Piper PA-34-200 Seneca, G-EMER

AAIB Bulletin No: 10/2004	Ref: EW/G2004/06/23	Category: 1.3
Aircraft Type and Registration:	Piper PA-34-200 Seneca, G-EMER	
No & Type of Engines:	2 Lycoming IO-360-C1E6	
Year of Manufacture:	1973	
Date & Time (UTC):	29 June 2004 at 0950 hrs	
Location:	Old Sarum Airfield, Salisbury, Wiltshire	
Type of Flight:	Training	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damage to both propellers, nose landing gear and nose cone	
Commander's Licence:	Licence not required (see below)	
Commander's Age:	59 years	
Commander's Flying Experience:	5,695 hours (of which 22 were on type)	
	Last 90 days - 27 hours	
	Last 28 days - 10 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further AAIB enquiries	

Synopsis

After takeoff and selection of gear UP, a gear unsafe warning occurred. The landing gear was selected DOWN but the nose landing gear continued to indicate an unsafe condition. An attempt was made to lock the nose landing gear down by carrying out a touch and go on the main landing gear only. However, during the touch and go the pilot was unable to prevent the aircraft from pitching nose down, causing the unlocked nose landing gear to collapse and the propellers to strike the grass runway surface. Examination of the nose landing gear assembly showed that a failed bracket had allowed the upper end of the nose landing gear leg to leave a guide track, making it impossible for the leg to be locked in either the down or up position.

Commander's Licence

Article 21 of *'The Air Navigation Order 2000'* states that a person may act as a member of the flight crew of an aircraft registered in the United Kingdom without being the holder of an appropriate licence if, in so doing, he is acting in the course of his duty as a member of any of Her Majesty's naval, military or air forces. The commander of G-EMER was a Royal Air Force Officer on duty.

History of the Flight

The pilot conducted a thorough pre-flight check, including a visual inspection of the nose landing gear bay; 'full and free' movement of the rudder pedals and normal nose wheel steering was confirmed during taxiing. The takeoff proceeded normally until the landing gear was selected UP after takeoff. The red 'gear unsafe' light remained illuminated, indicating that the landing gear remained in transition between the down and locked position and the full up position. The pilot selected the gear DOWN, which was in accordance with the Pilots' Operating Handbook, and achieved two green 'down and locked' lights for the main landing gear but no light for the nose landing gear. The red 'gear unsafe' light remained illuminated, indicating that the problem was with the nose landing gear.

The pilot reported the situation to Old Sarum Radio and carried out the checklist action for manual extension of the landing gear. This involved activating the emergency gear extension system, which removes hydraulic pressure to the system and allows the gear to free-fall to the down and locked position. However, the cockpit indications remained unchanged. The pilot also changed indicator light bulbs, applied increased positive 'g' and side-slipped the aircraft, none of which improved the situation.

Witnesses on the ground were able to see that the nose leg was only partially extended, being some 15 to 20 degrees short of the fully extended position. It was also apparent to some witnesses that the nose wheel was at an angle to the aircraft centre line, as if nose wheel steering was being applied. The position of the nose landing gear on the Seneca aircraft can be visually confirmed by the pilot using a convex mirror mounted on the left engine nacelle. In this case, the gear was visible in the mirror but it was not possible to determine the exact state of extension or whether the nose wheel was centred.

After discussing the situation by radio with the club personnel, the pilot decided to attempt to jolt the nose landing gear to the down and locked position by carrying out a touch and go on the main landing gear only. The intention, if this did not lock the leg down, would then be to carry out an asymmetric approach, shutting down the remaining engine during the landing flare.

The approach was made to Runway 24 at Old Sarum, which was a grass runway of 2,558 foot length. The weather was fine, with a surface wind from 240°(M) at 10 kt. Although a firm landing was intended, in fact the touchdown was quite gentle. As the pilot applied power the aircraft started to pitch nose down, despite the application of full aft yoke, causing the unlocked nose landing gear to contact the surface. As the nose leg retracted further, the aircraft nose and both propellers also contacted the surface. The deceleration was quite smooth and the aircraft came to rest centrally on the runway, approximately 1,000 feet from the touchdown point. There was no fire and the uninjured pilot was able to vacate the aircraft without assistance. The aircraft sustained damage to the nose cone, nose landing gear assembly and both propellers.

Description of the nose landing gear

The nose landing gear of the Seneca is of the forward retracting type which, when extended, has the wheel axle forward of the oleo pivot. When retracted, the gear is held up by hydraulic pressure in the actuator and, when extended, it is held in the down position by a geometric downlock mechanism. There are no locking hooks for either position.

Since the gear is held up by hydraulic pressure gear extension can be accomplished in the event of a hydraulic failure. If the pressure is relieved for any reason, gravity will cause the gear to extend. Aerodynamic loads and springs assist in locking the gear down. Once the nose gear has started towards the down position, the airflow pushes against it and assists in moving it to the down and locked position. Thus if the hydraulic pump fails with the gear not in the down and locked position, it is necessary only to relieve the hydraulic pressure. An emergency gear extension knob, located near the centre of the instrument panel, is provided for this purpose. Pulling this knob releases the hydraulic pressure holding the gear in the UP position, allowing it to fall free.

Mounted on the upper end of the nose leg is a tiller assembly, attached to which is a roller assembly. This roller sits within a curved track which it follows as the gear leg is raised (see Figure 1).

Figure 1 Nose landing gear - general arrangement

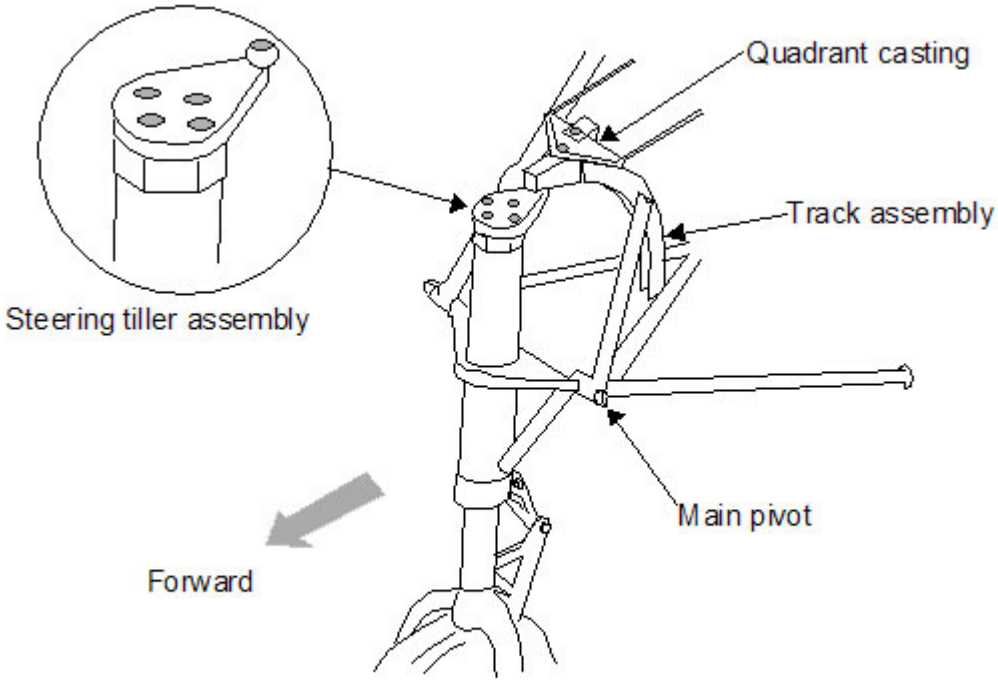

Figure 1 Nose landing gear - general arrangement

The track assembly itself is made up of two sections. The lower section is fixed to the aircraft structure, whilst the upper section is attached to a hinged quadrant casting, to allow for nose wheel steering. This quadrant is attached by cables to the steering arm. With the gear locked down, the roller assembly remains within the upper hinged section of track, movement of which is transmitted to the nose wheel from the quadrant via the tiller. As the nose landing gear starts to retract, the nose wheel and tiller is centred automatically, and the hinged and fixed sections of track line up, allowing the roller assembly to follow the track as the nose leg retracts.

The quadrant and associated section of track pivot laterally about a bolt that passes through a U-bracket. This bracket is welded to a section of frame within the nose landing gear bay.

Aircraft examination

Inspection of the nose landing gear assembly showed that the lower arm of the U-bracket had fractured, allowing the quadrant casting and the upper section of track to pivot upwards (see Figure 2). This in turn placed bending loads on the upper arm of the U-bracket that showed initial signs of failure as a result of these loads. The two fracture faces had suffered significant abrasion and it was not possible to determine the reason for the fracture.

Figure 2 Quadrant Assembly - side view

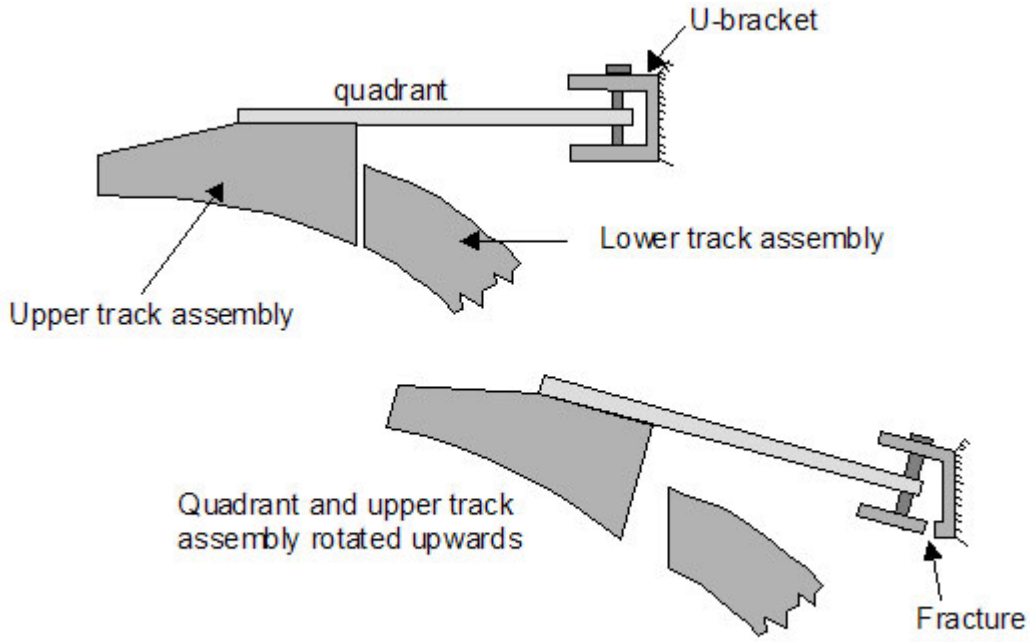

Figure 2 Quadrant assembly - side view

The roller assembly, which would normally be captive within the track assembly, was found to be out of the track, and against the outer side of the track mounting.

Analysis

With the quadrant and the hinged section of track able to pivot upwards, a larger than normal gap formed in the channel of the curved track assembly. With the nose landing gear down and locked, this had no effect, as the roller assembly was still captive within the upper track section, which was still able to transmit steering commands to the nose wheel via the tiller. However, as the nose leg commenced retraction, the roller assembly moved along the track until it encountered the gap, at which point it left the channel and continued aft and down in contact with the outside of the track mounting. The leg continued to retract until, still short of the fully up position, the loads associated with the abnormal condition of the leg could no longer be overcome by the hydraulic actuator.

When the gear was selected DOWN, the actuator was able to rotate the leg towards the down position, but the roller assembly stayed on the outside of the track mounting. Again, a point came when the actuator could not overcome the resistance, at which time the leg was between 15 and 20 degrees from the down and locked position.

With the leg outside the track, the roller assembly was displaced from the aircraft centreline as it would be if a steering command had been transmitted to the quadrant casting. This was the cause of the nose wheel deflection seen by some observers on the ground.

The location of the failed U-bracket in the nose bay was such that the failure could not have been detected during the pilot's pre-flight inspection. Once the nose leg roller assembly had left the track, there was no action that the pilot could have taken to lock the nose gear down.

Conclusion

The accident was caused by the failure of the U-bracket which allowed the nose landing gear roller assembly to leave the guide track, making it impossible to lock the nose landing gear down.