



# **CENTURY IIB**

## **AUTOPILOT FLIGHT SYSTEM**

PILOT'S OPERATING HANDBOOK

MARCH 1981  
68S75

## NOTICE

**This manual contains general information on the operation of the Century IIB Autopilot. Specific FAA Approved information on special techniques, limitations and emergency procedures of a particular model airplane are contained in either an Airplane Flight Manual Supplement or a Limitations Placard. Be sure and familiarize yourself with the information contained, therein, before flight.**

## CAUTION

**This autopilot system uses the pilot's panel mounted heading and attitude gyros for sensing. In the event of a gyro failure or a vacuum (or air) supply system failure, autopilot operation must not be attempted.**

## INTRODUCTION

The Century Flight Systems, Inc. Century IIB is a light weight automatic flight system utilizing an advanced electronic design for maximum performance and utility. Operating on the versatile 5000 cycle audio frequency, the Century IIB represents a design concept, pioneered by Century Flight Systems, Inc., in which the conventional follow-up or control position feedback signals are replaced by solid state analytical computers. In addition to providing a more stable and adaptable platform, the new system can cope with uneven fuel loads and directional mistrim without the usual directional errors.

Roll responses are time controlled for human-like control action and smooth heading changes.

This manual describes the basic characteristics of each function and its relationship to other functions on the flight system. Maximum utility will be realized after familiarization and practice.

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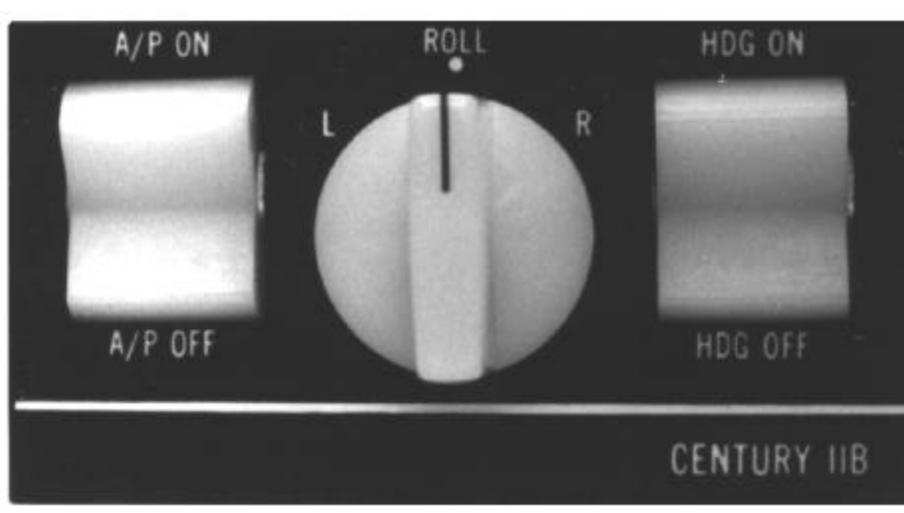
**COMMAND CONSOLE**

FIG.1

The Century IIB Console is designed to provide convenient finger tip command of the basic roll and heading functions. The lucite panel incorporates optically engineered night lighting with revisions for dimming control through the standard aircraft rheostat.

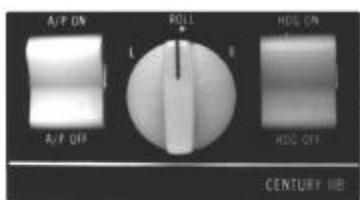


FIG.2

### ROLL (AILERON) ENGAGEMENT

The Century IIB incorporates a fail safe electrical engage and disengage mechanism in the roll servo which is operated by the A/P ON-OFF Rocker Switch in the console. When only this switch is engaged, the autopilot is responsive to the roll command knob on the center console.

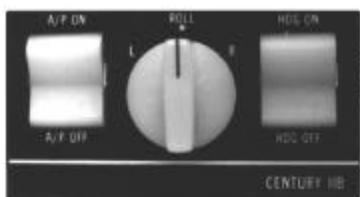


FIG.3

### ROLL COMMAND KNOB

The roll command knob may be used to maneuver the aircraft up to approximately 30° of bank right or left. The centered position represents approximate wings level flight. When the Heading mode switch is engaged the roll knob is removed from the autopilot circuit and is ineffective.



FIG.4

### HEADING MODE

The heading mode rocker switch is used when turning the aircraft to a preselected heading on the Course Selector D.G. or when conducting course intercepts or tracking. Activating this switch removes the roll command knob from the autopilot circuit and adds the D.G. heading and coupler functions as basic autopilot inputs. The Course Selector D.G. and coupler mode selector should be set prior to engagement of the heading mode. (See Section on Coupler Operations when optional coupler is installed).



FIG.5

### COURSE SELECTOR D.G.

The course selector D.G. replaces the standard directional gyro and provides a fully visible, 360° course indication. The D.G. dial is marked in 5° intervals and numbered each 30° around its azimuth. A center indice is provided at the top to align selected headings. Additional indices are located each 45° to facilitate rapid turn selection without mental arithmetic. Any heading may be selected, either before or after engagement, and turns up to 160° may be programmed directly, either right or left. If the course selector indicator is rotated beyond 180° from the D.G. card heading, the autopilot will turn in the shortest direction to reach the selected heading.

In normal operation the maximum bank in HDG mode is 20°. The D.G. card is set with the caging knob on the left of the instrument and the course selector indicator is rotated by the HDG. knob on the right. Direction of response to rotation for both knobs is conventional.

## LATERAL GUIDANCE SYSTEM

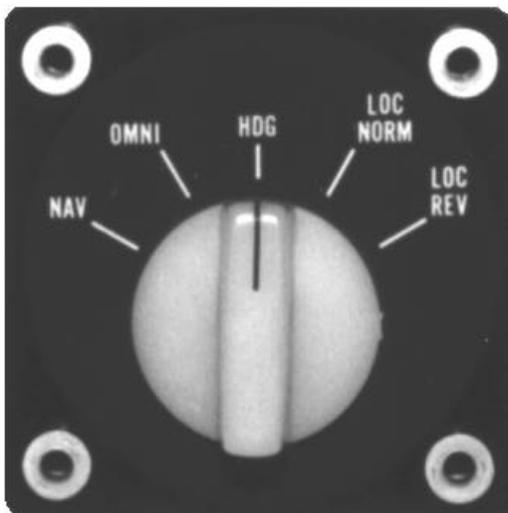


FIG. 6

## COUPLER MODE SELECTOR

The Century flight Systems, Inc. Lateral Guidance System contains a completely automatic, analog computer that directs the autopilot in both VOR and ILS navigation. The system contains a five position coupler mode selector switch which mounts in the instrument panel. Nominal interception angles are  $45^\circ$  and an automatic  $15^\circ$  crosswind correction capability is provided. The complete capture, intercept and tracking sequence is accomplished automatically without monitoring or multiple switching.



Figure 7

### OMNI MODE

When in the OMNI MODE position, the system is coupled to the Omni Bearing Indicator. To select a desired course for interceptor tracking, always set both the OMNI course Selector and the D.G. Course Indicator to the desired course. All headings will then be controlled by the OMNI radio signals. A full deflection on the OMNI Indicator will produce a  $45^\circ$  interception angle. With less than full deflection, the system will automatically direct a smooth, tangential intercept to arrive over the radial with crosswind correction established.

The same dynamic intercept is accomplished whether 2 miles or maximum reception distance from station. Below approximately 2 miles autopilot bank limitations will allow a slight overshoot of the selected radial.



Figure 8

### NAV MODE

NAV Mode operation is initiated in the same manner and serves the same functions as Omni Mode. The NAV, however, incorporates an extended time delay in the computer circuitry which reduces reaction to short term needle deflections. The NAV Mode is recommended for enroute navigation or anytime autopilot response to short term needle deflections becomes excessive. The NAV Mode should not be used for close in VOR approach work, as close in work requires the proportioned dynamic response provided by the Omni Mode.

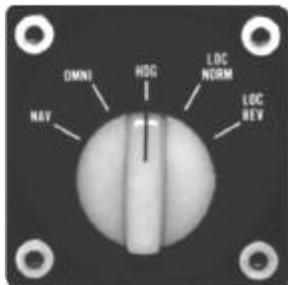


Figure 9

### HEADING MODE

When in the HDG mode the Century IIB Autopilot will function as described on pages 4 and 5 of this manual.



Figure 10

### LOCALIZER (Normal) MODE

In the LOC Norm mode, the system adjusts its sensitivity to accommodate the 5° localizer course width. Since the localizer course width is only 1/4 as wide as the nominal omni indication, additional damping circuits are included to produce smoother, more optimum intercept and track maneuvers. Intercept angles of 45° are automatic with tangential intercepts outside the outer marker and automatic crosswind correction. As with the Omni Mode, the Course Selector D.G. must be set to correspond with the desired magnetic course.

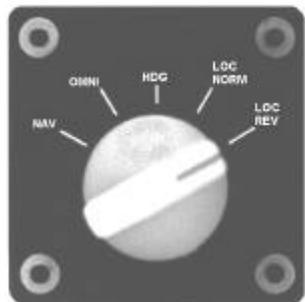


Figure 11

### LOCALIZER (Reverse) MODE

The Century Flight Systems, Inc. Lateral Guidance System is equipped with the Localizer Reverse feature to permit automatic back course approaches and to allow outbound tracking on the Front Course prior to procedure turn. The features of LOC-REV are identical to the LOC-NORM except that the aircraft will fly away from the Localizer Indicator Needle instead of toward it. When using the LOC-REV mode, the Course Selector Indicator must be set to the reciprocal of the Front Course heading.

## **GENERAL OPERATIONS**

The Century IIB and optional coupler are FAA approved on each make and model aircraft under a "Supplemental Type Certificate" STC

There are no restrictions to operations in turbulence and as a general rule autopilot operation in turbulence will result in smoother operation.

Autopilot operating limitations and any special limitations will be specified on the Limitations Placard or in the Airplane Flight Manual Supplement. This should be carefully read and understood.

Autopilot override forces are adjusted to the servo power output requirements of each particular aircraft. The autopilot may be overridden by the pilot without damage to the system.

**NOTE:** Only Century Flight Systems, Inc. trained specialists at approved service centers should adjust servo torque outputs.

### **PILOT'S PREFLIGHT PROCEDURE**

1. With engines running and gyros erected, check vacuum readings. Should be 4.75" to 5.00" HG.
2. With the autopilot off, place coupler mode selector on HDG. position. Center roll knob and D.G. course selector indicator.
3. Engage roll switch, rotate roll command knob left and right and note that the control wheel responds in the proper direction.
4. Engage the heading mode switch and rotate course selector indicator to either side. Note roll servo response; again, without aerodynamic response, servo action is unlimited.
5. Override the autopilot at the control wheel in both directions. Force required should be approximately 15 lbs. At wheel edge dependent upon aircraft model.
6. Disengage autopilot before takeoff.

### **AUTOPILOT ENGAGE SEQUENCE (IN FLIGHT)**

1. Trim aircraft to a wings level flight attitude.
2. Center roll knob and engage autopilot "ON" switch.
3. If navigation mode selector is installed select "HDG" mode.
4. Center D.G. course selector indicator and engage heading mode switch.

### **LATERAL GUIDANCE SYSTEM OPERATION**

Perform Steps 1-4 above then continue below:

5. Match course selector indicator to selected VOR or ILS course.
6. Select Lateral Guidance Mode desired.

**VOR NAVIGATION (See Fig. 12)****1. TO INTERCEPT**

- A. Using Omni Bearing Selector (OBS) dial desired course, inbound or outbound.
- B. Set identical heading on course Selector D.G.
- C. After aircraft has stabilized, position coupler mode selector knob to OMNI mode.

**NOTE**

**If aircraft is positioned less than 45° from selected radial aircraft will intercept before station. If more than 45°, interception will occur after station passage.**

- D. As aircraft nears selected radial, interception and crosswind correction will be automatically accomplished without further switching.
- E. As the aircraft nears the OMNI station, (1/2 mile) the zone of confusion will direct an "S" turn in alternate directions as the OMNI indicator needle swings. This alternate banking, is an indication that station passage is imminent.

**2. TO SELECT NEW COURSE**

- A. To select any outbound course or radial, dial the new course into the Course Selector D.G.
- B. Rotate OBS to the same course.
- C. Aircraft will automatically turn, to the interception heading for the new course.

**3. TO CHANGE STATIONS**

- A. If same course is desired, merely tune receiver to new station frequency.
- B. If different course is desired, position coupler mode selector to HDG mode.
- C. Dial Course Selector D.G. to new course.
- D. Dial OBS to new course.
- E. Position mode selector to OMNI mode.

# VOR NAVIGATION

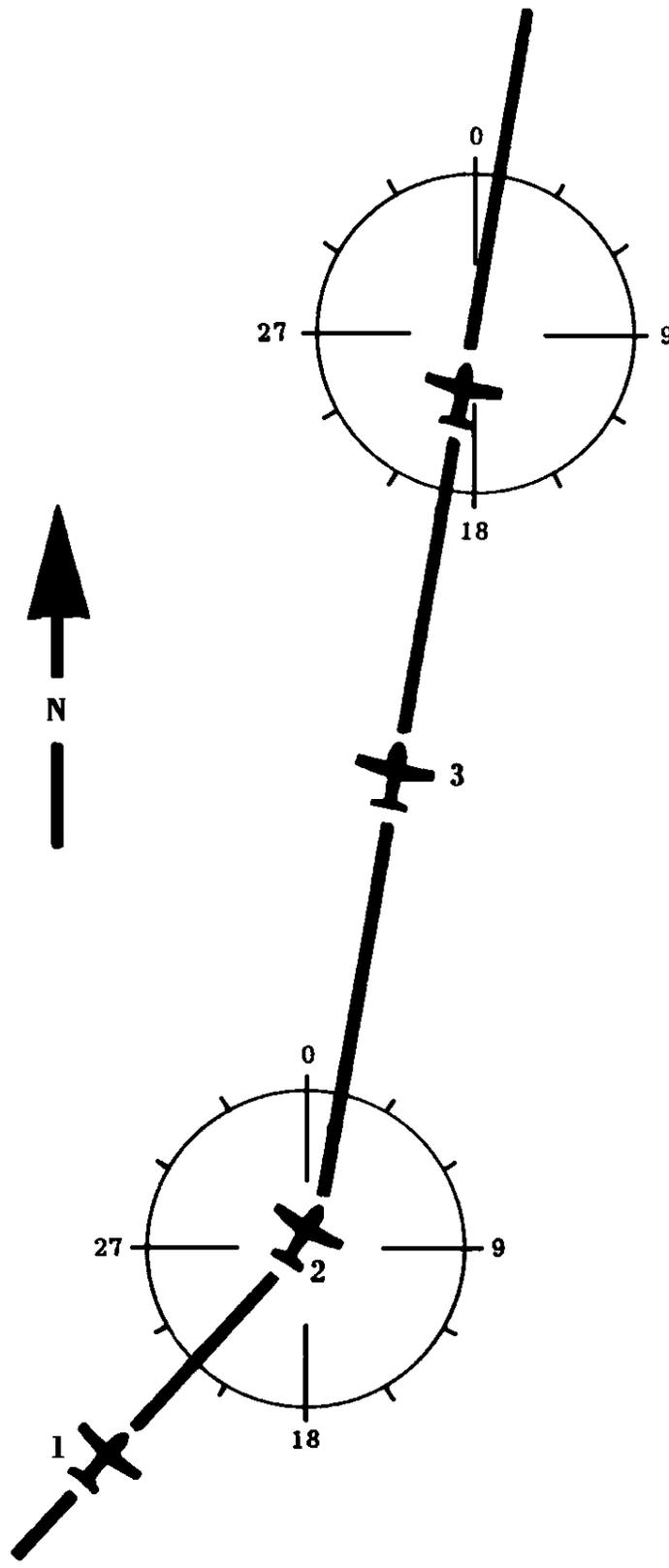


FIG. 12

**VOR APPROACH (See Fig. 13)**

1. Track inbound to station as described in VOR Navigation Section.
2. At station passage dial outbound course on Course Selector D.G. and on OBS.
3. After established on outbound radial, position coupler mode selector to HDG mode and select outbound procedure turn heading.
4. To turn inbound, dial inbound procedure turn heading on Course Selector D.G. dialing in desired direction of turn. Set OBS to inbound course.
5. When turned to within 90° of inbound course, dial Course Selector Indicator to inbound course and position coupler mode selector to OMNI mode.
6. If holding pattern is desired, position mode selector to HDG mode at station passage inbound and select outbound heading in direction of turn.
7. To turn inbound, dial inbound course on Course Selector inbound.
8. When turned to within 90° of inbound radial, position coupler mode selector on OMNI mode.

**NOTE**

For precise tracking over Omni Station, without "S" turn, position coupler mode selector on HDG until station passage

### VOR APPROACH

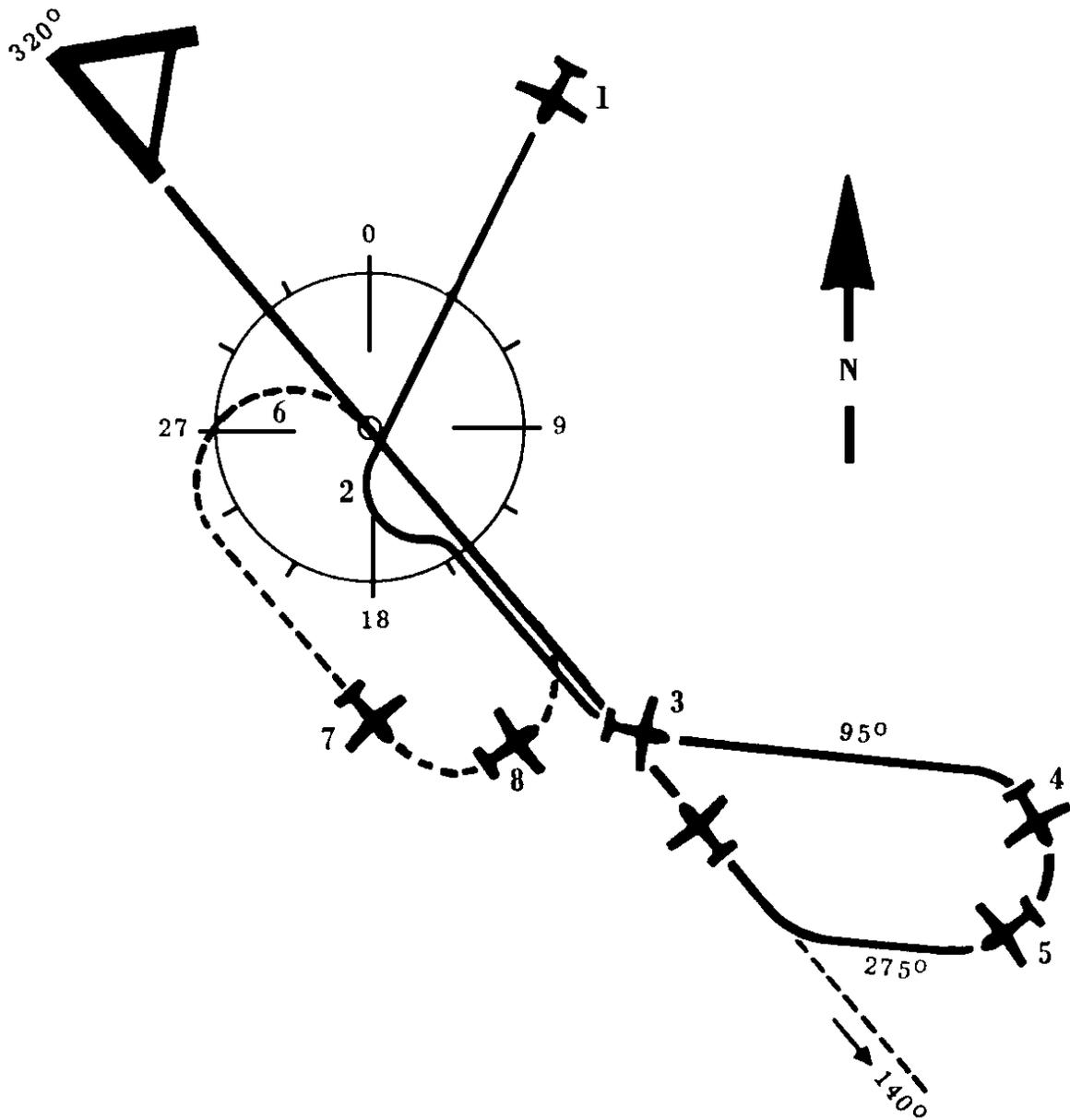


FIG. 13

**ILS APPROACH-- NORMAL (See Fig.14)**

1. To Intercept Outbound:
  - A. Dial ILS Southbound course on Course Selector D.G.
  - B. When stabilized; position mode selector to LOC REV mode.
  
2. For Procedure Turn:
  - A. Following outbound course interception and when beyond outer marker, position mode selector to HDG and dial outbound procedure turn heading.
  - B. To turn inbound, dial inbound procedure turn heading in direction of turn.
  
3. When within 90° of ILS inbound course, dial inbound course on Course Selector D.G. and position mode selector to LOC NORM mode.
  
4. At the Decision Height (DH), or when missed approach is elected, position mode selector to HDG mode and execute missed approach procedure.

ILS APPROACH-- NORMAL

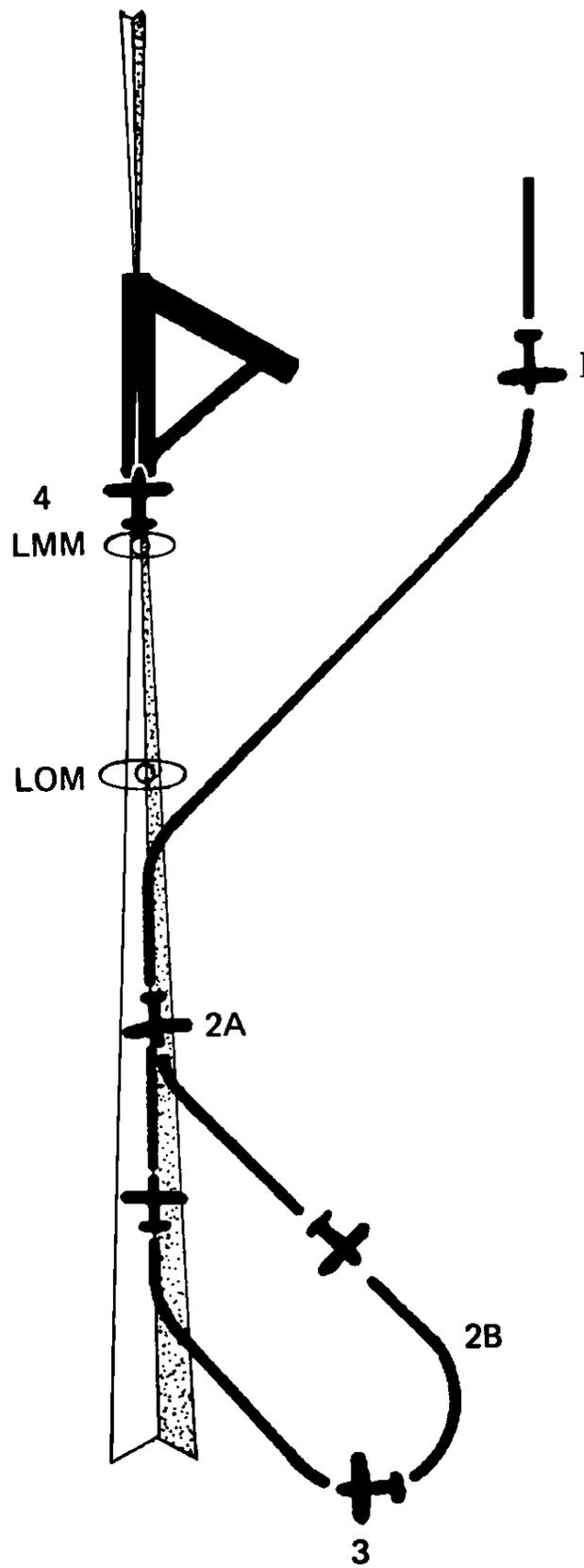


FIG. 14

**ILS APPROACH-- BACK COURSE (See Fig. 15)**

1. To Intercept Back Course Outbound:
  - A. Dial ILS Front Course heading on Course Selector D.G.
  - B. When stabilized, position mode selector to LOC NORM mode.
  
2. For Procedure Turn:
  - A. After interception and when beyond final approach fix, position mode selector to HDG and dial outbound procedure turn heading.
  - B. To turn inbound, dial inbound procedure turn heading in direction of turn.
  
3. When within 90° of inbound course, dial inbound course on Course Selector D.G. and position mode selector on LOC REV mode.
  
4. Position mode selector to HDG mode to prevent "S" turn over ILS station near runway threshold.
  
5. Execute missed approach procedure.

ILS APPROACH -- BACK COURSE

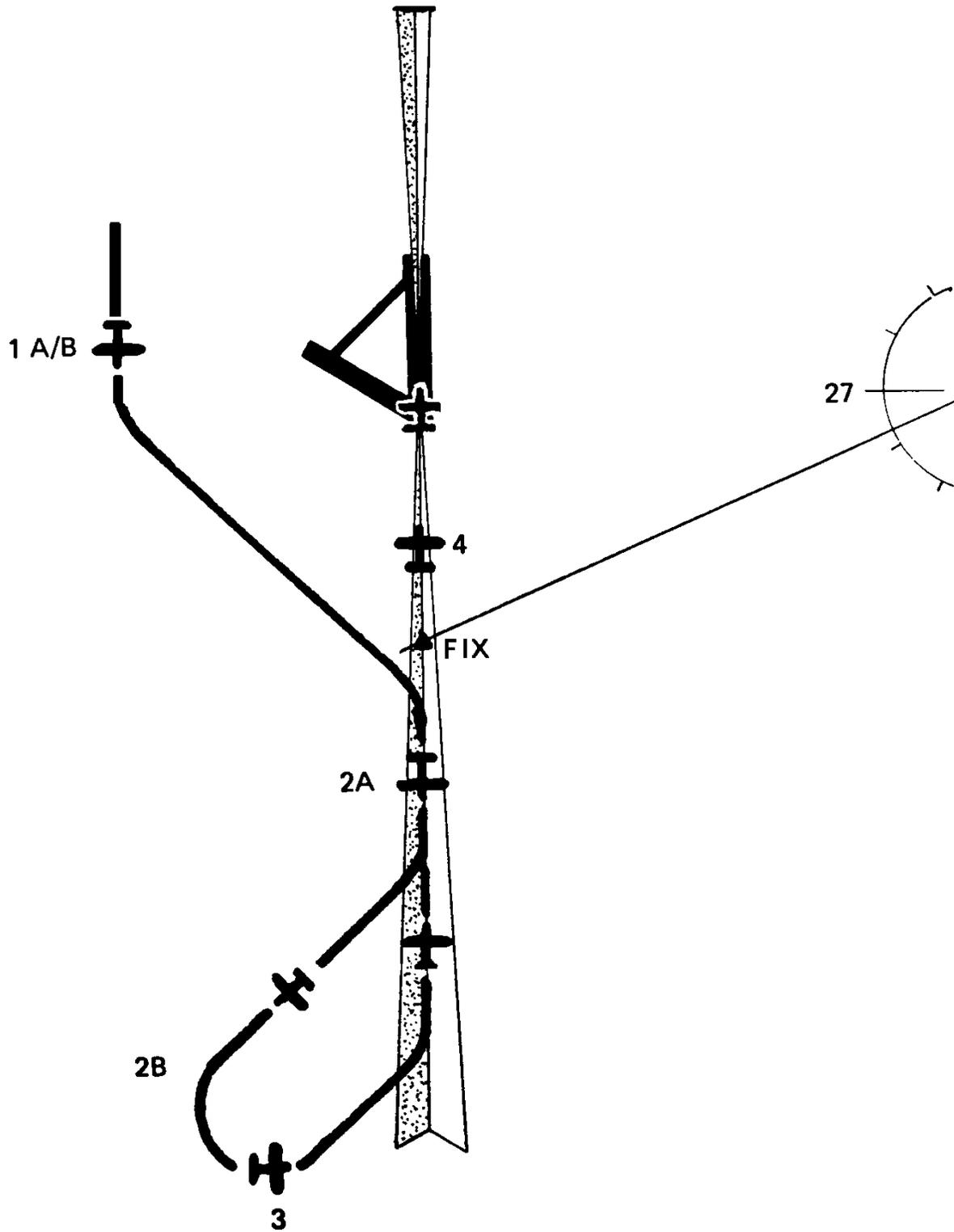


FIG. 15

**CAUTION**

When electrical power is first applied to the NSD-360A instrument, the compass card may rotate or “slew” rapidly. This is NOT an indication that the compass system is orienting itself to the proper magnetic heading. The proper heading orientation must be verified and set prior to takeoff and should be verified prior to approach to landing using the magnetic compass.

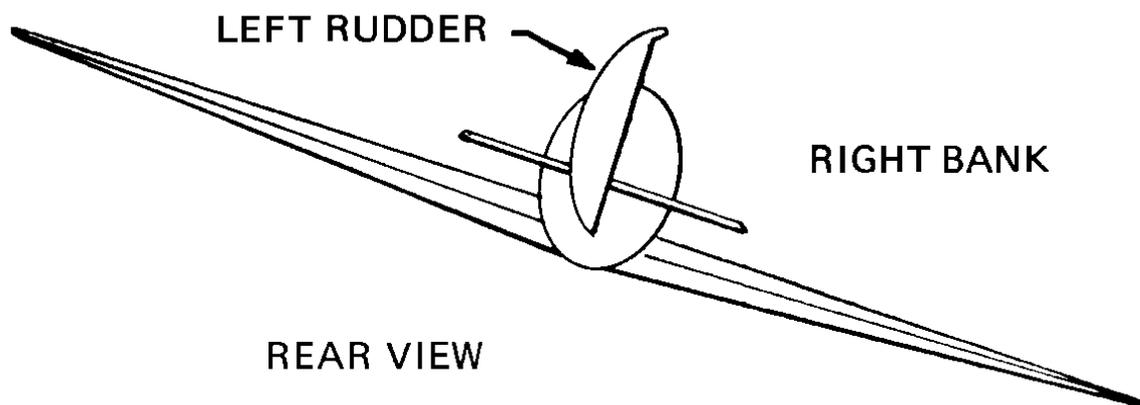
**CAUTION**

The NSD has an optional slaving feature that requires initial heading setting on start-up. Subsequent resetting of the heading card, required manually on non-slaved versions, is automatically accomplished with the slaved version.

Proper heading synchronization must be verified on both non-slaved and slaved NSD-360A units. This is accomplished by comparing the heading displayed under the lubber line with the magnetic compass...

The NSD-360A incorporates a heading warning flag to warn of loss of either air or electronic power. Appearance of the flag during flight should be sufficient grounds to question the validity of the displayed heading. In slaved versions, the slaving meter should oscillate about a 45° point to show that the slaving circuits are accomplishing their function. Should the needle remain motionless or either vertical or horizontal for an extended period (two minutes) in level flight, the heading should be manually set using the magnetic compass and the performance of the heading card observed. If this condition persists, set the slaving mode switch to SL#2 on free gyro. In free gyro mode, the instrument must be periodically reset to manually counteract the effects of gyro precession.

## AIRCRAFT TRIM EFFECTS



**FIG. 16**

An important point to remember is that while the Century IIB Autopilot is maintaining heading the airplane should never fly with a wing low. This statement applies equally to an airplane without an autopilot.

Consider the effect of rudder trim in the above drawing (Fig. 16). Viewing the airplane from the rear, note that with left rudder applied the right wing must be lowered to offset the rudder effect and keep the heading constant, i.e., the left turn effect of the rudder is canceled by the right turn effect of the bank.

Since the autopilot is slaved to heading this is exactly what it will do in order to hold a heading when the rudder is out of trim.

Thus when operating on autopilot heading mode, if the aircraft flies with one wing low while maintaining heading, this indicates the rudder trim is required in the direction of the low wing.

## **AIR FILTER**

### **AIR FILTER AND ELEMENT**

The Century flight Systems, Inc. 1X314 central air filter is incorporated on all 3" gyro systems with the exception of aircraft with original equipment filters of like quality.

The 1X314 filter system uses the 51A5 replaceable filter element which is capable of removing 97% of all contaminating substances above 3 microns. This includes tobacco tars that would otherwise be harmful to bearings and vanes. Because of this exceptional filtering ability contaminants tend to accumulate at higher rate than in other types. It is therefore considered necessary that filter elements be replaced at each 100 hour period and that filters subjected to tobacco tars, industrial smoke and like environment, be inspected each 50 hours for possible replacement.

Gyro warranty is dependent upon following this procedure.

## NOTES

**Effective: July 4, 1975**

**LIMITED WARRANTY CENTURY FLIGHT SYSTEMS, INC. AUTOPILOT**

Each new Century Flight Systems, Inc. Autopilot is warranted by the manufacturer to be free from defects in material and workmanship under normal use, subject to the following conditions:

1. Century Flight Systems, Inc. Will through its designated service facilities at its option either repair or replace new components which, shall within (12 months after date of installation, be found, to Century Flight Systems, Inc. Satisfaction, to have been defective in material or workmanship under normal use.
2. The warranty registration must be signed and returned to Century Flight Systems, Inc. within ten days of equipment installation date. In the event that the registration card is not returned within this time, the date of shipment from the factory will be deemed to be the installation date.
3. This warranty will not apply to any product which has been installed, repaired, or altered in any way whatsoever in Century Flight Systems, Inc. Opinion to adversely affect its performance or reliability, or which has been subject to mis-use, contamination, negligence, or accident.
4. Cost of transportation, removal or reinstallation are at the option of Century Flight Systems, Inc.
5. This is Century Flight Systems, Inc. sole express warranty with respect to the goods supplied herein. CENTURY FLIGHT SYSTEMS, INC. MAKES NO OTHER EXPRESS WARRANTY OF ANY KIND WHATSOEVER. CENTURY FLIGHT SYSTEMS, INC. EMPLOYEES MAY HAVE MADE ORAL STATEMENTS ABOUT THE PRODUCTS DESCRIBED IN THIS CONTRACT. SUCH STATEMENTS DO NOT CONSTITUTE WARRANTIES, SHALL NOT BE RELIED UPON BY THE CUSTOMER, AND ARE NOT PART OF THE SALE CONTRACT.
6. THE DURATION OF ANY IMPLIED WARRANTY, AND OF ALL WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, SHALL BE LIMITED TO (12) MONTHS COMMENCING AT DATE OF INSTALLATION TO THE FULL EXTENT PERMITTED BY APPLICABLE LAW, CONSEQUENTIAL DAMAGE OF BREECH OF ANY WARRANTY ARE HEREBY DISCLAIMED AND EXCLUDED BY CENTURY FLIGHT SYSTEMS, INC.

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