ACCIDENT

Aircraft Type and Registration:	Raj Hamsa X'Air 133(1), G-CDHO
No & type of Engines:	1 Verner 133M piston engine
Year of Manufacture:	2005
Date & Time (UTC):	17 June 2006 at 1500 hrs
Location:	Near Tilbury Docks, Essex
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Engine magneto failure and damage to propeller
Commander's Licence:	Private Pilot's Licence
Commander's Age:	37 years
Commander's Flying Experience:	275 hours (of which 33 were on type) Last 90 days - 21 hours Last 28 days - 4 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and follow-up AAIB investigation

Synopsis

When close to Tilbury Docks, during a training flight, the magneto rotor separated from the engine, damaging the propeller and causing the engine to stop. The instructor carried out an uneventful forced landing in a field adjacent to the River Thames. The magneto separation was due to the failure of the crankshaft stub shaft, from crack propagation due to a torsional fatigue mechanism. Damage to the magneto coil formers indicated that the rotor had been operating out of alignment, increasing the torsional loads within the shaft. The cause of the misalignment was probably due to an impact on the magneto rotor, during engine handling, at some point between a workshop visit in July 2005 and re-installation of the engine.

History of the flight

The aircraft was being used for an instructional flight, with the owner under the tuition of a qualified instructor. It was operating in an area close to the north bank of the River Thames, near Tilbury Docks. With the aircraft at a high angle of attack and the engine at maximum speed, the magneto rotor separated from the engine and passed through the rotating propeller, severely damaging both blades. The instructor manoeuvred the aircraft into the gliding attitude and carried out an uneventful forced landing in a large field adjacent to the river. With the exception of the engine and propeller, the aircraft was undamaged and neither occupant was injured. After recovery, the fuselage was taken to the AAIB to allow the engine to be removed and stripped for investigation; the magneto rotor was not recovered.

Engine examination

The aircraft, a Raj Hamsa X'Air microlight, was constructed in 2004 and purchased by the present owner in February 2006. It was powered by a Verner 133M two-cylinder, horizontally opposed engine, manufactured in the Czech Republic and mounted above and ahead of the cockpit. At the time of the incident, the airframe and engine had a total time of approximately 43 hours.

Engine history

A review of the engine and airframe log book showed that the engine had been installed in January 2005 and had completed its post installation runs satisfactorily. In July 2005, with no further recorded operation, it was then removed and returned to the manufacturer for the crankshaft (including the stub shaft) to be replaced. This was because the manufacturer had identified this engine as one of a batch where the crankshafts had been produced from steel of a higher than normal sulphur content. Subsequently, after a total of 20 hours of operation, two cylinder head studs pulled from the crankcase, which required their replacement. Twenty-one hours after that event, several other cylinder studs pulled out which also required replacement. The engine manufacturer's UK agent confirmed that, on both occasions, the cylinder head studs were replaced without removing the engine from the airframe. The engine then operated for approximately two hours prior to the failure of the magneto rotor.

Magneto description

The magneto on the Verner 133M engine is located on the front of the engine, immediately below the propeller shaft. It consists of eight primary and two secondary coils secured to the front of the gearbox casing (Figure 1). Magnets are secured to the inside of a rotating casing which covers the entire assembly. The casing is bolted to a steel stub shaft, pressed into the forward end of the crankshaft, which passes through the centre of the coils, (Figure 2).

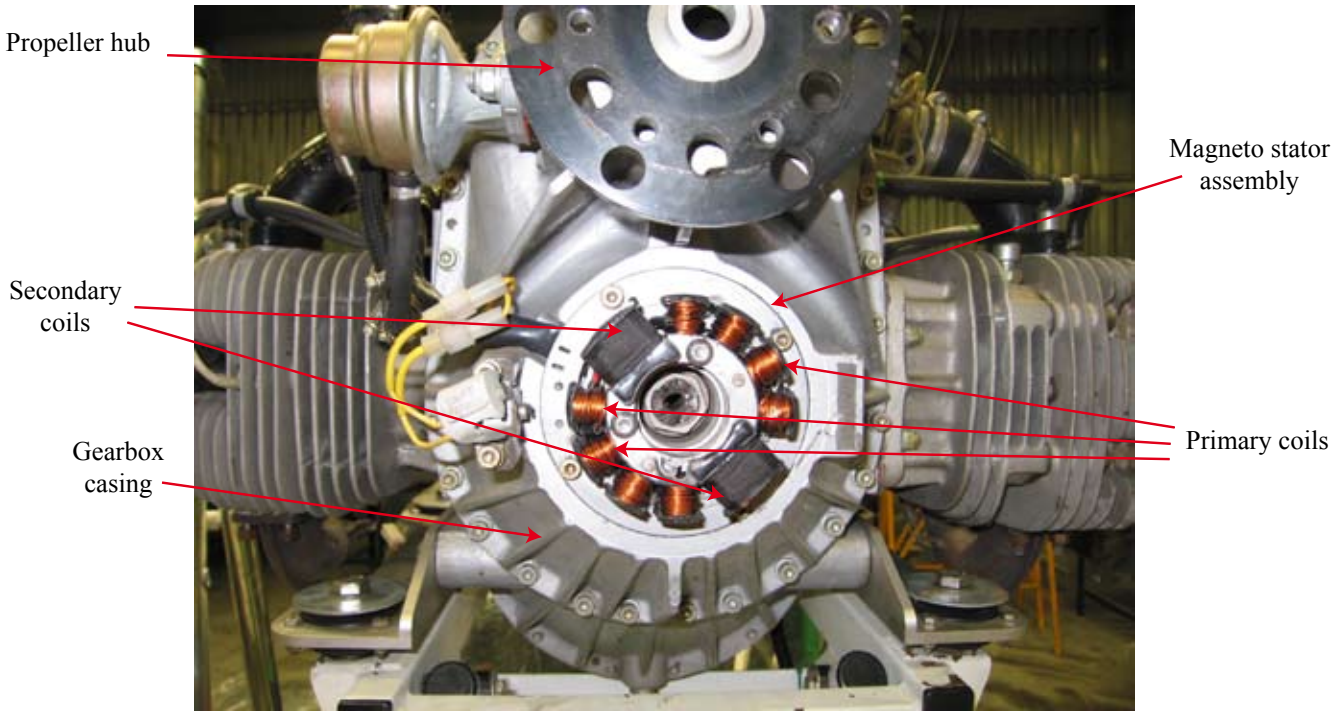

Figure 1

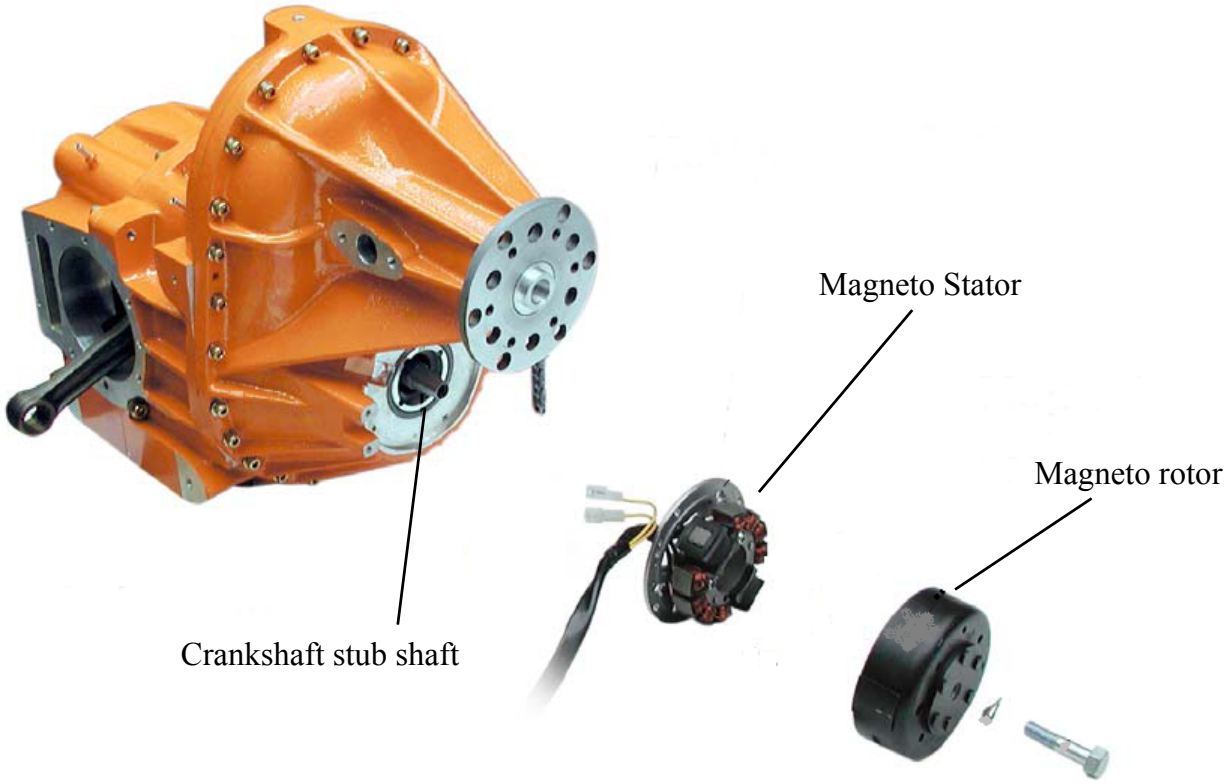

Figure 2

Stub shaft examination

Examination of the engine identified that the release of the magneto rotor resulted from the failure of the stub shaft. The magneto coils showed evidence of uneven and heavy rubbing to the end of the coil formers, indicating that the magneto rotor had been operating out-of-alignment prior to the failure, (Figure 3). Metallurgical examination of the stub shaft fracture surface revealed the presence of a pre-existing crack, which had propagated by a torsional fatigue mechanism, across 65% of its cross-sectional area, before failing in overload. Mechanical damage to the fracture surface precluded an estimation of the number of stress cycles experienced prior to failure, or positive identification of crack initiation site(s). No material abnormalities or inclusions were identified in the fracture surface.

Engine examination

Examination of the engine prior to removal, showed evidence of impact damage to a stiffening rib on the gearbox casing, at the 6 o'clock position (Figure 4). The condition of the rib indicated that it had been damaged for some time and was unlikely to have been caused when the magneto rotor separated from the engine. When placed on a work surface, the balance of the engine caused it to tip forward, where it came to rest on the damaged stiffening rib. Measurements confirmed that, had the magneto rotor been in place, it would have made contact with the work surface before the stiffening rib.

Analysis

In normal operation, the torsional loading of the stub shaft is low and would be unlikely to be of sufficient

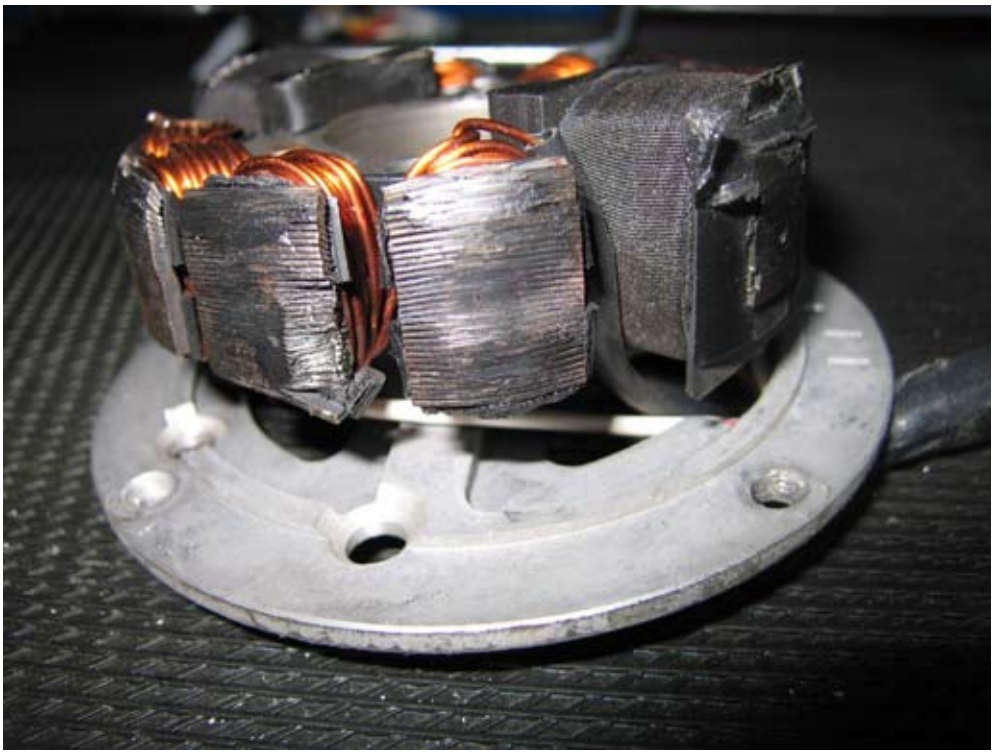

Figure 3 (left)
Damage to stator formers

Figure 4 (right)
Damaged stiffening rib

magnitude to cause crack initiation or progression in the shaft. The damage to the magneto coil formers indicated that the rotor had been sufficiently out of alignment, prior to the failure, to make contact with the formers whilst rotating. This would have significantly increased the torsional loads within the shaft and, most likely, both precipitated and propagated the crack.

When installed in the X'Air, the engine is approximately six feet above the ground and the magneto rotor is partially shielded by the propeller, which should protect it from inadvertent damage. However, whenever the engine is removed, the position of the magneto rotor makes it vulnerable to handling damage. Any impact on the magneto rotor has the potential to distort the stub shaft and allow the rotor to make contact with the coil formers.

Conclusions

The magneto rotor was released as a result of failure of the crankshaft stub shaft, which had failed due to crack progression from a torsional fatigue mechanism. The torsional loading on the shaft was likely to have been increased as a result of the magneto rotor being sufficiently out of alignment to make contact, when operating, with the coil formers. The damage to the gearbox stiffening rib indicated that the engine had probably been allowed to tip forward at some point when being handled 'off-wing', possibly causing a slight distortion to the stub shaft. As a new crankshaft, including the stub shaft, had been installed by the manufacturer in July 2005, and the engine had not been removed again until this incident, it is likely that the stub shaft became damaged at some time between the workshop visit and completion of the re-installation process.

Follow up action

The manufacturer has stated that they are aware of one previous loss of a magneto rotor, which they confirmed to be the result of an engine being allowed to tip forward during handling, distorting the stub shaft. They have since introduced a modification to fit a guard to protect the magneto from such damage.