CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: August 5, 1957 Released: August 8, 1957

PHILLIPS PETROLEUM COMPANY, LOCKHEED LODESTAR 18-14, N 28366, BARTLESVILLE, OKLAHOMA, DECEMBER 12, 1956

The Accident

A Lockheed Lodestar, model 18-14, N 28366, owned and operated by the Phillips Petroleum Company, crashed and burned 6-1/2 miles southeast of the Bartlesville, Oklahoma, Municipal Airport, December 12, 1956, about 0850.1/ Both pilots and the six passengers were killed.

History of the Flight

The purpose of this flight was to take six passengers, all Phillips' employees, from Bartlesville, Oklahoma, to Salt Lake City, Utah. Company Pilot Joe Mark Bower and company Copilot-Mechanic Robert Ellwood Ulrich were assigned to the flight by the Aviation Department of Phillips.

When the aircraft was loaded and prior to leaving the ramp Copilot Ulrich called the company radio station, located on the airport, requested taxiing instructions, and asked for an IFR clearance to Salt Lake City, nonstop. The company radio operator obtained the desired clearance from ARTC through Tulsa, and immediately relayed it to the aircraft. A flight plan previously prepared contained the following information: Proposed time of departure 0805; estimated elapsed time 5 hours, 15 minutes; fuel on board 6 hours.

Departure was at 0826. At that time the gross weight of the aircraft was 19,284 pounds (maximum allowable was 19,500 pounds), and the load was properly distributed with respect to allowable center of gravity limitations.

About 14 minutes after takeoff, at approximately 0840, Copilot Ulrich called Bartlesville Radio and stated that the flight was having engine trouble, with an oil temperature over 100 degrees, and requested that the IFR flight plan be canceled as they might return. The Bartlesville operator complied and notified Tulsa.

At the next contact, about 0845, the copilot again called Bartlesville Radio stating that they could not unfeather the propeller. At that time he asked the Bartlesville operator to determine the condition of the runways at Tulsa (about 40 miles to the south). This information was obtained and immediately relayed to the copilot, whereupon he said, "Going to Tulsa, changing

1/ All times herein are central standard based on the 24-hour clock; all distances are in nautical miles and all airspeeds are in knots.

over." Bartlesville's single 4,600-foot runway had patches of snow and ice while all runways at Tulsa Airport were clear. This was the last radio contact with the flight. None of the messages had mentioned which engine was giving trouble; none indicated any anxiety or stress. There is no known record of N 28366 having made radio contact with any ground station or aircraft other than Bartlesville Radio.

About the same time as the last radio contact, the Bartlesville radio operator and Phillips' chief pilot saw the aircraft passing south of the Bartlesville Airport heading easterly. They estimated its altitude to be 3,000 feet above the ground. The aircraft continued east for about 4-1/2 miles, until beyond the more congested part of Bartlesville, and then turned to the right about 90 degrees toward Tulsa.

A number of persons saw the flight after it turned toward Tulsa. When it had been on this southerly heading for about four miles the aircraft was seen to plunge to earth in a manner described by several witnesses as a spin. Impact with the rolling terrain was on a heading of about 240 degrees, while the wings were about level, and while the nose-down angle was close to vertical. An explosion and intense fire ensued, largely destroying the general structure of the aircraft.

Investigation

At the time and place of the accident the weather was generally good and readily allowed VFR flight. Specifically, the Bartlesville weather at 1850 (20 minutes before the accident) was: Ceiling 6,000 feet, overcast; visibility 10 miles; temperature 36; dewpoint 30; wind calm.

Early in the investigation the possibility of collision with, or encountering of violent wash from, other aircraft was advanced as a reason for the seeming loss of control. Accordingly, this possibility was thoroughly probed. It was learned that there had been large military aircraft (B-36's) in the general area after the accident but it appears conclusive that they were not there before or at the time of the accident. Several weeks later a wheelwell door from a USAF jet fighter was found on the ground 3-1/2 miles from the crash site. Investigation revealed that this door had fallen free on December 17, five days after the crash of the Lodestar. None of the several witnesses who actually saw the Lodestar in apparently normal flight, and then descend in what appeared to be a spin, saw any other aircraft at the time or reasonably close to that time. In short, investigation determined that no other aircraft was involved in this accident.

A consensus of ground witness testimony indicates that: The altitude of the aircraft decreased from an estimated 3,000 feet as it passed south of the airport to considerably less altitude, possibly as low as 1,200 feet, as it neared the crash site; the speed of the aircraft decreased during this short interval; the final part of the flight was stable directionally toward the south and stable laterally with wings level; the aircraft fell off to its right and spun slightly more than two turns to its right before striking the ground.

Extreme localization and physical features of the general crushing and deformation of the wreckage indicated that the angle of impact was within 15 degrees of vertical. There was no evidence of rotation of the aircraft about the longitudinal axis. This together with the steep impact angle and the similar damage to both wing leading edges, suggests that there may have been an attempt to recover from the spin. No part of the aircraft was found elsewhere than in the wreckage area, indicating that no parts were shed prior to or during the final descent. There was no evidence of fire before impact.

Violent impact and fire had destroyed a great deal of the general structure. Aileron control cables remained attached to the steel chain and sprocket assemblies of both control wheels. Unmelted portions of the right-hand rudder pedals remained attached to their torque tubes while the left rudder pedals were intact but broken loose at the floor brackets. All rudder control horns were broken at impact. Rudder control cables remained attached to their fittings.

The master ignition switch was "on." Both individual ignition switch levers were sharply bent to the left, the right one beyond the "both magnetos on" position, and the left one to the left of the "off" position.

The autopilot was "off." The landing gear handle was about midway of the quadrant and bent sharply to the left. The flap handle was at "up" position. The left fuel tank selector valve was turned to the right front tank and the engine selector valve to the right engine. This aircraft was not equipped with wing de-icer boots.

Impact and fire damage precluded determining the readings of any of the cockpit indicators for rudder, elevator, and aileron trim. The engines' fire selector valve was positioned in the normal "off" position and the oil shutoff valves were in normal operating position. Fuel dump valve handles were broken off.

Wing flaps were fully retracted. The ailerons could be moved by their control cable at the wing roots. Both aileron push-pull rods were bent and the left bell crank was broken at its attach point. Balance weights in both ailerons were intact.

Examination of the aileron, rudder, and elevator control mechanisms disclosed no irregularities or breakage other than caused by impact and fire. All primary cables and trim tab cables had parted in the burned-out area. No evidence of metal fatigue was found in any of the broken parts.

Impact had moved control tabs so that their settings were incompatible and meaningless.

Number 1 (left) engine. All cylinders were damaged at impact or by fire after impact and 5 were knocked off their pads; others were badly burned. Several rocker boxes were broken off.

Intake manifolds were severely crushed but all remained connected to their cylinders and were free of indications of foreign deposits or operating

difficulties. Exhaust manifolds were also severely deformed. They were secure at the cylinders, but uncoupled at the collector ring. The exhaust stacks and the collector ring showed no burnouts or other indications of operating failures.

Examination of the valve actuating assemblies indicated that all valve adjustment screws were uniform in appearance. Valve guides showed no indication of burning or high operating temperatures. All rocker assemblies were apparently in normal condition prior to impact.

Cylinder interiors appeared to be in normal condition. Pistons were intact and free of indications of maloperation; piston rings were free in their grooves, and the piston pins were intact and free.

All link rods were free with their knuckle pins in normal condition. The rear master rod was seized to the crankshaft and the front one was immobilized by impact. Master rod bearing material was found loose in the rear power section. The rear master rod bearing had failed completely. All of the lead indium coating of this bearing and approximately 95% of its silver was worn away. Bearing oil holes were plugged with this material and bearing shells were blued by overheating. Approximately 45% of the bearing material was bonded to the rear crankpin. Two of the rear crankpin oil tubes were completely filled with bearing material.

The front master rod bearing was intact with no indications of failure. A small area, approximately one-half inch wide, of the lead indium coating was slightly worn. Bearing and front crankpin oil holes were open and free of foreign material.

Both master rod assemblies were in place with only the rear rod showing signs of high operating temperatures. The crankshaft and its counterweight bore no evidence of operating difficulty. Both front and center main bearings were intact and free of failures; the rear main bearing had been severely heated by ground fire.

The rear support plate was entirely consumed by ground fire and melted metal from it filled the rear cam compartment. The rear cam assembly was in place although damaged by fire and impact. The cam lobes were not spalled or excessively worn and the cam tracks appeared normal.

Spark plugs were BG Type RB27R. They had been in service about 22 hours since factory reconditioning, according to company maintenance personnel. None had fused or peened electrodes nor were there any deposits built up on the nose ceramics. The electrode gaps were properly set.

All engine-mounted accessories, with the exception of the propeller governor and carburetor, were destroyed by ground fire.

The carburetor, a Stromberg model PDL2H-4, S/N 266279-A, was broken from the rear case. Its fuel control assembly had broken free and the mixture control was jammed in the idle cutoff position. The fuel strainer was broken and the fuel screen was free of any foreign matter. The throttle assembly was jammed in full closed position and the fuel discharge line had broken free.

The propeller governor, a Woodward model 4G8-C-23, had separated from the nosecase at impact. Its control cable was severed. This governor appeared to be in normal condition and with no evidence of foreign material.

Number 2 (right) engine. This engine was also examined with great detail. Nothing was found to indicate any malfunctioning, no excess or abnormal wear was evident, and there was no sign of oil starvation. The accessory section of this engine was destroyed by fire. It was therefore impossible to determine whether or not a malfunction or failure in this portion of the engine had occurred.

Spark plugs in this engine were also BG model RB27R with 22 hours of service since factory reconditioning. No fused or peened electrodes or foreign deposits built up on the nose ceramics were found. The electrode gaps were properly set at .013". Examination of the firing ends of these plugs revealed no evidence to cause operating difficulty.

The propeller governor, a Woodward model 4G8-G-23, was broken from its mounting at impact. It appeared normal with no indications of foreign material or excessive wear.

Number 1 (left) propeller. This propeller was tight on the shaft and two blades were tight in the hub; the third blade was broken off at the shank. As a result of impact all blades were bent in various amounts and the dome shell was deformed inward in the area of the dome plug. The dome retaining nut was secure and safetied.

The pitch-changing mechanism was in normal condition. The stop rings were in place and set for a range from 88 degrees, full feathering, to 24 degrees, low pitch. The dome piston position corresponded to a blade angle of 81 degrees.

The barrel halves were intact and all barrel bolts were tight. All barrel blocks were in place although severely crushed by impact. The spider assembly and cones showed no damage. The propeller retaining nut was loose although the safety ring was in position. The distributor valve was in place although its lock ring was displaced.

The No. 1 propeller blade was broken off in the shank near station 5 and was bent toward its face side approximately 20 degrees at station 42. Thrust bearings, washers, and segment gear were free of damage or failure. The Nos. 2 and 3 blades remained tight in the hub. Both were bent slightly toward their face sides approximately 10 degrees at station 42. All blade bearings, thrust washers, and segment gears were free of indications of inflight failures. The shim plates of all three blades of the propeller were marked at impact, indicating a blade angle of 88 degrees, and were broken along the impact loading lines.

Nothing was found during the examination of this propeller and its associated mechanisms to show why it could not have been unfeathered.

Number 2 (right) propeller. The propeller was tight on the shaft with two blades broken off at the shank; the remaining one was tight in the hub. All blades were bent toward their cambered sides.

The dome shell was completely broken from the pitch-changing mechanism at impact. This mechanism exhibited no indications of maloperation prior to impact. The stop rings were installed for a blade range of 24 degrees, low pitch, and 88 degrees, full feathering. The dome piston position corresponded to a blade angle of 24 degrees.

The barrel halves were free of inflight failures. All barrel bolts were tight and all seals were in place. The spider assembly was in normal condition although its phenolic ring was severely crushed. All retaining nuts and cones were in position and free of damage. Barrel blocks were in place although crushed. The distributor valve was secure in the shaft, but its valve spring and housing were impact-damaged.

No. 1 propeller blade was broken off in the shank at station 5. It had a gradual bend toward the camber side of approximately 20 degrees at station 36, and a sharp rearward bend of 60 degrees at station 46. The blade segment gear was pulled loose from the blade butt by impact, as were four of the spring pack assemblies. Thrust washers were intact and thrust bearings were free of indications of failures. The blade chafing ring was severely mutilated. The blade shim plate was broken at impact and impact marks on it indicated a blade angle of 24 degrees.

No. 2 propeller blade was broken off at the shank in a similar manner. It was bent toward its cambered side approximately 10 degrees at station 36. The blade segment gear, thrust bearings, and washers were intact and free of indications of operational distress. The shim plate was broken at impact, and a measurement of the impact mark indicated a blade angle of 24 degrees.

The No. 3 propeller blade remained tight in the hub. It also was bent about 10 degrees toward its cambered side at station 36, and the tip was bent forward about 30 degrees at station 56. The segment gear, thrust washers, and bearings exhibited no evidence of failures or operating difficulties. The shim plate was broken, due to impact, along the unsupported section of the spider assembly. A measurement of impact mark on the shim plate indicated a blade angle of 24 degrees.

Fuel and oil. Samples of the fuel and oil were collected immediately after the accident. The fuel sample, 91/98 octane, was taken from the storage tank used by N 28366. Analysis of the sample indicated that it was considerably better than the specification minimums. An oil sample was taken from a barrel used in servicing N 28366. It met, or was above, all requirements for SAE 50 oil. The analysis of this sample was compared with the oil from the No. 1 engine which also met required specifications. Spectographic analysis of the oil from the No. 1 engine was made for trace metals and it only reflected the presence of master rod bearing material.

Pilot Bower had been employed by Phillips for more than eight years prior to which time he had been employed as a captain for a major airline. He held all necessary CAA certification and had flown some 8,800 hours, 700 in Lodestars. Copilot Ulrich, also adequately certificated, had some 3,000 hours of piloting, of which 500 hours had been in Lodestars. It was company policy to work pairs of pilots together as unit crews and these two had flown together quite consistently in the subject aircraft and in others.

Bower was flight checked in this particular Lodestar by Phillips' hief Pilot Clark on October 18, 1956. Bower sat on the left, Clark on he right. No other persons were aboard and the aircraft at that time rossed a computed 18,274 pounds. The check flight lasted for 1 hour, 5 minutes. It covered a variety of unusual flight conditions including ingle-engine operation, single-engine operation at near stall speed, and he checking of speeds close to the stall point. Different flight configuations, involving landing gear and landing flaps, were also tried. At the onclusion of this flight, which was primarily to check the aircraft rather han Bower's flying ability, Chief Pilot Clark was completely satisfied with oth. At the time of the flight check, the maximum gross weight of the aircraft was 18,500 pounds; authorization for an increase in maximum gross to 9,500 pounds became effective 22 days prior to the accident.

The Bartlesville Airport is at an elevation of 715 feet m. s. l. and he crash site is at substantially the same elevation. Witnesses at varied ocations and distances estimated that the aircraft was about 1,200 feet above he ground when the spin started. Thus, it was at about 1,900 feet m. s. l. t that time. The subject aircraft, grossing 19,500 pounds, should have been apable of sustained single-engine flight at maximum continuous power at that ltitude. This capability is a prerequisite of CAA certification. Its maxium single-engine operating altitude with en route configuration (flaps up, gear p, and inoperative propeller feathered) was 7,600 feet. This presumes sustained aximum continuous power.

nalysis

There are a number of possibilities to account for the loss of control. ilot Bower may not have been sufficiently alert to the somewhat critical ingle-engine flight characteristics of the aircraft grossing as much as it id. It has been mentioned that the computed gross at takeoff was 19,284 ounds, quite close to the maximum allowable of 19,500 pounds. The duration f the flight, about 24 minutes, would have lessened the fuel weight by possibly 00 pounds. The aircraft would thus have grossed about 18,884 pounds at the ime of the accident. Bower was quite familiar with the subject aircraft at a esser weight. The check ride, mentioned under Investigation, was at a takeoff eight of 18,274 pounds gross. The fact that Bower decided to continue for 40 iles to Tulsa, over flat terrain and in good weather, rather than land at his ome field indicates that he was not particularly perturbed. And yet within a ew minutes considerable altitude had been lost as well as enough speed so that ontrol was also lost.

Other possibilities remain. One is of an obscure irregularity of control lthough none was found in that part of the wreckage which could still be gainully examined. Another was po er reduction in the remaining engine. Again othing was found to indicate or even suggest this. Of course, the singlengine flyability of the aircraft was dependent upon sustained maximum continuus power from the right engine, with the left propeller feathered, as this one as. As has been pointed out, it is impossible to determine if maximum coninuous power was sustained.

Neither induction nor wing icing appears to have been possible.

The reason for the inability to unfeather the left propeller was not learned. Had it been possible, and if the left engine could have been temporarily brought back into use (this does not necessarily follow because of the nature of the bearing damage), Bower undoubtedly would have landed at Bartlesville, as must have been his initial intent. Possibly there was an electrical defect in that propeller feathering mechanism; if so, it remains undetermined because of destruction by fire.

Obviously, the failure of the rear master rod bearing of the left engine was the reason for the reported rise in oil temperature necessitating shutting down that engine. The cause of the bearing failure cannot be determined because of a multiplicity of factors which could not be isolated due to the complete destruction of that bearing. It probably was not oil starvation because this would normally cause distress first in the front bearing which receives oil after the rear bearing; the front bearing was intact.

Master rod bearings sometimes develop hard spots on their lead indium coatings if stored for long periods. These hard spots can become foci of failure. The subject bearings were installed in the left engine in March 1954. The overhaul agency had no record of the length of time the bearings had been in stock prior to that time.

The failed bearing had been reconditioned by its manufacturer. However, the extent of the damage precluded analysis of the quality of the reconditioning process which requires high precision and closely controlled processes.

Master rod bearings must be fitted to extremely close tolerances. Engine overhaul records indicated that engine assembly was performed in accord with manufacturer's procedures. Since this engine had 791 hours of operation at the time of the accident, it is unlikely that the bearing was fitted incorrectly because if it had been it would almost certainly have failed much earlier.

Findings

On the basis of all available evidence the Board finds that:

1. The aircraft and both pilots were properly certificated.

2. The gross weight of the aircraft at the time of the accident was approximately 616 pounds less than the maximum certificated gross takeoff weight of 19,500 pounds.

3. There was no indication of unairworthiness in the airframe or its controls, as far as could be learned.

4. The No. 2 (right) engine, although not subject to complete examination due to ground fire, exhibited no signs of malfunctioning.

5. Neither propeller nor their feathering mechanism showed any evidence of malfunctioning.

6. The left engine developed a bearing failure and its propeller was feathered.

7. The reason for the bearing failure cannot be isolated.

8. Single-engine flight was started for a distance of 40 miles.

9. Early in this flight altitude, speed, and then control were lost, and the aircraft spun to the ground.

Probable Cause

The Board determines that the probable cause of this accident was loss of flying speed during single-engine flight for reasons undetermined, resulting in a spin to the ground.

BY THE CIVIL AERONAUTICS BOARD:

/s/ JAMES R. DURFEE

/s/ CHAN GURNEY

/s/ HARMAR D. DENNY

/s/ G. JOSEPH MINETTI

/s/ LOUIS J. HECTOR

SUPPLEMENTAL DATA

Investigation and Depositions

The Civil Aeronautics Board was notified of this accident immediately after its occurrence. An investigation was started promptly in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. This investigation included examination of the physical evidence at the scene of the crash and examination of the company records. Depositions were taken at and near Bartlesville, Oklahoma, on January 30 and 31, and February 1, 1957, and at Washington, D. C., on February 9, 1957.

Operator

Phillips Petroleum Company is a Delaware corporation with headquarters at Bartlesville, Oklahoma. The company owned the subject airplane, N 28366, as well as a fleet of nine other aircraft of various makes, all used in the furtherance of company business. Phillips has owned and operated a total of 50 executive-type aircraft since 1927.

Flight Personnel

Joe Mark Bower, age 38, had been employed by the Phillips Company since April 1948. Prior to that time he had been employed by a major airline as a captain flying regular schedules. Mr. Bower had flown a total of 3,937 hours, of which about 700 had been in aircraft of the subject type. He had flown 24 hours, 20 minutes within the previous 30 days, and had not flown for 72 hours prior to the subject flight. His certification included a valid airman certificate with an airline transport rating and type ratings for several aircraft, including the Lockheed Lodestar. On December 12, 1955, he passed his last physical examination, and on October 18, 1956, his last competency check (described under Investigation).

Robert Ellwood Ulrich, age 36, had been employed by Phillips since July 1948. He had flown a total of 3,000 hours, of which some 500 had been in Lodestars. Mr. Ulrich held valid certificates as a private pilot and as an aircraft and engine mechanic.

The Aircraft

Lockheed Lodestar, model 18-14, N 28366, serial number 2043, had been owned by the Phillips Petroleum Company since January 22, 1941. The aircraft was initially certificated for a gross takeoff weight of 18,500 pounds. However, 22 days before the accident the authorized gross takeoff weight was increased to 19,500 pounds. This authorization was contingent upon certain requirements which had been met.

Engines were Pratt and Whitney, model R-1830-92, the left (No. 1) having 791 hours since overhaul and the right (No. 2) having 756 hours since overhaul. Propellers were Hamilton Standard, model 23E50-473 with model 6379A-0 blades. Both hubs and all six blades had had 800 hours of service since last overhaul.

Although many pertinent maintenance records were lost in the fire following the crash, it appears that all maintenance on the aircraft and its powerplants was adequate and current.