

of the engine instrument power takeoff.

Continuing along the circuit, there is evidence that the Phase A circuit breaker and the first officer's inverter selector switch were intact and conductive before the takeoff and during the flight. This is substantiated by the crew's report of normal reception of the La Guardia ILS on the No. 2 Navigation receiver, normal reception of the La Guardia range station on No. 2 ADF receiver, and normal indication of the No. 2 pointers of the ADF indicators. Each of the aforementioned items is operated from the 115-v. Phase A of the lower inverter, when the inverter switches are positioned as described.

Evidence that Phase A power remained available during the flight is the finding of the first officer's course indicator azimuth ring indicating 282 deg. when recovered from the wreckage. This heading presentation indicates that the instrument was operating properly and receiving proper heading information during the flight. Both the course indicator and the A-12 gyropilot, which supplies it with heading information, are powered by Phase A.

Gyro Power Source

The first officer's turn-and-bank indicator and gyro horizon indicator were powered by both Phase A and Phase C of the lower inverter. These, incidentally, were the only items powered by Phase C of the lower inverter. The circuits supplying power to these instruments are identical to those supplying the captain's instruments, and, therefore, they lend themselves to a similar analysis. Briefly, it is considered possible to lose the Phase A primary fuse and have the gyro horizon tumble before receiving an inverter failure warning indication. The other three fuses must have been intact. It is equally possible to have a failure of an electrical connection or wire at or within one of these instruments, as with the captain's instruments, resulting in an inoperative instrument and no warning light indicator.

In summary, loss of power to both the gyro horizon indicator and the turn-and-bank indicator of the captain's panel, without receiving an inverter failure warning, can occur as the result of a single failure; however, this failure will not cause loss of power to the similar instruments on the copilot's panel. At least one additional and similar failure or two additional unrelated failures would be required to lose power to both sets of gyro horizon and turn-and-bank indicators. At least two additional failures would be required to lose indication of both ADF receivers.

In analyzing the operational phase of this flight, a careful study was made of all known facts in conjunction with the testimony of the crew. In the analysis it must be borne in mind that the aircraft was airborne approximately 31 sec. during which time it traveled a distance of some 6,600 ft. and turned approximately 119 deg. to the left.

Both Capt. Marsh and First Officer Dixwell testified that the takeoff was normal and that they observed no indication of any irregularity or deviation from the takeoff heading. Testimony of the crew and passengers appears to be in general agreement in that the aircraft was not banked when it

passed over the runway and there was no feeling of any abrupt changes in attitude during the flight. One passenger, with 400 hr. of piloting experience, testified that the aircraft was in a steep left bank just prior to the time he observed a leveling action of the aircraft immediately prior to impact. Considering this testimony, the time consumed in reaching the end of the runway, and the time involved in attempted recovery, it must follow that the turn, although steep, was a coordinated one and was accomplished within a period of some 20 sec. Thus, the rate of turn was in the magnitude of six degrees per second.

From the testimony, it is evident that the aircraft's acceleration after takeoff was normal and that Capt. Marsh followed the prescribed company procedures in ordering the landing gear to be retracted, the wing flaps raised, and power reduced to METO. Considering the short time involved in the execution of these commands, it is considered highly probable that, when the power was being reduced to METO, the wing flaps were still either in the process of retracting or were just completing the retraction. During this period, in which the configuration of the aircraft was progressively changing to en route climb, it would be imperative that the pilot devote his full attention to his flight instruments in order to control the aircraft effectively.

Observes Engineer

Capt. Marsh testified that he observed the flight engineer in the process of reducing to METO power. Without reference to the proper flight instruments at this time, Capt. Marsh would be unable to take the proper control action. Capt. Marsh stated that his prime concern was the airspeed, rate of climb, and direction. Further testimony indicated that he used his ADF indicator as a primary directional instrument, took little advantage of the C-2A Gyrosyn compass or azimuth card of the course indicator, and made little reference, if any, to the artificial horizon or turn-and-bank indicator. He did not use the magnetic compass.

Capt. Marsh testified that he knew at the time that the C-2A Gyrosyn compass had been somewhat unreliable. This fact, and the knowledge that the course indicator was a repeater, should have alerted the captain to check the C-2A Gyrosyn compass against the magnetic compass at the engine runup position. Following takeoff he also

disregarded the altimeter and substituted the rate of climb indicator, referring to the altimeter only on every third or fifth scan of the panel, attaching little importance to this instrument. From this testimony it is evident that Capt. Marsh did not take advantage of his full instrumentation nor did he rely upon primary instruments.

A consideration that cannot be overlooked is the possibility of the pilot becoming disoriented by reason of attempting to remain visual for too long a period after takeoff and losing visual contact before the transition to instrument flight. However, Capt. Marsh was very emphatic in his testimony that he went on instruments when the gear was retracted and did not look out again until he saw the ground immediately prior to striking it. Snowfall occurring during the takeoff at night, with the landing lights on, could have produced a glaring effect or a period of temporary blindness, and the time involved after reference to the instruments may not have been sufficient to allow return to normal vision. This consideration cannot be completely ruled out; however, because of Capt. Marsh's testimony, it would appear not to have been a major contributing factor.

Both pilots stated that they went on instruments shortly after takeoff. They described their duties and manner in which they performed such duties. Both stated everything was normal. Neither pilot was able to give a reasonable explanation for the unusual attitude of the aircraft.

The possibility of pilot fatigue was considered. The crew reported on duty some 10 hr. prior to the accident. Total flight time involved a period of approximately four hours. A delayed departure and waiting for the aircraft, which was fully loaded with passengers for several hours, to be released for flight may have caused the crew some concern; however, there was no evidence to indicate that fatigue was a factor in this accident. Had the flight to Miami been completed in the planned time the total duty hours of the crew would not have exceeded their contract limits.

It is customary for the first officer to monitor the flight instruments during an instrument climb-out. According to his testimony, First Officer Dixwell monitored the engine instruments and the flight instruments until the command was given for METO power. He then devoted his attention to monitoring the flight engineer's ac-