

TESTS AND RESEARCH

Investigators from the Safety Board and the Federal Aviation Administration examined the wreckage on March 17, 2017, at a hangar in Corona, California.

The main wreckage came to rest on the airport property on flat, soft vegetation. The accident site was located about 1,650 feet from the departure end of runway 07. The front seat had a control quadrant on the left side; the levers were all bent and folded over to the right. The throttle was positioned in the mid-position and the mixture and propeller controls were full forward.



Picture 01: Main Wreckage

FUEL SYSTEM

The airplane's fuel system was a gravity-fed design where fuel flowed from the metal tanks in the inboard section of each wing, through a selector valve, and continued to an electric fuel pump. From the pump, the fuel was routed to a transducer where it was plumbed through the firewall to the gascolator, which contained a fuel screen. Thereafter, the fuel was directed to the engine-driven fuel pump, and then routed under the left cylinders to the fuel servo (located at the forward bottom of the engine). From the servo, the fuel was routed between the Nos. 1 and 3 cylinders to the fuel distribution manifold (i.e., spider) and then to each cylinder's injector.

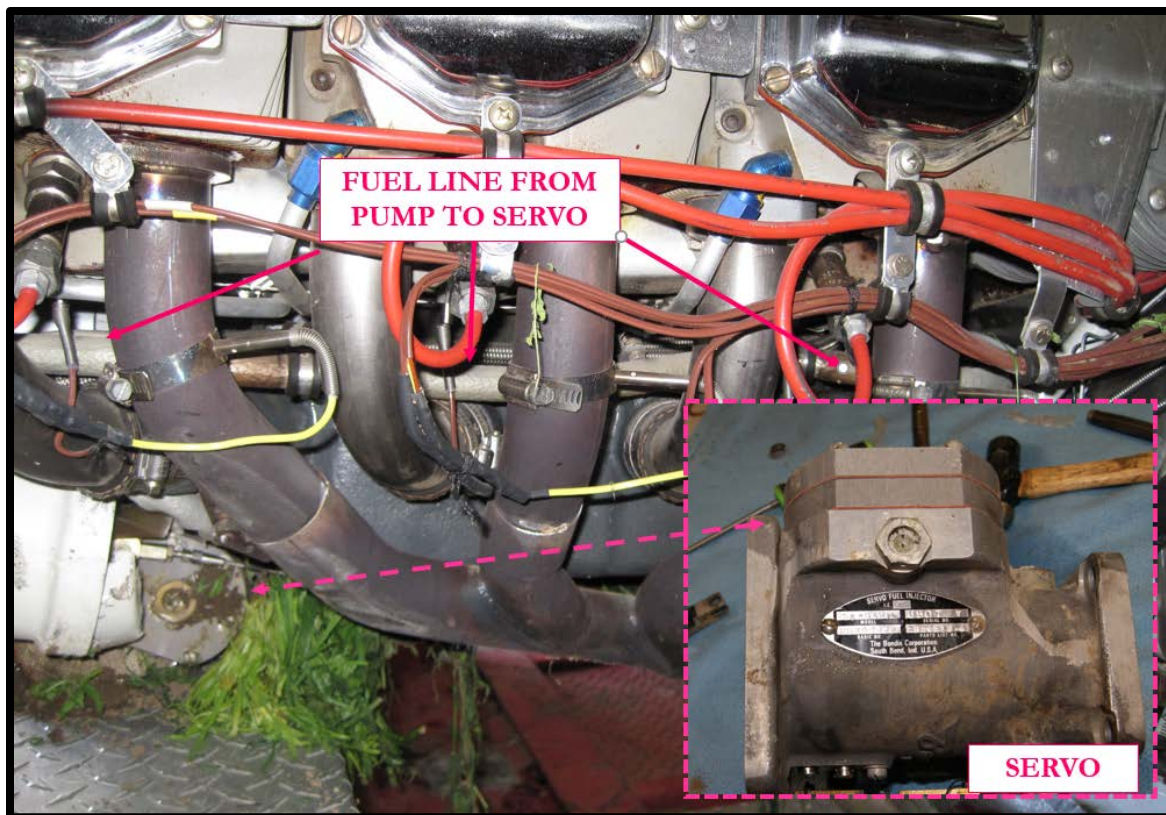
Both wings remained affixed to the airframe; the left fuel tank was breached. Fuel was recovered from both wing tanks. The fuel selector valve was found in the "OFF" position, but witnesses reported that first responders had repositioned the selector. The fuel selector was removed and found to turn smoothly and keyed correctly (i.e., when the right, left, off position was selected the valve would open to that side). The fuel pump was removed and investigators connected it to a power source. The pump clicked and air egressed from the outlet. The transducer was removed and disassembled; the wheel was intact and no anomalies were found. The gascolator contained trace amounts fuel and was free of debris. The upper housing of the fuel manifold was removed; there was no evidence of fuel and the diaphragm was dry.

The engine was mounted on a test stand and fuel was plumbed to the fuel pump; the fuel flowed freely and there was no evidence of blockage. Fuel was then plumbed to the fuel servo and investigators were unable to obtain flow to the outlet. The fuel servo was then removed and replaced with a similar model and fuel ran freely.

The fuel source was then attached to the inlet of the mechanical fuel pump and the system was reconnected with the exemplar servo. The propeller, damaged from the accident, was removed from the engine and a club propeller was installed on the engine. The engine was successfully started and ran for over five minutes at various power settings from idle to about 2,700 rpm. A magneto check was conducted on the left and right magnetos with a minimal rpm drop per magneto; no anomalies were found during the engine run.

FUEL SERVO

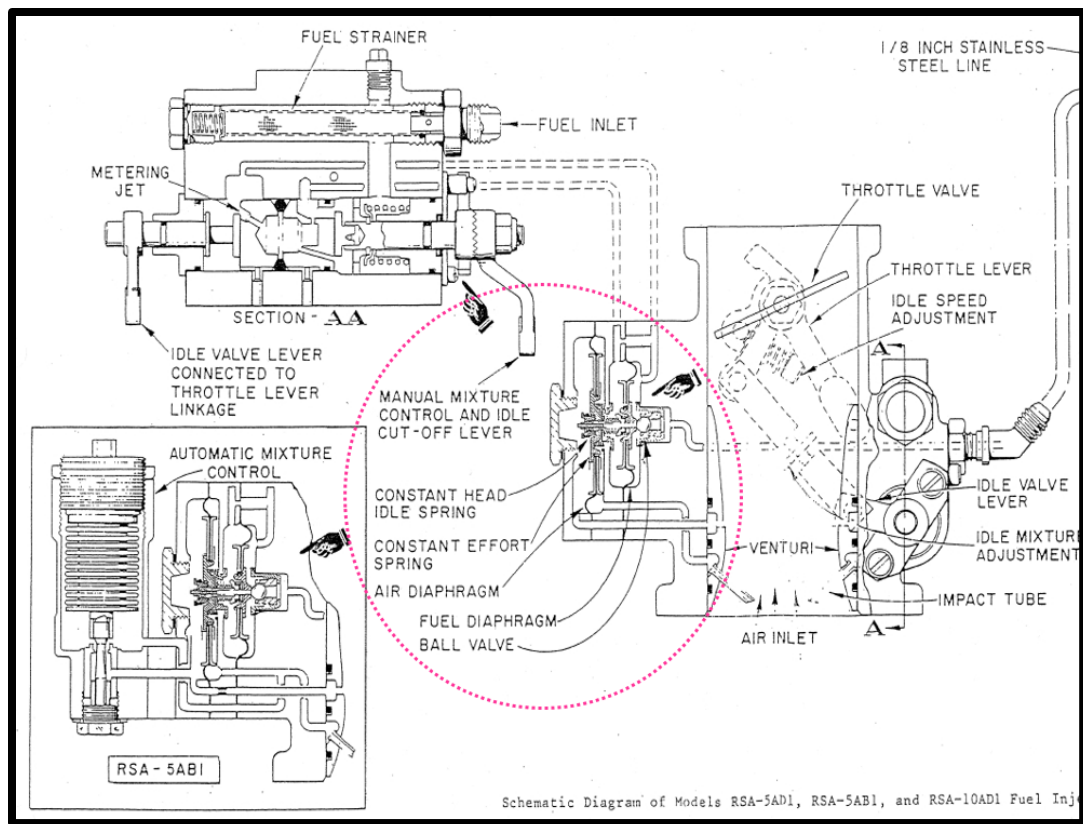
The fuel servo was a Bendix RSA-5AD1, (part number 2524213-1, serial number 6507-T), manufactured in 1977. The major components of the servo include the airflow section, the flow metering section, and the fuel regulator section. Together, these sections are designed to meter fuel in direct ratio to the volume of air being consumed by the engine.



Picture 04: Fuel Servo (on engine)

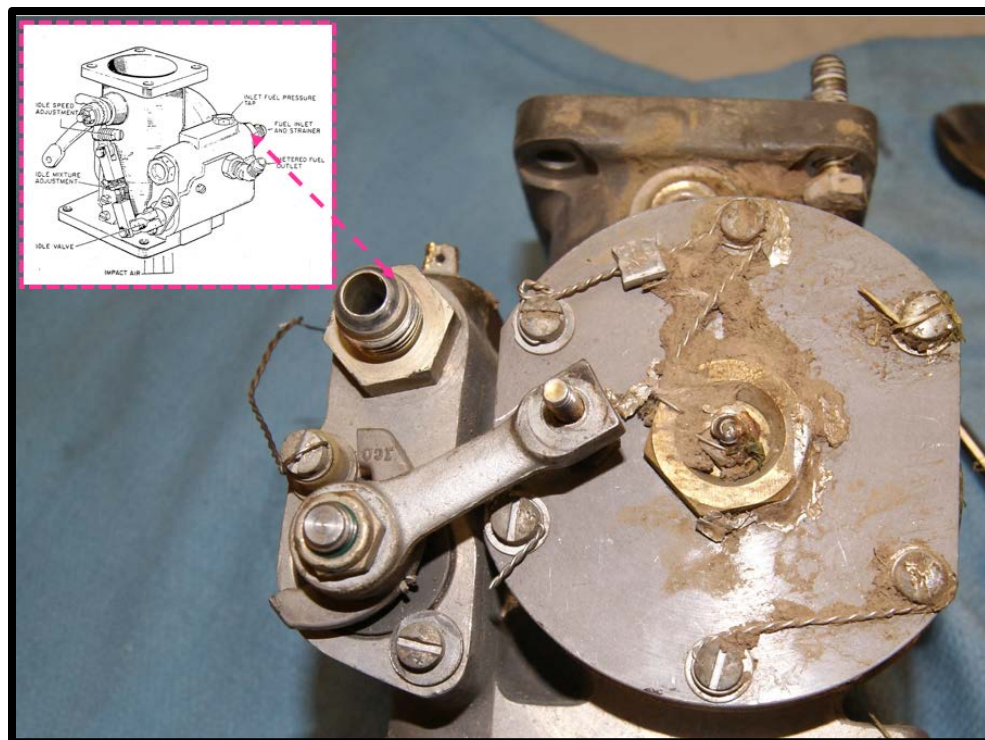
The regulator assembly contains an air diaphragm, a fuel diaphragm, and regulator stem that has a regulator ball affixed at the end. The air diaphragm senses impact air and compares it to venturi suction. The fuel diaphragm compares metered and unmetered fuel pressure. The diaphragms are connected by the regulator stem, which passes through the center body section of the regulator. The four chambers in the regulator section of the servo act in unison to cause the diaphragms to equalize and regulate the appropriate amount of fuel to the engine when the airflow is altered. When the engine is operating at a constant throttle setting, opposing forces of the fuel and air diaphragms cause the regulator valve stem to unseat to a specific position and an appropriate quantity of fuel is provided to the engine. As the throttle setting is increased, velocity of air through the venturi increases and pressure decreases within the suction side of the air chamber relative to the impact side. This creates a pressure differential across the air diaphragm and causes the regulator valve (ball at the end of the regulator stem) to move towards a

more open position. As the regulator valve opens (ball moves off the seat), more fuel is provided to the engine. Once the pressure differential across the fuel diaphragm stabilizes and reaches a force in equilibrium with the air diaphragm, fuel flow is again stabilized.



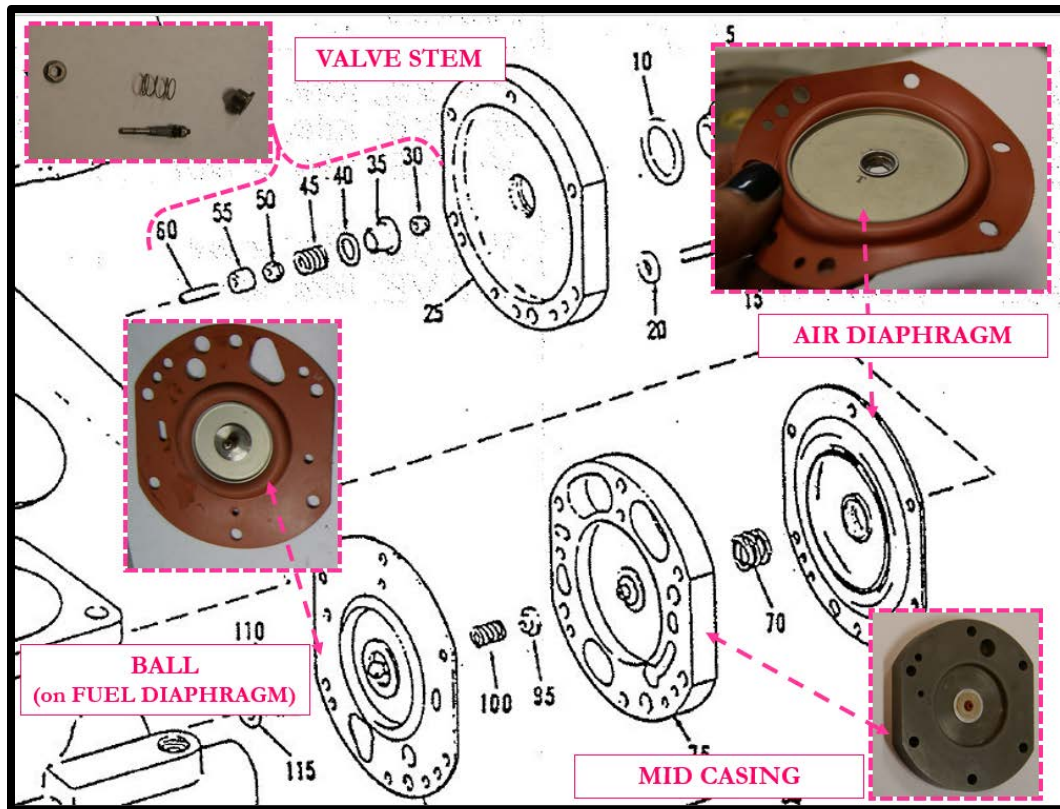
Picture 05: Fuel Servo (engineering drawing)

Fuel servo was completely disassembled. The safety wire on the regulator housing had a crimp with a stamp that read "AKB."

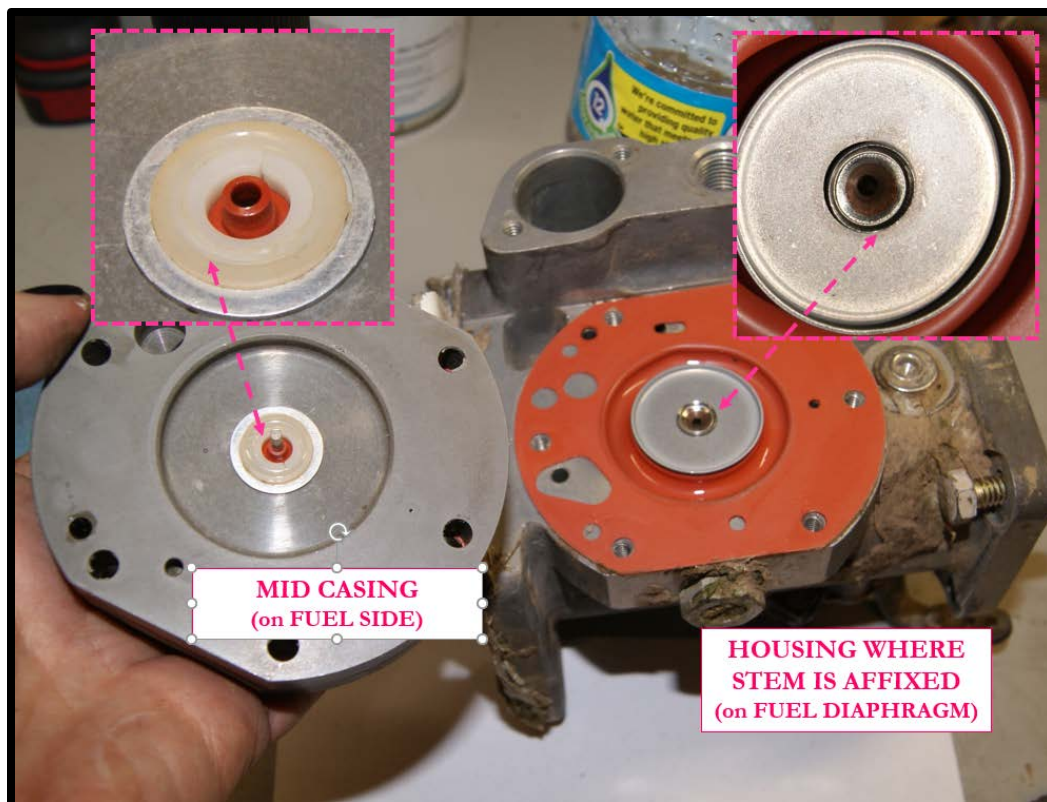


Picture 06: Fuel Servo (upper casing of regulator)

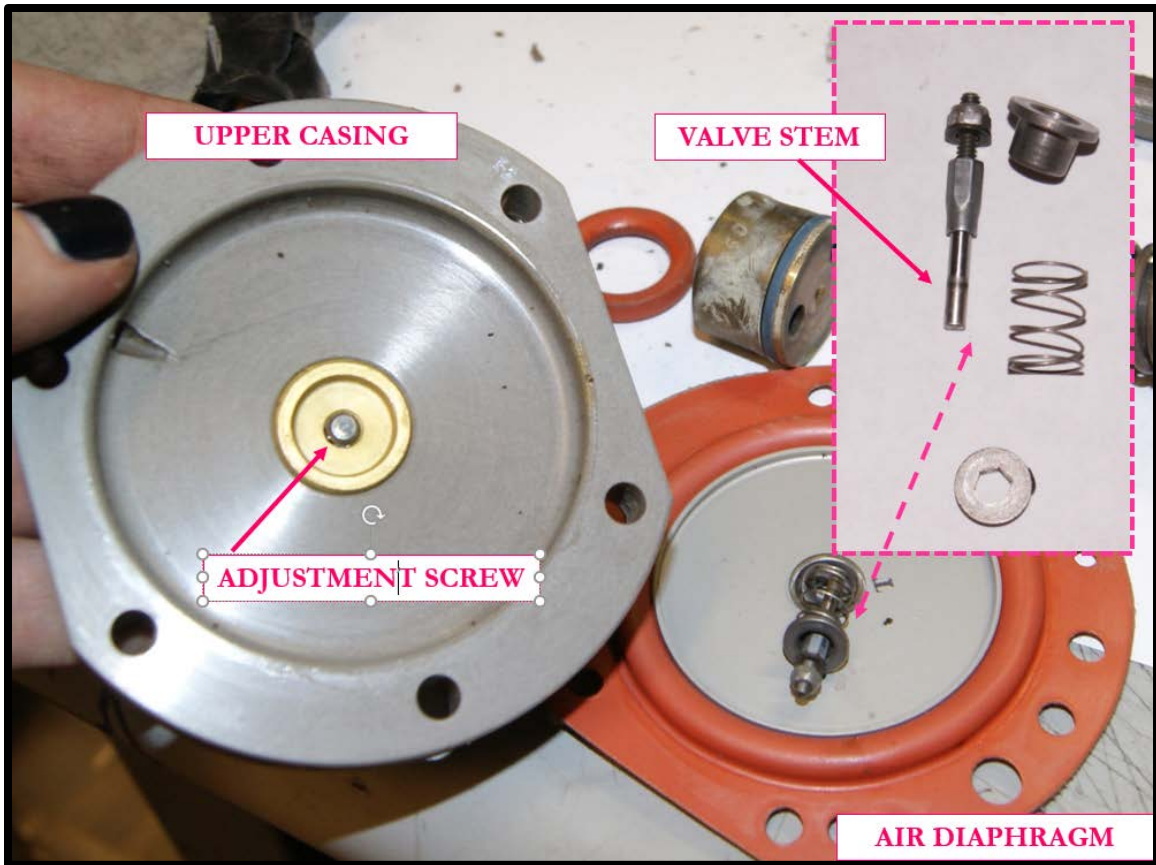
Upon disassembly of the regulator, investigators noted that the valve stem was separated from the regulator valve (ball). The accident servo was reassembled and investigators affixed the exemplar servo's regulator section. A fuel source was connected and the servo flowed fuel normally. The accident regulator section was installed on the exemplar servo and tested; the fuel would not flow.



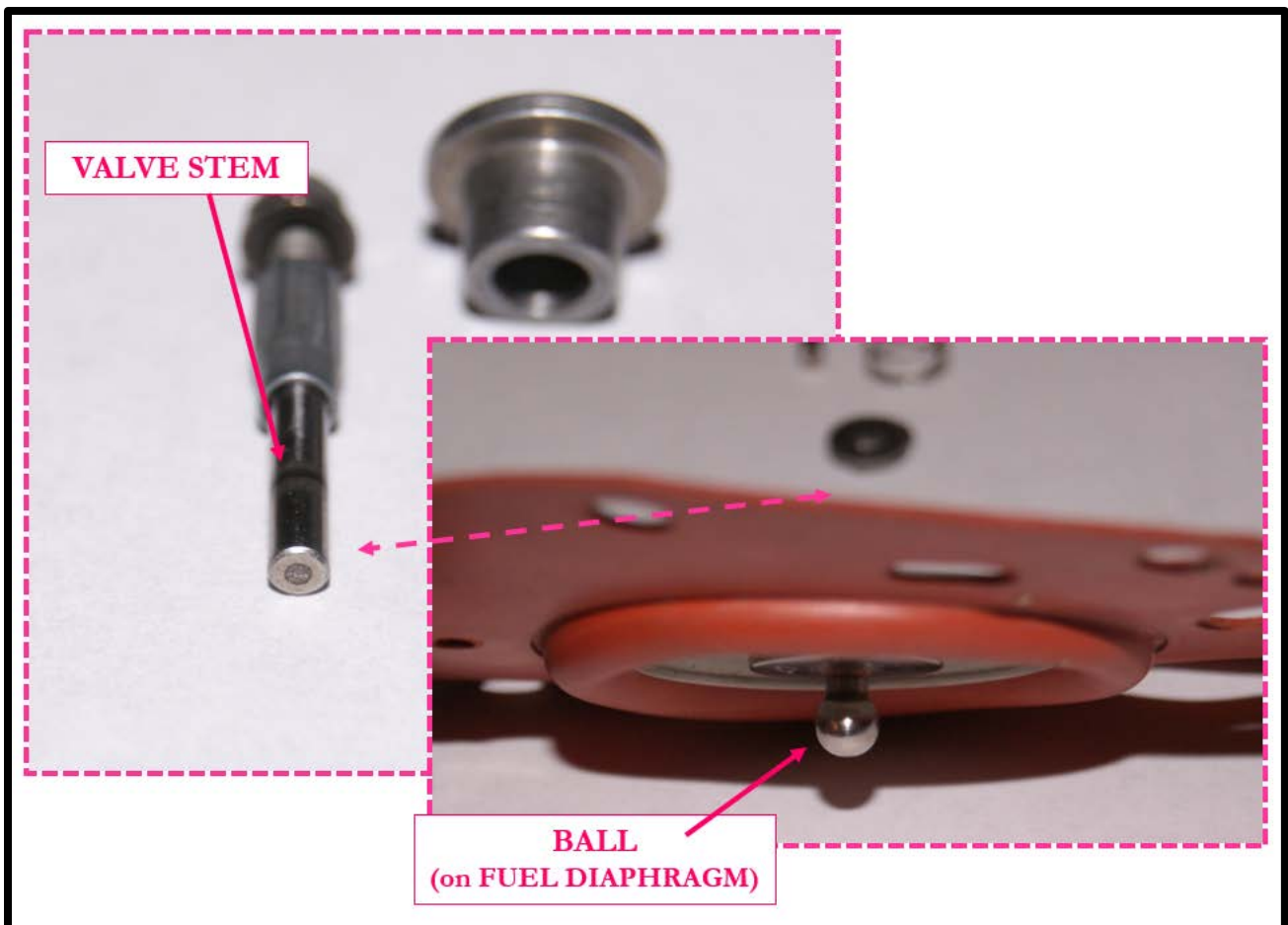
Picture 07: Regulator Section of Servo



Picture 08: Fuel Side of Diaphragm



Picture 09: Air Side of Diaphragm



Picture 10: Valve Stem and Ball

MAINTENANCE HISTORY

Several pictures of the accident servo were provided to a representative from Precision Airmotive. He stated that the internal parts appeared to be original to the servo. He stated that all of the parts inside the regulator side are required replacement items at the time of overhaul. At the time of the servo's manufacture, the overhaul requirements were the same as the TBO (time between overhaul) specified by the engine manufacture. In the 1991, Precision issued a calendar requirement, where the servo must be overhauled every 12 years. After overhaul, the servo should have a yellow data plate attached; the accident servo still had the original black data plate.

The airplanes maintenance records and invoices were provided to investigators. The pilot purchased the engine in 2009 after it had been overhauled. The maintenance entry for the overhaul was dated in May 2009 and noted "serviceable fuel servo RSA-5AD1, pn 252-4213-1, sn 6507-T." A representative from the maintenance facility that performed the overhaul stated that "serviceability appears to have been determined by a functional check during the test run of the complete engine." There were no other maintenance records found regarding the servo.

5-26-09
MODEL: IO-540 EXPERIMENTAL
S/N: L-5545-48
TTE: UNKNOWN
TSMO: 0.0

Page 1 of 1

AIRCRAFT ENGINE SPECIALISTS, LLC
2330 SOUTH AIRPORT BOULEVARD, SUITE #5
CHANDLER, ARIZONA 85286
(480) 516-0390
CRS # ZF7R728Y

This experimental engine was inspected and assembled, and test run with parts supplied by owner, work done in accordance with Lycoming Overhaul Manual 60294-7-12. Crankcase repaired by Avian Aeronautics Inc. wo 05-8341. Cylinders repaired by J&J Air Parts wo JJI56701, 56702, 56703, 56704, 56705 and 56706. Aircraft Specialties Services reconditioned counter weights wo's 132498 and 139647 and crankshaft pn 77616, sn 55163 wo 131618. Rock Aviation reconditioned camshaft wo 9781-8, lifter bodies wo 9781, connecting rods wo's 10115 and 10310-2. Rocker arms reconditioned by Poplar Grove Airmotive wo 9329. Magnetos RT 6371 sn 97011586, LT 6371, sn 93061694 repaired by Air-Craftsman wo's 16800 and 16900. Cylinder pn SL36000, sn's N2C1X20CJ01-003, N2C1X20CJ01-106, NCA20CJ01-009, -001, 36W-K02-P022 and 36W-L01-6771. New fuel pump LW-15473, sn 4707. Serviceable fuel flow divider pn 75278, sn 2524232-2. Serviceable fuel servo RSA-5AD1, pn 2524213-1, sn 6507-T. AD's were checked for compliance, see AD sheet. Engine test run and was found to be in airworthy condition for return to service. Further details of this overhaul may be found at this facility under work order E4266.

[Signature]

Picture 11: Maintenance Entry at Engine Overhaul