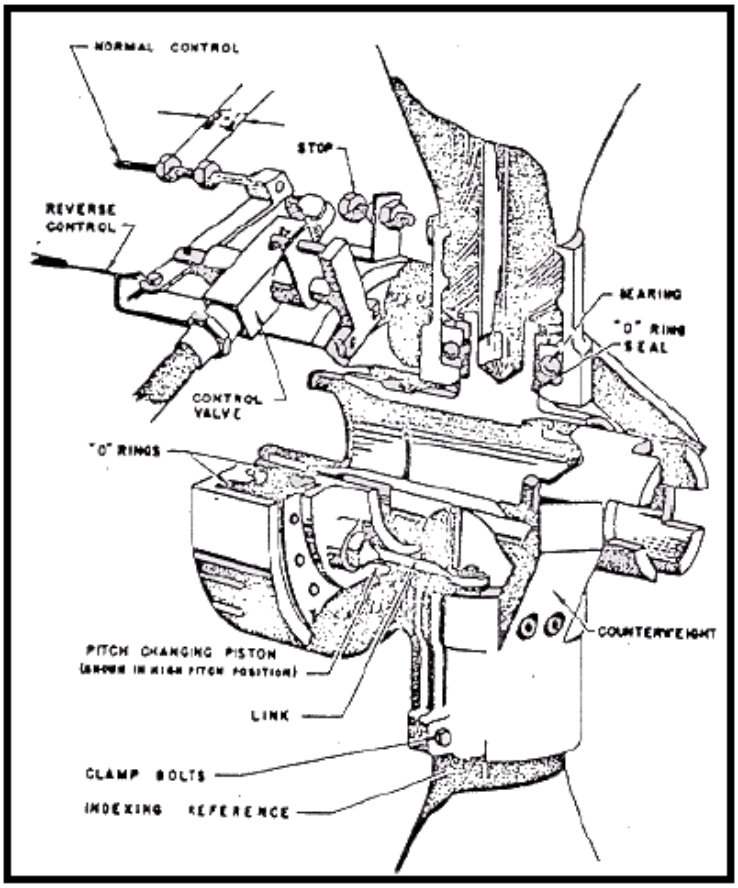
Seabee Service News

REPUBLIC AVIATION CORPORATION
FARMINGDALE, LONG ISLAND, NEW YORK
• • • SERVICE DEPARTMENT • • •

JANUARY 20, 1947 No. 8

HARTZELL PROPELLER

The following article presents a brief description of the principle of operation, methods of control adjustments and a few trouble-shooting hints concerning the Hartzell Propeller as used on the Seabee. Although some of the information has been obtained from the Hartzell Manual which contains complete instructions for disassembly, overhaul, inspection and reassembly of the propeller, this information is intended mainly to supplement the Hartzell Manual for use on the Seabee.

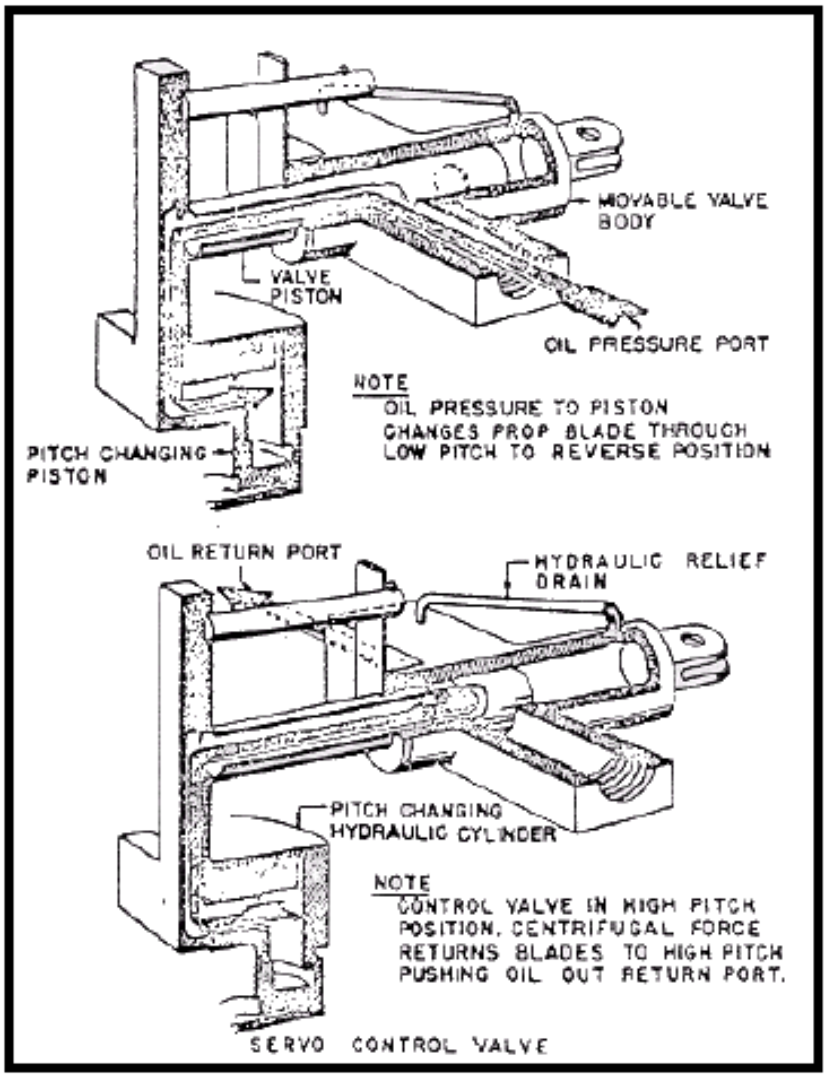


GENERAL

The Hartzell Propeller used on the Seabee is a hydraulic controllable propeller incorporating a reverse pitch feature. The propeller operates with engine oil pressure to reduce pitch and centrifugal force of the counterweights to increase pitch. The centrifugal forces are highest when the propeller is in full reverse pitch. The aerodynamic forces on the blades also contribute to the operation of the propeller. If the operation of these three forces is unbalanced by introducing excessive friction or binding of the blades when a change of pitch is required, the propeller will not function properly.

SERVO CONTROL VALVE

The flow of engine oil from the piston of the propeller to provide any desired pitch setting is regulated by a servo valve. This valve is controlled by the pilot with a push-pull mechanism which changes the position of the valve cylinder. The position of the servo valve piston is governed by the propeller piston to which it is rigidly attached. The action of this valve is shown below. For any desired pitch setting, movement of the control changes the position of the valve cylinder pressure and return ports with respect to the servo valve piston pressure and return ports. When the propeller piston has traveled the required distance the valve piston is centered, thereby shutting off the valve cylinder pressure and return ports so that flow of oil ceases. A check valve is used in the pressure line leading to the servo valve to prevent any possibility of return flow when the centrifugal forces are higher than the oil pressure when pitch is being reduced or placed in reverse.



PISTON TRAVEL

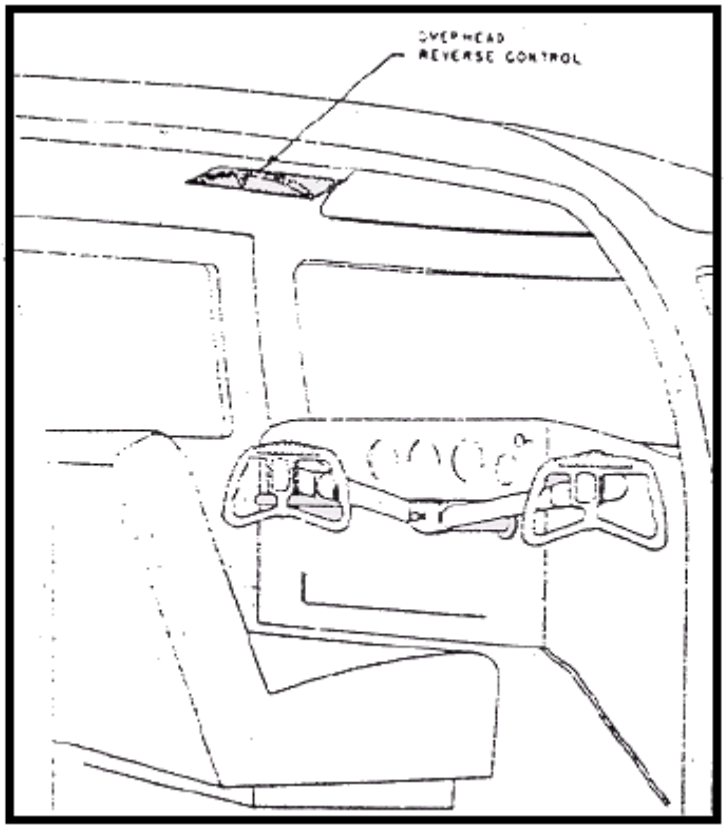
The piston-jack plate assembly is in the full forward position for high pitch and full aft for reverse pitch, the total travel being approximately 1-1/16 inches. The forwardmost position (high pitch) is obtained when the propeller piston bottoms in the cylinder. If it protrudes more than 1/16 inch (exclusive of the gasket and coverplate), the cause must be determined and corrected. The 1-1/16 inches travel is measured from this position to the shoulder of the hub. In other words, the jack plate of the piston travels rearward until it strikes the shoulder of the hub. This means that the hub position regulates the piston travel and therefore the reverse pitch blade angle.

To maintain the hub in its proper position with respect to the propeller cylinder, shims are used between the engine thrust plate and the propeller cone. Once these shims are properly determined there should be no need to change them even if the propeller is replaced provided the original cone is used; therefore they should remain with the engine. On a new engine the amount of shims to be used must be determined when the propeller is installed so that 1-1/16 inches piston travel is obtained from the full high pitch position.

BLADES

The propeller blades are set for 18° ± ½° when the piston is in the full forward (high pitch) position. This angle is measured at blade station 30 (marked with a red line) with respect to the face of the propeller shaft nut. The 1-1/16 inches piston travel automatically sets the blades in the correct reverse pitch position which is approximately 14 ½ ° giving a total travel of about 33°. The low pitch (high RPM) position is set manually on each airplane by adjusting the controls so that the desired high RPM is obtained with the cockpit control in the full forward position.

It is essential to proper function of the propeller that the blades are absolutely free to rotate. This can best be checked by disconnecting the link going to the hub from the jack plate of the piston by removing the lockwire and bolt. When these are removed, the blades are free. If the blades do not turn freely even after being lubricated with AN-G-15 or other approved type grease, the blade clamp bolts should be checked as per instructions in the Hartzell Manual against the guide tube. The clamps should be just tight enough to prevent the blade from rotating when a torque of 2000 inch lbs is applied to the blade. However, it should be remembered that the blade binding could also be a result of too heavy a grease, lack of grease or a faulty bearing. Loosening of the clamps must be done with great care as too loose a clamp will result in slippage of the blade which will change its pitch with respect to the hub position.

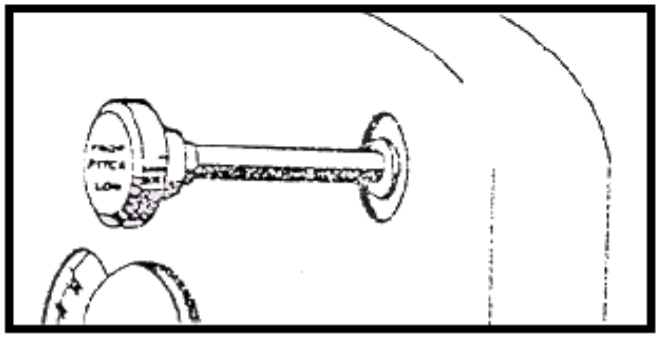


REVERSE CONTROL

The reverse control used to regulate servo control valve consists of a heavy wire in a casing. When adjusting the propeller controls this control must be always checked first to be certain that it is the correct forward position. With the cockpit handle locked in its forwardmost position, the propeller servo control valve arm must be snug against its stop. The controls should move freely and the valve should move without any indication of play or slackness at the cockpit handle. Should any handle movement be noted without a corresponding movement of the valve body, the control should be thoroughly inspected for lose or broken clamps especially at the forward end (behind the upholstery) and aft end (rear valve).

HIGH-LOW CONTROL

The high-low control used to regulate the propeller servo control valve consists of a wire wound cable in a casing. This type of control permits the necessary bends from the instrument panel to the roof to be made with a minimum of internal friction. At the end of the control, the cable continues beyond the wound wire through two bolts, one of which is threaded into the other. The cable is then swaged into the aft bolt which attaches to the arm of the propeller servo control valve. The purpose of the threads is to take up the slack of the cable with respect to the wound wire by increasing the space between the bolt heads. The head on the forward bolt acts as the high pitch stop when it butts against the control casing. This control requires approximately two inches movement to permit the full RPM range to be obtained. Therefore the casing must be properly located and clamped so that 2300 ±25 RPM at full throttle can be obtained when the cockpit handle is forward against the instrument panel. As the final objective is to obtain 2500 RPM at 70 MPH climb with full throttle and with landing gear and flaps down, the 2300 RPM figure may vary slightly from one airplane to another. The low pitch bolt stop is provided only as a safety precaution in case of a control cable failure to prevent over-speeding of the engine and loss of power. As a ground check, place propeller in high pitch at full throttle. If RPM drops below 1800, satisfactory operation is indicated but is still subject to flight checks.



A number of methods of adjusting the controls can be used, however it is believed the following is the easiest and requires a minimum of experimenting:

1. Pull cockpit high-low control full OUT.
2. Check reverse control to insure it is full forward and locked
3. Push propeller piston to full forward (high pitch) position. The cylinder should protrude 1/16 inch at this position.
4. Check reverse pitch control at servo control valve arm to be sure it is against its stop.
5. Place servo control valve in the mid position of its travel. Valve piston should be ½ inch from its stop.
6. Loosen clamps holding the control casing and attach rear bolt on control cable to the servo control valve arm.
7. Tighten control casing clamps temporarily.
8. Back off on the low pitch (high rpm) stop bolt.
9. Start and warm up engine.
10. At full throttle, move cockpit prop control handle back and forth until 2300 rpm position is located.
11. Without changing the prop control handle position, shut off engine.
12. Adjust low pitch (high rpm) stop bolt until it touches the servo control valve arm. Lock bolt in place.
13. Loosen control casing clamps.
14. Push cockpit prop control handle full IN against instrument panel.
15. Slide prop control casing fore or aft in the clamps until the servo valve arm just touches the low pitch (high rpm) stop bolt.
16. Clamp control casing firmly.
17. Start engine again and recheck setting for 2300 ±25rpm.
18. Make test flight and check for 2500 to 2550 rpm at point of take-off just as wheels leave the ground.
19. TO check for proper cruise setting, set prop control to full high pitch and throttle at 25 inches Hg. If propeller is working properly, rpm will be 2200 or less.

If any changes in the maximum rpm are necessary, they can be made by adjusting the low pitch (high rpm) position 3/16 inch for each 100 rpm. This can be accomplished by first measuring the present length of the stop bolt from its bracket, adjusting the length as required, loosening the control casing clamps and sliding the casing until it touches the stop when the cockpit handle is full IN and then retightening the clamps.

When final adjustments are made, check all clamps for tightness to insure against control slippage. Any rubber-type clamps should be replaced with plain metal clamps as the rubber may be conducive to slippage when saturated with oil. Also check to see that the control does not bend when is strikes the low pitch (high rpm) stop.

As another precautionary note, when greasing the propeller be sure to place the same number of shots of grease in each blade to avoid throwing out the balance. For satisfactory performance, the propeller should be greased about every 10 hours of operation so that the blades rotate freely.