

Beech 200 Super Kingair, G-ROWN

AAIB Bulletin No: 3/2004	Ref: EW/G2003/08/11	Category: 1.2
Aircraft Type and Registration:	Beech 200 Super Kingair, G-ROWN	
No & Type of Engines:	2 Pratt & Whitney PT6A-41 turboprop engines	
Year of Manufacture:	1980	
Date & Time (UTC):	5 August 2003 at 1444 hrs	
Location:	Biggin Hill Airport, Kent	
Type of Flight:	Private	
Persons on Board:	Crew - 2	Passengers - 2
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Damage to fuselage underside, nacelles and flaps	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	46 years	
Commander's Flying Experience:	3,906 hours (of which 150 were on type)	
	Last 90 days - 106 hours	
	Last 28 days - 34 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional enquiries by the AAIB	

History of the flight

After take off from Biggin Hill the pilot executed the normal after take-off checks; these involved selecting the landing gear UP, taxi light OFF and yaw damper ON. As he was about to ask the pilot's assistant to read the after take-off checklist ATC informed him that his landing gear was still down. Looking down, he noticed that the selector handle was in the UP position and the 'Gear Unsafe' red light in the handle knob was illuminated. The pilot could not recall the status of the three green 'Gear down and locked' lights. A visual check indicated that the main landing gear (MLG) legs were still down.

He states that he then selected the gear DOWN to recycle the landing gear but was subsequently unable to select gear UP. Suspecting that the nose landing gear (NLG) might not be locked down, he returned to the airfield where a fly-past of the control tower elicited the information that all three legs appeared to be down; the pilot decided to land from the next circuit. On landing the aircraft rolled straight along the runway for a while before it veered to the left and stopped. Realising that the landing gear had collapsed, the pilot shut-down the engines, switched-off the electrical master switch and activated the fuel firewall shut-off valves before evacuating the aircraft, together with the other occupants, through the main entry door.

Description of the landing gear system

The tricycle landing gear is operated by an electric motor and gearbox assembly located on the forward face of the main spar under the cabin floor. The screw-jack type, main gear actuators are driven by torque shafts from the motor gearbox, and the nose gear actuator is driven by a chain from the gearbox torque shaft. Mechanical down-locks are provided by notched hook and plate attachments on the main gear drag braces, with an 'over centre' action on the nose gear drag brace.

The electric motor is a split-field, series wound unit. One field drives the motor in the gear UP direction and the other drives the motor in the gear DOWN direction. A motor control relay box controls the energising of the motor field windings. To prevent over travel of the landing gear, a dynamic brake relay within the relay box simultaneously breaks the power circuit to the motor winding in use and makes a complete circuit through the armature and the unused field winding. This causes the motor to act as a 'generator' and the resultant electrical load on the armature stops the gear almost instantly. The dynamic brake relay is activated by the 'landing gear UP' and 'landing gear DOWN' limit micro-switches, which are operated by cams on the motor gearbox.

The power supply for the landing gear control relays is supplied through a 5 amp circuit breaker (c/b) located to the left of the landing gear selector handle. Power to the electric motor is fed through a 60 amp c/b located beneath the cabin floor, next to the motor and gearbox assembly. (Note: this can not be readily checked during flight.)

In order to prevent inadvertent landing gear UP selection on the ground, a safety switch (squat switch) is located on the right hand landing gear torque linkage. This prevents the motor from running in the UP direction whilst the aircraft is on the ground with the oleos compressed. Additional protection is provided by a spring-loaded hook, or latch, that covers the selector handle whilst it is the DOWN position when the aircraft is on the ground. The latch is withdrawn by a solenoid after the aircraft becomes airborne (ie no weight on the wheels), when the squat switch connects the solenoid coil to earth.

Post-accident examination

Examination of the aircraft after its recovery showed that all three landing gears had collapsed, however, the NLG had remained sufficiently extended to keep the propellers clear of the ground whilst the MLG had almost completely retracted, resulting in severe abrasive damage to the rear fuselage underside skin and frames, flaps and the nacelles.

The MLG actuator attachment fittings showed that they had taken the aircraft's weight, causing failure as a consequence and therefore the MLG was not locked at touchdown or had become unlocked during the landing roll. The 60 amp motor c/b was also found to be tripped but the 5 amp landing gear control c/b was not. The maintenance organisation noted that the emergency mechanical extension mechanism moved freely but, due to the damage, could not wind-down the landing gears which had to be pulled down by hand and locked before the aircraft was towed to a hangar. It was noted that the landing gear selector was in the DOWN position.

Previous similar occurrences

In June 2001 another Beech 200 aircraft, registration G-BPPM, suffered an 'uncommanded retraction' on landing following a failure of the landing gear to retract after takeoff. This accident is reported in AAIB Bulletin 1/2002, which noted an intermittent operation of the left MLG squat switch as being the probable reason for the failure to retract. The uncommanded retraction during the landing roll was more difficult to understand unless it is postulated that the crew forgot to place the landing gear selector lever in the DOWN position when landing, in which case the same intermittent squat switch operation, perhaps triggered by the landing jolt, could have erroneously fooled the system into believing the aircraft was airborne and permitted retraction. The report noted that a previous occurrence of this nature had been experienced in Australia.

As a consequence, the operator had amended their Operations Manual to include a procedure for 'failure to retract' which included checking that the selector lever was down and isolating the landing gear control circuit breaker before using the emergency extension mechanism to ensure 'three greens' prior to landing. They also instituted a policy of replacement of the squat switches at landing gear overhaul (they were 'on-condition' according to the manufacturer's maintenance schedule).

Discussion

In the case of G-ROWN, it would appear that there was an electrical problem, which prevented the gear from retracting fully but this had occurred after the downlocks had been unlocked. The amount of physical movement of the legs was clearly small enough to give the impression to the pilot and observers on the ground that the gear was fully down. However, the 'Gear Unsafe' red warning light and the lack of confirmation of the three green lights in the cockpit suggested that it was not. In any event, the correct procedure when faced with this eventuality was to select the landing gear down again and, if 'three greens' were not obtained, to isolate the landing gear c/b before activating the emergency gear extension, manual crank mechanism, until they were obtained. The pilot omitted to follow this procedure. His assertion that he was prevented from selecting UP when he wished to re-cycle the gear would seem to point to a problem in the squat switch but, for reasons discussed below, this does not fit with the failure logic.

The discovery of the tripped 60 amp c/b appears to indicate that the motor had tried to complete the extension cycle against the weight of the aircraft on the unlocked legs after touchdown, assuming that there was no internal fault in the motor itself which had caused the trip. This could not be due to an intermittent squat switch as postulated for G-BPPM because it would not prevent gear extension unless, of course, the pilot had also forgotten to place the selector in the DOWN position as occurred in the Australian incident. Thus suspicion would fall on the various relays and limit switches described above which control power to the motor but unfortunately, at the time of writing, the maintenance company has commenced work on structural repair of the aircraft and it is not possible to apply power to check the operation of these components. When repair work is complete a thorough check and test of the landing gear system is planned and any findings which explain a malfunction of the gear will be notified in a future issue of the AAIB Bulletin.