TM 630
Gyroscope

Description

- **properties of a guided gyro**
- **effect of precession**

A gyroscope is used in aviation and the aerospace industry to stabilise the position or as a navigation tool in so-called inertial navigation. The basic element of a mechanical spinning top is a rapidly rotating mass. A free spinning top is desired, which maintains the position of its rotational axis in space independently of gravity. This property is exploited in the artificial horizon in the aircraft. If the spinning top is mounted on a frame, it is referred to as a guided or enclosed gyro. A guided spinning top is the main component of a gyroscope. If a force acts on a guided spinning top perpendicular to the axis of rotation, the spinning top exerts a moment: the gyroscopic moment. The rotation perpendicular to the axis of rotation is known as precession. A gyroscope therefore has three axes: the axis of rotation of the spinning top, the precession axis and the axis of the gyroscopic effect that triggers the gyroscopic moment, which are all perpendicular to each other.

The TM 630 unit enables familiarisation with how a gyroscope works. The moments caused by the precession of the spinning top can be experimentally determined.

The spinning top is composed of a flywheel mass that is driven at high speed by an electric motor. The spinning top is mounted in a cardan frame. The frame can be rotated about the vertical axis by a second electric motor. This generates the precession of the spinning top. By means of the precession, the spinning top exerts a moment – the gyroscopic moment – about the horizontal axis. The gyroscopic moment causes deflection of the inner frame. The gyroscopic moment can be determined with a lever and a sliding weight.

The speeds of both electric motors for rotation and precession can be adjusted and are displayed digitally.

A transparent protective cover above the rotating arm ensures safety: operation is only possible when the protective cover is properly attached.

Learning objectives/experiments

- experimental verification of the gyroscopic laws
- familiarisation with the three gyro axes
- calculation of gyroscopic moments
- study the effect of precession

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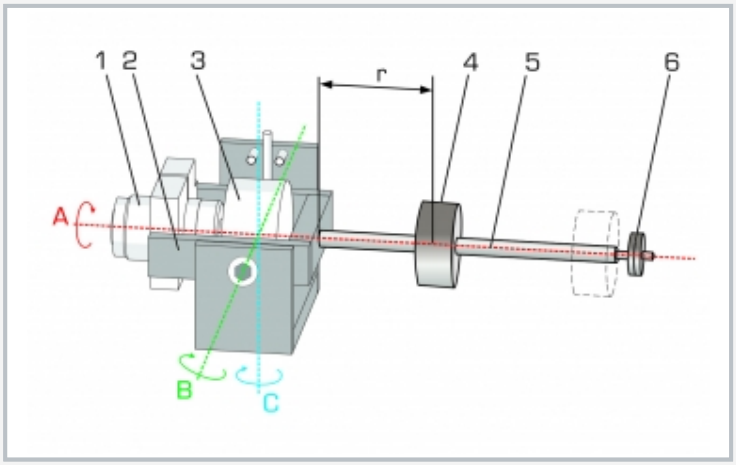
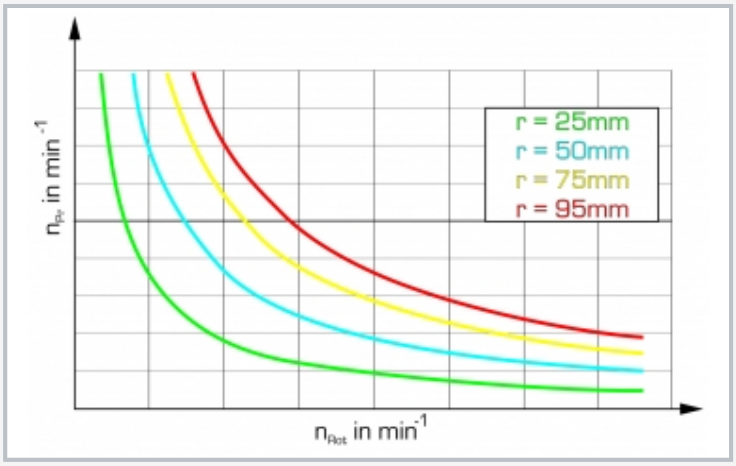
1 protective cover, 2 gyro drive motor, 3 speed displays and adjustment for of the horizontal gyro axis and the vertical precession axis, 4 spinning top flywheel mass, 5 lever, 6 sliding weight, 7 inner frame



1 drive motor, 2 inner frame, 3 spinning top flywheel mass, 4 sliding weight, 5 lever, 6 fine weights; r distance of the weight, A horizontal axis of the spinning top = axis of rotation, B rotational axis of the inner frame = axis of gyro effect, C vertical axis = precession axis



Curve of the precession speed for different gyroscopic moments n_{Pr}, speed of the precession axis, n_{red} speed of the rotational axis, r distance of the sliding weight (gives gyroscopic moment)

Specification

[1] familiarisation with a gyroscope
[2] investigate a guided spinning top
[3] adjustment of the speed along the rotation axis
[4] adjustment of the speed along the precession axis
[5] determine the gyroscopic moment
[6] digital display of speeds along the rotation axis and the precession axis
[7] protective cover with release for the drive ensures safe operation

Technical data

Gyro
- drive motor power: 3,6W
- moment of inertia of the spinning top: 375gcm^2
- speed of the rotation axis: 1000...6000min^{-1}
- gyroscopic moment: 0...61Nmm

Precession
- drive motor power: 19W
- speed of precession axis: 5...63min^{-1}

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 420x400x310mm
Weight: approx. 22kg

Scope of delivery

1 experimental unit
1 set of tools
1 set of instructional material

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Optional accessories

020.30009	WP 300.09	Laboratory trolley