No. 5

Trans-World Airlines Inc., Martin 202-A and Castleton, Inc., Douglas DC-3C, collided near Greater Cincinnati Airport, Ohio, on 12 January 1955. Civil Aeronautics Board (U.S.A.) Accident Investigation Report No. 1-0014, released 8 July 1955

Circumstances

The DC-3 aircraft departed Battle Creek, Michigan, at approximately 0733 hours en route to Lexington, Kentucky, and thence to Miami, Florida, carrying two pilots. The flight was proceeding in accordance with Visual Flight Rules to Lexington and if the weather lowered en route the pilot planned to file in flight for an IFR clearance. However, no plan was filed before departure or in the air, nor were radio facilities along the route contacted by the pilot. The Martin 202-A departed Greater Cincinnati Airport at 0902 hours Eastern Standard Time on an Instrument Flight Rules flight plan to Cleveland, Ohio, with 13 persons aboard. While making a right turn after take-off from Runway 22, the Martin 202-A collided with the DC-3 about 2-1/2 miles west of the Greater Cincinnati Airport, in the control zone*, at 0904 hours. Both aircraft went into steep dives, struck the ground, killing all occupants, and were demolished as a result of collision, ground impact and fire.

Investigation and Evidence

Examination of the Martin wreckage (2-1/2 miles west of the airport control tower and approximately the same distance from the southwest end of Runway 22) showed that the right wing was partially severed chordwise at collision about 22 feet from the center line of the fuselage, and wrenched off while the aircraft was still in the air. Due to striking the ground in a fairly steep dive the cockpit and its components disintegrated to such a degree that no information was obtainable on the position of cockpit controls and radio equipment. It was ascertained that both the landing gear and the flaps were retracted when the aircraft struck the ground. Inspection of the propeller domes showed that the pitch of the propeller blades at ground impact was 47 degrees. No evidence was disclosed in examination of the wreckage to indicate any malfunction or failure prior to the collision.

The DC-3 struck the ground in a steep dive (on the stub of the left wing, the nose section and engines) one mile south of the Martin, approximately 2-1/4 miles west-southwest of the control tower. A number of battered and torn sections of the left wing outboard of the flap and portions of the vertical tail were torn off at the time of collision. The cockpit was demolished. Four propeller cuts were found across the top of the fuselage, two in the vertical tail, and one in the left wing. The fin was badly crushed and torn, and the rudder was detached at the hinges. The landing gear was retracted. The flap mechanism was destroyed and, therefore, the position of the flaps at impact could not be ascertained. Examination of the propeller dome assemblies revealed that the pitch on the left propeller at ground impact was 41 degrees, and the right 39 degrees. All radio equipment was so severely damaged that it was impossible to ascertain with any certainty what, if any, equipment was in use, or to which frequency it might have been tuned.

Study of the wreckage of both aircraft disclosed that immediately prior to impact the aircraft approached each other at an angle of about 30 degrees from head on, with the longitudinal axis of the two aircraft crossing to the left of the Martin and to the right of the DC-3. The aircraft were banked relative to one another so that the left wing of the Martin was higher than the right wing of the DC-3, while the right outer wing of the Martin and the left outer wing of the DC-3 were in position to collide. In addition, the collision damage indicates that the Martin was climbing relative to the DC-3.

The first major components to come in contact were the left wing of the DC-3 and the right propeller of the Martin. The right wing of the Martin and the left wing of the other

* A control zone is an airspace of defined dimensions, extending upward from the surface, to include one or more airports.

aircraft then struck, resulting in disintegration of the DC-3 wing in the contact area, and causing such structural damage to the Martin right wing that it separated from the aircraft before ground impact. While the two wings were tearing through one another, the left propeller of the Martin started its cuts across the top of the DC-3 fuselage and through the vertical fin and rudder while the Martin moved across and to the rear of the other aircraft. Near the end of the contact period, the inboard side of the Martin left nacelle inflicted severe crushing damage on the DC-3 vertical tail, causing portions of the DC-3 fin and rudder to separate in flight.

Several witnesses were found who saw or heard the two aircraft after collision. Witness No. 1* heard the Martin take off. About two or three minutes later he heard a sharp sound to the southeast which resembled a clap of thunder or blasting. Directing his attention toward the source of this unusual sound, he saw nothing except the low overcast for an appreciable time, testifying that it might have been as long as 30 seconds before he saw an aircraft (Martin 202-A) dive out of the clouds and burst into a ball of flame when it struck the ground. At no time did this witness see or hear the DC-3.

Witness No. 2 heard an explosion while at home. Looking out of his west window he saw an aircraft (Martin 202-A) headed north. For an instant it appeared to be in level flight near the base of the clouds, then went out of control, dived to the ground at about a 45-degree angle, and exploded upon impact.

Witness No. 3 "heard a loud noise". Looking up, he saw two aircraft to the northwest, just under the base of the overcast. The DC-3 was in a steep dive and the Martin was apparently trying to pull out of a dive. Although this witness lived near the end of Runway 22, he did not recall hearing the Martin take-off.

Witness No. 4, a teacher in a school about a mile and a half north of the site of the intermingled wreckage, testified that she heard an aircraft west of her position, flying south, shortly before the time of the collision.

One of the students (Witness No. 5) testified that he heard an aircraft and on looking out of the window he saw it pass the end of the building, going west, and it appeared to be flying close to the base of the clouds. His attention was again drawn to the aircraft a few moments later, when he heard a roar of engines, looked up, and almost at the same instant saw an explosion in the air, accompanied by a mushroom of smoke. He said that he saw "two tails" and the wreckage "came down in one heap".

Witness No. 6 who lived near the schoolhouse, heard an aircraft take off from the airport. He then heard an aircraft coming from the north and it passed, going south, west of where he was standing. It seemed to him from the sound that this second aircraft was very low. He searched the sky but never saw either of the two aircraft apparently because of the "hazy condition". On searching the sky he heard a thud and an explosion, followed by a surge of engines from one of the aircraft.

Witness No. 7 was in west Cincinnati when at about 0855 his attention was drawn to an aircraft flying much lower than usual, which he definitely identified as a DC-3. It continued past his position, flying in a southwesterly direction, disappearing and reappearing in the overcast several times.

The presence of the DC-3 in the control area was unknown to CAA Air Route Traffic Control and the Cincinnati tower. Civil Air Regulations specify that aircraft shall not be flown within a control zone beneath the ceiling when it is less than 1 000 feet, unless authorized by air traffic control. If operating on an IFR clearance, a flight would already be under the jurisdiction of air traffic control for flight within a control zone; if on a VFR flight plan, or no flight plan, a clearance to operate within the control zone would have to be requested if weather conditions were IFR (ceiling less than 1 000 feet or visibility less than 3 miles). If the ceiling is less than 1 000 feet, an aircraft, if cleared, may operate within the zone, remaining underneath and clear of clouds. In this instance, the ceiling was less than 1 000 feet and no request was received from the

* Position denoted on Figure 4 by numeral 1; other witness positions are similarly noted by appropriate numbers.

DC-3 for a clearance to operate within the control zone.

The weather reports reviewed by the captain of the DC-3 before departure from Battle Creek showed the existence of an overcast over the entire route, ceilings lowering from 3 100 feet at point of departure area to 1 300 feet at Lexington, visibility lowering from 8 miles at departure point to 2 miles at Lexington, precipitation throughout, icing in the clouds and precipitation areas, and below freezing temperatures existing over the entire route from the surface upwards. Since the flight was conducted without flight plan, in weather conditions which became poorer, and without communicating with any station en route, it is considered that the captain failed to exercise reasonable judgment and conducted this operation contrary to good operating practices. In the light of the weather situation the flight should have been planned and conducted so as to avoid flying at low altitudes in marginal VFR conditions.

At 0907 (3 minutes after the accident) the U.S. Weather Bureau reported the following conditions: ceiling 800 feet variable; overcast; visibility 4 miles; light freezing drizzle; fog (extending from ground to overcast); temperature 28; dewpoint 25; wind southwest 11 knots; altimeter setting 29.99 inches. Remarks - ceiling 700 feet variable to 900 feet, cloud cover between 3 000 to 4 000 feet thick.

It appears that in the collision area, visual reference to the ground was possible up to 900 feet above the surface. It also appears highly probable that visibility progressively decreased with altitude, and that near the cloud base it was considerably less than the surface visibility of four miles. Visibility could have been reduced in either aircraft by windshield icing unless preventive measures were used.

Since the DC-3 was equipped with several transmitters and receivers it is considered remote that total radio failure could have occurred. As there were no radio contacts from the DC-3 it is unknown at what altitudes the flight was made. It would have been possible for the pilot to have conformed with VFR rules between Battle Creek and Cincinnati by flying through areas of low ceiling and visibility at less than 700 feet altitude (below airways) provided the aircraft was operated clear of clouds and visibility was not less than one mile.

The elapsed time from take-off of the Martin 202-A, possible flight paths of both aircraft and the techniques and flying habits of both captains were thoroughly investigated.

TWA flight operations procedures specify that aircraft are to climb straight ahead until reaching an altitude of 500 feet. The flaps are then retracted; power reduced to climb power, and a climbing turn to the desired heading is commenced.

Two test flights were conducted to learn what the altitude and position of the aircraft at various stages would be if standard company procedures during instrument flight were followed. The test pilot had given the captain of the Martin 202 his checks for the past 18 months and it was believed that this pilot could closely duplicate the techniques which the captain probably used. The test runs showed that the aircraft would fly over the intermingled wreckage at an altitude of 1 500 feet above the ground on a heading of 340 to 345 degrees and in an elapsed time of 2-1/2 minutes. Thus, as the captain was a conscientious and conservative pilot who had never been known to deviate from company policy, the collision probably occurred at 1 500 feet.

An aeronautical engineer representing Castleton, Inc. conducted a detailed study of the wreckage and other evidence and submitted a separate report to the Board. He concluded that the point of collision was very near the location of the recovered DC-3 wing tip since this unit fell straight downward after the collision. His value of the closure angle between the two aircraft at the time of collision substantially agreed with the Board's findings. Part of his study was devoted to the calculated trajectory of the DC-3 following collision. From this analysis he concluded that the DC-3 struck the ground 14 seconds after collision, and that it covered a distance of 3 000 feet over the ground and rolled somewhat beyond the vertical in this interval. Based on conservative assumptions he testified that the study further showed the maximum collision altitude as 1 000 feet, and that if the elevator trim, the exact amount of left wing lost, and elevator control displacement (pilot's effort to raise the nose of the aircraft), were more precisely known the collision altitude might be as low as 500 feet. He further stated that his study showed that the DC-3 heading was 170 - 180 degrees and that of the Martin 202-A was 315 - 330 degrees. The Martin heading at time of collision indicated that the TWA pilot started his right turn at the far end of Runway 22, and that the collision occurred 50 seconds later.

It is reasonable to assume that the DC-3 was in level flight on a south heading. Whether it flew over Cincinnati or not could not be absolutely verified. However, the DC-3 seen by Witness No. 7 in West Cincinnati was probably the Castleton DC-3 as no other DC-3's were known to be in the area.

Since the DC-3 was not on an IFR flight plan the pilot could be expected to have tried to remain in visual contact with the ground. Analysis of some witness testimony, however, indicates that it was being operated in the clouds. The controller believed that he lost sight of the TWA aircraft due to its entry into the overcast. Witness No. 1 states that an appreciable period of time elapsed between hearing the collision and the time an aircraft came into view, apparently out of the overcast. Witness No. 5 stated that he saw an explosion in the air which may indicate that the collision occurred at the base of or in the overcast.

During the several seconds it took for the sound of collision to reach the witnesses, the inertia of the two aircraft would tend to make them continue along the same general paths they had immediately prior to the collision. As a result, the two aircraft may have changed altitude very little during the interval until the first witness saw the Martin.

The Martin 202-A is capable of climbing at considerably higher rates than those indicated by the test flight. Results of the test flight indicated that collision occurred in the clouds, several hundred feet above the base of the overcast. However, the results of the study by Castleton indicated that the accident could have occurred between 500 and 1 000 feet. In considering the test flight results, the engineering studies, and all other pertinent evidence, the Board concluded that the accident occurred close to the base of, or in, the overcast.

Probable Cause

The probable cause of this accident was operation of the DC-3 in the control zone as unknown traffic, without clearance, very close to the base of, or in, the overcast.

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ICAO Ref: AR/375

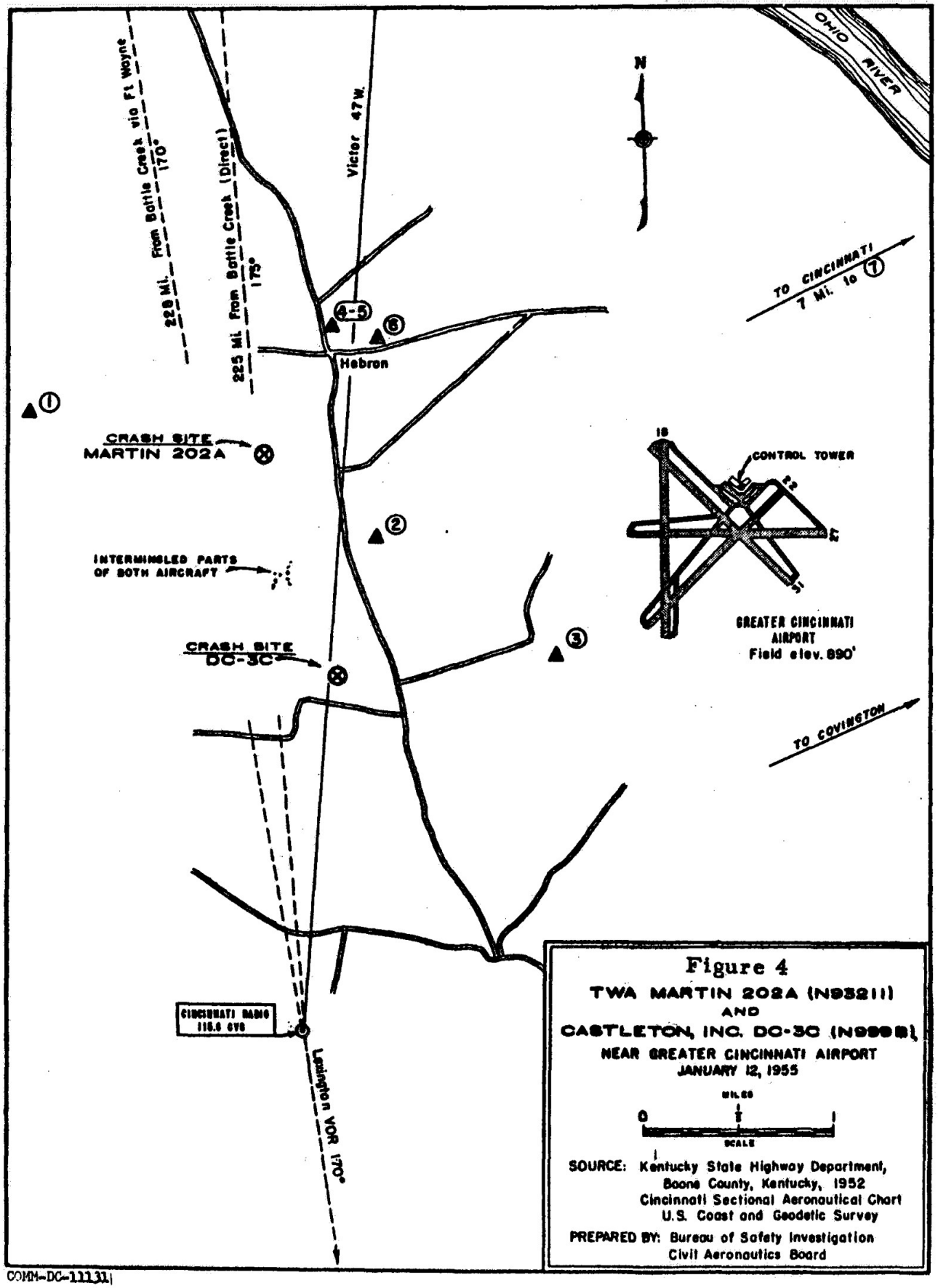

Figure 4

TWA MARTIN 202A (N93211)
AND
CASTLETON, INC. DC-3C (N9998)
NEAR GREATER CINCINNATI AIRPORT
JANUARY 12, 1955

MILES
0 1
SCALE

SOURCE: Kentucky State Highway Department, Boone County, Kentucky, 1952
Cincinnati Sectional Aeronautical Chart
U.S. Coast and Geodetic Survey

PREPARED BY: Bureau of Safety Investigation
Civil Aeronautics Board

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