McCAULEY™

Professor Von Kliptip Answers Your Questions About The

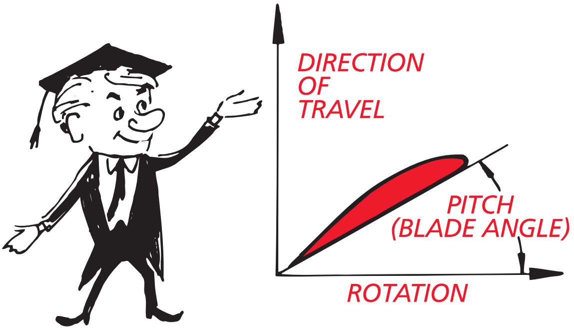
McCAULEY CONSTANT SPEED PROPELLER GOVERNING SYSTEM

FOR NON-COUNTERWEIGHTED PRESSURE TO INCREASE PITCH PROPELLERS ON TYPICAL SINGLE ENGINE AIRCRAFT

Professor, what do you mean by a "constant speed" system?

We mean a constant RPM system that permits the pilot to select the propeller – and engine – speed he wants for any situation, and then automatically maintain that RPM under varying conditions of airspeed and power.

How do you control the RPM?



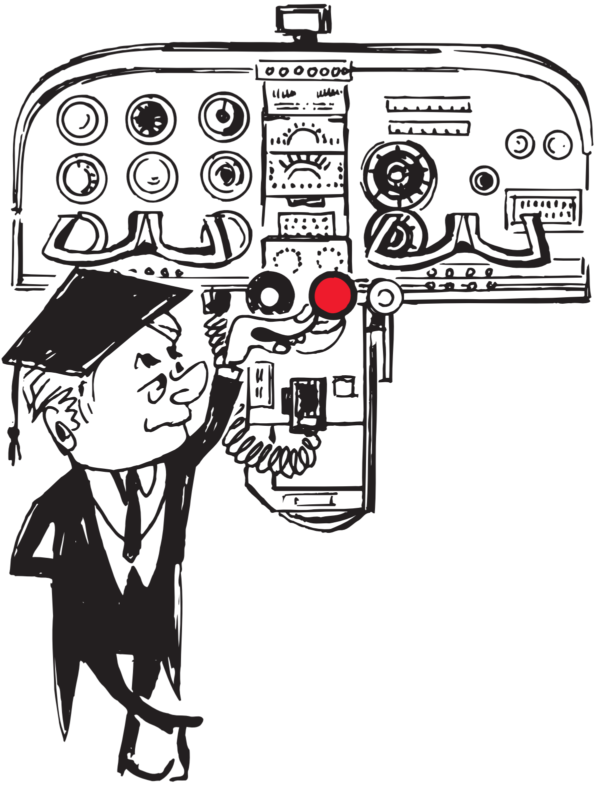
We do it by varying the pitch of the propeller blades. In the sense that we're talking about it, the pitch is the angle of the blades with relation to the plane of the rotation. As the blade angle is reduced, the torque required to spin the propeller is reduced and, for any given power setting, the airspeed and RPM of the engine will tend to increase. Conversely, if the blade angle increases, the required torque increases. Then the engine and the propeller will tend to slow down. Thus, by varying the blade angle or pitch of the propeller, we can control the RPM.

EDITOR'S NOTE: Don't let the professor's looks fool you. He knows his stuff.

Do you mean that the propeller operates at the same speed all the time?

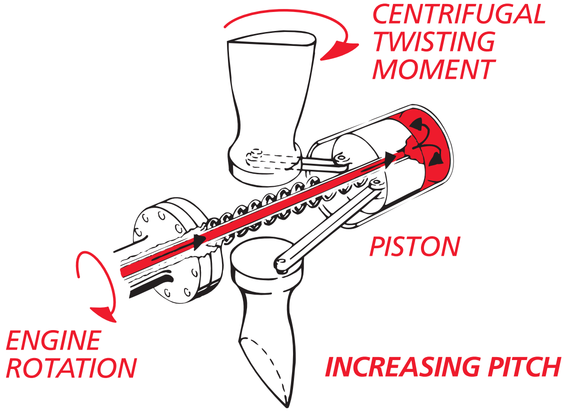
Heavens. No! That would never do.

Remember, we said that the system permits the pilot to select the RPM he wants. He has a control in the cockpit for this. When he wants maximum power at low airspeed, such as for take-off, he pushes this low pitch and maximum RPM. This is great for getting off the ground, but it's normally not desirable for cruising at high airspeeds. So, for cruising, he can ease back on the throttle and the propeller control. This increases the pitch and the speed settles into the desired RPM for cruise conditions. The RPM automatically stays set until he moves the control.



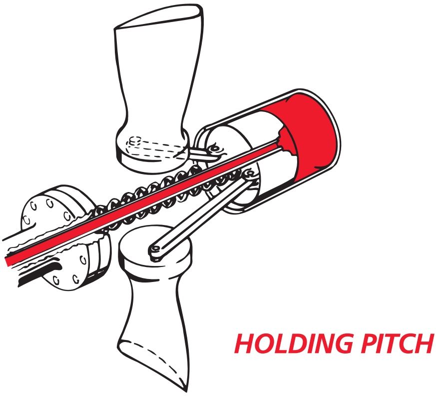
How do you change the pitch of the blades?

We do it hydraulically in a single acting system, using oil from the propeller governor to increase the pitch of the propeller blades.

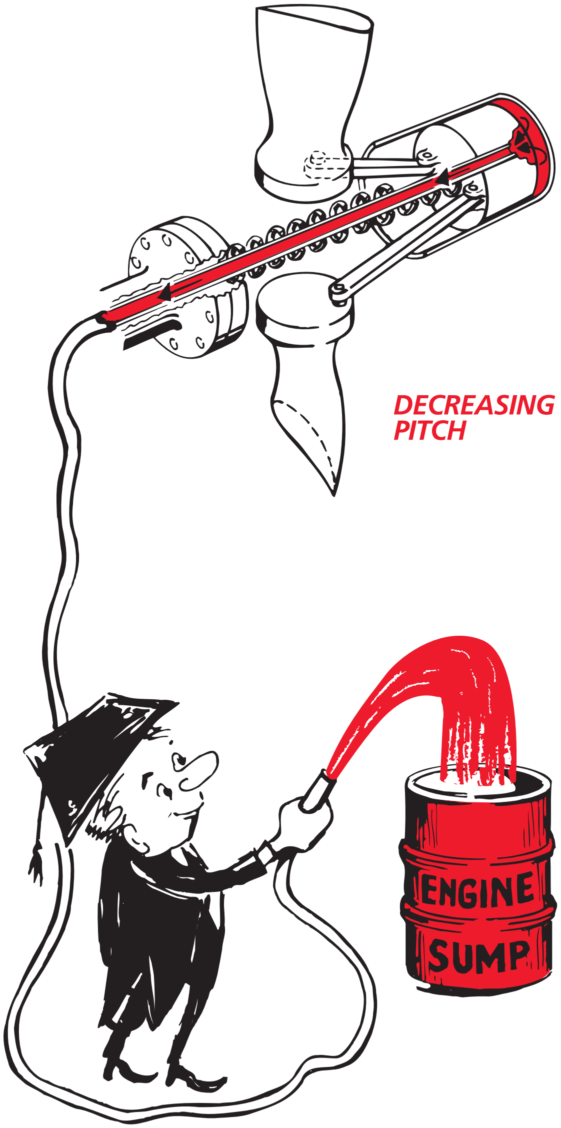


In the propeller, oil pressure acting on the piston produces a force that is opposed by the natural centrifugal twisting moment of the blades and a spring. To increase the pitch or blade angle, we direct high pressure oil to the propeller. This moves the piston back. Motion of the piston is transmitted to the blades through the actuating link and pins, moving the blades toward high pitch.

When the opposing forces are equal, oil flow to the propeller stops, and the piston will stop also. The piston will remain in the position, holding the pitch of the blades constant until the oil flow to or from the propeller is established by the governor.

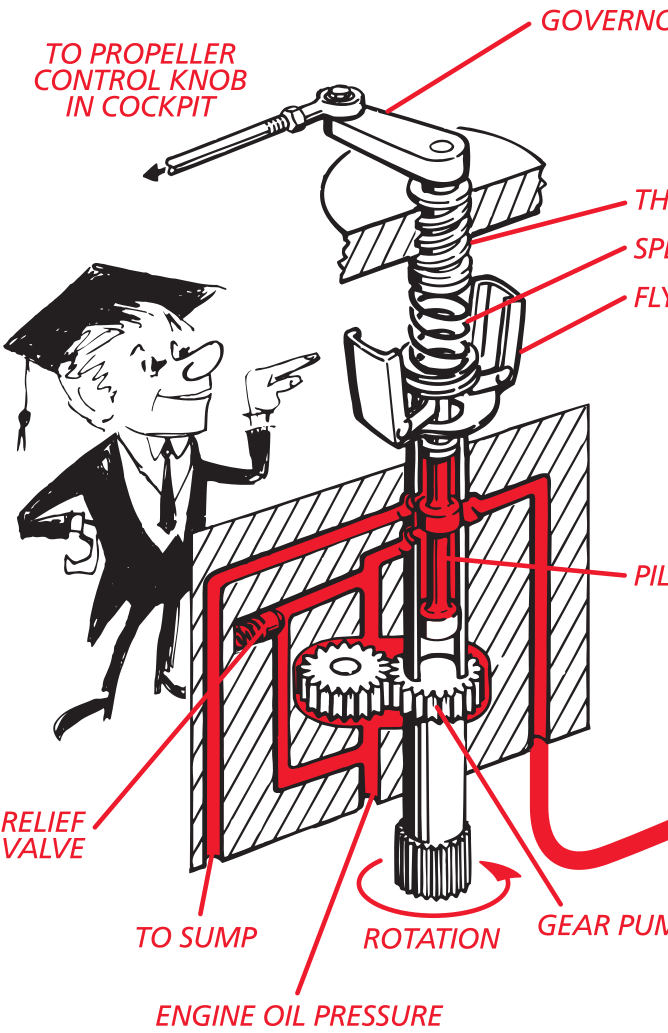


Pitch is decreased by allowing oil to flow out of the propeller and be returned to the engine sump. When the governor initiates this procedure, hydraulic pressure is decreased and the piston moves forward, moving the blades towards low pitch. The piston will continue to move forward until the opposing forces are again equal.



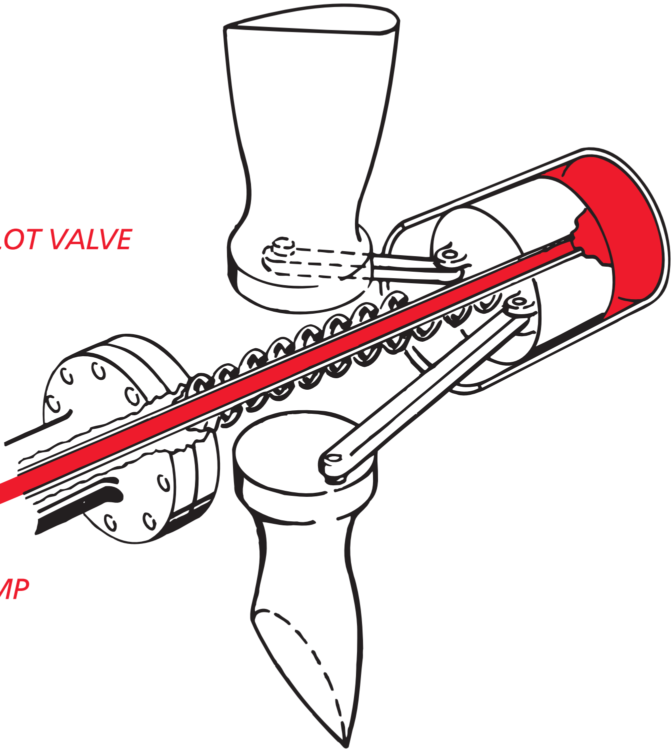
Although they aren't shown in our illustrations, mechanical stops are installed in the propeller to limit travel in both the high and low pitch directions.

So you do it with oil. How, Professor?



A look at the total system will help to explain this. Besides the propeller, the other major component of the system is the governor. The governor mounts on, and is geared to, the engine. This drives the governor gear pump and flyweight assembly. The gear pump boosts engine oil pressure to provide quick and positive response by the propeller. The rotational speed of the flyweight assembly varies directly with engine speed and controls

NOTE:
The Governor is represented schematically for clarity. In actual construction, the sump return is down through the center of the pilot valve.

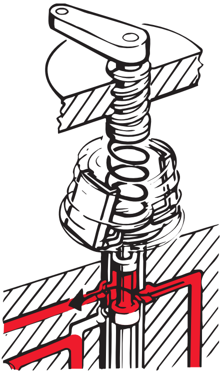


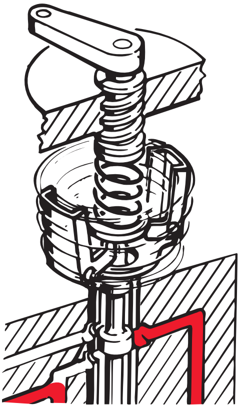
the position of the pilot valve. Depending on its position, the pilot valve will direct oil flow to the propeller, allow to flow back from the propeller, or assume a neutral position with no oil flow. As we saw earlier, these oil flow conditions correspond to increasing pitch, decreasing pitch or constant pitch of the propeller blades.

How do the flyweights change the position of the pilot valve?

By utilizing centrifugal force.

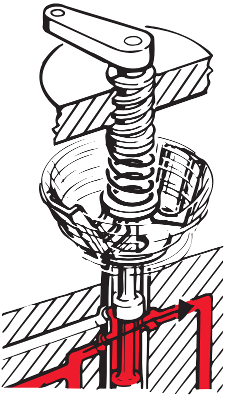
The “L” shaped flyweights are installed with their lower legs projecting under a bearing on the pilot valve. When the engine RPM is lower than the propeller control setting, the speeder spring holds the pilot valve down and oil flows from the propeller.





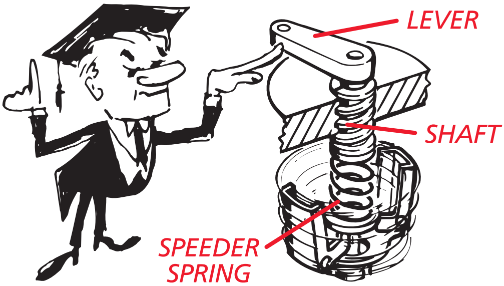
As engine RPM increases, the tops of the weights are thrown outward by centrifugal force. The lower legs then pivot up, raising the pilot valve against the force of the speeder spring, so there is no oil flow to or from the propeller.

The faster the flyweights spin, the further out they are thrown, causing the pilot valve to be raised and allowing more oil to flow to the propeller.



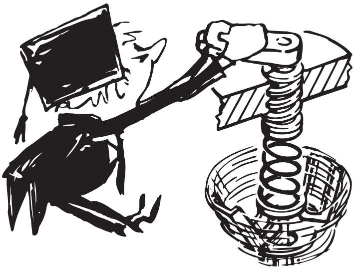
How does the aircraft pilot control this governor action?

The cockpit control is connected to the governor control lever. The lever is attached to the threaded shaft. As the lever is moved, the threaded shaft turns and moves up or down to increase or decrease compression on the speeder spring.



For example, when the cockpit control moved forward, the governor control shaft is screwed down, increasing compression on the spring. This means that the flyweights must spin faster to raise the pilot valve, which results in a higher RPM setting.

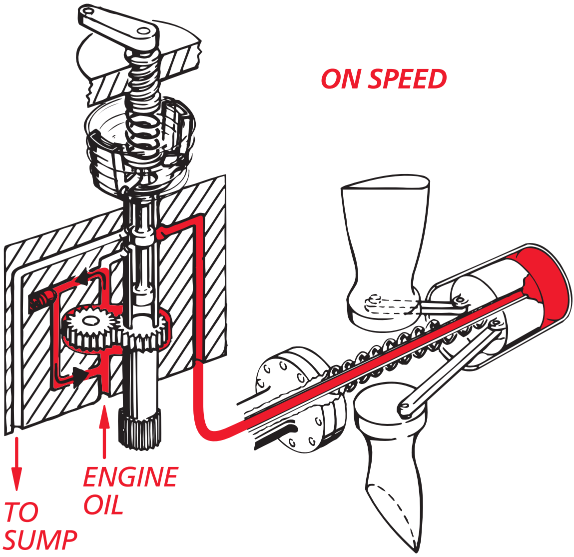
When the cockpit control is pulled back, the governor control lever and shaft turn in the opposite direction, relaxing compression on the spring. This reduces the speed necessary for the flyweights to move the pilot valve and produces a lower RPM setting.



Thus, with the cockpit control, the aircraft pilot can shift the range of governor operation from high RPM to low RPM or any area in between.

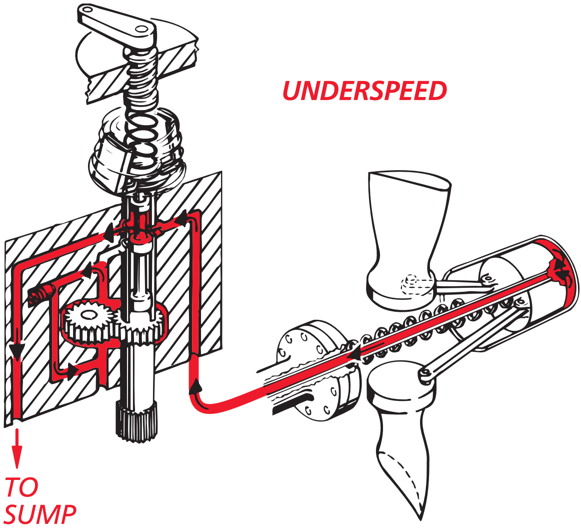
So how does all this result in constant speed?

By producing what is known as an ON SPEED condition. This exists when the RPM is constant. Movement of the cockpit control has set the speeder spring at the desired RPM. The flyweights have positioned the pilot valve to direct oil to or from the propeller. This, in turn, has positioned the propeller blades at the pitch that absorbs the engine power at the RPM selected. When the moment the RPM balance occurs, the force of the flyweights equals the speeder spring load. This positions the pilot valve in the constant RPM position, with no oil flowing to or from the propeller.



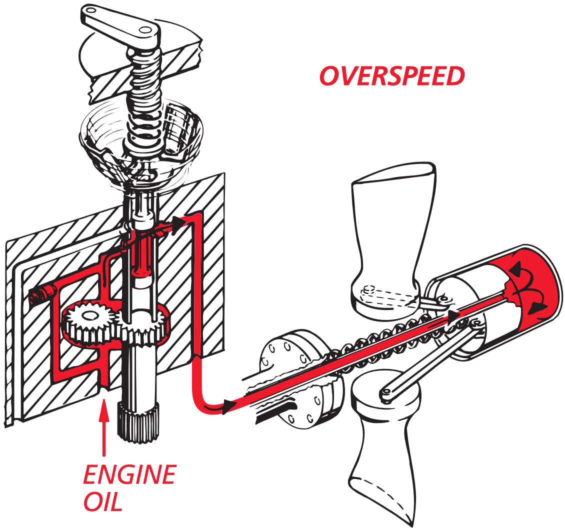
OK, so we're flying along at constant RPM. What happens if the airplane begins to climb or engine power is decreased?

This results in an UNDERSPEED condition. Airspeed is reduced and, since the pitch of the propeller blades is too high, the engine starts to slow down. However, the instant this happens the flyweights will drop, causing the pilot valve to move down. Then oil flows from the propeller, reducing the pitch of the blades. This automatically increases the speed of the engine to maintain the former RPM setting.



What happens if the airplane goes into a descent or engine power is increased?

This causes an OVERSPEED condition. Airspeed increases. Since the pitch of the propeller blades is too low to absorb engine power, the engine RPM begins to increase. But the instant this happens, the flyweights move out and raise the pilot valve. This, in turn, causes oil to flow to the propeller, increasing the pitch of the blades. Engine speed then slows down to maintain the original RPM setting.



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