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**ACCIDENT**

<b>Aircraft Type and Registration:</b>	Rockwell Commander AC11, N115TB	
<b>No &amp; Type of Engines:</b>	1 Lycoming TI0 540 AG/A piston engine	
<b>Year of Manufacture:</b>	2000	
<b>Date &amp; Time (UTC):</b>	31 January 2006 at 1640 hrs	
<b>Location:</b>	Oxford Airport, Oxfordshire	
<b>Type of Flight:</b>	Private	
<b>Persons on Board:</b>	Crew - 2	Passengers - None
<b>Injuries:</b>	Crew - None	Passengers - N/A
<b>Nature of Damage:</b>	Damage to propeller, nose landing gear doors and nose landing gear actuator	
<b>Commander's Licence:</b>	Private Pilot's Licence (FAA)	
<b>Commander's Age:</b>	53 years	
<b>Commander's Flying Experience:</b>	485 hours (of which 310 were on type) Last 90 days - 8 hours Last 28 days - 1 hour	
<b>Information Source:</b>	Aircraft Accident Report Form submitted by the pilot, AAIB examination and enquiries	

**Synopsis**

During the first flight following maintenance work the pilot was unable to confirm the full extension of the nose landing gear. The nose gear collapsed during landing. It was not possible to conclusively determine the reason for the failure of the nose landing gear to fully extend.

**History of the flight**

The aircraft had been undergoing maintenance which involved the removal of the engine for crankshaft replacement and subsequent refitting. A test flight comprising a circuit was planned following the maintenance. Taxi and takeoff were normal; however, having selected the gear down on the downwind leg the

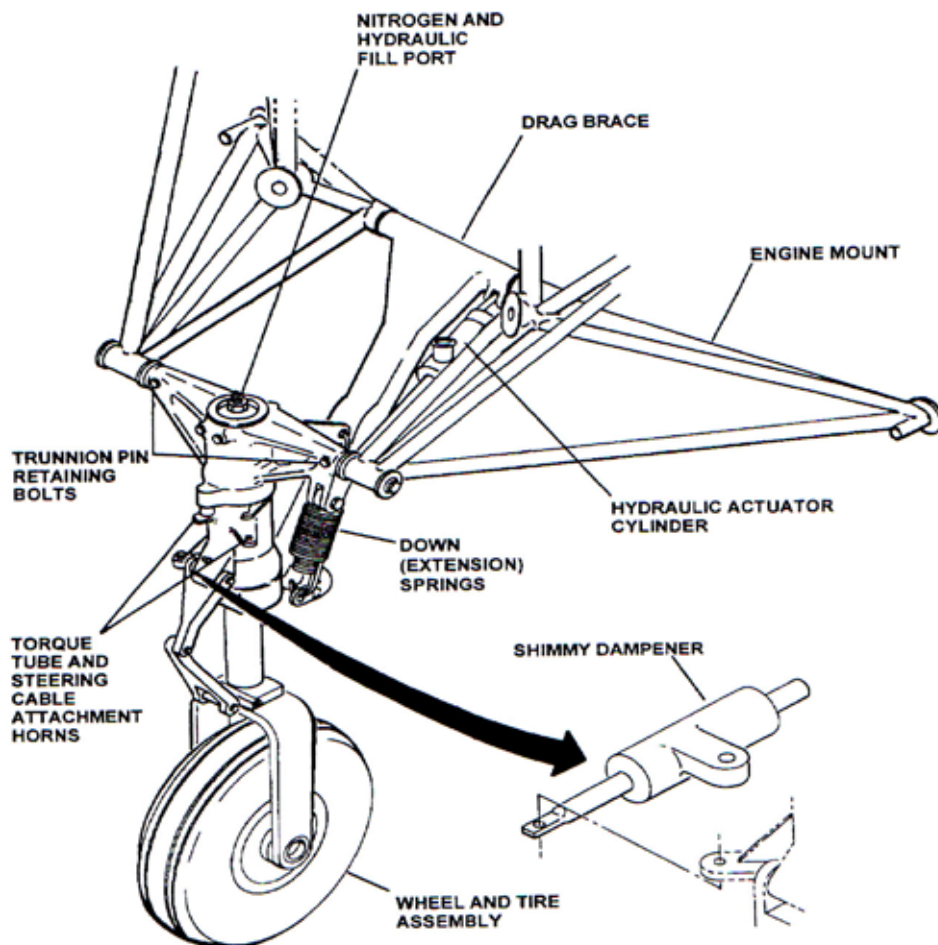
pilot noticed that the green 'down and locked' indication on the nose landing gear was not illuminated. He carried out a flypast of the ATC tower, which confirmed that the nose landing gear was only partially extended. He then climbed to 3,500 ft in order to investigate the problem and, having reselected the gear several times, he carried out manoeuvres hoping to shake the landing gear down, but without effect. He then selected the landing gear down using the emergency landing gear system, but again the nose landing gear indication did not illuminate. He carried out another flypast of the ATC tower which confirmed the nose landing gear was still only partially extended.

The pilot carried out an approach and landing to the grass strip, shutting down the engine in the flare just prior to touchdown. As the nose was lowered onto the runway the aircraft continued to roll on the main landing gear, two of the three propeller blades and the nose wheel bay doors. The aircraft came to a stop and both occupants exited without injury.

### Description of the landing gear system

The aircraft is fitted with a tricycle landing gear which is retracted by an electrically driven hydraulic power pack actuated by the landing gear selector switch. When the landing gear selector switch is placed in the UP position, the landing gear retracts and, when all three gears are retracted, the pump is shut off and the gear held up by hydraulic fluid lock. A hydraulic

pressure switch controls the pump by removing power when the pressure reaches a preset limit. A loss in hydraulic pressure is sensed by pressure switches which actuate the power pack to build up additional hydraulic pressure. When the landing gear selector switch is placed in the DOWN position, the hydraulic fluid lock is released and hydraulic fluid directed to the down side of the landing gear actuator cylinders. When all three landing gear are down, each drag brace moves into an over centre position so that the gear is down and locked (see Figure 1). There is no electrical indication of gear retraction other than all indicator lights being extinguished. When the landing gear extends to the down position, the three landing gear microswitches are actuated, causing the three green lights to illuminate, indicating that the gear is down and locked.



**Figure 1**  
Nose landing gear assembly

Operation of the emergency landing gear system opens a valve which bypasses hydraulic fluid directly to the hydraulic power pack reservoir, allowing the gear to drop by gravity; gear extension is assisted by down springs.

### **Aircraft examination**

When the aircraft's nose was lifted during recovery it was noted that during the ground roll the nose landing gear had been pushed toward the retracted position. The extension of the nose landing gear actuator shaft confirmed that the nose gear had not been fully extended when the aircraft contacted the runway. The pin attaching the nose gear actuator to the nose leg was removed following which the leg fell unhindered and unaided into the down and locked position. A thorough search was carried out from the aircraft touchdown point to the area where it came to rest; no items which could have fallen from the aircraft and which may have interfered with the nose landing gear mechanism were identified.

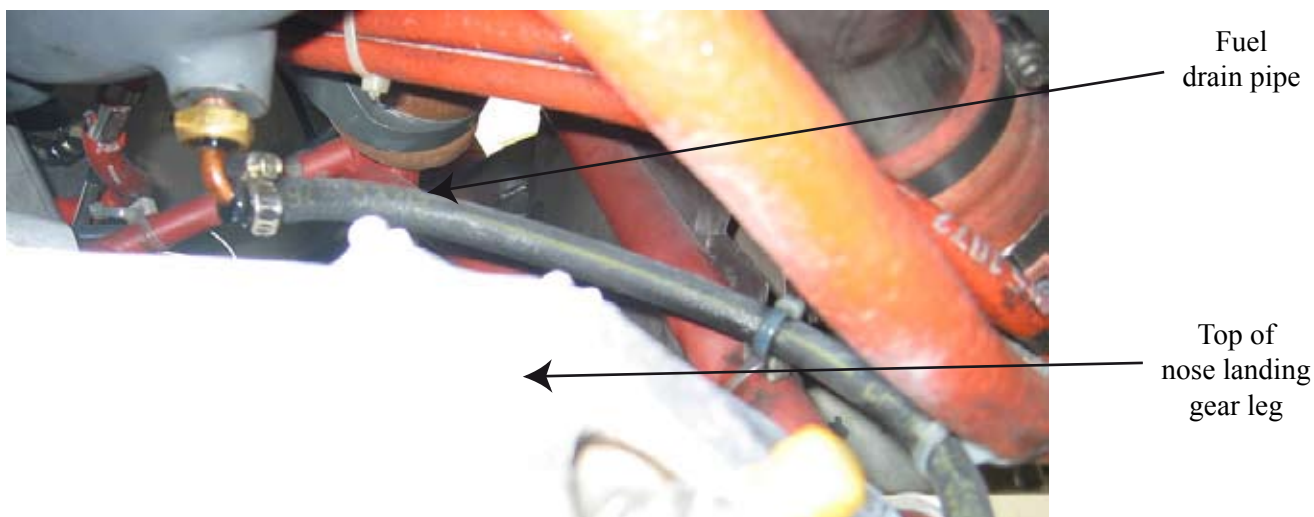
The aircraft was towed to the maintenance facility for a further examination by the maintenance organisation. A thorough examination of the nose landing gear revealed no witness marks to indicate that full extension may have been inhibited by a foreign object. There were some blue paint marks from the nose gear doors on the leg itself. The hydraulic pump reservoir was noted to be full. The damaged actuator was removed and a pressure test of the system carried out; this was within limits, although the hydraulic pack was only tested for a short period of time. The nose gear actuator was disassembled; fluid on the shaft side of the piston was found to contain a piece of metallic debris, which was probably a crushed drilled out rivet head. This debris was not considered to be of a sufficient size to restrict the flow of fluid from the actuator. There were no signs of scoring on the inner surface of the cylinder to indicate that the debris had been trapped between the piston and the cylinder wall.

The remaining hydraulic components were purged of fluid; no further debris was found.

The maintenance manual describes a test for the emergency extension gravity system. This requires the aircraft to be on jacks and a 5½ lb weight to be applied to the nose landing gear axle to simulate the air loads. When the landing gear emergency valve control knob is operated the landing gear should free-fall and the green landing gear light should illuminate showing it is in a down and locked condition. This test was performed in the presence of the AAIB. The nose landing gear fell into the down and locked position; however, the nose landing gear actuator had not been fitted due to the non-availability of a spare so the test may not have been totally representative in that the gravitational forces were not opposed by drag from the actuator.

Subsequent examination of the nose landing gear microswitch showed that one attachment screw nut was missing and it was loose on its mounting. It was demonstrated that this could prevent the nose gear down and locked indicator light from illuminating; however, this was an intermittent fault. The condition of the screw, with dirt and grease present on the thread, suggested that it had been missing for some time.

The engine installation included a flexible fuel drain pipe from the induction manifold (Figure 2). This attached to the underside of the engine and was tie-wrapped at various points to route it around the nose landing gear bay. Some tie-wraps were present and their condition indicated that these had not been disturbed during the recent maintenance work; however the pipe was loose around the front of the nose leg. It was reported to the AAIB that on another aircraft it was possible to demonstrate that, if this pipe were loose, the nose gear could be jammed, preventing full extension by fouling the down spring lever arm around



**Figure 2**

Flexible Fuel drain pipe

the fuel drain pipe. During the AAIB examination it was not possible to demonstrate such a jam on the accident aircraft.

### **Previous maintenance work**

The aircraft had arrived at Oxford on 16 November 2005 for a crankshaft replacement in accordance with Lycoming Service Bulletin 566 to satisfy FAA AD 2005-19-11. The pilot reported no pre-existing defects on the aircraft. The engine was removed on 17 November and the aircraft kept in a hangar at Oxford while the work was carried out. The installation of the engine was completed and the Certificate of Release to Service issued on 31 January 2006. Engine operational and performance checks were carried out in accordance with the Aircraft Maintenance Manual and the relevant engine manufacturer's Service Information. As part of the installation engine ground runs were carried out for leak checks; however there is no requirement to carry out

a landing gear function test. None of the landing gear components were disturbed during the work and there were no tools reported missing following the work.

### **Discussion**

It was not possible to determine conclusively the reason for the failure of the nose landing gear to extend completely. The aircraft was flown past the tower with the gear extended using the normal, hydraulically operated, system and later with the gear extended using the emergency, gravity assisted, system. On both occasions ATC reported the gear to be only partially extended.

No fault was found in the hydraulic system; however it has not been possible to test the complete landing gear system as yet with a new nose landing gear actuator. If any further evidence is revealed when these tests are complete they will be reported in a later AAIB bulletin.