AAIB Bulletin No: 9/93 **Ref: EW/G93/07/27** **Category: 1b**

Aircraft Type and Registration:	Cessna 310Q G-BBHG	
No & Type of Engines:	2 Continental IO-470-VO piston engines	
Year of Manufacture:	1973	
Date & Time (UTC):	19 July 1993 at 1254 hrs	
Location:	Manston Airport, Kent	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Damage to propellers and underside of aircraft	
Commander's Licence:	Private Pilot's Licence with IMC and Night Ratings	
Commander's Age:	38 years	
Commander's Flying Experience:	428 hours (of which 299 were on type) Last 90 days - 31 hours Last 28 days - 12 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and examination of the aircraft by the AAIB	

The aircraft had just taken off from Southampton on a VFR flight to Canterbury when a loud bang was heard by the pilot during the undercarriage retraction sequence. As all the associated lights were extinguished the pilot elected to continue the flight but, on arrival in the circuit, only two green undercarriage down and locked lights were visible. The pilot was in receipt of a radar information service from Manston at the time and so requested, and received, permission to fly past Manston tower in order to ascertain the state of the undercarriage. This showed the nose leg to be only half deployed with the system selected down. Fuel endurance at this time was reported as 5.5 hours. During the next two hours the pilot flew around to use up fuel and repeatedly tried to get the nose gear to lock down by, manoeuvring, re-cycling and manually operating the system. This was unsuccessful.

The pilot's handbook for the aircraft list two options for landing the aircraft without a deployed nose gear. If landing on a hard runway it suggests that the main gear is selected down, but on a grass runway that it is landed with the undercarriage retracted. The pilot considered the second option to be the best and, with due warning for the emergency services, made an approach under power at approximately 74 kts with 15° flap set and landed the aircraft on (grass) runway 24. (During this

approach, the cabin door was unlatched and wedged open using the first aid box. This, however, made the aircraft difficult to handle and during this period the box was dislodged and inadvertently lost overboard). The aircraft made a gentle touchdown, with the engines still turning, and after a short ground slide came to rest on the runway heading. There was no fire and the occupants were easily able to exit the aircraft. The aircraft was subsequently recovered to a maintenance organisation on the airfield where it was available for examination.

Landing Gear Retraction System

The retractable tricycle landing gear on the Cessna 310 is electrically operated. An electric motor is signalled from a switch in the cockpit and drives into a reduction gearbox located below the cabin floor just aft of the front left seat position. Three push-pull rods are connected to the gearbox output shaft, one for each gear, and directly drive the operating and locking mechanisms. There are no spring struts or load relieving devices in the system so that should a restriction occur, the gearbox is capable of generating abnormally high loads. In case of overload, the motor itself is protected by a circuit breaker. The gearbox travel is limited by two microswitches mounted on top of the unit. Three green lights are illuminated by microswitches on each gear side/drag stay when these are in the down and locked position and a single red 'gear in transit' light comes on whenever the gear is neither locked down or fully up as sensed by the gearbox mounted microswitch. Manual operation of the gearbox is possible by use of a stowable handle in the cockpit. This caters for a failure of the electric motor only and depends upon the mechanical integrity of the system to be effective. The linkage to the nose gear is shown in diagrammatic form in Figure 1.

Aircraft Examination

Examination of the aircraft quickly revealed that failures had occurred to the upper and lower lugs of an idler lever, Pt No 0842102-497, which supports the junction of the two push/pull rods which transmit the drive from the gearbox forward to the nose gear mechanism. This lever is located between the cabin floor and the fuselage skin and cannot be inspected without removing the front seats, trim and some floor panels. Specifically the lugs had failed through the attachment hole for the aftmost rod end bearing, Figure 2; the lugs associated with the other rod being intact.. Close examination of the failures revealed both to have been as a result of overload. However, deformation and the extent of wear and frettage patterns associated with the upper lug, rod end and particularly the attachment bolt suggested that the failure of the lower lug had occurred some time before the upper lug, probably during a previous flight. A wear /frettage step in the shank of the attachment bolt caused by the inner race being loaded assymetrically during gear operation after the failure of the lower lug, Figure 3, is shown in Figure 4.

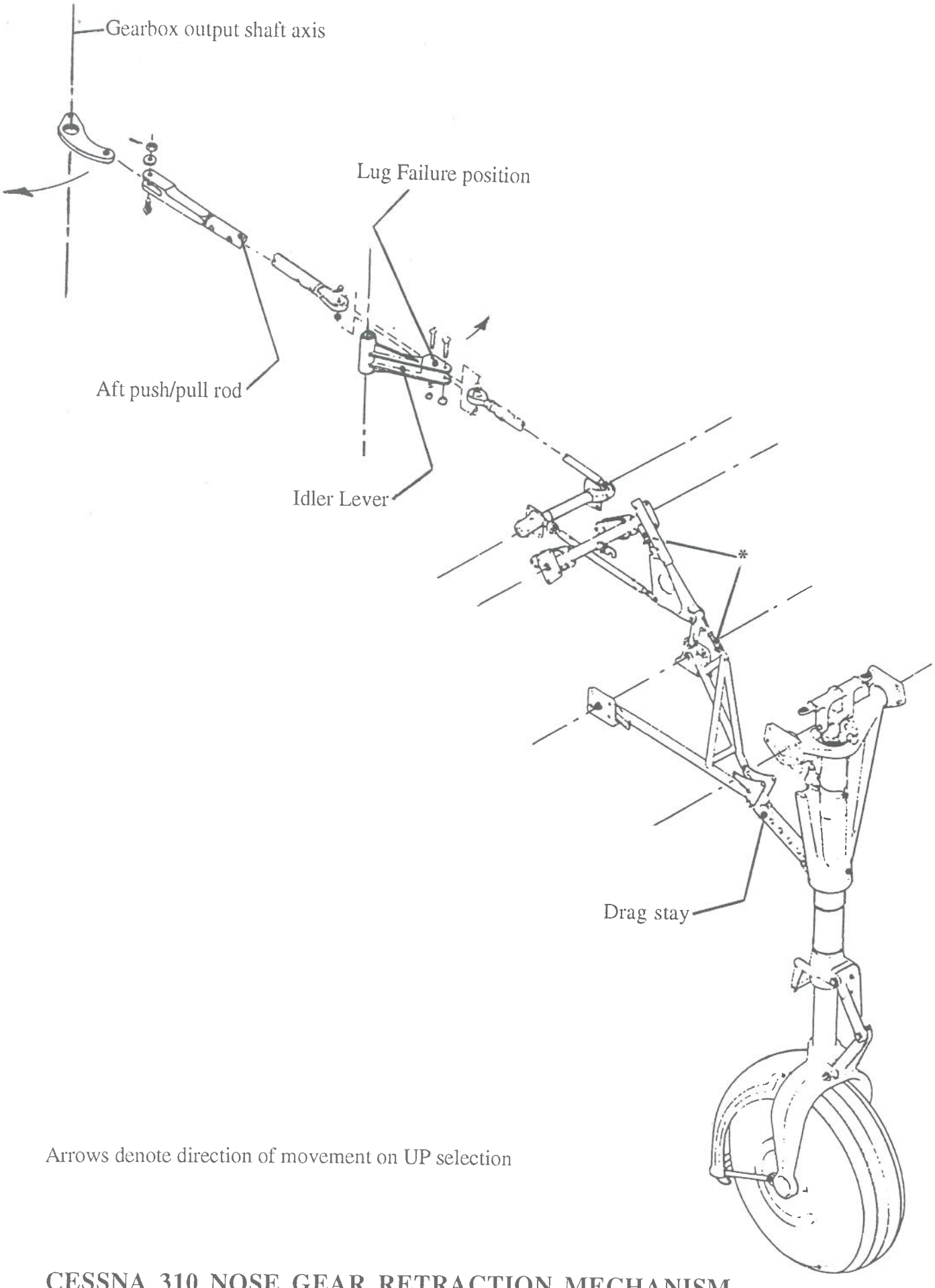
Maintenance History

The aircraft most recently underwent a 150 check some 60 days, 43 flights, prior to the accident, in accordance with the CAA/LAMS FW/1978 iss 2 maintenance schedule. At that time the maintenance organisation noticed when carrying out a functional check of the landing gear that the nose gear doors remained partially open and the gear slightly extended with the system selected to up. Adjustments made to the rigging of the mechanism, at two points marked * in Figure 1, in accordance with the maintenance manual appeared to resolve this problem and the aircraft was released back into service. As no reason was reported at the time why the rigging might have altered since the previous retraction check it is possible that the lower lug of the idler lever was already broken at this time, effectively lengthening the push/pull rod a small amount and thereby precluding the nose gear from travelling far enough to lock up.

Type History

Since 1976 nine incidents/accidents have been identified involving nose gear operating mechanism failures on Cessna 310 aircraft on the UK register. Approximately half of these were associated with failure of the lugs on the subject idler lever, the remainder being associated with failure or distortion elsewhere in the mechanism. All these failures seem to have been precipitated by either a stiff linkage or fouling between the nosewheel and nose gear bay in the latter stages of retraction, thereby allowing the retraction gearbox to develop excessively high loads in the linkage. The former is due to inadequate lubrication of the many bearings in the system, the latter to the nose oleo strut failing to fully extend. In the past this has been attributed to low inflation pressure or high seal friction, effects often attributed to infrequent use. The most recent incident occurred on Cessna 310Q G-BBXL in July 1989 where it was reported that one lug of the idler lever 'may have been faulty for some time'.

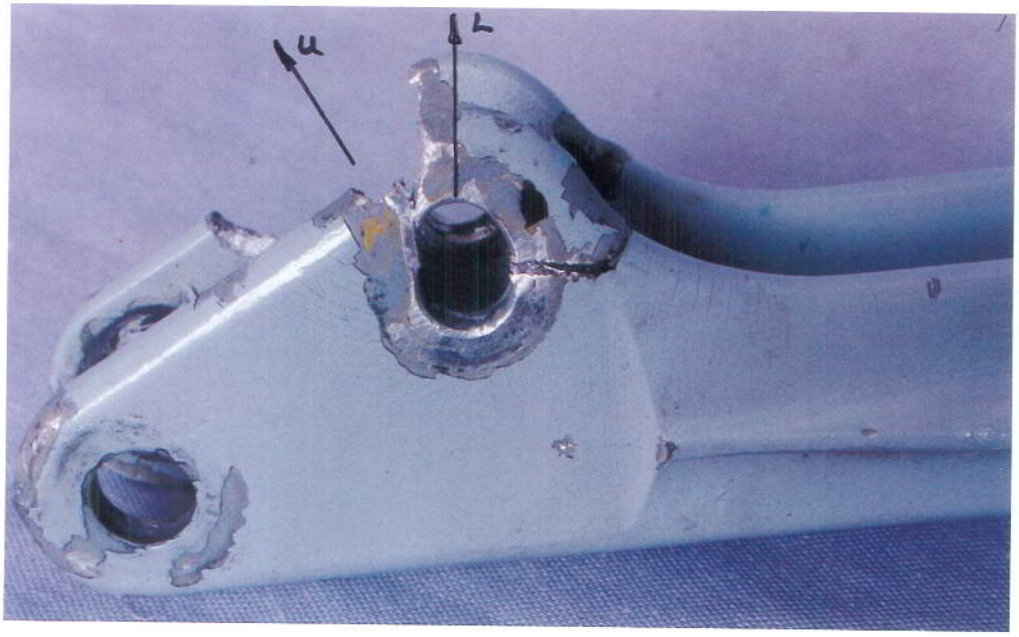
When G-BBHG was examined there were no signs of any foreign object damage, the mechanism itself was reported to have been reasonably free to operate and the oleo strut appeared to be correctly inflated. However, any relevant abnormalities discovered during repairs to the aircraft will be reported upon in a future edition of the AAIB Bulletin.



Arrows denote direction of movement on UP selection

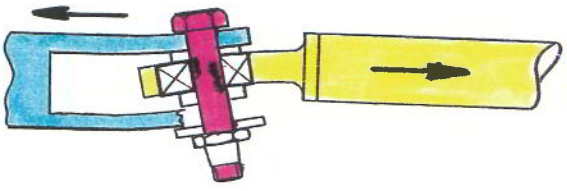
CESSNA 310 NOSE GEAR RETRACTION MECHANISM

Figure 1



Arrows indicate directions of upper and lower lug failures

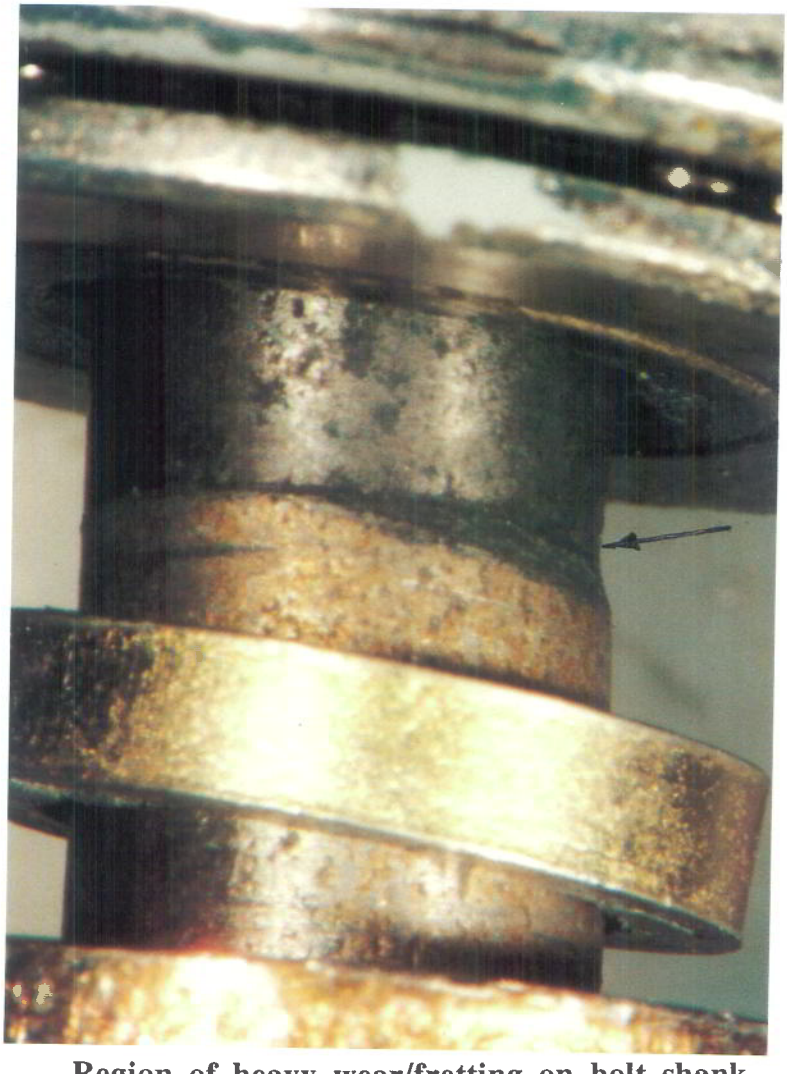
Figure 2



Working configration of joint after failure of lower lug

Arrows indicate load transfer during gear retraction

Figure 3



Region of heavy wear/fretting on bolt shank

Figure 4