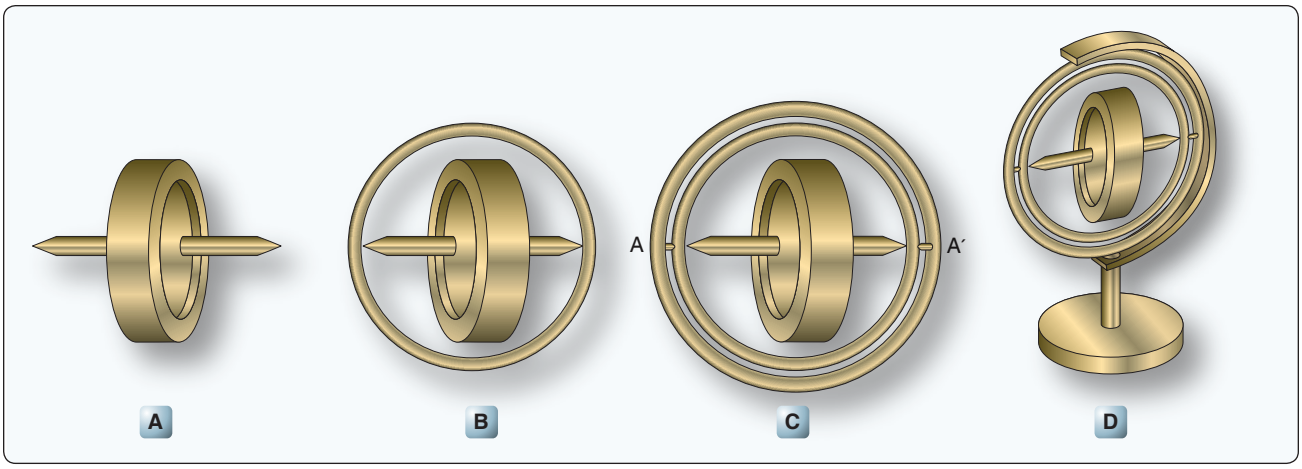

Figure 10-93. *Gyroscopes.*

A gyroscope with this configuration, two rings plus the mounting bracket, is said to be a free gyro because it is free to rotate about two axes that are both perpendicular to the rotor's spin axis. *[Figure 10-93D]* As a result, the supporting ring with spinning gyro mounted inside is free to turn 360° inside the outer ring.

Unless the rotor of a gyro is spinning, it has no unusual properties; it is simply a wheel universally mounted. When the rotor is rotated at a high speed, the gyro exhibits a couple of unique characteristics. The first is called gyroscopic rigidity, or rigidity in space. This means that the rotor of a free gyro always points in the same direction no matter which way the base of the gyro is positioned. *[Figure 10-94]*

Gyroscopic rigidity depends upon several design factors:

1. Weight—for a given size, a heavy mass is more resistant to disturbing forces than a light mass.
2. Angular velocity—the higher the rotational speed, the greater the rigidity or resistance is to deflection.
3. Radius at which the weight is concentrated—maximum effect is obtained from a mass when its principal weight is concentrated near the rim, rotating at high speed.
4. Bearing friction—any friction applies a deflecting force to a gyro. Minimum bearing friction keeps deflecting forces at a minimum.

This characteristic of gyros to remain rigid in space is exploited in the attitude-indicating instruments and the directional indicators that use gyros.

Precession is a second important characteristic of gyroscopes. By applying a force to the horizontal axis of the gyro, a unique phenomenon occurs. The applied force is resisted. Instead of responding to the force by moving about the horizontal axis, the gyro moves in response about its vertical axis. Stated another way, an applied force to the axis of the spinning gyro does not cause the axis to tilt. Rather, the gyro responds as though the force was applied 90° around in the direction of rotation of the gyro rotor. The gyro rotates rather than tilts. *[Figure 10-95]* This predictable controlled precession of a gyroscope is utilized in a turn and bank instrument.

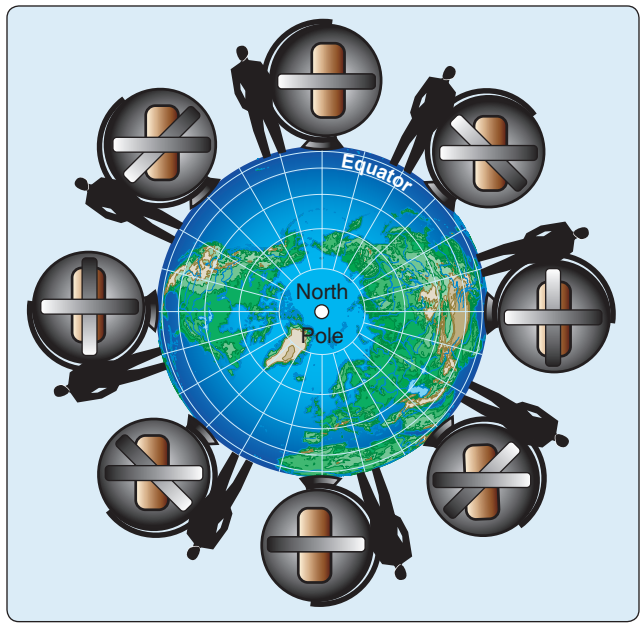

Figure 10-94. *Once spinning, a free gyro rotor stays oriented in the same position in space despite the position or location of its base.*

Solid State Gyros and Related Systems

Improved attitude and direction information is always a goal in aviation. Modern aircraft make use of highly accurate solid-state attitude and directional devices with no moving parts. This results in very high reliability and low maintenance.