The antenna, located on the top ot the vertical stabilizer, is used for both reception and transmission.

The UHF system is powered by the primary bus. The control panel is on the left hand console.

OPERATION OF THE COMMAND RADIO SYSTEM

1. Move main control switch to BOTH and allow approximately one minute for warmup of main and guard receiver.
2. Place MANUAL-PRESET-GUARD mode switch into the PRESET position.
3. Set the desired frequency with the channel selector.
4. Adjust volume.
5. In order to select a frequency not preset on the channel selector rotate the four frequency selector knobs in sequence until the desired frequency is set (the four numbers in the windows indicate the desired frequency when read from left to right). Then move the MANUAL-PRESET-GUARD switch to MANUAL.
6. Transmission and reception on the guard frequency is obtained by moving the MANUAL-PRESET-GUARD switch to GUARD. This tunes the transmitter and the receiver to the guard frequency.
7. To turn set off, rotate main switch to OFF.

MARK III B PHI NAVIGATION EQUIPMENT

The PHI MARK III B is a dead reckoning navigation system which does not require the support of ground installations to continuously display bearing and distance information in nautical miles to or from any predetermined points.

COMPONENTS OF PHI SYSTEM

Phi Station Selector

The switch of this unit, located on the right hand console (fig. 4-7/C), permits the pilot to select any of the points preset before the flight. Position 1 always corresponds to the PHI base or home station to which the other points are correlated. The selector is mounted flush in the control panel and can be removed after the RELEASE button has been pressed.

WARNING

The SEQUENCE warning light comes on when the PHI is corrected by the pilot or when the mode selector's switch is moved from HOLD to PHI position.

When light is on, no change to the control settings should be made as this may result in incorrect reading of the PHI indicator. No readings should be taken during such operational sequence change since they will be unreliable.

Doppler System

This system continuously supplies ground speed and drift information to the PHI computer.

The system consists of:

a) The RECEIVER-TRANSMITTER, located in the radio equipment bay, which radiates four frequency modulated beams (8,800 megacycles) through the antenna located on the forward bottom section of the fuselage. The signals are reflected by the ground, received by the antenna and fed to the computer which is also located in the radio equipment bay. The computer calculates ground speed and drift angle and feeds the information to the PHI system.

b) The GYROSCOPE UNIT, located aft of the armor plate under the canopy, corrects errors caused by slight deviations of the aircraft in pitch and bank. If changes in attitude are large (30° - 40° PITCH or BANK) the doppler system is cut out and information from the true airspeed transmitter and wind unit is fed to the PHI system only.

c) The CONTROL PANEL, on the right hand console provides control of the system in flight and during functional checkouts on the ground. The controls are as follows (fig. 4-7) :

- 4 position switch: OFF (system de-energized), RECVR. ONLY (receiver pre-heated and ready to operate), ON (receiver and transmitter energized), TEST (system checkout on the ground with aircraft on jacks).
- 4 position switch: INCREASE, DECREASE, RIGHT, LEFT (speed increase, decrease - drift right, left) (used only during ground checkout to apply simulated signals to the computer).
- 2 position switch: SEA - LAND (used in flight only to adapt equipment to the intensity of the ground reflections over sea or land).
- 1 warning light: ALARM (illuminates whenever the Doppler System is disconnected from the PHI system).

d) The GROUND TEST override switch permits system testing on the ground with the landing gear down.

Wind Unit (Alternate To Doppler System)

The WIND UNIT (fig. 4-7/A) is located on the left hand side on the instrument panel. It is used to feed wind information (speed and direction) into the PHI system on the ground and in flight. The PUSH TO SET-W/S knob is used to feed in the three digit wind speed data displayed on the counter. The PUSH TO SET-W/D knob is used to feed in wind direction information by rotating the azimuth card.

Note

The PUSH TO SET-W/S and PUSH TO SET-W/D knobs can only be rotated after they have been depressed. Data should be fed only when the mode selector of the PHI indicator is set at PHI.

In addition to an internal instrument light the wind unit also has a SEQUENCY warning light which goes on during computation. Wait until light goes off before taking readings or changing PHI system control settings.

Position & Homing Indicator

The PHI indicator (fig. 4-7/B) is located in the center of the instrument panel and gives continuous indication of :

- Grid bearing and distance to or from a selected station.
- Magnetic heading shown on the azimuth card against the point of the rigid miniature aircraft.

The following knobs are located on the four corners of the indicator :

a) VAR : to move lower outer dial pointer (variation/grivation setting).

b) BRG : to adjust center pointer (bearing pointer).

c) DIST : to set distance counter.

d) Mode selector : 5 positions :

- HOLD: Corrections to the PHI control settings can be made only when the selector is in this position. When in flight, the electronic memory circuit is simultaneously energized.

- PHI: The PHI indicator is energized and the system operates as an automatic dead reckoning device.
- PS (PILOT SELECT): In this mode, the system is no longer operating as dead reckoning system but merely as directional gyro. Using the BRG knob, the bearing pointer may be set to any desired heading.
- ADF: Inoperative on this aircraft.
- TCN: Inoperative on this aircraft.

Note

The distance counter begins to operate only when the airspeed is above 160 ± 5 kts.

Airspeed Integrator And Resolver

The airspeed integrator and resolver is located in the radio equipment bay and consists of a disc type speed integrator and a ball resolver to compute true airspeed distance, and bearing.

Junction Box

The junction box is located in the cockpit above the rudder pedals. The LATITUDE knob on the box is used to set latitude information. The junction box is also used as the terminal center of the entire PHI system. Besides the equipment described above, the PHI system also includes the following equipment used to automatically supply information needed for system operation :

True Airspeed Transmitter And Temperature Sensor

The true airspeed transmitter is connected to the aircraft pitotstatic system and the temperature sensor. The transmitter, therefore, produces a singal proportional to the true airspeed of the aircraft.

Gyrosyn Compass CL 11

The gyrosyn compass is a directional gyro slaved to magnetic north through an amplifier and a flux valve. The flux valve is located inside the left hand wing and senses the direction of the earth's magnetic field. Magnetic north is shown on the PHI azimuth card against the tip of the rigid miniature aircraft.

The Compass Control Panel is located on the right console. The panel has a MAG and DG two position switch, two manual synchronizing buttons L (left) and R (right) and an indicator to show alignment of the compass to magnetic north. In MAG position the compass is selfcentering if one button is depressed. When the switch is turned to DG the compass operates as a directional gyro.

The annunciator (with center zero marking) indicates whether or not the heading output and the "sensed" direction of the flux valve are the same. It provides, therefore, indication of alignment error to be corrected by manual synchronization and indicates whether the system is operating properly.

PHI SYSTEM OPERATING MODE

The pilot proceeds as follows :

(1) Before entering the cockpit ask the communications specialist whether the LATITUDE knob of the JUNCTION BOX has been properly set.

(2) Select station No. 1 on the PHI station selector for departure station (reference station in this case).

(3) Turn PHI indicator mode selector to HOLD.

(4) Set PHI indicator distance counter to "000" with DIST knob.

(5) Turn mode selector to PHI again. After the SEQUENCY light goes out, set wind speed and direction

on the WIND UNIT in accordance with meteorological information by depressing and rotating the W/D and W/S knobs. The WIND UNIT indicating light illuminates as the wind vector is set. Goes out after about 7 seconds from the moment both knobs (W/D - W/S) are released.

(6) As soon as the SEQUENCE light goes out again select destination point on the station selector. The PHI indicator will then show the direction and distance of the destination point with reference to departure point (1).

(7) With PHI indicator VAR knob set lower, outer dial pointer to magnetic variation for area where flight is to be accomplished.

Note

If GRIVATION values (variation with reference to grid north) are known, they too can be set with the VAR knob. In this case, the pilot must make certain before the flight that LATITUDE knob on the JUNCTION BOX is properly set.

Note

For flights to be accomplished in areas where considerable changes in magnetic variation are expected, or if latitude and grivation changes, instead of setting total average value divide flight into several legs and set average value for each leg (it is not necessary to place the main switch in HOLD while making these settings).

As soon as air speed has increased up to 160 ± 5 kts after takeoff, the PHI indicator continually displays flight data with reference to the selected point. According to station selected, the distance counter gives the distance in nautical miles to the selected station, and the bearing pointer presents station bearing in relation to the longitudinal axis of the aircraft and grid north.

To put the aircraft on a tracking course toward the desired station merely align bearing pointer with the grivation pointer by changing aircraft heading accordingly. When the distance counter reads "000" the aircraft has arrived at the station. The bearing pointer rotates 180 degrees, the distance counter displays miles flown from the station and the bearing pointer presents station bearing with reference to the longitudinal axis of the aircraft.

Corrections To The Indicator And Determination Of Wind Data

In fig. 4-8, it is assumed that the aircraft flies from point (2) to point (3) and that point (1) is the reference point. Since in the problem given here the departure point is not identical with the reference point the distance counter must be set at zero in the following manner:

1. Select station (2) on the PHI station selector.
2. Set the mode selector to HOLD.
3. Set the distance counter on the indicator to ZERO by means of the DIST knob.
4. Return the mode selector to PHI.
5. Set local variation with VAR knob.
6. Select station (3) for homing course to selected station.

At about half the distance to destination it is assumed that the aircraft passes a known fix "D". The exact location of "D", with reference to point (1), can be ascertained from the aeronautical charts (distance and bearing).

As soon as the aircraft is directly above "D" the pilot proceeds as follows:

1. Select station (1).
2. If the PHI information does not agree with the results obtained by using the maps, set mode selector to HOLD.

Note

Whenever the PHI indicator mode switch is set to HOLD the instrument no longer indicates. However, a mechanical MEMORY continues to store information on the track made good and feeds the data to the indicator as soon as the mode selector is returned to PHI.

3. Correct the data displayed on the indicator using the BRG and DIST knobs.
4. Depress either the W/D or W/S button of the WIND UNIT to obtain automatic correction of wind data in the PHI system concurrent with the actual position of the aircraft.

CAUTION

When the WIND UNIT warning light goes out this means that wind vector has been corrected. Therefore, wait until light goes out before making changes to control settings.

5. Return the mode selector to PHI.

CAUTION

Donot operate the MEMORY for more than 15 minutes at any one time.

6. Select the destination (no. 3 in our problem). In case the correction had been erroneous the setting can be cancelled. Before returning the mode selector switch to PHI, set wind unit to old values. The PHI indicator will automatically indicate the old data.

Mission And Return To Point Of Departure

When a mission is scheduled and no flight plans has been established or when a blank station selector box has been installed on the control panel, proceed as follows before taking off :

1. Select station No. 1 on the PHI control panel.
2. Set mode selector to HOLD.
3. Set distance counter to ZERO by means of the DIST knob.
4. Return the mode selector to PHI.

In Flight

Keep station No. 1. The PHI indicator will continually display information about the momentary position of the aircraft in terms of distance and bearing from or to the point of departure.

ADF 102 RADIO COMPASS

The ADF 102 radio compass automatically indicates relative bearing from aircraft to a station to which it is tuned.

The system consists of a receiver, an indicator, a control unit (fig. 4-9), a sense antenna, a fixed loop antenna (fig. 4-10) and a goniometer.

The system operates on power from the primary bus. Operating frequency range is from 200 to 1600 kilocycles, divided into two bands, one from 200 to 540 and the other from 520 to 1600 kilocycles. The system incorporates the functions of both automatic and manual directional finding and auto reception of modulated and nonmodulated radio signals. The controls are on the control panel located on the right hand console.