# Montgomerie-Bensen B8MR Gyroplane, G-INCH

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| **AAIB Bulletin No: 12/2002** | **Ref: EW/C2002/3/7** | **Category: 2.3** |
| **Aircraft Type and Registration:** | Montgomerie-Bensen B8MR Gyroplane, G-INCH | |
| **No & Type of Engines:** | 1 Rotax 532 piston engine | |
| **Year of Manufacture:** | 1989 | |
| **Date & Time (UTC):** | 23 March 2002 at 1642 hrs | |
| **Location:** | Kirkbride Airfield, Cumbria | |
| **Type of Flight:** | Private | |
| **Persons on Board:** | Crew - 1 | Passengers - N/A |
| **Injuries:** | Crew - Fatal | Passengers - N/A |
| **Nature of Damage:** | Gyroplane destroyed | |
| **Commander's Licence:** | Private Pilots Licence (Gyroplanes) | |
| **Commander's Age:** | 55 years | |
| **Commander's Flying Experience:** | 750 hours of which approximately 50 hours were on type) | |
| | Last 90 days - 1/2 hour | |
| | Last 28 days - 1/2 hour | |
| **Information Source:** | AAIB Field Investigation | |

## Synopsis

After eight months without flying, the pilot made at least two flights in his own gyroplane. During his first flight, he demonstrated a mixture of caution and unwise actions, including a takeoff downwind. On the accident flight shortly after takeoff, G-INCH was seen to climb and enter rolling manoeuvres in both directions, probably at lower than normal airspeed, before crashing on the runway. There was evidence that the rotor blades had contacted the teeter stops during flight. Examination of the machine indicated that it was generally well constructed.

## Background to flight

The pilot was the owner and builder of the gyroplane, which he had built and initially registered in 1989 as G-BRES. He changed the registration in 1991 to G-INCH but the aircraft Permit-to-Fly

(PTF) expired during 1995. In 2001, the pilot contacted the Popular Flying Association (PFA), which has the responsibility for issuing the PTF on behalf of the CAA, with the intention of putting this gyroplane back into the air. Various work needed to be done to G-INCH before a new PTF could be issued. When this had been completed, the PTF was issued by the PFA on 22 May 2001 and this was valid until 21 May 2002.

There was little information about the amount of flying done by the pilot or aircraft up to 2001. In 1988 the pilot had contacted the CAA to apply for a Student Pilot Licence; on his application form, he declared that he had approximately 700 hours flying experience. However, this application was not progressed by the pilot and the CAA had no record of any further licence application until 2001.

In the summer of that year, the pilot commenced training with a CAA licenced gyroplane flying instructor and successfully completed the PPL syllabus; he received his licence from the CAA on 27 June 2001. Thereafter, there is no record of any flying done by him until the day of the accident. On 3 March 2002, he joined the Kirkbride Aero Club. By then, he had moved to accommodation near the airfield and kept his aircraft in a building at his home; he had been working on the aircraft by himself in preparation for some proposed flying at Kirkbride.

**History of flight**

At home, after lunch on 23 March 2002, the pilot loaded G-INCH onto his trailer and he and his partner drove to Kirkbride Airfield. Once there, he unloaded the gyroplane and prepared it for flight. This included refuelling and attaching the rotor blades to the rotor head. During this time, at least two other club members spoke to the pilot and considered that he seemed to be in normal spirits. One of these club members was also the Radio Operator (RO) for the airfield and he was on duty for the two subsequent flights of G-INCH. The pilots partner recalled that he, the pilot, was wearing an orange flying suit and a helmet for the flights. The weather was good with a light westerly surface wind, good visibility and some scattered cloud.

Throughout the afternoon, the RO located in the airfield Tower recorded a total of thirteen flights by various aircraft using Runway 28. He recalled seeing G-INCH taxiing out to the end of Runway 28 and the pilot then carrying out some short hops along the full length of the runway; during these, the aircraft never exceeded an estimated twenty feet above the ground. At the end of the runway, the pilot turned his aircraft and, with a surface wind of approximately 270°/ 10 to 11 kt, took off using Runway 10. This takeoff, at 1515 hrs, appeared uneventful to the RO, although he was surprised that the pilot had taken off with a tailwind. He watched the pilot perform what he described as exuberant manoeuvres once G-INCH was airborne, before it left the area to the west. At 1535 hrs, G-INCH returned, landed on Runway 28 and taxied back to the parking area. The pilot returned to his car and spoke with his partner for a short time; he seemed pleased with his flight and told her that he intended to do one other short flight. He was seen to put more fuel into G-INCH before taxiing back to the runway. There was then some confliction in witness recollections as to whether the accident occurred on the next flight or whether the pilot made a short intervening flight.

Nevertheless, the accident occurred shortly after G-INCH got airborne. The RO stated that he watched the aircraft backtrack down Runway 28 for about 250 metres, saw it turn into wind with the rotors turning and sit for about five or six seconds. He then heard a gradual increase in engine noise; the window in the Tower was open. With the surface wind remaining at 275°/11 kt, the aircraft commenced the take-off and was quickly airborne. Shortly afterwards, it was seen to climb

and then turn to the left with about a 20° angle of bank. Then, at a height of approximately 60 to 70 feet agl, it started a banked turn to the right. It continued to climb to a height of about 100 to 150 feet, but then started a roll to the left and continued this roll until it impacted the runway in what appeared to be an almost inverted attitude; the RO thought that the engine noise was constant until the impact. On impact, the aircraft came to rest immediately and there was no indication of any fire. The RO immediately dialled 999 and saw people rushing towards the scene of the accident.

The pilots partner was sitting in the car, upwind and to the right of Runway 28 and she watched the aircraft as it took off. Her impression was that it seemed as if he was going to turn over sideways and she stated that the plane turned and fell onto the runway. Most other witnesses only heard the aircraft. All commented that the rotor blades appeared to be loaded on successive occasions before the sound of the impact. Most heard the sound of two impacts and two witnesses thought that the noise of the engine stopped before the sound of these impacts. Some of the witnesses were on the scene within a few seconds of the crash. One of these was a retired mortuary technician and he considered that the pilot was dead when the witnesses arrived on the scene. He stated that the pilots helmet was lying on the ground a few feet away.

**Gyroplane information**

In flight, the gyroplane always flies with the rotor operating in autorotation, ie, forces generated by air flowing up through the rotor disc provide the rotational force to keep the blades revolving and hence the lift to keep the gyroplane airborne. The power provided by the engine and propeller overcomes the total drag of the machine and in flight maintains the forward speed that ensures airflow through the rotors. It is normal airmanship for pilots to carry out some short hops, following any period away from flying, to re-familiarise themselves with the control inputs and feel of the machine prior to making a flight.

Instrumentation on most gyroplanes is simple. On G-INCH, the flight instruments comprised an ASI, calibrated in MPH, and an altimeter. For engine monitoring, there was an engine RPM indicator and a water temperature indicator. At the bottom of the instrument panel there was also a Limitation Placard. This included the following operational limitations: Aerobatics prohibited; Maximum AUW of 280 kg; Maximum engine RPM of 6,800; Maximum IAS of 80 MPH (72 kt).

Prior to takeoff, the gyroplane rotor must first achieve a rotor speed sufficient to create the necessary lift. On G-INCH, in common with similar gyroplanes, this is initiated by spinning the blades by hand. The machine is then taxied with the rotor disc tilted aft, to allow airflow through the disc, to accelerate it to flight RPM. Full power is normally used for takeoff to minimise the take-off roll. G-INCH would normally become airborne at about 25 MPH after a ground roll of about 200 metres. Once airborne, the pilot would typically hold the gyroplane level to accelerate to the usual cruise speed of about 50 MPH. The rotor blades react quickly to a change in applied force; rotor speed tends to rise with increased loading and decrease when disc loading is reduced.

Turns are accomplished by tilting the rotor disc using the cyclic control. With the disc tilted laterally, the horizontal component of the rotor lift provides the centripetal force that causes the machine to turn. As with a fixed wing aircraft, increased power is required to maintain speed in a level turn, especially when using steep angles of bank; such turns are normally achieved using a maximum of 30° of bank. Beyond that angle of bank, full power is normally required together with an increase in normal acceleration (g). However, under these conditions and with a relatively low powered engine, airspeed can still decrease. If g is relaxed, the rotor RPM will decrease and a sideslip descent can begin.

## Engineering investigation

G-INCH was a Montgomerie-Bensen B8MR gyroplane with a Rotax 532 twin cylinder two stroke engine driving a three bladed composite Ivoprop pusher propeller of 60 inches diameter. It had a tricycle landing gear and a two bladed Rotordyne rotor with all metal blades and a teetering head.

The first impact mark was made by the red blade tip as it struck the runway, with sufficient energy to make a small hole in the hard surface and to break up the aluminium tip fitting. The blade had been progressively deformed rearwards during the impact. The next ground contact was made by the rear right side of the trike unit, which was travelling in the general direction of the takeoff but facing backwards as it struck the ground, having turned through about 180 degrees. The main impact had been taken by the right wheel and support structure, which was badly broken up, and also by the engine which had absorbed much of the impact. The two impacts were very close, indicating a high bank angle when the rotor struck the ground. The general direction of movement was along the runway in the line of flight, but at a low speed. The rotor mast was deformed into a smooth curve, which suggested that this deformation was caused by transmitted and inertial loadings from the trike unit and rotor, rather than impact directly on the mast. The composite propeller showed extensive breakup and damage, characteristic of high power applied at impact.

The pilot, who had severe head injuries, had been released from his harness after the accident, but his helmet was undamaged and was lying nearby. The helmet strap was found unfastened, but it had not been undone or removed by rescuers, according to witnesses.

More detailed examination carried out at the AAIB facility at Farnborough indicated that the gyroplane appeared, in general, to be properly constructed and assembled. One unusual feature was the pitch trim system springs and their associated bungee cords, which had been installed in an unconventional manner. This would possibly have altered the pitch trim datum but, even so, no serious adverse effect on controllability was considered likely.

The controls were examined for any evidence of malfunction and to try to determine their position at impact. It was not possible to determine such positions, and it is questionable as to what such indications would have meant had it been possible to discover them, due to the nature of the impact. There was, however, no evidence of a control jam or disconnect prior to the accident. An examination of the teeter head and teeter stops revealed positive indications of heavy and repeated contact during flight. Such contact cannot occur during normal flight with normal rotor speed; it can occur when the rotor speed is lower than normal, and/or when the normal g loading is reduced. Once the teetering angle is large enough for the stops to make contact, the rotor dynamics are such that large forces can be generated which are capable of rolling the aircraft over.

Before the accident flight, there had been comments made by the pilot to the effect that he was concerned about possible delamination of the rotor blades at the trailing edges. The aluminium skins of the blades are bonded at the trailing edges, with anti-peel rivets installed at an appropriate spacing. On examination, these rivets along the trailing edges were found to be intact, so that no serious delamination could have occurred in flight. There was some delamination between the anti-peel rivets, but it could not be determined if this had occurred pre- or post- the impact.

## Medical information

A post mortem examination was carried out on the pilot. There was no evidence of any existing medical condition, or toxicological factor, which may have contributed to the accident. The pilots

helmet was one that complied with BS 6685 1985 Type B and was appropriate for gyroplane use. The damage to the helmet indicated that it was being worn at the time of the impact. However, it was considered that the forces experienced by the pilot in the accident were greatly in excess of that which could be attenuated by any helmet shell and liner.

**Discussion**

The weather was suitable for the flight and engineering examination of G-INCH revealed no evidence of any malfunction which may have had a bearing on the accident. Indeed, the workmanship was generally of a high standard. Although two ear witnesses stated that the engine noise appeared to stop shortly before the crash, other witnesses stated that the engine noise continued until the impact. Furthermore, evidence from the crash scene indicated that the engine was producing power up to the point of impact. The anomaly concerning the method of attachment of the pitch trim bungee cords could not be resolved but this should not have had any adverse effect on the flying characteristics of the machine. This view was reinforced by the fact that the machine had just completed at least one apparently uneventful flight.

Evidence from the crash site indicated that the machine was in a high angle of bank at impact and at a high rate of descent. It is likely that the action of the rotor blade striking the ground caused the trike body to further rotate about the blade, before contacting the ground on its right side.

Prior to his first flight, the pilot was seen to carry out some short hops along the runway. Since evidence suggests that he had not flown in G-INCH since completing his PPL course the previous summer, this was a sensible precaution. However, at the end of these manoeuvres he proceeded to carry out a downwind take-off. This would have required a greater than normal groundspeed to generate the required airflow through the rotor for take-off and was not a sensible action. Then, once airborne, the pilot carried out what one witness described as exuberant manoeuvres. While this may have been indicative of someone who was pleased to be airborne after a break of some eight months, it would have been sensible, at least initially, to carry out gentle manoeuvres to ensure the integrity of the machine and to become re-familiarised with the flying characteristics of G-INCH. Nevertheless, the pilot completed an apparently uneventful flight of some 20 minutes. At the completion of this flight, he was in good humour and expressed his intention to complete a further flight. In the absence of any adverse comments from the pilot and in his apparent enjoyment of the flight, it is reasonable to assume that the aircraft was fully serviceable. There was then some confliction between the witnesses as to whether the pilot then completed a further short flight prior to the accident. The pilots partner was sure that he carried out a short intervening flight; the RO was not aware of this flight but commented that, as he was not always in the Tower, he may have missed it. Nevertheless, the RO and the pilots partner were eyewitnesses to the accident flight.

On the accident flight, the pilot carried out an apparently uneventful take-off into wind. However, soon after becoming airborne G-INCH climbed and started a turn to the left. This was followed by a turn to the right, after which the machine started a further turn to the left, and this continued until ground impact, which was not survivable.

In the absence of any technical malfunction being identified from the wreckage examination, it is possible that the pilot was controlling the gyroplane throughout most of these manoeuvres. Witnesses recalled hearing the sounds of the rotors being loaded; this may have been indicative of the machine being subjected to reasonable amounts of g and would suggest that the pilot was making positive control inputs. However, if a low powered aircraft such as G-INCH is subjected to positive manoeuvring, the airspeed could decrease. This would be particularly relevant shortly after

takeoff when there had been little time to accelerate. At the start of the initial turn, it is possible that the airspeed was not much higher than the take-off speed of 25 MPH, and less than the normal cruise speed of 50 MPH and, if so, the continuous climb and subsequent turn to the right would probably have resulted in a speed decrease.

One possibility considered is that the pilot was maintaining visual contact with a point on the ground. In that situation, with the limited instrumentation available to him, he may inadvertently have allowed the bank to increase. Increasing angles of bank would require increasing amounts of g to sustain the turn but any reduction in g would result in decreasing rotor RPM. This situation could quickly lead to a sideslip and a high rate of descent and, in the height available, the pilot would not have been able to recover. In this situation, rotor blades contact with the teeter stops may have resulted from extreme control inputs by the pilot to try and recover the situation.

However, it is also possible that the pilot only had full control over the initial climb and first turn. If the pilot had initiated the left turn at a slow speed, he may have also have pushed forward to try and decrease his rate of climb and maintain speed. Any reduction in g would have caused a reduction in rotor RPM and this may have resulted in the blades becoming unstable and contacting the teeter stops. Unstable blades may cause uncommanded rolling manoeuvres and lead to a loss of control.