CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: March 6, 1952 Released: March 12, 1952

NORTHWEST AIRLINES, INC., NEAR REARDAN, WASHINGTON, JANUARY 16, 1951

THE ACCIDENT

Northwest Airlines' Flight 115 of January 16, 1951, a Martin 202, N-93054, crashed about three miles west of Reardan, Washington, at approximately 1214 [1] The seven passengers and the three crew members were killed, and the aircraft was demolished.

HISTORY OF THE FLIGHT

Flight 115 originated at Minneapolis, Minnesota, for Seattle, Washington, with several scheduled stops including Billings, Montana, and Spokane, Washington It departed Minneapolis at 0110, on schedule, made two planned stops, and arrived at Billings at 0512, eight minutes behind schedule because of head winds. These three segments of the flight were routine

At Billings the crew was changed. The new crew consisted of Captain Lloyd M. Rickman, First Officer Edmond John Gander, and Stewardess Joann Tabor Departure from Billings was at 0540, twenty-five minutes late because of ramp congestion The flight made intermediate stops en route to Kalispel, Montana, without reported incident Between Kalispel and Spokane it radioed that oil temperature in the right engine was high, but shortly radioed that the oil temperature had dropped to normal Landing at Spokane was at 1122, fifty-two minutes late due to head winds and station delays Water was found in the right engine's oil cooler air scoop, the high oil temperature was attributed to the temporary presence of ice or snow in that scoop

At Spokane the aircraft was checked visually, and departed Geiger Field at 1204 with the same crew, seven passengers, and 800 gallons of fuel The flight plan was under Instrument Flight Rules to cruise at 6,000 feet Mean Sea Level between Spokane and Wenatchee, Washington. At takeoff the aircraft's total weight was 33,822 pounds, as compared with a maximum allowable of 37,780 pounds The disposable load was distributed in such a manner that the aircraft's center of gravity was within prescribed limits

Four minutes after takeoff, at 1208, the flight reported having reached the cruising level of 6,000 feet MSL at 1207. At 1212 it was given the Wenatchee weather which was below minima. The flight immediately asked clearance to the next scheduled stop, Yakima, where the weather was above minima. While the Spokane radio operator was obtaining the requested clearance, the flight broadcasted an emergency message. This was at about 1213, only some 15 seconds after asking for the new clearance. No difficulty of any sort had been reported previously.

This emergency message was copied by company operators at Spokane, Yakima and Seattle. At the latter place it was also recorded on a magnetic tape by Aeronautical Radio, Inc , an independent radio organization serving several air carriers The message was in three short sentences All operators agree that the first was, "We are in trouble," and that the last was, "Going down fast." The middle sentence was interpreted by one operator as, "Plane gone nuts" and by the second as, "Right engine haywire " The third operator put down a series of Q's, meaning not understood The actual context of the message will be discussed later in this report

There was no further radio contact with the flight At or about 1214 the aircraft crashed on the Lundy farm about three miles west of Reardan, Washington, and approximately 20 miles from Geiger Field All aboard were killed A flash fire followed impact and burning continued for some time at

[1] All times referred to herein are Pacific Standard and based on the 24-hour clock

several locations throughout the wreckage area.

Weather conditions during the short flight from Geiger Field to the impact site included restricted visibility due to light snow. At the flight level there was no icing or turbulence either forecast or reported. Instrument conditions prevailed at the flight's altitude. At the place and time of the crash the ceiling was about 200 feet and the surface visibility about one-third mile.

INVESTIGATION

The time of impact was fixed at close to 1214. A woman who was in her home, only a few hundred feet from the impact site, heard the crash and telephoned the nearby United States Air Force Fairchild Air Base, where the time of the call was recorded. Local persons had previously been briefed on this procedure by the Air Force and had been given the telephone number to call, as well as gridded maps to help in reporting the location of a crash.

The aircraft struck the ground which was at an altitude of 2,310 feet MSL, while on a heading of about 245 degrees true, in a nose-down attitude of about 45 degrees and with its right wing low. The speed of the aircraft at impact was high as evidenced by the explosive-like violence of the general disintegration and the fact that one air speed indicator showed about 340 miles per hour. Thousands of pieces of wreckage fanned out in a general southwesterly direction but were fairly localized due to the steep angle of impact. A number of relatively small and light pieces of wreckage were found north of the crash site as far as two and one quarter miles. The prevailing south wind is believed to have carried some of these fragments following their being thrown aloft by impact.

Eight persons in the vicinity of the impact site heard, but did not see, the aircraft just before it struck. A ninth saw a bright flash at the time of impact. Of the eight persons who heard the aircraft, the majority were sure that it was proceeding from west to east at low altitude as if headed back to Spokane from whence it came. One of the witnesses heard an aircraft traveling from east to west, but an attempt to reconcile this direction with other factors leads to the belief that he heard a later aircraft. Several of these witnesses described a short-lived but large increase in engine noise immediately preceding the sound of impact. One, who had some aeronautical experience, likened this noise build-up to that made by an aircraft ending a loop.

Another Northwest Airlines' aircraft, Flight 503, was also westbound only three minutes ahead of Flight 115. Following receipt of the emergency message it was instructed to return and search for Flight 115. It did so, unsuccessfully. In the vicinity of the crash site it encountered instrument conditions with low variable ceilings, light to moderate snow, no icing and little turbulence.

Cold weather and fresh snow shortly after the accident greatly hampered the work of gathering and examining wreckage, much of which was imbedded in the frozen ground. The work was pressed, however, when weather conditions permitted. Ground crews searched an area of about 30 square miles exhaustively. A helicopter, carrying a Board investigator, was also employed for this purpose. This extensive ground and air search resulted in securing additional small, light, pieces of wreckage, it appears that all such pieces were removed from the impact site by wind.

The original tape recording made at Seattle was studied carefully by personnel of the Board and others accustomed to hearing radio messages. No complete agreement could be reached as to the full context of the message. Accordingly, the message was re-recorded through the courtesy of the nearby Boeing plant. This copy of the recording was also studied carefully and compared to the original, and was subsequently sent to the Board's Investigation Division at Washington for analysis and interpretation. It was believed that the middle sentence of the message was, "The wheel has gone nuts." Later the original tape recording was obtained from Aeronautical Radio, Inc., and subjected to an analysis by the Bell Telephone Laboratories, Inc. A graphical method was employed and the resulting spectrogram confirmed the initial belief that the sentence was, "The wheel has gone nuts."

Arrangements were made for the use of a hangar at Geiger Field, Spokane (the airport of departure), to lay out and store all recovered portions of the wreckage. This work was done by three groups, each headed by a Board representative and concerning

themselves, respectively, with the power plant and propeller, the structural, and the hydraulic and electrical aspects of the wreckage. These groups included personnel from the carrier, the aircraft manufacturer, the engine and propeller manufacturers, NACA, the CAA, and ALPA. All recovered parts of the structure were arranged on the hangar floor in an effort to reproduce as closely as possible their original relative positions in the aircraft.

Investigation disclosed that at the time of impact both propellers were in forward pitch position, the left at 29 degrees, and the right at 36 degrees. The propeller reversing mechanism on this and similar aircraft had been made inoperative prior to the accident Investigation did not reveal any malfunctioning of either propeller, of either power plant, of the aircraft's electrical system, or of its hydraulic system.

Aircraft maintenance records reflected that the automatic pilot had been placarded as inoperative prior to the takeoff of the subject flight from Minneapolis, due to a malfunction of the rudder control mechanism, however, it had not been rendered inoperative The captain who flew the subject aircraft prior to its final flight stated that the automatic pilot was so placarded. Examination of the automatic pilot and its controls disclosed no evidence to indicate that the automatic pilot was engaged at impact.

There was no consistent fire pattern apparent in any of the aircraft's structure. Parts of the wreckage that had burned were mated with adjacent parts of the structure which were unburned This indicates that there was no fire prior to the crash.

The aileron trim tabs were found approximately in the neutral position. The control wheel mechanism was found jammed in a position corresponding to approximately 30-45 degrees to the left of neutral, the rudder trim tab was set eight degrees to the right, however, evidence indicates that the rudder had been deflected between 8 1/2 and 19 degrees to the left The elevator trim tab was found in approximately the neutral position (normal for cruising), however, the elevator position at the moment of impact could not be ascertained Gust locks were off, and it was determined that the landing gear and wing flaps were up when the crash occurred.

Later in the investigation, when the ground at the impact site had thawed, a number of other small pieces of wreckage were recovered. This material, together with wreckage previously recovered, was flown to the factory of the Glenn L. Martin Company at Middle River, Maryland, where further extensive analyses were made with the help of additional Martin personnel.

Despite the intensity of effort involving a great number of man hours by many technicians, and extending over many months, nothing was found in any of this wreckage to allow a determination of the initial trouble. This intense effort included actual reconstruction of many suspected portions of the aircraft, complete tracing of control systems, and thorough probing into numerous contingencies and combinations of contingencies.[2] Moreover, a review of the pertinent maintenance records did not reveal any evidence that would indicate that the aircraft was not in an airworthy condition prior to takeoff from Spokane.

ANALYSIS

The following portion of this report will deal in some detail with many possibilities, all thoroughly investigated and later discounted.

At the time of the initial failure or malfunction the flight was operating under instrument conditions in snow. However, there was no indication of icing, and there was little or no turbulence. For this reason the Board feels that the state of weather was not a contributing factor to the initial failure or malfunctioning but may conceivably have affected any subsequent recovery of the aircraft from any unusual attitude.

From Geiger Field to the site of the crash is approximately 20 miles. However, the aircraft flew farther than this as computed from its climbing and cruising speed, the existing wind and the elapsed flight time of about 10 minutes It should have progressed a distance of approximately two miles beyond the impact site when the initial difficulty developed. It then turned, or was turned,

[2] Shortly after the accident a Modification Board was established to study the design of the aircraft as regards safety and possible design changes Its work was thoroughly considered in the Board's investigation of the accident

eastward toward Spokane, and from available evidence, crashed within 30 to 90 seconds after the initial trouble manifested itself. The reversal of flight direction is substantiated by persons who heard the aircraft just before it struck. The path of the airplane to the ground cannot be determined positively, it seems likely that the initial trouble was immediately followed by a sudden sharp descent coupled with a reversal of direction accounting for the final high speed and for the build-up in noise.

The circumstances under which the accident occurred, as determined by investigation, dictated the nature of the structural investigation and established certain facts which must necessarily be consistent with any determination of the initial difficulty. The emergency became known to the crew suddenly, as evidenced by a distress call shortly after a routine radio message, and was of such an extreme nature as to result in the aircraft striking the ground at a very high speed within 30 to 90 seconds after the distress call. The phrase in this radio transmission—"the wheel has gone nuts"—suggests that the trouble originated with or manifested itself in unusual movement of the aileron or elevator controls in the cockpit. The fact that the flight was under instrument conditions undoubtedly made it more difficult to maintain or regain control once the trouble had begun. That the aircraft had reached cruising altitude and was flying a straight course with little or no turbulence precludes a number of possibilities that might have occurred had the aircraft been climbing, descending, or maneuvering.

In the belief that it would be of assistance in the search for the cause of the accident, an effort was made early in the investigation to determine the attitude of the aircraft at the moment of contact with the ground. The direction of the accordion pleating of the right outer wing considered in conjunction with the impact gouge and the wreckage distribution at the scene of the accident, indicates that the right wing tip struck the ground first with the aircraft yawed to the left, right wing low and nose down. From the above it was established also that during the disintegration of the right wing on impact with the ground the aircraft pivoted slightly to the right until the nose of the fuselage struck the ground. Almost simultaneously with the break-up of the right wing, much of the right wing fuel ignited with explosive force scattering pieces of the right wing in all directions from the point of impact.

During the investigation at Spokane and later at the Martin factory, the wreckage was carefully examined for evidence of failures or malfunctions that could explain the facts as listed in the previous paragraphs. Many possible causes were considered and checked through by detailed wreckage examination, laboratory tests, etc.

It should be pointed out here that the elimination of some of the possibilities as probable causes is restricted to an evaluation of the physical evidence available in the wreckage and does not preclude the possibility of the substantiating evidence either being obliterated or undetectable due to the severely damaged condition of the wreckage

Possibilities:

(A) *Fire in Flight*

During the early stages of the investigation it was thought that the numerous indications of burning on many of the parts, especially those in the fuselage belly and in the right wing, pointed to the possibility of in-flight fire. This suspicion resulted in building a mock-up of these areas. Careful examination of all pertinent parts of the mock-up, such as wiring bundles, flooring, tubing, structure, etc., failed to disclose any consistent space relationship of burned and unburned parts as would result if there were an extensive fire prior to disintegration. The cabin heater and anti-icing heaters were sectioned, but showed no evidence of burn through. The control cables on the right side of the fuselage showed indications of having been exposed to intense heat but the affected areas formed no consistent pattern and did not match or correspond with other burned areas on adjacent wiring bundles, flooring and structure. In addition, it was established that the amount of burning on the cables was not sufficient to affect the strength of the cable appreciably or to prevent the cable from transmitting pilot forces to the surfaces. The right nacelle showed no evidence of in-flight fire, indicating that the burned condition of the right landing gear, wheels and tires occurred

after the landing gear was detached from its supporting structure. Wherever a positive check could be made, the mating of burned pieces of wreckage with adjacent unburned pieces of wreckage proved that the burning occurred after disintegration.

The track of small, light-weight, metal parts discovered along a general heading of 345° from the impact point and a considerable distance away were, at first, believed to indicate a fire in flight inasmuch as most of them were burned. However, in view of the facts that many of these fragments were later identified as coming from areas where adjacent pieces were found to be unburned and that there was a high wind shortly after the accident which would tend to blow light parts from the impact area to the path on which they were found, it is probable that these bits of wreckage were picked up from some of the more intense fires which occurred after the accident by gusts which carried them considerable distances.

Numerous specimens of burned parts were submitted to the Bureau of Standards early in the investigation for chemical analysis to determine sources of combustion. Preliminary examination disclosed no significant evidence, but in the event that any new evidence throws light on the problem, a supplementary analysis with respect to fire in flight will be made.

(B) *Explosion in Flight*

The general absence of recovered and identified material from the right wing lower surface and the fuselage belly area gave rise to the thought that an in-flight explosion might have occurred in either of these areas, resulting in loss of control and ultimately in the accident itself. This possibility was another reason for the reconstruction of these areas for more detailed study.

Although only approximately 20% of the right wing lower skin blanket fragments from Station 187 to the tip were identified, the coverage of the lower surface was fairly uniform. Nothing to indicate that an explosion had occurred was found from a detailed examination of the structure that was pieced together.

The fuselage belly structure was so severely damaged that only a small portion of the structure forward of the wing was identified. Portions of all belly doors were identified, however. Examination of the belly structure identified, and the other items located in the fuselage mock-up, revealed no evidence of an explosion.

If an explosion had occurred in flight parts or debris from the area involved would have in all probability become separated from the aircraft and would have been found during the extensive search of the surrounding locality. However, no pieces of wreckage other than the track of small, light fragments were found outside the general perimeter of the wreckage at the crash site, further indicating the improbability of an explosion in flight.

(C) *Structural Failure in Flight*

No component parts of the airplane, such as the wings, tail, flaps, ailerons, doors, fuselage, etc., were found away from the main wreckage. Places of minimum calculated stress analysis margins of safety in the wing structure were examined carefully for evidence of failure, but in all cases these points were intact while adjacent structure was broken up. The fact that the points of minimum margin of safety in the wing were intact indicates that the wing was not subjected to excessive loads in flight. This same general approach was used on the stabilizer and elevator but these surfaces were so severely damaged, including the points of minimum margin of safety that nothing conclusive could be drawn from the examination. However, it should be pointed out that the stabilizer is overstrength in bending because following the basic design steel straps were added to the chords to increase the rigidity of the surface, thus increasing the strength over the basic requirements. All of the wing spar splices, the inner to outer wing cover splices, the stabilizer to fuselage attachments, and the fin to fuselage attachments, were either intact or showed evidence of impact type of failure. The aft fuselage mock-up was constructed to examine for evidence of wrinkling in the aft fuselage side skin due to high loads on the vertical surface in conjunction with an unsymmetrical loading on the horizontal tail. This condition was critical for the aft fuselage and had wrinkling been found it would have indicated high vertical tail loadings, but no wrinkling was found.

All of the control surfaces, including the flaps, were examined carefully for evidence

of structural failure in flight, but no evidence was found. The tail ramp and all of the fuselage doors were accounted for and the condition of the ramp locks indicated that the ramp was in the closed position at impact. During the investigation it was brought out that Martin had conducted flight tests with the ramp open and no unusual flight characteristics were evident.

Aside from the points enumerated above, it is believed that had structural failure occurred in flight, it is quite probable that the failed portion or some adjacent structure would have become separated from the aircraft before impact and would have been found some distance from the scene. However, as mentioned before, search of the area around the accident scene failed to produce any such portion.

The possibility that one of the tail surfaces, ailerons, or flaps had failed structurally but had hung on to the airplane up to impact was considered, but examination of the structure adjacent to these surfaces revealed no evidence of parts beating against each other as would be the case if this type of failure had occurred.

No fatigue was evident in any of the many fractures. All critical areas in which a fatigue failure would have been catastrophic were covered in the examination.

(D) *Control System Failure or Malfunction*

The crew's message with regard to the wheel and the violent nature of the accident suggested a failure or malfunction in the control system. For this reason intensive studies of all parts of the primary control system and the tab control systems were made. All cable breaks, bracket fractures, rod failures, etc. were examined in detail for evidence of any unusual condition. Various possible causes were considered and the wreckage was carefully examined to verify or discard the theory. No evidence of in-flight failure or malfunction was found.

It was further brought out that since the airplane was in a cruising configuration had any ordinary failure in the system occurred it would not result in such a violent reaction. Even if a cable had parted (no cable fraying was found), the surface would trail. It was established that had the elevator cartridge been sheared from its attachment to the torque tube, the pilot could still fly the airplane by means of the trim tab. If the elevator spring cartridge had failed, the pilot would be able to control the airplane through motion of the spring tab, although in this case the control forces would be greatly reduced. These and many other exploratory considerations were investigated without positive result. Nothing was found in the control system to explain the crew's emergency message. The possibility of control system jamming cannot be discounted entirely even though no evidence of such a condition was found. There must remain the possibility of jamming with the evidence thereof being destroyed.

The possibility of failure of the fabric or binding tape on the rudder (the ailerons and elevators on the Martin 202 are metal covered) of the subject aircraft was considered. Examination of the rudder disclosed that the major portion of the fabric covering had burned following impact, however, small pieces of fabric were found still adhering to structural members and around portions of the trailing edge former of the rudder, the appearance of which indicated that the fabric covering and tape was intact at impact.

(E) *Flutter*

One of the earliest considerations was the possibility of wing or control surface flutter but all checks, including detailed examination of the wreckage for evidence of vibratory loads, proved negative. The hinge bearings of all surfaces were examined for signs of large load reversals but in all cases the bearings were either undamaged or showed only evidence of impact loading. One of the outboard elevator balance weights was not recovered and this suggested the possibility of flutter originating with the elevator. Aside from the fact that the physical evidence showed no evidence of failure due to flutter, a binary flutter analysis made for the condition of both outboard balance weights missing, which is more critical than the condition for a single weight missing, disclosed that the elevator was free from flutter. When the elevator spring tab cartridge was found separated from its attachments, it was thought that this could set up a flutter condition. Checks indicated, however, that with the elevator cartridge completely disconnected there was no tendency for the elevator to flutter.

(F) *Auto-Pilot*

An intensive investigation of the auto-pilot installation was made to determine whether or not malfunctioning of the auto-pilot could be the initiating cause of the accident. The auto-pilot had malfunctioned en route from New York, New York, to Minneapolis on the previous day and was placarded inoperative prior to departure from Minneapolis on the subject flight. At the time of the accident it was placarded inoperative. Since it was not disconnected or otherwise rendered inoperative, consideration was given the possibility that the crew might have engaged it intentionally or unintentionally. It is still possible for the pilot to overpower the servos and maintain control of the aircraft or to turn off the auto-pilot by use of either of two electrical switches, or by disengaging the mechanical clutch. Although it cannot be used as conclusive evidence, the portion of the disengaging controls (mechanical clutch) recovered indicated that the auto-pilot was disengaged at impact. The auto-pilot servo generator unit was opened and no evidence of rotation at impact was found. Further, the forces introduced by the servos into the surfaces are so selected in the design that they will not exceed the design strength or airplane loading. Malfunctioning of the aileron, elevator and rudder controls were all considered and it was found that, of these, only a malfunction in the aileron portion of the auto-pilot could produce a condition consistent with the time interval involved. Even then, a malfunction in the aileron auto-pilot control could only result in a dangerous condition if the pilot did not attempt to regain control or could not achieve control because of inadequate time. No evidence was found that this occurred.

(G) *Miscellaneous*

In addition to the items discussed in previous sections, many other possible causes were considered and probed by intensive study of the wreckage. There had been reports of marginal or inadequate lateral stability of the model aircraft, and this point was explored in some detail. The chief complaint here was associated with aileron ineffectiveness due to ice build-up on the wings. However, the problem only became apparent at the slow speeds of take-off or landing approach. As a result, it appears that this difficulty could not be involved in this accident. In addition, the Martin Company had conducted an elaborate series of flight tests which demonstrated that even with large accumulations of ice on the wings and ailerons or with spoilers placed on the wing in front of the aileron, lateral control could still be maintained in all flight configurations and over a wide range of operating speeds.

Sabotage was considered but nothing was found during the investigation to give credence to this possibility.

The condition of the pilot and co-pilot seat tracks and safety belts indicated that both seats were occupied at the time of impact and that they were in the proper range of positions for effective use of the flight controls by the crew.

The possibility that the crew was incapacitated by an excessive concentration of carbon dioxide could not be checked positively from the condition of CO_2 bottles, since all but one were damaged sufficiently by impact forces to be discharged. However, the single bottle with the head still intact was found to be charged, indicating the probability that at least one of the two banks of bottles was not discharged by the crew. Since no evidence of in-flight fire was found by examination of the wreckage there is no reason to believe that either bank was discharged by the crew. The coherence of the crew's last radio transmission tends further to disprove the possibility of incapacitation by carbon dioxide.

Various possible causes of buffeting, such as the loss of an engine cowl, the opening of an access door, etc., were considered. However, fragments of all pieces of the engine cowls were found at the crash site indicating the improbability of buffeting due to the loss of one or more segments. Although it could not be proven that an access door was not open in flight, they are so positioned as to be an unlikely cause of severe tail buffeting if open.

The position of the rudder trim tab screw which was found to correspond to an 8° right tab setting could not be satisfactorily explained It was felt that this position indicated an effort of the crew to raise the right wing or compensate for an unusual turning moment such as might be produced by

an excessive drag on the right wing, but nothing was found despite intensive investigation to disclose any abnormality that would produce wing heaviness or drag.

No evidence was found to substantiate or give credence to any of the many theories with regard to the source of the initial trouble that were considered during the course of the investigation. No evidence of in-flight structural failure, fire, explosion, electrical or hydraulic systems failure or malfunction was found. The facts disclosed by investigation indicate that the initial difficulty, source undetermined, resulted in a loss of control while the airplane was in a cruising configuration. This resulted in a rapid descent at high speed and in the disintegration of the aircraft upon contact with the ground.

FINDINGS

Upon consideration of all available evidence, the Board finds that

1. The carrier, the aircraft and the crew were properly certificated.

2. The total weight at takeoff was less than the maximum allowable of 37,780 pounds, and the disposable load was properly distributed.

3. Weather was not contributory since there was no icing and little turbulence.

4. The flight was uneventful until 30 to 90 seconds before the crash.

5. A difficulty of undetermined origin resulted in loss of control and rapid descent to the ground.

6. Examination of the wreckage remaining failed to disclose any evidence of structural failure and/or fire in flight.

PROBABLE CAUSE

The Board, after extensive study of all evidence, determines that the probable cause of this accident was a sudden loss of control for reasons unknown, resulting in rapid descent to the ground.

BY THE CIVIL AERONAUTICS BOARD

/s/ DONALD W. NYROP
/s/ OSWALD RYAN
/s/ JOSH LEE
/s/ JOSEPH P. ADAMS
/s/ CHAN GURNEY

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Supplemental Data

INVESTIGATION AND HEARING

The Civil Aeronautics Board was promptly notified of an accident involving an aircraft of Northwest Airlines, Inc., near Reardan, Washington, by telephone from Northwest Airlines' Flight Control at 1245, January 16, 1951 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. The first session of the hearing embraced, in general, testimony of ground witnesses, company operational and maintenance records, crew histories, and physical aspects of the investigation to that time, this hearing was held at Spokane, Washington, on February 7 and 8, 1951 The hearing was continued at St. Paul, Minnesota, on July 11 and 12, 1951, to explore the results of detailed technical investigations which were not completed at the time of the first hearing.

FLIGHT PERSONNEL

Captain Lloyd M. Rickman, age 33, was employed by Northwest Airlines as a copilot trainee on January 19, 1943. He served continuously as a copilot from March 4, 1943, until he completed captain's transitional training on July 17, 1950. He had logged 4,850 hours of flight time, 277 hours of this total having been flown on Martin 202 equipment Captain Rickman had 597 hours of instrument time as of January 1, 1951. He had flown 64 41 hours during the 30 days prior to the accident and had a rest period of 15 09 hours prior to Flight 115. Captain Rickman was the holder of airline transport pilot certificate No. 55046-41 with DC-3, DC-4 and Martin 202 ratings. He had completed a first-class CAA physical examination on June 28, 1950, received a route check on Martin 202 equipment on January 14, 1951, and had completed his last instrument check on January 10, 1951, on Martin 202 equipment.

First Officer Edmund John Gander, age 28, was employed by Northwest Airlines as a copilot trainee on July 21, 1950, and was assigned to copilot duties on August 4, 1950. His total logged flight time was 692 hours, 84 hours of which were on Martin 202 equipment. Mr. Gander had logged 155 hours of instrument time as of January 1, 1951. He had flown 91 02 hours in the previous 30 days, and had a rest period of 15·09 hours prior to Flight 115. Mr. Gander held commercial certificate No. 1167955, with single and multiengine, land and sea, and instrument ratings. He was qualified on DC-3, DC-4, and Martin 202 equipment. Copilot Gander had completed a first-class CAA physical examination on August 1, 1950.

AIR CARRIER

Northwest Airlines, Inc., is a Minnesota Corporation, having its principal place of business at 1885 University Avenue, St. Paul, Minnesota. The company is engaged in the transportation by air of persons, property, and mail, and holds a certificate of public convenience and necessity issued by the Civil Aeronautics Board pursuant to Order Serial No. E-6003. This certificate authorizes it, among other things, to operate between New York, New York, and Seattle, Washington, via various intermediate stops. The carrier also holds an air carrier operating certificate No. 20, issued December 27, 1946, by the Administrator of Civil Aeronautics.

AIRCRAFT

N-93054, a Martin 202, was certificated by the Administrator Civil Aeronautics, and was owned and operated by Northwest Airlines, Inc. It was manufactured on May 10, 1948, was received by Northwest Airlines on May 30, 1948, and entered the service of that company on June 6, 1948. At the time of the accident it had a total airframe time of 5,874 19 flight hours and 2,126 38 since the last overhaul. The engines, Pratt and Whitney Model R-2800-CA-18, had been flown 3,725 22 and 3,431 25 hours, left and right, respectively. The propellers were Hamilton Standard Model 23260-1.