

CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: May 17, 1954

Released: May 24, 1954

AMERICAN AIRLINES, INC., NEAR BUFFALO,
NEW YORK, ON JANUARY 20, 1954

The Accident

An American Airlines' Convair 240, N 94244, shortly after takeoff made a wheels-up forced landing in a sparsely wooded field about one mile south of the Buffalo Airport, Buffalo, New York, at approximately 1642, 1/January 20, 1954. The crew and several of the 21 passengers aboard were injured, however, none fatally. The aircraft received major damage.

History of the Flight

American Airlines' Flight 767 was scheduled to originate at Boston, Massachusetts, and terminate at St. Louis, Missouri, with intermediate stops, one of which was Buffalo, New York. Due to weather over the first segment of this route, the flight originated this date at Albany, New York, and was designated Flight 6767. Turbulence and head winds between Albany and Buffalo caused the flight to be 40 minutes behind schedule, arriving Buffalo at 1618. Except for a sluggish left BMEP (Brake Mean Effective Pressure) instrument noted only on takeoff, this portion of the flight was uneventful.

The sluggish instrument was mentioned to a maintenance man and to the captain of the new crew assigned to continue from Buffalo.

The new crew consisted of Captain Charles A. Halborn, First Officer John A. Ryan and Stewardess Patricia Dixon.

Captain Halborn studied the weather conditions and was dispatched by the company INSTOP (Instrument or on Top of Clouds) to the Willow Run Airport, Detroit, Michigan, with Cleveland and Columbus, Ohio, as alternates.

The weather at Buffalo was reported at 1635 by a special weather report as: ceiling measured 500 feet broken, overcast 800 feet, visibility 2 miles, light rain showers, fog, surface wind southwest 32 m.p.h. with gusts to 40 m.p.h.

The aircraft received a through-service inspection at Buffalo and was loaded to a gross takeoff weight of 40,541 pounds which was below the allowable gross weight of 41,200 pounds; the load was distributed within approved limits with respect to the center of gravity.

While taxiing to Runway 23 the flight received an IFR (Instrument Flight

1/ All times herein are Eastern Standard Time and are based on the 24-hour clock.

Rules) clearance from ARTC (Air Route Traffic Control). Normal pre-takeoff checks were performed and the takeoff roll was started at 1640. The aircraft became airborne after using approximately one-half of the 5,630-foot runway. Immediately after leaving the ground the gear was raised and the first officer saw the left feathering button light come on dimly which indicated that the left propeller was in the process of being feathered by the auto-feathering system. After definitely determining the light was on and visually checking the left propeller, the auto-feathering system was disarmed and the captain, in an effort to stop the feathering cycle, pulled the feathering button to neutral. This effort was unsuccessful, the left propeller feathered, and the engine stopped. During the climb an air speed of 140 m.p.h. was reached and maintained, the right engine remaining at full takeoff power. Approximately 250 feet above the ground a shallow left turn was started and the first officer was ordered to reinstate the left engine, the captain believing the aircraft would climb no farther. In the effort to restart the left engine by unfeathering the left propeller, only 600 r.p.m. could be obtained and the captain felt a buffeting through the control yoke. The aircraft at this time had progressed in the left turn approximately 180 degrees from the takeoff direction and the captain, fearing he would be unable to clear obstructions, including high tension lines, decided to make a wheels-up landing. The landing was made in a field approximately one mile south of the airport. When the aircraft stopped, the passengers and crew evacuated it in an expeditious and orderly manner.

Investigation

The aircraft came to rest 1,201 feet beyond its initial contact with the ground and on a magnetic heading of 71 degrees. It struck several trees along its path, one of which sheared the left wing outboard of its engine nacelle and another the left horizontal stabilizer and adjoining elevator. A large hole was torn in the left side of the cockpit by the trees. The forces resulted in severe damage to the airframe although no fire occurred. Examination of the damaged components of the airframe revealed no evidence to indicate failure or malfunction prior to the accident.

Company maintenance and inspection records relative to the aircraft and engines disclosed no discrepancies and appropriate CAA directives had been complied with.

The crew were currently certificated for their respective duties.

Investigation directed to the power plants revealed both engines had sustained only minor impact damage. The accessories of the left engine were intact and the various components failed to reveal any pertinent discrepancies prior to a test stand run. During this test the engine was started and given a magneto check at 2200 r.p.m. and 30 inches of manifold pressure. At that time it was noted the torquemeter boost pump delivered only 65 p.s.i. (pounds per square inch), the normal being 250 p.s.i. at 1600 r.p.m. Increased power failed to give a pressure increase. The front oil pressure and torquemeter boost pump assembly was immediately removed and disassembled. This revealed a sheared torque boost pump drive gear key as well as a failure of the boost pump drive gear. The drive gear failure occurred in the radius of the gear key slot and extended through the nearest gear tooth valley. Microscopic examination revealed evidence of a fatigue-type failure with the progression lines radiating out from a tool mark on the edge of the chamfered area. The

gear shaft was heavily worked and metal displaced in the gear key way. The boost pump body section was scored approximately 30 degrees around on the outer edge of the pump pocket. This failed assembly was subsequently replaced and the engine restarted with a resultant satisfactory engine operation with normal pressure and BMEP indications.

The right engine was also given a test stand run which revealed no indications of operating difficulties to the engine or its accessories.

All propeller blades were attached to their hubs although bent rearward or broken from impact. Examination of the impact marks on the shim plates revealed the left propeller blades were set at an angle of 55 degrees at impact and the right propeller blades at 34 degrees.

Investigation of the auto-feathering system failed to reveal any evidence of malfunction or failure. A functional test of the torque switch and BMEP transmitter on another Convair 240 aircraft revealed normal operation when power was reduced to 78 BMEP; the torque switch closed normally activating the auto-feathering system.^{2/} Functional testing of the left propeller feathering switch light circuit revealed intermittent operation causing the light to flicker. Also, the light appeared less brilliant than the right feathering button light. Examination revealed this discrepancy was caused by a loose terminal to the light circuit as well as the light bulb being loose. The reduced brilliancy was caused by a frosted white bulb being installed in the left switch as compared to a clear amber bulb in the right. The investigation further disclosed that a failure of the boost pump drive gear and/or key with the attendant loss of pressure to the torquemeter system will cause auto feathering of the associated propeller in the same manner as a loss of engine power.

During the investigation and subsequent hearing, the first officer stated that in his attempt to restart the left engine he pulled the feathering button to the unfeather position and held it probably more than two seconds, repeating this action several times. He also stated he was unaware that continued holding of the button would result in the propeller blades rotating back and forth in a six-degree travel (hunting) in the high pitch range. He thought that by holding the button, unfeathering would be expedited. He further stated that the mixture control remained in the off position because the engine r.p.m. never exceeded more than 600 and did not attain the required 1300 r.p.m. for reinstating the mixture control to the "auto-rich" position. In regard to unfeathering as required to reach starting r.p.m., the company flight manual stated, "For unfeathering the button must be pulled out and held out as required to accomplish unfeathering," the word "held" being underscored. The emergency procedure instructions appearing elsewhere in the same manual, however, stated to hold the button for two seconds maximum. This ambiguity was corrected immediately subsequent to this accident.

Several ground witnesses were interviewed during the investigation and mainly substantiated the sequence of events as set forth. One witness, a

^{2/} This is normal because the switch is designed to close between 73 and 78 BMEP.

mechanical research engineer, was near the end of the runway with the aircraft taking off toward his position, stated that the takeoff appeared normal until the aircraft reached an altitude of 30 or 40 feet and the landing gear retracted whereupon the left propeller began to slow down. The propeller continued to slow down and the aircraft climbed to between 200 and 300 feet and was near the end of the runway when the propeller completely stopped; he could see the blades very clearly. The aircraft continued 200 or 300 yards maintaining a level attitude and gaining little or no additional altitude; the propeller was still not moving. The aircraft began to turn left in a shallow bank and the witness observed the propeller begin to rotate, the individual blades visible at first then becoming blurred, again visible and again becoming blurred. The aircraft continued this shallow turn for approximately one-half mile, gaining no altitude, whereupon its bank increased sharply and it began to lose altitude. It then went into a glide and was lost from view behind the tree tops.

The Buffalo area was located in a low pressure system which earlier in the day was centered over eastern Michigan moving northeast. A cold front extended southwest from this low into Texas and a warm front southeast from the low to near Buffalo. At the time of the accident the warm front had moved north with the air south of the warm front and east of the cold front moist and of a semi-tropical origin. As the low center moved northeastward, the surface winds shifted and resulted in the path of the air passing over Lake Erie and being appreciably cooled by the lake's ice and cold water. This, together with the strong surface winds and turbulent mixing, created a pseudo cold front which in turn caused a rapid decrease in ceiling height, produced fog and an increase in the wind velocity and gustiness.

The flight took off at 1640, the time the most rapid change was taking place and toward the southwest, the direction from which the worsening weather was approaching. Icing was not a factor by virtue of a higher than freezing temperature. The existing weather at the time of the accident was: ceiling measured 500 feet, broken clouds, overcast at 800 feet, visibility 2 miles, light rain showers, fog, wind southwest 32 m.p.h. with gusts to 40 m.p.h.

Analysis

It will be recalled that Captain Sanderson experienced a fluctuation in BMEP indication during takeoff at Albany and although mentioned to a maintenance man and to Captain Hilborn, this discrepancy was not written up because the sluggishness was momentary and did not recur throughout the remainder of that flight. The sluggishness was considered by all concerned characteristic of the gauge especially during cold weather. Captain Hilborn stated that the BMEP gauge gave correct indications during pre-takeoff checks and during takeoff. The Board is of the opinion, nevertheless, that any installed instrument should be given careful attention in order that corrective action may be taken and long-term evaluation made. However, the sluggishness of the BMEP gauge was probably not an indication of the impending failure in this accident. This is based on the characteristics of the instrument and the physical evidence presented by the torque meter boost pump gear and key failures. Evidence indicated the failure of both components was instantaneous with the underlying cause--a fatigue-type failure.

Captain Hilborn stated that he attempted to stop the auto feathering and was unsuccessful. He also stated that he pulled the feathering button to neutral and upon releasing it, it "sucked back in" to the feathering position. Based on the functional design of the propeller auto-feathering system and the fact that when functionally tested the system operated normally in all respects, pulling the button to neutral would shut off the feathering pump causing the feathering cycle to stop. The propeller would then windmill, immediately returning to governing range and starting r.p.m. The feathering itself was caused by the failure of the torque-meter boost pump drive gear and key and a resulting loss of pressure which activated the auto-feathering system.^{3/}

Captain Hilborn stated that his decision to order restarting of the left engine was based on several factors: weather was further deteriorating in the direction of flight with lowering ceiling and poorer visibility, and turbulence added to the single-engine situation made instrument flight inadvisable. When the left propeller feathered, the captain stated that he believed by feel of the aircraft controls and by the engine sound that the feathering was not the result of power failure but a malfunction of the auto-feathering system. This belief, he said, was predicated on his knowledge of previous instances of such featherings, and his decision was based on his belief that he could not continue flight on one engine under the existing circumstances.

During the latter part of the flight the captain experienced a buffeting in the yoke component of the aircraft controls. The buffeting was probably caused by the turbulent air flow from the windmilling propeller.

When the first officer attempted to restart the left engine, it is indicated that he held the feathering button to the unfeather position longer than two seconds in each of the attempts and as a result the hunting condition took place. This condition is evidenced by the engine r.p.m. remaining at approximately 600, a characteristic of the condition, and the description of the propeller movements supplied by witnesses and confirmed by flight tests. The engine did not start because the mixture control remained in the "idle cutoff" position; the first officer waiting for the required 1300 r.p.m. before reinstating it to "auto-rich." It is very probable that had the correct unfeathering procedure been used at this time the engine was capable of restarting and would have done so. The Board is of the opinion that some responsibility for this incorrect procedure must be placed on training and on the manner of

^{3/} In order to prevent, so far as possible, recurrence of this failure and to improve the component, American Airlines issued a directive April 1, 1954. The directive requires that Woodruff keys be replaced on all Convair engines which have more than 800 hours of operation. It also requires the torque-meter boost pump component to be replaced with a spline type pump on all engines having under 800 hours since overhaul as they reach 800 hours.

presenting the unfeathering procedure in the pilot's manual. The presentation was subject to misinterpretation as to the time required for holding the unfeathering button out to accomplish unfeathering, and did not explain the resulting "hunting" condition which could develop if it were held too long. Training was deficient as indicated by the first officer's testimony that he did not follow the correct unfeathering procedure. The company recognizing the significance of this discrepancy immediately subsequent to the accident amended its publication to clarify and explain the unfeathering procedure.

Findings

On the basis of all available evidence the Board finds that:

1. The carrier, the aircraft and the crew were currently certificated.
2. The aircraft was loaded to a weight less than its maximum allowable for takeoff and its center of gravity was located within the approved limits.
3. During pre-takeoff checks at Buffalo the engines, propellers and instruments functioned normally.
4. Immediately after takeoff the left propeller automatically feathered due to a mechanical failure of the torque meter boost pump.
5. The engine stopped as a result of the feathering and was capable of being restarted.
6. The procedure used to unfeather the propeller and reach starting r.p.m. was incorrect due to an ambiguity of the unfeathering instructions outlined in the flight manual.
7. The first officer did not reinstate the mixture control to "auto-rich" because starting r.p.m. was not reached.
8. The windmilling propeller drag, the existing weather and the banked attitude of the aircraft caused it to lose altitude.
9. A forced landing was made one mile south of the Buffalo Airport shortly after becoming airborne.

Probable Cause

The Board determines that the probable cause of this accident was (1) a mechanical failure of the torque meter boost pump that automatically

feathered the left propeller immediately after becoming airborne, and (2) the use of an incorrect procedure for unfeathering which resulted from the ambiguity of the instruction for unfeathering contained in the company's manual.

BY THE CIVIL AERONAUTICS BOARD:

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

/s/ OSWALD RYAN

/s/ JOSH LEE

/s/ JOSEPH P. ADAMS

S U P P L E M E N T A L D A T A

Investigation and Hearing

The Civil Aeronautics Board was notified of this accident at 1648E, January 20, 1954. An investigation was immediately initiated in accordance with the provisions of Section 702 (a)(2) of the Civil Aeronautics Act of 1938, as amended. A public hearing was ordered by the Board and was held in Buffalo, New York, on February 24 and 25, 1954.

Air Carrier

American Airlines, Inc., is a scheduled air carrier incorporated in the State of Delaware with its principal offices in New York, New York. It operates under a currently effective certificate of public convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate issued by the Civil Aeronautics Administration. These certificates authorize the company to transport by air, persons, property and mail between various points in the United States, Mexico, and Canada.

Flight Personnel

Captain Charles A. Hilborn, age 32, held a currently effective airline transport certificate and the appropriate rating for the subject aircraft. Captain Hilborn was employed October 15, 1942. He had a total of 8,671 hours of which 574 were instrument and 4,389 in the type of equipment involved. His last instrument check was effected December 2, 1953, and his latest physical was taken September 21, 1953.

First Officer John A. Ryan, age 36, was the current holder of an effective commercial and instrument rating. He was employed by the company June 18, 1951. His total time was 4,249 hours of which 310 hours were instrument and 2,082 in the Convair 240. First Officer Ryan's latest physical was accomplished June 28, 1953, and his last instrument check April 16, 1953.

Stewardess Patricia Dixon was employed by the company January 8, 1951.

The Aircraft

N 94244, a Convair 240, was manufactured on August 4, 1948, and delivered to American Airlines August 13, 1948. The aircraft bore manufacturer's serial number 88 and had accumulated a total time of 11,018 hours and was currently certificated by the Civil Aeronautics Administration. The aircraft was equipped with Pratt and Whitney Model R-2800-83 AM-4 engines and Hamilton Standard 43E60 propellers.