

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



WPR24LA060/193573

EXAMINATION SUMMARY

March 25, 2024

A. ACCIDENT

Location: Carlin, Nevada
Date: December 21, 2023
Time: 1210pst
2010utc
Airplane: MOONEY - M20J - N2073K

B. EXAMINATION PARTICIPANTS

IIC Michael Hicks
National Transportation Safety Board
Federal Way, Washington

Subject Matter Expert Mark Platt
Lycoming Aircraft Engines
Phoenix, Arizona

Subject Matter Expert Philip Grice
Continental Aerospace Technologies
Mobile, Alabama

C. SUMMARY

Examination of the airplane's engine revealed that the propeller governor pressure relief valve jam nut was finger tight and exhibited evidence of an oil leak. Additionally, while checking the magneto to engine timing, the single drive dual magneto contact assembly breaker points failed to open on the left magneto.

D. DETAILS OF THE EXAMINATION

1.1 Fuel/Fuel System

Fuel Pump Manufacturer: Lycoming
P/N: LW-15473
S/N & Date Code: H4411

All engine compartment fuel lines were found to be in place and secure at their respective fitting of each fuel system component. The fuel injection servo remained securely attached at the mounting pad of the plenum. The throttle/mixture controls were found securely attached at their respective control arm of the servo. The throttle and mixture arm castellated nut and cotter pin remained secure with the serrated

interface securely mated. The plug on the side of the injector body was secure with the safety wire in place.

The fuel flow divider (aka: spider) remained secure at the mounting bracket situated at the top of the engine. The fuel lines remained secure at each flow divider fitting and fuel injector at each cylinder. The flow divider was not disassembled. The fuel injection nozzles remained secure at each cylinder with the respective fuel line attached. The nozzles were not removed.

The fuel pump was attached to the engine at the mounting pad. The fuel lines remained secure at their respective fittings. The fuel pump was removed for examination and contained fuel. The fuel pump remained free of internal mechanical malfunction and obstruction to flow. The diaphragm remained pliable and intact with no oil present on the fuel vane side.

1.2 Accessories

The starter was securely attached at the mounting pad, with the electrical connection secure at the post.

The alternator was securely attached at the mounting pad with the electrical connections secure at each post.

The rear-mounted vacuum pump was secure at the mounting pad. The drive was turned during hand rotation of the propeller. The vacuum pump was not removed for examination.

The oil filter was secure at the mounting pad and was not removed for examination. The oil suction screen was found secure and uncontaminated by any pre-mishap debris. There was no evidence observed of any pre-mishap lubrication system contamination found during the examination.

2.0 Engine Examination

IO-360-A3B6D
Serial No. L26123-51A
TBO: 12 year or 2,000 hours

Last Annual: 1/5/2023
-T/T @ Annual: 3,894.0 hrs.
-TSO @ Annual: 1,996.8 hrs.
-Tachometer: 1,432.8 hrs.

- No issues documented at Annual Inspection
- Magneto timing checked

Last Oil Change Recorded: 10/4/2023

Last Maintenance: 10/25/2023

- Replaced mechanical fuel pump
- No times recorded

The powerplant was a four-cylinder, air cooled, direct drive, horizontally opposed, normally aspirated (carburetor), internal combustion engine rated at 200hp @ 2,700rpm. The engine remained attached to the airframe by the engine mount. The engine sustained no significant impact related damage. Visual examination of the engine revealed no evidence of pre-impact catastrophic mechanical malfunction or fire. The oil dip stick showed approximately 6 quarts of lubricating oil. All fuel and oil lines remained secure at their respective components and fittings. The firewall surface on the right side (seated looking forward) was coated with an oil residue.

The propeller revealed no damage to the spinner. The propeller blades showed impact damage with one blade bent slightly aft with chordwise scratches from the leading edge to the trailing edge. The opposite blade revealed aft bending, about 33 percent of the outboard section of the blade showed chordwise and spanwise scratches. The rocker covers were not damaged. The intake and exhaust pipes were unrestricted with minor scratches. The exhaust stack sustained minor impact damage. The throttle and mixture linkage remained connected. All accessories remained attached and secure. The upper and lower engine cowling were unremarkable and removed for the engine examination.

Spark Plug Manufacturer: Tempest
Type: UREM-38E



Figure 1: Forward to aft view of top spark plugs

The spark plugs were secure at each position with their respective spark plug lead attached. The top spark plugs were removed, examined and revealed equal wear with no visible abnormalities. The spark plug electrodes remained mechanically undamaged, and according to the Champion Spark Plugs Check-A-Plug Chart AV-27, the spark plug electrodes displayed coloration consistent with normal operation. The magneto impulse coupling could be heard via audible clicking. The ignition harness was attached at the magneto cap and each spark plug.

The crankshaft was rotated by hand utilizing the propeller. The crankshaft was free and easy to rotate in both directions. "Thumb" compression was observed in proper order (1, 3, 4, 2) on all four cylinders. The complete valve train was observed to operate in proper order and appeared to be free of any pre-mishap mechanical malfunction. Normal "lift action" was observed at each rocker assembly with equal travel on each. The valve springs, seats and keepers were all present, and intact. Clean, uncontaminated oil was observed at all four rocker box areas. Mechanical continuity was established throughout the rotating/reciprocating group, valve train and accessory section during propeller rotation of the crankshaft.

The combustion chamber of each cylinder was examined through the spark plug holes utilizing a lighted borescope. The combustion chambers and bottom spark plug electrodes remained mechanically undamaged and there was no evidence of foreign object ingestion or detonation. The valves were intact and undamaged. There was no evidence of valve to piston face contact observed. The gas path and combustion signatures observed at the spark plugs, combustion chambers and exhaust system components displayed coloration consistent with normal operation. There was no oil residue observed in the exhaust system gas path.

The single drive dual magneto was found securely clamped at the mounting pad. The impulse coupling was heard clicking near top dead center (TDC) during rotation of the crankshaft. The magneto to engine timing was checked utilizing a timing synchronizer box, by advancing the No. 1 cylinder piston to 20° before TDC. However, the timing synchronizer box would not produce an audible tone to indicate that either of the contact assemblies were open. The single drive dual magneto did not produce spark at any of the ignition leads and was removed for further examination. The magneto distributor housing was removed; the cam drive was rotated by hand and found that neither of the contact assemblies was functioning. The contacts did not appear burnt and the plastic cam follower foot was intact and showed no evidence of heat distress. There was no evidence of internal mechanical malfunction of the internal gears. The wiring within the magneto appeared normal. The magneto cap internal surfaces and wires remained free of oil residue or evidence of arcing. A definitive magneto service history could not be determined from available maintenance records.

With the timing synchronizer box positive wire attached to the right magneto capacitor spade terminal and with a proper ground connection assured, the single drive was rotated by hand, and the cam was observed in rotation. However, the cam follower would not engage the main breaker point frame bracket, thus allowing the breaker points to open or close. Subsequently, the contact assembly breaker points were manually separated using a screwdriver to lift the main breaker point frame bracket, separating the main breaker point from the retard breaker point, which produced a corresponding audible tone from the synchronizer box and the green light was not illuminated.

With the timing synchronizer box positive wire attached to the left magneto capacitor spade terminal and with a proper ground connection assured, the single drive was rotated by hand, and the cam was observed in rotation. However, the cam follower would not engage the main breaker point frame bracket. Subsequently, the contact assembly breaker points were manually separated by using a screwdriver to lift the main breaker point frame bracket, separating the main breaker point from the retard breaker point, which did not produce an audible tone, and the green light illuminated.

The magneto was shipped to the manufacturer, and a bench test was completed. The bench test revealed that the right magneto produced a spark to each of the four ignition leads. The left magneto did not produce a spark to any of the four ignition leads. The magneto distributor housing was removed for further examination and revealed that the right magneto cam follower was engaging the cam, thus allowing the contact assembly breaker points to open when the cam lobe lifted the cam follower, contact assembly frame bracket and breaker point. However, the left magneto cam follower was not engaging the cam.

The manufacturer's High Tension Magneto Service Support Manual (page 9-15) provided instructions to adjust the assembly frame bracket for breaker points clearance. Step No. 8 of the Contact Assembly Installation stated that the cam should be rotated so the high lobe(s) is (are) under the cam followers of the contact assemblies. Adjust the left main contact to obtain 0.016 ± 0.002 inch opening. Check the retard contacts for 0.016 ± 0.004 inch clearance.

The contact assembly frame bracket was adjusted to increase the breaker points opening clearance and subsequently, the magneto drive housing and the distributor housing were reassembled. A second bench test was conducted, and both the left and right magnetos produced a shower of sparks to each of the designated ignition leads. The left main contact was not measured before or after the bench test.

A review of the airplane's maintenance logs revealed that a definitive magneto service history could not be determined.

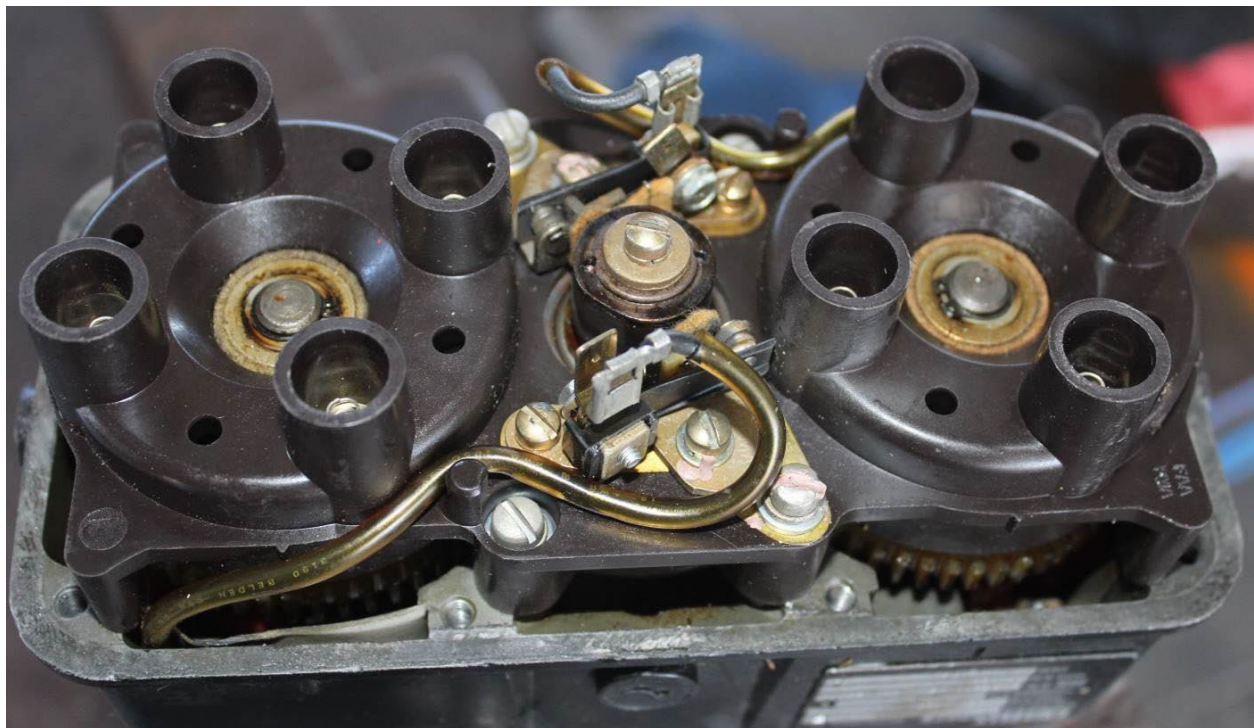


Figure 2: Top view of single drive dual magneto

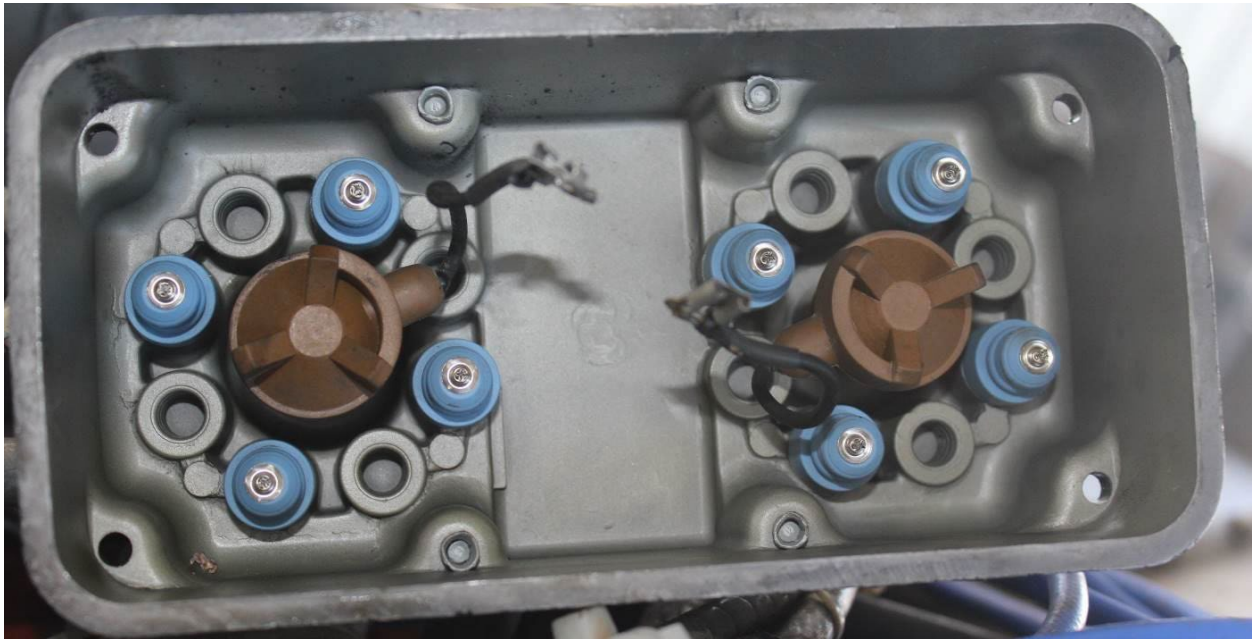


Figure 3: Inside view of the single drive dual magneto distributor housing

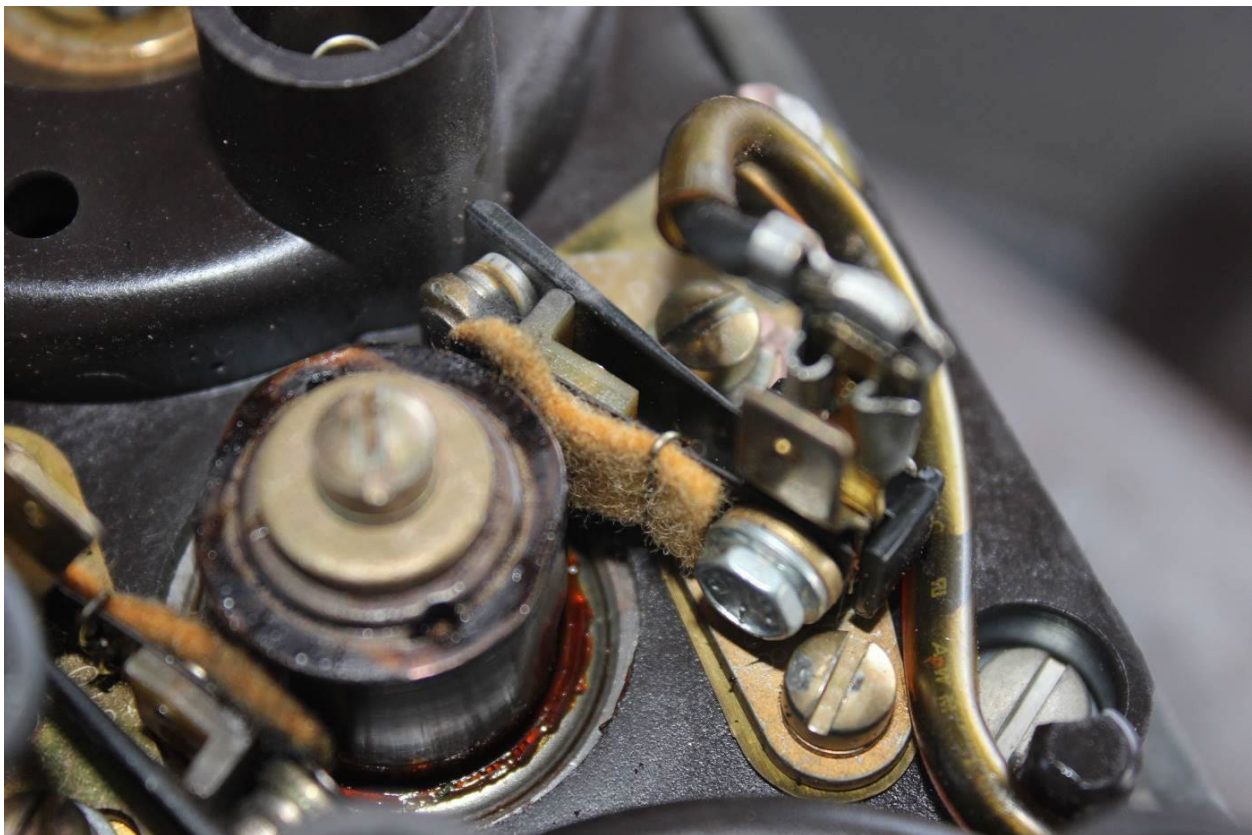


Figure 4: View of the right magneto breaker points contact assembly



Figure 5: View of left magneto breaker points contact assembly

3.0 Propeller Examination

Manufacturer: McCauley
Type: Metal

Propeller Governor Manufacturer: McCauley
P/N: C290D-5 J/T 17
S/N: 820470

The two bladed constant speed propeller remained attached at the crankshaft flange. The spinner was attached to the propeller. The propeller blades remained attached to the propeller hub. One blade was bent aft approximately 45° and the opposing blade remained showed slight aft bending. The propeller blades displayed leading edge burnishing and chordwise striations across the cambered surface. The

signatures were consistent with the absorption of rotational forces applied at the crankshaft at the time of impact.



Figure 6: View of impact damage to propeller blade with about 45° aft bending, chordwise polishing and spanwise scratches



Figure 7: View of impact damage with slight aft bending to propeller blade chordwise polishing

The propeller governor was securely attached at the mounting pad with the pitch control rod securely attached at the control arm. The governor was removed for examination. The drive was intact and free to hand rotate. The gasket screen was free

of visible contamination. The jam nut on the pressure relief valve was finger tight and exhibited evidence of an oil leak (figure 8).



Figure 8: View of propeller governor mounting gasket stack with oil residue

The proper governor mounting gasket stack as depicted in the applicable Illustrated Parts Catalog (IPC) and Lycoming Service Instruction 1438A was present and appeared free of visible oil leaks.

Submitted by:

Michael Hicks
Investigator-in-charge