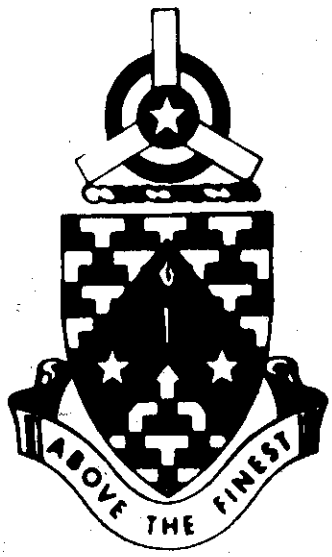
PROGRAMED TEXT

INSTRUMENT INDOCTRINATION V

SLAVED GYRO COMPASS AND MAGNETIC COMPASS

AM-89B



MARCH 1969

UNITED STATES ARMY
PRIMARY HELICOPTER SCHOOL
FORT WOLTERS, TEXAS

PROGRAMED TEXT

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FILE NO: AM-89B

PROGRAM TITLE Instrument Indoctrination V
Slaved Gyro Compass and Magnetic Compass

POI SCOPE: Basic construction, principles of operation, interpretation, possible malfunctions, and errors of the magnetic and slaved gyro compasses.

INSTRUCTOR REFERENCES:

TM 1-215, Ch 2, Sec I, VII & VIII

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DATE: February 1969

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DATE: March 1969

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Instrument Indoctrination V

PREFACE

The purpose of this programed text is to teach you the two types of heading indicators you will use while flying under IFR (Instrument Flight Rules) conditions.

Start with frame 1 and work each frame in succession. Each frame will normally ask you a question. The correct answer is printed on the top of the next frame. If you were incorrect, turn back and restudy the frame before continuing on to the next frame. When you have finished the text, complete the Self Evaluation Exercise.

PERFORMANCE OBJECTIVES

Given a multiple choice examination, you will select the correct statement concerning the construction, operation, and uses (to include errors and limitations) of the magnetic and slave gyro compasses.

FRAME 1

Since man first began to travel, he has required something to help him determine or maintain direction.

Without directional information, the navigation of aircraft as we know it, would be most difficult.

The slaved gyro compass will be your primary heading indicator while flying under actual instrument conditions because it gives stable heading information.

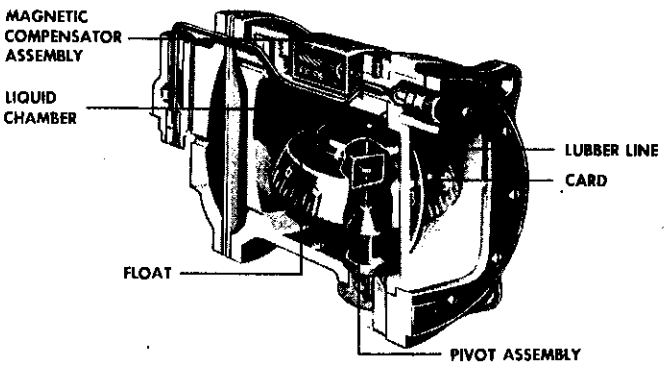
Each slaved gyro compass system consists of a flux valve unit, an amplifier, a directional gyro, and a heading indicator.

TURN TO PAGE 3, FRAME 2

FRAME 6

Construction

The magnetic compass contains two steel magnetized needles mounted on a float around which the compass card is mounted.

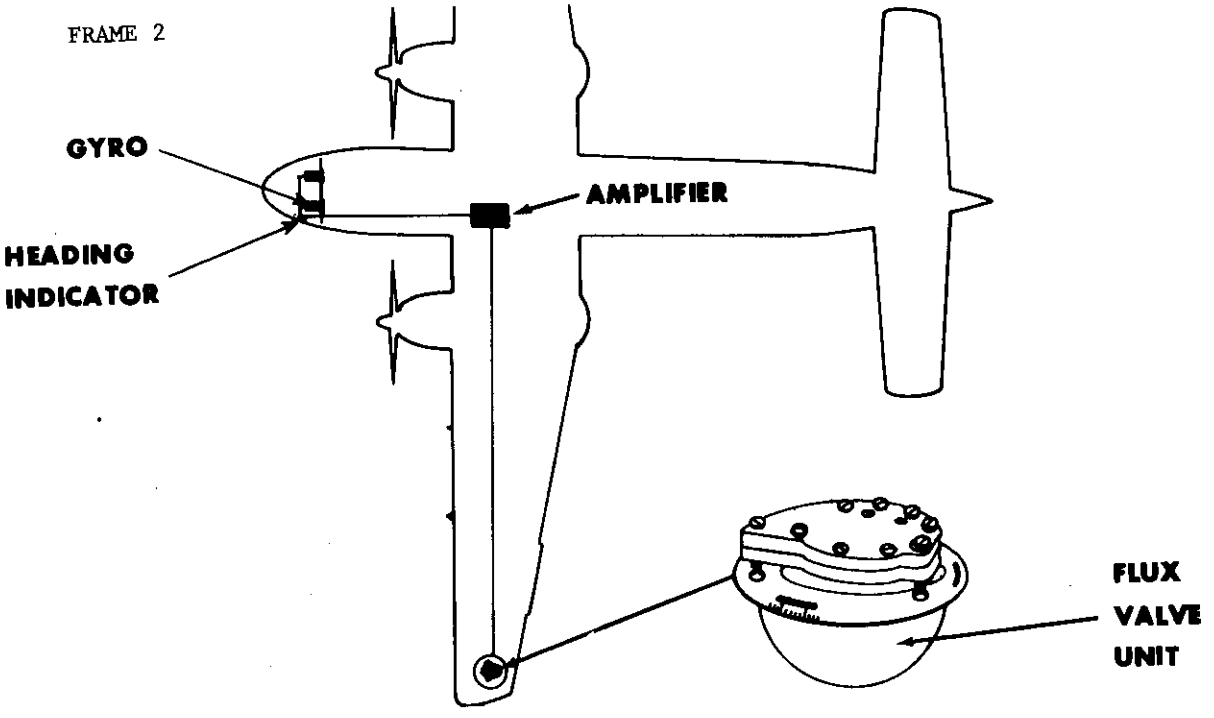


The float assembly, which consists of the magnetized needles, compass card, and float, is housed in a bowl filled with acid free white kerosene.

A pedestal rising from the bottom of the bowl supports the float.

A compass compensating assembly, consisting of several small bar magnets, permits adjustment of the compass by authorized maintenance personnel.

FRAME 2



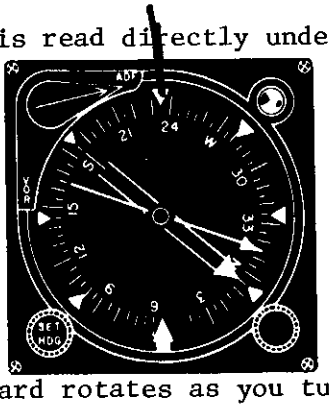
Flux Valve Unit - This is the direction sensing device of the system. It detects the horizontal components of the earth's magnetic field.

Amplifier - The coordinating and distributing center. Its principle function is to increase the strength of the signals from the flux valve unit.

Directional Gyro - Maintains a constant directional reference using the gyroscopic property of rigidity in space and signals from the flux valve unit.

Heading Indicator - Gives magnetic heading information.

Heading information is read directly under the index at the top of the instrument.



The entire compass card rotates as you turn the aircraft, thus your present heading is always read directly below the index.

The above instrument indicates a heading of 235°.

FRAME 7

Although the magnetic compass is simple in construction and operation and requires no external power, it has many errors that the aviator has to compensate for.

Oscillation Error - rough air or poor control technique causes erratic swing of the compass card.

Swirl - rapid pedal turns cause fluid and card to swirl.

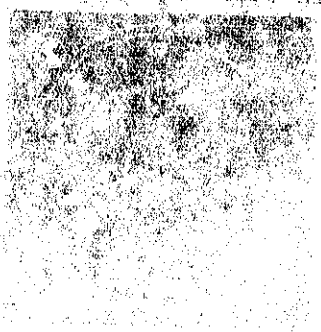
Variation - the angular difference between true north and magnetic north.

Deviation - influence from electrical equipment and metallic objects located nearby.

Dip - the tendency of the magnetic compass to point down as well as north in certain latitudes.

The errors of the magnetic compass are

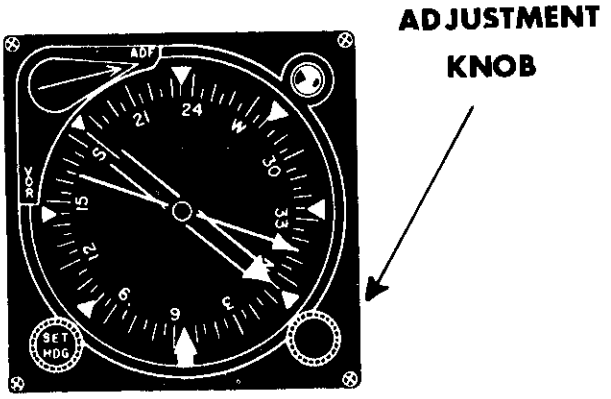
a. deviation, variation, oscillation, swirl, and dip.
b. variation, deviation, electrical disturbance, swirl, and dip.
c. deviation, magnetism, dip, swirl, and oscillation.



ANSWER: 235°.

FRAME 3

The slaved gyro compass should read within plus or minus 2° of a known heading. If it does not, it can be manually adjusted with the knob on the lower right hand corner of the instrument.



ANSWER: a. Deviation, variation, oscillation, swirl, and dip.

FRAME 8

Dip is the one error that you as an aviator must learn to compensate for. This can be broken down into two different categories: northerly turning error, and acceleration/deceleration error.

Compass turning error - When turning from a heading of east or west to a heading of north, the compass reading lags behind the nose of the aircraft. When turning to a heading of south, the compass reading leads the nose of the aircraft.

On a 90° turn from east or west, the lead or lag will equal the number of degrees of the local latitude.

EXAMPLE

You are flying on a heading of 090° and want to turn and roll out on a heading of north. Since the local latitude factor in this area is 30 and you know the compass lags when turning to north, start your roll out when the magnetic compass shows 030°.

NOTE: The entire local latitude factor is added or subtracted only when making a turn from due east or west to due north or south. When the turn is less than 90° the student must interpolate.

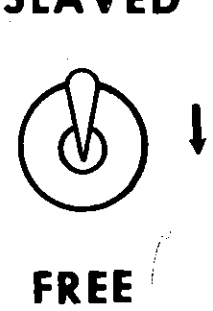
You are flying on a heading of 270° and want to turn and roll out on a heading of north. You should start your roll out when the magnetic compass shows a heading of (local latitude factor is 30)

a. 000°
b. 030°
c. 330°
d. 300°

FRAME 4

The slaved gyro compass system may be operated as a free gyro heading indicator in areas where the earth's magnetic field is unusable.

In a free mode of operation, the direction-sensing flux valve is



disconnected from the system, and the gyro is used only as a heading reference indicator. Since the gyro is not slaved to the flux valve unit, the heading indicator is subject to drift, an average of about 3° every 15 minutes. Therefore, the aviator should periodically check the heading indications with those of his stand-by source (magnetic compass, known heading, runway, etc) and reset if necessary.

If the gyro compass is in the "FREE" mode, how many degrees will it drift in one hour? 12°

ANSWER: c. 330° (Subtract the "local latitude factor" from north)

FRAME 9

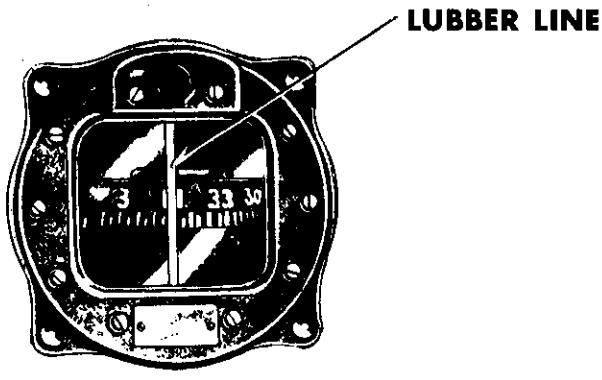
You are flying on a heading of 090° and want to turn and roll out on a heading of 180°, you should start your roll out when the magnetic compass indicates a heading of 210°.
(local latitude factor is 30)

ANSWER: 12°

FRAME 5

There are numerous types of heading indicators, most of which are highly complex and require a power source for operation. The magnetic compass, simple in construction and operation, is an exception and is therefore less subject to failure.

The magnetic compass is a simple self contained heading indicator, the heading being read directly behind the lubber line.



STOP! TURN BACK TO PAGE 2, FOR FRAME 6

ANSWER: 210° (Turning to south, the compass leads, so add the "local latitude factor").

FRAME 10

Acceleration Error - When accelerating on either a heading east or west, the magnetic compass indicates a turn to the north.

When decelerating, the error is an indication of a turn to the south.

If the aircraft is on a north or south heading, no acceleration error is apparent while climbing, diving, or changing speed.

When accelerating or decelerating on a heading of east or west, the magnetic compass

a. remains steady.
b. fluctuates.

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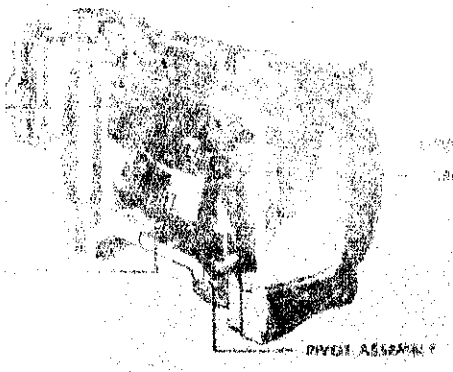
ANSWER: b. fluctuates (due to dip error).



NOW GO TO PAGE 13 AND COMPLETE THE SELF EVALUATION EXERCISE

SELF EVALUATION EXERCISE

1. The primary advantage of the magnetic compass is that

   a. most aircraft have one.
   b. it serves as a cross check against gyro heading indicators.
   c. it has few errors.
   d. it requires no external power for operation.

2. What is the primary advantage of the slaved gyro compass over the magnetic compass?

   a. Stable heading indication-
   b. No aircraft power required
   c. No magnetic variation
   d. No advantage

3. The main components of the slaved gyro compass are

   a. flux valve, amplifier, heading indicator, and gyro.
   b. flux valve, battery, and amplifier.
   c. heading indicator, gyro, and amplifier.
   d. gyro and amplifier.

4. The exact heading as read from a magnetic compass would be the

   a. indication read behind the lubber line.
   b. indication read to either side the lubber line.
   c. exact heading can't be determined.
   d. indication determined by comparison with the gyro compass.

5. The 5 errors of the magnetic compass are

   a. deviation, altitude, variation, dip, and swirl.
   b. variation, magnetism, oscillation, dip, and deviation.
   c. deviation, variation, oscillation, swirl, and dip.
   d. oscillation, static electricity, metal, swirl, and altitude.

6. After proper warm up, the slaved gyro compass should read the known heading

   a. plus or minus 8 degrees.
   b. plus or minus 4 degrees.
   c. plus or minus 2 degrees.
   d. plus or minus 1 degree.

7. When turning to north from a easterly heading, you would start your roll out when the magnetic compass indicates (latitude factor is 30)

a. 360
b. 035
c. 030
d. 000

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ANSWERS TO SELF EVALUATION EXERCISE

1. d
2. a
3. a
4. a
5. c
6. c
7. c

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