

No. 21

Great Lakes Airlines, Inc., Douglas C54-G, emergency landing at Gage, Oklahoma, U.S.A., 15 June 1954. CAB Accident Investigation Report, File No. 0135. Released 3 February 1955

Circumstances

A Douglas C54-G, operated by Great Lakes Airlines, Inc., made an emergency landing off the runway at the Gage Oklahoma Airport, at 0320 on 15 June 1954, because of an uncontrollable fire in the number 3 engine nacelle. There were no injuries to the 82 passengers and crew. The aircraft was destroyed by fire.

Investigation and Evidence

The flight originated at New York, N. Y., with its destination Burbank, California, and with intermediate planned stops at Chicago, Illinois, and Kansas City, Missouri. The segments of the flight to Kansas City were made without incident and the aircraft landed there at 0005, 15 June 1954.

At Kansas City a routine crew change was effected and the aircraft was refuelled. No service was performed on the aircraft at Kansas City other than refuelling. According to company records the take-off weight of the aircraft was 71 143 pounds, which was within the allowable limits and the load was properly distributed with respect to the centre of gravity of the aircraft. Prior to the take-off the captain made a pre-flight inspection and no discrepancies were noted. The flight, normally dispatched, departed Kansas City at 0107 and was cleared IFR (Instrument Flight Rules) to Burbank, California, via Green 4 and Amber 1, to cruise and maintain 4 000 feet. The estimated en-route time was 7 hours and 40 minutes and there was sufficient fuel for a flight of 11 hours and 30 minutes. There were 75 adult passengers, 4 infants and 3 crew on board.

At 0213, when the flight was over Wichita, Kansas, a routine position report was made in which it was estimated that the flight would be over Gage, Oklahoma, at 0307. The crew testified that when the aircraft was in the vicinity of Gage, radio reception was poor due to static caused by local thunderstorms in that area. At approximately 0305, Gage INSAC, (Interstate Airways Communications) advised the flight that Albuquerque ARTC (Air Route Traffic Control) cleared it to climb and maintain 6 000 feet. Accordingly, the flight began to climb. Shortly thereafter the stewardess entered the cockpit and told the pilots that she had seen sparks trailing from No. 3 engine. The captain immediately requested the first officer to look out of his window and see if he could see anything wrong. This was done but nothing unusual was seen. At the same time the captain checked the instruments and found their indications to be normal. The stewardess was then told to return to the cabin and to again advise the captain if and when she observed anything out of the ordinary.

At approximately 0308, when the aircraft was at an altitude of 5 500 feet and in the vicinity of Gage, the zone 2 fire warning light of the No. 3 engine came on. As soon as this was observed the first officer went to the cabin to make a visual check. He returned a few seconds later and reported there was a fire in the No. 3 engine. The captain immediately returned the aircraft to level flight and feathered the No. 3 propeller. The firewall shut-off valve was then pulled, the CO<sub>2</sub> selector set for the No. 3 engine and the first bank of CO<sub>2</sub> bottles was discharged. As this application of carbon dioxide did not appear to put the fire out, the engine's cowl flaps were closed and the second bank of CO<sub>2</sub> bottles was discharged. Following this action the fire was seen to momentarily die down but almost immediately to flare up again.

The first officer called Gage INSAC at approximately 0312 while the captain was performing these duties and advised that the No. 3 engine was on fire and that its propeller had been feathered. The Gage INSAC communicator immediately turned on the airport runway lights for the north-south runway. There were no other radio contacts with the flight.

The captain, unable to extinguish the fire, began a left descending turn toward the airport. During this turn the No. 3 engine fell from the aircraft at which time a complete failure of the electrical system was experienced. The captain testified that throughout the approach he was unable to see the runway lights on the airport and, not being able to use the aircraft's landing lights, he headed in the general direction of the airport beacon. Throughout the latter stages of descent the first officer used a flash light so that he could observe and call out altimeter and airspeed readings. As the aircraft neared the ground the fire illuminated the surface permitting the captain to see the ground and land the aircraft safely. After rolling a considerable distance the right main landing gear collapsed. When the aircraft came to a stop all passengers were quickly evacuated. Fire eventually destroyed the aircraft.

The Gage weather at the time of the accident was: ceiling estimated 12 000 feet, overcast, visibility 15 miles, thunderstorms, wind south-southeast 10 miles per hour. Weather was not a factor in this accident.

The investigation conducted at the scene of the accident disclosed that the aircraft first contacted the ground on a heading of 110° about 900 feet to the left of Runway 4 (040°) and 1 000 feet inside the airport boundary. After rolling approximately 1 100 feet the right main landing gear collapsed because of fire damage and the aircraft then skidded sideways to the right stopping 1 800 feet from the first ground contact point. The captain ordered an immediate evacuation of the aircraft, which was done quickly and in an orderly manner through the main cabin and pilot doors. Evacuation was accomplished in an estimated 1-1/2 minutes without serious injuries to any of the passengers or crew. The intense fire in the No. 3 nacelle area continued to burn, spreading progressively throughout the entire aircraft with the exception of the left wing and empennage.

The INSAC communicator at Gage stated that at the time the aircraft reported to him he did not receive the information that the aircraft's engine was afire but only that a propeller had been feathered. Another flight operating in the range of Gage, however, heard the flight report the engine was also on fire. When the operator learned that fire was existent the flight had already made its emergency landing. The communicator, alone on duty, was unable to leave his position to go outside because of his attention to radio operation. He was also unable to see the airport landing area from his position, therefore, he did not see the aircraft coming toward the airport or see it land. He did not know that the aircraft had landed until the crew entered his office and advised that it was on the field and burning; also that the Gage Fire Department had been notified by the captain. The fire truck arrived approximately 30 minutes later. The equipment consisted of 2 CO<sub>2</sub> bottles and a water tank, operated by volunteer firemen, and was not designed to combat an aircraft fire but for the use of the small community of Gage, Oklahoma.

The No. 3 engine, which fell from the aircraft, was found 11 miles northwest of the airport. It, being the area of the origin of the fire, was given exhaustive examination. The nose case of the engine was demolished by impact and cylinders 8, 9, 10, 11 and 12 were severely damaged by impact and fire. The diffuser section and accessory case were destroyed. Only portions of the accessories normally installed on the rear case were recovered; all had sustained fire damage. Disassembly of the engine indicated that there was no failure or malfunction prior to impact.

The generator for this engine, a Jack and Heintz Model JH 11300, type R-2, serial No. 772, was recovered. It was badly damaged by the intense fire and impact. Disassembly revealed that the inner and outer races of the front bearing were badly galled and distorted. Three accessory case generator mounting studs were recovered. Two were 6-1/2 inches long and were bent about five degrees at the point where they passed through the generator mounting flange. The third stud had failed in tension and bending at approximately the same place where the others bent. Only the inner race of the rear generator bearing was found. It was still attached to the drive shaft and armature support tube. Approximately 1/4 of the circumference of the forward and rear edges of the bearing groove was cut, distorted, and rolled. The generator drive shaft was broken just aft of the clutch assembly. The shear section of the shaft, designed to fail under excessive loads, was intact although bent one degree. The armature and commutator components of the generator were severely scored, distorted, and burned. The score marks on the armature matched similar ones on the coils and interpoles and were rotational in direction

which indicated they were made while the armature was still turning. According to company records, the generator had accumulated 550 flight hours since overhaul. The overhaul included replacement of the front bearing.

Investigation further disclosed that the Douglas C54-Gelectrical system originally consisted of four 100 ampere generators, one installed on each engine. This system was subsequently modified on the subject aircraft by the carrier in favour of a two 300 ampere generator system, a generator mounted on No. 2 and No. 3 engines. The modification was made in accordance with a CAA approved Delta-C and S Airline Engineering Order Number 336, dated 29 July 1946. The modification was made to provide a more efficient generator system for the aircraft. In the specific instance of the aircraft in question, the modification was completed and approved 15 November 1953.

Investigation and examination of the wreckage definitely indicated that the failure of a generator bearing was the initial malfunction. This failure resulted in the generation of extreme frictional heat capable of weakening and burning through adjacent fluid lines causing the release of inflammable fluids which were ignited. The fire progressed so rapidly and became so intense that available CO<sub>2</sub> was insufficient to extinguish it.

The loss of all electrical power at the time the engine separated from the aircraft was most probably caused by a ground fault on the power cables during the physical break up of the nacelle installation. Further radio contact with the Gage INSAC and the use of the aircraft's landing lights were prevented by the electrical power loss. The landing was made on the airport off the runways due to the surface type runway lights being obscured by a growth of tall grass. This tall grass was normally mowed 5 feet on either side of the runways and unless an aircraft, on approach, was lined up with a runway the lights would not be visible from a low approach as in this incident. The Gage INSAC communicator testified that he did not hear any mention of fire when the flight contacted him. It is probable that static and interference from other radio receivers prevented him from hearing the complete message. Before further transmission from the aircraft could be made all electrical power was lost, consequently, the Gage Fire Department was not at the airport when the aircraft landed. It is doubtful that the available fire equipment would have been able to extinguish the fire had it been alerted and present at the time of the landing.

The Board commended both the captain and first officer who, under the emergency conditions present, effected a safe landing at night, without aircraft lights and only the airport beacon as guidance. The stewardess is also to be complimented for the prompt and efficient manner in which she supervised the evacuation of all passengers from the burning aircraft without injury to any of them.

#### Probable Cause

The Board determined that the probable cause of this accident was a bearing failure of the No. 3 engine generator causing extreme frictional heat and the release of inflammable fluid which ignited in flight.