CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: June 30, 1949 Released: July 1, 1949

NATIONAL AIRLINES, INC., TAMPA, FLORIDA, SEPTEMBER 8, 1948

The Accident

At approximately 1352,* September 8, 1948, National Airlines Flight 72, a Douglas DC-4, NC-33682, en route from Miami, to Tampa, Florida, experienced a fire in the No. 3 engine nacelle. The flight landed at 1405 at the Tampa International Airport.

History of the Flight

Flight 72 departed from Miami, at 1305, September 8, 1948, for New Orleans, Louisiana, via Tampa with a flight crew consisting of Captain M. J. Morse, Copilot W. G. Leyshon and Captain Marshall Hope, who was a third crew member. The aircraft carried 13 passengers, 1,800 gallons of fuel and 690 pounds of cargo. At the time of takeoff, the gross weight of the aircraft was 56,387 pounds which was within the certificated limit and properly loaded with respect to the center of gravity.

The flight progressed en route in accordance with an instrument flight plan at an altitude of 6,500 feet. When approximately 75 miles southeast of Tampa, at 1342, the flight was granted clearance to descend for a landing at the Tampa International Airport. Ten minutes later, when the descent had been made to 3,500 feet, the crew observed that the fuel pressure gauge for the No. 3 engine indicated zero, the cylinder head gauge indicated 265 degrees and was rising rapidly, and that the oil pressure gauge indicated zero. Immediately, the crew attempted to feather the No. 3 propeller, but it continued to rotate slowly. Then, observing fire in the No. 3 engine nacelle, they closed the fire wall shutoff valves and discharged the right bank of CO_2 bottles into the nacelle, after which the fire appeared to be out. At 1355, three minutes later, when the flight was approximately 45 miles southeast of the airport, it was cleared by the Tampa Tower to make a straight-in approach for a landing on Runway 27

Two and one-half miles southeast of the airport, when the landing gear and flaps were extended for landing, an explosion occurred in the No. 3 engine nacelle. Following the explosion, the aircraft vibrated violently and directional control became difficult to maintain. Again, fire was observed in the No 3 engine nacelle. This time the left bank of CO_2 bottles was discharged and all electrical sources were cut off by the emergency power switch The approach was continued, and a landing accomplished at 1405. Since there was no hydraulic pressure to operate the right brake, the stop was accomplished by the use of the emergency air bottle.

Investigation

Examination of the aircraft disclosed that a fire had originated in the No. 3 engine nacelle. Though the greatest damage was confined to the interior of the nacelle, the wing and flap area immediately aft of the nacelle was scorched and wrinkled on both top and bottom sides. Sparks and pieces of molten metal flowing from the nacelle completely destroyed the fabric of the right elevator Fabric on the right side of the rudder was loose and slightly scorched The entire right landing gear was damaged by fire The hydraulic and air lines to the right landing gear were destroyed. Both right main wheel tires were burned and worn to the fabric due to the fire and the emergency stop. The right outboard tire had blown out. The fire wall shutoff valves for the No. 3 engine were in the off position. Both CO_2 bottles were empty and the seals ruptured

The No. 3 engine was disassembled and it was found that all parts had been properly installed at the time of overhaul, and the engine was in satisfactory

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

mechanical condition The maintenance and operating history of the engine was reviewed and found to be normal. At the time of the fire the engine had been flown 1.12 hours since the last overhaul. The installation of the engine was completed the day of the flight and it was test flown for a period of 10 minutes.

As part of the investigation, the No. 3 engine nacelle was reconstructed to determine the fire pattern. There was no fire damage or evidence of mechanical malfunctioning in Zone 1 The propeller was eight degrees from the full feathering position. The mechanism was bench checked and found to be in normal operating condition.

In Zone 2 the severest fire damage was concentrated on the upper right side of the nacelle Intense fire in this area consumed the vacuum pump oil separator and the magnesium starter brush housing. The fuel flow meter was severely damaged. All fuel, hydraulic, electrical and drain lines were either consumed or severely burned. Many of these lines showed indications of having been burned by a concentrated fire. Electrical junction boxes and transmitters were either consumed or severely damaged. The manifold drain line was partially destroyed. The right side of the outer cowling surrounding Zone 2 had been subject to intense heat, but was not destroyed. The oil separator screen was found in the bottom of the nacelle in a molten condition. A piece of molten metal identical in composition to that of the oil separator screen and the vacuum pump discharge line fire wall fitting was found in the discharge line between the oil separator and the fire wall fitting. Portions of the hose connection of the discharge line showed indications of burning from the inside out

Fire damage in Zone 3 was also concentrated on the right side of the nacelle All fuel, hydraulic and oil lines were severely burned or consumed in this area. Electrical junction boxes and their conduits were either destroyed or severely burned. Many of the longitudinal stringers on the right side of the nacelle including the oil tank support were destroyed. The oil tank was missing, and despite an intensive search along the flight path, it was not located. A jagged hole four feet long and 15 inches wide was burned through the top right side of the nacelle aft of the fire wall. The front wing spar in the nacelle was badly warped and cracked from heat.

The engine fuel pump was removed and pressure checked and it was found that there were no leaks. Particles of hose liner inside the pump indicated that it was rotating after the inlet line had started to deteriorate from heat. The propeller governor was bench checked and found capable of normal operation. The carburetor was removed for testing, but the leaks were too extensive to accomplish a flow check. After disassembly of the carburetor these leaks were found to be the result of exposure to intense heat.

The vacuum pump was bench checked and found capable of normal operation, however, the fire pattern in Zone 2 indicated that the origin of the fire may have been caused by malfunctioning of the vacuum pump system Since a metal slug had been found lodged in the discharge line of the vacuum pump, a series of tests were conducted to determine the effect of a restriction in the line. A partial, or complete block in the line resulted in pressures to 60 pounds per square inch and air temperatures to 1200 degrees F. Under these conditions, it was found that a fire or an explosion resulted in the line.

Analysis

Tracing the pattern of the fire damage showed that the fire started in Zone 2 of the No. 3 engine nacelle in the vicinity of the oil separator, and then traveled into Zone 3, either around the fire wall or through the fire wall fittings after they had been burned. It was in this area of the oil separator that the greatest concentration of heat was found. Furthermore, this area contained the transmitters for the oil and fuel pressure gauges and it was the drop in the oil and fuel pressure gauge readings which first indicated engine trouble. Once the fire entered Zone 3, it was fed by the fuel and oil in lines which are located in that zone.

In the area of the oil separator there are three possibilities of fire, the oil separator, the fuel pressure transmitters, and the fuel flow meter. Of these three possibilities, only one, the oil separator, contains both a source of fuel and a source of ignition.

The fuel flow meter and the fuel pressure transmitter contain the source of fuel but not ignition. Had the fire started in either the fuel flow meter or the fuel pressure transmitter, the ignition for the fire would be limited to the generator, magnetos, or the exhaust system of the engine.

The generator is the sealed type and for this reason can be reasonably eliminated as a source of ignition Furthermore, had fire started at the generator, fuel would have had to travel through the air intake blast tube, and this tube showed no signs of internal fire. The magnetos are entirely sealed Accordingly, they are not considered to be a source of ignition.

The exhaust system is not considered a likely source of ignition. The collector ring is forward of the diaphragm which isolates it from Zone 2 where the fire occurred, therefore, it would be extremely unlikely that fuel would be carried forward from Zone 2 to the collector ring. The engine exhaust stacks are located outside of the nacelle and in this case too far removed from the source of fuel to be a likely source of ignition.

The one remaining possibility of fire which contains the sources of both fuel and ignition is the oil separator Tests conducted, as have been previously described, showed that when the discharge line from the vacuum pump to the oil separator was restricted, the pressure inside the line was sharply increased followed by a like increase in temperature. This increase in temperature and pressure was sufficient to ignite or explode the mixture of oil and air present in the oil separator or discharge line Therefore, the oil separator must have been the origin of the fire This conclusion is supported by the fact that the oil separator was completely consumed, and that the hose connection for the discharge line showed that it had been burnt from the inside out

The only fact not determined is the cause of the restriction in the discharge line or the oil separator for the vacuum pump system The slug of metal found in the discharge line could not have been the restriction. It had been melted and was of the same material as the oil separator screen and the vacuum pump discharge line fire wall fitting. It appears, therefore, that this material from the oil separator screen and the fire wall fitting melted and flowed into the discharge line as a result of fire, and was not itself the cause of the fire. Other possible sources of the restriction are a clogged oil separator screen due to oil or carbon deposits, a foreign object which may have entered the line during the installation of the engine, or a faulty check valve Since the oil separator screen was reduced to a molten mass, its condition could not be determined The oil separator and the check valve were completely consumed and most of the discharge line aft of the fire wall was destroyed For the above reasons it was not possible to make any determination as to which of these three possibilities was the cause of the restriction

Findings

1. The aircraft, crew and carrier were properly certificated.
2. Forty-five minutes after takeoff the fuel and oil pressure for the No. 3 engine were reading zero, and the cylinder head temperature was rising rapidly
3. Fire was observed in the No 3 engine nacelle, after which the No 3 propeller was partially feathered and both banks of CO_2 in the nacelle were discharged.
4. Shortly after experiencing fire in the No. 3 engine a normal landing was accomplished at the Tampa Airport.
5. Greatest fire damage was in Zone 2 in the area of the vacuum pump oil separator.
6. A restriction in the discharge line of the vacuum pump causes increases in pressure and temperature sufficient to ignite the fuel-air mixture in the oil separator.

Probable Cause

The Board determines that the probable cause of this accident was a fire in the vacuum pump exhaust system due to a restriction of an unknown origin.

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 of the accident September 8, 1948, by National Airlines at Miami, Florida. An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Public hearing was held in two parts, first being held in Tampa, Florida, September 30, 1948, and the second being held in Miami, Florida, December 15, 1948.

Air Carrier

National Airlines, Inc., a Florida Corporation, with headquarters in Miami, Florida, is a holder of a certificate of public convenience and necessity awarded by the Civil Aeronautics Board, which authorized the company to conduct flight operations between Miami, Florida, and New Orleans, Louisiana, via Tampa, Florida.

Flight Personnel

Captain M. J. Morse possessed a valid airline transport pilot rating. He was employed by National Airlines February 5, 1948, and at the time of the accident had logged approximately 6,000 flying hours, of which 829 were accumulated in four-engine equipment. W. G. Leyshon, copilot, possessed a valid airline transport pilot rating. He was employed by National Airlines July 15, 1948, and at the time of the accident had logged approximately 9,800 hours, of which 217 had been obtained in four-engine equipment.

The Aircraft

NC-33682, a DC-4 aircraft, currently certificated by the Civil Aeronautics Administration, was owned and operated by National Airlines. It had a total of 7,740 flying hours, of which 598 had been accumulated since the last major overhaul. It was equipped with four Pratt and Whitney R-2000-D3 engines. The No. 3 engine had a total of 3,918 hours, and had accumulated one hour and 12 minutes since overhaul. The aircraft was equipped with Hamilton Standard Propellers Model 23E50-505.