Chapter IV Feathering Systems

Propeller feathering systems are used on most multi-engine aircraft to reduce the drag created by a windmilling propeller if an engine should fail. To be able to feather, the propeller must have a great enough blade angle range to achieve an approximate 90° blade angle. Also, the governor must be designed so that the constant-speed operation can be overidden at anytime to feather the propeller.

A means of unfeathering in flight is required in the system and this may require additional system components. These additional components may include accumulators, electric oil pumps, and oil flow control valves.

A. Basic Feathering System

The basic constant-speed operating components of a feathering governor are the same as those used in a constant-speed governor. In most feathering governors, the pilot valve and the governor oil passages are designed so that oil pressure is directed to the propeller to decrease the propeller blade angle (underspeed condition) and oil pressure is released from the propeller to increase the blade angles (overspeed condition).

The primary design difference between a constant-speed and a feathering governor is the addition of a lift rod connected to the pilot valve to mechanically lift the pilot valve to the overspeed position when it is desired to feather the propeller. The lift rod raises the pilot valve when the cabin propeller control is moved full aft. When the pilot valve is raised, all of the oil pressure in the propeller is released and the blades move to the feather angle by the centrifugal force on the blade counterweights and some other force, such as springs, depending on the propeller design.

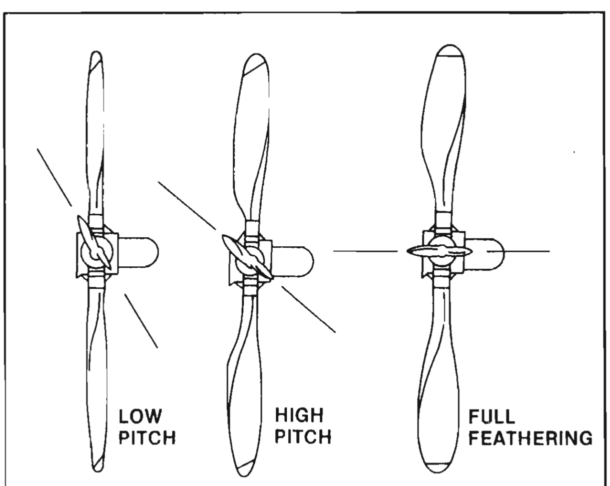


Figure 4-1. The feather angle is 90° to the plane of rotation whereas the constant-speed blade angle is between 10 and 25° to the plane of rotation.

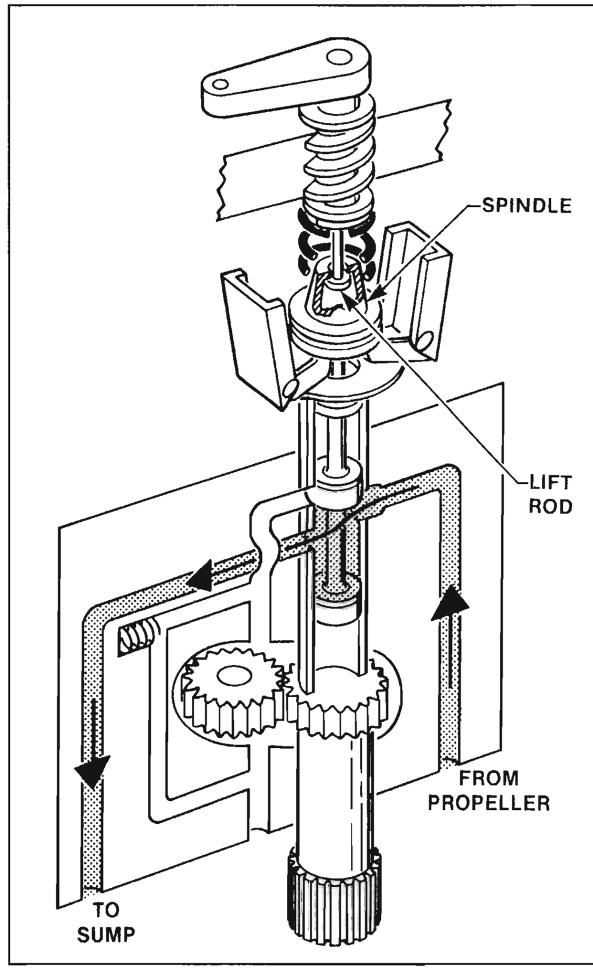


Figure 4-2. The lift rod engages the pilot valve to feather the propeller.

The full aft movement of the cabin propeller control usually requires additional effort or a sideways or outward movement to enter the feather position. This is to prevent accidental

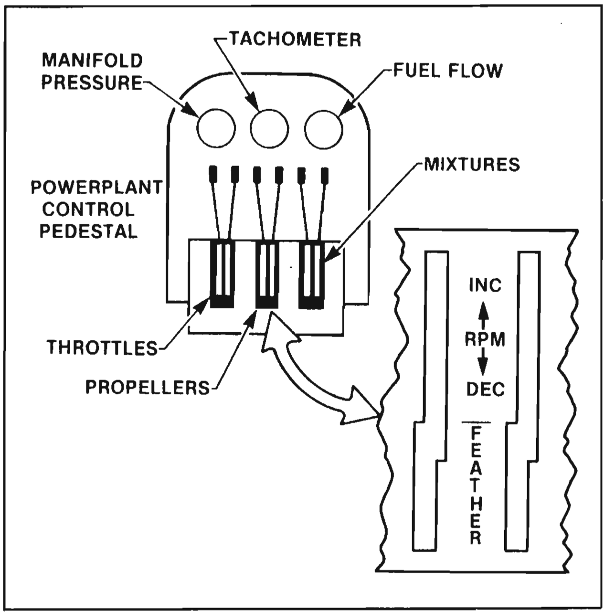


Figure 4-3. The cabin propeller control may have to be moved sideways to go into the feather range on the control quadrant.

feathering of the propellers during constant-speed adjustment.

When unfeathering the cabin propeller control is moved forward into the constant-speed range. This lowers the lift rod far enough so that it disengages the pilot valve and the governor returns to constant-speed operation (underspeed condition before the engine restarts) and allows the engine to be restarted.

The engine is usually restarted by supplying oil pressure to the propeller through the governor, which causes the blade angle to decrease and the engine to windmill. Once the engine is windmilling, the ignition and fuel for the engine is turned on according to the particular aircraft operations manual and the system returns to normal operation.

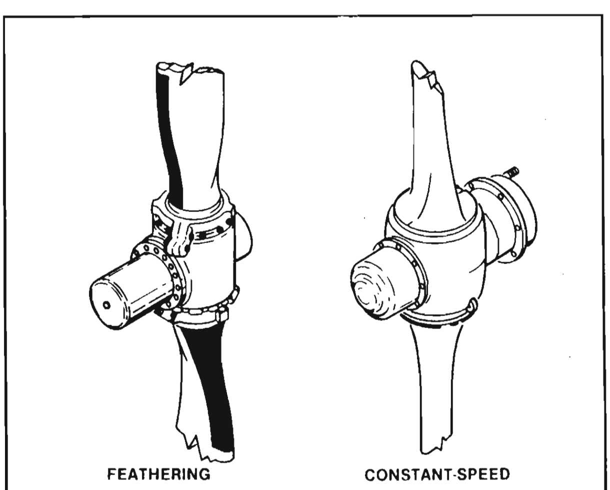


Figure 4-4. A feathering McCauley propeller compared to a McCauley constant-speed propeller.

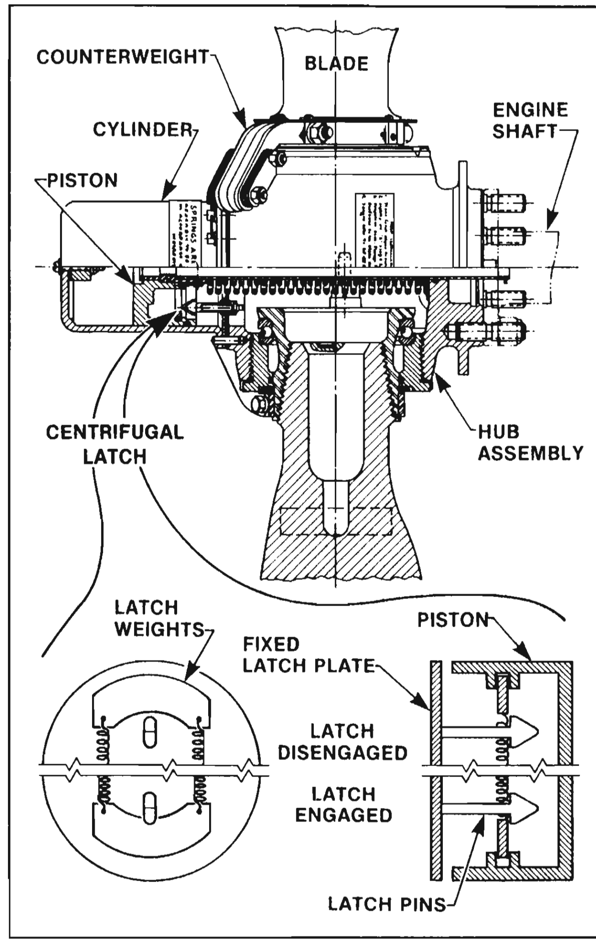
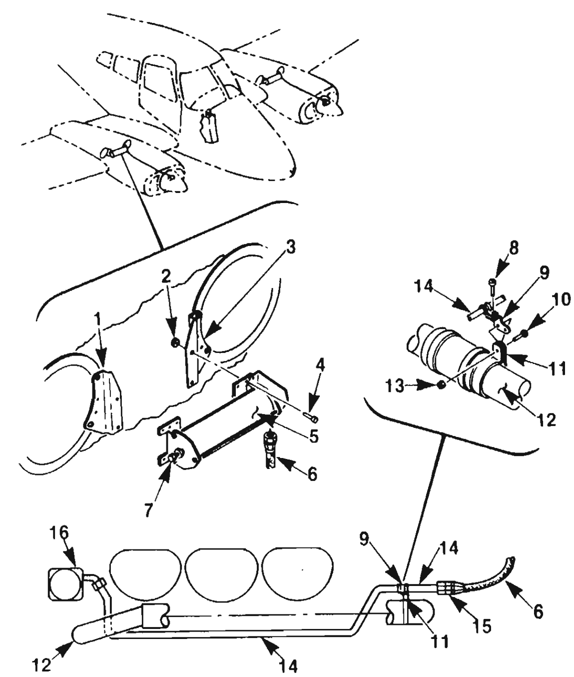


Figure 4-5. A version of the centrifugal latch mechanism used to prevent a feathering propeller from feathering when the engine is shut down on the gorund.

B. Feathering Propellers

The propellers used with feathering systems are basically the same as constant-speed propellers except for the additional blade angle range and a longer nose cylinder to accommodate the greater blade angle range. These propellers use oil pressure from the governor to decrease the propeller blade angles and counterweights, springs, and air pressure in various combinations to increase the blade angles and feather the propellers.

Most feathering propellers incorporate a centrifugally operated latch mechanism which locks the blades at a low angle when the engine is at idle



1. BRACKET
2. NUT
3. BRACKET
4. BOLT
5. ACCUMULATOR
6. HOSE ASSEMBLY
7. FILLER VALVE
8. SCREW
9. CLAMP
10. SCREW
11. CLAMP
12. INTAKE MANIFOLD
13. NUT
14. LINE ASSEMBLY
15. UNION
16. PROPELLER GOVERNOR

Figure 4-6. The accumulator system in a Cessna 310.

on the ground. These latches prevent the blades from feathering when the engine is shut down on the ground. In flight, centrifugal force holds the latches out and they do not interfere with the constant-speed or feathering operation.

C. Unfeathering Systems

To unfeather a propeller, oil pressure must be supplied to the propeller so that the blades will rotate to a lower angle and start to windmill the engine. There are four methods which may be used to accomplish unfeathering: developing oil pressure by rotating the engine with the engine starter; supplying oil pressure to the propeller from an accumulator; using an electric pump to supply oil pressure to the governor; and, directing oil from another engine propeller system to apply pressure to the feathered propeller.

1. Engine Starter

To unfeather the propeller in some aircraft the starter motor for the engine is used to rotate the engine and the governor to develop oil pressure which is directed to the propeller through the underspeed condition of the governor and decreases the propeller blade angle. As the blade angles decrease, the airflow from the aircraft moving through the air will cause the propeller to start to rotate. As the engine and propeller start to rotate, the oil pressure from the governor will increase to the normal governor pressure and the propeller-governor system will return to constant speed operation.

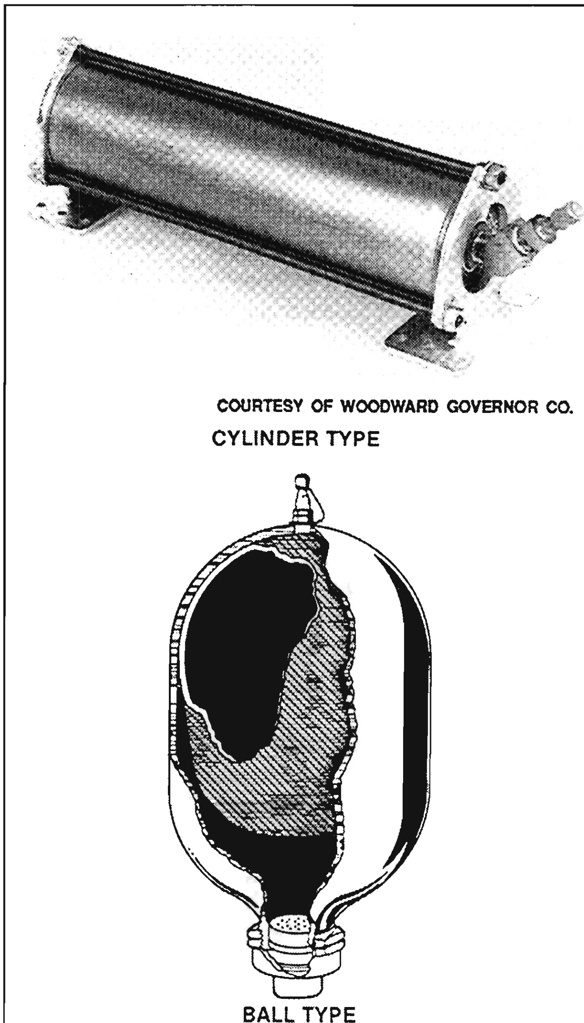


Figure 4-7. Two types of unfeathering accumulators.

2. Accumulator Systems

Many aircraft incorporate an accumulator in the propeller system to be used when unfeathering the propeller. The accumulator is normally located in the engine compartment and is connected to the governor by a flexible or a rigid oil line.

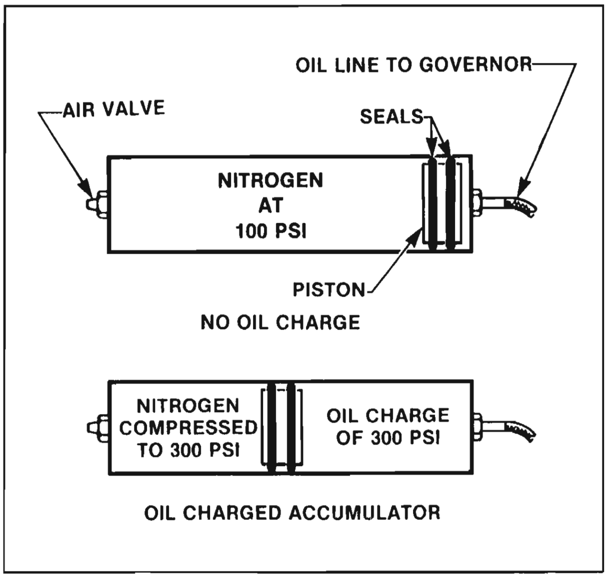


Figure 4-8. When the accumulator is charged with oil the air in the accumulator is compressed to the same pressure as the oil.

The accumulator may be of the ball-diaphragm or the piston-cylinder type. In either case, an air charge of about 100 psi will be on one side of the diaphragm or piston when the engine is shut down on the ground and the other side will be connected to the governor oil pressure line for the propeller through the oil line mentioned above.

During normal constant-speed operation, the governor oil pressure that is applied to the propeller is also directed to the oil side of the accumulator to charge the accumulator with oil at governor oil pressure. Since the governor oil pressure is two to three hundred psi, the oil pressure in the accumulator will compress the air in the accumulator to the same pressure as the oil and thereby store a charge of oil at governor oil pressure.

If the propeller is feathered, the oil in the accumulator is trapped by a check valve in the governor or by a control valve attached to the governor.

To unfeather the propeller, the cabin propeller control is moved forward. This sets the governor pilot valve to direct oil to the propeller (governor underspeed condition) and the check valve or control valve is opened and the oil pressure in the accumulator is released into the propeller. The oil pressure moves the propeller to a lower angle, the propeller starts to windmill, and the engine can be restarted.

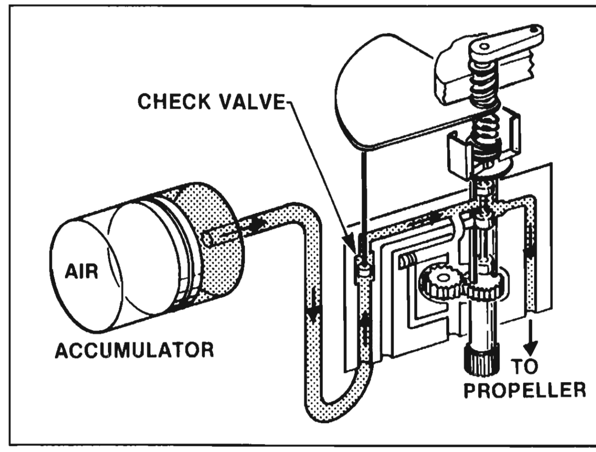


Figure 4-9. The governor is set to decrease the propeller blade angle when unfeathering with an accumulator.

Once the system returns to constant-speed operation, the accumulator is again charged and is set for the next unfeathering operation.

3. Unfeathering Oil Pumps

A few aircraft use an electrically operated oil pump to supply oil pressure for unfeathering the propeller. In this unfeathering system an oil line from the engine oil sump is connected to an electric oil pump located in the engine compartment. The output side of the pump is connected to the propeller oil line between the governor and the propeller.

The oil pump operation is controlled from the cabin by a toggle switch or push button. When the pilot desires to unfeather the propeller, the propeller control lever in the cabin is moved into the constant-speed range and the cabin unfeathering switch is operated until the oil pressure from the electric oil pump causes the blades to move to a low enough angle that the propeller starts to windmill. The switch is then released and the normal engine restart procedure is followed. During this operation, oil pressure from the electric pump is also applied to the governor, but with the governor in the underspeed condition. No significant amount of oil pressure is lost through the governor.

4. Unfeathering Crossfeed System

A few aircraft designs use a crossfeed device to tap oil pressure from an operating constant-speed system and direct it to the feathered propeller.

To unfeather with a crossfeed system, the propeller control lever for the feathered engine is placed in the full forward position (this may vary for some aircraft) and the crossfeed valve in the