ROYAL CANADIAN AIR FORCE

HANDBOOK WITH PART LIST

ASTRO COMPASS

(SPERTI)

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LIST OF RCAF REVISIONS

DATE	PAGE NO	DATE	PAGE NO

TABLE OF CONTENTS

PARTS CATALOG

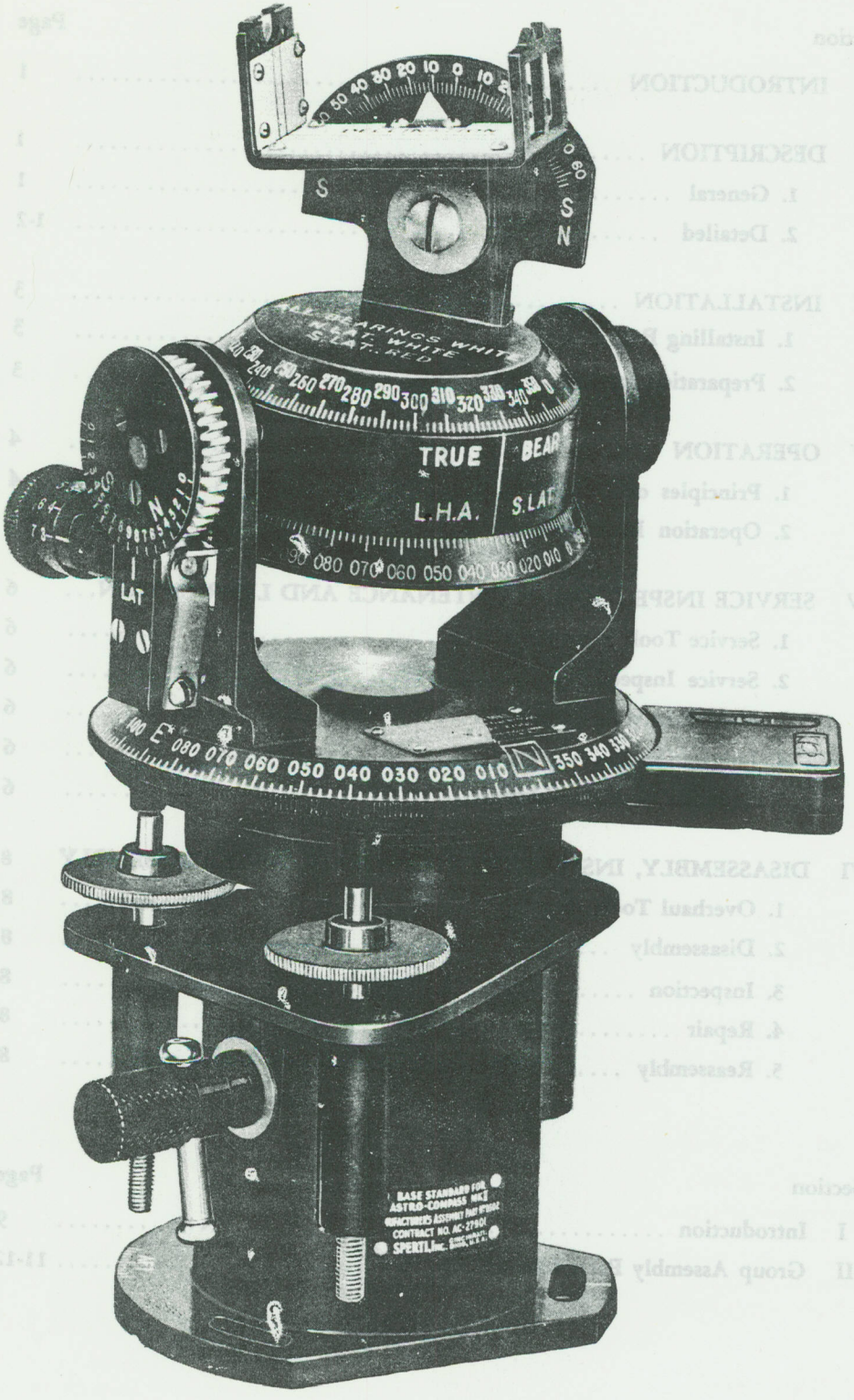


Figure 1—Complete Astro Compass

SECTION I
INTRODUCTION

1. This Handbook is issued as the basic technical instructions for the equipment involved.

2. This Handbook with Parts Catalog contains descriptive data on, and instructions for the Operation, Maintenance, and Overhaul of the Astro Compass Type AN 5738-1, manufactured by Sperti, Incorporated, Cincinnati, Ohio.

3. The Compass-Astro covered by this Handbook and the Base Standard are interchangeable with the same British items, except where magnetic compensation is required.

4. The terms Compass-Astro and Astro Compass are identical in meaning wherever occurring in this Handbook.

SECTION II
DESCRIPTION

1. GENERAL DESCRIPTION

a. The Astro Compass was designed to enable the aerial navigator to obtain accurately and rapidly the true heading of the aircraft or the true bearing of a distant object.

b. The Astro Compass is a self-contained instrument consisting of five integrated main assembly groups:

(1) The Base with Leveling Screws.

(2) An Azimuth Circle.

(3) Latitude Dial with Micrometer Adjustment Knob.

(4) Hour Circles.

(5) Shadow Bar, Screen and Declination Scale.

c. The graduations for North latitudes are colored White and the graduations for South latitudes are colored Red.

d. The instrument is designed for mounting on a fixed standard in the aircraft.

2. DETAILED DESCRIPTION

a. THE AZIMUTH CIRCLE.—The lower part of the Astro Compass consists of an azimuth circle mounted on its base. The azimuth circle can be rotated to coincide with a lubber line and it can be leveled by means of the leveling screws. The instrument is designed for mounting on the Astro Compass Standard in the aircraft.

b. THE LATITUDE SCALES.—Two vertical standards support a horizontal axis above and parallel to the 090°-270° graduations of the azimuth circle. On one end of the horizontal axis is a worm wheel to which is attached the latitude scale graduated in steps of ten degrees. Graduations in steps from one to ten degrees are on the micrometer knob drum. The scales for North latitudes are White and the scales for South latitudes are Red.

c. HOUR CIRCLES.—The two hour circles are on either side of the horizontal axis. These hour circles are graduated in opposite directions, one for North latitudes and one for the South latitudes. Rigidly joined, they are moved as a unit by an internal bevel gear controlled by a knob at the end of the horizontal axis opposite the latitude worm gear.

(1) The hour angle always increases in the same direction, from East to West. This increase in the hour angle demands that the hour circle be turned over when crossing the equator. Since the sighting device side of the hour circle must always be uppermost to meet this

condition, two hour circles are provided, one for the Northern Hemisphere and one for the Southern Hemisphere.

(2) The hour circle for North latitudes is White and is read against the white index marked L.H.A., N. LAT. The hour circle for South latitudes is Red and is read against a red index marked L.H.A., S. LAT. These two index marks are 180° apart and are in a vertical plane passing through the 000° and 180° graduations of the azimuth circle.

(3) A white index marked TRUE BEARG is to be used when taking bearings in either North or South latitudes.

(4) The hour circle is set by pushing the knob inward and rotating it until the value required can be read. When the knob is released, a tension spring prevents accidental movement of the hour circles.

d. SIGHT ASSEMBLY.—On the upper hour circle, parallel to its 000°-180° line is the Shadow Bar and Screen for use in making observations of the sun and moon, in combination with a Star Sight for making observations of other celestial or terrestrial objects. The Sight Assembly can be tilted relative to the plane of the hour circle and can be set to any degree of declination from 64° North to 64° South. The declination value is indicated by a white pointer against a graduated arc. Below the ends of the arc are the letters N and S in both white and red. The white letters are used in North latitudes and the red letters are used in South latitudes. The Shadow Bar is over the white 000° and the Screen is over the white 180° graduation of the hour circle.

(1) The star sight consists of a lens mounted over the screen and a foresight consisting of two white lines placed above the shadow bar. A star or a terrestrial object is sighted by looking at the same time, both through and over the lens, when the white lines and the object will be clearly seen at the same time. The object is correctly sighted when it is seen at the place where the two white lines would intersect if produced.

(2) If the assumed position, setting of the latitude and hour angle and leveling are exact, when the Astro Compass is rotated in azimuth, the star will pass through the intersection of the two white lines of the foresight. When the star does not pass through the intersection of the white lines, the azimuth is correctly set when the star is VERTICALLY ABOVE OR BELOW the point of intersection of the white lines, regardless of the position of the Sight Assembly, relative to the vertical.

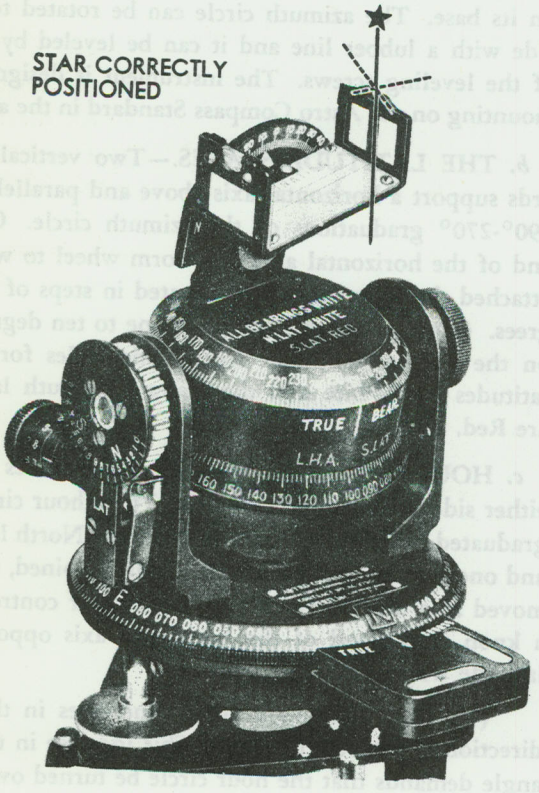


Figure 2—Star Correctly Positioned

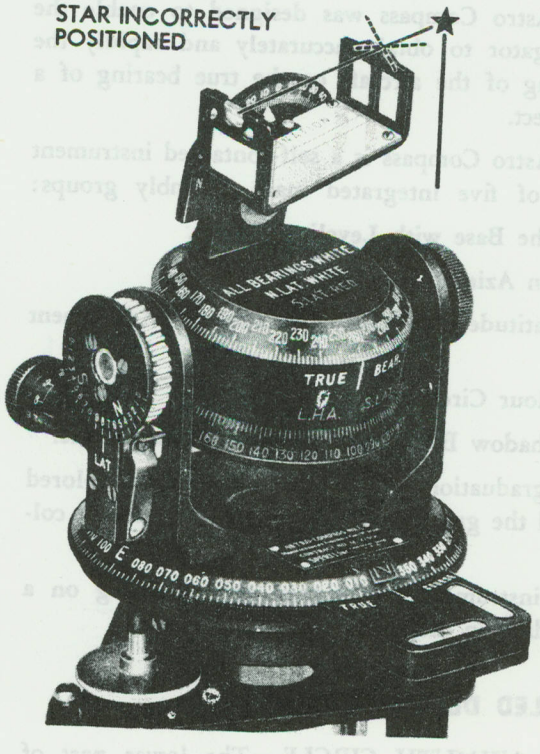


Figure 3—Star Incorrectly Positioned

SECTION III
INSTALLATION

1. INSTALLING BASE STANDARD

a. The Astro Compass Base Standard is permanently secured to the aircraft in accordance with applicable aircraft installation drawings.

b. The Sperti Astro Compass Base Standard is interchangeable with the British Base Standard, Type 0-5, except where magnetic compensation is required. No compensating magnets are installed in the Sperti Astro Compass Base Standard.

c. The Astro Compass Base Standard must be aligned correctly fore and aft in the aircraft. Two simple methods of alignment follow:

(1) WHEN THE SUN IS VISIBLE.

(a) Place Astro Compass in Astro Compass Base Standard and level by means of the leveling screws. (This may be done in the "tail down" position.)

(b) Find course of aircraft by Astro Compass, using the prescribed method.

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

(d) Compare the two courses. If there is a discrepancy, rotate the Astro Compass Base Standard until the Astro Compass course agrees with the correct true course.

(2) WHEN THE SUN IS NOT VISIBLE.

(a) Place Astro Compass in the Astro Compass Base Standard and level.

(b) Set latitude at 90 degrees.

(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 BEARG" datum line on Astro Compass.

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

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

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

(h) Adjust by rotating Base Standard.

2. PREPARATION FOR USE

To prepare the Astro Compass for use, remove the compass from the transit case and loosen the binding screw in the adapter of the Astro Compass. Insert Astro Compass in Astro Compass Base Standard. Tighten the binding screw.

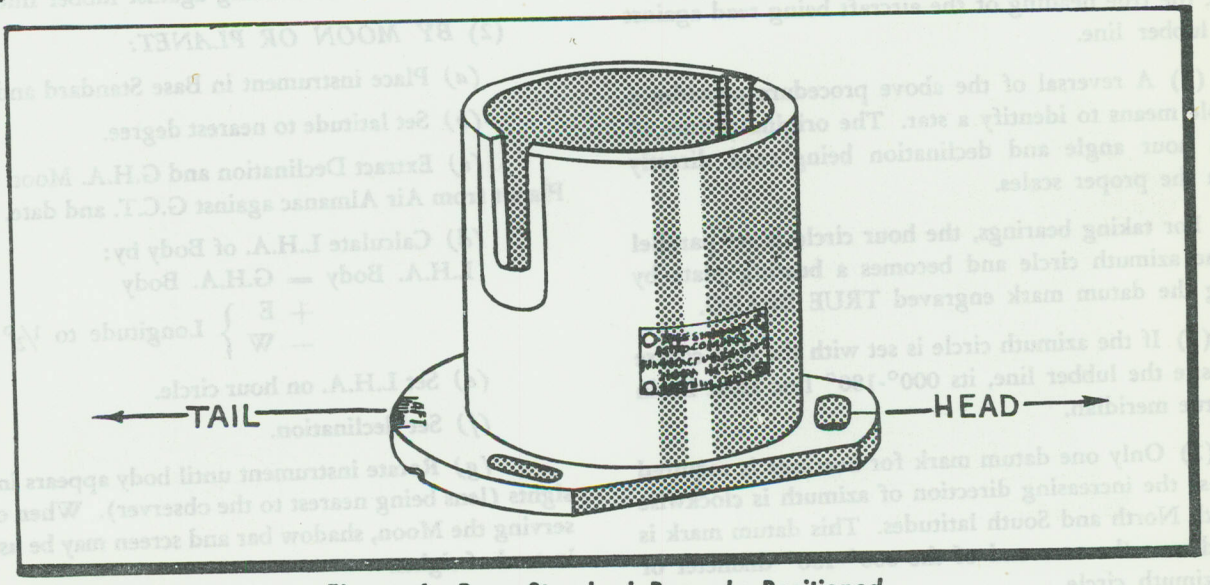


Figure 4—Base Standard Properly Positioned

SECTION IV
OPERATION

1. PRINCIPLES OF OPERATION

a. The local hour angle of a celestial body is the angle which is measured westward along the equinoctial between the plane of the observer's celestial meridian and the plane of the celestial meridian of the body being observed.

b. When the latitude is set on the latitude scale of the Astro Compass, the hour circle will be parallel to that of the equinoctial when the two datum marks are in the meridianal plane.

c. Under these conditions, when the sights or shadow devices are lined up on the body, the two L.H.A. datum marks must lie in the plane of the observer's true meridian. In north latitudes the L.H.A. datum mark colored White will indicate true South, and in south latitudes the L.H.A. datum mark colored Red will indicate true North.

(1) The datum marks are fixed in the same vertical plane as the 000°-180° line of the azimuth circle. The white datum mark is vertically above the 180° graduation while the red datum mark is vertically above the 000° graduation. Therefore, the azimuth circle is automatically brought into correct orientation with the true meridian.

(2) The azimuth circle can now be used as a compass, the true heading of the aircraft being read against the lubber line.

(3) A reversal of the above procedure provides a simple means to identify a star. The original values of local hour angle and declination being read directly from the proper scales.

d. For taking bearings, the hour circle is set parallel to the azimuth circle and becomes a bearing plate by using the datum mark engraved TRUE BEARG.

(1) If the azimuth circle is set with the true course opposite the lubber line, its 000°-180° line must lie in the true meridian.

(2) Only one datum mark for bearings is required because the increasing direction of azimuth is clockwise in both North and South latitudes. This datum mark is placed over the zero end of the 000°-180° diameter of the azimuth circle.

2. OPERATION INSTRUCTIONS

a. GENERAL.—It is essential that the Base Standard in which the Astro Compass is used be lined up correctly with the fore and aft line of the aircraft. Level the instrument as accurately as possible because an error of 1° in level may cause an error of 1° or more in observation. The altitude of the body to be observed must be small, especially in lower latitudes.

b. TO CHECK THE TRUE HEADING:

(1) *BY THE SUN.*

(a) Place instrument in Base Standard and level.

(b) Set latitude to nearest degree.

(c) Extract Declination and G.H.A. Sun from Air Almanac against G.C.T. and date.

(d) Calculate L.H.A. Sun by:

L.H.A. Sun = G.H.A. Sun $\begin{cases} + \text{E} \\ - \text{W} \end{cases}$ Longitude to ½°.

(e) Set L.H.A. SUN on hour circle

(f) Set declination.

(g) Rotate instrument until shadow of bar falls between parallel lines on shadow screen.

(h) Read true heading against lubber line.

(2) *BY MOON OR PLANET:*

(a) Place instrument in Base Standard and level.

(b) Set latitude to nearest degree.

(c) Extract Declination and G.H.A. Moon or Planet from Air Almanac against G.C.T. and date.

(d) Calculate L.H.A. of Body by:

L.H.A. Body = G.H.A. Body $\begin{cases} + \text{E} \\ - \text{W} \end{cases}$ Longitude to ½°

(e) Set L.H.A. on hour circle.

(f) Set declination.

(g) Rotate instrument until body appears in the sights (lens being nearest to the observer). When observing the Moon, shadow bar and screen may be used instead of sights.

(h) Read true heading against lubber line.

(3) *BY STAR (using Air Almanac):*

(a) Place instrument in Base Standard and level.

(b) Set latitude to nearest degree.

(c) Extract G.H.A. Aries from Air Almanac against G.C.T. and date.

(d) Extract Declination and S.H.A. Star from front cover of Air Almanac.

(e) Calculate S.H.A. Star by:

L.H.A. Star = G.H.A. Aries + S.H.A. Star $\begin{cases} + \text{E} \\ - \text{W} \end{cases}$ Longitude to ½°.

(Adjust for 360° if necessary).

(f) Set declination of star on declination scale.

(g) Rotate instrument until star appears in sights (lens being nearest observer).

(h) Read true heading against lubber line.

(4) *BY STAR (using Astrograph)*

(a) Switch on and set Astrograph.

(b) Select Astrograph Star with least altitude and read altitude (to nearest degree) for assumed position of aircraft.

(c) At this assumed 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 by using the chart table plotter. Lay long edge of plotter tangential to star curves and read angle given by short edge of plotter when transferred to the compass rose on chart. The true bearing of star is in the direction of increasing altitude.

(d) Place instrument in Base Standard and level.

(e) Set latitude 90°.

(f) Set star's true bearing on hour circle against the true bearing mark.

(g) Set star's approximate altitude on declination scale.

(h) Rotate the instrument until selected star appears correctly in the sights.

(i) Read true heading of aircraft against lubber line.

c. TO STEER A COURSE:

(1) Obtain true heading by using one of the foregoing methods.

(2) Compare this with the required true course.

(3) Change heading if necessary on directional gyro.

(4) Maintain heading by directional gyro, checking at 15 minute intervals.

d. TO OBTAIN TRUE BEARING OF A DISTANT OBJECT:

(1) Place instrument in Base Standard and level.

(2) Set true heading against lubber line.

(3) Set latitude to 90°.

(4) Rotate hour circle until object appears correctly in sights (lens being nearest observer).

(5) Read true bearing on hour circle against bearing datum mark.

e. TO IDENTIFY A STAR:

(1) Place instrument in Base Standard and level.

(2) Set true heading against lubber line.

(3) Set latitude.

(4) Rotate hour circle and adjust sights until Star appears in sights at intersection of the lines.

(5) Read declination and L.H.A. on proper scales.

(6) Extract G.H.A. Aries from Air Almanac against G.C.T. and date.

(7) Determine S.H.A. Star by:

S.H.A. Star = L.H.A. Star $\begin{cases} - \text{E} \\ + \text{W} \end{cases}$ Longitude to ½°. − G.H.A. Aries

(Adjust to 360° where necessary).

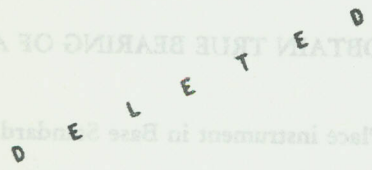
(8) Extract name of Star from Air Almanac against S.H.A. and declination.

SECTION V
SERVICE INSPECTION, MAINTENANCE AND LUBRICATION

1. SERVICE TOOLS REQUIRED

No special tools are required for the maintenance of the Astro Compass.

2. SERVICE INSPECTION



25 HOUR

Check for loose fit in the leveling screws, excess play between face plate and horizontal circle, loose fit on sight bracket and cracked lens.

100 HOUR

After every 100 hours of service the Astro Compass should be placed in a test bench rig and all scales and rotation tolerances checked. Check the bearing surfaces between the horizontal circle and face plate; the drum stator and the North and South Hour Angle Heads; the sight bearing parts should be carefully checked. To check these, level the Astro Compass and set the latitude dial at "9"; the micrometer knob at "0" and the sight bracket at "0". Rotate the hour angles (push in to turn) in several positions at 0, 90, 180, 270 degrees. The line of sight should be constant within ½ degree at any point. The readings of the S.H.A. and N.H.A. shall always total 360 degrees and the datum line shall register on both heads within ±½ degree.

3. MAINTENANCE

Only necessary maintenance is discussed in paragraph 5, this section.

4. LUBRICATION

It is not necessary to lubricate any of the parts in the Astro Compass.

5. TROUBLES AND REMEDIES

The most commonly encountered difficulties and their correction are described below. Before investigating for any trouble, check the following:

TROUBLE	POSSIBLE CAUSE	REMEDY
Loose fit in leveling screws.	Prolonged use.	If excess play is noticed through loose fitting of the leveling screws, clamp the compass tightly between the base and the horizontal circle above the spring plunger. Then, with a screw driver, remove the set screws and pins on one side of the yoke. This permits separating the base adapter from the face plate, which in turn allows the adjusting screws to be moved. After removing the adjusting screws, squeeze the legs of the adapter together and replace the parts in reverse order.
Excess play between face plate and horizontal circle.	Prolonged use.	After lengthy use, it is possible that there will be excess play between the surfaces of the face plate and the horizontal circle. At this time, the lock nut, the nut, and the washer (viewed from the under side of the compass) should be removed and the two parts separated. Both contact surfaces should be inspected and cleaned, after which the instrument should be reassembled with the proper amount of friction between the two surfaces. The screw is then locked in position.
Loose fit on Sight Bracket.	Prolonged use.	Loosen the lock nut and tighten the screw which holds the sight bracket to the declination scale. The screw is then locked in position.
Cracked lens.	Vibration.	In the event of a cracked lens, remove the lens retainer by removing the two lens retainer screws. Clean thoroughly for bits of broken glass and replace with a new lens. Reassemble with the convex side of the lens toward the shadow bar. In tightening the lens retainer, care should be taken to prevent breaking the lens when it is being replaced.

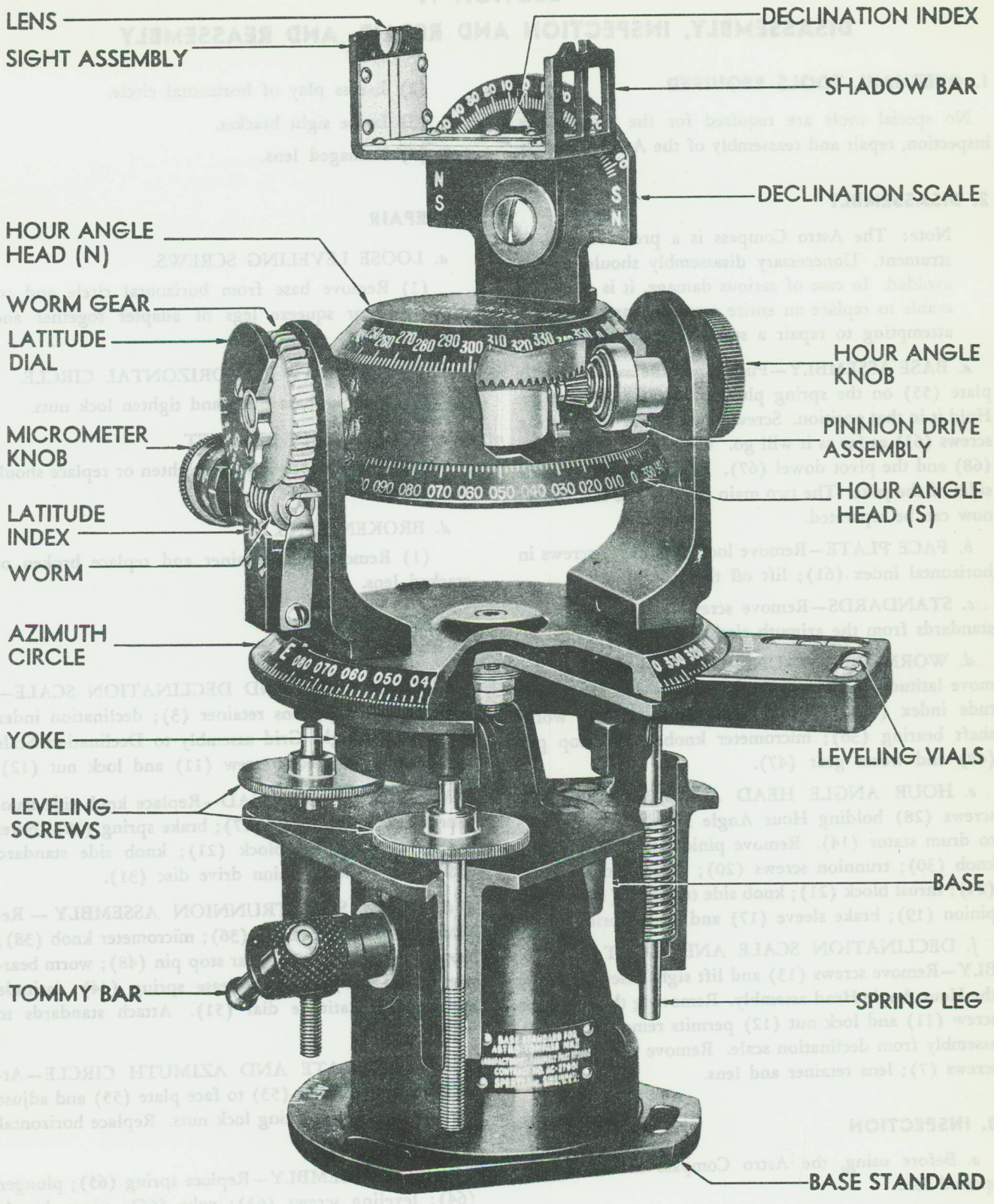


Figure 5—Sectional View

SECTION VI
DISASSEMBLY, INSPECTION AND REPAIR, AND REASSEMBLY

1. OVERHAUL TOOLS REQUIRED

No special tools are required for the disassembly, inspection, repair and reassembly of the Astro Compass.

2. DISASSEMBLY

Note: The Astro Compass is a precision instrument. Unnecessary disassembly should be avoided. In case of serious damage, it is preferable to replace an entire assembly instead of attempting to repair a small part.

a. BASE ASSEMBLY—Push down the azimuth circle plate (55) on the spring plunger as far as it will go. Hold it in that position. Screw down one of the leveling screws (63) as far as it will go. Withdraw the set screw (68) and the pivot dowel (67). Repeat on the opposite sides of the yoke. The two main parts of the instrument now can be separated.

b. FACE PLATE—Remove lock nuts (58); screws in horizontal index (61); lift off the face plate.

c. STANDARDS—Remove screws (54) and lift the standards from the azimuth circle.

d. WORM SIDE TRUNNION ASSEMBLY — Remove latitude dial screws (52); latitude dial (51); latitude index (43); worm bearing spring (40); worm shaft bearing (36); micrometer knob (38); stop pin (48) and worm gear (47).

e. HOUR ANGLE HEAD ASSEMBLY — Remove screws (28) holding Hour Angle Head "N" and "S" to drum stator (14). Remove pinion drive disc (31); knob (30); trunnion screws (20); thrust block screws (24); thrust block (21); knob side trunnion (16); bevel pinion (19); brake sleeve (17) and brake spring (18).

f. DECLINATION SCALE AND SIGHT ASSEMBLY—Remove screws (13) and lift sight assembly from the Hour Angle Head assembly. Removing the shoulder screw (11) and lock nut (12) permits removal of sight assembly from declination scale. Remove lens retaining screws (7); lens retainer and lens.

3. INSPECTION

a. Before using, the Astro Compass should be inspected for:

(1) Loose leveling screws.

(2) Excess play of horizontal circle.

(3) Loose sight bracket.

(4) Damaged lens.

4. REPAIR

a. LOOSE LEVELING SCREWS.

(1) Remove base from horizontal circle and replace base or squeeze legs of adapter together and replace.

b. EXCESS PLAY IN HORIZONTAL CIRCLE.

(1) Remove base plate and tighten lock nuts.

c. LOOSE SIGHT BRACKET.

(1) Remove lock nut and tighten or replace shoulder screw.

d. BROKEN LENS.

(1) Remove lens retainer and replace broken or cracked lens.

5. REASSEMBLY

a. SIGHT GRID AND DECLINATION SCALE—Replace lens (2); lens retainer (3); declination index (5). Attach Sight Grid assembly to Declination Scale by means of shoulder screw (11) and lock nut (12).

b. HOUR ANGLE HEAD—Replace knob side trunnion (16); brake sleeve (17); brake spring (18); bevel pinion (19); thrust block (21); knob side standard (29); knob (30); pinion drive disc (31).

c. WORM SIDE TRUNNION ASSEMBLY — Replace worm shaft bearing (36); micrometer knob (38); worm gear (47); worm gear stop pin (48); worm bearing spring (40); worm release spring (44); latitude index (43); latitude dial (51). Attach standards to azimuth circle.

d. FACE PLATE AND AZIMUTH CIRCLE—Attach horizontal circle (53) to face plate (55) and adjust for friction by tightening lock nuts. Replace horizontal index (39).

e. BASE ASSEMBLY—Replace spring (65); plunger (64); leveling screws (63); yoke (66); pivot dowels (67) and set screws (68). Attach to Face Plate.

PARTS CATALOG

SECTION I
INTRODUCTION

1. This Parts Catalog lists the parts for the Astro Compass Type AN 5738-1, manufactured by Sperti, Incorporated, Cincinnati, Ohio.

2. The Group Assembly Parts List, Section II, divides the major assemblies into subassemblies and detailed parts. Each assembly listed is directly followed by its component parts properly indented to show their relationship to the assembly.

3. Parts designated "Commercial" are those parts of general availability which may be found in any common or unrestricted market.

4. The asterisk (*) denotes those parts are not procurable separately.

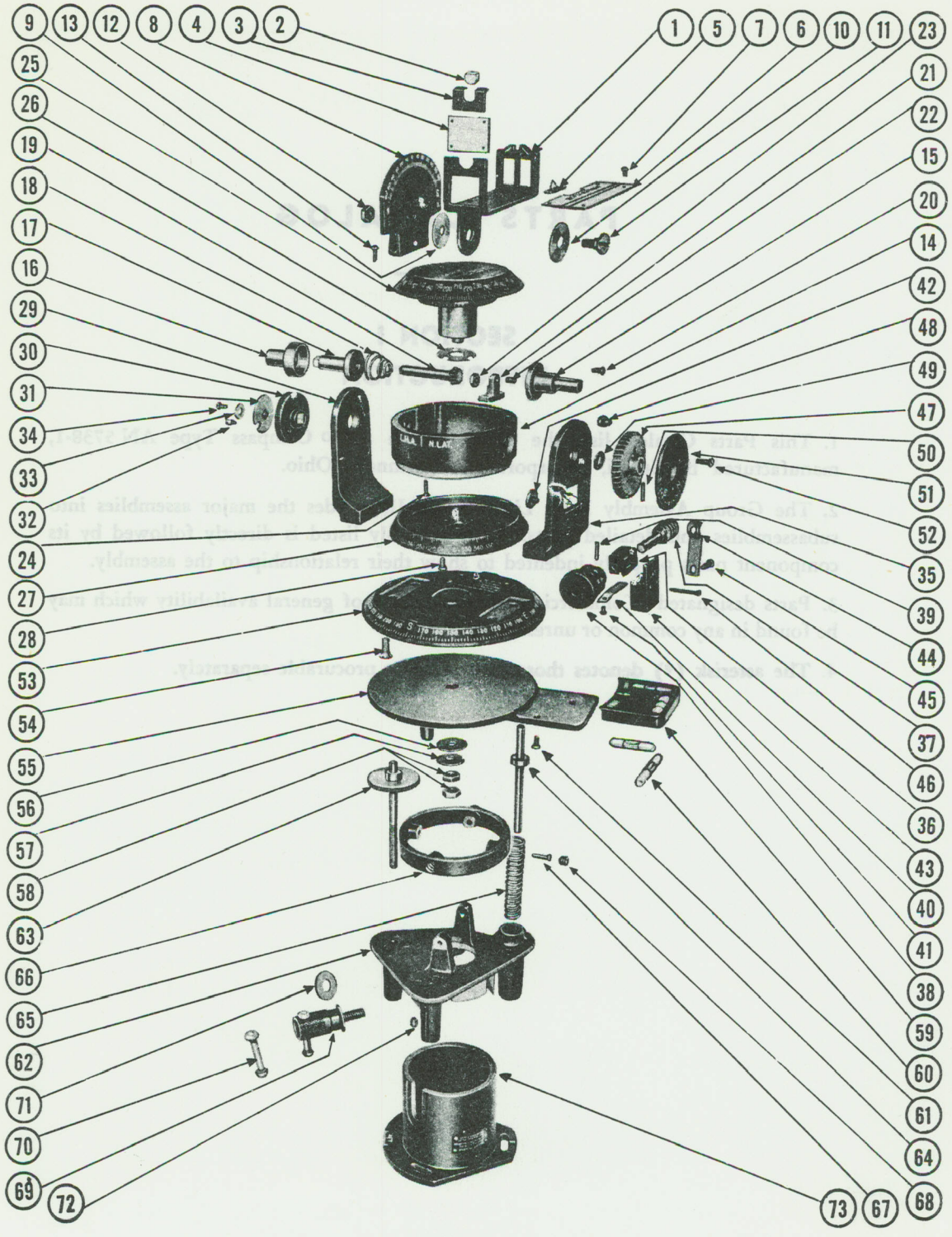


Figure 6—Exploded View

SECTION II—GROUP ASSEMBLY PARTS LIST

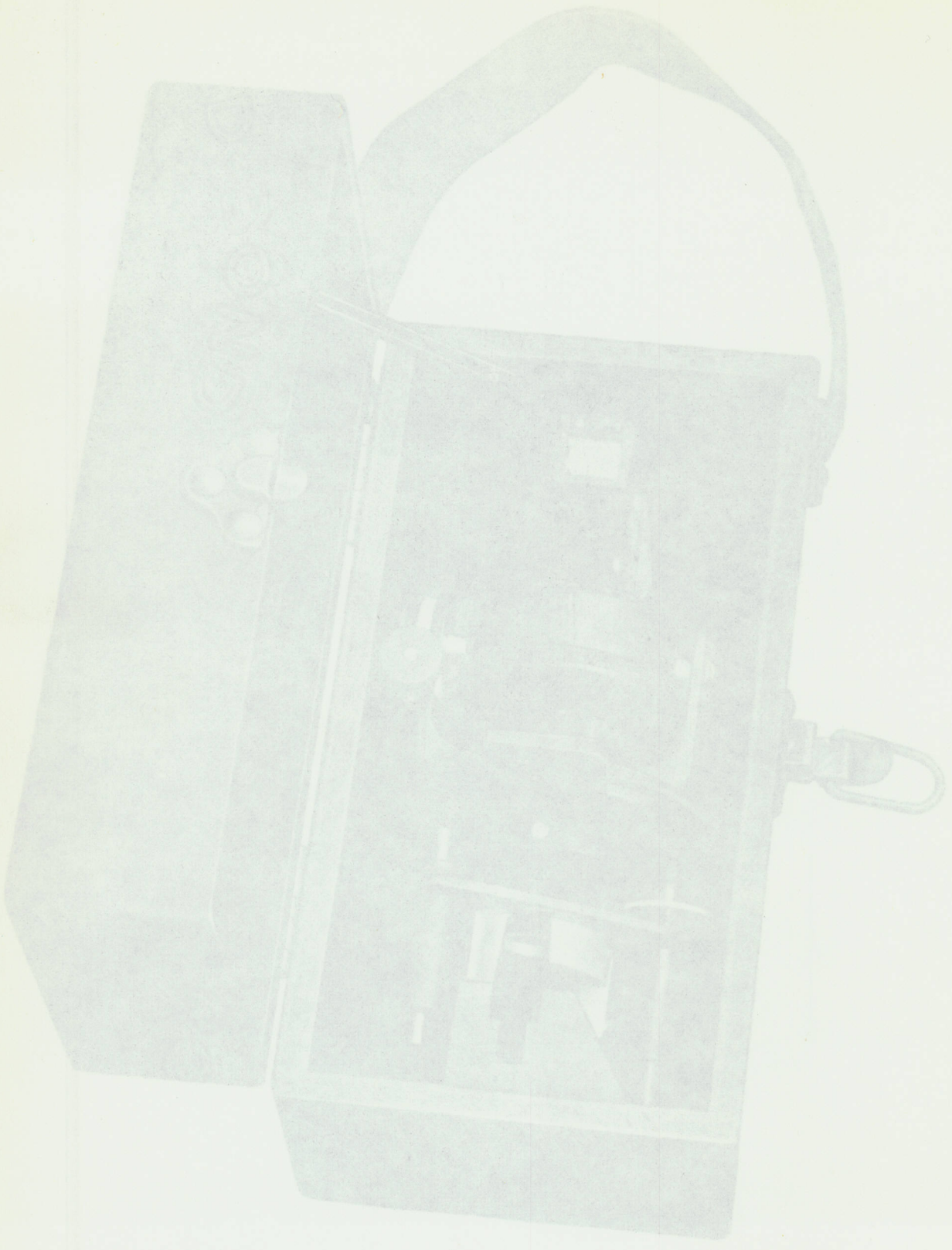
GROUP Aircraft Instruments
MAJOR ASSEMBLY Astro Compass

FIG. NO.	INDEX NO.	STOCKED	PART NUMBER	1	2	3	4	5	6	NOMENCLATURE	UNITS PER ASSY
6			D-500							Main Assembly—Astro Compass	1
6			D-500-DAX							Sight Assembly	1
6	1		D-69*							Sight	1
6	2		D-72*							Lens	1
6	3		D-73*							Retainer—Lens	1
6	4		D-74*							Upright—Sight grid	1
6	5		D-70*							Index—Declination	1
6	6		D-75*							Base—Sight grid	1
6	7		AN520-B1-2*							Screw—Sight, round head	12
6	8		D-64-DAIX							Scale—Declination	1
6	9		D-68*							Washer—Plain, flat	1
6	10		D-67*							Washer—Domed	1
6	11		D-65*							Screw—Shoulder	1
6	12		AN345-B6*							Nut—Lock	1
6	13		AN515-B4-3*							Screw—Round head	2
6			D-500DAVIII							Head Assembly—Hour angle	1
6	14		D-55*							Stator—Drum	1
6	15		D-42*							Trunnion Assembly—Worm side	1
6	16		D-43*							Trunnion Assembly—Knob side	1
6	17		D-46*							Sleeve—Brake	1
6	18		D-45*							Spring—Brake	1
6	19		D-47*							Pinion—Bevel	1
6	20		AN505-B2-3*							Screw—Trunnion, flat head	8
6	21		D-48*							Block—Thrust	1
6	22		D-49*							Screw—Grub set	1
6	23		Coml.							Nut—Hex Lock, No. 4-48x5-64 in.	1
6	24		AN510-B4-4*							Screw—Thrust block, flat head	2
6	25		D-96*							Head—Hour angle, N	1
6	26		D-116*							Shim	As Req.
6	27		D-56*							Head—Hour angle, S	1
6	28		AN505-B4-4*							Screw—Flat head	3
6			D-500DAVII							Standard Assembly—Knob Side	1
6	29		D-22*							Standard—Knob side	1
			AN505-B8-7*							Screw—Flat head	2
6	30		D-52*							Knob	1
6	31		D-54*							Disc—Pinion drive	1
6	32		D-53*							Post—Pinion drive disc	1
6	33		D-93*							Washer—Pinion drive disc	1
6	34		AN515-B2-3*							Screw—Pinion drive, round head	1
6			D-500DAVI							Standard Assembly—Worm Side	1
6	35		D-21*							Standard—Worm side	1
6	36		D-35*							Bearing—Worm shaft	1
6	37		D-31*							Worm	1
6	38		D-33*							Knob—Micrometer	1
6	39		D-83*							Pin—Taper	1
6	40		D-26*							Spring—Worm bearing	2
6	41		Coml.							Screw—Round head, No. 2-56x3-32 in.	1

SECTION II—GROUP ASSEMBLY PARTS LIST

GROUP: Aircraft Instruments
MAJOR ASSEMBLY: Astro Compass

FIG. NO.	INDEX NO.	STOCKED	PART NUMBER	1	2	3	4	5	6	NOMENCLATURE	UNITS PER ASSY
6	42		D-36*							Screw—Bearing retaining	1
6	43		D-24*							Index—Latitude	1
6	44		D-27*							Spring—Worm release	1
6	45		AN520-B4-4*							Screw—Round head	1
6	46		AN505-B2-8*							Screw—Flat head	3
6	47		D-37*							Gear—Worm	1
6	48		D-39*							Pin—Stop	1
6	49		D-41*							Washer—Stop pin clearance	1
6	50		D-83*							Pin—Taper	1
6	51		D-25A*							Dial—Latitude	1
6	52		AN505-B2-5*							Screw—Flat head	2
6			D-500DAIV							Circle Assembly—Horizontal, azimuth	1
6	53		D-16*							Circle—Horizontal, azimuth	1
6			D-17A-1*							Insert	1
	54		AN505-B8-7*							Screw—Flat head	2
6			D-109*							Plate—Name	1
6			AN535-00-2*							Screw—Drive	4
6	55		D-14*							Plate—Face	1
6	56		D-117*							Washer—Flat	1
6	57		D-18*							Washer—Domed	1
6	58		AN345-B10*							Nut—Hex	2
6			D-500DAV							Index Assembly—Horizontal	1
6	59		D-13*							Body—Horizontal index	1
6	60		D-12*							Vials—Leveling	2
6	61		AN510-B4-5*							Screw—Flat head	2
6			D-500DAII							Base Assembly	1
6	62		D-1*							Base	1
6	63		D-6*							Screw—Base leveling	2
6	64		D-7*							Plunger	1
6	65		D-8*							Spring—Plunger	1
6	66		D-9*							Yoke	1
6	67		D-103*							Dowel—Pivot	4
6	68		Coml.							Screw—Set, cup point, No. 1/4-20x3-16 in.	4
6			D-500DAIII							Screw Assembly—Binding	1
			D-2A-1*							Body—Binding screw	1
6	69		D-2A-2*							Screw—Adjusting	2
6	70		D-3-1*							Knob—Tommy bar end	1
			D-3-2*							Bar—Tommy	1
6	71		D-4*							Washer—Domed	1
6	72		Coml.							Screw—Retaining, set, cup point, No. 10-32x3-16 in.	1
6			D-500DAI							Base—Standard Assembly	1
6	73		D-102*							Standard—Base	1
6			D-108*							Plate—Name	1
6			AN535-00-2*							Screw—Drive	4
6			D-500DAXI							Case Assembly—Transit	1
6			D-121*							Case—Transit	1
6			D-107A*							Plate—Name	1
6			302-16-2*							Pins—Escutcheon	4



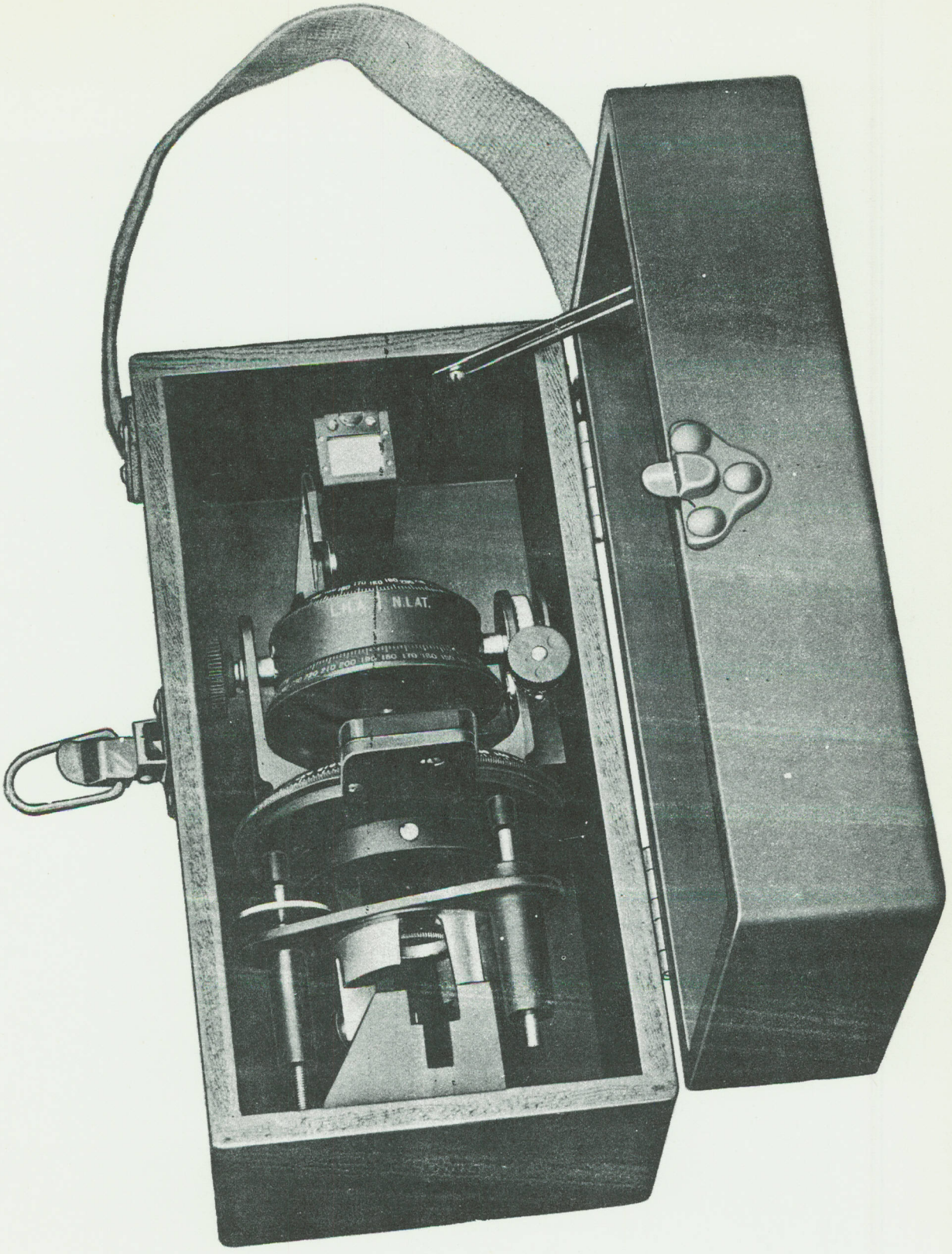


Figure 7— Astro Compass in Carrying Case