E230 Aircraft Systems

The Right Direction

6th Presentation

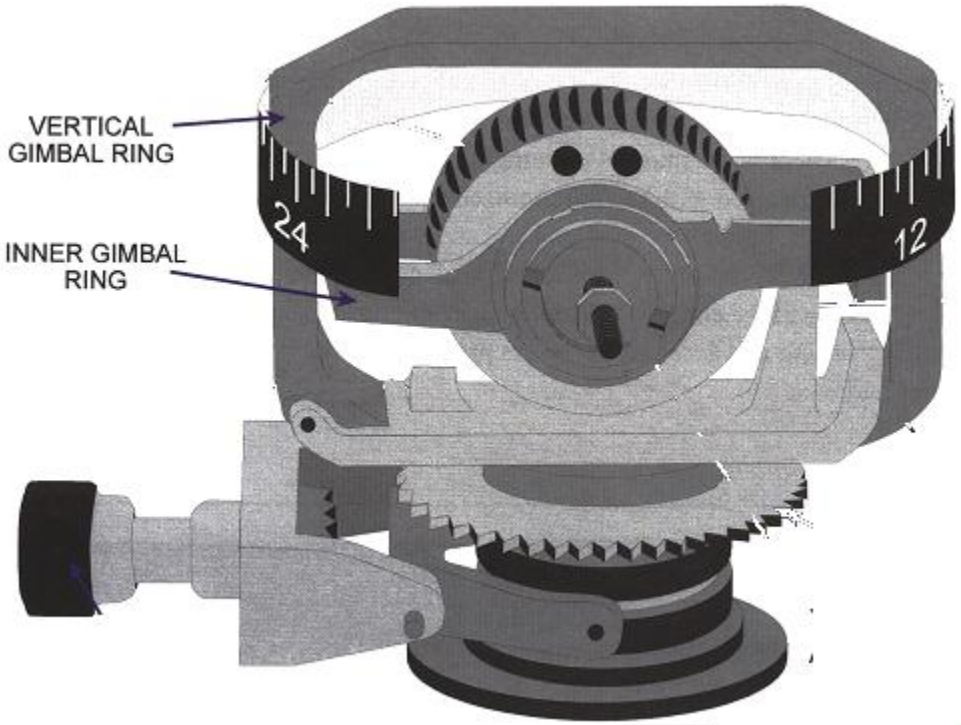
School Of Engineering

Directional Gyro Indicator (DGI)

- Contains a horizontal-axis gyro
- Makes use of rigidity property of gyroscope
- Usually powered by vacuum or electric
- Accuracy is affected by drift over time (Refer to P06 on drift)
- Pilot still need to regularly make correction to the DGI heading by using information from magnetic compass

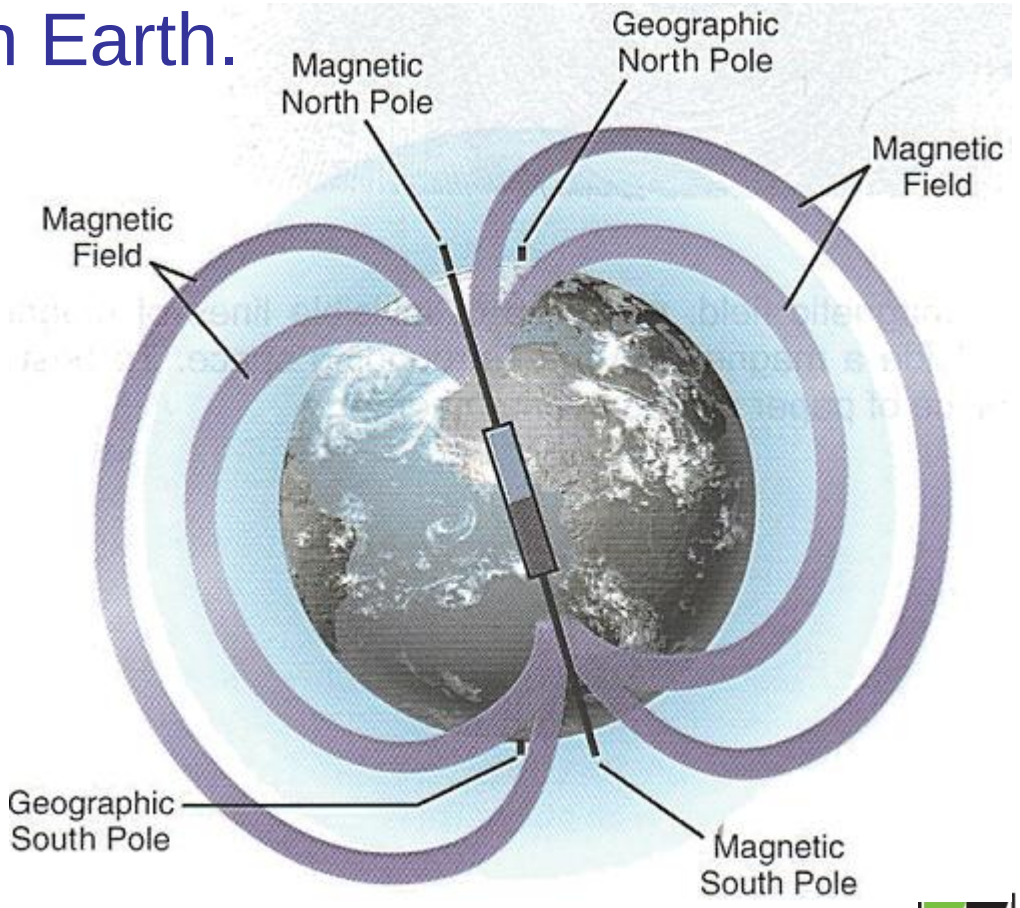
DGI

- Spin axis is horizontal and remains pointing in the same direction due to rigidity
- Vertical gimbal yaws together with aircraft, rotating the compass card in the process
  - Knob on the DGI is to correct for drift



Earth's Magnetic Field

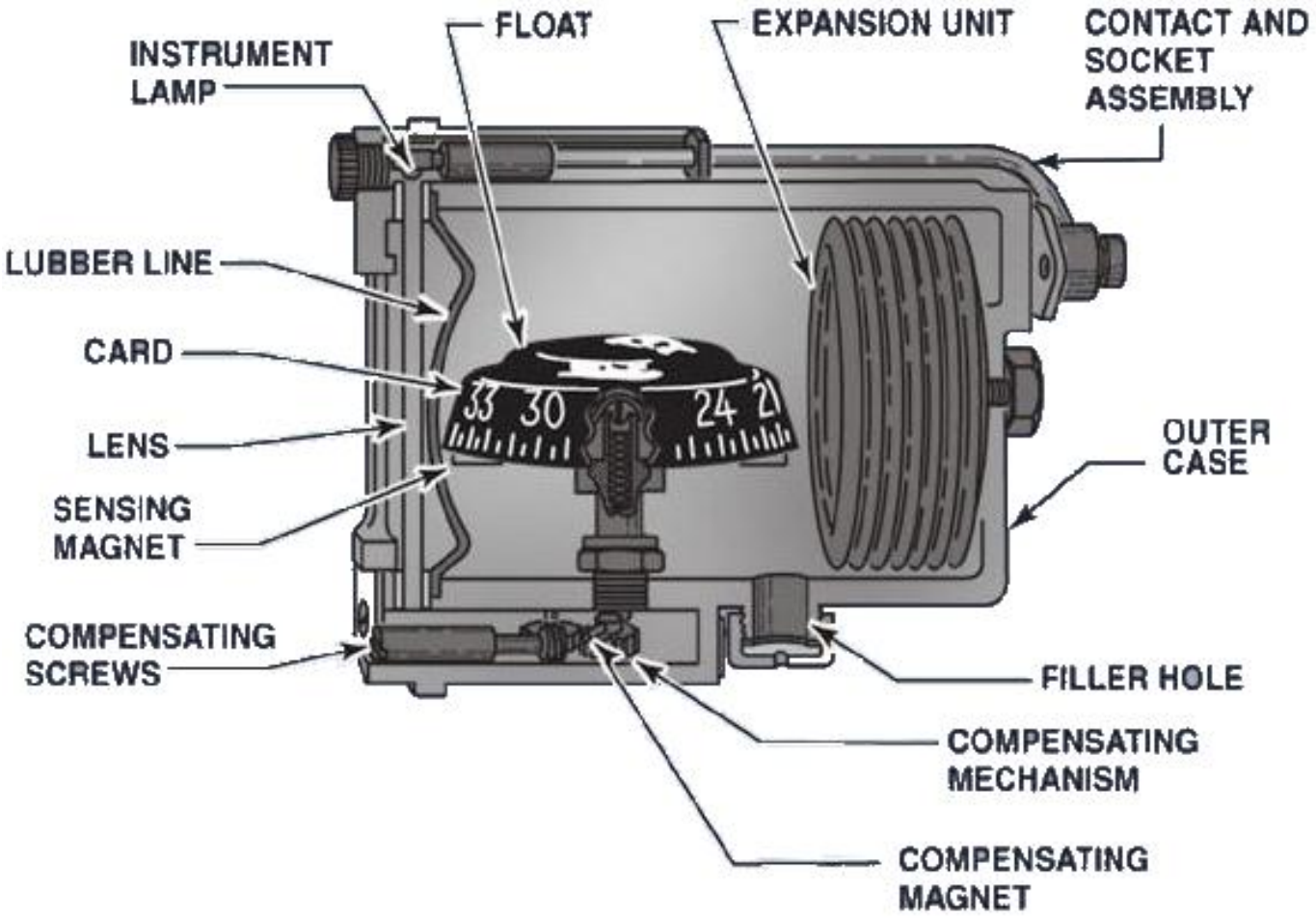
- True North and Magnetic North are different locations on Earth.



Variation and Dip

- Magnetic Variation
  - Angular difference between True North and Magnetic North
- Magnetic Dip
  - Magnetic field lines are not parallel to Earth's surface except at Equator
  - Thus a freely-suspended magnet will not be horizontal
  - Float is weighted at one end to correct for dip

Construction of Direct Reading Compass

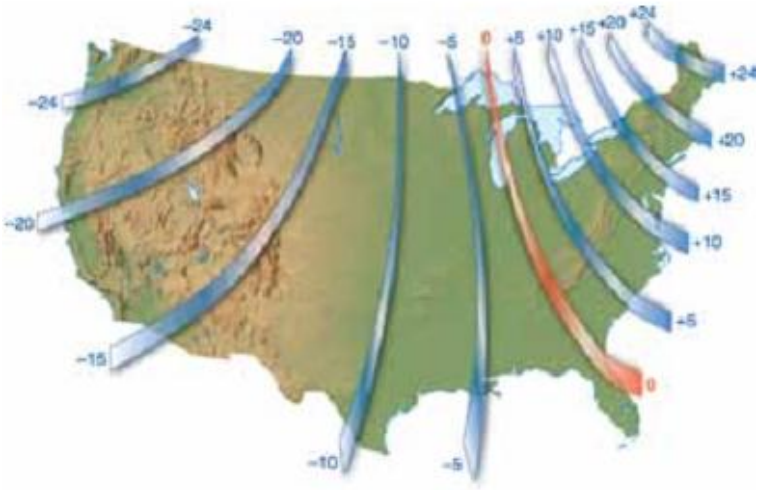


Magnetic Deviation

- Difference between compass north and magnetic north
- Caused by aircraft magnetism (i.e. magnetic field in the aircraft due to electric current flowing in wires or metal parts that are magnetised)
- Compass swing is done to minimise deviation
- Affected by heading - different headings produce different deviation error
- Any remaining error will be recorded on a compass deviation card

Magnetic Variation

- Difference between magnetic north and true north
- Caused by magnetic variation
- Affected by geographical location
  - Different locations on Earth have different amount of variation error



Correction for Variation

- East of Agonic line:
  - Magnetic Heading = True Heading – Variation
- West of Agonic line:
  - Magnetic Heading = True Heading + Variation
- Memory Aid: West is Best, East is Least
  - Means when variation is west, add to true heading

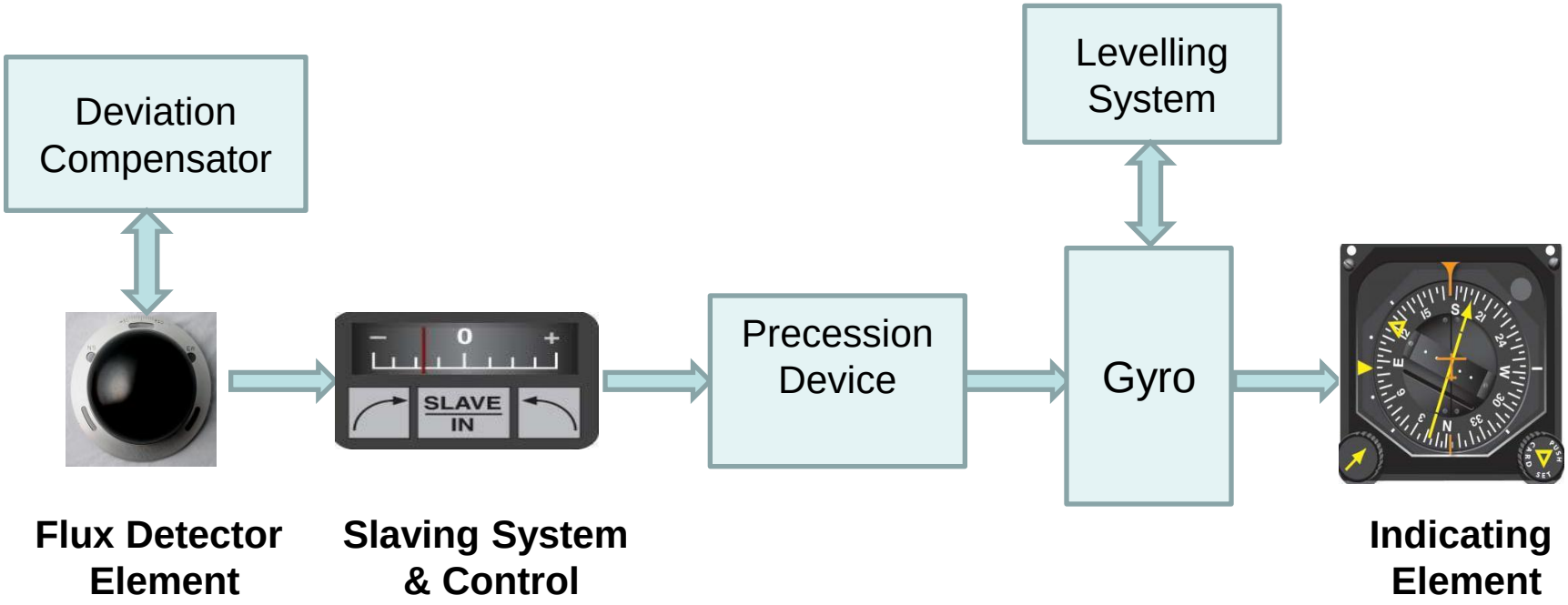
Another Memory Aid

- Cadbury Dairy Milk Very Tasty
- Compass heading → Deviation error→ Magnetic heading → Variation error→ True heading

Other errors in a Direct Indicating Compass

- Turn error
  - Caused by vertical component of Earth's magnetic field rotating the compass card
  - Affects the compass when aircraft is flying in North-South direction and turning East or West
- Acceleration error
  - One end of the compass is heavier than the other end to correct for magnetic dip
  - Error is caused by inertia of weight rotating the compass card during acceleration
  - Affects the compass when aircraft is flying in East-West direction and accelerating

Magnetic Heading Reference System (MHRS) or Remote-Indicating Compass



Main Features of MHRS

- Flux detector element senses the horizontal component of Earth's magnetic field
- The signals from the flux detector element are "slaved" to or "drives" a gyro-stabilized system

Advantages of MHRS

- No drift error because gyro is “slaved” to the flux detector
- No turn error and acceleration error because gyro senses maneuvers
- No deviation error because flux detector is mounted at tail or wing, far away from interference
- No dip error because flux detector instead of magnet is used to sense magnetic field
- Contains the strengths of the direct indicating compass and the DGI and eliminates the errors of both → Higher accuracy

Learning Objectives

- Describe the operating principles of a DGI
- Identify the errors inherent in DGI and direct indicating compass readings
- Differentiate and convert between true heading, compass heading and magnetic heading
- Describe how a Direct Indicating Compass (DIC) works
- Explain how MHRS system can eliminate the errors of a DGI and a DIC