

CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

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AMERICAN AIRLINES, INC., NEAR MEMPHIS, TENN., JUNE 22, 1949

The Accident

American Airlines' Flight 402, A Convair 240, aircraft N-94266, crash landed 3.6 miles east-northeast from the Memphis Municipal Airport, Memphis, Tenn., at 1313,¹ June 22, 1949. Although the aircraft was extensively damaged, no fatalities were sustained. Thirteen of the 41 passengers and one crew member received serious injuries, and 18 passengers and two crew members received minor injuries.

History of the Flight

The flight originated in Fort Worth, Tex., 0909, June 22, 1949, and made scheduled stops at Dallas, Tex., and at Texarkana and Little Rock, Ark., arriving at 1255 in Memphis, Tenn. Prior to its departure from Fort Worth, the aircraft had been given a thorough pre-flight and a 130-hour inspection during the course of which all items concerning aircraft and engine operation were found normal, or corrected. During the trip from Fort Worth to Memphis, the aircraft operated satisfactorily.

A new crew was assigned to the flight at Memphis, which consisted of Captain Edwin H. Hatch, First Officer Norman E. Lundeen, and Stewardess Yvonne Hanavan. At 1304, the aircraft was taxied from the ramp for a continuation of the flight to Washington, D. C., and intermediate points. On board were 40 passengers, plus one infant in arms, 2,820 pounds of fuel, and 1,331 pounds of mail and cargo. Total aircraft weight was 38,893 pounds which was within the allowable limit, and the load was so distributed that the center of gravity of the aircraft was within the certificated limits.

The flight parked near the southwest end of Runway 2 for the accomplishment of

¹All times referred to herein are Central Standard and based on the 24-hour clock.

the before takeoff check of controls and engines. All components of the aircraft were found to operate normally. Wing flaps were then extended 16 degrees, the aircraft was taxied on to the runway, and at 1311, the takeoff was started. Ceiling over the airport was 3,000 feet; visibility was 15 miles, temperature, 90 degrees, dew point, 74 degrees; wind was from the northeast 8 to 10 miles per hour, and the barometer reading was 29.92.

After 2,700 feet of takeoff roll the aircraft became airborne with an estimated air speed of 120 miles per hour, but at an altitude from 20 to 50 feet the right engine failed and the right propeller automatically feathered. Retraction of the landing gear was accomplished after momentary hesitation as the flight continued straight ahead, gaining altitude very slowly. It passed over the end of the runway at about 50 feet.

A power transmission line, 11,700 feet from the start of the takeoff roll, was located across the flight's course. Two towers of this transmission line between which the aircraft was flown extended to an elevation of 371 feet, or a height of 111 feet above the southwest end of Runway 2 from where the takeoff was started. Elevation of the lowest point of the top series of wires as they hung between the two towers was 335 feet or 75 feet above the southwest end of Runway 2. The flight cleared these wires at this lowest point by 10 to 20 feet.

Just before flying over the power lines at an air speed of 110 miles per hour, a slow retraction of the flaps was started. After crossing the power lines, the air speed fell to 105 miles per hour even though the left engine continued to develop full takeoff power. Not being able to hold altitude, a shallow right turn was made to relatively clear terrain where the aircraft was crash landed

18,713 feet northeast from the starting point of the takeoff. The aircraft slid over the ground for a distance of 217 feet, skidded over an embankment and a highway, then came to rest.

Control tower personnel had observed the feathering of the right propeller and the slow rate of climb. Feeling that the aircraft would not remain airborne, the airport controller instructed another air carrier flight, then on a landing approach to Memphis, to circle the Convair so as to keep the tower advised of its position. Instructions were immediately transmitted to the field's fire and crash personnel following which the city fire and police departments and hospitals were notified. Since fire and crash equipment had actually been dispatched while the aircraft was still in flight, it arrived only two or three minutes after the crash. Fire which started in the left engine nacelle after landing was quickly extinguished, and prompt medical attention was available for all occupants. Although the stewardess had received minor injuries, she, with the aid of one of the passengers, had opened two emergency exits. She had then deplaned all passengers. Thirteen passengers and one crew member received serious injuries, and 18 passengers and two crew members received minor injuries.

Investigation

Considerable crushing and tearing of the external parts of the aircraft resulted during the course of the crash landing. Leading edges of the horizontal stabilizer and the right elevator were dented, buckled, and wrinkled. The entire wing, including ailerons and flaps, was similarly damaged, the leading edge being badly crushed and the bottom skin scarred and torn. The fuselage was broken at Station 227. From this break forward the nose section was deflected approximately 45 degrees to the left of the remainder of the fuselage. Skin and structure forward of Station 607 was extensively torn and wrinkled. Both engine nacelles were badly crushed. The landing gear was found fully retracted and the wing flaps up.

Considerable damage also resulted to the interior of the aircraft. Floor beams, hat racks, frames and seat structures were twisted and broken. Five sets of double seats had separated completely from their floor attachments, and two

other sets had almost completely separated. The safety belt for aisle seat No. 11 was broken 7-1/2 inches from the buckle. A piece of the belt when tested withstood a load of 1,030 pounds before failing, which was in excess of the required strength of 1,000 pounds. Of all injuries sustained it was found that the principal ones included the head, spine and lower chest.

After completion of the examination at the scene of the accident, the aircraft engines, Pratt and Whitney R-2800's, were transported to the American Airlines' overhaul depot in Tulsa, Okla., where disassembly and functional tests could be accomplished. No defects were found in the left engine which could have resulted in power failure during flight, all items of damage being the result of impact. In the disassembly of the right engine, however, the oil feed cavities in the impeller shaft thrust bearing were found clogged by oil sludge, and as a result of this condition it was found that the thrust bearing had failed from lack of lubrication. This had permitted the impeller shaft to move rearward .150 inches which placed the impeller split ring in contact with the supercharger intake insert liner. This in turn interrupted the flow of fuel into the induction system.² All other defects noted in this engine were the result of crash damage. The pattern of breakage and damage of the two propellers was consistent with the known facts that the left engine had been developing power, that the right had failed, and that the right propeller had been feathered.

American Airlines was in the process of reworking the impeller thrust front plates and impeller shaft thrust spacers at the time of the accident to provide greater lubrication for the parts concerned. This reworking was accelerated after the accident and by the time of the hearing, which was held as a part of this investigation June 22, 1949, the work had been accomplished on all engines in

²In the R-2800 engine, fuel is introduced into the induction system through a series of holes in a slinger ring on the impeller shaft. The fuel reaches these holes after passing through a sleeve around the impeller shaft which is called a "supercharger intake insert liner". The "impeller split ring" referred to above is a retaining ring on the impeller shaft to hold the impeller in place. When the impeller shaft moved to the rear the ring moved against the liner closing the holes through which the fuel was fed into the induction system.

American's fleet of Convairs. Overhaul records for these engines show that the reworking has corrected the trouble experienced at the time of the accident.

Performance curves in the CAA Approved Airplane Flight Manual show that for the configuration and weight at a corresponding pressure altitude at standard atmospheric conditions, a Convair 440 when flown at an air speed of approximately 121 miles per hour will climb 280 feet above the point of takeoff after traversing the same distance of 11,700 feet which the American Airlines flight traveled from its start of takeoff to the power lines.

Following the accident, tests were conducted by Consolidated Vultee Aircraft Corporation and American Airlines to determine whether the aircraft was capable of performing as described in the flight manual, and also to obtain further information concerning the effect of flaps. The results showed that if the aircraft were properly flown, in particular, that the flaps remained extended in the takeoff position of 16 degrees and the air speed at approximately 120 miles per hour, the aircraft would perform substantially as described in the flight manual.

The tests had particular significance in demonstrating that, in order to obtain the best rate of climb with varying degree of flaps, the climb must be made at the proper speed. At 120 miles per hour the highest rate of climb was obtained with 16 degrees flaps, and at the same speed when no flaps were extended, the climb rate was zero. When the flaps were retracted at between 103 and 107 miles per hour, which was approximately the speed of the aircraft as it passed over the power lines, the tendency to stall was increased accompanied by a loss in altitude. In these respects the flight tests supported the information in the flight manual which shows that when the aircraft is loaded to 38,893 pounds, as it was at the time of the accident and during the flight tests, it will stall at 112 miles per hour with zero degrees flaps, but will stall at only 101 miles per hour with 16 degrees flaps.

Both Captain Hatch and First Officer Lundeen had received training in the flying of the Convair 440 at the American Airlines' school at Ardmore, Okla. While there they had completed flights in which they were required to demonstrate their proficiency in the handling of the air-

craft during landings, takeoffs, and in various flight configurations. A part of this training consisted of takeoffs with only one engine operating. Information concerning flaps and single-engine performance was contained in the performance curves in the CAA-approved Airplane Flight Manual. However, at that time, company instruction left the manner in which the flaps were to be used to the discretion of the captain.

Following this accident, Consolidated on July 28, 1949, amended the Convair CAA Approved Manual to incorporate specific instructions under emergency operating procedures, concerning flap management in relation to indicated air speeds for single engine operation. This information was received by American on September 1, 1949. At the time of the accident, American Airlines Operating Manual for the Convair 440 did not contain any specific precautionary items relative to wing flap management for one-engine operation. On the date of November 14, 1949, Section 1, Page 2, of this manual was modified to include specific instructions, including flap management under emergency procedures, relative to the operation of the aircraft when an engine failure occurs during takeoff.

Since the operating data for the Convair 440 for single engine takeoff are based on the use of the automatic feathering device, and since difficulties had been experienced in its use, the investigation of this accident included a study of reported malfunctions to determine what, if any, part the automatic feathering device could have played in the accident. The reported failures concerned principally automatic feathering of a propeller when the engine was capable of developing substantial power. There were a few cases where a single backfire in an engine was sufficient to actuate the feathering switch. But, of all complaints concerning the device, no instance was found where the automatic feathering system failed to operate under conditions of complete, or substantial power failure. A modified feathering switch has now been placed in service which should eliminate in a large part the difficulties which were experienced up to the date of this accident.

Analysis

Because of the nature of the failure in the right engine there was a loss of power in that engine. Nevertheless,

according to the aircraft operating data in the manufacturer's approved Flight Manual, and according to the flight tests described, the aircraft should have continued to climb without losing air speed. That it did not do so but instead lost air speed and altitude was due to the steepness of the climb and the retraction of the flaps.

Since the left engine developed full takeoff power continuously during takeoff and climb, it must be concluded that the drop in air speed resulted from flying the aircraft in a too steep climbing attitude, due to the mental hazard imposed on the pilots as the aircraft rapidly approached the power lines across the flight path. The raising of the flaps just before passing over the power lines at 110 miles per hour air speed not only destroyed what little climb performance may have remained at that time, but it increased the stalling speed of the aircraft to approximately 112 miles per hour which was above the speed of the flight. Accordingly, the aircraft could not remain airborne, and there was not sufficient altitude to permit recovery from the stalled condition into which the flight had flown. As a result there was no alternative to crash landing the aircraft.

Findings

1. The carrier, aircraft and crew were properly certificated.
2. After 2,700 feet of takeoff roll at an estimated air speed of 120 miles per hour, and at an altitude from 20 to 50 feet, the right engine failed.
3. Failure of the right engine resulted from failure of the impeller

shaft thrust bearing which caused the flow of fuel into the induction system of the right engine to be interrupted.

4. Retraction of the landing gear was accomplished shortly after failure of the right engine.

5. The left engine developed full takeoff power continuously during takeoff and climb.

6. The manner in which the flaps were to be used under emergency conditions was left to the captain's discretion and was not specifically pointed out in the manual of operation.

7. The aircraft was flown 10 to 20 feet over wires which were 75 feet above and 11,700 feet from the point of takeoff.

8. Just before flying over the wires and at an air speed of 110 miles per hour, flaps were slowly but fully retracted from the takeoff position of 16 degrees.

9. After crossing the wires, the air speed fell to 105 miles per hour.

Probable Cause

The Board determines that the probable cause of this accident was a reduction in air speed resulting from flying the aircraft at a steep climbing attitude after power failure of the right engine, followed by retraction of the flaps which destroyed the aircraft's climb performance.

BY THE CIVIL AERONAUTICS BOARD

/s/ JOSEPH J. O'CONNELL, JR.
 /s/ OSWALD RYAN
 /s/ JOSH LEE
 /s/ HAROLD A. JONES
 /s/ RUSSELL B. ADAMS

Supplemental Data

Investigation and Hearing

The Civil Aeronautics Board was notified promptly after the accident by CAA Communications. An investigation was begun immediately 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 Memphis, Tenn, July 12, 13, and 14, 1949.

Air Carrier

American Airlines is a Delaware corporation with general offices in New York, N Y, and operates as an air carrier under currently effective certificates 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 over various routes within the continental limits of the United States, which include the route segment from Fort Worth, Tex., to Memphis, Tenn., Washington, D C., and New York, N. Y.

Flight Personnel

Captain Hatch, age 35, held a currently effective airline transport pilot

certificate. He had a total of 8,239 flying hours, of which 469 had been in the Convair 240. First Officer Lundeen, age 29, also held a currently effective airline transport pilot certificate. He had a total of 7,077 flying hours, of which 135 were in the Convair 240. Both pilots had completed training in the aircraft at the American Airlines' school at Ardmore, Okla.

The Aircraft

NC-94266 was a Convair 240 manufactured by Consolidated Vultee Aircraft Corporation and was currently certificated by the Civil Aeronautics Administration. It was equipped with two Pratt & Whitney engines, Model R-2800. Total time for the left engine was 558 48 hours and the time for the right engine was 566 25 hours. The propellers were manufactured by Curtiss-Wright, Model C-6328-A102, blade Model 7406C2-0. The engine model numbers were right engine—83M3, and the left engine—34M1. The M1 and M3 indicate that the engine has been modified for water injection, however, at the time of the accident water injection was not being used in these engines.