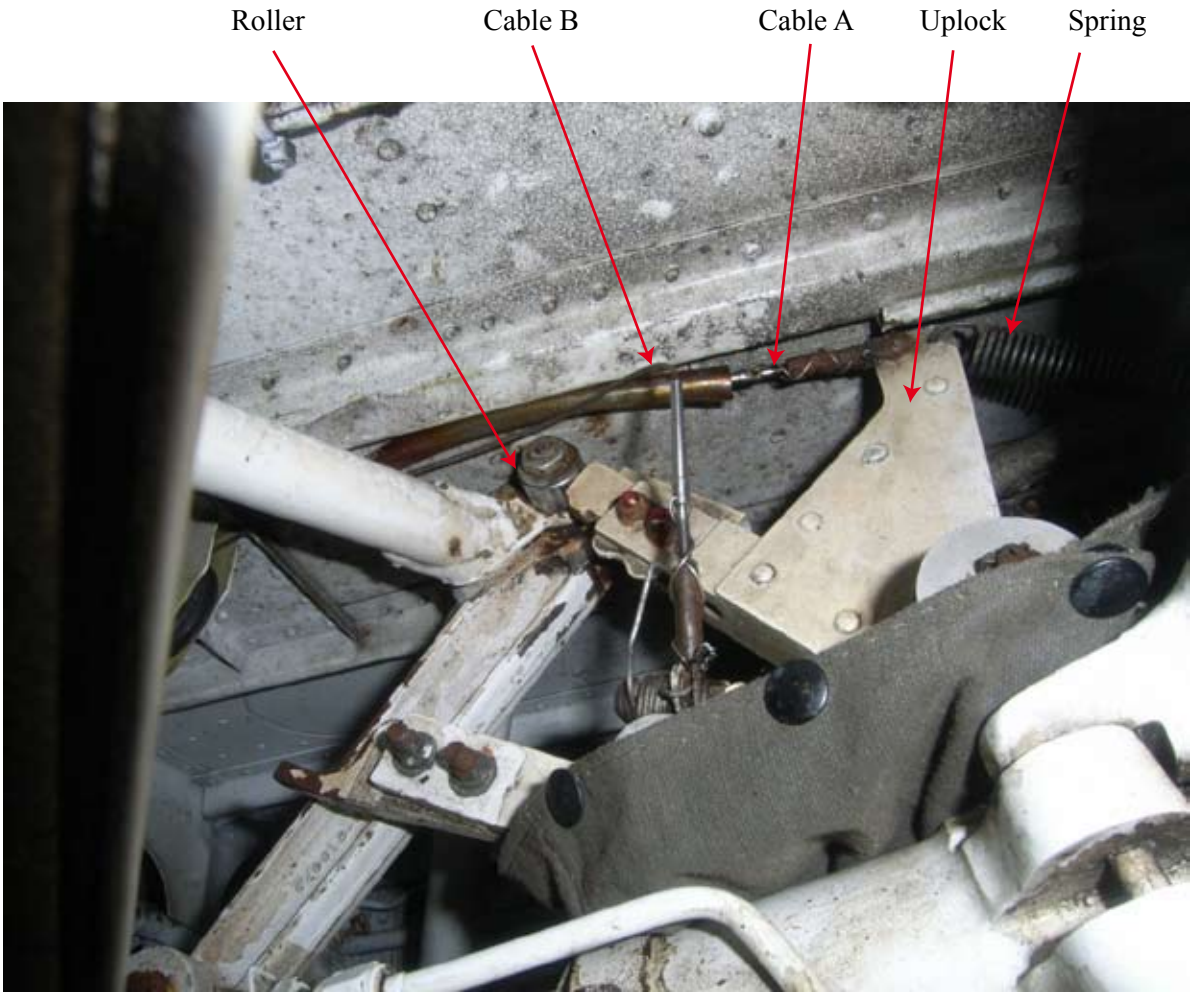

Figure 2

Gear up and locked

Maintenance Manual (MM) requires this gap to be only 0.010 – 0.020 inches. In Figure 1 it can be seen that the secondary lock is hard up against the roller, whereas the MM specifies the same clearance. Both left and right gear rollers were found to have seized solid and could not be freed. A third roller of the same type in the nose landing gear mechanism was also seized.

A test was devised in which the uplock was temporarily prevented from moving during a hand-cranked extension cycle. As the gear started to move, the roller contacted the uplock and the whole mechanism jammed; further cranking would have caused the extension/retraction rod to bend. This situation could occur if the extension cycle was initiated during an encounter with turbulence or, possibly, freezing of the uplock. When a 'free' roller was used, and the test repeated, the roller was able to nudge the uplock upwards out of the way and gear extension was unimpeded.

G-OSDI had flown only 13 hours since its lastAnnual/ Certificate of Airworthiness inspection, which had taken place 5 months previously. The records showed that the left roller had been lubricated but there was no entry for the right. Total airframe hours at the time of the accident were 2,188. Considerable corrosion was found on components of both main landing gears, such that replacement would be required before the aircraft flew again.

Roller maintenance requirements

In May 2007, the FAA issued Airworthiness Directive (AD) 2007-08-08, which was effectively a re-issue of AD 72-22-01 to add a new model to the list of aircraft to which the earlier AD applied. Essentially the AD required replacement of the uplock rollers with a type which could be regularly greased and thereafter to lubricate at 100 hour intervals. The reason for the AD was:

> *'....to decrease the possibility of gear-up landings caused by seizure of the uplock rollers.'*

The AD is not directly applicable to G-OSDI because the modified rollers were fitted at build, but it is an indication that the importance of maintaining free rotation of the rollers had been recognised in 1972.

The '*Pilot's Operating Handbook and FAA approved Flight Manual*' requires lubrication of the rollers at 100 hour intervals. The same document requires a check of the rollers as part of the pre-flight inspection.

Discussion

The accident to G-OSDI bears many similarities to an accident to a Beech A36 Bonanza, G-CDJV, also in this Bulletin. The aircraft share a similar mechanism for the main landing gears and can suffer the same problems from seized rollers. It appears that some pilots and maintainers are unaware of the potential for seized rollers to cause hang-ups of the main gear. The probable cause is that contact between a seized roller and the uplock results in a transient jam, which distorts the extension/retraction rod so that it can no longer fully move the gear into downlock, despite reselections. The gross bending of the rod occurs as the gear folds on landing. It is possible that, when observing a properly rigged system during extension and retraction, there appears to be no contact between the roller and the up/ downlocks and the necessity of maintaining free rotation is not apparent.

The Pilot's Operating Handbook requirement to check the rollers prior to flight is not specific, but the intent is that the pilot should check them for free rotation. In the case of G-OSDI, this would not have been possible because the system was misrigged such that

the roller was hard against the secondary downlock. Equally, there is little point in pumping grease into a roller which has seized and free rotation should be checked as well – this requires jacking the aircraft when, as was the case with G-OSDI, the system is improperly rigged.

In the scenario described, hand-cranking the gear down would not have been successful had the pilot attempted it, nor would any attempts to force the gear into lock using 'high g' manoeuvres.