INSTRUCTIONS

FOR THE USE OF

Astro Compass

MK. II

The W. W. Boes Co. DAYTON, OHIO

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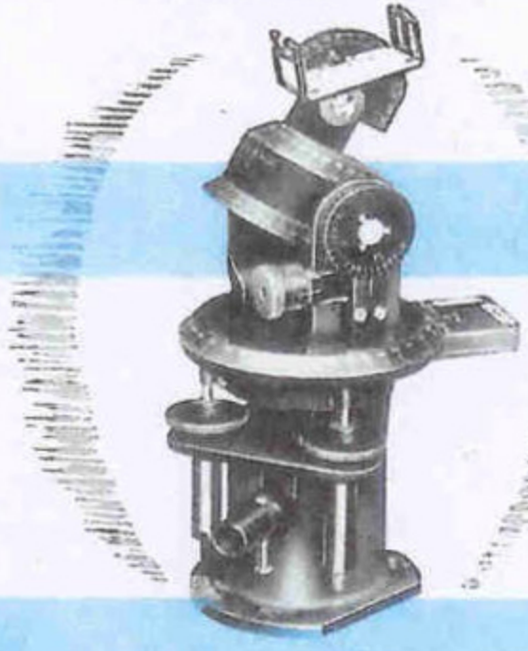

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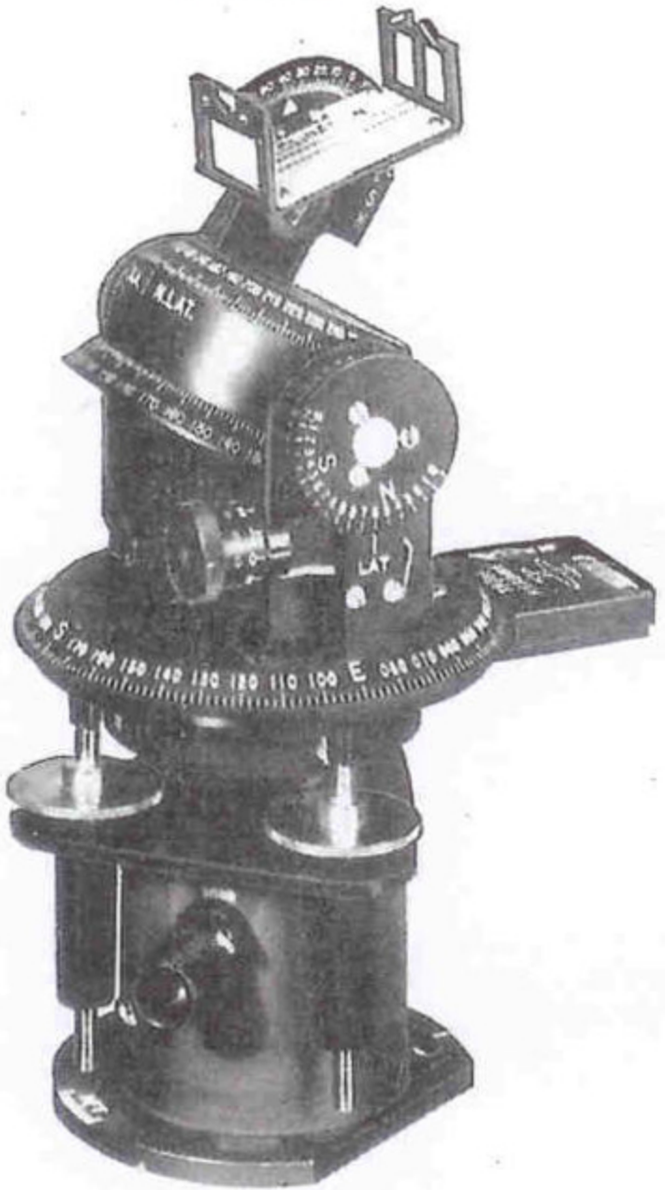
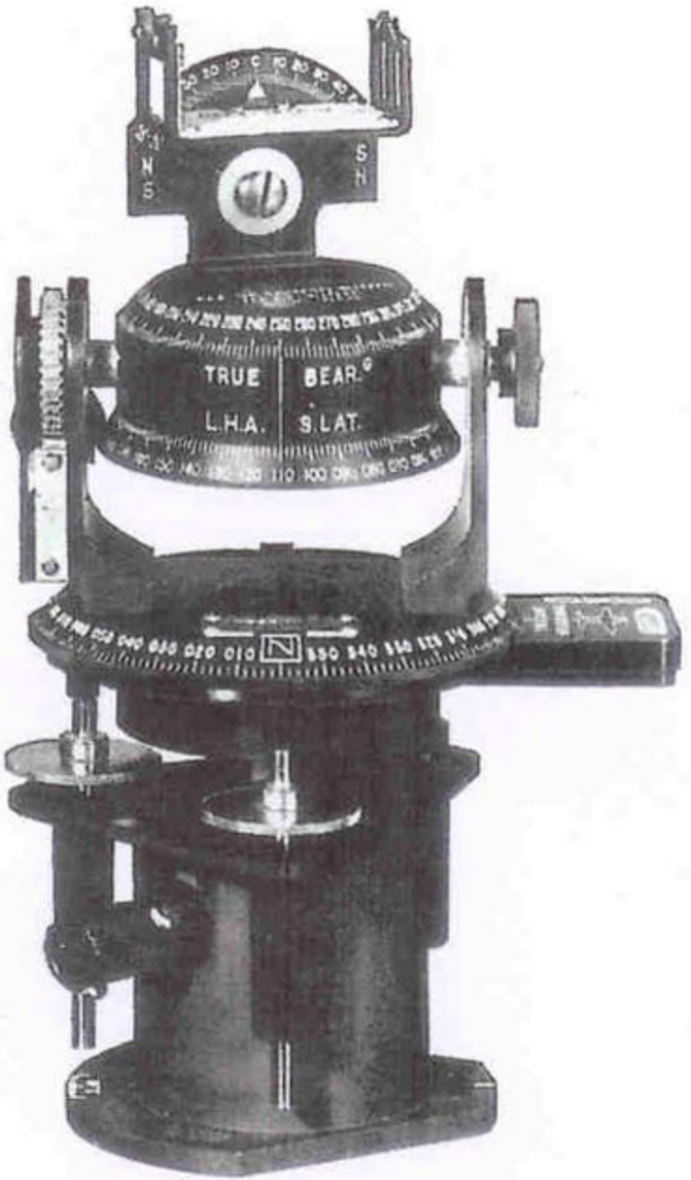
FIGURE 1



View of Astro Compass, Mk. II, with Hour Circle and Declination Sight set for True Heading or Star identification.

FIGURE 2



View of Astro Compass, Mk. II, set up for True Bearing, relative Bearing, or for steering a Heading.

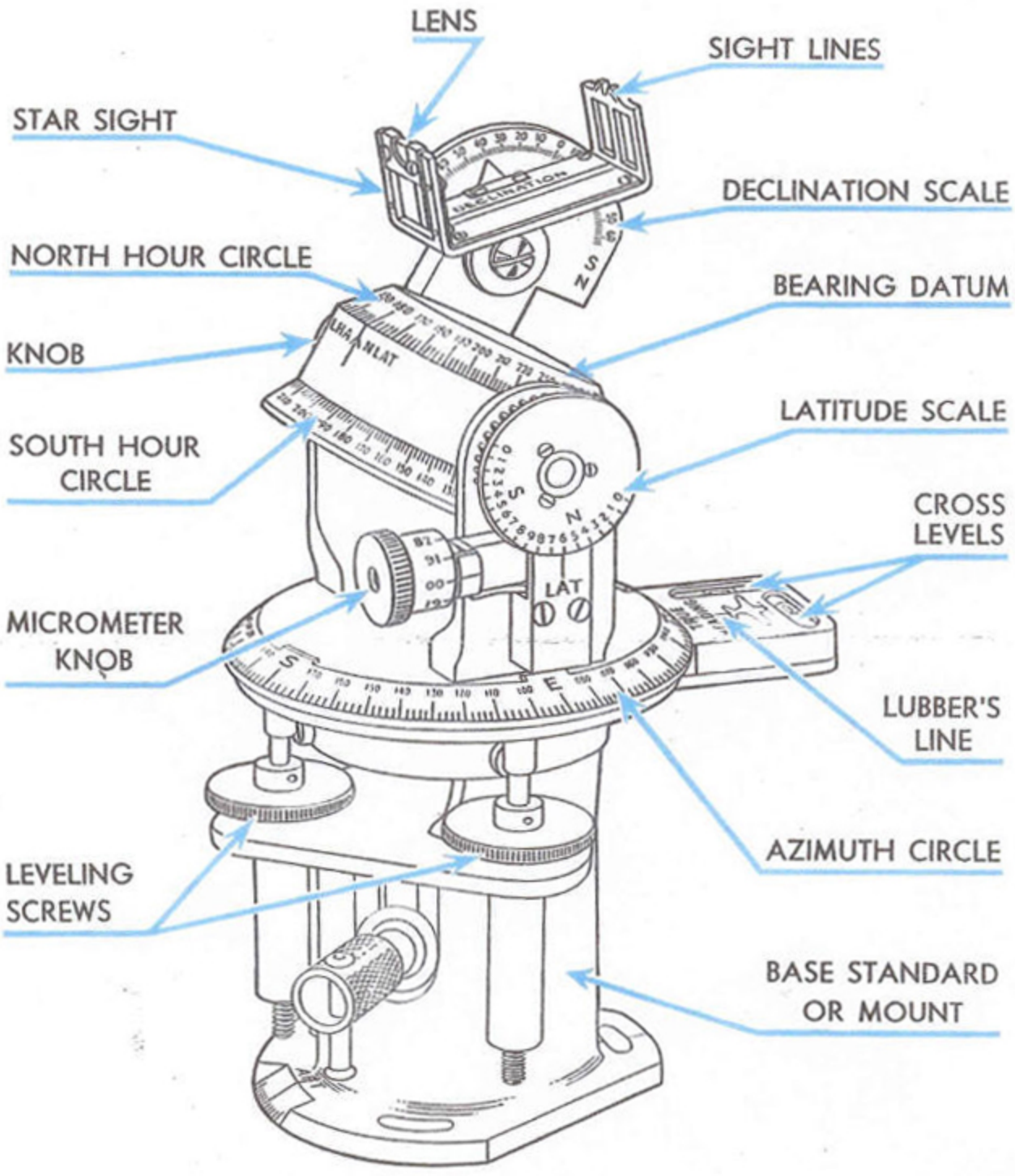
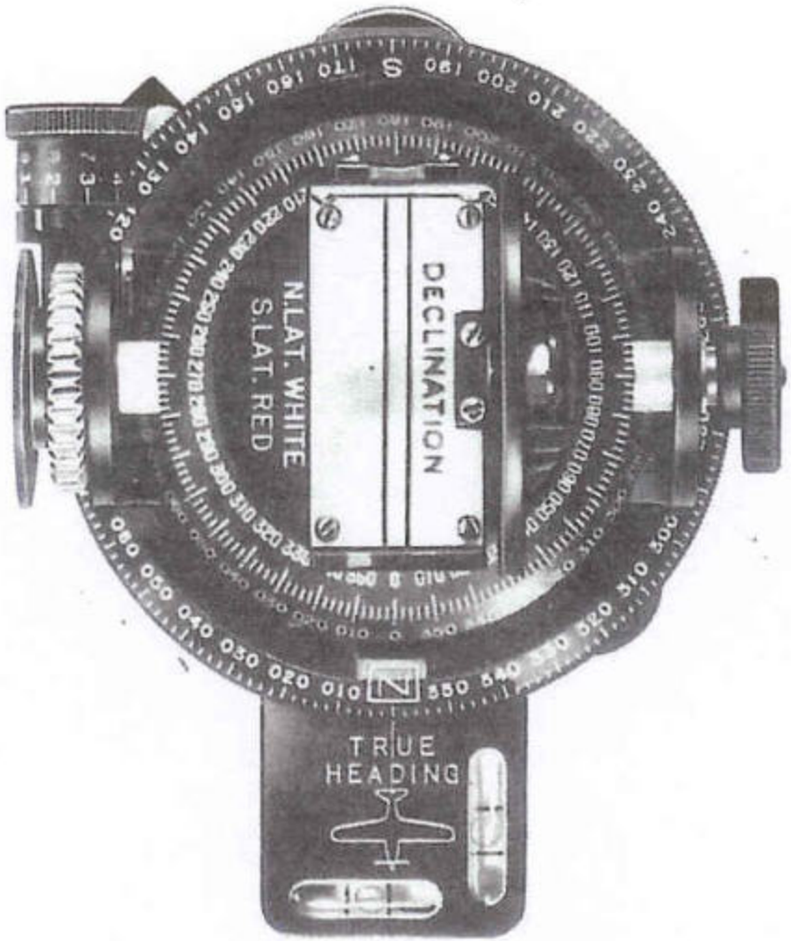


FIGURE 3A.

Explanatory view Astro Compass Mk. II.

FIGURE 3



Top view of Astro Compass, Mk. II.

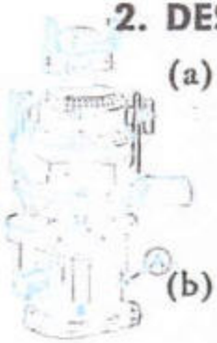
THE ASTRO COMPASS MK II

1. PURPOSE.

The Astro Compass is designed to provide the navigator accurately and rapidly with

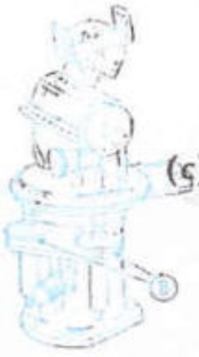
(a) The TRUE HEADING of the aircraft,
(b) The TRUE BEARING of a distant object,
(c) The RELATIVE BEARING of a distant object.

2. DESCRIPTION.



(a) **The Base Standard (or Mount).** The Mount and Astro Compass are separable. In use they are properly positioned by means of two key-ways and are secured by means of the Binding Screw.

(b) **Two Leveling Screws,** one on the lateral and one on the longitudinal axis, operate against a spring loaded plunger and transmit movement to the upper section of the Astro Compass through a gimbal ring whose pivots are in line with the lateral and longitudinal axis.



(c) **A Horizontal Index,** in which two bubble level vials indicate the lateral and longitudinal adjustments, serves the dual purpose of a lubber's line and level indicator. It is located

on a table at the fore part of the Astro Compass and in line with the Azimuth Circle.

(d) **The Azimuth Circle** is rotatable about the vertical axis. It is graduated clockwise with two degree lines. Major lines and numerals appear at each ten degrees, except at the cardinal points, where the letters, N. E. S. W. are engraved.

(e) **The Drum Stator,** which is supported by two vertical standards, is rotatable about the lateral axis. Movement of the Drum Stator is actuated by turning a Micrometer Knob which transmits the motion through a Worm and Gear. A dial, expressing latitude in ten-degree increments, is directly connected to the Drum Stator. The barrel of the Micrometer Knob is divided in ten equal parts to supply the unit digit to the ten degrees shown on the dial.

White numerals are used in North Latitudes; red numerals are used in South Latitudes; the 90 is in white only.

Datum lines are placed on the Drum Stator. One above "S" on the Azimuth Circle for setting or indicating the Local Hour Angle when in North Latitudes; another is placed above the "N" on the Azimuth Circle for Local Hour Angle settings in South Latitudes. The latter line is extended to the

upper hour circle to be used when taking TRUE BEARINGS or RELATIVE BEARINGS, either in North or South Latitudes.

The latitude settings of the Drum Stator place the hour circles parallel with the celestial equator when the N and S of the Azimuth Circle are properly positioned on the observer's meridian. This setting provides a horizon for the instrument.

(f) **The Hour Circles** are located above and below the Drum Stator. The Hour Circles are graduated every two degrees with major lines with numerals at each ten degrees.

The top Hour Circle is for North Latitude and is identified by white marks; the lower Hour Circle is for South Latitude and is marked in red.

The two Hour Circles are graduated in opposite directions to permit readings on either side of the equator.

Movement of the Hour Circles is controlled by a knob above "W" on the Azimuth Circle. The knob is connected by Bevel Gears to a Spindle that supports the two Hour Circles.

Normally the knob and the Hour Circles are held in position by a Brake Sleeve within the actuating mechanism. Free rotation is obtained by pressing the knob inward and turning.

(g) **The Declination Scale Bracket.** This is mounted atop and perpendicular to the North Hour Circle. The face of the Declination Scale is aligned with 0 & 180 on the Hour Circle.

The scale is graduated 64° to 0 to 64° and the letters "N" and "S" at opposite ends are marked in white and red. Attention is paid only to the white markings in North Latitudes; to the red markings in South Latitudes.

(h) **The Sighting Device.** This is attached to the Declination Scale Bracket. An index pointer is placed on the base of the Sight to indicate 0 when exactly parallel with the Hour Circle.

The fore sight is constructed with a shadow bar in the lower area and luminized sight lines at the top.

The rear sight is equipped with a lens whose focus is infinity with the fore sight when an object is sighted beyond the fore sight. The rear sight has a translucent screen with two parallel lines to correspond with the fore sight shadow bar. The base of the sight has a reflecting member on its top side.

When all settings are accurately made the star will appear at the intersection of the white lines in the fore sight.

This will seldom occur (due to slight errors), therefore a star is considered as properly positioned when it appears vertically above or below the line intersection. See Fig. 4.

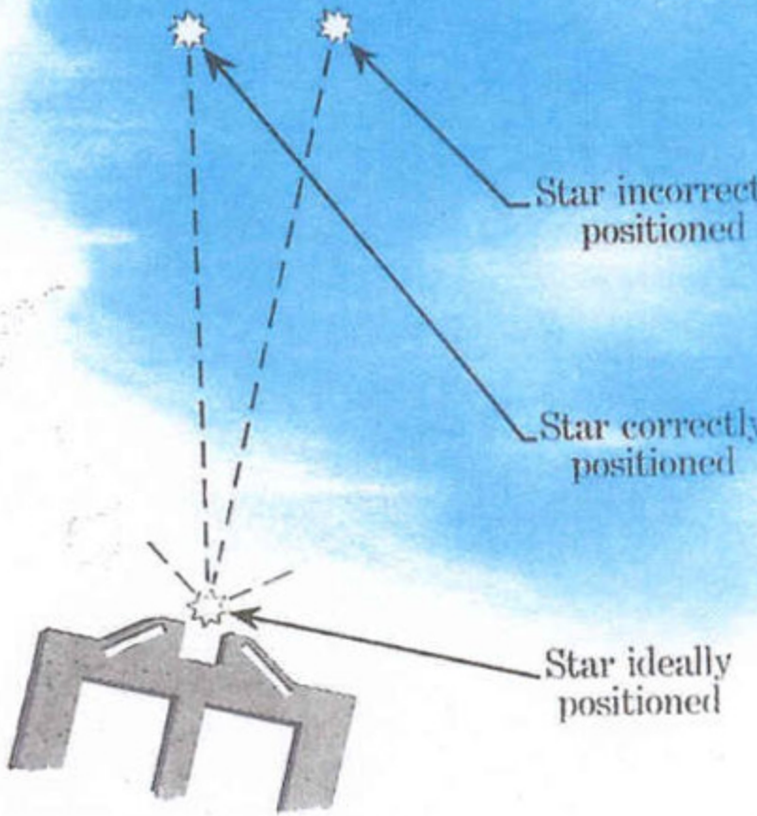


FIGURE 4

View of Fore Sight, Astro Compass, Mk. II, with Star in ideal, correct, and incorrect positions.

Installation

OF THE BASE STANDARD (or Mount)

The Base Standard is installed in accordance with AAF Drawing H42D5583.

The alignment of the Base Standard may be done in one of three procedures.

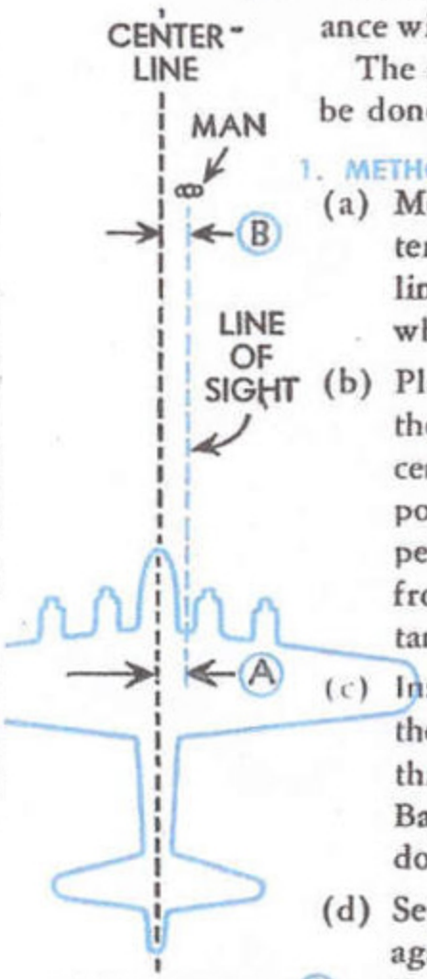
1. METHOD ONE.

(a) Measure the distance from the center line of the airplane to the center line of the fore mounting screw which holds the Base Standard.

(b) Place a person or object in front of the airplane and in line with the center of the airplane. With this position determined then cause the person or object to be displaced from this center line the same distance and direction as in (a) above.

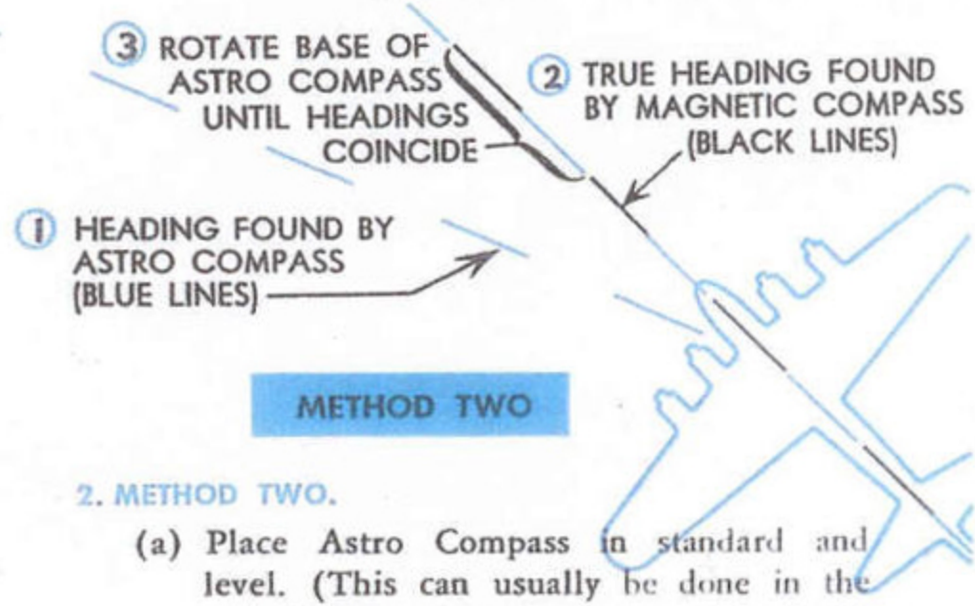
(c) Insert the Astro Compass Mk. II in the Base Standard and level. The three securing screws holding the Base Standard should be drawn down tightly.

(d) Set the Azimuth Circle to 360° (N) against the True Heading lubber's line. Set the hour circle to 0 on TRUE BEARG. Set Declination at 0 (or forward if necessary).



METHOD ONE

(e) Rotate Base Standard to aline distant person or object in sights of Astro Compass Mk. II. This may be done by loosening the Base Standard holding screws slightly and applying correction slowly. Then tighten the holding screws and make final check.



METHOD TWO

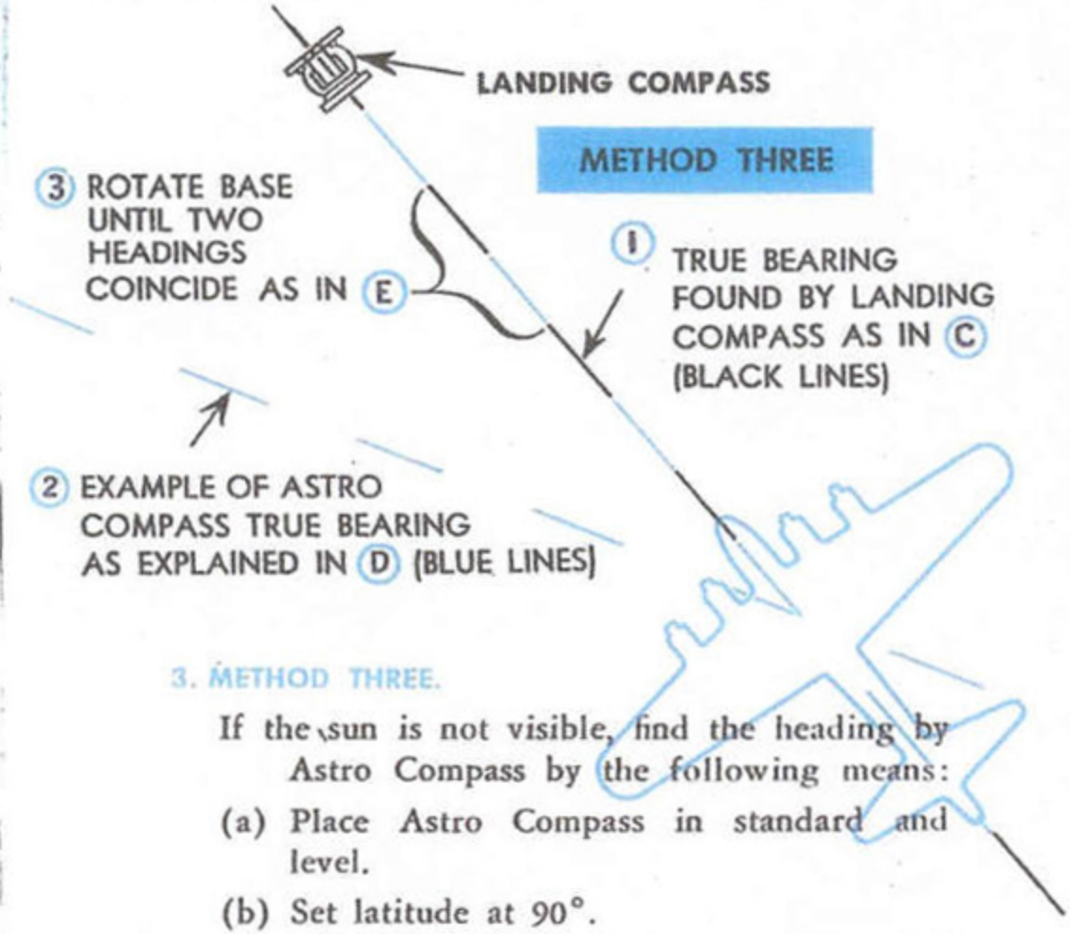
2. METHOD TWO.

(a) Place Astro Compass in standard and level. (This can usually be done in the tail down position.)

(b) Find heading of aircraft by Astro Compass by a method described under Instructions for Use.

(c) Find true heading of aircraft by landing compass or other external means.

(d) Compare the two headings. If there is a discrepancy, rotate the standard until the Astro Compass heading agrees with the correct true heading.



3. METHOD THREE.

If the sun is not visible, find the heading by Astro Compass by the following means:

(a) Place Astro Compass in standard and level.

(b) Set latitude at 90°.

(c) Set up landing compass at a distance and find true bearing of the Astro Compass.

(d) Set reciprocal of this true bearing against "True Bearing" datum on Astro Compass.

(e) Rotate instrument until sights are lined up on landing compass.

(f) Note "True Heading" as given by Astro Compass.

(g) Compare this heading with aircraft heading as found by external means.

(h) Adjust as in Method 1.

(i) Repeat for other standards.

Instructions for Use

NOTE: In all uses the Astro Compass is inserted in the Base Standard and is leveled by means of the two leveling screws. These instructions will not be repeated hereafter.

When taking TRUE OR RELATIVE BEARINGS the latitude is always set at 90°. Then the top (white) hour circle becomes a pelorus.

All observations are made with lens nearest observer.

1. To Find True Headings.

(a) BY THE SUN.

(1) Extract the GHA Sun and Declination against GCT and Date in Air Almanac.

(2) Compute LHA Sun by:

$$\text{LHA Sun} = \text{GHA Sun} \begin{matrix} + \text{E} \\ - \text{W} \end{matrix} \text{Longitude.}$$

(3) Set DECLINATION.

(4) Set LHA.

(5) Set LATITUDE.

(6) Rotate Azimuth Circle until shadow appears on shadow screen of Sight.

(7) Read TRUE HEADING against lubber's line.

(b) BY MOON OR PLANET.

(1) Extract the GHA Moon (or Planet) and Declination against GCT and Date from Air Almanac.

(2) Calculate LHA Moon (or Planet) by:
LHA = GHA Moon
(or Planet) $\overset{+}{-}$ $\overset{E}{W}$ Longitude.

(3) Set DECLINATION.

(4) Set LHA.

(5) Set LATITUDE.

(6) Rotate Azimuth Circle until body appears in Sights. (Frequently the Moon will cast a shadow on the screen when properly aligned.)

(7) Read TRUE HEADING against lubber's line.

(c) BY STAR (Using Air Almanac).

(1) Extract GHA Aries against GCT and Date from Air Almanac.

(2) Extract SHA and Declination of Star from cover of Air Almanac.

(3) Calculate LHA Star by:
LHA Star = GHA Aries +
SHA Star $\overset{+}{-}$ $\overset{E}{W}$ Longitude.

(4) Set LHA.

(5) Set DECLINATION.

(6) Set LATITUDE.

(7) Rotate Azimuth Circle until Star is properly positioned in the Sights (See Fig. 4).

(8) Read TRUE HEADING against lubber's line.

(d) BY STAR (Using Astrograph).

(1) Switch ON and set Astrograph.

(2) Select the Astrograph Star with the lesser altitude and read altitude (to the nearest degree) at the dead reckoning position.

(3) At this dead reckoning position, a line drawn at right angles to the star curves in the direction of increasing altitude will be the TRUE BEARING of the Star.

This may be measured quickly, using the chart table plotter thus:

Lay the longer edge of the plotter tangential to the Star curves and read the angle given by the shorter edge of the plotter when transferred to the Compass rose on the chart. The TRUE BEARING of the Star is in the direction of increasing altitude.

(4) Set Astro Compass LATITUDE at 90°.

(5) Set Star's TRUE BEARING on Hour Circle, against TRUE BEARING datum mark.

(6) Set the Star's approximate altitude on the DECLINATION Scale.

(7) Rotate the Azimuth Circle until selected Star appears properly in the Sights.

(8) Read TRUE HEADING against lubber's line.

2. To Steer a Heading.

(a) Obtain TRUE HEADING by one of above means.

(b) Compare with required TRUE HEADING.

(c) If they disagree, alter heading the required amount by directional gyro.

(d) Maintain heading by directional gyro, checking at 15-minute intervals in same manner.

3. To Obtain the True Bearing of a Distant Object.

(a) Set TRUE HEADING against lubber's line.

(b) Set LATITUDE scale at 90°.

(c) Rotate Hour Circle until object appears correctly in Sights.

(d) Read TRUE BEARING on Hour Circle against TRUE BEARING datum mark.

4. To Obtain the Relative Bearing of a Distant Object.

(a) Set 360° (N) against TRUE HEADING lubber's line.

(b) Set LATITUDE scale at 90°.

(c) Rotate Hour Circle until object appears correctly in the Sights.

(d) Read RELATIVE BEARING against TRUE BEARING datum mark.

5. For Identifying a Star.

(a) Set TRUE HEADING against lubber's line.

(b) Set LATITUDE.

(c) Rotate Hour Circle and adjust Sights until Star appears in Sights at intersection of lines.

(d) Read DECLINATION and LHA on respective scales.

(e) Extract GHA Aries against GCT and Date from Air Almanac.

(f) Determine SHA by:

$$\text{SHA} = \text{LHA Star} \begin{matrix} -\text{E} \\ +\text{W} \end{matrix} \text{Long.} - \text{GHA Aries.}$$

(g) Extract name of Star from cover of Air Almanac against SHA and DECLINATION.

6. For Swinging Compass (In the Air).

NOTE: The requirements for the air swing with the Astro Compass are: A visible sun, altitude of 40° or less, calm air, and a 360° field of vision for the compass.

(a) Prepare a graph of the LHA sun for the period of the flight.

(b) **Take-off.** Obtain the TRUE HEADING as shown in 1 above. Then obtain the MAGNETIC HEADING. Note the deviation at NES and W.

(c) **Land.** Head the aircraft within 5° of compass N and correct for coefficient C. Head the aircraft within 5° of Compass E and correct for coefficient B.

(d) **Take-off.** Check the cardinal and quadrantal points for deviation.

(e) **Land.** Correct for coefficient A. Prepare a compass deviation card.

Maintenance

In course of time the leveling screws may become too loose, and the Azimuth Circle motion and the motion of the Sight gear in declination may become too free; these may be corrected as follows:

1. To Tighten Up the Leveling Screws and the Azimuth Circle Motion.

(a) Push down the Azimuth plate above the spring leg as far as it will go and fix a clamp at the bottom of the spring leg to hold it in that position.

(b) Screw down one of the two leveling screws as far as it will go; this gives access to one of the four set-screws of the gimbal ring used for leveling; withdraw the set-screw; withdraw the pivot pin; repeat on the opposite side of the gimbal ring and the upper and lower halves of the instrument can be separated.

(c) Remove the leveling screws and squeeze up the legs from which they have come, by means of a vise, taking care not to overdo the correction.

(d) Tighten up the nut in the center till the described amount of friction is restored to the Azimuth Circle.

(e) Reassemble in reverse order.

2. To Tighten Up the Sight Gear Motion in Declination.

(a) Loosen locknut; tighten shoulder screw until desired friction is obtained. Tighten locknut.

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THE ASTRO COMPASS is a PRECISION INSTRUMENT

TREAT IT AS SUCH!

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TO IDENTIFY A STAR

		SOURCE OF INFORMATION
1.	DATE	
2.	GCT	
3.	TRUE HEADING (set against lubber's line)	GYRO, MAGNETIC OR ASTRO COMPASS
4.	LATITUDE (set on lat. index)	ASSUMED OR OBSERVED
5.	LHA (read against datum mark)	BY OBSERVATION
6.	LONGITUDE (Subtract E; add W)	ASSUMED OR OBSERVED
7.	GHA	COMPUTED FROM 5 & 6
8.	GHA ♈ (subtract)	AIR ALMANAC
9.	SHA	COMPUTED FROM 7 & 8
10.	DECLINATION (set on decl. scale)	BY OBSERVATION
11.	STAR'S NAME	AIR ALMANAC

GRAPHIC EXPLANATION OF USE OF ASTRO COMPASS MK. II

TO FIND A HEADING

				SOURCE OF INFORMATION
1.	DATE			
2.	GCT			
3.	BODY			
	☉ ♀ ☾	☆		
4.	GHA	GHA ♈		AIR ALMANAC
5.	CORR.	CORR.	(add)	AIR ALMANAC
6.		SHA	(add)	AIR ALMANAC
7.	GHA			COMPUTED FROM 4, 5 & 6
8.	LONGITUDE (add E; subtract W)			ASSUMED OR OBSERVED
9.	LHA (set on datum mark)			COMPUTED FROM 7 & 8
10.	DECLINATION (set on decl. scale) N S			AIR ALMANAC
11.	LATITUDE (set on lat. index) N S			ASSUMED OR OBSERVED
12.	TRUE HEADING			LUBBER'S LINE

GRAPHIC EXPLANATION OF USE OF ASTRO COMPASS MK. II

PRONOUNCING GUIDE

STAR NAMES

The Pronouncing Guide below is a popular Pronouncing Guide and does not in all cases conform with the dictionary pronunciations.

Achernar	Ack′ er nahr
Acrux	Ack′ rucks
Aldebaran	Al deb′ a ran
Alpheratz	Al′ fa rats
Altair	Al tair
Antares	An tair′ aze
Arcturus	Ark tour′ us
Betelgeux	Betl′ juice
Canopus	Kan oh′ pus
Capella	Ka pell′ ah
Deneb	Den′ ebb
Dubhe	Doo′ bee
Fomalhaut	Foam′ al howt
Peacock	Pea′ cock
Pollux	Pol′ lucks
Procyon	Pro sigh′ yon
Regulus	Reg you′ lus
Rigel	Ree′ gull
Rigel Kent	Ree′ gull Kent
Sirius	Sear′ ee yus
Spica	Speek′ ah
Vega	Vay′ gah

NOTES

See Graphic Explanation of Astro Compass MK. II on Pages 20 and 21.

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Additional copies of this booklet and the work sheets shown on pages 20 and 21 may be obtained by authorized personnel or schools.

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