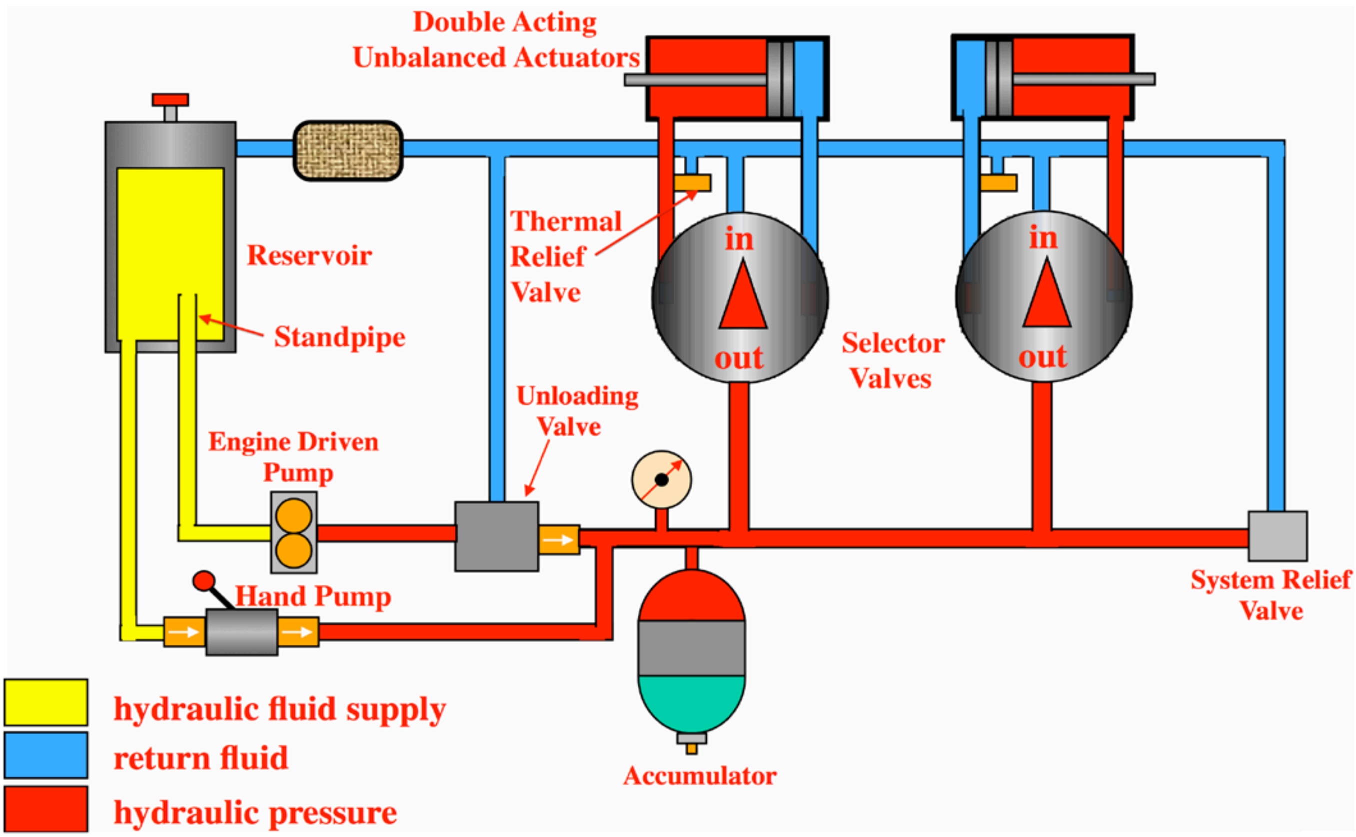

Figure 7-12. Small airplane hydraulic system.

Figure 7-13 shows the hydraulic system for a large commercial transport airplane. There are three separate subsystems shown, identified as System A, System B, and the Standby System. System A is powered by a hydraulic pump on the left engine, and backed up by an electric motor driven pump. System B is powered by a hydraulic pump on the right engine, and backed up by an electric motor driven pump. The Standby System is only powered by an electric motor driven pump. The reservoirs for each of the three systems are pressurized by bleed air from the airplane's turbine engines. The airplane would use phosphate ester type hydraulic fluid, dyed purple.

Hydraulic fluid would leave the System A reservoir and the variable displacement piston type hydraulic pump, and travel the path shown in red. Through various valves and fluid control components, System A ends up powering the following:

1. Rudder
2. Ailerons
3. Elevator
4. Landing gear
5. Nose wheel steering
6. Alternate brakes
7. Autopilot
8. Flight spoilers
9. Left engine thrust reverser
10. Power transfer unit

Hydraulic fluid would leave the System B reservoir and the variable displacement piston type hydraulic pump, and travel the path shown in blue. System B also powers the rudder, ailerons, elevator and landing gear, so there is redundancy between the two systems. For some hydraulically operated items, one system acts as the primary source of power and the other system acts as the secondary. Operation of the brakes is a good example of this, with System B providing normal brakes and System A providing alternate brakes. System B powers the wing leading edge flaps and slats, but through the Power Transfer Unit, it gets help from System A when the demand is heavy. The pressure switch in System B senses when the demand is heavy.

If both systems A and B were to fail, the Standby System would provide power to the rudder, the leading edge flaps and slats, and both engine thrust reversers. On the airplane in question, the pilots are able to move the ailerons and elevator manually, so the airplane can still be flown in this situation. There are emergency brakes, operated by nitrogen pressure, so it is still possible to stop the airplane after landing.

RESERVOIRS

The reservoir is a tank in which an adequate supply of fluid for the system is stored. Fluid flows from the reservoir to the pump, where it is forced through the system and eventually returned to the reservoir. The reservoir not only supplies the operating needs of the system, but it also replenishes fluid

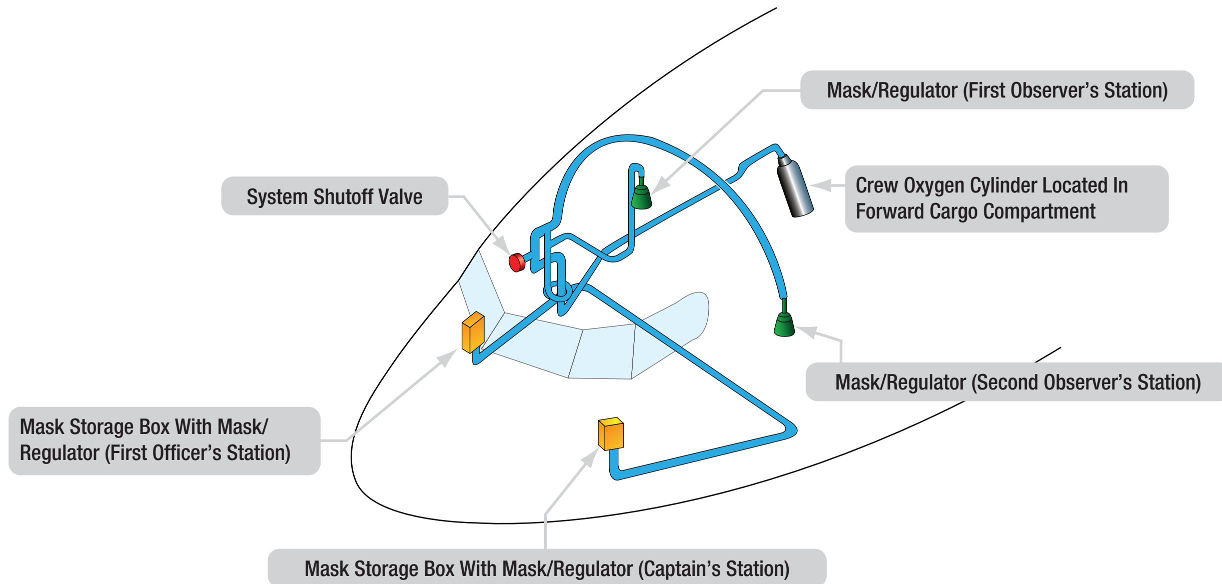

Figure 11-14. Location of demand-flow oxygen components on a transport category aircraft.

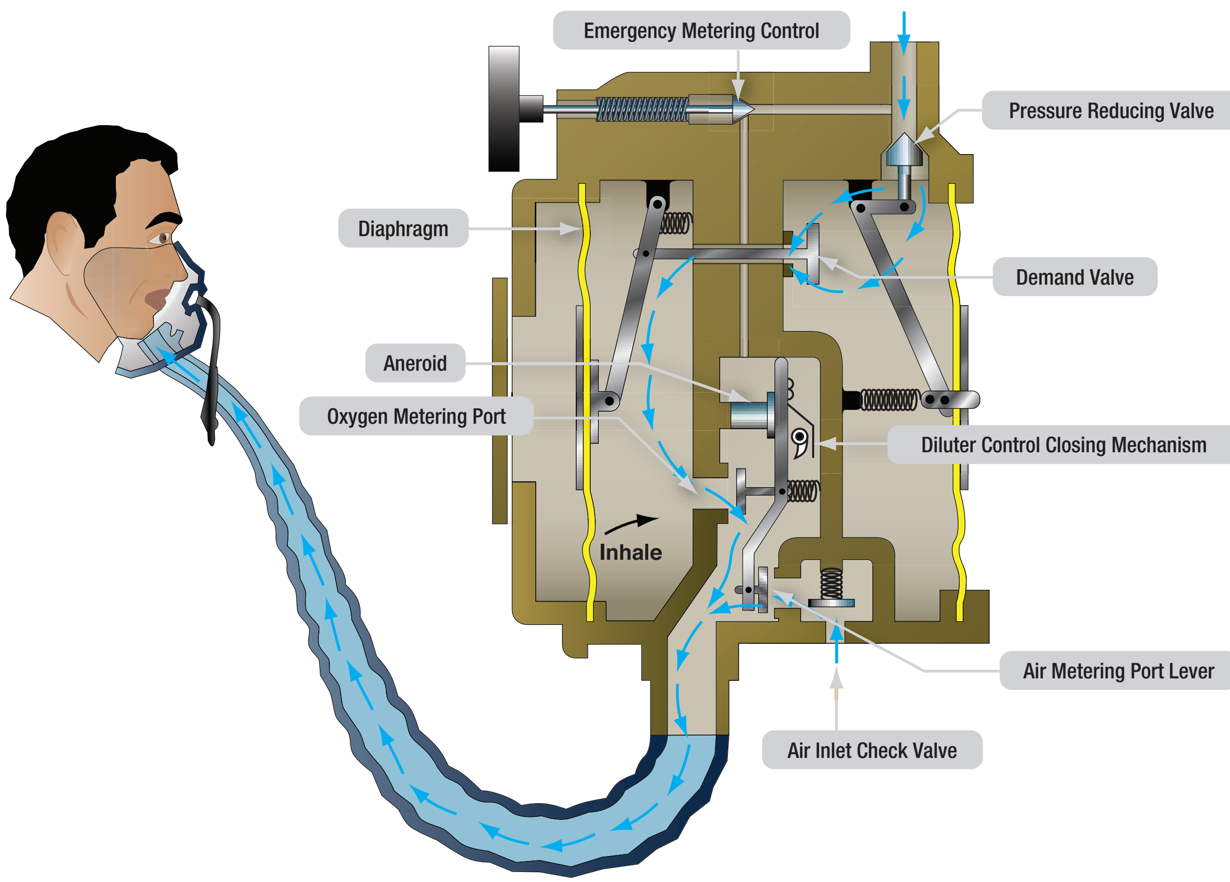

Figure 11-15. A demand regulator and demand-type mask.

Flow Indicators

Flow indicators, or flow meters, are common in all oxygen systems. They usually consist of a lightweight object, or apparatus, that is moved by the oxygen stream. When flow exists, this movement signals the user in some way. (Figure 11-18) Many flow meters in continuous-flow oxygen systems also double as flow rate adjusters. Needle valves fitted into the flow indicator housing can fine-adjust the oxygen delivery rate. Demand-flow oxygen systems usually have flow indicators built into the individual regulators at each user station. Some contain a blinking device that activates when the user inhales and oxygen is delivered. Others move a colored pith object into a window. Regardless, flow indicators are used to provide verification that the oxygen system is functioning.

Figure 12-3. Ice and rain protection systems on a large transport aircraft.

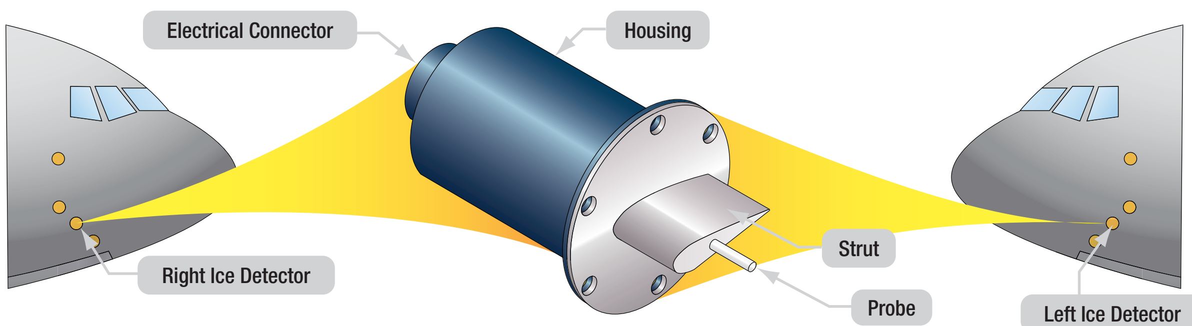

Figure 12-4. An ice detection probe on large aircraft warns the flight crew of the presence of ice.

LOCATION OF ICE	METHOD OF CONTROL
Leading Edge of the Wing	Thermal Pneumatic, Thermal Electric, Chemical, and Pneumatic (deice)
Leading Edges of Vertical and Horizontal Stabilizers	Thermal Pneumatic, Thermal Electric, and Pneumatic (deice)
Windshield, Windows	Thermal Pneumatic, Thermal Electric, and Chemical
Heater and Engine Air Inlets	Thermal Pneumatic and Thermal Electric
Pitot and Static Air Data Sensors	Thermal Electric
Propeller Blade Leading Edge and Spinner	Thermal Electric and Chemical
Carburetor(s)	Thermal Pneumatic and Chemical
Lavatory Drains and Portable Water Lines	Thermal Electric

Figure 12-5. Ice control methods.

Wing Anti-Ice (WAI) System

Thermal wing anti-ice (WAI or TAI) systems for business jet and large-transport category aircraft typically use hot air bled from the turbine engine compressor. (Figure 12-6) Relatively large amounts of very hot air can be bled off the compressor, providing a satisfactory source of anti-icing heat. The hot air is routed through ducting, manifolds, and valves to components that need to be anti-iced. Figure 12-7 shows a typical WAI system

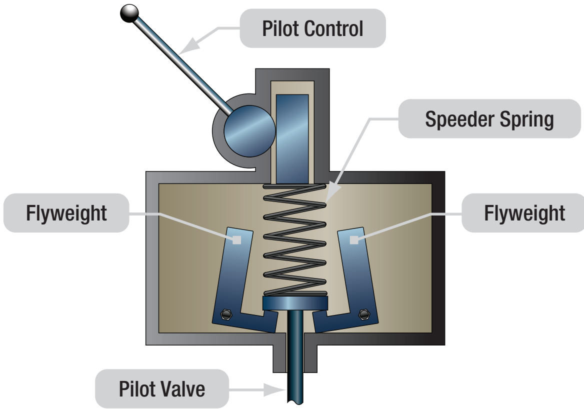

Figure 17-21. Governor sensing an underspeed condition.

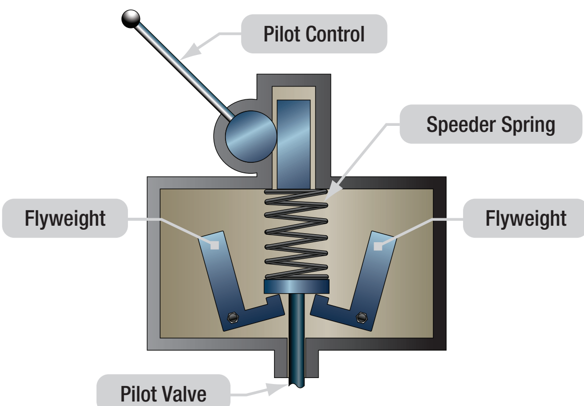

Figure 17-22. Governor sensing an overspeed condition.

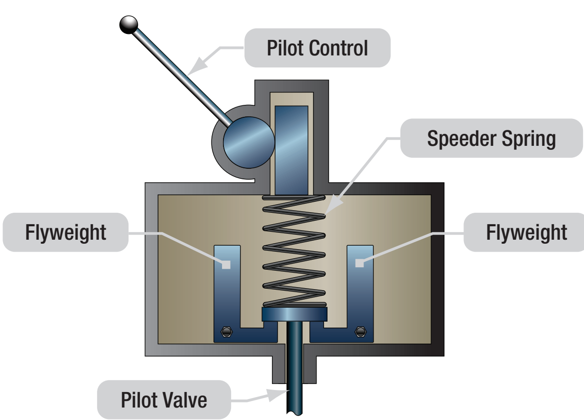

Figure 17-23. Governor sensing an on-speed condition.

unbalance these forces, such as if the aircraft dives or climbs, or the pilot selects a new rpm through the propeller control (changes tension on the speeder spring), then these forces are unequal and an underspeed or overspeed condition would result. A change in rpm comes about in the governing mode by pilot selection of a new position of the propeller control, which changes the tension of the governor speeder spring, or by the aircraft changing attitude.

GENERAL AVIATION AIRCRAFT PROPELLERS

FIXED PITCH WOOD PROPELLERS

Although many of the wood propellers were used on older airplanes, some are still in use. The construction of a fixed pitch, wood propeller is such that its blade pitch cannot be changed after manufacture. (Figure 17-24) The choice of the blade angle is decided by the normal use of the propeller on an aircraft during level flight when the engine performs at maximum efficiency. The impossibility of changing the blade pitch on the fixed-pitch propeller restricts its use to small aircraft with low horsepower engines in which maximum engine efficiency during all flight conditions is of lesser importance than in larger aircraft. The wood, fixed-pitch propeller is well suited for such small aircraft because of its light weight, rigidity, economy of production, simplicity of construction, and ease of replacement.

A wood propeller is not constructed from a solid block, but is built up of a number of separate layers of carefully selected and well-seasoned hardwoods. Many woods, such as mahogany, cherry, black walnut, and oak, are used to some extent, but birch is the most widely used. Five to nine separate layers are used, each about 3/4 inch thick. The several layers are glued together with a waterproof, resinous glue and allowed to set. The blank is then roughed to the approximate shape and size of the finished product. The roughed-out propeller is then allowed to dry for approximately one week to permit the moisture content of the layers to become equalized. This additional period of seasoning prevents warping and cracking that might occur if the blank were immediately carved. Following this period, the propeller is carefully constructed. Templates and bench protractors are used to assure the proper contour and blade angle at all stations.

After the propeller blades are finished, a fabric covering is cemented to the outer 12 or 15 inches of each finished blade.

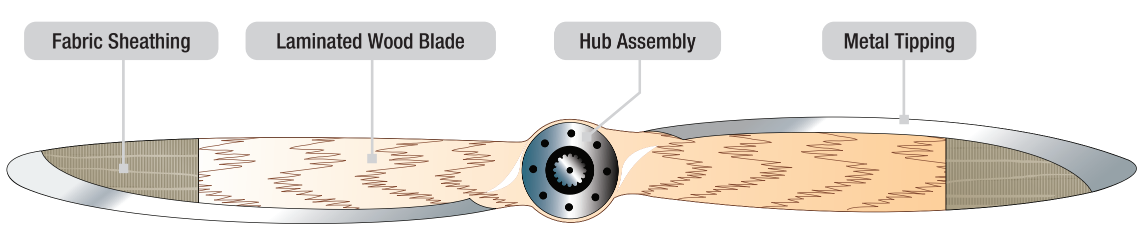

Figure 17-24. Fixed-pitch wood propeller assembly.