



## HARTZELL REVERSIBLE PROPELLER MODEL HC-A3VF-5R

*(Ed note: The following was reproduced from an article dated June 27, 1974 from Hartzell. Although the model number above is slightly different than our A3(M)V20-3L the theory is identical. Don't feel bad, I don't get it either!)*

### OPERATION

The propeller utilizes oil pressure from the governor to move the pitch into low pitch and on into reverse. Counterweights attached to the blade clamps plus springs acting on the hydraulic piston oppose the action of the oil pressure and move the pitch out of reverse to low and on into high (pitch), when the governor calls for oil to be drained from the propeller. The governor supplies oil to the propeller when RPM is below the prescribed value and drains oil from the propeller when the RPM is above the prescribed value.

A hydraulic low pitch stop is provided in the form of a Beta valve, which has a valve spool linked to the propeller piston. This Beta valve is located between the governor and the propeller and acts to shut off the supply of governor oil when the pitch is moved to the low pitch position. The Beta valve is slightly open when the pitch is in the low-to-high range. The pitch is moved into the reverse range by manually readjusting the linkage connecting the Beta valve spool to the piston, so that the low stop becomes the reverse pitch stop.

The pitch can only be reversed when the RPM is below the governor setting, because only then does the governor supply oil to the propeller. Thus the propeller cannot be put into reverse pitch during level flight because the governor is not pumping oil to the propeller, except during momentary periods in order to maintain constant RPM. Nor can the propeller be reversed at airspeeds above certain airspeed because the propeller will windmill at governing speed.

The propeller can be reversed during power-off descent after the airspeed has reduced below the speed where the propeller windmills below the governor speed setting.

*(NOT IN A SEABEE!).*

Engine power can be applied during descent with the pitch set at some low value, in order to increase drag. The power must be limited, however, to avoid the RPM reaching the governor setting. If this occurs, the governor will take charge and move the pitch out of the reverse pitch range since it calls for draining oil out of the propeller to correct the overspeed condition.



After the aircraft has touched down, the pitch can be moved to full reverse, after which the power can be applied to increase the braking action of the propeller. Again, it is vitally important that the pitch be in full reverse and the RPM kept below the governor setting, else the governor will take charge and move the pitch out of reverse. This would cause the engine to overspeed when the pitch went through flat pitch, unless the power was reduced very quickly.

The pitch must be moved to the low pitch value before the engine is shut off; otherwise the linkage may be damaged when springs move the propeller to the high position.

Taxiing the aircraft is facilitated by controlling the thrust with the Beat system, since it is possible to go from positive to negative thrust. The engine power is adjusted for normal taxiing power.

## INSTALLATION INSTRUCTIONS

### Installation of Propeller on Engine

(Reference Installation Drawing of Propeller)

See manual 106 ( ) for instruction to install the "F" flange propellers onto the engine.

### Installation of Beta Valve

The Beta valve is installed between the governor and the engine pad. In order to provide for this added thickness of the Beta valve, longer studs are installed in the engine. The Beta valve is installed first, using a gasket between the valve and engine pad.

A drive coupling is installed on the engine governor drive shaft.

The governor is mounted over the Beta valve, using another gasket.

(Note: The governor gasket isn't your typical gasket. It has a small screen filter impregnated in it so don't try to make one. Be sure you use the right one)

### Installation of the reverse Pitch Push-Pull Control

The push-pull control is installed in the aircraft, and the one end is connected to the Beta valve linkage as shown in the assembly drawing.

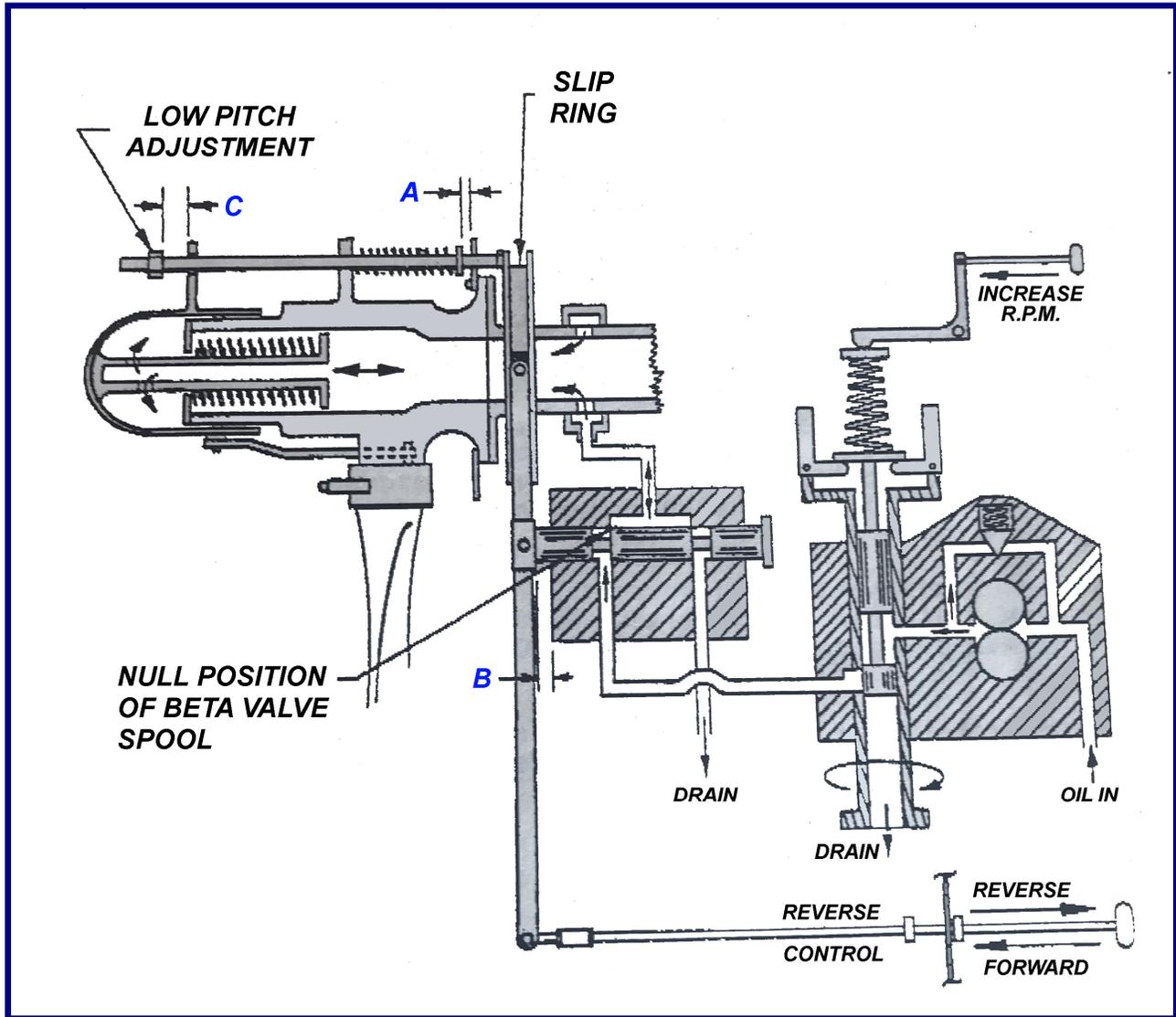


FIGURE 1: DIAGRAM OF PROPELLER – GOVERNOR CONTROL SYSTEM



## PROCEDURE FOR ADJUSTING PROPELLER CONTROL

(See diagram)

- 1) Set reverse control in FORWARD position.
- 2) Adjust reverse control rod to position Beta valve approximately  $1/16'' - 3/32''$  in open position. "B" = approximately  $1/16'' - 3/32''$ . "A" = 0.
- 3) Check travel of push control when in reverse pitch. Use blade bar to move pitch into full reverse. Move push-pull control into reverse. Beta valve should be in Null position. "B" =  $1/8'' - 5/32''$ .
- 4) Run up engine to check low pitch RPM. Set governor for maximum RPM. Adjust low pitch adjustment nuts to provide maximum rated prop RPM less approximately 100. Screw all four (two or three on a Seabee) nuts one turn counterclockwise rotation to increase RPM setting by 100, or vice versa.
- 5) Check reverse pitch RPM. Set pitch in full reverse. Set governor maximum RPM. Run up engine full throttle. Maximum RPM should be at least 100 less than maximum rated RPM to provide a safety factor.
- 6) If RPM is too high, increase reverse pitch by rotating blades in clamps. Increase reverse pitch blade angle  $1^\circ$  per 100 RPM, or vice versa.
- 7) If blade angle is changed under (6), it is then necessary to reset low pitch under (4).
- 8) Check runout of slip ring. Total runout within .010 static. "A" and "C" must be uniform distances for all three rods within  $\pm .003''$ . Observe wobble of slip ring when engine is running during low pitch and reverse pitch operation. If slip ring does not run true, recheck runout.
- 9) Flight test.



## OPERATING INSTRUCTIONS

- 1) Reverse pitch **ONLY** when throttle is **CLOSED**.
- 2) Propeller can only be reverse when pitch is in low. This means airspeed must be below a certain value, and throttle is closed. Governor control must always be in maximum RPM position forward.
- 3) Be sure pitch is either in **LOW** or **FULL REVERSE** before throttle is opened up. Otherwise engine will overspeed. The reverse pitch control provides a means to feel the position of the pitch.
- 4) Do not shut off engine with pitch in reverse. This would cause damage to control mechanism because propeller spring will return pitch to high after engine is shut down. There is not enough "Beta" valve travel to allow for this change in pitch unless reverse control is moved to low position.

## TROUBLESHOOTING

### Variations in Low Pitch Static RPM

The linkage may have too much backlash in the joints.

### Pitch Goes to Full High During Idle – Governor Ineffective

The Beta valve is shut off and drain opened up allowing piston to move full into high.

Correction: Adjust the reverse push-pull to reduce "B", so Beta valve is open to governor by at least 1/16 inch. Beta valve spool is in Null position when centered approximately between stops.