AN 08-30ARN7-2

HANDBOOK

OPERATING INSTRUCTIONS

for

RADIO COMPASS *AN/ARN-7

RESTRICTED

(For Official Use Only)

Approved 25 MAY 1945

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LIST OF REVISED PAGES ISSUED

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Destruction of Abandoned Materiel in the Combat Zone

In case it should become necessary to prevent the capture of this equipment and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:-

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper, or wood.
4. Grenades and shots from available arms.
5. Burying all debris or disposing of it in streams or other bodies of water, where possible and when time permits.

Procedure:-

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch- and instrument-boards.
3. Destroy all controls, switches, relays, connections, and meters.
4. Rip out all wiring and cut interconnections of electrical equipment Smash gas, oil and water-cooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving, or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

★

Unsatisfactory Report

For U. S. Army Air Force Personnel:

In the event of malfunctioning, unsatisfactory design, or unsatisfactory installation of any of the component units of this equipment, or if the material contained in this book is considered inadequate or erroneous, an Unsatisfactory Report, AAF Form No. 54, or a report in similar form, shall be submitted in accordance with the provisions of Army Air Force Regulation No. 15-54 listing:

1. Station and organization.
2. Nameplate data (type number or complete nomenclature if nameplate is not attached to the equipment).
3. Date and nature of failure.
4. Airplane model and serial number.
5. Remedy used or proposed to prevent recurrence.
6. Handbook errors or inadequacies, if applicable.

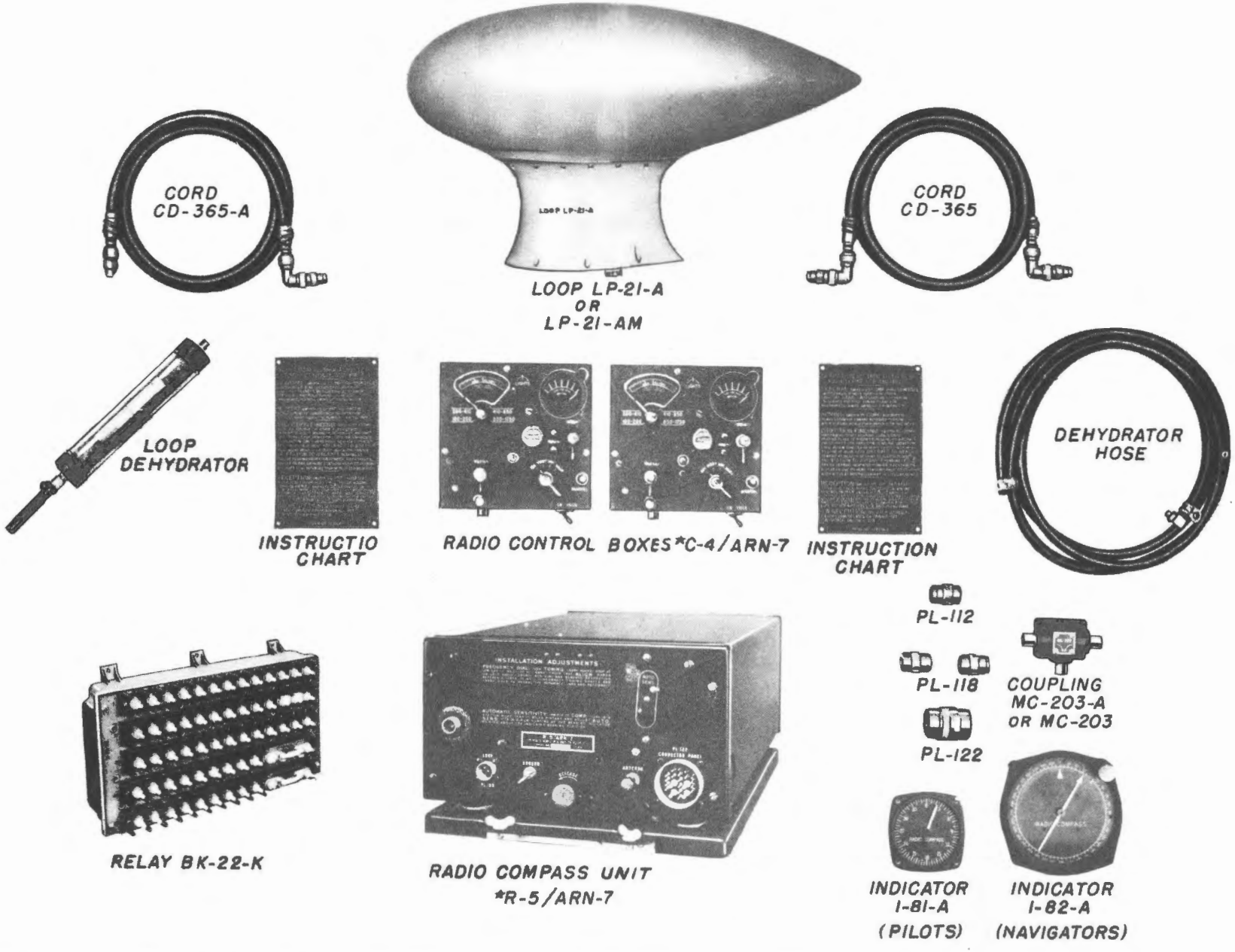
For U. S. Navy Personnel:

Report of failure of any part of this equipment during its guaranteed life shall be made on N. Aer. 4112, "Report of Unsatisfactory or Defective Material," or a report in similar form, and forwarded in accordance with the latest instructions of the Bureau of Aeronautics. In addition to other distribution required, one copy shall be furnished to the inspector of Naval Materiel (location to be specified) and the Bureau of Ships. Such reports of failure shall include:

1. Reporting activity.
2. Nameplate data.
3. Date placed in service.
4. Part which failed.
5. Nature and cause of failure.
6. Replacement needed (yes—no).
7. Remedy used or proposed to prevent recurrence.

For British Personnel:

Form 1022 procedure shall be used when reporting failure of radio equipment.



Frontispiece • Radio Compass ★AN/ARN-7—Components

SECTION I
GENERAL DESCRIPTION

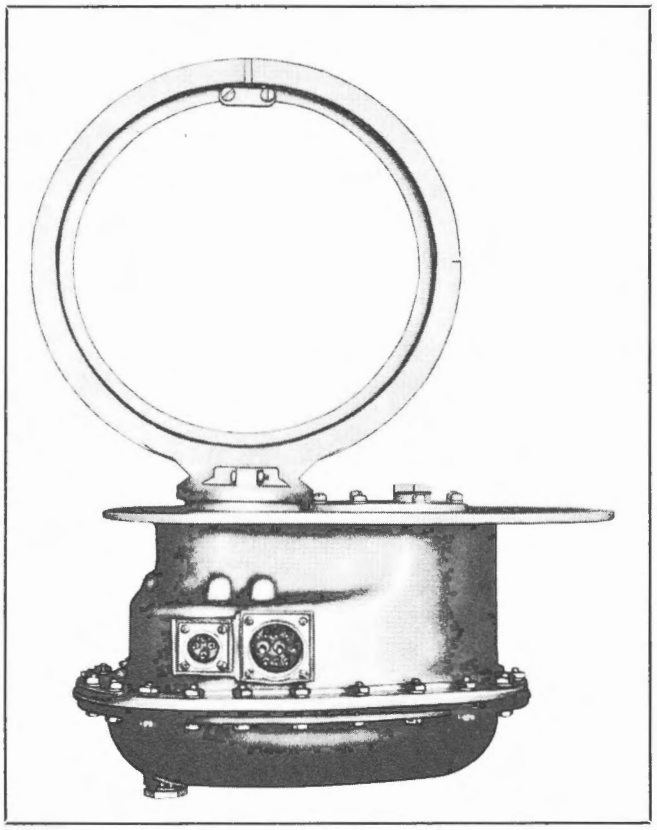


Figure 1-1. Loop LP-31-A or LP-31-AM

1. GENERAL.

a. Radio Compass ★AN/ARN-7 is an airborne navigational instrument. It utilizes signals transmitted from a range, commercial, or standard broadcast radio station to obtain directional or locational information.

b. Under favorable conditions, stations up to 250-miles distance may provide the necessary signal to operate this equipment, depending on the power of the transmitting station.

c. The radio compass operates from signals which are within the frequency range from 100 to 1750 kilocycles and is manually tuned by a remote control unit.

d. Radio Compass ★AN/ARN-7 requires the following power supply:

(1) 90 to 135 volts, 400 cycles alternating current at 0.7 to 1 ampere.

(2) 28 volts direct current at 1.95 amperes. (A 14-volt d. c. source also can be used if Rectifier Unit RA-59-A is added to the installation.)

2. COMPONENTS.

a. EQUIPMENT SUPPLIED.—The following table lists the components of Radio Compass ★AN/ARN-7. Components for both dual and single remote control installations are given. Total weight of the equipment is 65 to 90 pounds (minus cordage).

Quantity		*Name of Unit*	*Overall Dimensions*	*Weight*	*Numerical Series of Reference Symbols*
Dual Control	*Single Control*				
1	1	★Radio Compass Unit R-5/ARN-7 includes: 1 #6 Bristo setscrew wrench 5 Tube Shield MC-202	19 13/16" x 12" x 7 25/32"	46.0	100-199 600-699
1	1	Mounting FT-213-A	19 13/16" x 12" x 3/4"	1.0	
2	1	Radio Control Box ★C-4/ARN-7 includes: 1 Mounting FT-224-A 5 Lamp LM-32 (3 in use. 2 mounted spares) 1 #6 Bristo setscrew wrench	7 1/2" x 7 11/16" x 3 15/16"	4.50 ea.	200-299
1	1	Loop LP-21-( ) except LP-21-(B) (housing and mounting)	25 3/8" x 9" x 15 1/4"	10.37	400-499
		or			
1	1	Loop LP-31-A or LP-31-AM	11 5/16" x 6 3/32" x 14 23/32"	6.8	400-499
1	1	Loop dehydrator	12 1/16" x 1 5/8" x 1 13/16"	1.25	

Quantity					
Single Control	*Dual Control*	*Name of Unit*	*Overall Dimensions*	*Weight*	*Numerical Series of Reference Symbols*
1	1	Cord CD-365 includes: 2 Plug PL-108 2 Conduit Elbow FT-184 1 Flexible conduit assembly	72" long, 1/2" diameter	1.62	400-499
		or			
		Cord CD-365-A includes: 2 Plug PL-108 1 Conduit Elbow FT-184 1 Flexible conduit assembly	72" long, 1/2" diameter	1.62	
		or			
		Cord CD-365-B includes: 2 Plug PL-108 1 Flexible conduit assembly	72" long, 1/2" diameter	1.62	
		or			
		Cord CG-( ) 42/ARN	14 feet long, 1/2" diameter		
1	0	Coupling MC-203-A (Coupling tuning shaft from both radio control boxes to radio compass unit)	3 3/4" x 2 7/16" x 1 19/64"	0.34	400-499
1	1	Indicator I-81-A, (Pilot's) or I-81- or I-81-N	3 1/4" x 3 1/4" x 3 11/16"	0.75	400-499
1	1	Indicator I-82-A (Navigator's)	5 1/8" x 5 1/8" x 4 3/32"	1.19	400-499
1	0	Relay BK-22-K (switching from one radio control box to the other) includes 1 Autotransformer.	11 3/4" x 7" x 3"	6.25	500-599
0	1	Relay SW-172-A (for 24-volt d.c. installation) or Relay SW-182-A (for 12-volt d.c. installation) (ON-OFF switching)	2 3/4" x 3/8" max. 1 7/8" max.	0.31	
1	1	Plug PL-112 (loop power circuits to connector panel)	1 3/32" Dia. x 1 15/32" long	0.06 ea.	
2	1 or 2	Plug PL-118 (1 for each bearing indicator to connector panel)	1 3/32" Dia. x 1 15/32" long	0.06 ea.	
1	1	Plug PL-122 (compass unit to connector panel)	1 23/32" Dia. x 2 1/8" long	0.20	
2	1 or 2	Chart for Radio Compass ★AN/ARN-7	4 1/2" x 7 1/8" x 1/32"	0.06 ea.	
1	1	Alignment Tool TL-138-B			

b. EQUIPMENT REQUIRED BUT NOT SUPPLIED.—In addition to the components previously listed, the equipment listed in the following table is required.

Quantity	*Name of Unit*	*Required Characteristics*
1 or 2	Headset	With cord and plug
1	Sense Antenna (with insulators, lead-in etc.)	Suitable, non-directional
1	Power source	12/14 or 24/28-volt d-c source
1	Power source	115-volt, 400-cycle a-c source
	Tuning Shaft MC-124	Necessary lengths
	Suitable interconnecting wiring	
1	Rectifier Unit RA-59-A★	For operation from 1/14.25 volts

★Not necessary when 28-volt power supply is used.

c. INTERCHANGEABLE COMPONENTS. — The following table lists the interchangeable components for Radio Compass ★AN/ARN-7.

Components — *Interchangeable Components*

Loop..... Loop LP-21-A, LP-21-AM and LP-21-LM.

Loop..... Loop LP-31-A and LP-31-AM.

Relay..... Relay BK-22-A, BK-22-E and BK-22-K. Relay BK-22-E and BK-22-K include an auto transformer of 500-ohm impedance output for use with low impedance headsets.

Indicator..... Indicator I-81-A, I-81-L or I-81-N.

1. Indicator I-81-A for mounting from back of instrument panel.
2. Indicator I-81-L has dial different from Indicator I-81-A and can be mounted from front or back of instrument panels.
3. Indicator I-81-N is the same as Indicator I-81-L except the dial lettering and markings are for night flight operation.

Cord..... Cord CD-365, CD-365-A, CD-365-B, CG-43/ARN or CG-95/ARN.

1. Cord CD-365-B is 6 feet long.
2. Cord CD-365-A is same as CD-365-B but has *one* 90° elbow.
3. Cord CD-365 is same as CD-365-B except has *two* 90° elbows.
4. Cord CG-42/ARN is same as CD-365 but is 14 feet long.
5. Cord CG-95/ARR is same as Cord CD-365-A but is 14 feet long.

SECTION II
INSTALLATION AND ADJUSTMENT

1. INSTALLATION.

a. GENERAL.—Radio Compass ★AN/ARN-7 requires a sense antenna in addition to the loop furnished. This antenna should be non-directional, having a 0.25-meter effective height and a 50-micromicroforad capacitance. The wire diameter of the non-directional antenna may vary in size and still provide satisfactory operation. On aircraft which will accommodate any one of several types of antenna installations, use the type that most nearly meets the above requirements and which, in addition, has the largest possible ratio of vertical to horizontal length. Vertical rod antennas and T-type wire antennas supported by stub-masts have been found satisfactory. Do not place an antenna or lead-in closer than 3 feet from the loop. Keep the capacitance of the lead-in as low as possible.

b. BENCH TEST.

(1) See that all components are in good condition. Pay particular attention to the seal between the loop housing and base of the loop.

(2) Set up the equipment in a place free from electrical interference and at least 200 feet from large electrical conductive objects such as buildings, hills power lines, or railroads.

Note

Sensing or bearing accuracy checks are not reliable if they are made inside of, or close to, building with metal structure or large electrical conductive objects.

(3) Connect the components according to the wiring diagram (see figs. 6-4 and 6-5). If the system voltage in a dual remote control installation is 12/14 volts, insert the connecting link between terminal 59 and terminal 60. This link is supplied in a bag with Relay BK-22-K. If the system voltage is 24/28 volts, this link is not required.

(4) Remove the compensator from the loop. (See fig. 2-1.)

(a) Remove the bottom cover plate.

(b) Remove the four screws to disconnect the four connector lugs from the terminal board on the compensator assembly.

(c) Remove the three mounting screws and lift the compensator assembly from the loop base casting.

(d) Check to see that there is no correction set up on the compensator, or if calibration data is available for the installation in the particular type of aircraft concerned set up the correction.

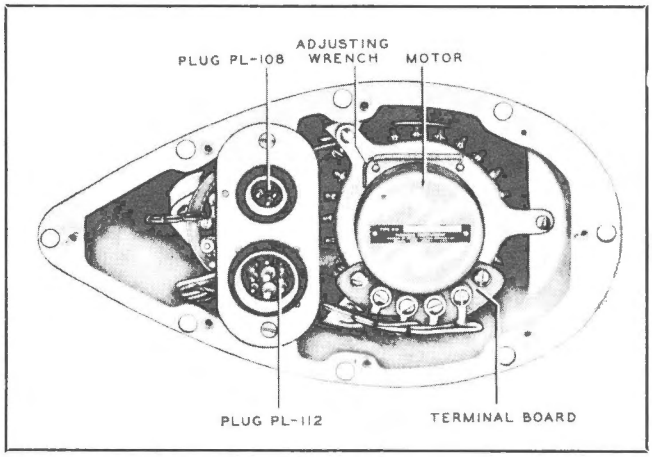


Figure 2-1. Loop LP-21-( ) — Bottom Plate Removed

(5) Place the compensator assembly with the asimuth scale up and see that the proper azimuth scale is in place. (Red for belly mounting and black for top mounting.) This scale may be changed in the following manner:

(a) Remove the four screws located around the top edge of the compensator. (See fig. 2-2.)

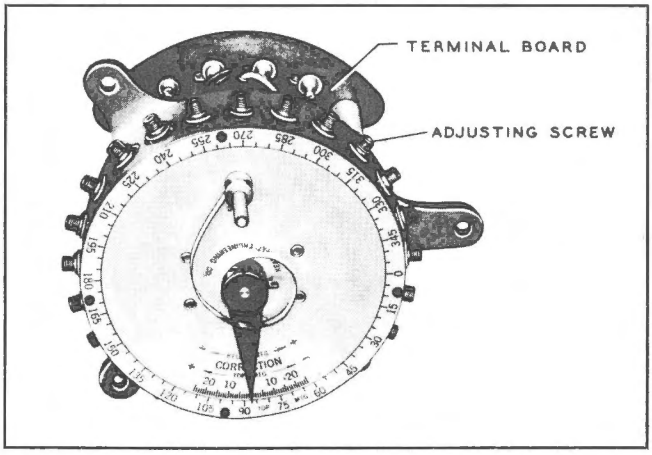


Figure 2-2. Compensator Removed from Loop

(b) Remove the azimuth scale and replace with the desired scale.

(c) Replace the four screws.

(6) Remove the adjusting screw wrench from the helical spring mounting on the side of the compensator assembly.

(7) Turn the zero mark on the correction scale, opposite the zero mark on the azimuth scale.

(8) Use the adjusting wrench and adjust the compensator screw opposite the zero correction mark, until the pointer reads zero.

(9) Set the zero correction mark successively to the next number on column 4 and adjust the screw opposite this mark until the pointer indicates the corresponding number in column 5. (See fig. 2-3.)

Note

If large errors are to be corrected, it may be more accurate to do only part of the above adjustment as a preliminary measure, and then complete step (9) above.

(10) Repeat the entire procedure given in step (8) and (9) once or twice more until all screws have been satisfactorily adjusted.

(11) Replace the set screw wrench and replace the compensator within the loop.

(12) Reconnect the four terminals according to markings on terminal board.

(13) Replace the bottom cover plate, taking care that the neoprene gaskets are in place, and that the base plate is properly sealed. (See T.O. #08-5-53.)

(14) Apply glyptal to the cover holding screws and secure the cover plate to the base casting.

(15) Check the operation of parts carefully.

(a) Be sure that all tubes are firmly seated in their respective sockets and that all grid clips and grid cap shields are pushed down tightly.

(b) Visually check all lamps and fuses, both operating and spares.

(c) Check operation of tuning drives and all controls on both control boxes for freedom of operation.

(d) Check the operation of the "CONTROL" switch and see that the band switching mechanism is operating properly on both radio control boxes.

(e) Check the operation of the "LOOP L-R" switch.

(f) Check the operating voltage of the inverter, if it is used. Be sure that it is the same as the system voltage in the aircraft in which the equipment is to be installed.

(16) Connect a non-directional sense antenna approximately 5 feet high, to the radio compass unit and make the following tests:

(a) Push the "CONTROL" switch on Control Box ★C-4/ARN-7 and after tubes warm up, tune in a radio station on band one with the "TUNING" control.

(b) Operate the equipment on the "COMP.", "ANT.", and "LOOP" positions.

Note

When operating the equipment on "COMP." adjust the "AUTO. SENS." control so that the loop is oscillating or hunting about ± 0.25 degree on each side of the mean indication. This mean bearing should check with geographical bearings within one degree. Repeat this operation while tuned to another radio station in the same band.

(c) From a knowledge of the distance, power, and direction of the station, make a rough check on the performance of the equipment. The sensing of the radio compass should be such that the bearing is zero when the broad nose of the loop housing points toward the station. At the same time, the bearing indication should increase as the loop housing is rotated counterclockwise.

(d) Tune to other stations and repeat the operation of the equipment on the "COMP.", "ANT." and "LOOP" positions for each station. Repeat tests for band two, three and four.

(e) Allow the equipment to operate for at least one-half hour. Check operation of the headset in the audio output jacks of both radio control boxes. Vibrate or jar the equipment. Any clicks or increase in noise will require a thorough investigation and removal of the cause.

(f) If the equipment does not seem to operate satisfactorily, recheck the interconnecting leads and vacuum tubes and substitute satisfactory equipment for any faulty components.

Note

Efficient bonding and shielding of the ignition, generator and other electrical systems are necessary for the satisfactory operation of an aircraft radio receiver. When installing any radio compass, follow exactly the directions for shielding and bonding given in Air Corps Technical Orders and the *"Handbook of Instructions for Airplane Designers"*.

c. LOOP LP-21-( )★.

(1) LOCATION.—Locate the fore-and-aft center line of the fuselage as far as practicable from sources of interference from the engine, metal masses and conductors. (For typical installation see fig. 6-1.) In deciding where to put the loop, consider:

(a) The space available for the base and housing of the loop.

(b) The structural requirements of the loop and aircraft.

(c) The length of Cord CD-365, Cord CD-365-A, Cord CD-365-B, Cord CG-42/ARN, or Cord CG-95/ARN.

(d) The location of the radio compass and other factors incident to the normal operation of the aircraft.

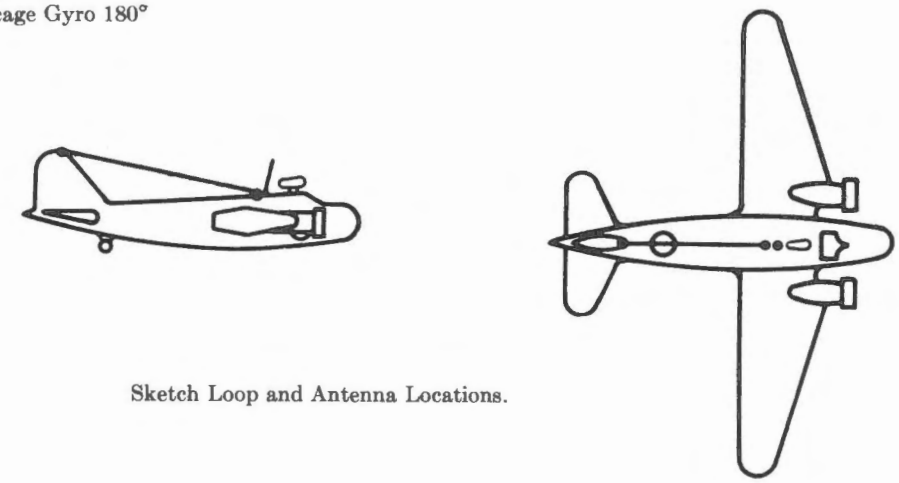
★Loop LP-21-( )★ Indicates all Loop LP-21 series except Loop LP-21-B.

NOTE: Head toward station over predetermined point on reference line, steady, set GYRO on 0° and check zero bearing.

Station Used ID- WWIL
Frequency 266
Plane No. B-23 39-27
Pilot
Recorder

	Flight Test Data for Curve			Compensator MC-217 Adjustment Data	
	Column # 1	Column # 2	Column # 3	Column # 4	Column # 5
	Gyro Bearing	Plane to Radio Station Bearing	Indicated Bearing	Compensator Inner Scale Zero Bearing	Compensator Pointer Bearing
*	0	0	0	0	0
	15	345	349	15	29
	345	15	7	345	340
	30	330	338	30	48
	330	30	16	330	321
**	180	180	180	45	62
	195	165	170	315	306
	165	195	188	60	73
	210	150	159	300	293
	150	210	197	75	82
*	45	315	325	285	281
	315	45	27	90	90
**	225	135	146	270	271
	135	225	208	105	100
	270	90	90	255	263
	105	255	248	120	111
	255	105	112	240	254
	120	240	221	135	124
	240	120	131	225	244
**	90	270	269	150	139
	285	75	64	210	228
	75	285	291	165	158
	300	60	43	195	208
	60	300	309	180	180

NOTE: This form to be used in conjunction with "Radio Compass Deviation Calibration Curve."
* Cage Gyro 0°
** Recage Gyro 180°



Sketch Loop and Antenna Locations.

Figure 2-3. Radio Compass Deviation Calibration Data—Numerical Example

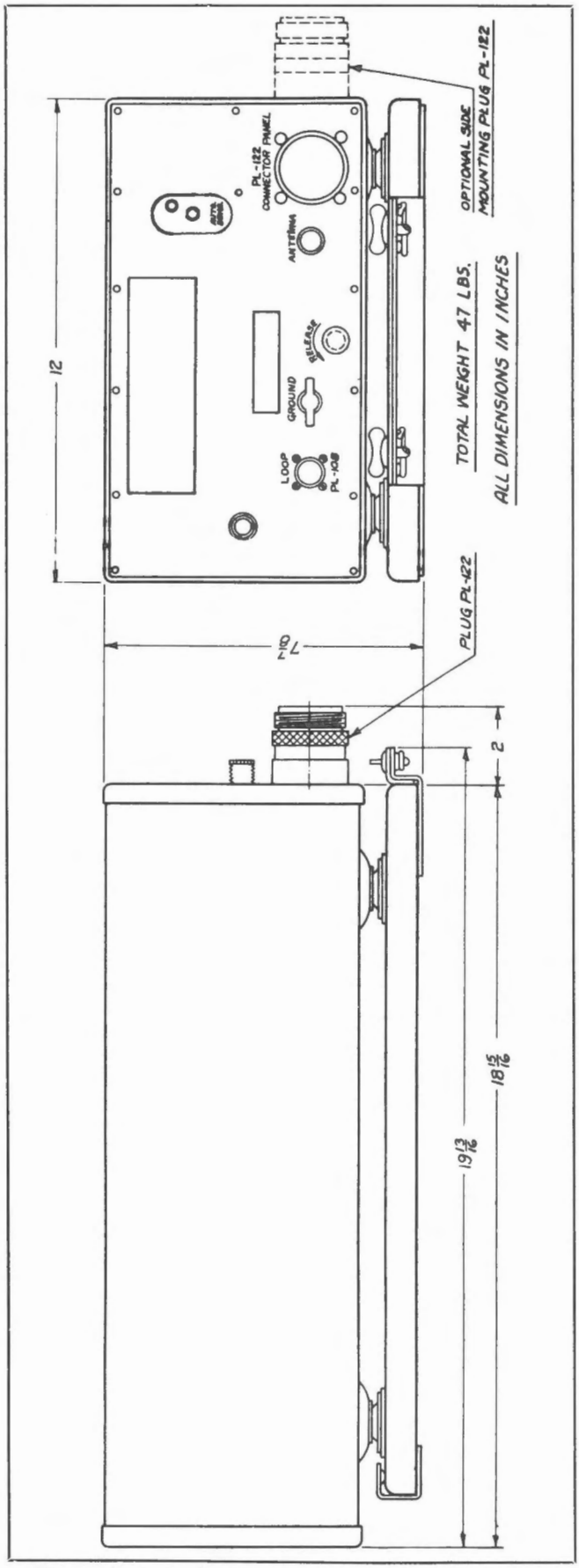


Figure 2-4. Radio Compass Unit ★R-5/ARN-7— Outline Drawing

(8) Reassemble the coupling to the dehydrator.

(9) Coat the scarfed section of the dehydrator connector coupling with Valvlube and slip the free end of the hose on this scarfed section.

(10) Assemble and tighten the remaining hose clamp.

(11) Check to see that the dehydrator hose is free from kinks and sharp bends.

(12) *Be sure to remove the sealing tap and plug from the breather end (open end) of the dehydrator.*

Note

The dehydrator is connected to the loop assembly by suitable fittings and a 5/16-inch ID vinylite hose. For proper operation of the dehydrator, keep the loop assembly well sealed.

f. RADIO COMPASS UNIT ★R-5/ARN-7, INCLUDING MOUNTING FT-213-A. *(See figures 2-4 and 2-5.)*

(1) Install Radio Compass Unit ★R-5/ARN-7 in accord with airplane design information so that the clearance on all sides allows free action of the shock absorbers, for adjustment of the "AUTO. SENS." control, and for removal of the unit from the mounting. Provision is made in the radio compass unit for changing the location of the socket for Plug PL-122 from the front panel to the right side of the chassis. Before making this change, remove the four screws which secure the socket and the four screws holding the socket-hole cover plate 152. Take care not to break the wires connected to the socket or to damage the terminals when making the change of socket location.

(2) Secure Mounting FT-213-A to the principal structure of the aircraft by six No. 10 screws. Mounting dimensions are shown on figures 2-4 and 2-5. Bond the mounting to the metallic framework of the aircraft and fasten the ground braid on the mounting to the "GROUND" post on the radio compass unit when Radio Compass Unit ★R-5/ARN-7 is installed on the mounting.

g. RADIO CONTROL BOX ★C-4/ARN-7. *(See figure 2-6.)*

(1) Locate each Radio Control Box ★C-4/ARN-7 where the panel will be easily visible and the controls accessible to the operator. There should be enough clearance for connection of the tuning shaft and the cables from Relay BK-22-K or connector panel.

(2) Mounting FT-224-A which is included with the control box, is not provided with mounting holes since the requirements will vary with individual installations. In drilling such holes, take care not to damage the wiring in the base. (See fig. 2-6.) To avoid the possibility of short circuits or fouled gears, clean out carefully all metal chips. Radio Control Box ★C-4/ARN-7 plugs into Mounting FT-224-A. First tighten the plug release screw at the lower left corner near the tuning crank; then tighten the other three captive mounting screws.

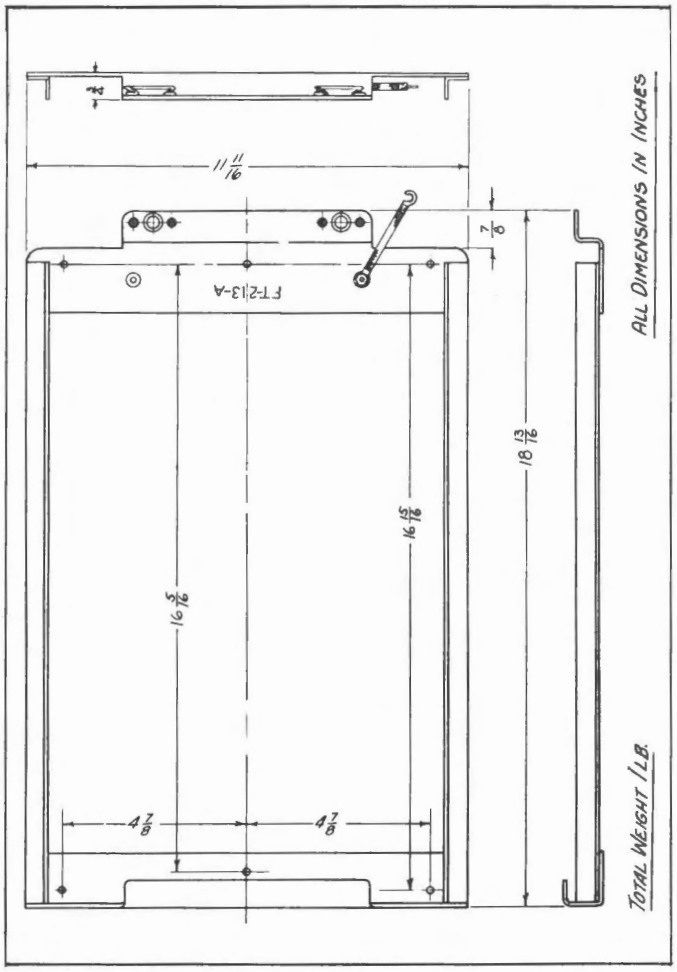


Figure 2-5. Mounting FT-213-A—Drilling Plan

(3) Mount the chart of operation instructions which accompanies the control box near each radio control box in a position easily readable by day or night.

b. INDICATOR I-81-A (PILOT'S).—Mount Indicator I-81-A (Pilot's) so that the entire bearing scale is visible to the pilot. This indicator is designed for mounting from the back of the instrument panel. For front or back mounting, use Indicator I-81-L or I-81-N. A 5-9/64-inch hole is necessary to expose the face of the instrument. Four stop nuts tapped for 6-32 screws are spaced around the edge of the indicator. See the outline drawing in figure 2-7 for mounting dimensions.

i. INDICATOR I-82-A (NAVIGATOR'S).—Mount Indicator I-82-A (Navigator's) so that the operator can see the entire bearing scale. Mount so that the operator can set up headings and magnetic variations by turning the "VAR." knob in one corner of the indicator. This indicator may be mounted on either the front or back of a panel. If the indicator is mounted behind a panel, a 3-1/64-inch hole will expose the face of the instrument, and a 3/8-inch hole in the corner will clear the "VAR." knob. Three clearance holes for a No. 8 screw are placed around the edge of the indicator. (See outline drawing in fig. 2-8 for mounting dimensions.)

j. TUNING SHAFT AND COUPLING MC-203-A.

Note

Coupling MC-203-A is used only in dual remote control installations.

(1) Run the tuning shaft in a straight line, avoiding as many bends as possible. Where bends are necessary, the radius of the bend should be as large as practicable and never less than six inches. The shaft must be held firmly in place to prevent movement and must be well bonded.

(2) Locate Coupling MC-203-A on a solid surface at some point between Radio Compass Unit ★R-5/ARN-7 and two Radio Control Boxes ★C-4/ARN-7.

(a) Mount Coupling MC-203-A with four No. 8 screws. (See fig. 2-9.)

(b) Connect a tuning shaft between the radio compass unit and the center fitting of the coupling.

(c) Connect a tuning shaft to each of the two end fittings on the coupling.

(d) Temporarily connect a tuning shaft into one Radio Control Box ★C-4/ARN-7 and rotate the tuning crank counterclockwise until the stop is reached. This stop indicates the maximum capacitance end of the tuning capacitor.

(e) Disconnect the tuning shaft from Radio Control Box ★C-4/ARN-7.

(f) Set the dials on each of the radio control boxes to the "ALIGN" mark which appears at the low frequency end of the 850-1750 kc band.

(g) Connect the tuning shafts to the radio control boxes.

k. RELAY BK-22-K.

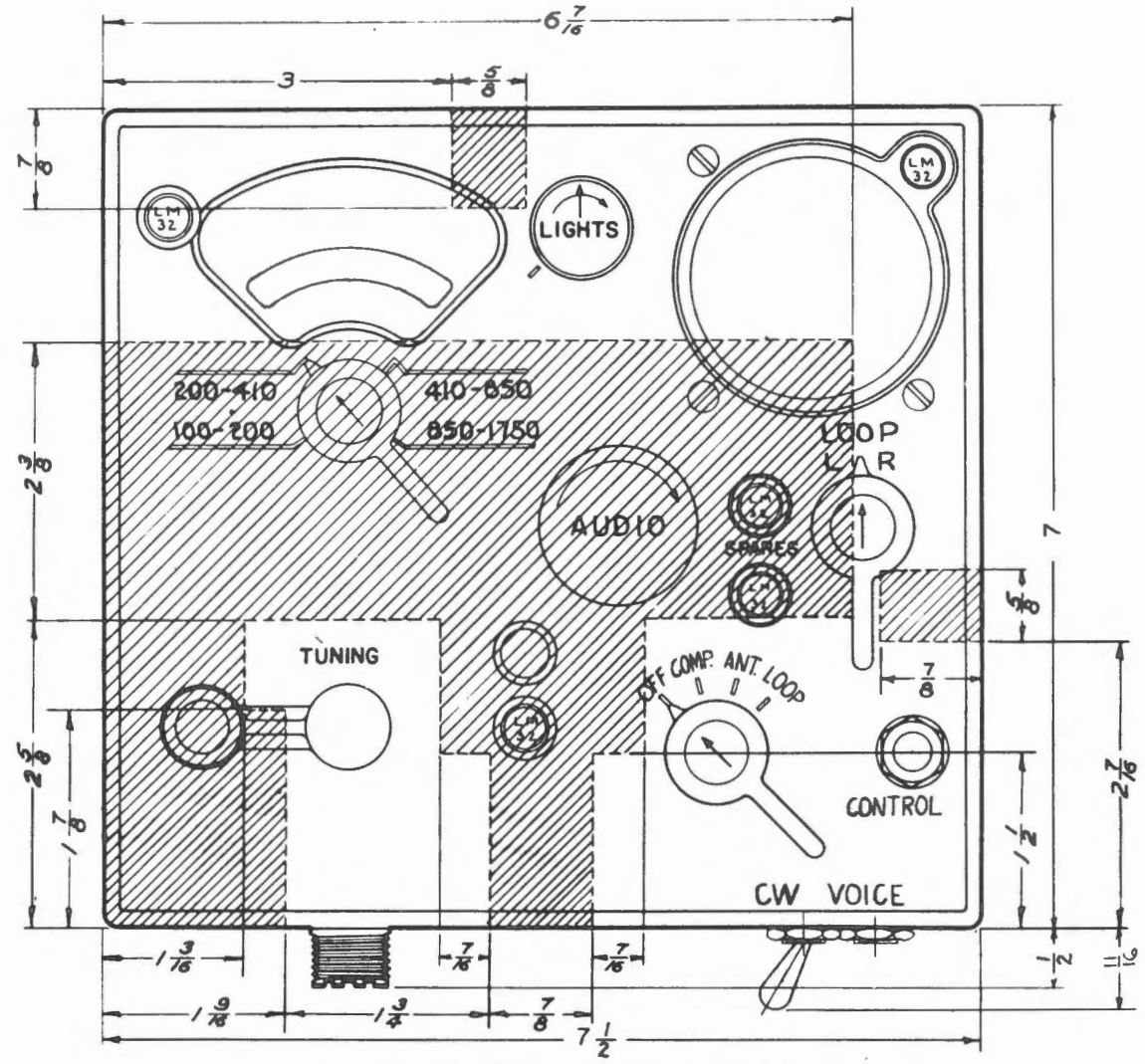
(1) Relay BK-22-K is provided with six mountings lugs by which the relay unit is to be securely fastened into the connector box in the aircraft wiring system. (See fig. 2-10.) It is accompanied by a bag of terminal lugs and nuts, a fuse block marked "20 AMP.", and a terminal bar or link. Locate Relay BK-22-K centrally in the connector box to allow clearance on all sides for wiring. Pull the mounting screws down evenly to avoid distorting the relay. Arrange the cables to the relay terminals and bind in place so that they enter the relay from one side. Without disconnecting any cable, remove the relay panel screws and fold the relay panel outward to expose the internal parts for inspection.

(2) Mounting is provided on the terminal panel for two Air Corps fuses (Specification No. 32271). The fuse block between terminals 49 and 50 is for the a-c supply fuse and is marked "115V A.C.-FUSE 3A." This fuse should be rated at 3 amperes.

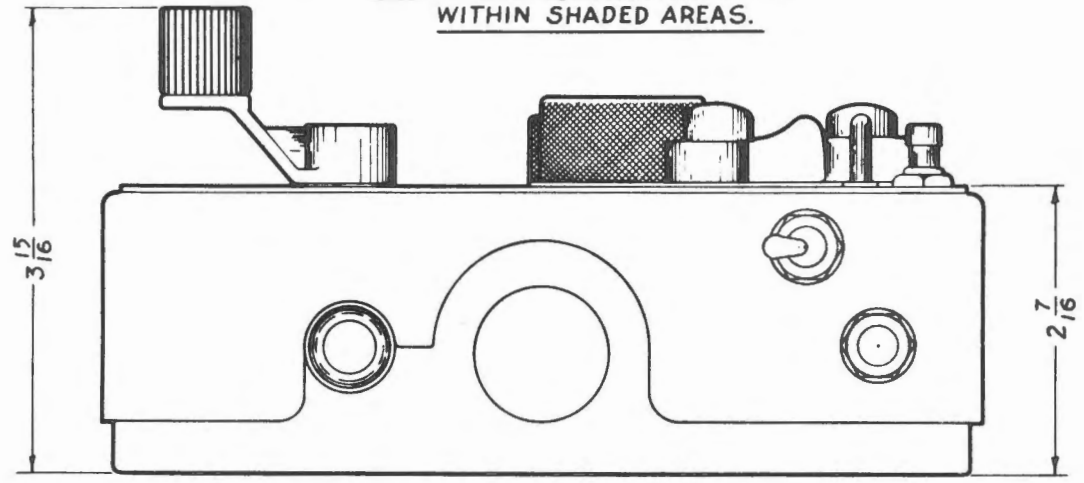
Note

Some relays are marked "FUSE 5A"; however, a 3-ampere fuse should be used.

(3) The other fuse block is between terminals 60 and 61 for the d-c supply fuse. Its rating varies according to the auxiliary equipment used. As normally delivered, Relay BK-22-K has a d-c fuse block in place is marked "2 AMP", and is connected for 24/28-volt installation. The following are the possible variations.



DO NOT DRILL MOUNTING HOLES WITHIN SHADED AREAS.



TOTAL WEIGHT 4.12 LBS.

ALL DIMENSIONS IN INCHES

*Figure 2-6. Radio Control Box *C-4/ARN-7—Outline Drawing*

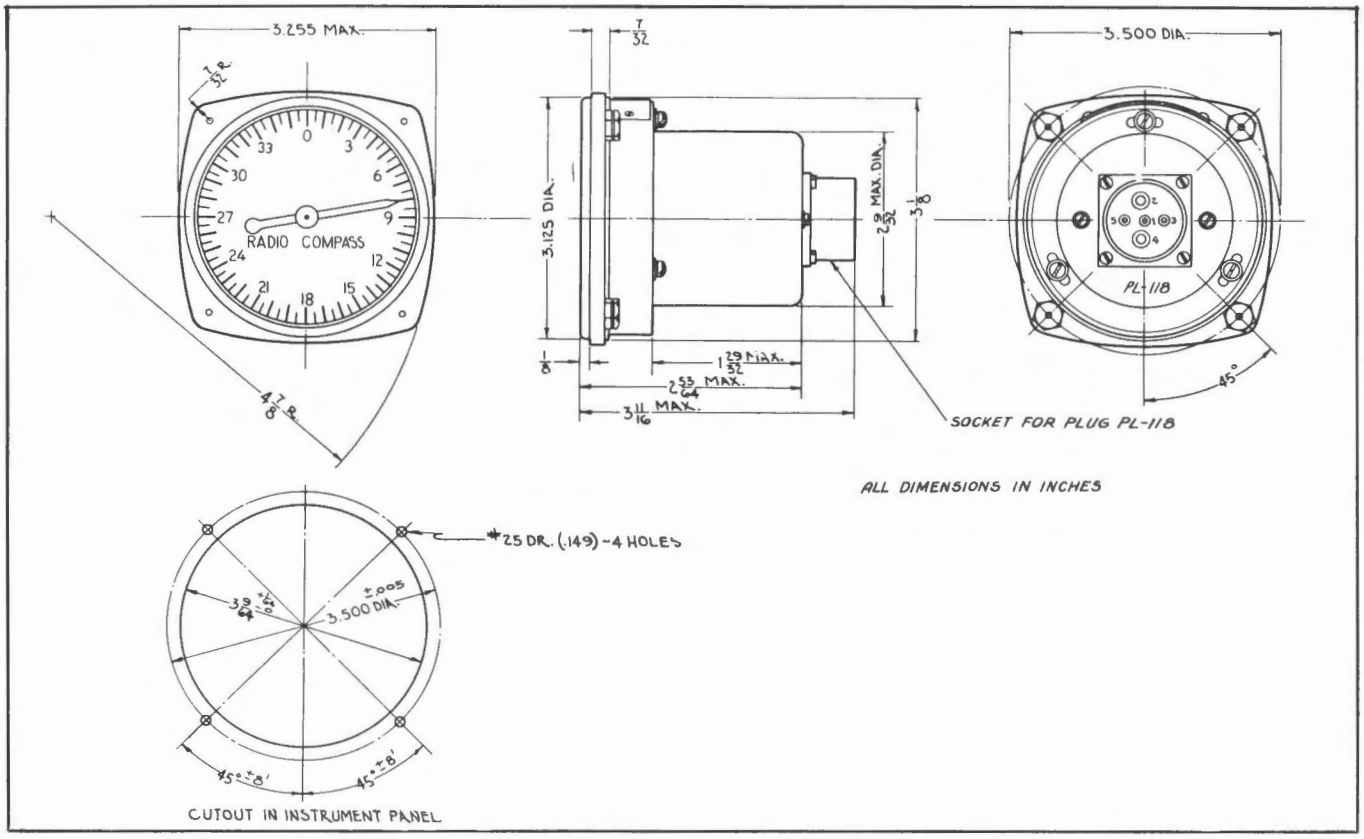


Figure 2-7. Indicator I-81-A—Outline Drawing

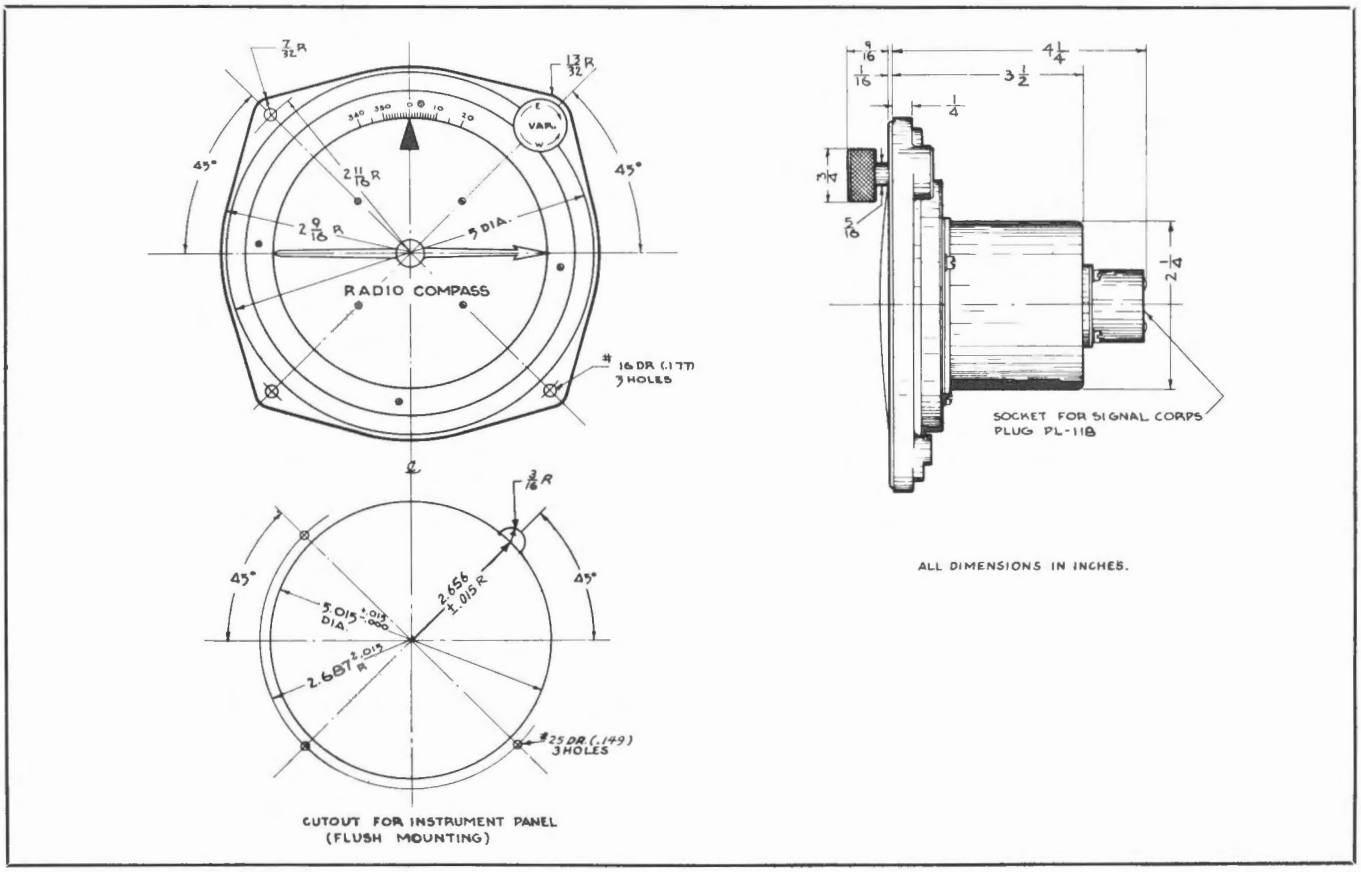


Figure 2-8. Indicator I-82-A—Outline Drawing

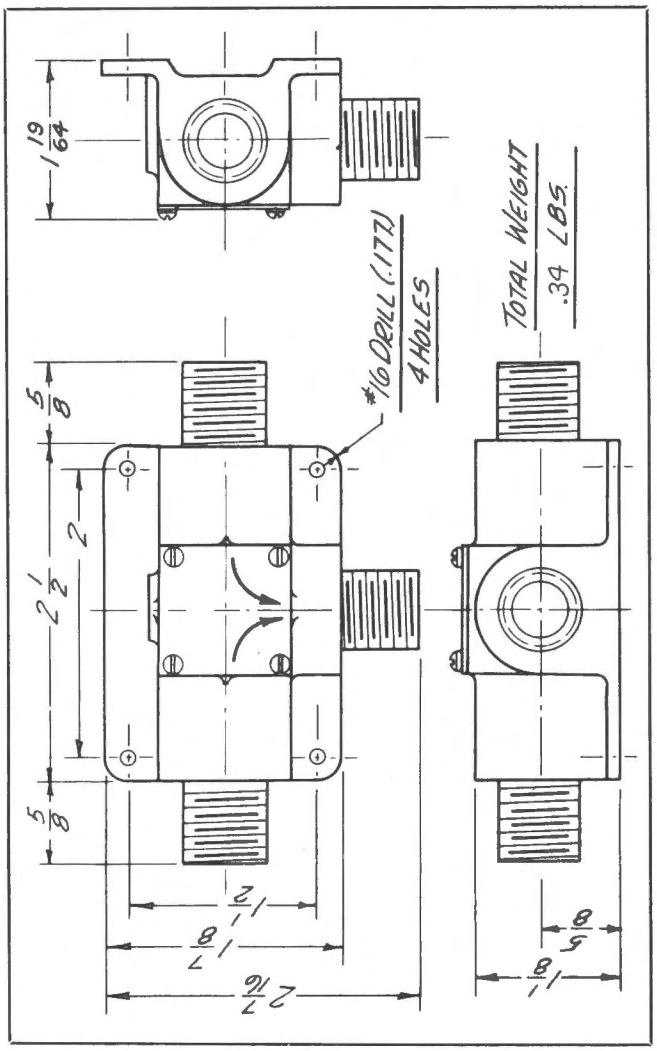


Figure 2-9. Coupling MC-203-A—Outline Drawing

(a) When the relay is used to control the inverter input power, replace the 2-ampere d-c fuse with a solid bar jumper and insert a separate fuse block in the circuit external to Relay BK-22-K. This block should accommodate a fuse meeting the requirements of Air Corps Specifications No. 32084-C.

(b) In 24/28-volt installation when Radio Compass ★AN/ARN-7 is used with inverter unit, install the fuse block marked "20 AMP."

(c) In 12/14-volt installations when Radio Compass ★AN/ARN-7 is used with Inverter Unit PE-109-D, replace the fuse block marked "2 AMP." or "20 AMP." (whichever may be in place) with a solid bar jumper. Then insert a separate fuse block with a 50-ampere fuse in the circuit external to Relay BK-22-K.

(d) To operate the power on-off relay RE8 at 12/14 volts, connect the link contained in the bag between terminals 59 and 60.

2. CABLE CONNECTIONS.

(See figure 2-11.)

a. The equipment and cables must not interfere with the airplane controls or with other instruments or equipment.

b. Fasten the open-wiring cables and the flexible tuning shafts securely in place where necessary to prevent rubbing or vibration. The cables connected to Radio Compass Unit ★R-5/ARN-7 should be unsupported for a distance of 2 feet from the unit and should have enough slack so that they will not interfere with the action of the shockmounting.

c. Cord CD-365, CD-365-A, CD-365-B, CG-42/ARN or CG-95/ARN, (use the one most convenient for the installation) connects Radio Compass Units ★R-5/ARN-7 to the loop. *Do not change the length of this cord.* If it is too long, coil the extra length wherever convenient. If it is too short, request a longer cord through the proper channels. (See fig. 2-11.)

3. LOOP POLARITY CONNECTIONS.

Unless connections are made in accordance with the table III, on figure 6-4, the navigator's bearings will be wrong if both the loop and non-directional antenna are mounted on the bottom of the aircraft, or if the loop and non-directional antenna are mounted on opposite sides (top and bottom) of the aircraft. The proper connections for any loop and non-directional antenna installation are shown in the charts.

Note

When installing this equipment, keep the antenna lead-in well separated from the operating cables. Also avoid running the antenna lead-in parallel to the operating cables. Failure to do so may result in a great deal of background noise.

4. PLUGS AND WIRING.

Plugs and wiring should be installed according to instructions for the particular aircraft. Refer to the "*Handbook of Instructions for Airplane Designers*" and to the installation drawings. To prevent the ferrule from rubbing the insulation, the wires should be bundled and taped or wrapped with cord for about 2 inches back from the plug. Solder the wires to the plug terminals as follows:

a. Disassemble the plug by removing the spring retainer ring, and withdrawing the plug body from the shell. Remove the slotted bakelite disc, and withdraw the terminals from the plug body.

b. Remove the insulation from the individual wires for a distance of 3/8-inch and tin the ends of the wires.

c. Run all wires through the metal shell of the plug.

d. Slip a 3/8-inch length of a spaghetti tubing on each wire, but leave the tinned ends clear.

e. Being careful not to spill solder into the pin receptacle, tin the cups of the terminals.

f. Solder the terminals to the wire. Use sufficient solder to fill the cups. Test each terminal to be sure that the joint is secure.

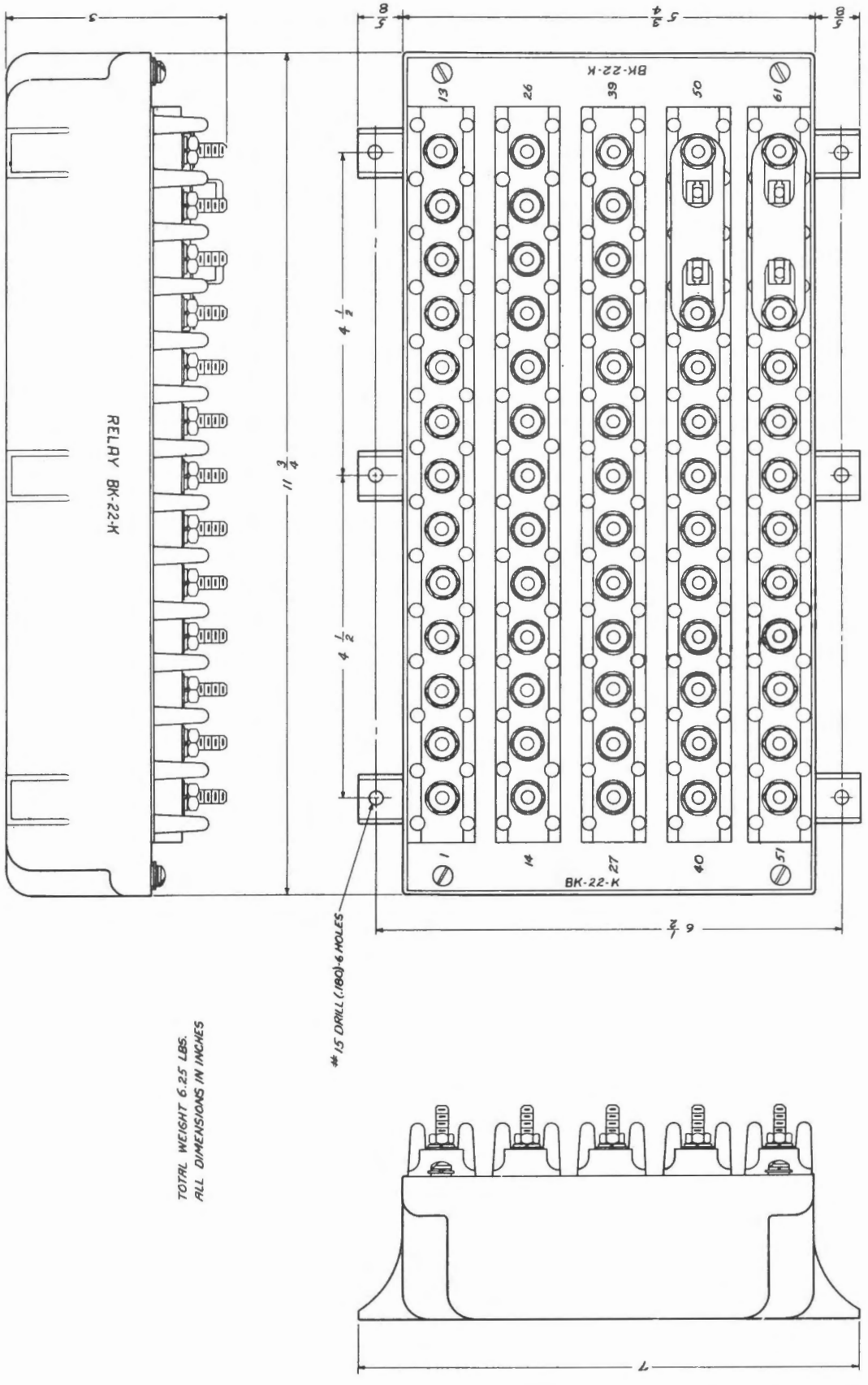


Figure 2-10. Relay BK-22-K—Outline Drawing

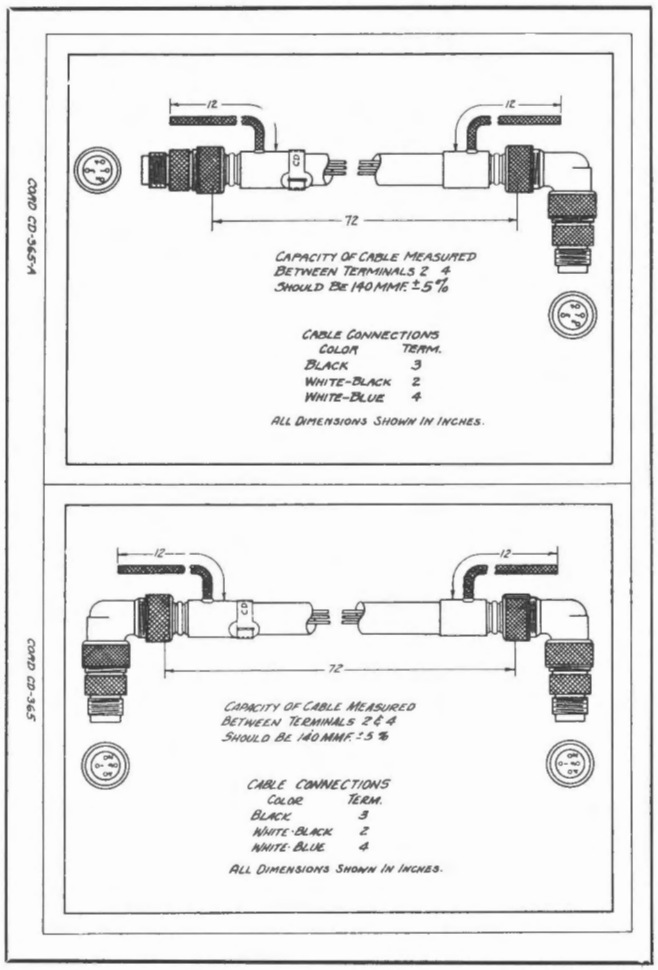


Figure 2-11. Cord CD-365 and CD-365-A—Outline Drawing

g. Make sure that each terminal is in its proper place in the plug body and that the spaghetti tubing is pushed down over the soldered joint. Replace the slotted bakelite disc.

h. Reassemble the plug body in the metal shell and replace the spring retainer ring. The plug retaining ring should fit snugly around the groove in the plug shell. If the ring is bent away from the groove, the socket pins may be grounded.

5. HOOKUP WITH OTHER EQUIPMENTS.

a. MARKER BEACON RECEIVING EQUIPMENT.—Provision has been made to supply 14/28 and 220 volts direct current for operation of the marker beacon receiving equipment.

(1) In dual remote control installations, make the low voltage connection between terminals 57 and 24, or 25, or 26 of the plane's connector panel. Make the high voltage connection between terminals 2 and 25 of the connector panel of Relay BK-22-K. *(See figure 6-5.)*

(2) In single remote control installations, make the low voltage connection to terminals 28 and 20 or 21, or 22 of the plane's connector panel; and make the high voltage connection to terminals 2 and 20 and to 21 and 22 of the connector panel. (See fig. 6-6.)

b. INTERPHONE.—Removal of the headset plug at the control box having control connects the input of the interphone to the audio output of the radio compass. Then the interphone volume is controlled by means of the "AUDIO" knob at the controlling radio control box.

Note

Radio Compass Unit ★R-5/ARN-7 is designed with an output impedance of 300 ohms or 4000 ohms. The compasses are shipped from the factory connected for 4000 ohms output impedance. If it is desired to change to 300 ohms, it is necessary to remove the yellow lead from terminal 5 of the output transformer 610 and connect it to terminal 4.

(1) For high impedance interphone connection, connect the audio output of Radio Compass ★AN/ARN-7 to the input of the interphone at the connector panel on Relay BK-22-K between terminal 16 and ground terminal 25. For single remote control installations, make the connections between terminals 22 and 3 of the connector panel.

(2) For low impedance interphone system, disconnect the yellow lead from terminal 5 of output transformer 610 in Radio Compass Unit ★R-5/ARN-7 and connect it to terminal 4 of the same transformer. Interphone connections are made to the same terminals of Relay BK-22-K or the connector panel as given in paragraph 1 *g.* (1) *(a)* this section for high impedance connections.

c. SEPARATE INVERTER POWER SUPPLY.—The inverter input power is controlled by Relay BK-22-K in dual installations. In case of single control installations, it is controlled by Relay SW-172-A or SW-182-A. The rated input voltage of the inverter must be the same as the d-c supply voltage available from the electrical system of the aircraft.

For airplanes using 24/28-volt d-c supply, use a 250 VA inverter in accordance with Air Corps Specifica tions No. 23370. When this inverter is used, the size of the d-c supply fuse should be 20 amperes. The equipment may also be used with an inverter having the same output rating but requiring 12/14-volt d-c input, such as Inverter Unit PE-109-D. In this case, short-circuit the fuse clips on the terminal panel, and attach a 50-ampere fuse externally to the d-c supply circuit. Larger or other inverter units require a means of closing the external circuit.

d. RECTIFIER UNIT RA-59-A.—The control relays and band switch mechanism of Radio Compass ★AN/ARN-7 are designed for operation from a 24/28-volt d-c source. Therefore, in 12/14-volt installations, Rectifier Unit RA-59-A must be used to provide the additional voltage.

(1) In 12/14-volt installations with dual remote control:

(a) Remove the jumper between terminals 27 and 57 of the connector panel of Relay BK-22-K.

(b) Connect terminals "C" and "D" (d-c output) of Rectifier Unit RA-59-A to terminals 27 and 57 respectively.

(c) Connect terminals "A" and "B" (a-c input) of Rectifier Unit RA-59-A to terminals 30 and 29 respectively of the connector panel.

6. SINGLE REMOTE CONTROL INSTALLATIONS.

a. Refer to section I, paragraph 2 for list of components required.

b. Figures 6-4 and 6-6 are typical wiring diagrams of the single remote control installation.

c. Connect tuning shaft between Radio Compass Unit ★R-5/ARN-7 and Control Box ★C-5/ARN-7.

d. Since Relay BK-22-K is not used in single remote control installations, the terminal board and power on-off relay will not be available. Therefore, provide the required number of terminals in a connector panel and a power on-off relay. Relay SW-182-A or SW-172-A will do.

e. Relay SW-182-A is for installations where the d-c supply is 12 volts, and Relay SW-172-A is for the 24-volt d-c supply.

f. Fuses are required and are normally mounted near the connector panel.

7. TEST AND ADJUSTMENTS.

a. INITIAL CHECKS.

(1) Before turning on Radio Compass ★AN/-ARN-7, check as follows:

(a) Check the battery voltage and polarity from terminal 61 on the terminal panel of Relay BK-22-K to ground. For single control installations, check from terminal 34 on the connector panel to ground.

(b) If an inverter is used, see that its rated input voltage is the same as the available supply voltage. Be sure that the proper fuse is in place, as outlined in paragraph 1c (9), this section. If the supply voltage is 12/14 volts, install the connecting link between terminal 59 and terminal 60. Then remove the jumper from terminals 27 to 57 and install Rectifier Unit RA-59-A. If the supply voltage is 24/28 volts, the link and Rectifier Unit RA-59-A are not used.

(c) In single remote control, see that Relay SW-182-A is used for 12-volt installations and Relay SW-172-A in 24-volt installations. In 12-volt installations, remove the jumper between terminals 26 and 28 and see that Rectifier Unit RA-59-A is installed.

(2) Check the vacuum tubes to make sure that they are securely seated in their sockets. See that the grid clips and grid shields are making positive contact and are not shorting.

(3) Inspect the loop to see that it is securely and properly mounted.

(a) Lock and waterproof the mounting screws with Permatex No. 1 sealing compound or its equal.

(b) Check the loop housing and base casting for damage or cracks which may weaken it or admit moisture. A well-sealed loop structure is essential for efficient dehydrator action and operation of the compass.

(c) Be sure that index lines on the fore-and-aft edges of the mounting plate are exactly in line with the fore-and-aft axis of the aircraft.

(d) See that the hose connecting the dehydrator to the loop assembly is not bent so sharply that it keeps the air from passing freely between these two units or forms a trap in which moisture may accumulate.

(e) See that the silica gel is a deep blue color indicating that it is activated and ready for service.

(f) Remove the plug and tape from the end of the short piece of hose at the open end of the dehydrator. This is necessary to assure that any air breathed into the loop will flow through the dehydrator.

(4) Test the operation of the tuning shaft and Coupling MC-203-A and inspect the connections at both radio control boxes. The "ALIGN" mark on both radio control boxes should coincide and line up with the dial index when the stop is reached.

(5) Check the base screws of Mounting FT-213-A and the Dzus fasteners which hold Radio Compass Unit ★R-5/ARN-7 to the mounting.

(6) See that Radio Control Box ★C-4/ARN-7 is securely mounted to the aircraft structure. Check the mounting screws on the panel for tightness.

(7) Be sure that Cord CD-365, CD-365-A, CD-365-B, or CG-42/ARN is secure. The ground braids at each end of the cord should be bonded to the aircraft structure. Check the tightness of Plugs PL-108 and the ferrule couplings on the plugs.

(8) Check the operation of the instrument lights and light controls.

b. OPERATIONAL CHECKS.

(1) Set the function switch to "COMP.", "ANT.", or "LOOP" position.

(2) Turn the set on by pushing the "CONTROL" switch.

(3) Using the proper headsets, check the "ANT." and "LOOP" operation on all four bands. Check compass operation and indicator response. Jar Radio Compass Unit ★R-5/ARN-7 to check possible sources of noise.

(4) Switch the complete equipment on and off by repeated operation of the "CONTROL" and "OFF" switches; note whether or not the magnetic compass is affected.

(5) Check for effects of other radio equipment in the aircraft upon the communicational and navigational performance of Radio Compass ★AN/ARN-7. Also, determine the extent of any interference produced by the radio compass in the other radio equipment.

(6) Tune the radio compass to a transmitting station, and operate on the "COMP.", "ANT.", and "LOOP" positions. Observe that the tuning meters and bearing indicators are working properly.

(7) Switch to the "LOOP" position and tune to several transmitting stations to see that the sensitivity is satisfactory.

(a) Operate the "AUDIO" control to see that it properly controls the headset volume.

(b) Check the operation of the "LOOP L-R" switch. When it is in the "R" position, the bearing indicator pointers should rotate clockwise at a speed of about 10 degrees per second; when it is in the "L" position, the bearing indicator pointers should rotate counterclockwise at about the same speed. Similarly, if this switch is first pushed inward toward the panel and then turned to "R" and "L", the bearing indicator pointers should rotate clockwise and counterclockwise, respectively, at a rate of 30-40 degrees per second.

(c) When checking reception of transmitting station, rotate the loop by means of the "LOOP L-R" switch for maximum headset volume. On a clear day in a place free from electrical disturbances, it should be possible to receive clearly radio range signals 50 to 100 miles away, and broadcast signals 100 to 250 miles away, depending upon station power and external interference.

(7) Switch to the "COMP." position and swing the heading of the aircraft so that it is exactly pointing toward a transmitting station. Use very accurate means to determine this heading. Tune Radio Compass ★AN/ARN-7 to this transmitting station. The indicator pointer should swing to the zero index within ± 2 degrees. The accuracy of this zero heading bearing will depend upon:

(a) The accuracy with which the fore-and-aft line of the aircraft was aligned with the line of direction of the transmitting station.

(b) The accuracy with which the loop mounting base was aligned with the fore-and-aft line of the aircraft.

(c) The amount of distortion in the direction of arrival of the radio waves. This distortion is caused by unsymmetrical location of the loop in relation to the metal mass of the aircraft and location of other unsymmetrical antennas or masts.

(d) The error in radio compass equipment. This error does not exceed ± 1 degree under normal conditions at zero heading. An error in indicated zero heading of not over ± 5 degrees will not be serious if this error can be definitely shown to be caused by paragraph *(c)* preceding. In these circumstances, this error results from the particular aircraft installation and can be corrected when the radio compass deviation correction is applied to the compensator. (See pars. 2*b* (5) and 2*b* (6), this section. If the bearing indicator pointer swings to 180 degrees instead of 0 degrees, the sensing is not correct. It can be corrected by connecting components properly. Correct connections are given on figure 6-4.

(8) Swing the heading of the aircraft approximately 15 degrees to the right of the line of direction of the transmitting station. The bearing indicator pointer should swing immediately to an azimuth reading of about 345 degrees. An azimuth reading of 15 degrees instead of 345 degrees indicates improper interconnection of the components for the location of the loop in this installation. Instructions for proper connections for top or bottom mountings are given on figure 6-4.

(9) Swing the heading of the aircraft toward the transmitting station again. Switch to "LOOP" position and rotate the loop for an amizuth reading of 175 degrees as indicated by the indicator pointer. Switch to the "COMP." position, the pointer should return to the zero reading at a rate of 35 to 40 degrees per second when the a-c supply voltage is 115 volts. When the pointer arrives at zero, the overshoot should not exceed two degrees under any condition and will usually be less than one degree. The amount of hunting of the indicator needle may be controlled by means of the screwdriver adjustments which are marked "AUTO. SENS." on the panel of Radio Compass Unit ★R-5/ARN-7. Adjust this automatic sensitivity control to obtain the desired amount of hunting, but maintain enough sensitivity so that if the loop is rotated one degree from its bearing postion, the automatic control will return it to within 0.5 degree of its bearing position. This sensitivity can be checked as follows:

(a) Switch to "COMP." position with the radio compass still tuned to the radio transmitting station.

(b) Note the azimuth reading of the bearing indicator pointer.

(c) Switch to "LOOP" position and rotate the loop so that the indicator pointer is one degree from the reading taken in *(b)* above.

(d) Switch to "COMP." position and again note the azimuth reading of the bearing indicator pointer. This reading should be within 0.5 degree of that noted in *(b)* above.

(10) With the "AUDIO" control fully clockwise, tune through each band with the engines stopped and note the noise level. Repeat the test with the engines running at various speeds. If any appreciable increase in noise is noted with the engines running at any speed, improve the aircraft shielding and bonding and the battery circuit filtering.

(11) Switch the "CW-VOICE" switch to "CW" and tune in several stations. Each station when tuned in should give a good strong audio indication. If a strong audio indication is not obtained, check the operation of relay RE12.

c. COMPASS SENSITIVITY ADJUSTMENT.—The "AUTO SENS." control, located on the front panel of Radio Compass Unit ★R-5/ARN-7, controls the sensitivity of the loop control circuits to small changes in

bearing and adjusts the hunting (residual oscillation) of the loop and bearing indicators to desired value. The adjustment procedure is as follows:

(1) Set the function switch to the "COMP." position. The "AUDIO" control may be at any position.

(2) Tune in a transmitter between 10 and 50 miles away, and allow time for the loop to reach the null.

(3) After rotating the control cover-plate to a vertical position, adjust control to obtain the desired amount of hunting of the indicator pointer about the indicated bearing position. However, maintain enough sensitivity so that, if the loop is rotated one degree from its bearing position, the automatic control circuits will restore it to within 0.5 degree of the original bearing position. Check this sensitivity as follows:

(a) Switch to "COMP." with the radio compass tuned to a suitable transmitter;

(b) Note the azimuth reading of the bearing indicator pointer;

(c) Switch to "LOOP", and rotate the loop so that the indicator pointer is one degree from the reading taken in 2 above;

(d) Switch to "COMP." and again note the azimuth reading of the bearing indicator pointer. This reading must be within 0.5 degree of that noted in 2 above.

d. ACCURACY OF BEARING.—Radio Compass ★AN/ARN-7 is designed so that its bearing indications are accurate to within ± 2.5 degrees. To gain the full advantage of this bearing accuracy, be certain that the loop base is exactly aligned with the fore-and-aft line of aircraft.

e. RADIO COMPASS DEVIATION CALIBRATION.—Check the direction of radio bearings every 15 degrees from the fore-and-aft axis of the aircraft. In this way, it is possible to determine and compensate for deviations caused by distortion of the radio field pattern due to wings, engines, propellers, antennas, and other parts of the aircraft. When the loop is on top of the airplane, the calibration may be done on the ground. (See par. 1b, this section.) When the loop is beneath the fuselage, accurate calibration must be made during a flight. Ground methods will not be discussed in detail because they require more time and more personnel, and because a flight check is still necessary. Using Indicator I-82-A (Navigator's) for all radio bearings, obtain calibration data in flight by the following method:

(1) Make the test when the wind is less than eight miles an hour and the air is smooth, to avoid excessive drift angles and errors in reading the bearing angles. Do not make the calibration within one hour of sunrise or sunset, or when bearings fluctuate widely.

(2) Choose a medium or high powered radio station between 25 and 100 miles away from the locality where the test is to be made. This radio station should not be in a congested channel or near other high powered channel signals which could, by slight mistuning, cause bearing errors. The station also should normally provide good bearings with little or no fluctuation of the indicator pointer.

(3 Use the "VAR" knob on Indicator I-82-A (Navigator's) and set the azimuth scale zero to the index.

(4) Select a landmark or several landmarks (such as a road, railroad tracks, or section lines) which provide a direct line toward the radio station. Since power lines or railroads near the landmark can distort the radio path, find out whether or not distortion is present. Check the distortion by crossing the reference line at various angles while maintaining fixed courses by means of the directional gyro. If the bearing changes rapidly as the line is approached, distortion is present. Avoid this distortion by flying higher or by finding a new landmark.

(5) With the plane in level flight, fly along this reference line at an altitude low enough to avoid parallax error. If the airplane has a drift meter, use it to make sure that the direction of flight is parallel to or directly over the reference line. This maneuver is shown in figure 2-12 as well as those discussed in the following paragraphs. In practice, it is best to have the co-pilot use figure 2-12 to direct the pilot and to check the location of the airplane at all times with respect to the flight pattern shown.

(a) Set the directional gyro to zero.

(b) When passing over some predetermined point or line intersecting the reference, record both the bearing on Indicator I-82-A (Navigator's) and the reading on the derectional gyro.

(c) Also record the drift meter reading if a drift meter is being used.

(d) These readings should be zero if the previous setting and the line of flight have been maintained.

(6) Turn the aircraft to the left and then swing back to the right, crossing the reference line at an angle of 15 degrees by the directional gyro. The pilot should be instructed to swing far enough out on these maneuvers to regain level flight some distance before the reference line is reached. Make readings only during conditions of level flight. Have the pilot inform the radio compass operator at the instant the airplane crosses the reference line. Record the radio compass bearing for that instant in the third column of figure 2-13. Greater accuracy can be obtained by using a drift meter since the drift meter observer can determine the exact heading of the aircraft in relation to the reference.

(7) Repeat the above procedure throughout step I of figure 2-12, recording the data in the third column of figure 2-13. Then return on the reference line as shown in step II. Reset the directional gyro each time a new step is begun.

(8) Repeat the above procedure until the entire flight pattern of figure 2-12 has been flown.

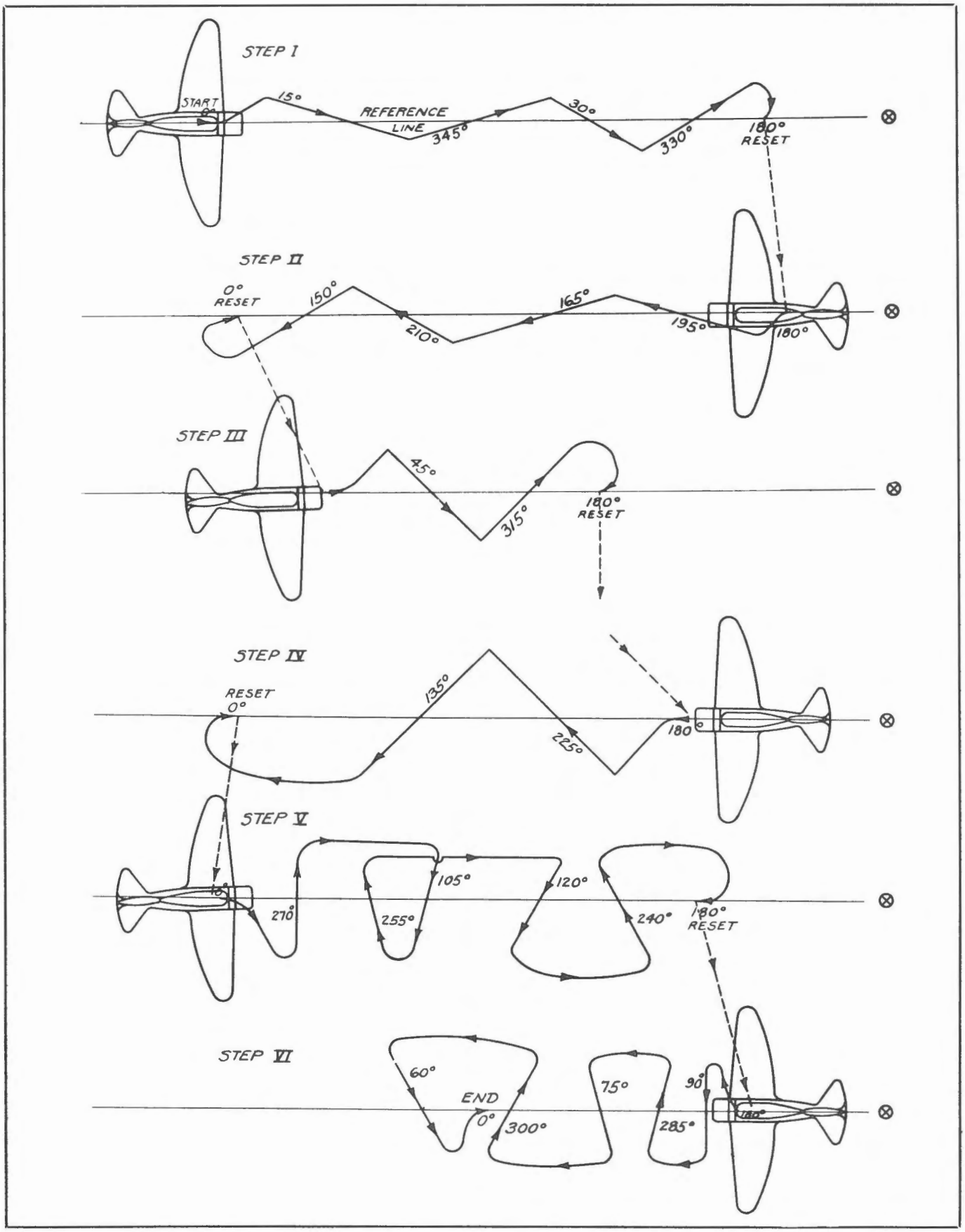


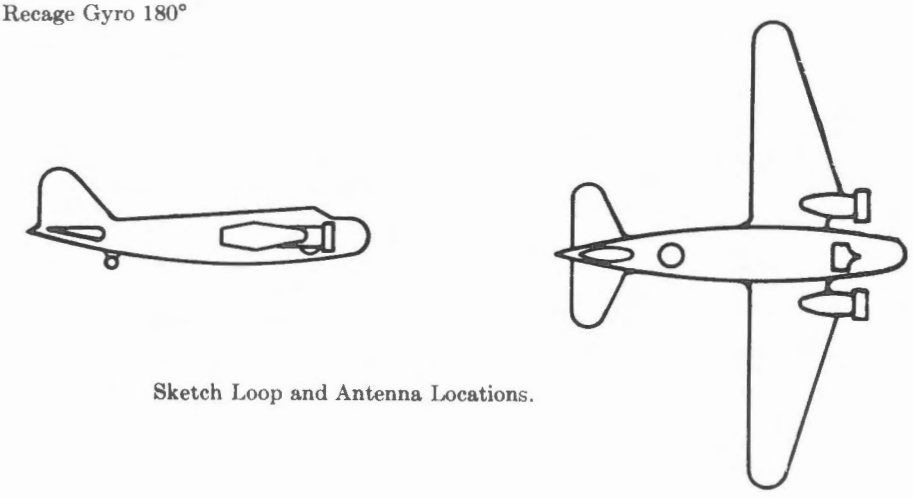
Figure 2-12. Procedure for Obtaining Radio Compass Deviation Data in Flight

NOTE: Head toward station over predetermined point on reference line, steady, set GYRO on 0° and check zero bearing.

Station Used _____
Frequency _____
Plane No. _____
Pilot _____
Recorder _____

	Flight Test Data for Curve			Compensator MC-217 Adjustment Data	
	Column # 1	Column # 2	Column # 3	Column # 4	Column # 5
	Gyro Bearing	Plane to Radio Station Bearing	Indicated Bearing	Compensator Inner Scale Zero Bearing	Compensator Pointer Bearing
*	0	0	0	0	0
	15	345		15	
	345	15		345	
	30	330		30	
	330	30		330	
**	180	180		45	
	195	165		315	
	165	195		60	
	210	150		300	
	150	210		75	
*	45	315		285	
	315	45		90	
**	225	135		270	
	135	225		105	
	270	90		255	
	105	255		120	
	255	105		240	
	120	240		135	
	240	120		225	
**	90	270		150	
	285	75		210	
	75	285		165	
	300	60		195	
	60	300		180	

NOTE: This form to be used in conjunction with "Radio Compass Deviation Calibration Curve."
* Cage Gyro 0°
** Recage Gyro 180°



Sketch Loop and Antenna Locations.

Figure 2-13. Radio Compass Deviation Calibration Data

If the loop is belly mounted and fastened to a primary structural member, any landing with wheels retracted may damage the aircraft beyond repair. Areas affecting safety in flight operation of the aircraft, and maintenance should not be obstructed by the loop and associated equipment. The loop should be mounted so that it will be level in normal flight.

Note

Do not remove the loop housing to install the loop. This housing has been carefully sealed at the factory to prevent entrance of moisture which may damage the loop mechanism.

(2) INSTALLATION. *(See figure 6-2.)*

(a) Make holes in the skin of the aircraft to permit passage of the two cables with their plugs which leads to the two sockets on the loop base and for the right-angle fitting which provides connection to the dehydrator.

(b) Allow sufficient clearance inside the fuselage to attach and remove the loop cable, the junction box cable, and the hose connection to the dehydrator.

(c) Use a velutex or similar gasket between the loop mounting base and the aircraft to make a watertight seal in order to prevent water, oil, or dirt from entering the fuselage.

(d) In locating the mounting holes to match the eight holes in the base, the fore-and-aft holes must be exactly in line (or within ± .25 degree) with the center line of the fuselage. Reference lines are scribed on the edge of the loop mounting base to assist in this alignment when mounting the loop.

(e) For belly-mounted loops, it may be necessary to build a small diversion dike or enclosure, about 1-1/2 inches high, around the loop connections on the interior of the airplane. This enclosure prevents any oil, water, grease, or hydraulic fluid which may accumulate in the belly of the airplane, from damaging cable connections to the loop or entering the loop base.

(3) AZIMUTH SCALE.

(a) The azimuth scale used on the compensator is different for top mounting and for belly mounting. For a top mounting, the scale on the compensator supplied with each loop is in black characters, while the scale used for belly mounting has red characters. The scale for use with a belly-mounted loop is furnished as an extra part which may be installed, if required, at the time that the compensator is removed to apply the radio compass deviation correction.

(b) Assemble Plug PL-108, Plug PL-112 and the dehydrator fitting into their respective receptacles provided on the bottom of the loop base.

d. LOOP LP-31-A OR LP-31-AM.—Loop LP-31-A or LP-31-AM is designed for use in pressurized-cabin aircraft and is intended to be mounted within a plastic blister which is a part of the aircraft structure. Since installation detail is very closely allied to the structure of the particular aircraft, only the following precautions apply to any installation. (See fig. 6-3 for outline drawing.)

Note

Loop LP-31-A or LP-31-AM is shipped with a wooden cradle bolted to the mounting plate. This cradle is made with a slotted block which engages the loop to prevent damage to the loop-drive mechanism as a result of lifting or carrying the loop assembly by the loop winding. *Leave this cradle on Loop LP-31-A or LP-31-AM until the loop is mounted.*

(1) Mount the loop so that it is level during normal flight.

(2) Align the loop so that the lubber lines scribed on the mounting plate coincide exactly (±0.25 degree maximum deviation) with the center line of the fuselage.

(3) Mount the loop so that the drain plug in the plastic cover plate is aft.

(4) Seal the mounting plates to the fuselage. Be sure that the gasket and sealing compound will withstand a 7.5-pound pressure differential. Also, the seal between the housing casting and the plastic cover plate must withstand this pressure. See that this sealing is adequate after replacement of the compensator assembly and cover plate following the adjustment for deviation compensation.

e. LOOP DEHYDRATOR.—Place the dehydrator where it can be visually inspected and easily replaced, and so that it will be as near the loop as is convenient. Its mounting position must not be horizontal, for the breather end (open end) must be lower than the hose connection so that liquids cannot gather in the dehydrator and escape into the loop. Take care that the connecting hose does not form a trap for condensed moisture.

(1) Mount the two clips with No. 6 screws through the two mounting holes provided on each clip. (See fig. 6-2.)

(2) Mount the unit and be sure there is no play between the mounting clips and the end caps of the dehydrator.

(3) Cut the 5/16"—ID vinylite hose to the proper length, and slip two hose clamps on the hose.

(4) Coat the threads on the hose elbow with Valvlube or other sealing compound. Thread the elbow into the mounting plate so that the threads are entirely engaged. Turn the elbow in the direction of the approaching hose and tighten the elbow jam nut.

(5) Coat the scarfed section of the elbow with sealing compound. Slip the hose from the dehydrator on this scarfed section.

(6) Slip the hose clamp over the hose on the elbow and tighten.

(7) Remove the hose connector coupling from the dehyrator and coat the threads of the nut with sealing compound.

(9) During the above procedure, take care to avoid parallax in reading the instruments. Set the directional gyro accurately. Make one or two check runs to obtain the best accuracy.

(10) Calibration data obtained for a particular type of airplane can be used without change for all airplanes of that type when the location of the loop and other antennas is the same. Since all airplanes of the same type may not have the same radio installations, an accurate diagram showing antenna dimensions and the exact location of the loop will add to the usefulness of the recorded data. (See figure 2-3.)

Note

Since radio compass deviation changes some with frequency, take calibration data at several frequencies to insure greatest accuracy in use. The readings used to set up the compensator should be obtained at some frequency between 200 and 800 kilocycles. In that frequency range the radio wave characteristics are best suited to Radio Compass ★AN/ARN-7. Under service conditions, and with the compensator unit properly adjusted, the over-all radio compass deviations should not exceed three degrees except at points of large rate of change of error between 15-degree rhumb lines or sectors.

f. ADJUSTMENT OF COMPENSATOR IN LOOP. —After the radio compass deviation is determined according to paragraph 2b (5), this section, compensate for it on the compensator on the loop assembly. Then correct bearings may be read directly from the bearing pointers of Indicators I-81-A and I-82-A. It is possible to make the compensating correction by direct reference to the observed data; but because of the compensator design, it is better to plot the data and interpolate from the resulting curve. Correction values are applied at each adjusting screw when the cam roller is aligned with the screw. To determine the correct data:

(1) Turn to figure 2-13. Plot the indicated bearings from column 3 against the corresponding plane-to-radio-station bearings of column 2. Use the chart of figure 2-14. (See figs. 2-3 and 2-15 for examples.)

(a) Lay a straight edge parallel to the dotted line (see note 1, fig. 2-15). Through the chosen point of column 3, draw a fine line. The point at which this line intersects the solid 15-degree line (column 2) is the plot point. For a true bearing of 15 degrees (column 2), for example, the indicated bearing is seven degrees (column 3).

(b) Lay the straight edge parallel to the dotted line through the 17-degree vertical graduation, and draw a fine line. This fine line intersects the solid line which passes through the 15-degree graduation. This intersection is one point on the deviation curve.

(c) Repeat *(a)* and *(b)* for each of the twenty-four 15-degree positions.

(d) Draw a smooth curve through the plotted points to form the deviation curve.

Note

Do not try to apply corrections of more than ±20 degrees on the compensator. The correction curve should be smooth and essentially sinusoidal. If there are sharp discontinuities in the curve, or if the rate of change of correction exceeds 12 degrees in 15 degrees of azimuth, find and remove the cause of these errors, since such errors cannot be corrected by the compensator. Unsymmetrical antenna structures on the aircraft usually cause these errors. After correcting them, rerun the radio compass deviation calibration. If antennas or the aircraft structure are changed in any way after the calibration test, also rerun the calibration. The indicated bearings are listed in column 4, figure 2-13, in proper order for adjusting Compensator MC-217 or Compensator Assembly MC-507. Adjustment of the compensator must progress both clockwise and counterclockwise from zero; use the data that apply to each position. This type of adjustment is necessary because the cam strip is anchored at zero and the open ends are 180 degrees from the zero position.

(2) Determine the values for column 5 from the deviation curve.

(a) Draw fine lines (see note 3, fig. 2-15) parallel to the solid lines between the intersections (see note 2, fig. 2-15) of the plotted deviation curve and the dotted lines to the vertical graduations.

(b) In column 5, record the values for the points of intersection (see note 4, fig. 2-15) as read on the vertical graduations beside the 15-degree dotted line values in column 4. For example, to determine the corrected pointer bearing for the loop position of 60 degrees (column 4), lay the straight edge parallel to the solid line and draw a fine line through the intersection of the dotted 60-degree line and the deviation curve. (See note 2, fig. 2-15.) This line passes through the graduations at 73 degrees. This bearing value is recorded in column 5. Similarly, a bearing of 105 degrees from column 4 gives a bearing of 100 degrees for column 5.

(3) Using the above data, make the adjustment to compensator as outlined in par. 1, *b* (3)-(15), this section.

Aircraft A. C. No._____ By_____ Date_____
Station_____ Frequency_____ K.C. Equipment Type_____
Reference Line, Landmark:_____ Predetermined Point_____

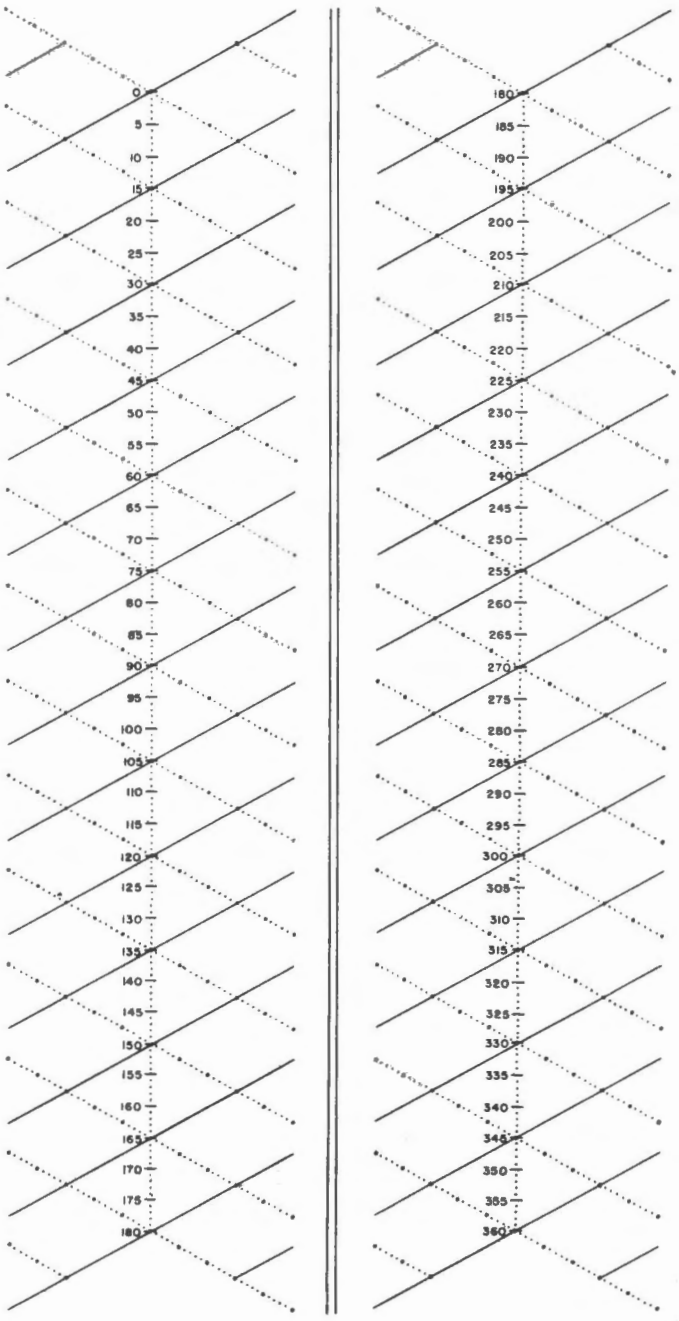


Figure 2-14. Radio Compass Deviation Calibration Curve

Aircraft A. C. No. B-23 39-27 By _____ Date Aug. 26-40
Station WWIL .. —.. Frequency 266 K.C. Equipment Type SCR-242-C
Reference Line, Landmark: U.S. Highway #35 Predetermined Point Eaton, Ohio

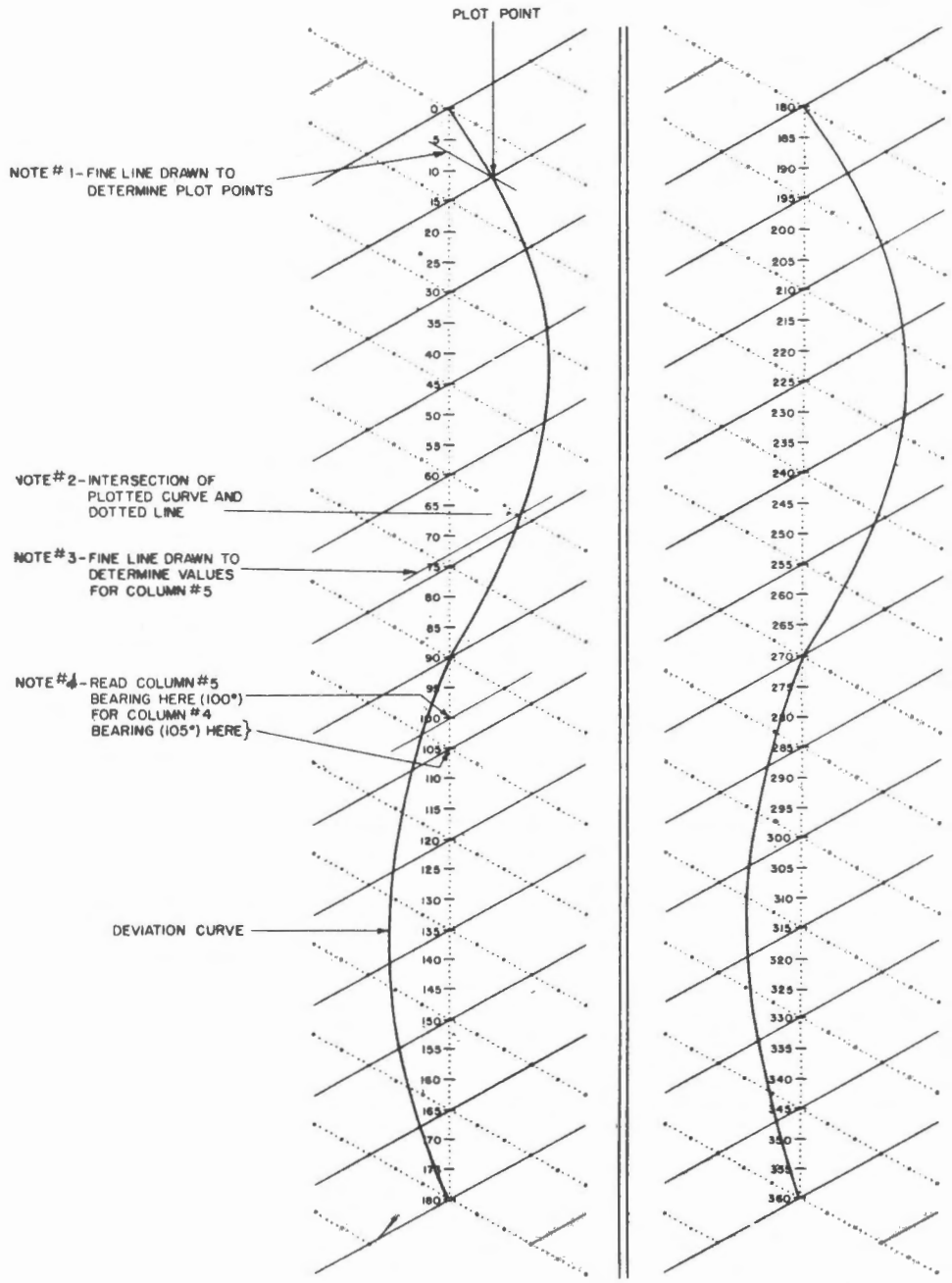


Figure 2-15. Radio Compass Calibration Curve—Numerical Example

SECTION III
OPERATION

1. GENERAL.

a. TURNING THE EQUIPMENT ON. *(See fig. 3-1.).*—Set the function switch on one of the Radio Control boxes ★C-4/ARN-7 to the "COMP.", the "ANT.", or the "LOOP" position. If the green light does not come on, push in the "CONTROL" switch of the control box. The green light indicates that this box has control of the equipment.

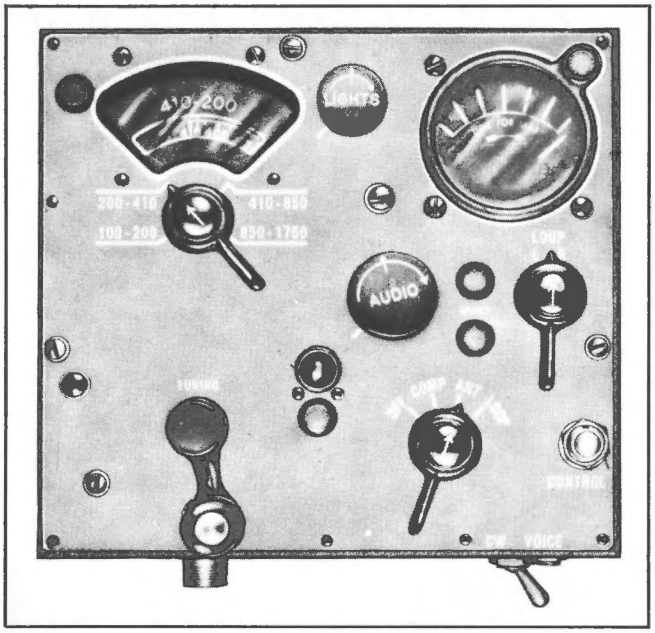


Figure 3-1. Radio Control Box ★C-4/ARN-7— Panel View

b. SELECTING STATION.

(1) Plug the headset into the jack on the control box.

(2) Rotate the bandswitch to the frequency band in which operation is desired.

(3) Turn the "TUNING" crank to the desired station frequency in kilocycles, and rotate back and forth through resonance for maximum clockwise deflection of the tuning meter to determine the exact setting of the dial. Listen for station identification to be sure that the correct station is being received.

Note

Radio Compass ★AN/ARN-7 provides for aural identification of keyed CW stations by means of internal modulation controlled by the "CW-VOICE" on the control box. Switch to "CW" when this type of operation is desired.

c. CHANGING FROM ONE CONTROL BOX TO THE OTHER.

(1) Set the function switch of the control box, not in position, to the "COMP." or the "ANT." operation.

(2) Push in the "CONTROL" switch. The green light will come on indicating that this remote control box now has control of the equipment.

Note

When the system employs Rectifier Unit RA-59-A, controlled by the power on-off relay in Relay BK-22-K assembly, it will be necessary to hold down the "CONTROL" button until the inverter builds up to rated output voltage, when taking control away from a radio control box whose function switch is in the "OFF" position.

d. TURNING THE EQUIPMENT OFF.—Turn the function switch of the control box that is in control to the "OFF" position.

2. HOMING COMPASS OPERATION.

For homing operation perform the operations of paragraph 1*a, b,* this section, and proceed as follows:

Note

Indicators I-81-A and I-82-A are referred to in the operating procedure. However, any indicator given in the table of interchange components in section I may be used.

a. Turn the "VAR." knob on Indicator I-82-A (Navigator's) until the azimuth zero is at the index. Indicator I-81-A (Pilot's) is effectively in this position at all times.

b. Switch to "COMP." position.

c. Apply the rudder in the direction shown by the indicator pointer. When the indicator pointer is at zero, the aircraft is headed toward the radio station to which the compass unit is tuned. The indicator pointer always points toward the radio station. If the pointer is to the right of zero, the station is to the right of the heading of the aircraft.

d. Adjust the "AUDIO" or interphone control for satisfactory headset level.

Note

Since in "COMP." operation, the equipment has an excellent automatic volume control action, it is not practical to home on a radio range course and fly aurally at the same time.

e. The homing operation of Radio Compass ★AN/-ARN-7 is such that the aircraft will ultimately arrive over the radio station antenna, regardless of probable drift due to cross wind. However, the flight path will be a curved line, and coordination with ground fixes or landing fields along the route may be either difficult or impossible.

(1) Consequently, it is often best to fly a straight line course by off-setting the heading of the aircraft to compensate for wind drift. To do this, determine the wind drift either with the drift sight or note the change in magnetic compass reading over a period of time while homing with the radio compass. A decreasing magnetic bearing indicates a wind from the left; an increasing magnetic bearing indicates a wind from the right.

(2) By trial and error, find the correct up-wind radio compass angle, as shown by the indicator pointer, providing the minimum rate of change of magnetic compass reading. The scale on the indicator shows the deviation of the heading of the aircraft from the direction of the radio station directly in degrees.

3. POSITION FINDING.

A. VISUAL METHOD.—For operation as an automatic, visual, indicating position finder, perform the operations of paragraphs 1*a, b,* this section. Use either Indicator I-82-A (Navigator's) or Indicator I-81-A (Pilot's) and proceed as follows:

(1) Switch to "COMP" position.

(2) Prior to making fix determinations, locate the stations to be used on the map, tune them in and identify them and log the dial reading. This procedure avoids delay and error at the time of obtaining the fix.

Note

Check the dial calibrations against actual station frequencies. If the calibration is wrong, report the defect on the proper AAF form.

(3) For greatest accuracy, take several bearings in rapid succession. This eliminates errors caused by the distance traveled between bearing observations. Bearings cannot be accurate unless the aircraft is held on a steady heading.

Note

False or fluctuating bearings in some instances are produced by reflection of radio waves from the surface of mountains. This is called "mountain effect", and is known to exist under certain circumstances in the vicinity of Pittsburgh and Salt Lake City. Because of this effect, do not rely fully upon bearings taken when flying over mountainous terrain.

(4) Adjust the "AUDIO" or interphone control for the desired headset level.

(5) Set the azimuth scale with the "VAR." knob on Indicator I-82-A (Navigator's), so that the numerical value of the magnetic heading of the aircraft is at the index.

(6) Determine the magnetic variation for the locality over which the plane is flying, and rotate the "VAR." knob for the required correction in the direction indicated by the arrows. The knob is marked with arrows to show the proper direction of rotation to compensate for east or west variation.

(7) Record the bearing shown by the tail end of the bearing indicator pointer. (This will be station-to-aircraft bearing from north.)

(8) To obtain a fix, take bearings on three or more stations, 30 degrees or more from the line of direction of any one station, and plot them on a map. The intersection of the plotted lines is the position of the aircraft at the time of observation.

Note

In this equipment, if the instructions in section II, paragraph 2*b*(5) have been followed, the radio compass deviation is automatically compensated for and need not be considered when taking bearings.

b. AURAL-NULL METHOD.

Note

For aural reception of A-N signals, operate the equipment on "ANT." or "LOOP, instead of "COMP." since the action of the AVC in the "COMP." position will cause broad course indications.

(1) Switch to "LOOP", and push the "CONTROL" switch to obtain a green light. Tune in the desired station as in paragraphs 1*a, b* this section. To obtain a good intelligible signal when listening for station identification, it may be necessary to rotate the loop to a maximum signal position. It is also necessary to use "CW" operation in order to identify keyed CW stations.

(2) Adjust the "AUDIO" or interphones control for the desired headset level.

Note

For aural reception of A-N signals or interphone, set the interphones volume control fully clockwise and use the "AUDIO" control on the radio compass control box to reduce headset volume. This is essential to obtain proper course definition. For best definition of A-N signals on "ANT." or "LOOP", set the "AUDIO" control to the lowest usable audio level and reduce it as a A-N signals increase.

(3) Use the "VAR." knob on Indicator I-82-A (Navigator's), and set the bearing scale so that the numerical value of the magnetic heading of the aircraft is at the index mark.

(4) Determine the magnetic variation for the locality, and rotate the "VAR." knob in the direction indicated by the arrows for the required correction. The knob is marked with arrows to show the proper direction of rotation to compensate for east or west variation.

(5) Use the "Loop L-R" switch and rotate the loop for minimum headset volume and read the bearing indicator. If the signal null exists over too wide an angle, greater accuracy may be obtained by rotating the "AUDIO" knob fully clockwise and locating the null, by either listening for the disappearance of the audio signal, or noting the dip in tuning meter deflection. The use of CW operation also decreases the width of the null indication.

Note

When determining direction on "LOOP" by aural-null method, there is a 180-degree ambiguity, and the direction of the station may be 180 degrees from the null obtained. The broadness of the null with aural-null direction finding depends on the strength of the signal. Strong fields produce very sharp nulls, sometimes as small as one-tenth degree. Vary the "AUDIO" control until the null is of satisfactory width. The tuning meter may be used as visual null indicator.

(6) Record the bearing shown by the tail end of the bearing indicator pointer. Bearings are subject to 180-degree ambiguity.

(7) Fixes may be obtained as by the visual method, except that 180-degree ambiguity must be resolved by a different method. Roughly, draw lines from the positions of the radio stations at the approximate angles indicated by the bearings obtained in paragraph 2*b*(6), this section. Use arrows to show the direction in which the lines are drawn from the stations and extend the lines until they meet. If all arrows point to the intersection, the position is correct, and bearings may be plotted accurately, as in paragraph 3*a*(8), this section. If the arrows do not point to the intersection, retake those bearings whose arrows point away from the intersection, rotating the bearing pointer to approximately 180 degrees from its original position.

4. RECEIVER OPERATION.

Perform the operation described in paragraph 1*a* and *b*, this section, and proceed as follows:

a. ANTENNA RECEPTION.

(1) Set the switch to "ANT." and adjust the interphone knob or the "AUDIO" knob of Radio Control Box ★C-4/ARN-7 for satisfactory headset volume.

(2) For the best definition of radio range signals (between 200 and 420 kc), set the interphone control fully clockwise, (and adjust the "AUDIO" knob for the lowest usable headset volume.

b. LOOP RECEPTION.

(1) If reception on the antenna is noisy because of precipitation static, commonly known as rain or snow static, loop reception may be employed for possibly better results. Turn the function switch to "LOOP" position. Depress "LOOP L-R" and turn to "L" or "R", holding until maximum signal strength is obtained. Adjust the "AUDIO" knob for the desired headset volume. To rotate loop at slow speed, do not depress "LOOP L-R" knob when turning it to "L" or "R".

(2) For the best definition of radio range signals on "LOOP", it is necessary to maintain the loop near the 90- or 270-degree position. Set the interphone control fully clockwise, and adjust the "AUDIO" knob for the lowest usable headset volume.

Note

Cone of silence indications with "LOOP" receiver operation depend on the particular type of range transmitting antenna and the mounting of the loop on the aircraft. Therefore, such indications are not always reliable. In some cases, an increase, instead of decrease, in signal strength will be noted.

SECTION IV
EMERGENCY REPAIR

1. FLIGHT ADJUSTMENTS.

a. If unsatisfactory operation is encountered in flight, it is often possible to restore normal operation in a very short time if a systematic check of the most likely causes of failure is made. Make the following checks in the order given:

(1) Check the vertical antenna lead-in and see that it is not grounded or has open circuit.

(2) Check the loop cable plug for tightness.

(3) Insert the headset plug in the phone jack of radio control box in control. If nothing is heard, try another pair of headsets.

(4) Observe the instrument lights on the control box which is in control. If these lights are off, push the control switch. If lights come on, the control box had not been in control. However, if lights remain off, push the control switch again and check a-c and d-c fuses in Relay BK-22-K. (See fig. 2-10.)

(5) Switch to the "ANT.", "LOOP" and "COMP." positions and check for normal operation on these positions.

(6) Observe the tuning meter. If the pointer is at the extreme right hand position, there is probably no plate voltage on the second detector tube. If the pointer looks normal, plate voltage is probably normal.

(7) Switch to each band one at a time checking in the "ANT.", "COMP." and "LOOP" position for normal operation.

(8) Switch to the other radio control box and repeat paragraphs (4) through (7) above.

(9) Remove the compass from its case and make sure that all tubes are seated properly.

(10) All tubes should be warm if they are operating properly.

(11) If any tubes feel cold, replace with new tubes, if available.

(12) Check all grid leads to tube caps to be sure none are shorting to ground or are open circuited.

b. If, after performing checks (1) through (12) above, the trouble is still not located, it is probable that the trouble is of such a nature that it can not be fixed in flight. If this is true, the equipment should be reported inoperative and submitted to the proper personnel for repair.

SECTION V
SUPPLEMENTARY DATA

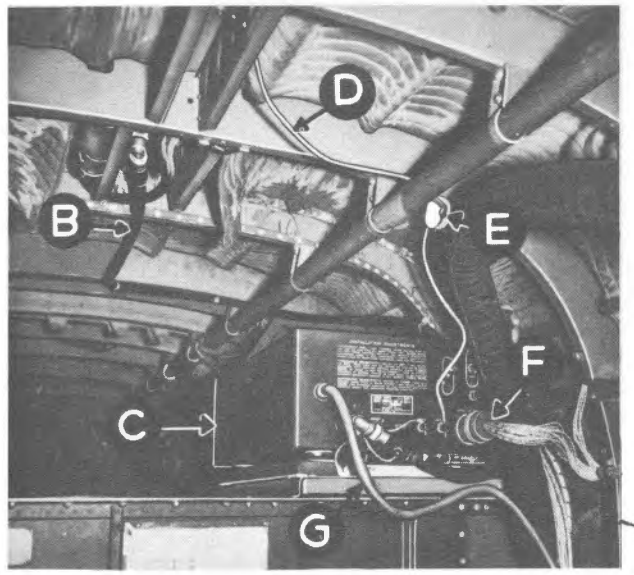
1. AMERICAN AND BRITISH TERMINOLOGY GLOSSARY.

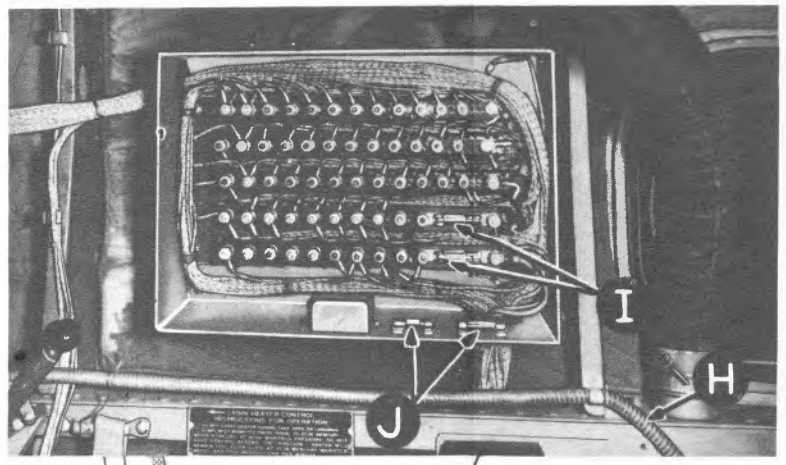
United States	*British Equivalent*	*Definition*
Antenna	Aerial	A conductor consisting of a wire or wires supported in the air for directly transmitting or receiving electric waves.
Aircraft	Aircraft	Any weight-carrying device designed to be supported by the air, either by buoyancy or by dynamic action. In Britain used only as a collective plural and in the United States, as either a singular or a collective plural.
Airplane	Aeroplane	A mechanically driven aircraft, heavier than air, fitted with fixed wings and supported by the dynamic action of the air.
Battery, storage	Storage battery or accumulator	A battery of leakproof design which will not discharge its liquid contents during violent maneuvers.
Beacon, radio range	Radio track beacon	A radio transmitter supplying directive radio waves that provide a means of keeping aircraft on the proper course.
Conduit or electrical tubing	Conduit	A tube for receiving and protecting electric wires or cables.
Controls, air, cable controls, or flight controls	Flying controls	The means employed to operate the control surfaces of an aircraft.
Copilot	Second pilot	The assistant to the pilot of an aircraft.
Course	Track angle	The direction over the surface of the earth, with respect to true north, that an aircraft is flown.
Direction finder radio, or automatic direction finder	Radio direction finder (R.D.F.), radio compass, or steering director	A radio instrument which, if once tuned to a station points continuously and automatically to the station.
Documents, classified	Protected papers	All documents which are classified for protection to a greater or lesser degree from the general public.
Drift	Drift-angle	The angle between the heading and the track.
Engine	Aero-engine	An engine used to provide the motive power for an aircraft.
Field, landing	Landing ground	A field of such a size and nature as to permit of aircraft landing and taking off in safety.
Gasket	Gasket, joint, or washer	A sheet or ring of packing used for engine heads, pipe joints, and similar purposes.
Generator	Generator or dynamo (obsolescent)	A machine by which mechanical energy is changed into electrical energy.
Ground	Ground or earth	The connection made in grounding an electrical circuit.
Gyro-directional or directional indicator	Directional gyro, direction indicator, or gyroscopic turn indicator	An instrument employing a gyroscope for indicating any change in the direction of the aircraft in azimuth from a straight course.
Heading	Course	The angular direction of the longitudinal axis of an aircraft with respect to true north.
Interphone	Intercommunication or intercom (slang)	A system of communication between different stations on the same aircraft.
Inverter	Motor generator (D.C. to A.C.)	A motor coupled to a generator for transforming electric currents.
Left	Port	Situated to the left, looking in the direction of motion of an aircraft.

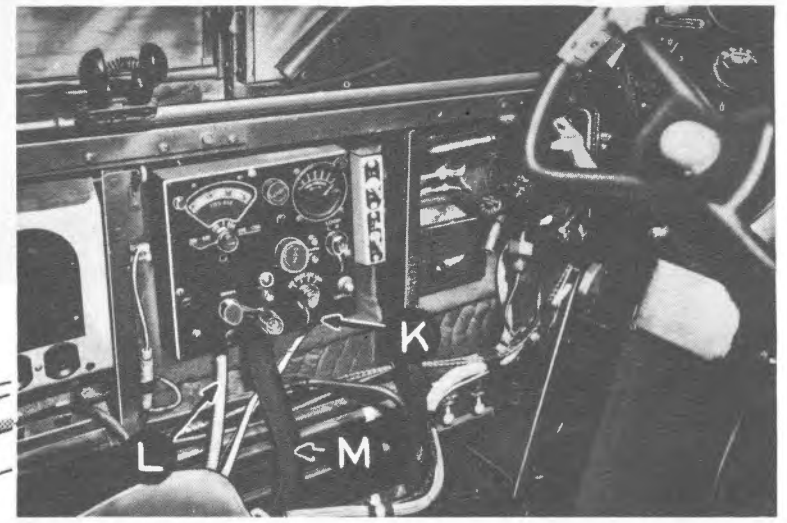
United States	*British Equivalent*	*Definition*
Loop, radio or loop antenna	Loop aerial	A specified number of turns of wire located in the wings or wound around the fuselage of an airplane. Small portable loops on a rectangular frame are also used.
Mast, radio	Rod aerial	A mast attached to an aircraft which serves as part of the radio antenna structure.
Meter, drift or drift indicator	Drift sight	An instrument for measuring the drift angle.
Mile, sea	Sea mile or admiralty mile	A measure of distance equal in the United States to 6080.20 feet and in Britain to 6080 feet. One knot is one sea mile per hour.
Navigation, air or aerial navigation	Avigation	The guidance of craft through the air in accordance with previous calculations. "Avigation" has been used, but is considered unnecessary, in the U. S.
Nut, self-locking or elastic stop nut (trade name)	Self-locking nut or Simmonds nut (trade name)	A nut so constructed that it locks in place when tightened.
Operator, radio	Wireless operator	The operator of a radio sending and receiving set.
Plug or attachment plug	Plug	A removable male fitting for making electrical connections by insertion in a receptacle or body.
Post, binding	Terminal	A metallic post attached to the electrical apparatus for convenience in making connections.
Radio	Wireless	A device for the transmission or reception of signals by means of electric waves.
Radio, directional	Direction finder or directional wireless	Equipment for finding the azimuth of a distant transmitter.
Right	Starboard	Situated to the right, looking in the direction of motion of an aircraft.
Screw, fillister	Cheese-headed screw	A screw whose head is cylindrical and slotted with a convex or flat top.
Setscrew or headless setscrew	Grub screw	A headless machine screw screwed through one part tightly upon another part to prevent relative movement.
Shield or screen (ignition)	Ignition harness or screening	A device which protects other electrical apparatus from being affected by magnetic fields set up by the ignition system.
Socket, plughole or jack	Socket	A fixed female fitting for making electrical connections by the insertion of a plug.
Track or course	Track	The projection of the path of the center of gravity of an aircraft onto the earth's surface.
Tube	Valve	A radio electron tube.
Wrench	Wrench or spanner	An instrument for exerting a twisting load, as in turning bolts or nuts.
Wire, safety or lock wire	Safety wire or lock wire	A wire used to secure a small part so that it cannot loosen.

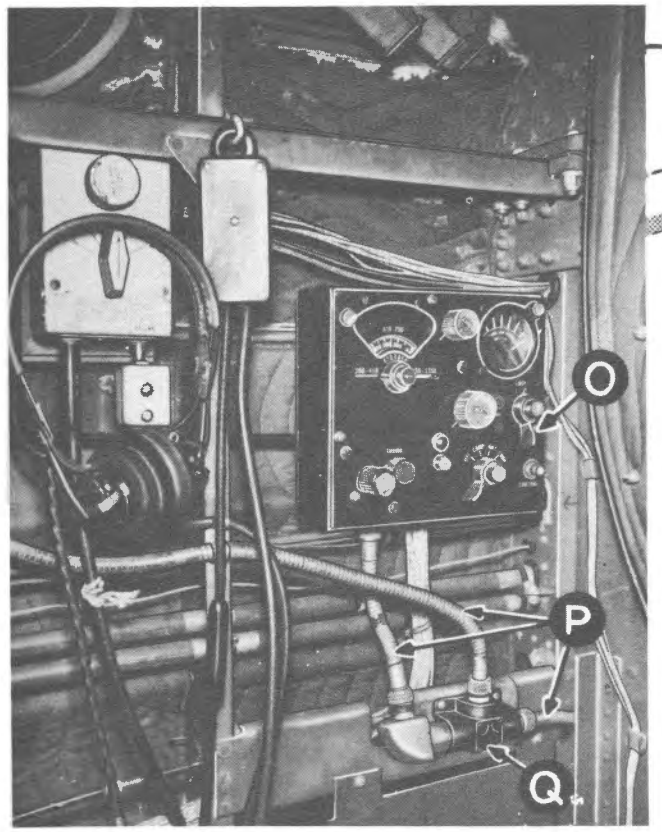
SECTION VI
DRAWINGS

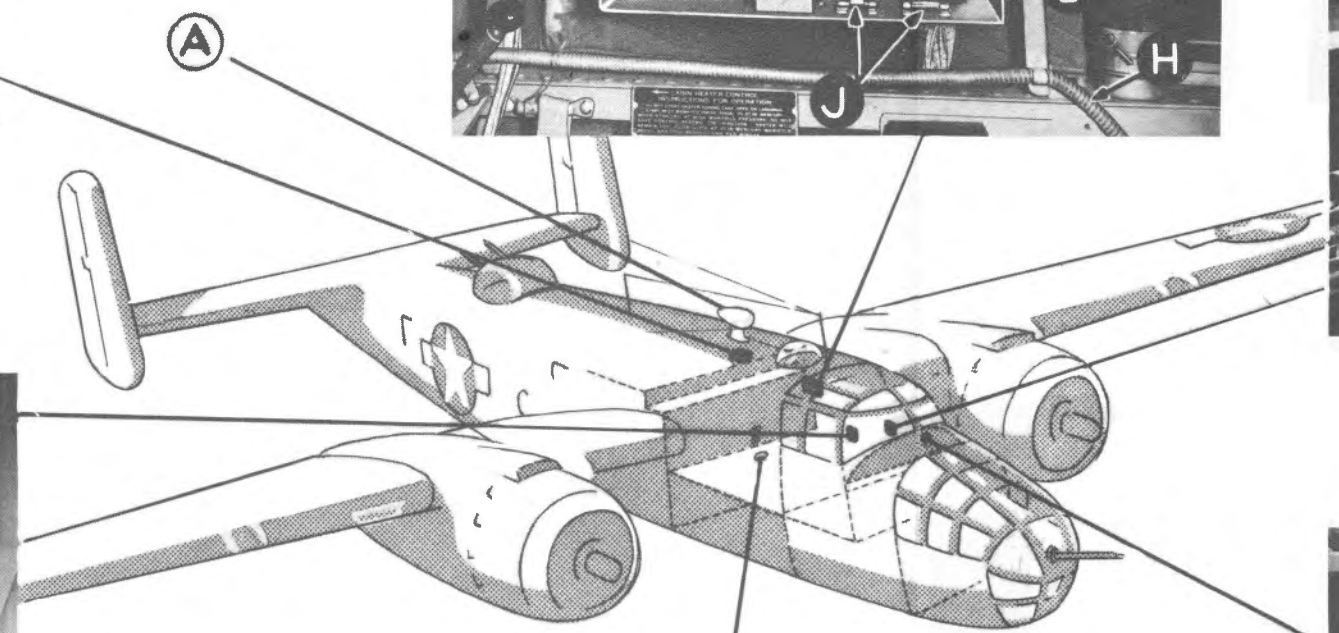
INTENTIONALLY BLANK

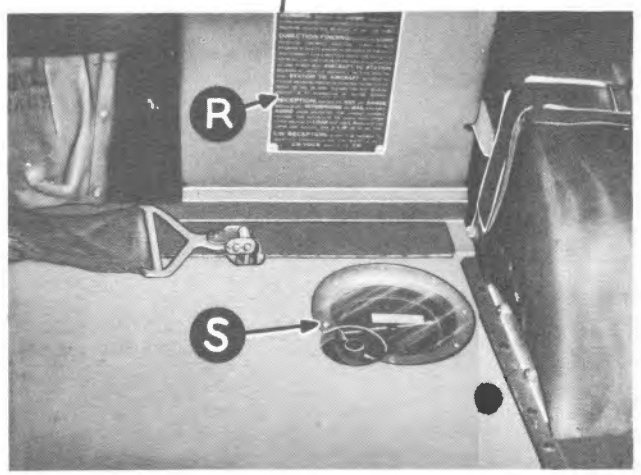


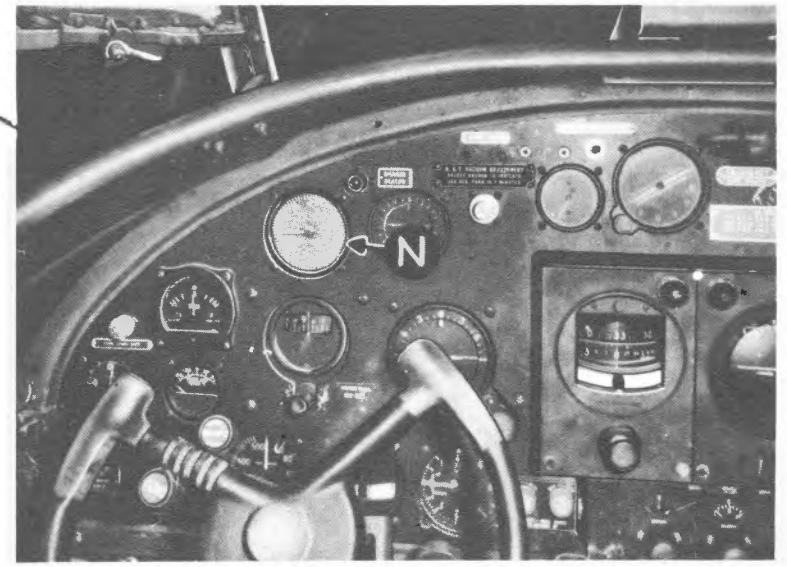












A. LOOP LP-21-A

B. CORD CD-365-

C. RADIO COMPASS UNIT

D. SENSE ANTENNA LEAD-IN

E. STAND-OFF INSULATOR

F. PLUG PL-122

G. TUNING SHAFT

H. TUNING SHAFT

J. FUSE (IN RELAY BK-22-K)

J. SPARE FUSES

L. TUNING SHAFT

K. PILOT'S RADIO CONTROL BOX

M. CABLING (WITH SHIELD)

N. PILOT'S INDICATOR

O. NAVIGATOR'S CONTROL BOX

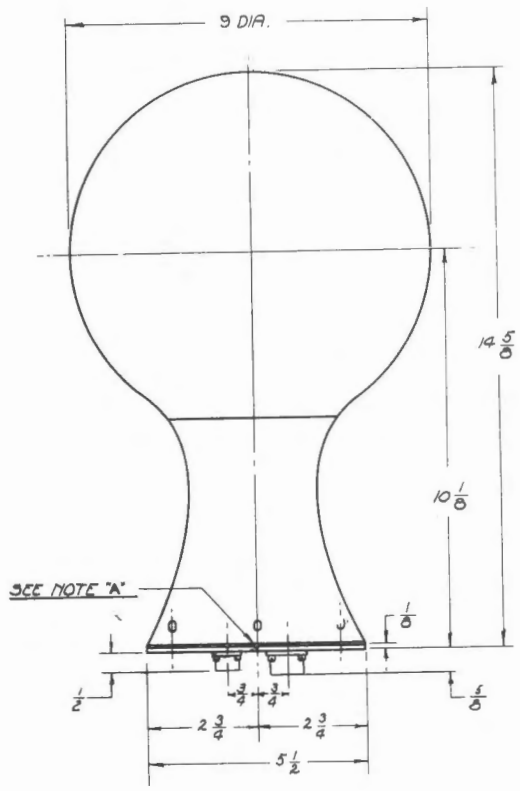
P. TUNING SHAFT

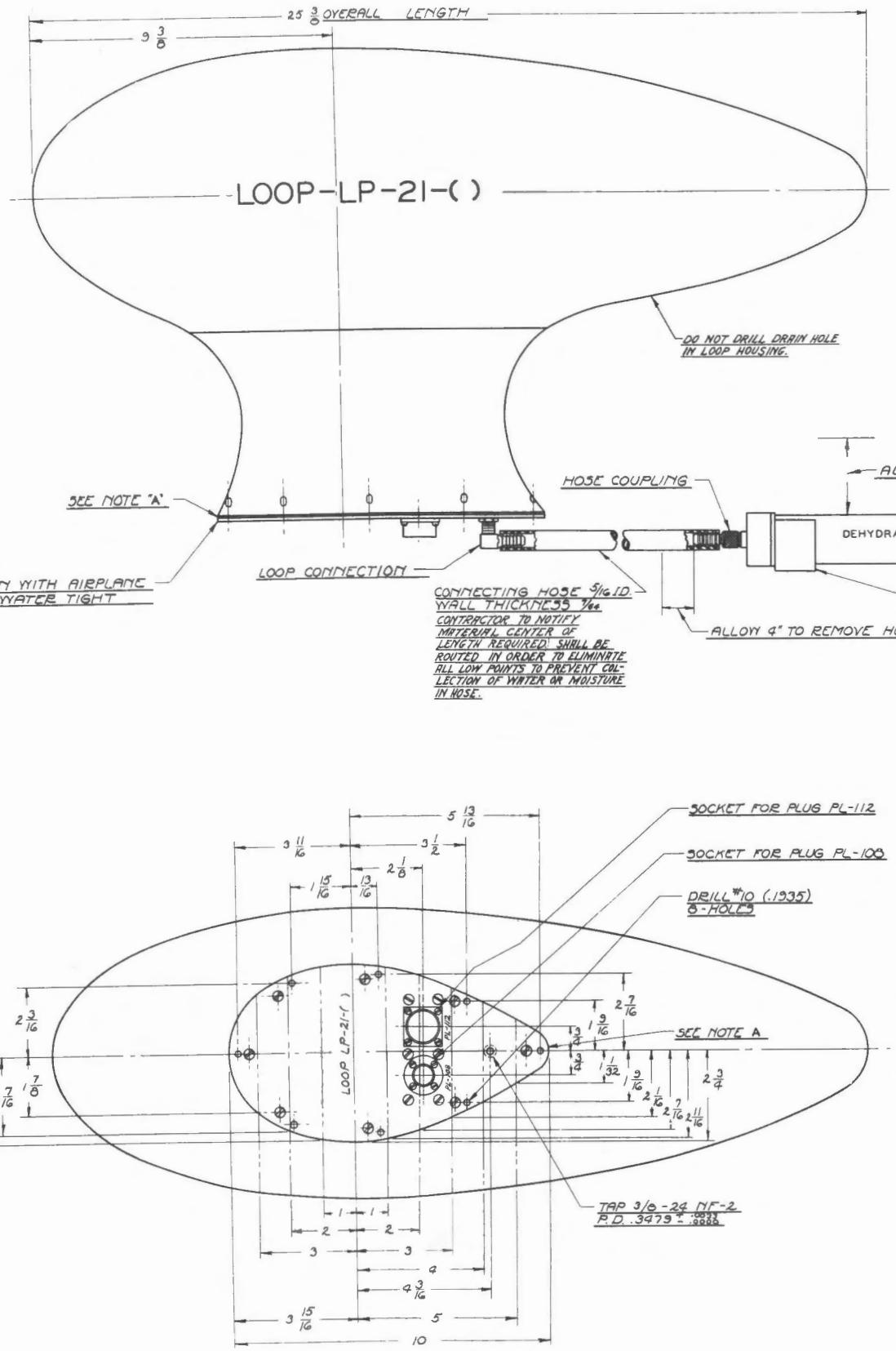
Q. COUPLING MC-203-A

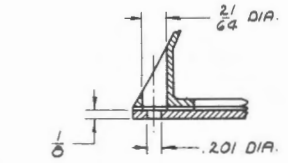
R. INSTRUCTION CHART

S. NAVIGATOR'S INDICATOR

Figure 6-1. Typical Installation of Radio Compass

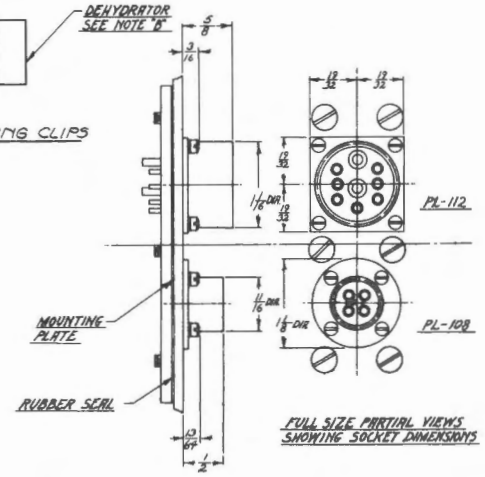






TYPICAL SECTION THROUGH 8 HOLES

VIEW SHOWING DEHYDRATOR MOUNTING DIMENSIONS



FULL SIZE PARTIAL VIEWS SHOWING SOCKET DIMENSIONS

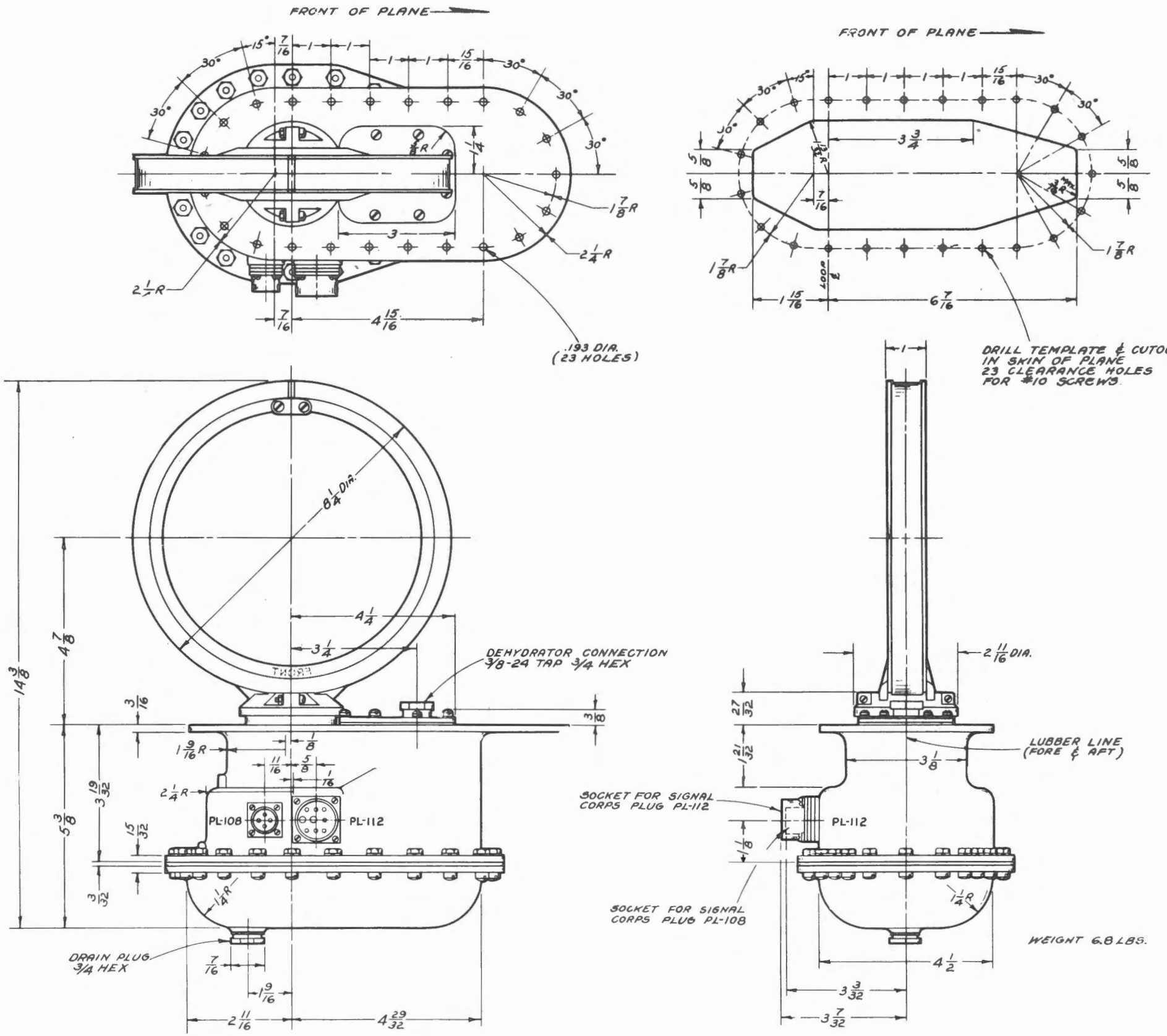
TOTAL WEIGHT 11.7 LBS.

NOTE "C" QUADRANTAL ERROR CALIBRATION SHALL BE SET-UP ON EACH LOOP LP-21-( ) AND LABELED "CALIBRATED FOR (TYPE AIRPLANE)" IN A PLACE VISIBLE FROM OUTSIDE OF AIRPLANE.

NOTE "B" DEHYDRATER IS PART OF LOOP LP-21-( ) & SHALL BE INSTALLED SO AS TO BE VISIBLE TO A CREW MEMBER, PREFERABLY THE RADIO OPERATOR, AND SHALL BE MOUNTED WITH BREATHER END DOWN AND REMOVE SEAL ON THE BREATHER END.

NOTE "A" CENTER LINE TO BE MARKED ON FRONT & REAR EDGE OF MOUNTING PLATE LINE THRU THESE TWO POINTS TO COINCIDE WITHIN ± 0.5 DEGREE OF NULL POSITION OF LOOP

Figure 6-2. Loop LP-21-( ) — Outline Drawing (Except Loop LP-21-B)



RESTRICTED **Figure 6-3. Loop LP-31-A or LP-31-AM—Outline Drawing**