

GYROSCOPE / GYROSCOPE



Date ___/___/___

Gyroscopes: A Gyroscope is a device designed to have a spinning disc or wheel mounted on a base such that its axis can turn freely in one or more directions in order to maintain its orientation regardless of any movement of the base. However, the orientation changes in response to an external torque acting in a different direction.

Design of Gyroscopes:

The gyroscope is a more massive rotator that is fixed in light supporting ring called gimbals. The gimbals consist of flexible bearings that isolate the central rotator from outside torques.

The axis of the spinning wheel defines the spin axis.

The rotator possesses three degrees of rotational freedom and spins about an axis. It acquires extraordinary stability of balance at high speed as if maintaining the high speed rotation axis of its central rotator.

Working principle:

When the gyroscope is applied with external torques or rotations about the given axis, the orientation can be measured by a precession phenomenon when an object rotating about an axis is applied with external torque along a direction \perp to rotational axis, the precession occurs.



This rotation about the spin axis is detected and compensation of this rotation is delivered to a motor or other device that applies torque in an opposite direction thereby cancelling the precession and maintaining its orientation.

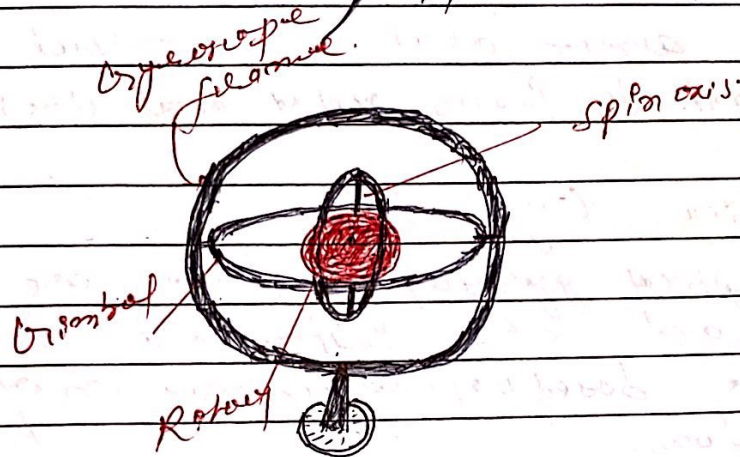


Fig 8 A gyroscope

The precession can also be prevented using gyroscopes that are arranged perpendicular to each other. The rotation rate can be measured by the pulsation of counterbalancing torque at constant time intervals.

A gyroscope is a wheel mounted on two or three gimbals, which are pivoted supports that allow the ~~rot~~ rotation of the wheel about a single axis. A set of these gimbals, one mounted on the other with orthogonal pivot axis, is used to allow a wheel mounted on the innermost gimbal to have an orientation remaining independent of the orientation.

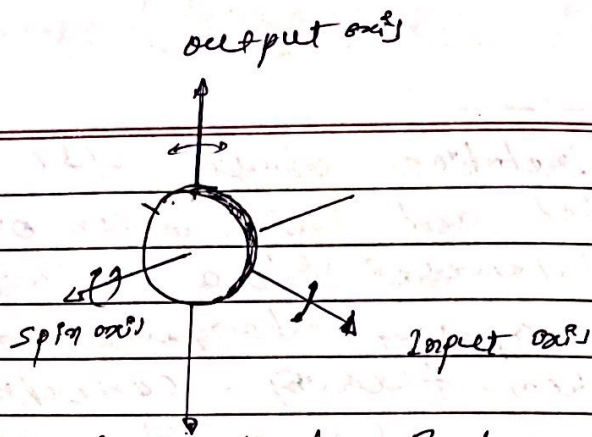


Fig: Gyro wheel, Reaction always ~~of~~ reaction ~~is~~ about the output axis (blum) corresponds to forces applied about the input axis.

Optical Gyroscope

In optical gyroscope, there are no moving parts and this instrument does not operate based on the conservation of angular momentum.

They are operated based on the principle of the Sagnac effect. A laser beam is first divided by a semicircular mirror half of the surface covered by silver.

During operation, one of the beam paths travels at a greater distance each the detector. The difference in path length is detected as a phase shift which is proportional to the angular velocity of system.

Applications

Gyroscopes are used in compasses for boats, spacecrafts, and airplanes.

Massive gyroscope are used to stabilize large boats and some satellites. Also used in guidance systems in missiles.