Piper PA-34-200T, G-BHFH

AAIB Bulletin No: 9/99 Ref: EW/C99/4/8/01 Category: 1.3

Aircraft Type and Registration:	Piper PA-34-200T, G-BHFH
No & Type of Engines:	2 Continental LTSIO-360-EB1B piston engines
Year of Manufacture:	1979
Date & Time (UTC):	11 April 1999 at 1545 hrs
Location:	Bembridge Airport, Isle of Wight
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers -1 + 2 dogs
Injuries:	Crew - None - Passengers - None
Nature of Damage:	Heat damage to GRP nosecone, burning/melting of nose-leg/battery cover panel, heat damage to electrical and hydraulic components within forward baggage bay, destruction of battery
Commander's Licence:	Private Pilot's Licence with IMC Rating
Commander's Age:	42 years
Commander's Flying Experience:	341 hours (of which 10 were on type)
	Last 90 days - 13 hours
	Last 28 days - 5 hours
Information Source:	Field Investigation

The accident

The pilot reported that after selecting gear-down on arrival at Bembridge, he was unable to obtain any green landing gear indications. The nosewheel could be seen to be correctly positioned by viewing in the mirror mounted on the No 1 engine nacelle. A fly-past of the tower was carried out and observers noted that all three units appeared to be correctly extended. An uneventful landing was carried out, soon after which it was noted that the 3 green lights were illuminated.

During the engine start-up for the return flight, the right engine was started successfully but four unsuccessful attempts were made to start the left engine.

A strong smell of burning was then noted, followed by entry of smoke into the cabin. Simultaneously, smoke and flames were seen by external observers in the region of the nose of the

aircraft. The pilot shut down the aircraft and ordered an evacuation, whilst the pilot of another aircraft tackled the fire with his own extinguisher. The pilot of the subject aeroplane then also used his extinguisher.

Initial examination

On examination, access was gained to the interior of the nosecone area via the baggage compartment door, and it was clear that considerable heat and smoke damage was present within the baggage hold.

Description of relevant parts of aircraft

Aircraft of the PA 34 series have a fixed GRP nose fairing which also forms the structural boundary of the forward baggage hold. The hold is accessed via a hinged door on the left side of the fairing. The fairing also houses the bay for the retracted nosewheel, the aircraft battery bay, the power pack for landing gear operation and a number of other aircraft systems components. The upper boundary of the nosewheel bay is a complex shaped removable panel of plastic material separating the bay from the baggage hold. The battery is situated forward of the nosewheel bay near the forward end of the nose fairing. The shaped panel covering the nosewheel bay extends forward to form the top cover for the battery compartment.

Detailed examination

The landing gear /battery bay cover was found to be largely burnt/melted, so that the ground beneath the aircraft was visible from within the baggage hold. The forward section of the cover was also largely melted/burnt and its remains were lying on top of the battery.

On removal of the battery, it was clear that the unit was severely heat damaged, the upper part being largely melted, such that the plates in a number of cells were visible. Damage between cells was such that the individual volumes of electrolyte were no longer separated.

The battery was subjected to a detailed examination by the AAIB in conjunction with the technical department of an aircraft battery manufacturer. It was noted that the lower part of the battery case was not distorted and the recovered electrolyte, although containing suspended fragments of black material, was otherwise clear. Previous instances of internal battery failure have normally resulted in bulging of the main casing and discoloration/opaqueness of the electrolyte.

The battery top at the negative end was not seriously damaged whilst over the remaining 5 cells the lid material was melted and burnt, being most affected at the positive end. The vent stoppers and rope handle were absent from the battery top and are presumed to have been burnt/melted.

The top-lead straps were visible through the melted top at the front of cells 1 to 5 and did not appear damaged or distorted. The top edges of the plates visible in some of the cells also appeared undamaged. Part of the positive terminal (the wing nut and stud) was attached to the flat braided aircraft connector but was separated from the battery.

A voltage check carried out after removal of electrolyte revealed that a potential difference of approximately 9 volts still existed across the whole battery, further indicating that an internal failure had not occurred.

There was little doubt from the examination that considerable heat had been present in the region of the positive terminal. A high resistance in this area accompanied by extensive engine cranking would have resulted in considerable heating with the risk of ignition of adjacent combustible materials or possibly of any residual hydrogen gas generated during charging of the battery after the first engine was stated (if sufficient running time took place between the first engine start and the final cranking of the second engine.)

Background information

Past problems have been encountered with terminals and connections of this class of battery such that the CAA issued an Airworthiness Notice on the subject, No 12 Appendix 44, on 12 November 1990. This was subsequently withdrawn and replaced by leaflet 11 to 12 Appendix 24-5 of CAAIP. The leaflet also makes reference to the FAA General Aviation Airworthiness Alert no AC 43-16.

The CAA documentation notes that batteries from a number of manufacturers are of generally similar construction to the type installed in G-BHFH at the time of the fire. At least one incident has occurred in the past in which damage similar to that observed by the AAIB on G-BHFH has resulted. The quoted FAA Alert includes the following advice:

a. Ensure that before installing any battery into an aircraft, it is the correct model for the installation.
b. Inspect the battery terminal and stud. If it is at all loose or deformed, it should not be installed.
c. Ensure that the battery cable terminal is clean and free from corrosion, oxidation and contamination.
d. Ensure that the battery cable terminal fits correctly on the terminal.
e. Ensure the battery terminal post wing nut is correctly tightened (it should not be possible to move the terminal lug by hand).

Caution: Do not over-tighten the terminal post wing nut. Over-tightening may result in deformation of the terminal post material which will eventually result in the terminal becoming loose in service.

Previous work on aircraft

It is known that the aircraft was subjected to an investigation of landing gear operation shortly before the flight to Bembridge; the landing gear circuit breaker reportedly 'popping' on lowering of the gear. The licenced engineer who carried out this investigation stated that it simply involved jacking the aircraft and functionally checking the gear. He stated that the battery was not disconnected and during operation the system functioned correctly. The documentation does not indicate that any cable disconnection or system rectification took place.

Analysis

The reason for the problem encountered with the landing-gear indication on arrival at Bembridge could not be determined.

The precise reason for the overheating of the positive battery terminal area is also not known. Any shortfalls of good contact owing to a loose terminal in the battery, corrosion/contamination of contact surfaces or an insufficiently tightened wing-nut (ie deficiencies implied by the advice

quoted in items (b), (c) or (e) above from the CAAIP) would be a reasonable explanation for the onset of the problem.

Since the battery was installed a significant time before the fire, it is reasonable to assume that at some time poor contact at the positive terminal, present for one of the above reasons, led to a degree of overheating during each subsequent engine start, which further progressively degraded the overall contact. The terminal takes the form of an inverted, tinned steel bolt with its head cast into the lead of the terminal post and the threaded portion protruding above the battery giving the appearance of a stud. If the bolt becomes hot, softening of the encapsulating lead readily occurs, reducing the quality of electrical contact between the lead and the bolt head. This further increases overall resistance and hence creates additional heating. Eventually, arcing can occur generating still higher temperatures which can lead to ignition of combustible substances if current flow is not interrupted first, either by a complete open circuit condition or by voluntary cessation of engine starting attempts.