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Colin Hinson

In the village of Blunham, Bedfordshire, UK.

AN-08-10-265

HANDBOOK OF

OPERATING INSTRUCTIONS

for

RADIO SETS

★AN/APN-1, ★AN/APN-1A, ★AN/APN-1B and ★AN/APN-1X

(AIRCRAFT RADIO ALTIMETER EQUIPMENTS)

RESTRICTED

(For Official Use Only)

Approved 4 JULY 1944

IMPORTANT

REPLACEMENT OF FUSES.—When necessary to replace the fuse in the Radio Set ★AN/APN-1 series equipment, use only the following types:

(1) FOR 27 VOLTS (Radio Transmitter-Receiver ★RT-7/APN-1).—Use "LITTELFUSE" #1443 (3-Ampere Special) or #1094 (5-Ampere).

(2) FOR 13.5 VOLTS (Radio Transmitter-Receiver ★RT-40/APN-1X.)—Use "BUSSMAN" #MDM-6.25 (6.25-Ampere) or #MDM-8 (8-Ampere).

WARNING

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE THE EQUIPMENT WITH VOLTAGE SUPPLY ON. UNDER CERTAIN CONDITIONS DANGEROUS POTENTIALS MAY EXIST IN CIRCUITS WITH POWER CONTROLS IN THE OFF-POSITION DUE TO CHARGES RETAINED BY CAPACITORS, ETC. TO AVOID CASUALTIES ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.

THE ATTENTION OF OFFICERS AND OPERATING PERSONNEL IS DIRECTED TO BUREAU OF ENGINEERING CIRCULAR LETTER No. 5a OF 3 OCTOBER, 1934, OR SUBSEQUENT REVISIONS THEREOF ON THE SUBJECT OF "RADIO—SAFETY PRECAUTIONS TO BE OBSERVED."

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LIST OF ILLUSTRATIONS

IMPORTANT

As the ★AN/APN-1 Series equipments are supplied by several Contractors (see Table 2 of Equipment Diagram, Figure 22), both the Contract Number and the manufacturer's code letters (as marked on the particular equipment or major unit) must be shown on all "Unsatisfactory" or "Failure" Reports specified below.

FOR U. S. NAVY PERSONNEL

Report of failure of any part of this equipment during its guaranteed life shall be made on Form N. Aer. 4112 "Report of Unsatisfactory or Defective Material" or a report in similar form and forwarded in accordance with the latest instruction of the Bureau of Aeronautics. In addition to other distribution required, one copy shall be furnished to the cognizant Inspector of Naval Material* and to 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 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 BRITISH PERSONNEL

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

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* The cognizant Inspectors of Naval Material for the several ★AN/APN-1 Series Contracts (manufacturer's code letters shown in parentheses) are as follows:

NXsa-21689 (CYR): Resident Inspector of Naval Material, 633 Jackson Bldg., 220 Delaware Ave. & Chippewa St., Buffalo, New York.

NXsa-22419, -42172, -44572, -49717, -62370 (CQC): Inspector of Naval Material, 141 West Jackson Blvd., Chicago, Illinois.

NXsa-22421, -43386 (CDT): Inspector of Naval Material, Detroit Free Press Bldg., Detroit, Michigan.

NXsa-23763, -44563 (CRV): Resident Inspector of Naval Material, c/o RCA, Front & Cooper Streets, Camden, New Jersey.

NXsa-36254 (CDL): Both INM, Chicago and RINM, Camden. (See NXsa-22419 and NXsa-23763 above for complete addresses).

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 or whatever heavy objects are readily available.**
3. **Burning by means of incendiaries such as gasoline, oil, paper or wood.**
4. **Grenades and shots from available arms.**
5. **Where possible, and when time permits, bury all debris or dispose of it in streams or other bodies of water.**

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 in 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.**

GUARANTEE

The equipment including all parts and spare parts, except vacuum tubes, batteries, rubber and material normally consumed in operation, is guaranteed for a period of one year from the date of delivery of the equipment to and acceptance by the Government with the understanding that all such items found to be defective as to material, workmanship, or manufacture will be repaired or replaced, f.o.b. any point within the continental limits of the United States designated by the Government, without delay and at no expense to the Government; provided that such guarantee will not obligate the Contractor to make repair or replacement of any such defective items unless the defect appears within the aforementioned period and the Contractor is notified thereof in writing within a reasonable time and the defect is not the result of normal expected shelf life deterioration.

To the extent the equipment, including all parts and spare parts, as defined above, is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing conditions, against defects in design with the understanding that if ten per cent (10%) or more of any such said item, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred per cent (100%) correction or replacement by a suitably redesigned item.

All such defective items will be subject to ultimate return to the Contractor. In view of the fact that normal activities of the Naval Service may result in the use of equipment in such remote portions of the world or under such conditions as to preclude the return of the defective items for repair or replacement without jeopardizing the integrity of Naval communications, the exigencies of the Service, therefore, may necessitate expeditious repair of such items in order to prevent extended interruption of communications. In such cases the return of the defective items for examination by the Contractor prior to repair or replacement will not be mandatory. The report of a responsible authority, including details of the conditions surrounding the failure, will be acceptable as a basis for affecting expeditious adjustment under the provisions of this contractual guarantee.

The above one year period will not include any portion of time the equipment fails to perform satisfactorily due to any such defects, and any items repaired or replaced by the Contractor will be guaranteed anew under this provision.

In some cases it has been found necessary to make substitution of original materials. However, all necessary factors have been maintained, so that replacements can be made, and wherever spare parts are involved in the substitutions, the spares are identical to the parts mounted in the equipment. If it is found that the latter cannot be met, special instructions will be issued and supplied for all shipments so affected.

SECTION I
GENERAL DESCRIPTION

1. PURPOSE OF EQUIPMENT AND HANDBOOK.

a. This handbook covers the installation, installation adjustments, operation, and emergency operation and repair of Radio Sets ★AN/APN-1, ★AN/APN-1A, ★AN/APN-1B and ★AN/APN-1X.

b. The ★AN/APN-1 Series aircraft radio altimeter equipments are designed for installation in aircraft to provide direct measurement of absolute altitude (terrain clearance) during flight. The equipments may be used in conjunction with an automatic pilot system. They are identical in function and approximately equivalent in design to the preceding low-range (0 to 400 feet) models AYD-3 and ★AN/ARN-1, except that an additional range (400 to 4000 feet) is provided. Interchangeability of major components with those models and with the earlier models AYB-1, AYB-2, AYD and AYD-2 is indicated in Table 1 of the equipment diagram, Figure 22.

c. Radio Set ★AN/APN-1 is designed for 27-volt d-c operation. It is provided with a double-range Altitude Indicator ★ID-14/APN-1, ★ID-14A/APN-1 or ★ID-14B/APN-1 equipped with a power switch and a range switch. The latter switch is geared to a shutter which changes the scale numerals to correspond to the range for which the control is set. The double-range Altitude Indicator is also supplied with the ★AN/APN-1X and (for test purposes) with some of the ★AN/APN-1B equipments.

d. Radio Set ★AN/APN-1A is equivalent to ★AN/APN-1 except that it is equipped with a single-range Altitude Indicator identical to the one supplied with models AYD-3 and ★AN/ARN-1. The single-range Altitude Indicator ★ID-1/ARN-1 is adaptable for two-range operation by installing an external range switch (kit supplied by U. S. Army).

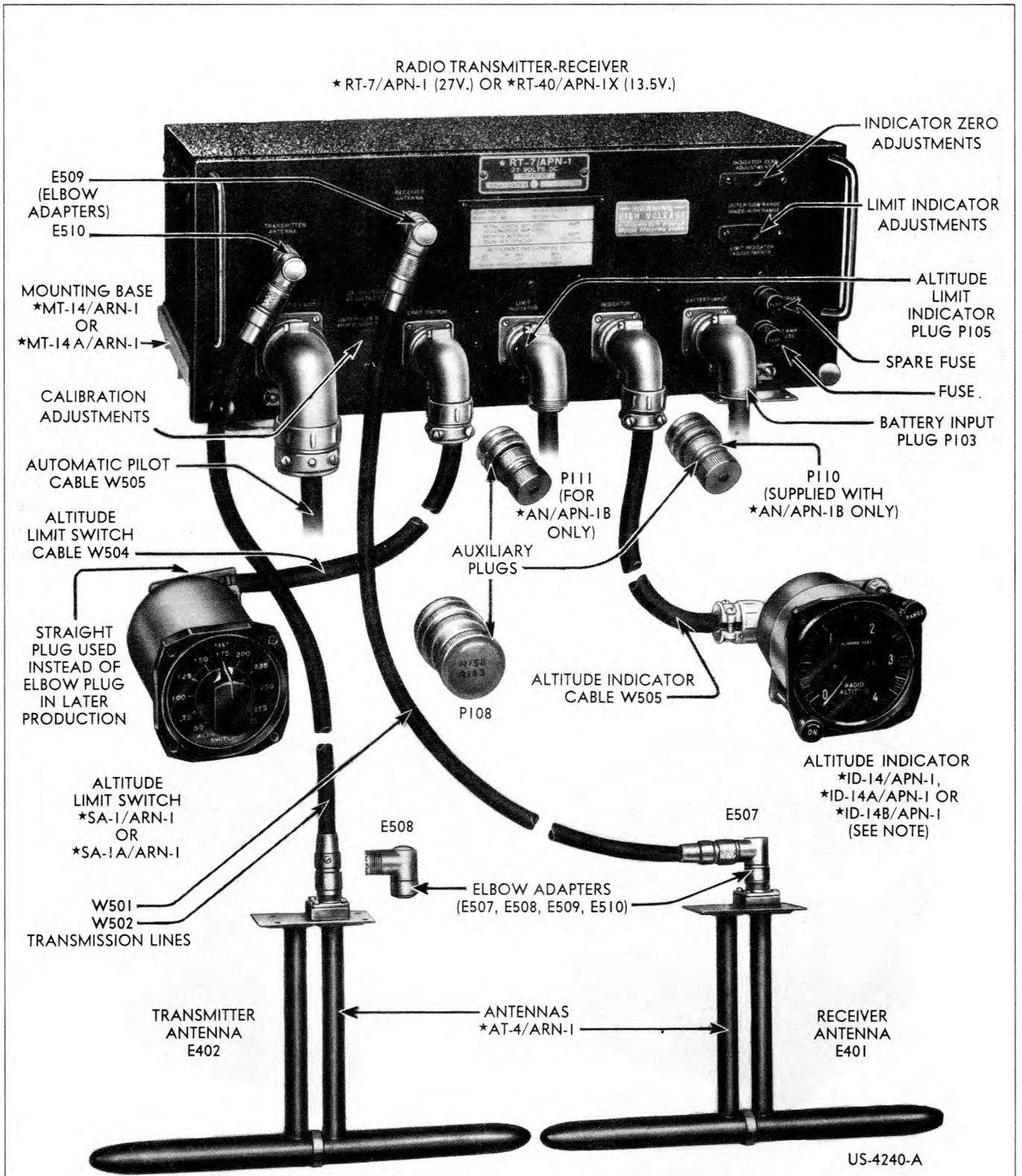
US-4069-A

(A)
RANGE SWITCH IN LOW-RANGE
(0-400 FT.) POSITION

US-4070-A

(B)
RANGE SWITCH IN HIGH-RANGE
(400-4000 FT.) POSITION

Figure 1—Double-Range Altitude Indicator ★ID-14/APN-1, ★ID-14A/APN-1 or ★ID-14B/APN-1



NOTE — RADIO SET ★AN/APN-1A USES SINGLE-RANGE ALTITUDE INDICATOR ★ID-1/ARN-1 WHICH DOES NOT INCLUDE RANGE SWITCH (UPPER RIGHT KNOB). EXTERNAL RANGE SWITCH KIT IS SUPPLIED FOR THIS MODEL BY U. S. ARMY

Figure 2—Radio Set ★AN/APN-1 Series Aircraft Radio Altimeter Equipment

e. Radio Set ★AN/APN-1B, also designed for 27-volt d-c operation, is for special duty in connection with other equipments.

f. Radio Set ★AN/APN-1X is designed for 13.5-volt d-c operation. In all other respects, it is equivalent to Radio Set ★AN/APN-1.

2. EQUIPMENT SUPPLIED.

a. GENERAL.—The complete ★AN/APN-1 Series equipments with accessories are shown on the equipment diagram, Figure 22. The dimensions and weights of the components are included on the outline drawings referenced in Table 1 of Figure 22. The overall dimensions and weights of the major units are given in Table I, page 1-5.

b. CABLES AND PLUGS.—As indicated on the equipment diagram, Figure 22, the bulk cable and required fittings are furnished for fabricating the two antenna transmission lines W501 and W502 (Figure 30, items 1 and 2); also the cables W503 (Figure 31, item 1) and W504* (Figure 31, item 2 or Figure 32, item 1) for connecting the Radio Transmitter-Receiver to the Altitude Indicator and Altitude Limit Switch, respectively. Plugs P103 and P105 (Figure 31, items 4 and 6) are furnished for connecting the cables from the battery and the altitude limit indicator, respectively, to the receptacles on the Radio Transmitter-Receiver. Cables for these connections are not supplied. Bulk cable and fittings for fabricating the cable W505 (Figure 33), which connects the Radio Transmitter-Receiver to the automatic pilot system, are furnished with Radio Set ★AN/APN-1B only. An auxiliary plug P108 (Figure 34, item 10) is supplied for installation in the "AUTOMATIC PILOT" receptacle J106 of the Radio Transmitter-Receiver when the installation includes an altitude limit indicator but is not connected to an automatic pilot system. The auxiliary plugs P110 and P111 (Figure 34, items 12 and 13) are supplied only with Radio Set ★AN/APN-1B, to be used in the "INDICATOR" J104 and "LIMIT SWITCH" J107 receptacles of the Radio Transmitter-Receiver.

3. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

a. Major units required for complete installations, but not supplied on the ★AN/APN-1 Series contracts (see Table II), are as follows:

(1) D-C POWER SOURCE.—The power source consists of a storage battery and charging apparatus capable of supplying the voltage and current requirements of the altimeter as specified in paragraph 4, this section. It should be equipped with a voltage regulator adjusted to supply the normal rated input voltage (27 or 13.5 volts) at the Radio Transmitter-Receiver when operating. The required cable connections to plug P103 are indicated in Figure 22. Negative ground polarity is essential for operation of the altimeter.

(2) ALTITUDE LIMIT INDICATOR.—The altitude limit indicator consists of three colored lamps suitably mounted and connected by a cable to plug P105, as indicated on Figure 22.

*Plug P301 of cable W504 was changed in later production from elbow type (Figure 31) to straight type (Figure 32).

Figure 3—Single-Range Altitude Indicator ★ID-1/ARN-1

(a) *Navy Department installations* use Grimes Mfg. Co. A2328 Indicator Assemblies equipped with Indicator Jewel Holders A3051-6 (white), A3051-7 (red) and A3051-8 (green). The following are approved alternates:

1. N.A.F. indicator light assemblies 1056-26 (white) or 1056-30 (amber); 1056-27 (red) and 1056-28 (green). These N.A.F. assemblies include Grimes dimming caps.

2. Grimes Mfg. Co. A2773 light assemblies—red, white, and green.

3. Drake Mfg. Co. No. 85 shutter type assemblies—red, white, and green—with 200-hour salt spray protection.

(b) Arrange the lights with green on top, white or amber in the middle, and red at the bottom. (Amber jewels are commonly used in place of white in some installations.) Suggested nameplate markings are shown in Figure 12. The lamps must be ordered separately as follows:

1. For 27-Volt Equipments.—28-volt, 0.17-amp. rating (Mazda No. 313, AN3121-313).

2. For 13.5-Volt Equipments. — 13-volt, 0.22 amp. rating (Mazda No. 57).

IMPORTANT

Do not use lamps with current ratings higher than specified above.

(c) *U. S. Army installations* use Signal Corps LM-56 lamps in sockets of Air Force Property Class 03-C

US-4241-A

NOTE—RADIO TRANSMITTER-RECEIVER ★RT-40/APN-1X (13.5 VOLTS DC) HAS SAME EXTERNAL APPEARANCE. FUSE RATING MARKED AT LOWER RIGHT CORNER OF PANEL IS "3AMP." FOR ★RT-7/APN-1 (27V.) AND "6.25 AMP." FOR ★RT-40/APN-1X (13.5V.)

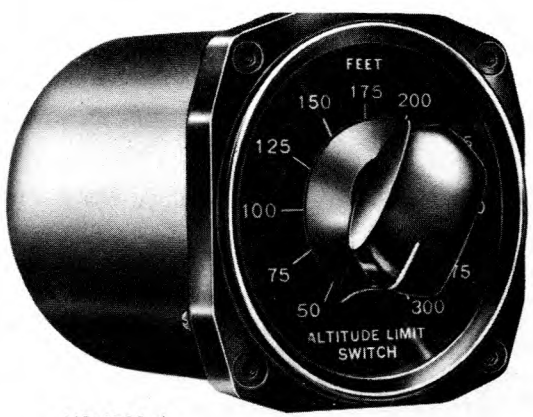
Figure 4—Radio Transmitter-Receiver ★RT-7/APN-1 (27-V)—Assembled on Mounting Base ★MT-14/ARN-1

as follows: 42B359 3-1 (red); 42B359 3-2 (amber); 42B359 3-3 (green).

(3) ATTITUDE CONTROL UNIT.—The attitude control unit is required when the ★AN/APN-1 Series altimeter is to be used in connection with an automatic pilot system for automatic altitude control. For a specific installation, the attitude control unit shall conform with detailed specifications to be issued by the Navy Department, Bureau of Aeronautics or Technical Orders issued by authority of the Commanding General, Army Air Forces.

4. POWER SUPPLY REQUIREMENTS.

a. The 27-volt rated equipments (★AN/APN-1, ★AN/APN-1A and ★AN/APN-1B) are designed for d-c operation at 22 to 29.5 volts and consume approximately 2.6 amperes with 27 volts delivered to the "BATTERY INPUT" receptacle J103 of Radio Transmitter-Receiver ★RT-7/APN-1. The input current at 27 volts is increased to approximately 2.8 amperes when either an altitude limit indicator or an automatic pilot system is connected to the Radio Transmitter-Receiver, and to approximately 3.0 amperes (intermittent maximum) when both an altitude limit indicator and an automatic



US-2533-A

Figure 5—Altitude Limit Switch ★SA-1/ARN or ★SA-1A/ARN-1

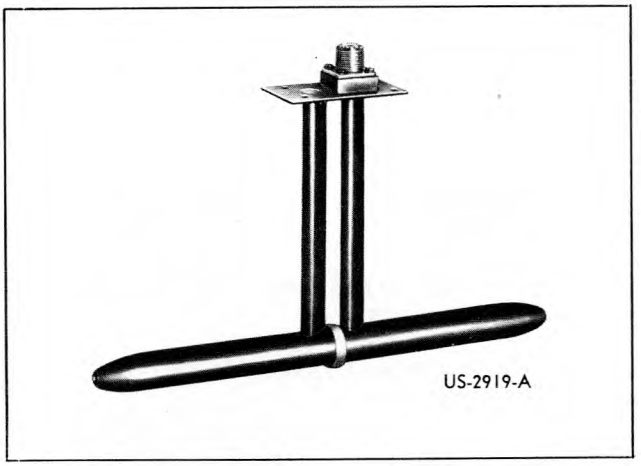


Figure 6—Antenna ★AT-4/ARN-1**

pilot system are connected. The drain is increased approximately 0.15 ampere when operating in the high range.

b. The 13.5-volt rated equipment (★AN/APN-1X) is designed for d-c operation at 11 to 14.75 volts and consumes approximately 5.3 amperes with 13.5 volts delivered to the "BATTERY INPUT" receptacle J103 of Radio Transmitter-Receiver ★RT-40/APN-1X. The input current at 13.5 volts is increased to approximately 5.6 amperes when either an altitude limit indicator or an automatic pilot system is connected to the altimeter, and to approximately 5.9 amperes (intermittent maximum) when both an altitude limit indicator and an automatic pilot system are connected. The drain is increased approximately 0.3 ampere when operating in the high range.

**One Antenna ★AT-4/ARN-1 is furnished for transmitting and one for receiving.

TABLE I—EQUIPMENT SUPPLIED (MAJOR UNITS)

QUANTITY RADIO SETS ★AN/APN-				NAME OF UNIT	OVERALL DIMENSIONS (INCHES)			WEIGHT (POUNDS)	REFERENCE SYMBOL OR GROUP
1	1A	1B	1X		WIDTH	DEPTH	HEIGHT		
X	X	X	X	Radio Transmitter-Receiver (Assembled on Mounting Base)	18-1/16	8-25/32	7-21/32	20.2	
1	1	1		Radio Transmitter-Receiver ★RT-7/APN-1 (27 V.)	18-1/16	8-19/32	7-9/64	18.7	101-199
			1	Radio Transmitter-Receiver ★RT-40/APN-1X (13.5 V.)	18-1/16	8-19/32	7-9/64		101-199
1	1	1	1	Mounting Base ★MT-14/ARN-1*	18-1/16	7-5/8	2-1/4	1.5	A101
1		1†	1	Altitude Indicator (Double Range) ★ID-14/APN-1, ★ID-14A/APN-1 or ★ID-14B/APN-1	3-1/4	5-1/32 Max.	3-1/4	1.8	M201
	1			Altitude Indicator (Single Range) ★ID-1/ARN-1	3-1/4	4-7/16 Max.	3-1/4	1.55	M201
1	1	‡	1	Altitude Limit Switch ★SA-1/ARN-1 or ★SA-1A/ARN-1	3-1/4	5-23/32	3-1/4	0.95	E301
2	2	2	2	Antenna ★AT-4/ARN-1	11-9/16	1-25/32	7-9/16	0.7	E401, E402
X			X	Total Weight of Equipment—Less Cables and Plugs (Weight of cables and plugs will vary with specific installation and can be computed from unit weights listed on Figures 30 to 34, inclusive.)				24.4	
	X							24.1	
		X						21.6§	

*Mounting Base ★MT-14/ARN-1 is to be superseded by ★MT-14A/ARN-1 (new design) in later production.

†Supplied with a percentage of equipments as specified by the contract.

‡Supplied in bulk spares only.

§Not including Altitude Indicator and Altitude Limit Switch.

TABLE II—EQUIPMENT REQUIRED BUT NOT SUPPLIED

QUANTITY RADIO SETS ★AN/APN-				NAME OF UNIT	REQUIRED CHARACTERISTICS
1	1A	1B	1X		
1	1	1		D-C Power Source (Including connections to "BATTERY INPUT" plug P103 of Radio Transmitter-Receiver	22 to 29.5 V. (27 V. normal), 3 amp. (approx.) input to Radio Transmitter-Receiver
			1		11 to 14.75 V. (13.5 V. normal), 6 amp. (approx.) input to Radio Transmitter-Receiver
1†	1†	1†		Altitude Limit Indicator (Including connections to "LIMIT INDICATOR" plug P105 of Radio Transmitter-Receiver)	27 V. normal, .25 amp. max. See paragraph 3-a(2), Section I for detailed specifications.
			1†		13.5 V. normal, .25 amp. max. See paragraph 3-a(2), Section I for detailed specifications.
1†	1†	1†		Attitude Control Unit‡ (Including conections to "AUTOMATIC PILOT" receptacle J106 of Radio Transmitter-Receiver)§	27 V. normal. See Handbook of Maintenance Instructions.
			1†		13.5 V. normal. See Handbook of Maintenance Instructions.

†If and as specified by the Navy Department, Bureau of Aeronautics (or Technical Orders issued by authority of the Commanding General, Army Air Forces).

‡For use in conjunction with automatic pilot system when altimeter is to be used for automatic control of altitude.

§Materials for fabricating cable W505 (to connect altimeter to automatic pilot system) are supplied with Radio Set ★AN/APN-1B only.

SECTION II
INSTALLATION AND ADJUSTMENT

IMPORTANT

(1) SATISFACTORY PERFORMANCE OF THE ALTIMETER EQUIPMENT DEPENDS UPON PROPER ARRANGEMENT AND INSTALLATION OF THE ANTENNAS. DETERMINATION OF THE BEST ANTENNA ARRANGEMENT FOR A SPECIFIC APPLICATION INVOLVES TECHNICAL CONSIDERATIONS BEYOND THE SCOPE OF THIS MANUAL. IN EVERY APPLICATION INVOLVING A NEW OR MODIFIED AIRCRAFT DESIGN AND/OR A DIFFERENT COMBINATION OF OTHER RADIO EQUIPMENT, THE ANTENNA LAYOUT SHOULD BE APPROVED BY A TECHNICIAN THOROUGHLY FAMILIAR WITH THE BASIC PRINCIPLES AND REQUIREMENTS EXPLAINED IN THE "★AN/APN-1," "AYD-3 AND ★AN/ARN-1," "AYD AND AYD-2" OR AYB-1 MAINTENANCE MANUALS. AN ANTENNA ARRANGEMENT SATISFACTORY FOR *LOW-RANGE* OPERATION WITH EARLIER SINGLE-RANGE ALTIMETERS WILL NOT NECESSARILY BE SUITABLE FOR *HIGH-RANGE* OPERATION WITH ★AN/APN-1 SERIES ALTIMETERS.

(2) PROPER FUNCTIONING OF THE ALTIMETER IN CONJUNCTION WITH AN AUTOMATIC PILOT SYSTEM DEPENDS UPON CORRECT PERFORMANCE OF THE ALTIMETER EQUIPMENT AND SATISFACTORY CORRELATION OF THE DESIGN AND ADJUSTMENT OF THE AUTOMATIC PILOT SYSTEM WITH THE CHARACTERISTICS OF THE ALTIMETER AND THE INDIVIDUAL AIRCRAFT. IN EVERY APPLICATION INVOLVING A NEW AIRCRAFT DESIGN AND/OR ANY MODIFICATION OF THE AUTOMATIC PILOT SYSTEM, THE COMPLETE INSTALLATION LAYOUT SHOULD BE APPROVED BY A TECHNICIAN THOROUGHLY FAMILIAR WITH THE FUNDAMENTAL PRINCIPLES AND REQUIREMENTS EXPLAINED IN THE "★AN/APN-1" AND "AYD-3 AND ★AN/ARN-1" MAINTENANCE MANUALS.

1. GENERAL DETAILS.

The design of the ★AN/APN-1 Series altimeter equipments permits considerable flexibility of installation of the major components and accessories, which are shown in the equipment interconnection diagram, Figure 22. The two antennas ★AT-4/ARN-1 are installed on the under surface of either the wings or the fuselage. The Altitude Indicator (★ID-14/APN-1, ★ID-14A/APN-1 or ★ID-14B/APN-1, double-range; or ★ID-1/ARN-1, single-range) and the Altitude Limit Switch (★SA-1/ARN-1 or ★SA-1A/ARN-1) are designed for instrument panel mounting. The Radio Transmitter-Receiver (★RT-7/APN-1, 27 volts; or ★RT-40/APN-1X, 13.5 volts), which is used with the Mounting Base (★MT-14/ARN-1 or ★MT-14A/ARN-1), can be installed in any desired location complying with the requirements listed in paragraph 2-b of this section. The altitude limit indicator and the auxiliary attitude control unit of the automatic pilot system, which are not supplied with the ★AN/APN-1 Series equipments, must be designed for operation at the same input voltage as the Radio Transmitter-Reeciver, and installed in acordance with instructions issued by the Navy Department, Bureau of Aeronautics or Technical Orders issued by authority of the Commanding General, Army Air Forces.

2. RADIO TRANSMITTER-RECEIVER AND MOUNTING BASE.

a. GENERAL. – The Radio Transmitter-Receiver (★RT-7/APN-1, 27 volts; or ★RT-40/APN-1X, 13.5 volts) is designed for use with Mounting Base ★MT-14/ARN-1 or ★MT-14A/ARN-1. The mounting base is to be attached permanently to the aircraft structure. (See Figures 23 and 24.) The chassis and front panel, together with the dust cover, comprise a unit which may be detached from the mounting base by loosening two snap fasteners. The chassis, including the front panel, is removed from the dust cover (without detaching the latter from the mounting base) by loosening two thumb screws. Before installing this unit, the chassis should be removed and carefully inspected to make sure that all tubes are properly seated in the correct sockets.

Note

The Radio Transmitter-Receiver must be calibrated for the specific installation by authorized personnel—see paragraph 11, this section. Once adjusted, the unit is interchangeable (without recalibration) only with other units which are identically adjusted. The "residual altitude" for which the Radio Transmitter-Receiver has been compensated should be recorded for future reference in the card holder provided on the front panel. (Army personnel will record this information on special Army cable markers—not supplied.)

b. LOCATION.—In determining the location of the Radio Transmitter-Receiver, consideration should be given to the following factors:

(1) The front panel must be accessible for adjustments, replacement of fuses and attachment of cables.

(2) Sufficient clearance must be provided (as indicated in Figure 23) to permit complete freedom of motion of the unit on the shock mounting base. *Do not run any cables beneath the frame of the mounting base.*

(3) Although the equipment is designed to withstand continuous operation at ambient temperature as high as 50 degrees Centigrade (122 degrees Fahrenheit) the Radio Transmitter-Receiver should be located with consideration to the ambient temperature and freedom of air circulation around the unit. (Approximately 70 watts is dissipated within the unit.)

(4) Space should be available for servicing the unit under actual operating conditions.

(5) The location with respect to other units must conform to specific requirements of cable lengths—see paragraph 6-a of this section, also Figure 22. Avoid excessive lengths of the cables so as to minimize (a) r-f attenuation in the antenna circuits, (b) voltage drops in the power circuits and (c) the overall weight of the installation.

c. MOUNTING PROCEDURE.—The Radio Transmitter-Receiver is to be mounted on a horizontal surface in a convenient operating location selected in accordance with the foregoing recommendations. With the unit removed from its mounting base, fasten the mounting base to the supporting surface.

(1) The drilling plan for mounting base ★MT-14/ARN-1 is shown dotted in the top view, Figure 23. Sixteen No. 8 machine screws (not furnished) are required, four screws for fastening each foot to the mounting surface. Make certain that a positive electrical contact is made to the aircraft structure at each foot, so as to ground the unit effectively through the locking devices and the individual grounding straps which connect each shock mounting foot to the frame. A good electrical ground promotes safety and minimizes possible electrical interference with other radio equipment.

(2) After the Radio Transmitter-Receiver has been calibrated for the residual altitude of the particular installation (see "NOTE," paragraph 2-a, this section), slide the unit into position and lock it to the mounting base.

3. ALTITUDE INDICATOR.

a. LOCATION.—Both the double-range Altitude Indicator ★ID-14/APN-1, ★ID-14A/APN-1 or ★ID-14B/APN-1 (Figure 25) and the single-range Altitude Indicator ★ID-1/ARN-1 (Figure 26) are "AN" type instruments designed for panel mounting.*

(1) Select the location for the convenience of the operator in viewing the scale and operating the power switch and the range switch.

*The double-range Altitude Indicator ★ID-14/APN-1, ★ID-14A/APN-1 or ★ID-14B/APN-1 is furnished with the ★AN/APN-1 and ★AN/APN-1X equipments, also with a number of ★AN/APN-1B equipments for testing purposes. The single-range Altitude Indicator ★ID-1/ARN-1 is furnished with the ★AN/APN-1A equipment only.

(2) Allow sufficient space for removal of the cable. See Figure 25 or Figure 26.

(3) Provide suitable illumination as required for the luminescent pointer and scale markings. Altitude Indicators ★ID-14/APN-1 and ★ID-1/ARN-1 have *pale green* markings. The dial numerals, the associated major graduations and the pointer tip are fluorescent-radioactive; all other scale markings and the remainder of the pointer are fluorescent-phosphorescent. Altitude Indicator ★ID-14A/APN-1 has luminescent markings of similar characteristics except *pale yellow* in color (for response to red illumination) and non-phosphorescent. Altitude Indicator ★ID-14B/APN-1 has *pale yellow* luminescent (non-radioactive and non-phosphorescent) markings throughout.

b. MOUNTING PRECAUTION.—Calibration of the aircraft's magnetic compass may be affected by close proximity to the magnet contained in the Altitude Indicator. *Therefore, the Altitude Indicator should be installed as far away as practicable from the compass.*

c. MOUNTING PROCEDURE.—For panel mounting, provide clearance holes for the meter rim, switch shafts and mounting screws, in accordance with the dimensions shown on the outline drawing for the double-range (Figure 25) or single-range (Figure 26) Altitude Indicator to be installed. The power switch and range switch knobs can be removed after loosening the set-screws (for this purpose an Allen wrench is provided in a spring holder located inside the Radio Transmitter-Receiver at top left end of chassis). The double-range Altitude Indicator ★ID-14/APN-1, ★ID-14A/APN-1 or ★ID-14B/APN-1 is mounted with two No. 8-32 machine screws; three No. 6-32 machine screws are used for mounting the single-range Altitude Indicator ★ID-1/ARN-1. In red-lighting sub-panel installations, replace the standard knobs with extended-length knobs, RCA part numbers K-259014-1 for the range switch and K-259015-1 for the power switch. (These special knobs are not included with the ★AN/APN-1 Series equipments.)

Note

The pointer normally rests against a stop and indicates below zero on the scale when the Altitude Indicator is not energized. DO NOT DISTURB THIS SUB-ZERO ADJUSTMENT.

d. EXTERNAL RANGE SWITCH (U. S. ARMY).—The single-range Altitude Indicator ★ID-1/ARN-1 supplied with Radio Set ★AN/APN-1A does not include a means for changing the range of Radio Transmitter-Receiver ★RT-7/APN-1. However, an external range switch kit is furnished by the U. S. Army with each ★AN/APN-1A altimeter equipment. The kit consists of a single-pole, single-throw toggle switch attached to a small mounting plate on which is marked the "400" (0 to 400 feet) and "4000" (400 to 4000 feet) altitude ranges corresponding to the two switch positions. The switch plate should be mounted in a convenient operating position as close to the Altitude Indicator as possible. The outline and mounting dimensions of the switch assembly and the necessary connections to the switch are shown at the upper right of the U. S. Army cable diagram, Figure 11. When the external range switch is in the "4000" position, the scale of the Altitude Indicator ★ID-1/ARN-1 will read directly in thousands of feet, instead of in hundreds of feet as marked.

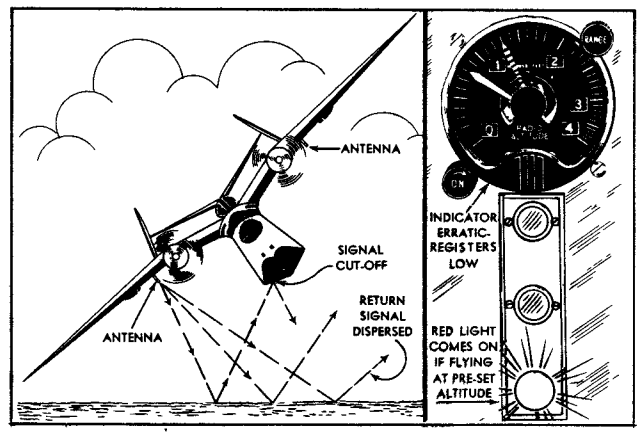


Figure 7—Example of Return Signal Cut Off During Steep Bank

4. ALTITUDE LIMIT SWITCH

a. LOCATION.—The Altitude Limit Switch* should be mounted on the instrument panel or at another location convenient to the operator where sufficient space is available for removal of the cable. See Figure 27. Provide suitable illumination as required for the luminescent scale and indicator knob. Altitude Limit Switch ★SA-1/ARN-1, supplied in equipments of early production, has a *pale green* fluorescent-phosphorescent scale and knob indicator line. Altitude Limit Switch ★SA-1A/ARN-1, supplied in equipments of later production, has *pale yellow* fluorescent(non-phosphorescent) markings.

b. MOUNTING PROCEDURE.—The Altitude Limit Switch, ★SA-1/ARN-1 or ★SA-1A/ARN-1, shown in Figure 27 should be mounted according to standard practice for "AN" type instruments, using four No. 6-32 machine screws (not furnished).

5. ANTENNAS

a. GENERAL.—Two identical antennas ★AT-4/ARN-1 (Figure 28) are used in the ★AN/APN-1 series altimeter installation, one for transmitting and the other for receiving. The main objectives of the antenna installation are (1) to radiate and receive as strong a signal as possible in a downward direction, (2) to avoid direct "feed through" of the signal from the transmitting antenna to the receiving antenna, and (3) to minimize variations in the received reflected signal resulting from changes in the position or attitude of the airplane when executing a normal dive, climb or bank

*The Altitude Limit Switch is not supplied with Radio Set ★AN/APN-1B, except in bulk spares for testing purposes only. (See paragraph 14-b of this section.)

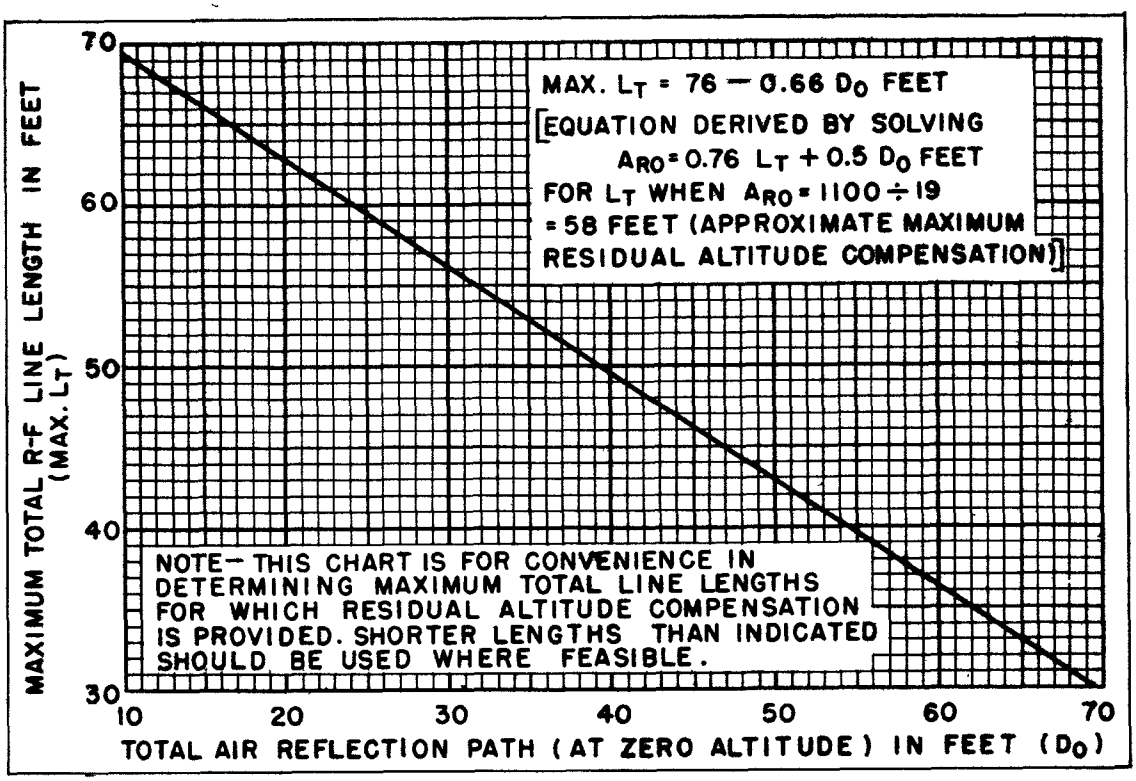


Figure 8—Chart for Determining Maximum Total Length of Transmission Lines

(see Figure 7). Unless there is a possibility of mutual interference with other radio equipment installed on the airplane, either antenna can be used for transmitting or receiving without affecting the operation of the altimeter equipment. To insure satisfactory high-range operation, careful consideration must be given to the prevention of electrical noise interference (including "field modulation"). Refer to Handbook of Maintenance Instructions.

b. MOUNTING PRECAUTIONS.—

(1) The antennas are to be installed where no protruding objects (struts, wires, tubes, etc.) exist within a distance of two feet. No obstructions should exist in the ground reflection path between the transmitting and receiving antennas at any flying position for which altimeter operation is required, as the shielding effect of such obstructions may interrupt the received signal and cause the altimeter and automatic pilot to function erratically.

(2) In cases where the equipment works simultaneously with other radio transmitting equipment operating near the same frequency as the altimeter, careful consideration must be given to the antenna installations of both equipments. For best operation of the altimeter, its receiving antenna should be installed where the pickup from the transmitting antenna of the other equipment will be minimized. Consideration should be given to the radiation patterns involved, shielding by the metal construction of the airplane, etc.

(3) If it is necessary to paint the antennas, avoid getting any paint on the insulator ring at the midsection of the horizontal radiating member.

c. MOUNTING PROCEDURE.—

(1) Locate the antennas so that the "residual altitude" or "residual delay" does not exceed 58 feet, in order that the altimeter calibration may be satisfactorily compensated. (See paragraph 2-a "Note" of this section.) The residual altitude A_{RO} may be computed as follows:

$$A_{RO} = 0.76\ L_T + 0.5\ D_O \text{ feet}$$

where: L_T = total combined length of transmission lines W501 and W502, in feet;

and D_O = total length of ground reflection path between antennas (at zero altitude when landing), in feet.

For a specific antenna placement, the zero altitude reflection path D_O is fixed by the spacing of the antennas when alighting, and is represented by $D_1 + D_2$ on Figure 29. With given values of D_O, the maximum permissible values of L_T (corresponding to 58 feet of residual altitude) are indicated on Figure 8. In general, the lengths of the transmission lines, the distance between the antennas, and the included angle of the ground reflection path should not be greater than required for a satisfactory installation. (For a more detailed discussion of residual altitude, see Handbook of Maintenance Instructions.)

(2) Each antenna requires a metal reflector at least two feet square, approximately flat, flush with and parallel to the antenna grounding plate. The outer

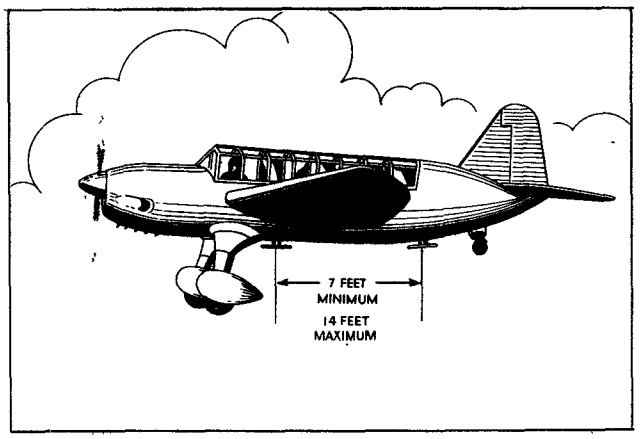


Figure 9—"In Line" Antenna Mounting—Under-Fuselage Arrangement

metal surface of the airplane inherently meets this requirement. If the mounting surface is fabric covered, a separate thin metal plate may be installed centrally with respect to each antenna as indicated in Figure 29, or the fabric may be metalized by a suitable metal spray. The surface of each reflector adjoining the antenna mounting plate should be thoroughly cleaned to insure positive electrical contact. Thoroughly remove all oxides, paint and anodization. If anti-corrosion preparations are to be used, they must be applied after the antennas have been installed.

(3) Details of the antenna installation are shown in Figure 29. In all installations, the two antennas must be mounted with the horizontal radiating member downward and parallel to the line of flight, with the thicker edges of the vertical members placed forward so as to obtain minimum slipstream resistance. The drilling plan for mounting the antennas is shown in Figure 28. The 1⅛-inch square hole is located toward the rear so that the thicker edges of the streamlined vertical members face forward. Securely mount each antenna with four No. 8 machine screws (not furnished). Before mounting the antennas, it may be desirable first to connect the r-f transmission lines to them (see paragraph 7 of this section).

d. "IN LINE" ANTENNA ARRANGEMENT.—

(1) The two antennas may be mounted on the under surface of the fuselage, with the horizontal members aligned on a common axis parallel to the axis of the fuselage, as shown in Figure 9. When the antennas are installed with a space of approximately seven feet between centers, no intermediate shielding is necessary. If a particular installation requires, the spacing may be increased to a maximum of 14 feet.

(2) In making an "in line" antenna installation, avoid proximity to objects (such as torpedoes, bombs, or floats) which will reflect an appreciable "feed through" signal from the transmitting antenna to the receiving antenna. In the case of torpedoes or bombs, it may be possible to align the antennas on a common axis with the obstruction. This usually reduces the reflected signal from this source to a satisfactory level.

CAUTION

Although this type of installation provides excellent operation of the equipment, damage to the antennas during take-off and landing in combat areas is severe. Therefore, the "in line" antenna arrangement should be avoided.

e. "SHIELDED" ANTENNA ARRANGEMENT.—Another satisfactory antenna arrangement is to use a metal part of the airplane with electrical continuity (such as the fuselage, the motor mounts, etc.) as shielding between the transmitting and receiving antennas. (See Figure 10.) This type of antenna installation is suitable for mid-wing or high-wing airplanes. When this arangement is used, little trouble is encountered from "feed through" between the two antennas.

6. INTERCONNECTING CABLES.

a. GENERAL.—The cable connections between the units are shown on the equipment interconnection diagram, Figure 22. (U. S. Army personnel refer also to Figure 11.) Since the cable lengths are determined by the requirements of the particular installation, the cable materials are furnished unassembled, as listed on the cable outline assembly drawings, Figures 30, 31, 32 and 33. (With the exception of the plugs P103 and P105 for attaching to the Radio Transmitter-Receiver, materials are not supplied for either the battery input or the altitude limit indicator cables.) All the cables should be as short as possible after meeting the following requirements:

(1) Avoid sharp bends in the cables. The minimum bending radius of each cable (for which materials are furnished) is specified on Figure 22.

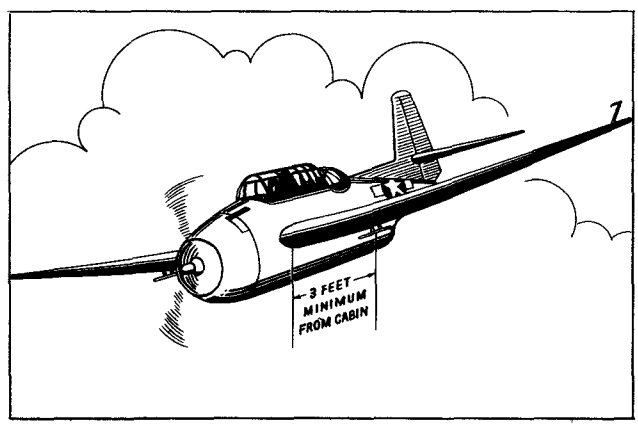


Figure 10—"Shielded" Antenna Mounting—Under-Wing Arrangement

(2) Provide sufficient length for disconnecting the cables from the units, also to permit removal of units for servicing while operating.

(3) The receiver antenna transmission line W501

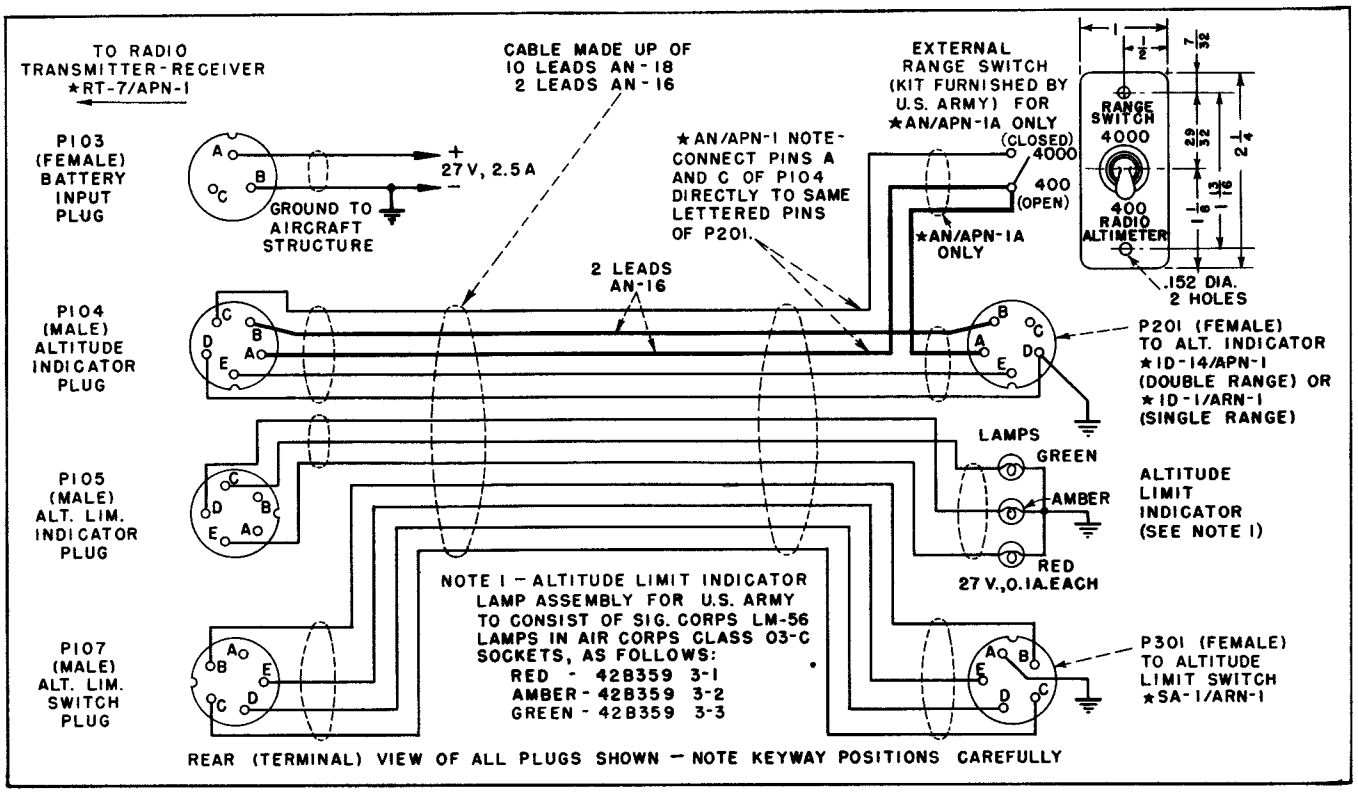


Figure 11—U. S. Army Cable Diagram for Radio Sets ★AN/APN-1 and ★AN/APN-1A

should be long enough to permit its connection to the "TRANSMITTER ANTENNA" receptacle J102 for tests.

(4) The combined length of the two antenna transmission lines W501 and W502 for a specific installation should not exceed the length determined from Figure 8. See paragraph 5-c (1) of this section.

(5) The length of the Altitude Indicator cable W503 should be limited so as not to exceed a total series resistance of the power switch leads (connected to pins A and B of P104 and P201) of 0.12 ohm for 13.5-volt models (equivalent to 20 feet of specified cable wired as shown for "Cable W503 Connections" on Figure 31), to avoid an excessive input voltage drop.

(6) Avoid excessive loading of the Radio Transmitter-Receiver shock mounting (Mounting Base ★MT-14/ARN-1 or ★MT-14A/ARN-1) in any direction, resulting from tension or weight of cables, by providing slack or by supporting the cable if necessary. The heavy automatic pilot cable W505 should always be supported when it is included in the installation.

(7) Do not run any cables beneath the frame of Mounting Base ★MT-14/ARN-1 or ★MT-14A/ARN-1.

b. ASSEMBLY OF CABLES.—Detailed information for assembling the r-f transmission lines W501 and W502, which connect the Radio Transmitter-Receiver to the two antennas, is given on Figure 30. The assembly information for the two multiple-conductor cables W503 and W504, connecting the Radio Transmitter-Receiver to the Altitude Indicator and the Altitude Limit Switch, is given on Figure 31.* If plug P301 is of the straight type (AN-3106-18-20S) supplied in later production to facilitate mounting of the Altitude Limit Switch on console panel ★MT-220/A, cable W504 is to be assembled as shown on Figure 32. Assembly of the automatic pilot cable W505 (for Radio Set ★AN/APN-1B) is shown on Figure 33.

PRECAUTION

For all soldered connections, use only rosin flux-core solder. Do not use flux which is corrosive in the slightest degree. Avoid using excess solder. Do not apply heat longer than necessary for soldering. Do not permit the soldering iron to contact the conductor insulation or the cable jacket.

c. CABLE TESTS.—After the transmission lines and cables have been assembled, check them for electrical continuity and for voltage breakdown, in acordance with Table IV, page 2-10. For the breakdown test, apply 1000 volts d-c or 700 volts a-c (r.m.s.) from a source protected by a circuit-breaking device to prevent damage if a breakdown should occur.

Note

The lengths of the antenna transmission lines should be carefully measured before they are installed. A record of these lengths should be

*Cables W503 and W504 normally will not be used in the final ★AN/APN-1B installation. See paragraph 8-a, this section.

kept for each installation. (For U. S. Army installations, these lengths are also to be stamped on special Army antenna cable markers—not supplied.) The calibration of the Radio Transmiter-Receiver (see paragraph 2-a "Note" this section) will be partially governed by these measurements.

7. ANTENNA CONNECTIONS.

a. GENERAL.—Either antenna can be connected for transmitting or receiving, without effect on the altimeter operation, unless interference occurs when the altimeter equipment is operated simultaneously with other radio equipment on the aircraft—see paragraph 5-b(2), this section. Connect the coaxial r-f transmission lines W501 and W502 to the antennas either directly or through the two elbow adapters* E507 and E508. (See Figures 22 and 29). Tighten the coupling nuts firmly by hand, being careful to engage the teeth at the male ends of the fittings with notches at the female ends. Check the engagement and firmness of the fitting by moving the connections frequently while tightening. After the antennas are mounted and the Radio Transmitter-Receiver is calibrated and installed, attach the r-f transmission lines to receptacles J101 and J102 at the Radio Transmitter-Receiver through elbow adapters* E509 and E510 in a similar manner.

Note

In all installations, elbow adapter E510 must be installed in the "TRANSMITTER ANTENNA" receptacle J102 of the Radio Transmitter-Receiver. The use of elbow adapter E509 in the "RECEIVER ANTENNA" receptacle J101 is optional.

8. CONTROL CONNECTIONS.

a. ALTITUDE INDICATOR AND ALTITUDE LIMIT SWITCH.—Connect the Altitude Indicator (M201) and the Altitude Limit Switch (E301) to the Radio Transmitter-Receiver by means of cables W503 and W504, respectively, as indicated in Figure 22. Tighten the coupling nuts securely by hand. In the final ★AN/APN-1B installation, which does not include the Altitude Indicator and the Altitude Limit Switch, special auxiliary plugs are installed in the corresponding receptacles J104 and J107 of the Radio Transmitter-Receiver, in accordance with paragraph 9-b this section.

b. ALTITUDE LIMIT INDICATOR.—A separate elbow plug P105 (Figure 31, item 6) is supplied to connect the altitude limit indicator cable to receptacle J105 of the Radio Transmitter-Receiver. The altitude limit indicator and the connecting cable are not supplied with the altimeter equipment. A suggested altitude limit indicator system, using colored lights, is shown schematically in the upper left inset of Figure 22. The

*Navy Type No. "49192-A" of any make. Originally supplied by Selectar Mfg. Corp. as "CSX-49192"—Do not substitute Navy Type No. "49192" adapters of other makes. Approved alternate: Gephardt Mfg. No. "19192".

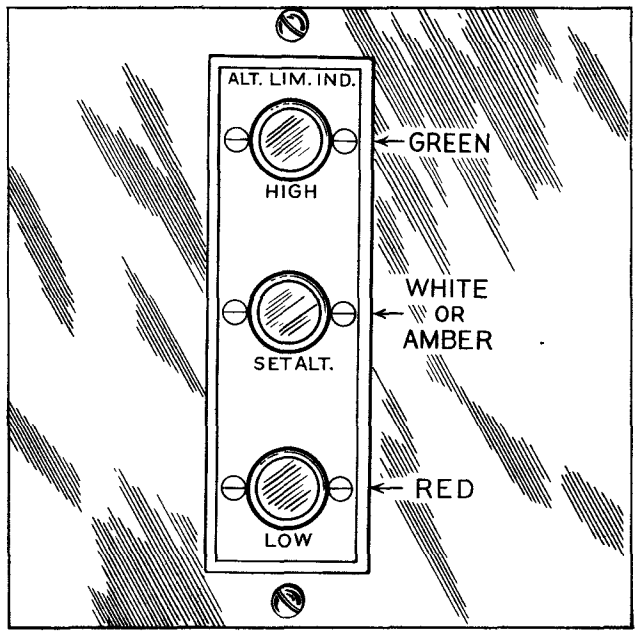


Figure 12—Altitude Limit Indicator Suggested Panel Arrangement

altitude limit indicator, when required in the installation, is installed and connected in accordance with instructions issued by the Navy Department, Bureau of Aeronautics, or Technical Orders issued by authority of the Commanding General, Army Air Forces. Make certain that the voltage rating is identical to that of the Radio Transmitter-Receiver. Refer to the "CAUTION" notice on Figure 22 if the altimeter is to be operated in conjunction with an automatic pilot system.

U. S. ARMY NOTE

In U. S. Army installations, the connections from the Radio Transmitter-Receiver to the Altitude Indicator, Altitude Limit Switch and Altitude Limit Indicator will be made by means of an external "harness" composed of individual conductors as shown for Radio Sets ★AN/APN-1 and ★AN/APN-1A in Figure 11. The standard 8-wire shielded cable WM-1/U (W503A, W504A), supplied for fabricating cables W503 and W504, will not be used in U. S. Army installations.

c. AUTOMATIC PILOT SYSTEM.—If the altimeter is to be operated in conjunction with an automatic pilot system, make the required connections to the "AUTOMATIC PILOT" receptacle J106 of the Radio Transmitter-Receiver (See Figure 22) in accordance with instructions of the Navy Department, Bureau of Aeronautics, or Technical Orders issued by authority of the Commanding General, Army Air Forces.

9. AUXILIARY PLUGS.

a. "AUTOMATIC PILOT" DUMMY P108.—If the installation includes an altitude limit indicator but

the altimeter equipment is not connected to an automatic pilot system, install the resistor-plug assembly P108 (Figure 33, item 10) in the "Automatic Pilot" receptacle J106 of the Radio Transmitter-Receiver, as indicated in Figure 22. Tighten the coupling nut securely by hand.

b. SPECIAL PLUGS FOR RADIO SET ★AN/APN-1B.—Two special auxiliary plugs are furnished with Radio Set ★AN/APN-1B only, as follows:

(1) "INDICATOR" DUMMY P110.—The connector assembly P110 (Figure 34, item 12) is installed in place of the cable W503 in the "INDICATOR" receptacle J104 of the Radio Transmitter-Receiver. The function of this auxiliary plug is to close the altimeter power and meter circuits when the Altitude Indicator is not used.

(2) "LIMIT SWITCH" DUMMY P111.—The connector assembly P111 (Figure 34, item 13) is for use in the ★AN/APN-1B installation only. The auxiliary plug P111 is installed in place of cable W504 in the "LIMIT SWITCH" receptacle J107 of the Radio Transmitter-Receiver. The function of the Altitude Limit Switch is then performed by a special unit (not furnished with the altimeter equipment) to which connections are made through the "AUTOMATIC PILOT" receptacle J106 and cable W505.

10. BATTERY INPUT CONNECTIONS.

a. The d-c primary power source for the altimeter equipment consists of a storage battery having the required nominal voltage (24 or 12 volts). Preferably, it should be operated with a suitable engine-driven generator and a voltage regulator which is adjusted to supply the normal rated input voltage (27 or 13.5 volts) at the Radio Transmitter-Receiver when operating. A separate elbow plug P103 (Figure 31, item 4) is supplied for connecting the battery input cable to receptacle J103 of the Radio Transmitter-Receiver. The battery input cable is not supplied. The required connections, indicated schematically on Figure 22, should be in accordance with instructions issued by the Navy Department, Bureau of Aeronautics, or Technical Orders issued by authority of the Commanding General, Army Air Forces. The battery input cable should be as short as possible and should run directly to the voltage source, to prevent excessive voltage drop. The effective resistance of the cable should not exceed 0.05 ohm for the 13.5-volt model. Care must be taken to insure proper polarity (negative ground, as indicated) or damage to the equipment may result. *Before making the connection to the "Battery Input" receptacle J103, make certain that the input voltage rating of the Radio Transmitter-Receiver (also of the Altitude Limit Indicator and the Attitude Control Unit of the Automatic Pilot, when used) corresponds to the battery input voltage.*

11. INSTALLATION ADJUSTMENTS

a. GENERAL.—The Radio Transmitter-Receiver must be calibrated for the particular installation as described in the "Note" following paragraph 2-a, this section. When the calibration is completed and the equipment is carefully installed in accordance with the foregoing instructions, the altimeter equipment normally requires no further routine adjustments. The equipment should be checked by a trained maintenance man before being placed in service and if necessary, adjustments should be made to insure proper functioning. (Comprehensive instructions for all tests and adjustments are contained in the Maintenance Handbook.) For purposes of the ensuing tests, both an Altitude Indicator and an altitude limit indicator should be temporarily, if not permanently, installed and connected to the Radio Transmitter-Receiver.

12. ALTITUDE INDICATOR.

a. As mentioned in paragraph 3-c "NOTE," this section, the meter pointer normally rests in a sub-zero position when the equipment is not energized. The unit has been adjusted at the factory so that a direct current of 1.5 milliamperes (applied through terminals D-E of the rear connector J201) causes the pointer to assume the zero position of the scale. *Do not disturb this sub-zero adjustment.*

b. The Altitude Indicator may not read zero with the equipment operating, when the airplane is standing still or taxiing. A false reading may be caused by spurious reflections from nearby objects and does not necessarily indicate the improper calibration of the equipment. Also, during take-off in some planes, the Altitude Indicator may read 25 to 50 feet higher than the actual altitude for approximately the first 50 feet of climb. This is usually caused by the abnormal vibration of the airplane under full power during take-off, and does not indicate faulty operation. The zero altitude calibration is best checked when landing, by noting the LOW-RANGE reading of the Altitude Indicator at the exact instant the landing gear makes contact with the ground. See paragraph 14-b(6), this section.

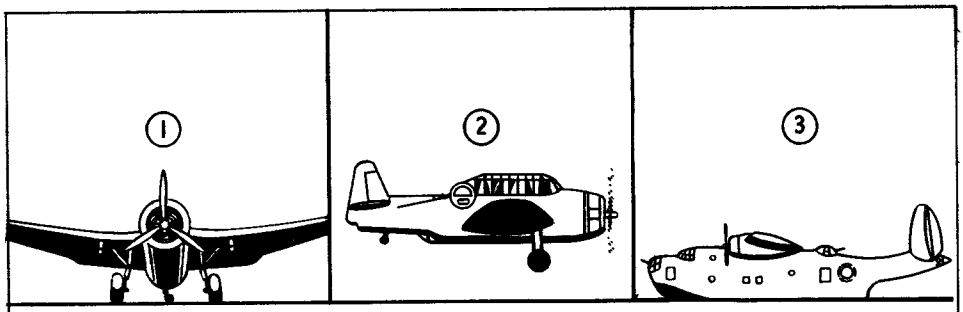
WARNING

The high range (400 to 4000 feet) of the altimeter must never be used when flying at altitudes within the low range (0 to 400 feet) or when landing. The high range is not calibrated for such use and an inaccurate altitude indication would result.

13. AUTOMATIC PILOT SYSTEM.

a. ADJUSTMENTS.—Instructions for adjusting the automatic pilot equipment (for operation in connection with the ★AN/APN-1 series altimeters) are provided by the Navy Department, Bureau of Aeronautics, or Technical Orders issued by authority of the Commanding General, Army Air Forces. See "IMPORTANT" NOTE (2) under the heading "INSTALLATION AND ADJUSTMENT" at the beginning of this section.

b. GROUND CHECK.—When the altimeter installation includes the connections to the automatic pilot



1. a. The altimeter may indicate zero when the airplane is at rest in an open area provided a normal ground reflected signal from the transmitter reaches the receiver antenna.

b. The altimeter indication may be above or below zero if the transmitted signal is prevented from being received directly. This condition may be accompanied by erratic indications on the instrument.

2. The altimeter on most land plane installations will indicate approximately zero immediately before the airplane lands.

3. The altimeter in a seaplane will not register properly when the seaplane is adjacent to the surface or when resting on the water.

Figure 13—Altimeter Indications At or Near Zero Altitude

equipment, a careful check should be made on the ground, before proceeding with the flight test. This is necessary to ensure that, when flying BELOW the preset altitude, the automatic pilot will act in the proper direction to INCREASE the altitude. The opposite response of the automatic pilot would naturally result in a crash unless prevented by prompt action of the pilot in taking over manual control of the aircraft. This check should be performed only by qualified maintenance personnel according to instructions contained in the Maintenance Handbook.

CAUTION

Do not proceed until you are thoroughly familiar with the operation of the equipment as described in Section III.

14. FLIGHT TESTS.

(Not for U. S. Army personnel.)

a. GENERAL.—A short initial flight test to check the overall operation and the calibration of both the altitude indicator and the altitude limit indicator channels is desirable. The accurate performance of the altimeter when used with the automatic pilot is directly dependent upon the correct calibration of the altitude limit indicator channel within the required limits. The aircraft should be equipped for test purposes with a barometric altimeter accurately adjusted and calibrated to indicate "absolute" altitude with reference to the water or the level terrain over which the test is to be conducted. If possible, avoid making the flight tests under extremely rough or "bumpy" air conditions.

b. ALTIMETER CALIBRATION CHECK.—For this test, install the "dummy" resistor-plug assembly P108 in the "AUTOMATIC PILOT" receptacle J106 of the Radio Transmitter-Receiver.

★AN/APN-1B NOTE

In the ★AN/APN-1B installation, it will be necessary to connect temporarily a standard Altitude Limit Switch ★SA-1/ARN-1 or ★SA-1A/ARN-1 (E301—supplied for this model only in the bulk spares) through cable W504 to receptacle J107 in place of the auxiliary plug P111. *In the final ★AN/APN-1B installation, the Altitude Limit Switch must never be substituted for P111 in receptacle J107 when the cable W505 is connected to the "AUTOMATIC PILOT" receptacle J106, or improper operation will result.*

After the barometric altimeter adjustment has been made, proceed immediately to check the calibration as follows:

(1) Before taking-off, turn the power switch of the Altitude Indicator to the "ON" position. Allow a minute or two for the tubes to heat and for the pointer to deflect from its sub-zero position (see paragraphs 12-a and 12-b, this section). Set the range switch for the low range (0 to 400 feet). MAKE SURE THAT THE CHANGEOVER CONTROL—SEE PARAGRAPH 1-a (4), SECTION III—IS SET FOR MANUAL OPERATION.

(2) After taking-off, climb until the calibrated barometric altimeter indicates an altitude intermediate

TABLE III—MINIMUM DROP-OUT ALTITUDES		
Type of Terrain	Minimum Drop-out Altitude (Feet)	
	Low Range	High Range
Calm water	1500	8000
Land of average conductivity	800	6000

between the upper scale limits of the Altitude Limit Switch and the Altitude Indicator. While maintaining this altitude over the smooth water or level unobstructed ground chosen for the test, note the Altitude Indicator deflection, which should agree approximately with that of the barometric altimeter.

(3) Continue the flight over the test terrain, checking the "drop-out" by climbing gradually to altitudes above that corresponding to full scale deflection of the Altitude Indicator. The pointer should remain off scale up to minimum altitudes (indicated by the calibrated barometric altimeter) as specified in Table III.

(4) With the aircraft in flight over reasonably smooth water or level unobstructed ground (not necessarily the previously chosen test terrain), check the altitude limit indicator signals for each setting of the Altitude Limit Switch. (During this check, no comparison with the barometric altimeter indications is required.) At any step of altitude, the "on altitude" signal (white or amber light in the limit indicator system suggested on Figure 22) should be obtained when the approximate corresponding altitude is indicated by the Altitude Indicator. The "low" and "high" signals (red and green, respectively) should appear at altitude indications slightly below and above the nominal altitude for which the Altitude Limit Switch is set. See paragraph 5-a(1), Section III.

(5) Repeat the foregoing steps with the range switch set for the high range (400 to 4000 feet).

(6) When preparing to land, set the range switch for the LOW RANGE. (See "WARNING" notice, paragraph 12-b of this section). Carefully observe the Altitude Indicator deflection. If the Radio Transmitter-Receiver is correctly calibrated, the pointer should indicate approximately zero altitude at the instant the landing gear contacts the ground.

If the required accuracy of calibration was not obtained throughout the preceding test, or if the "drop-out" occured at too low an altitude, refer to the Maintenance Handbook for further instructions before proceeding.

IMPORTANT

Do not tamper with the "INDICATOR ZERO ADJUSTMENTS," "LIMIT INDICATOR ADJUSTMENTS," or "CALIBRATION ADJUSTMENTS" (Figure 23) after the equipment has been calibrated.

c. TEST OF OPERATION WITH AUTOMATIC PILOT.—If the results of the altimeter calibration check were satisfactory as to calibration and performance of the altimeter equipment, another flight test should be made to check the overall performance with the automatic pilot system (when the latter is included in the installation). This test should be conducted over level unobstructed terrain or over water, and should be performed only by qualified personnel, in accordance with the recommended procedure outlined in the Maintenance Handbook. Other tests should be performed as specified by the Navy Department, Bureau of Aeronautics or Technical Orders issued by authority of the Commanding General, Army Air Forces, according to the type of service anticipated for the particular installation.

TABLE IV—CABLE TESTS (See Paragraph 6-c, this Section)		
CABLE	CONTINUITY	BREAKDOWN
W501, W502	1. Between male (center) terminals at opposite ends. 2. Between shells at opposite ends.	Male (center) terminal to shell, at either end.
W503, W504	1. Between each pin at one end and corresponding pin at opposite end. 2. Between shells at opposite ends. 3. W503—From pin D to shell, at each end. 4. W504—From pin A to shell, at each end.	W503—From each pin (except D) individually to all other pins and to shell, at either end. W504—From each pin (except A) individually to all other pins and to shell, at either end.
W505	1. Between each pin except C and D (or 3 and 4) of P106 and associated conductor at opposite end. Connections are shown on Fig. 33. 2. From P106 shell to pin F (or 6), also to cable shield and to six individual conductor shields at opposite end.	From each pin except F (or 6) individually to all other pins and to shell of P106.

SECTION III
OPERATION

CAUTION

OPERATING PERSONNEL MUST NOT DISTURB ANY OF THE COVERED SCREWDRIVER ADJUSTMENTS ON THE FRONT PANEL OF THE RADIO TRANSMITTER-RECEIVER. THESE ADJUSTMENTS ARE ACCESSIBLE EXTERNALLY ONLY FOR THE CONVENIENCE OF QUALIFIED INSTALLATION OR MAINTENANCE PERSONNEL WHEN CALIBRATING THE EQUIPMENT.

1. OVERALL FUNCTIONS OF EQUIPMENT.

a. INDICATION OF ALTITUDE.—The primary function of the Radio Set ★AN/APN-1 Series altimeters is to provide direct measurement of "absolute altitude" (terrain clearance) during flight. This is accomplished by measuring electrically the time interval required for a transmitted radio signal to travel to earth and return to the aircraft. The altitude is indicated directly by a d-c meter (Altitude Indicator) operated from the altimeter. Two altitude ranges are provided as follows:

(1) LOW RANGE—0 to 400 feet.

(2) HIGH RANGE—400 to 4000 feet.

b. AUTOMATIC ALTITUDE CONTROL.—In conjunction with a suitable automatic pilot system, the ★AN/APN-1 Series altimeter may be used to control the altitude of flight with reference to "pre-set altitudes" (settings of the Altitude Limit Switch) as follows:

(1) LOW RANGE—From 50 to 300 feet, inclusive, in steps of 25 feet.

(2) HIGH RANGE—From 500 to 3000 feet, inclusive, in steps of 250 feet.

c. ALTITUDE LIMIT INDICATIONS.—Provisions are made for connecting an altitude limit indicator (not supplied), to function as follows:

(1) WHEN USED WITHOUT AUTOMATIC PILOT.—Indicates whether flight is within, above or below a "control range" or "dead spot" at the pre-set altitude.

(2) WHEN USED WITH AUTOMATIC PILOT.—Indicates attitude (pitch) corrections signalled by the altimeter to the automatic pilot system.

2. FUNCTIONS AND LOCATIONS OF CONTROLS.

a. The controls used for operating the ★AN/APN-1 Series altimeters are as follows:

(1) POWER SWITCH.—The power switch controls the battery input to the altimeter equipment. It is operated by the knob marked "ON," with clockwise arrow, at the lower left corner of the Altitude Indicator. The double-range Altitude Indicator ★ID-14/APN-1, ★ID-14A/APN-1 or ★ID-14B/APN-1 is shown in Figure 1. The single-range Altitude Indicator ★ID-1/ARN-1, supplied only with Radio Set ★AN/APN-1A, is shown in Figure 3.

(2) RANGE SWITCH.—The range switch is used to select the desired altitude range of the altimeter. It is operated by the knob marked "RANGE" located at the upper right corner of the double-range Altitude Indicator. (See Figure 1.) This knob is set in the counter-clockwise position for the low range (0 to 400 feet) and in the clockwise position for the high range (400 to 4000 feet). The scale numerals are changed by operation of the switch so that the scale reads directly in hundreds of feet for either range, as shown in views (A) and (B) of Figure 1.

U. S. ARMY NOTE

In the ★AN/APN-1A installation, which uses the single-range Altitude Indicator ★ID-1/ARN-1 (Figure 3), an external toggle-type range switch is supplied by the U. S. Army for separate mounting. (See paragraph 3-d, Section II.) This switch, shown at the upper right of Figure 11, is set in the "400" position (downward) for the low range and in the "4000" position (upward) for the high range. On this model, the altitude indicator scale reads in hundreds of feet for the low range (0 to 400 feet), and in thousands of feet for the high range (400 to 4000 feet).

(3) ALTITUDE LIMIT SWITCH ★SA-1/ARN-1 or ★SA-1A/ARN-1.—The control setting of this unit (shown in Figure 5) determines the "pre-set altitude" with reference to which the altitude limit indicator and/or the automatic pilot system operate when used in conjunction with the altimeter. The scale of the Altitude Limit Switch is calibrated directly in feet for the low range; the same scale reads in tens of feet for the high range.

(4) CHANGEOVER CONTROL (MANUAL-AUTOMATIC).—The changeover control (not supplied with the ★AN/APN-1 Series equipments) is required in those installations which include connections from the altimeter to an automatic pilot system. Detailed instructions for manipulation of this control (or combination of controls) are supplied by the Navy Department, Bureau of Aeronautics, or in Technical Orders issued by authority of the Commanding General, Army Air Forces.

★AN/APN-1B NOTE

Radio Set ★AN/APN-1B is intended for spe-

cial duty in connection with an automatic pilot system and other equipment. As the Altitude Indicator and Altitude Limit Switch units are not included in the final ★AN/APN-1B installation, the power switch, range switch, and altitude limit switch functions are assumed by other units, which are connected through cable W505 to the "AUTOMATIC PILOT" receptacle J106 of the Radio Transmitter-Receiver. The auxiliary plugs P110 and P111 are required in the "INDICATOR" J104 and the "LIMIT SWITCH" J107 receptacles, respectively, as explained in paragraph 9-b, section II. Refer to special instructions for operation of Radio Set ★AN/APN-1B, issued by the Navy Department, Bureau of Aeronautics, or other government authority concerned.

3. OPERATING PROCEDURE.

a. STARTING THE EQUIPMENT.—To place the altimeter equipment in operation, proceed as follows:

(1) Set the range switch for the required range (see Figure 14). When on the ground, or in flight at an altitude below 400 feet, always use the low range (0 to 400 feet). When in flight at an altitude above 400 feet, use the high range (400 to 4000 feet).

WARNING

The high range is not calibrated for and must not be used at altitudes below 400 feet.

UNDER CONDITIONS OF POOR VISIBILITY, ALWAYS USE THE LOW RANGE WHEN FLYING AT ALTITUDES BELOW 600 FEET. SEE "CAUTION", PARAGRAPH 4, THIS SECTION.

(2) Set the Altitude Limit Switch for the desired pre-set altitude (altitude of reference for limit indicator and/or automatic pilot operation). See Figure 15.

(3) If the altimeter installation includes connections to an automatic pilot system, MAKE SURE THAT THE CHANGEOVER CONTROL IS SET FOR "MANUAL" OPERATION. See paragraph 2-a(4), this section.

WARNING

A sustained dive will result in step (4) during the warm-up period if the changeover control is in the "AUTOMATIC" position.

(4) Turn the power switch clockwise to the "ON" position (see Figure 16). If an altitude limit indicator is included in the installation, a "green" signal will appear immediately and will be sustained during the warm-up period. After allowing an interval of approximately one minute for the tubes to heat, the pointer of the Altitude Indicator will have moved from its sub-zero stop position to some other position, indicating that the equipment is operating. The altitude limit indicator signals will then function as described in paragraph 5-a(1), this section. See Figure 17.

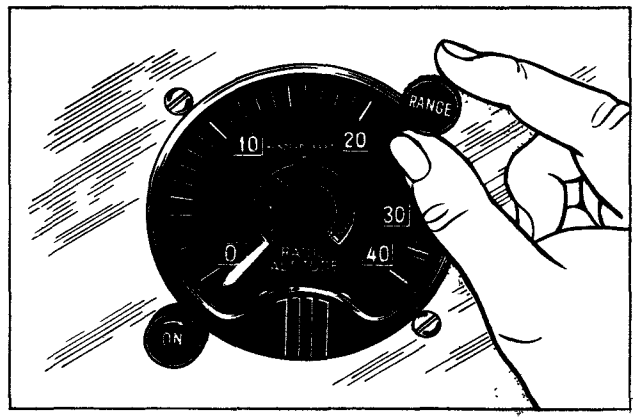


Figure 14—Operation of Range Switch on Altitude Indicator

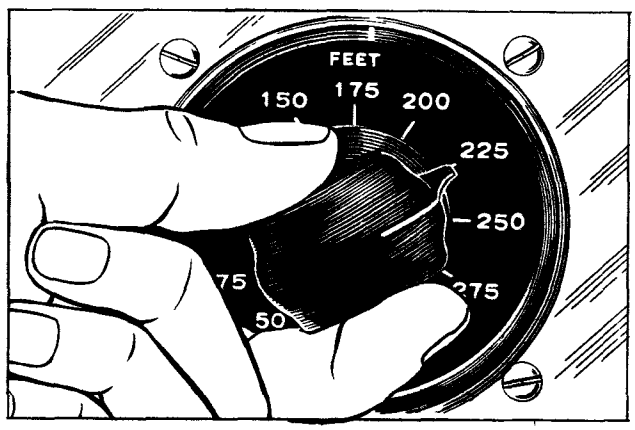


Figure 15—Pre-Set Altitude Adjustment of Altitude Limit Switch

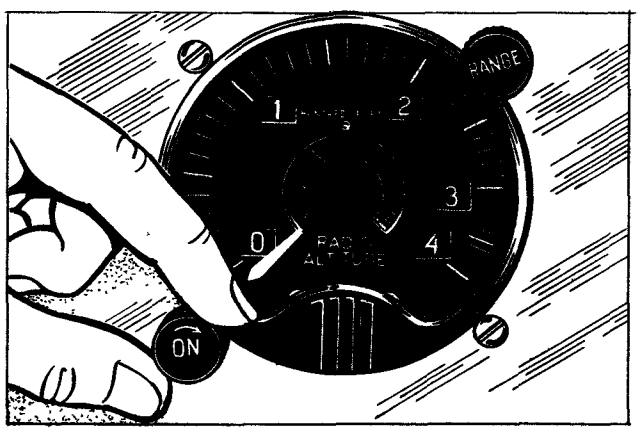


Figure 16—Operation of Power Switch on Altitude Indicator—Starting the Equipment

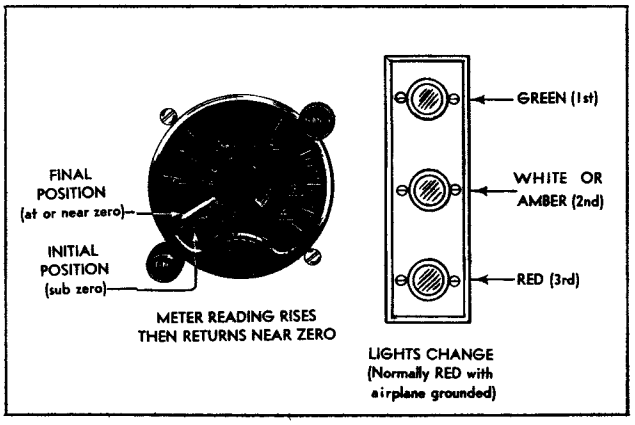


Figure 17—Altimeter Indications During the Warm-Up Period

IMPORTANT

When the aircraft is on the ground, the Altitude Indicator pointer may not indicate zero altitude exactly. NEVER ATTEMPT TO ADJUST THE EQUIPMENT TO OBTAIN A ZERO READING FOR THIS CONDITION. See paragraph 12, Section II.

(5) AUTOMATIC CONTROL OF ALTITUDE.—If the altimeter installation includes connections to an automatic pilot system, the changeover control may now be set for AUTOMATIC operation, causing the altimeter to assume control with reference to the pre-set altitude. The changeover from MANUAL to AUTOMATIC operation, or vice versa, should be made while in stable flight at the desired pre-set altitude, as indicated by the Altitude Indicator and the white or amber signal of the altitude limit indicator.

WARNING

AUTOMATIC operation should not be attempted until the pilot is thoroughly familiar with the principles outlined in paragraph 6, this section.

b. CHANGE OF PRE-SET ALTITUDE.—The setting of the Altitude Limit Switch may be changed at any time to a new pre-set altitude as desired. When using AUTOMATIC altitude control, discretion is necessary to determine the lowest safe altitude of flight according to the prevailing conditions of terrain, speed, air currents, etc.

c. CHANGE OF RANGE.—The setting of the range switch should be changed only during MANUAL operation. See paragraph 3-a(1), this section.

d. STOPPING THE EQUIPMENT.—To stop the operation of the altimeter, proceed as follows:

(1) If in AUTOMATIC flight, reset the changeover control for MANUAL operation, preferably while in stable flight at the pre-set altitude.

(2) Turn the power switch counterclockwise to the off position. See Figure 18.

4. ALTITUDE INDICATIONS.

a. Absolute altitude with reference to the underlying terrain is indicated after take-off over both the low range (0 to 400 feet) and the high range (400 to 4000 feet). The Altitude Indicator reading will normally fluctuate with changes in terrain clearance when flying over rough or obstructed terrain, or through bumpy air (see Figure 19). At "drop-out" altitudes considerably above the upper limit of either range of the altimeter, the Altitude Indicator pointer may be expected to fall back from its full stop position as mentioned in paragraph 14-b(3), Section II.

CAUTION

THE HIGH RANGE (400 TO 4000 FEET) OF THE ALTIMETER MUST NEVER BE USED WHEN FLYING AT ALTITUDES WITHIN THE LOW RANGE (0 TO 400 FEET) OR WHEN LANDING. THE HIGH-RANGE CIRCUITS ARE NOT CALIBRATED FOR SUCH USE AND INCORRECT ALTITUDE INDICATIONS WOULD RESULT.

IN SOME INSTALLATIONS (BECAUSE OF POOR LOCATION OF THE ANTENNAS OR INADEQUATE MAINTENANCE OF THE ★AN/APN-1 SERIES EQUIPMENT), THE HIGH-RANGE INDICATIONS MAY BE UNRELIABLE AT ALTITUDES BELOW 500 FEET OVER WATER OR 600 FEET OVER LAND. BELOW THESE ALTITUDES, WHEN ON THE HIGH RANGE, THE ALTITUDE INDICATOR OFTEN READS TOO HIGH AND MAY NOT INDICATE LESS THAN 400 FEET NO MATTER HOW CLOSE TO THE TERRAIN THE AIRPLANE ACTUALLY IS FLYING. *THEREFORE, WHEN FLYING BELOW 600 FEET UNDER CONDITIONS OF POOR VISIBILITY, ALWAYS USE THE LOW RANGE OF THE ALTIMETER.*

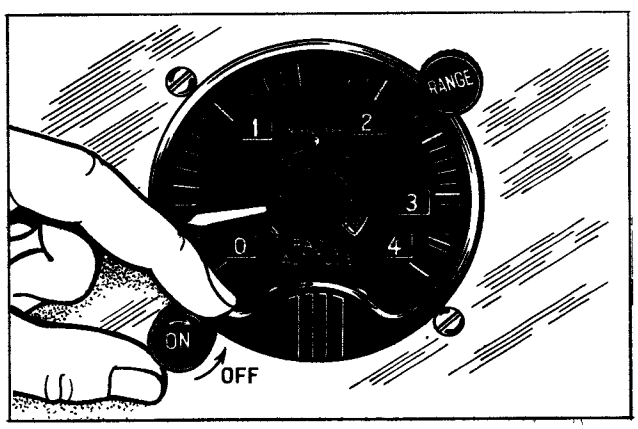


Figure 18—Operation of Power Switch—Stopping the Equipment

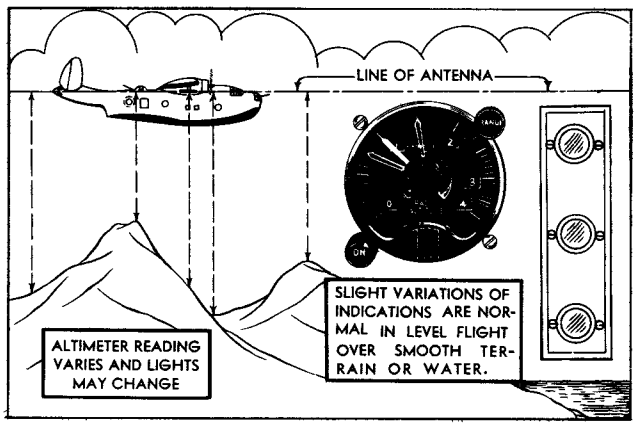


Figure 19—Altimeter Indications in Level Flight Over Varying Terrain

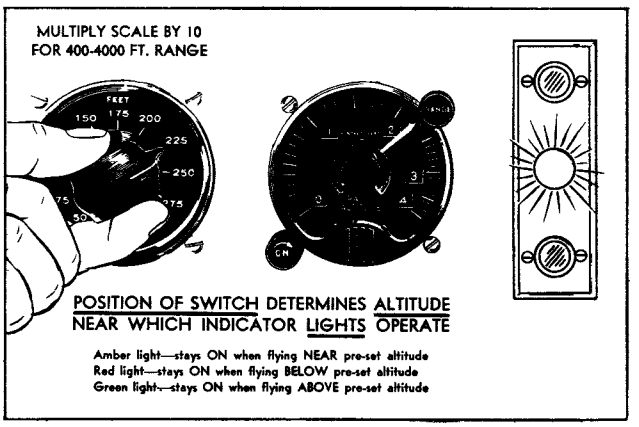


Figure 20—Altitude Limit Indicator Signals, When Altimeter Is Used Without Automatic Pilot

5. ALTITUDE LIMIT INDICATOR SIGNALS.

a. When included in the installation, the altitude limit indicator (not supplied with the ★AN/APN-1 Series altimeter equipments) relieves the pilot of constant attention to the Altitude Indicator scale. As described in paragraph 3-a(2), section I, it may consist of three colored lamps. The information provided by the altitude limit indicator is as follows:

(1) WHEN USED WITHOUT AUTOMATIC PILOT.—The following signals are obtained, either with the "dummy pilot" plug P108 inserted in the "AUTOMATIC PILOT" receptacle J106 of the Radio Transmitter-Receiver (as required for altitude limit indicator operation when the altimeter is not connected to the automatic pilot system); or (with J106 connected through cable W505 to the automatic pilot system) when the attitude control unit has been "centered" by setting the changeover control for MANUAL operation:

(a) RED LIGHT.—Indicates flight below the control range corresponding to the pre-set altitude determined by the Altitude Limit Switch setting.

(b) WHITE OR AMBER LIGHT.—Indicates flight within the pre-set altitude control range.

(c) GREEN LIGHT.—Indicates flight above the pre-set altitude control range.

Refer to Figures 20 and 21.)

(2) WHEN USED WITH AUTOMATIC PILOT.—In this case the altitude limit indicator informs the pilot of the attitude (pitch) correction signals transmitted to the attitude control unit by the altimeter, as follows:

(a) RED LIGHT—Indicates upward correction of attitude.

(b) WHITE OR AMBER LIGHT.—Indicates no change of attitude.

(c) GREEN LIGHT.—Indicates downward correction of attitude.

b. During operation with the automatic pilot, the altitude limit indicator signals may be interpreted with respect to flight conditions as follows:

(1) A steady white or amber signal indicates stable flight at a fixed attitude and approximately constant altitude. Normally, when flying over water or level terrain, this signal indicates level flight at approximately the pre-set altitude (setting of Altitude Limit Switch). Under certain conditions, however, this signal may be obtained with deviations as great as two Altitude Limit Switch steps above or below the pre-set altitude—see paragraphs 6-b, (1) and (2), this section.

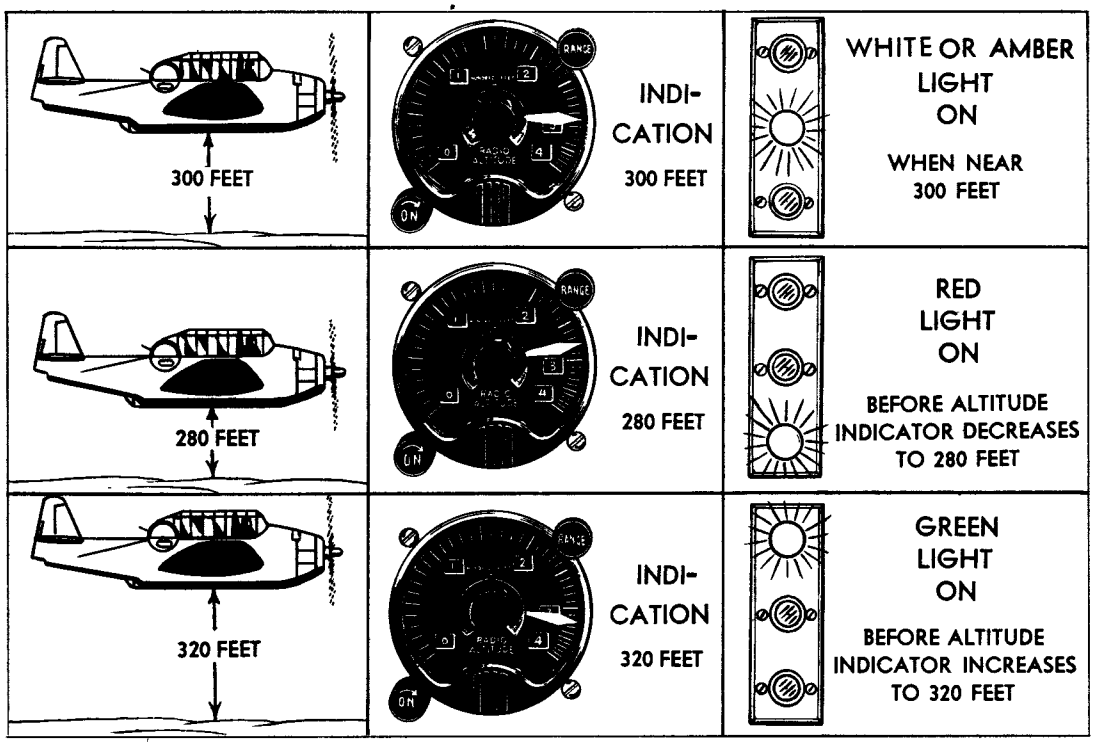
(2) Green flashes alternating with white or amber signals indicate steps of downward correction of attitude resulting in diminishing upward or increasing downward attitude.

(3) Red flashes alternating with white or amber signals indicate steps of upward correction of attitude, resulting in diminishing downward or increasing upward attitude.

(4) A steady red or green signal indicates that the maximum correction of attitude (upward or downward, respectively) is being applied because of an excessive deviation from the pre-set altitude. Normally, such signals will be obtained on the low range with deviations exceeding 50 feet (two steps on the Altitude Limit Switch scale). On the high range, such signals will be obtained with deviations of 500 feet or less, depending upon the "follow-up" design of the attitude control unit.

Note

Under some conditions, all three signals may be observed to flicker in sequence repeatedly, thus: red—(white or amber)—green—(white or amber)—red, etc. This indicates an oscillating condition which may occur at points not exceeding two Altitude Limit Switch steps from the pre-set altitude. This will cause no adverse effect on the flight of the aircraft but will tend to provide "tighter" control. (See Maintenance Handbook.)



NOTE: Altitude deviations for light operation on 400-4000 ft. range are greater than on 0-400 ft. range

Figure 21—Altitude Limit Indicator Operation (With Altitude Controlled Manually)—Example for Pre-Set Altitude of 300 Feet

6. OPERATION WITH AUTOMATIC PILOT.

a. AUTOMATIC ALTITUDE CONTROL.—When the Radio Transmitter-Receiver is connected through the cable W505 (see Figure 22) to a suitable automatic pilot system, the ★AN/APN-1 Series altimeter equipment can be used to control the flight altitude with respect to any of the altitude steps marked on the scale of the Altitude Limit Switch (50 to 300 feet, inclusive, at intervals of 25 feet in the low range; and the same steps multiplied by ten when the range switch is set for the high range). The installation with the altimeter connected to the automatic pilot will normally include a changeover control—see paragraph 2-a(4), this section—which will permit the pilot to control the airplane manually without opposition from the automatic pilot. However, *if the particular automatic pilot system permits,* the pilot can take over control manually in case of emergency, without disconnecting the system.

b. PRINCIPLES AND LIMITATIONS OF OPERATION.—Before operating the altimeter with the automatic pilot, for automatic control of altitude, the pilot should acquire a thorough knowledge of the manner in which the system functions. The extent to which the altimeter can control the altitude of the aircraft with respect to the terrain is governed and restricted by the following basic principles of operation:

(1) When the altitude of the aircraft with respect to the underlying terrain deviates from the existing "control range," a corrective change in attitude is signalled by the altimeter. (See paragraph 5-a(2), this section.) This attitude change is accomplished by operation of the auxiliary attitude control unit which is linked to the attitude or pitch control system of the automatic pilot. The "follow-up" setting is simultaneously changed so that the "altitude control point" is shifted *toward* the new altitude which the aircraft has assumed.*

(2) Steady flight at the desired pre-set altitude (setting of Altitude Limit Switch) normally will be obtained only when flying a straight course over water or level terrain, in fairly smooth air, and with the aircraft properly trimmed for the existing conditions of load and speed. (It is assumed that the attitude control system of the automatic pilot is correctly adjusted so that level flight is obtained when the attitude control unit is centered. See paragraph 13-a, section II.) When such

*The "control range" or "dead spot" is a narrow range of altitude (on the order of five to ten feet in the low range and 50 to 100 feet in the high range) throughout which the white or amber signal of the altitude limit indicator is obtained, and no change of attitude is signalled by the altimeter. The "altitude control point" (center of control range) is varied within the "follow-up range" by the operation of the attitude control unit. The follow-up range is normally centered with respect to the pre-set altitude (setting of Altitude Limit Switch). For the low range (0 to 400 feet), the follow-up range extends 50 feet (two steps of the Altitude Limit Switch) above and below the pre-set altitude. For the high range (400 to 4000 feet) the follow-up range extends 500 feet (or less, depending upon the "follow-up" design) above and below the pre-set altitude.

TABLE V—RELATION OF ALTITUDE DEVIATION TO ATTITUDE COMPENSATION
(Low-Range Operation†)

Attitude Compensation Required to Maintain Fixed Altitude (Percent of Maximum Range Provided by Attitude Control Unit)				Approximate Deviation from Pre-set Altitude in Low Range† (Feet)		
More than 100% (+) (Beyond Range—Upward)				More than 50 Feet (−) (Uncontrolled Loss of Altitude)		
Upward Attitude	(+)	(%) 100		(feet) 50	(−)	Controlled Flight Below Pre-set Altitude
		80		40		
		60		30		
		40		20		
		20		10		
Attitude Control Unit Centered		0		0		Controlled Flight at Pre-set Alititude
Downward Attitude	(−)	20		10	(+)	Controlled Flight Above Pre-set Altitude
		40		20		
		60		30		
		80		40		
		100		50		
More than 100% (−) (Beyond Range—Downward)				More than 50 Feet (+) (Uncontrolled Gain of Altitude)		

ideal conditions do not exist, the control range, and therefore the altitude of flight, will deviate from the pre-set altitude by an amount which is related to the attitude compensation required to balance the disturbing conditions. (See Table V.)

(3) If the required attitude compensation is greater than the maximum which the attitude control unit can apply, the system will be unable to hold the aircraft in fixed altitude flight, and continuous climb or dive relative to the underlying terrain will result (although the ★AN/APN-1 Series altimeter will continue to signal for the required corrections). The maximum attitude range over which the altimeter has control is limited by the adjustments of the automatic pilot system (including the attitude control unit). Since a discussion of these adjustments and their effects is beyond the scope of this handbook, reference should be made to information issued on this subject by the Navy Department, Bureau of Aeronautics, or Technical Orders issued by authority of the Commanding General, Army Air Forces. As these adjustments may vary in different types of installations, the pilot should be familiar with the attitude range limitations imposed in the particular installation. Beyond these limits (corresponding to the extreme climb or dive attitude positions of the attitude control unit), the altimeter is unable to apply any correction, regardless of the rate or amount of altitude deviation from the existing control range.

Example.—Assume that the link from the attitude control unit to the automatic pilot is adjusted to provide ten degrees maximum attitude control for both climbing and diving. Assume also that the aircraft is in level flight (attitude control unit "centered") in the low range and that a loss of altitude results from rising terrain, improper trim or some other cause. The altimeter will signal for one step (approximately one degree) of upward attitude correction which will be accompanied by a downward shift (approximately five feet) of the control range. If this attitude correction is not sufficient to maintain flight within the new control range, additional steps will be signalled by the altimeter. However, if the maximum ten-degree attitude of climb (corresponding to a 50-foot loss of altitude,—see Table V) is insufficient to maintain a fixed altitude, *the aircraft will continue to lose altitude unless the pilot takes control manually.*

(4) In installations where the automatic pilot system is equipped with attitude control means in addition to the auxiliary attitude control unit which is controlled by signals from the altimeter, ALL SUCH CONTROLS MUST BE RETURNED TO "NEUTRAL" BEFORE CHANGING OVER FROM "MANUAL" TO "AUTOMATIC" OPERATION, so that the system is properly adjusted for level flight when the attitude control unit is centered. Failure to do this will shift the attitude range (controlled by the altimeter) by the amount of such separate "bias" and will prevent the altimeter from controlling the altitude in the desired manner.

Example.—Assume that the attitude control unit is adjusted for a maximum attitude control range of plus or minus ten degrees, as in the preceding example. While in level flight, if an independent downward attitude "bias" of five degrees is applied to the automatic pilot system by a separate attitude control device, a compensating five-degree upward correction of attitude will be signalled by the altimeter to maintain level flight.* As this is 50 percent of the maximum upward (+) range of attitude compensation, the aircraft will reassume level flight (in the low range) at approximately 25 feet below the pre-set altitude—see Table V. If an additional five-degree upward correction is later required to maintain a fixed altitude, the aircraft will fly approximately 50 feet below the pre-set altitude, at an upward attitude of five degrees. If a further upward correction is needed, the altimeter will signal the requirements but *the automatic altitude control system will be unable to apply sufficient correction, and the aircraft will continue to lose altitude.*

†Altitude deviations in the *high range* for a particular installation will be a fixed multiple (ten times, maximum) of the low range deviations tabulated at the right of Table V.

*The effect of this five-degree downward "bias" is to change the attitude range controlled by the altimeter from ±10 degrees (assumed in this example) to +5 to −15 degrees.

CAUTION

Some loss of altitude may be expected while executing a steeply banked turn when the automatic pilot is controlled by the altimeter. When flight is desired above the highest altitude provided by the Altitude Limit Switch, or when preparing to land, the changeover control should be set in the position for MANUAL operation. Manual control should be used also when flying at low altitude over rough or obstructed terain, or in abnormally bumpy air. STUNT FLYING SHOULD NEVER BE ATTEMPTED WITH THE CHANGEOVER CONTROL IN THE "AUTOMATIC" POSITION.

WARNING

When flying with the automatic pilot controlled by the altimeter, the pilot should always be prepared to take over control manually.

c. While all reasonable safeguards have been taken in the design and manufacture of the ★AN/APN-1 Series altimeter equipments, some types of electrical failures are possible which may interfere with proper operation and require prompt action of the pilot in assuming manual control. For safety reasons, the equipment has been designed so that the type of faults most likely to occur will cause the aircraft to climb at the maximum angle for which the system is adjusted. However, other possible failures may cause the aircraft to dive at the maximum control angle. A third type of fault (which includes a fuse burnout or power failure) will result in interruption of control without an accompanying change in the attitude (pitch angle) which exists at the instant of failure. In general, the pilot will be warned immediately of such failures by inconsistent or interrupted indications of the Altitude Indicator and the altitude limit indicator. (See paragraphs 4 and 5 of this section.)

SECTION IV

EMERGENCY OPERATION AND REPAIR

CAUTION

Do not change any of the calibration control settings when making tests or checks on the equipment. If the settings are disturbed, the equipment must be recalibrated by a competent technician and will require precision calibration apparatus.

WARNING

Before attempting any servicing of the equipment, be sure to observe the following:

(1) If the altimeter installation includes connection to an automatic pilot system, set the changeover control to the MANUAL position.

(2) Make certain that the power switch on the Altitude Indicator is at the OFF position, counterclockwise.

1. GENERAL.

The altimeter equipment should be checked periodically by qualified maintenance personnel for performance and accuracy of calibration. If at any time the altimeter indications appear inconsistent or fluctuate abnormally, or if operation with the automatic pilot becomes erratic, the proper maintenance personnel should be notified. In the event of failure to operate, first check for a burned out fuse. Make sure that all the cable connections are tight and that normal battery voltage is being delivered to the equipment. If the trouble is not thus remedied, substitute another Radio Transmitter-Receiver unit of the same type and voltage rating (which has been calibrated for the correct residual altitude) to determine whether the trouble is in this unit or in another part of the equipment. The Maintenance Handbook contains complete information for servicing.

2. REPLACEMENT OF FUSES.

The altimeter equipments are protected against damage from short-circuits by a special fuse which is located at the lower right hand corner of the front panel of the Radio Transmitter-Receiver. A spare fuse is provided in an adjacent receptacle. WHEN NECESSARY TO MAKE REPLACEMENTS, USE ONLY THE FOLLOWING FUSES:

(1) F101 (FOR 27-VOLT EQUIPMENTS).— "Littelfuse" Type #1443, 3 Ampere Special. (Alternate: "Littelfuse" Type #1094, 5 Ampere.)

(2) F102 (FOR 13.5-VOLT EQUIPMENTS).— "Bussman" Cat. #MDM-6.25, 6.25 Ampere. (Alternate: "Bussman" Cat. #MDM-8, 8 Ampere.)

3. LIMITS OF EMERGENCY REPAIR.

Generally, it is impractical to trouble-shoot or repair the equipment without proper test apparatus. However, when the airplane is located at a remote base, or is in flight, some failures may be analyzed and corrected in an emergency without test equipment. These troubles, which are evidenced by incorrect or inconsistent indications of the Altitude Indicator or Altitude Limit Indicator, are listed in Tables VI and VII.

TABLE VI—TROUBLES EVIDENCED

TROUBLE	CAUSE
1. Reads sub-zero.	a. Loss of primary power.
	b. Faulty transmitter or modulator circuits.
	c. Faulty a-f amplifier or limiter circuits.
	d. Faulty indicator counter or indicator amplifier circuits.
2. Reads off-scale.	a. Faulty a-f amplifier or limiter circuits.
	b. Faulty indicator counter or indicator amplifier circuits.

BY ALTITUDE INDICATOR

REMEDY
Check power switch setting. This switch should be turned to the "ON" position. Check the fuse by replacing it with the proper spare. (See paragraph 2, Section IV.)
Replace tubes V112, V113 and/or V111 with the respective new spares. Inspect the circuits related to these tubes for "opens" or "shorts." (The replacement of tubes will probably affect the overall calibration. A temporary recalibration can be made by calibrating against the barometric reading at 3,000 feet on the high range, and adjusting R119B for an Altitude Indicator reading of 3,000 feet. Then reduce the altitude of the airplane to 350-400 feet, switch to the low range and calibrate against the barometric reading. Adjust R119A on the low range accordingly. This type of calibration should be carried out if possible while flying over water or flat land, and is recommended only as an emergency repair measure.)
Replace tubes V103, V104, V114, and/or V105 with the respective new spares. Inspect related circuits for "opens" or "shorts." (Recheck calibration as in 1-b, above.)
Replace tubes V107 and/or V108 with the respective new spares. (The calibration of the altitude indicator channel will be slightly affected. Check calibration by flying at 300 feet on the low range or 3,000 feet on the high range as indicated by the "white" or "amber" light with the Altitude Limit Switch set at 300 feet and the correct barometric reading.)
Check the switch for the correct range setting. Replace tubes as in 1-c, above.
Replace tubes V107 and/or V108 with the respective new spares. (The calibration of the altitude indicator channel will be slightly affected. Check calibration by flying at 300 feet on the low range or 3,000 feet on the high range as indicated by the "white" or "amber" light with the Altitude Limit Switch set at 300 feet and the correct barometric reading.)

TABLE VII—TROUBLES EVIDENCED BY

TROUBLE	CAUSE
1. Green light only.	a. Faulty a-f amplifier or limiter circuits.
	b. Faulty altitude limit indicator circuit.
2. Red light only.	a. Faulty altitude limit indicator circuit.
	b. Faulty transmitter or modulator circuits.
	c. Faulty a-f amplifier or limiter circuits.
3. All lights inoperative.	Loss of primary power.

ALTITUDE LIMIT INDICATOR

REMEDY
Check range switch for the correct range setting. Replace tubes V103, V104, V114 and/or V105 with the respetive new spares. Examine associated circuit wiring for "opens" or "shorts." (Recheck calibration as in 2-b, below.)
Check to see whether Altitude Limit Switch is set at the meter indicated altitude. Replace tubes V106 and/or V109 with the respective new spare. Examine the related circuits for "opens" or "shorts." Check relays K101 and K102 for faulty contacts. (The calibration of the altitude limit indicator circuit may be affected by a change of either the V106 tube or the V109 tube.)
Check to see whether Altitude Limit Switch is set at the meter indicated altitude. Replace tubes V106 and/or V109 with the respective new spares. Examine the related circuits for "opens" or "shorts." Check relays K101 and K102 for faulty contacts. (The calibration of the altitude limit indicator circuit may be affected by a change of either the V106 tube or the V109 tube.)
Replace tubes V112, V113 and/or V111 with the respective new spares. Inspect the related circuits for "opens" or "shorts." (The replacement of tubes may affect the overall calibration. A temporary recalibration can be made by calibrating against the barometric reading at 3,000 feet on the high range, and adjusting R119B for an Altitude Indicator reading of 3,000 feet. Then reduce the altitude of the airplane to 350-400 feet, switch to the low range and calibrate against the barometric reading. Adjust R119A on the low range. This type of calibration should be carried out while flying over water or flat land, and is recommended only as an emergency repair measure.)
Check range switch for the correct range setting. Replace tubes V103, V104, V114 and/or V105 with the respective new spares. Examine associated circuit wiring for "opens" or "shorts." (Recheck calibration as in 2-b, above.)
Check power switch setting. This switch should be turned to the "ON" position. Check fuse by replacing it with the proper spare. (See paragraph 2, Section IV.)

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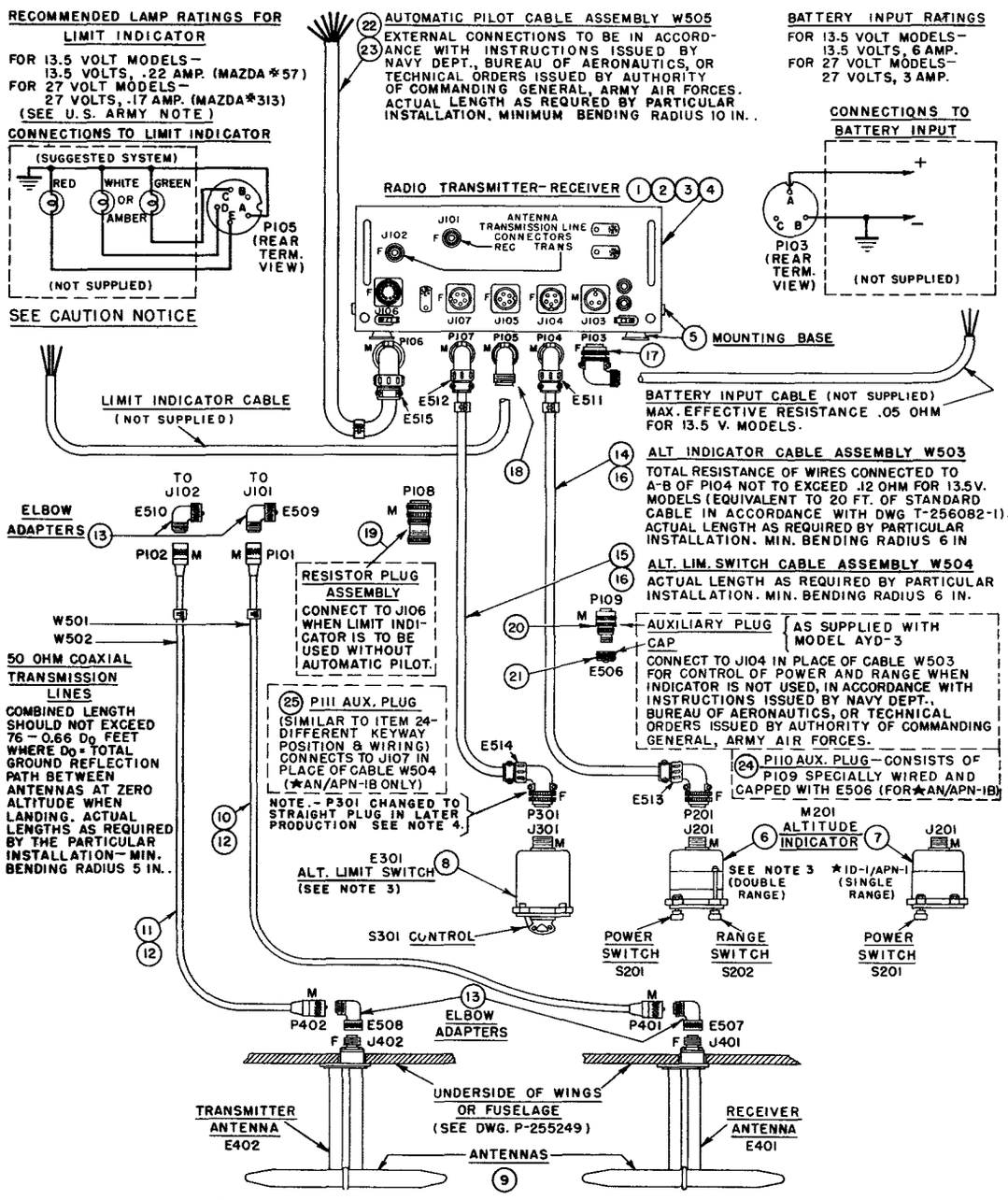

NOTE— LETTERS "M" AND "F" AT PLUGS AND RECEPTACLES INDICATE "MALE" AND "FEMALE" RESPECTIVELY.

U. S. ARMY NOTE— FOR LIMIT INDICATOR IN U.S. ARMY INSTALLATIONS, USE SIGNAL CORPS LM-56 LAMPS IN AIR CORPS CLASS 03-C SOCKETS, AS FOLLOWS: RED 428359 3-1; GREEN 428359 3-3; AMBER 428359 3-2.

NOTE 3.— ITEMS 6 AND 8 ARE SELECTED FROM FOLLOWING TYPES IN ACCORDANCE WITH CONTRACTUAL REQUIREMENTS:

ITEM NO.	ANB TYPE DESIGNATION	BRITISH REF. NO.	NAVY TYPE NO.	RCA ASSEMBLY DRAWING NO.*	LUMINESCENT MARKINGS	REMARKS
6°	★ID-14/APN-1	11098/14		P-255259-501	PALE GREEN	SUPPLIED WITH EARLY PRODUCTION EQUIPMENTS
	★ID-14A/APN-1	11098/46		P-255259-502	PALE YELLOW	" " LATER " "
	★ID-14B/APN-1	11098/47		P-255259-503	PALE YELLOW	MAY BE SUPPLIED IN BULK ON SEPARATE CONTRACT
8	★SA-1/ARN-1	11098/19	24130	P-255295-501	PALE GREEN	SUPPLIED WITH EARLY PRODUCTION EQUIPMENTS
	★SA-1A/ARN-1	11098/386		P-255295-502	PALE YELLOW	" " LATER " "

CAUTION— IF LIMIT INDICATOR IS TO BE USED WITH AUTOMATIC PILOT, THE COMMON RETURN LEAD MUST BE CONNECTED DIRECTLY TO GROUND WITHOUT SERIES RESISTANCE. DROPPING RESISTORS OR BRILLIANCE CONTROLS, IF REQUIRED, MUST BE INSERTED SEPARATELY IN SERIES WITH EACH LAMP, AS SHOWN IN FIG. A. THE ARRANGEMENT SHOWN IN FIG. B IS PERMISSIBLE ONLY FOR INSTALLATIONS WITHOUT AUTOMATIC PILOT.

NOTE 4.— FOR FABRICATION OF CABLE W504 (ITEM 15), REFER TO OUTLINE ASSEMBLY DRAWING AS FOLLOWS:
T-256405-1. — IF PLUG P301 IS STRAIGHT TYPE (AN-3106-18-20S).
T-256082-2. — IF PLUG P301 IS ELBOW TYPE (AN-3108-18-20S) AS ORIGINALLY SUPPLIED WITH EQUIPMENTS.

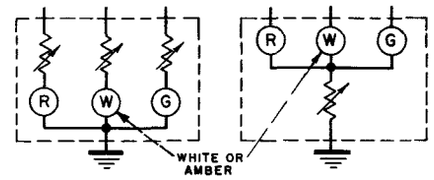

FIG A — CORRECT FOR USE WITH OR WITHOUT AUTOMATIC PILOT

FIG. B — MUST NOT BE USED WITH AUTOMATIC PILOT

TABLE 1 — EQUIPMENT SUPPLIED — QUANTITIES, REFERENCES AND INTERCHANGEABILITY OF COMPONENTS

ITEM NO.	QUANTITY SUPPLIED PER EQUIPMENT — RADIO SET ★AN/APN- I (27 V.)	IX (13.5 V.)	IA (27 V.)		IB (27 V.)		ANB TYPE DESIGNATION	BRITISH REFERENCE NUMBER	NAVY TYPE NUMBER	SYMBOL GROUP OR NUMBER	NAME	RCA* ASSEMBLY OR PART DRAWING NUMBER	OUTLINE DRAWING REFERENCE	INTERCHANGEABILITY AYB-1	AYB-2	AYD	AYD-2	AYD-3	†AN/ARN-1	SCR-718-A
1	1		1		1		★RT-7/APN-1	110 DB/25		101-199	RADIO TRANSMITTER-RECEIVER (LESS MOUNTING BASE)	K-252667-501	P-255414-1							
2		1					★RT-40/APN-1X	110 DB/163				K-252667-502	P-255414-3							
3																				
4																				
5	1	1	1		1		★MT-14/ARN-1	110 AB/14		A101	MOUNTING BASE	SEE NOTE 1	P-255418	✓	✓	✓	✓	✓	✓	✓
6°	1	1			1 §		SEE NOTE 3			M201	ALT. INDICATOR (2-RANGE)	SEE NOTE 3	P-255413							
7°			1				★ID-1/ARN-1	110 QB/2		M201	ALT INDICATOR (SINGLE-RANGE)	P-255072-504 OR P-255254-501	M-253155					✓	✓	
8	1	1	1				SEE NOTE 3			E301	ALTITUDE LIMIT SWITCH	SEE NOTE 3	M-253607			✓	✓	✓	✓	
9	2	2	2		2		★AT-4/ARN-1	110 BB/28	66083	E401, E402	ANTENNA	SEE NOTE 1	K-252401					✓	✓	✓
10	1 SET†	1 SET†	1 SET†		1 SET†					W501	REC ANT TRANSMISSION LINE	OUTLINE-ASS'Y	P-255415-1					✓	✓	✓
11	1 SET†	1 SET†	1 SET†		1 SET†					W502	TRANS. ANT. TRANSMISSION LINE	OUTLINE-ASS'Y.	P-255415-2					✓	✓	✓
12°	60 FT	60 FT.	60 FT		100 FT		RG-8/U □			W501A, W502A	50 OHM COAXIAL LINE	K-99208-1 □	P-255415-3					✓	✓	✓
13	4	4	4		4				49192-A‡	E507, 508, 509, 510	COAXIAL ELBOW ADAPTER	K-252666-1	P-255415-7					✓	✓	✓
14	1 SET†	1 SET†	1 SET†		1 SET†					W503	ALT IND. CABLE ASSEMBLY	OUTLINE-ASS'Y	T-256082-1						✓	
15	1 SET†	1 SET†	1 SET†		1 SET†					W504	ALT. LIM SW. CABLE ASSEMBLY	SEE NOTE 4				✓	✓	✓	✓	
16°	80 FT	80 FT.	80 FT.		60 FT		WM-1/U			W503A, W504A	8-WIRE SHIELDED CABLE	P-255421-4	T-256082-3			△	△	△	△	
17	1	1	1		1					P103	PLUG (BATTERY INPUT)	M-253474-8	T-256082-4	✓	✓	✓	✓	✓	✓	
18	1	1	1		1 §					P105	PLUG (LIMIT INDICATOR)	M-253474-10	T-256082-6	✓	✓	✓	✓	✓	✓	
19	1	1	1		1 §					P108	RESISTOR PLUG ASSEMBLY	K-251872-502	P-255321-10							
20										P109	AUXILIARY PLUG (FOR J104)	P-255262-48	P-255321-9					✓	✓	
21										E506	CAP (FOR P109)	K-251728-2	P-255321-8			✓	✓	✓	✓	
22					1 SET†					W505	AUTO. PILOT CABLE ASSEMBLY	OUTLINE-ASS'Y.	T-256282-1							
23					30 FT.					W505A	10-WIRE SHIELDED CABLE	M-253911-1	T-256282-2							
24					1					P110	AUXILIARY PLUG (FOR J104)	M-254020-501	P-255321-12					✓	✓	
25					1					P111	AUXILIARY PLUG (FOR J107)	M-254020-502	P-255321-13							

U.S. ARMY SIG. CORPS MODELS	RC-24-A		RC-24-B		SCR-718-A

* RCA DRAWING NUMBERS ARE USED FOR COMMON IDENTIFICATION OF ALL COMPONENTS BY ALL CONTRACTORS LISTED IN TABLE 2.
† CABLE COMPONENTS FURNISHED UNASSEMBLED AS SPECIFIED ON OUTLINE-ASSEMBLY DRAWING.
‡ ORIGINALLY "CSX-49192" (SELECTAR) — DO NOT SUBSTITUTE NAVY TYPE NO 49192 ADAPTER OF ANY OTHER MAKE (APPROVED ALTERNATE — GEPHARDT MFG. CO. NO 19192).
✓ INTERCHANGEABLE WITH CORRESPONDING ITEM OF EQUIPMENTS INDICATED.
△ ITEM 16 CABLE CAN BE USED BUT IS NOT STANDARD FOR W503A AND W504A ON EQUIPMENTS INDICATED.
§ SUPPLIED WITH PERCENTAGE OF EQUIPMENTS AS SPECIFIED BY CONTRACT.
□ NAVY TYPE NO. CASSF-50-1 (RCA DWG. K-871757-2) 50 OHM COAXIAL CABLE MAY BE SUPPLIED AS ALTERNATE FOR ITEM 12 ON SOME CONTRACTS.
° CONTRACT NO MARKED ON ALTITUDE INDICATOR MAY DIFFER FROM THAT OF EQUIPMENT WITH WHICH IT IS FURNISHED, WHEN AUTHORIZED BY WAIVER.
• ON SOME CONTRACTS, BULK CABLE ITEMS 12 AND 16 ARE NOT INCLUDED WITH EQUIPMENT TO BE SUPPLIED BY CONTRACTOR.

TABLE 2 — CONTRACTORS

RADIO SET ★AN/APN- I (27 V.)	IX (13.5 V.)	IA (27 V.)		IB (27 V.)		CONTRACT NUMBER° NXsa-	PRIME CONTRACTOR MFR CODE	NAME	ADDRESS
X						21689	CYR	RESEARCH ENTERPRISES, LIMITED	LEASIDE, ONT., CANADA
X						SEE TABLE 3	CQC	ADMIRAL CORPORATION ▲	CHICAGO, ILL., U.S.A.
	X					44572			
X						22421, 43386	CDT	INTERNATIONAL DETROLA CORP. ■	DETROIT, MICH., U.S.A.
X		X				23763	CRV	RCA VICTOR DIVISION OF RADIO CORPORATION OF AMERICA	CAMDEN, N.J., U.S.A.
X						44563			
				X		36254	NOTE 2		

▲ FORMERLY CONTINENTAL RADIO & TELEVISION CORP. ■ FORMERLY DETROLA CORPORATION.

TABLE 3 (SEE NOTE 1)

RCA ASSEMBLY DRAWING NUMBER* MOUNTING BASE ★MT-14/ARN-1	ANTENNAS ★AT-4/ARN-1	RESPECTIVE CONTRACT NUMBER STAMPING NXsa-
T-256002-507	P-255327-508	21689
T-256002-506, 512; 515	P-255327-507, 511, 515	22419, 42172, 49717,
T-256002-514 [-516	P-255327-513 [-516	44572 [62370
T-256002-505, -513	P-255327-506, -512	22421, 43386
T-256002-504	P-255327-505	23763
T-256002-511	P-255327-510	44563
T-256002-509	P-255327-509	36254
T-256002-501	P-255327-501	OMITTED

NOTE 1 — MOUNTING BASE ★MT-14/ARN-1 AND ANTENNAS ★AT-4/ARN-1 AS SUPPLIED WITH EQUIPMENT (ALSO ANTENNAS AS SUPPLIED IN BULK SPARES) HAVE CONTRACT NUMBERS STAMPED ON BASES, HENCE ARE IDENTIFIED BY SEPARATE DRAWING NUMBERS FOR EACH CONTRACTOR. IF SUPPLIED ON SEPARATE SERVICE ORDERS, THE CONTRACT NUMBER STAMPING MAY BE OMITTED. SEE TABLE 3.
NOTE 2 — MODEL ★AN/APN-1B ON CONTRACT NXsa-36254 SUBCONTRACTED TO BELMONT RADIO CORP., CHICAGO, ILL. (MFR. CODE-CDL)

Figure 22—Radio Set ★AN/APN-1 Series Altimeters, Equipment Diagram (T-256081)

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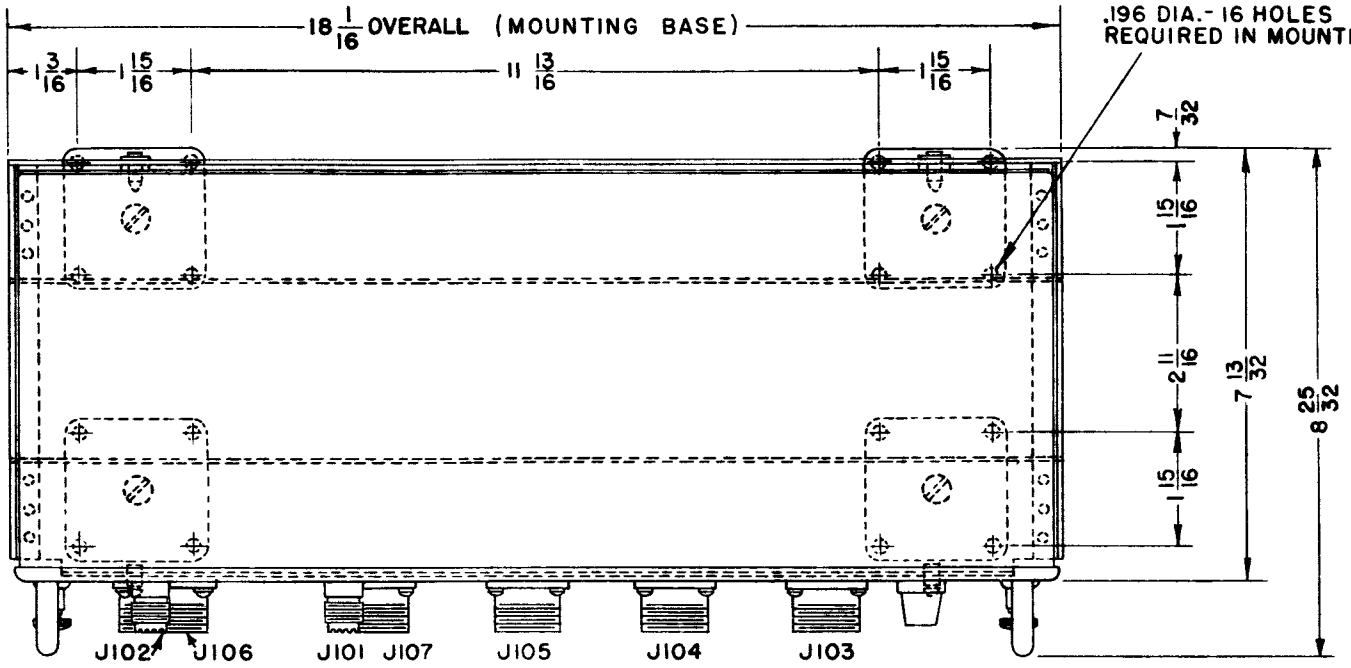
NOTE:-USE 16 No. 8 MACHINE SCREWS (NOT FURNISHED) FOR FASTENING MOUNTING BASE

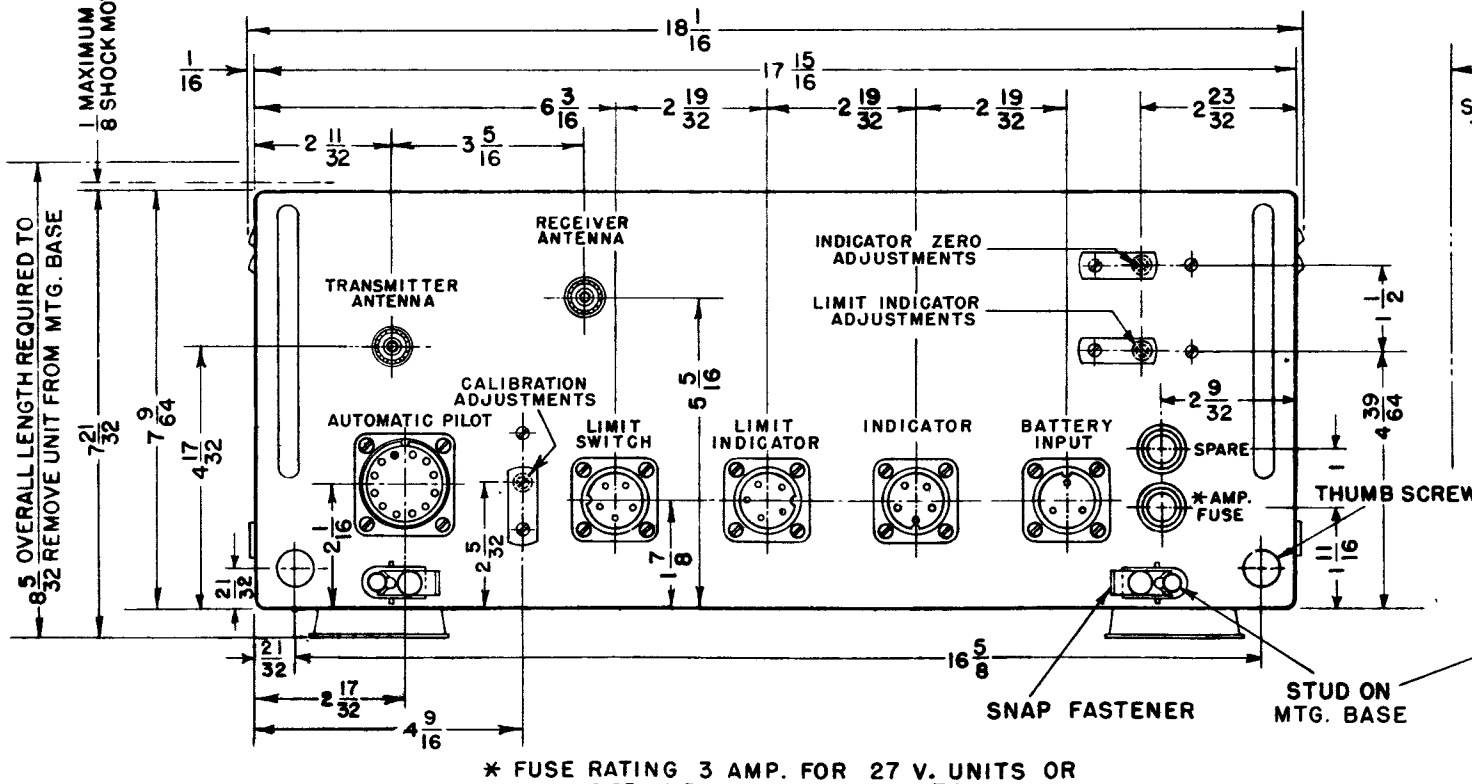


DRILLING PLAN FOR MOUNTING BASE

ITEM NO.	ANB DESIGNATION	VOLTS D.C.	MFR. CODE	EQUIPMENT MODEL NO.	EQUIPMENT DIAGRAM
1	★ RT-7/APN-1	27	‡	★AN/APN-1 SERIES	T-256081
2†	★ MT-14/ARN-1	–			
3	★ RT-40/APN-1X	13.5			

†IDENTICAL TO MOUNTING BASE USED FOR AYB-1, AYD SERIES AND ★AN/ARN-1 EQUIPMENTS.

‡SEE EQUIPMENT DIAGRAM.



* FUSE RATING 3 AMP. FOR 27 V. UNITS OR 6.25 AMP. FOR 13.5 V. UNITS

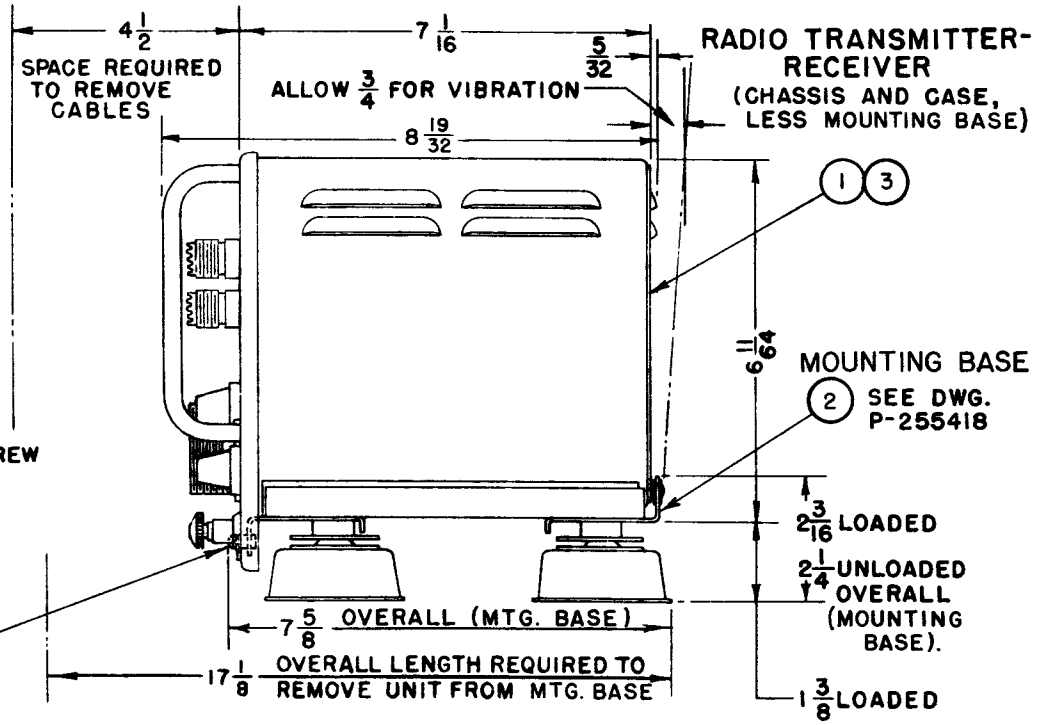
FOR ★AN/APN-1 SERIES

(50 OHM R-F TRANSMISSION SYSTEM)

WEIGHT—POUNDS

UNIT	MOUNTING BASE
18.7	1.5

RADIO TRANSMITTER-RECEIVER AND MOUNTING BASE ASSEMBLY

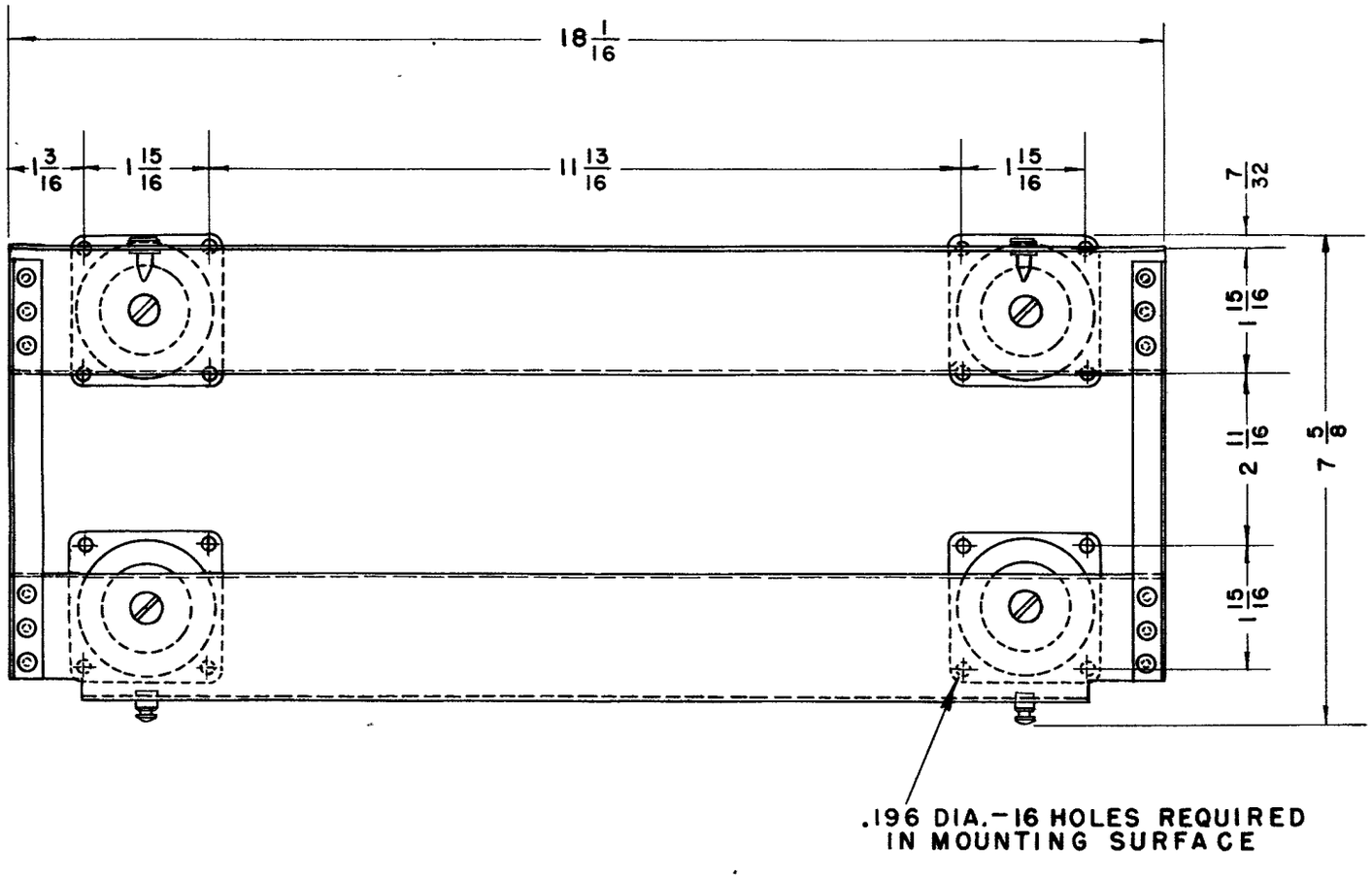


NOTE:
TO REMOVE CHASSIS AND CASE FROM MOUNTING BASE, LOOSEN SNAP FASTENERS, PULL UNIT FORWARD 1 INCH AND LIFT 1/2 INCH TO CLEAR ANGLES ON MOUNTING BASE.

TO REMOVE CHASSIS FROM CASE AND MOUNTING BASE, LOOSEN THUMB SCREWS AND PULL CHASSIS FORWARD 7 INCHES.

Figure 23—Radio Transmitter-Receiver ★RT-7/APN-1 or ★RT-40/APN-1X, Outline (P-255414)

AN-08-10-265



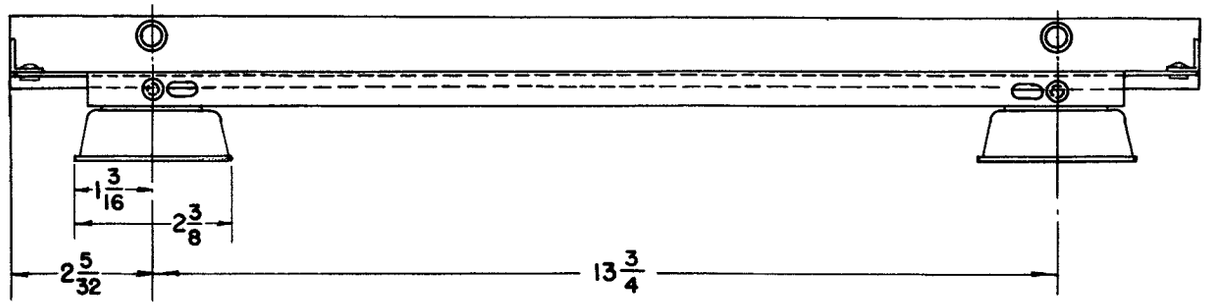
NOTE:— USE 16 NO. 8 MACHINE SCREWS (NOT FURNISHED) FOR MOUNTING.

MOUNTING BASE ★MT-14/ARN-1

FOR RADIO TRANSMITTER-RECEIVERS, AS FOLLOWS:

TRANSMITTER - RECEIVER		MFR. CODE	EQUIPMENT MODEL NO.	EQUIPMENT DIAGRAM
NAVY TYPE NO. OR ANB DESIG.	OUTLINE DRAWING			
CRV-43017	P-255141	CRV	AYB-1, AYB-2	P-255140
CRV-43020	P-255276	CRV	AYD	P-255275
CRV-43021			AYD-2	
CDL-43039	P-255248-1	CDL	AYD-3	P-255247
★RT-3A/ARN-1	P-255248-2	CDL	★AN/ARN-1 (27V.)	
★RT-3/ARN-1	P-255248-4	CRV		
★RT-2/ARN-1	P-255248-5	CRV	★AN/ARN-1 (13.5V.)	
★RT-7/APN-1	P-255414-1	*	★AN/APN-1, -1A, -1B	T-256081
RT-27/APG-4	P-255525-1	CRV	AN/APG-4	T-256306
RT-28/APG-4X	P-255525-2	CRV	AN/APG-4X	
★RT-40/APN-1X	P-255414-3	*	★AN/APN-1X	T-256081

* SEE EQUIPMENT DIAGRAM.



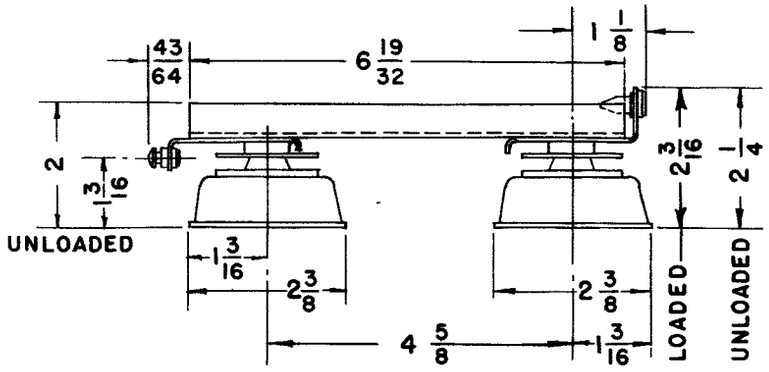
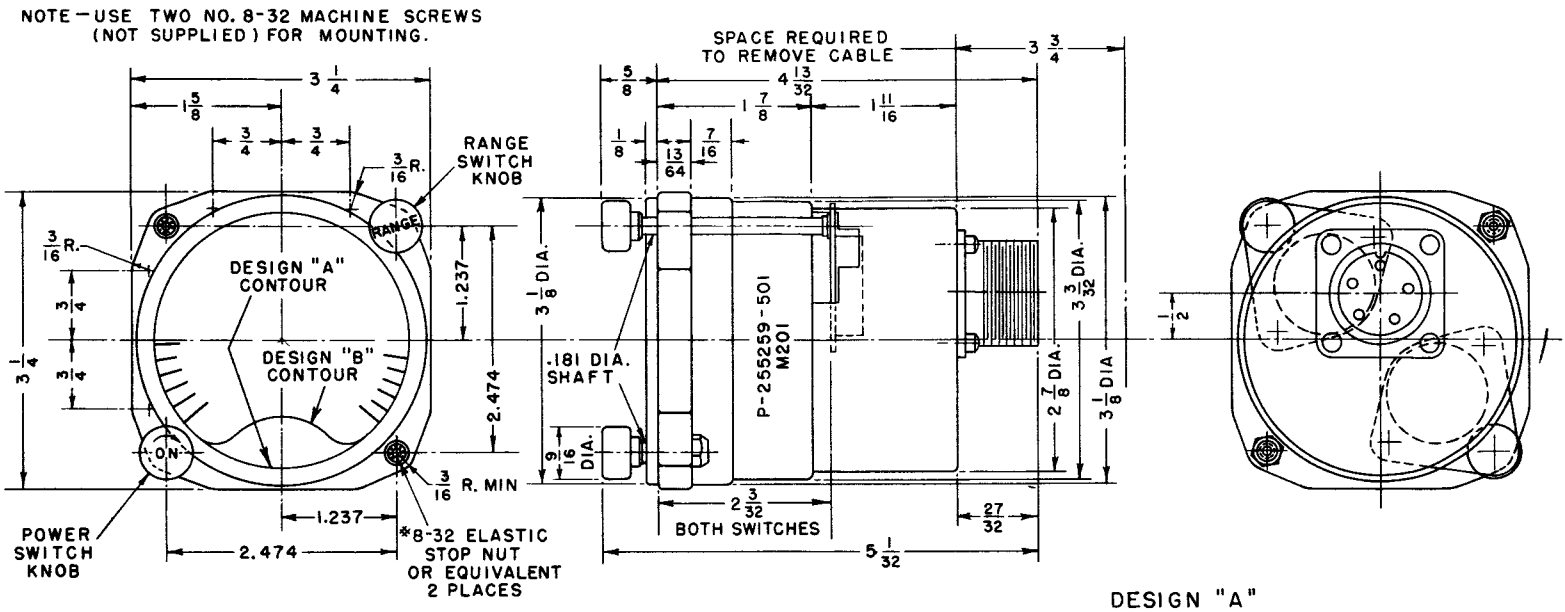
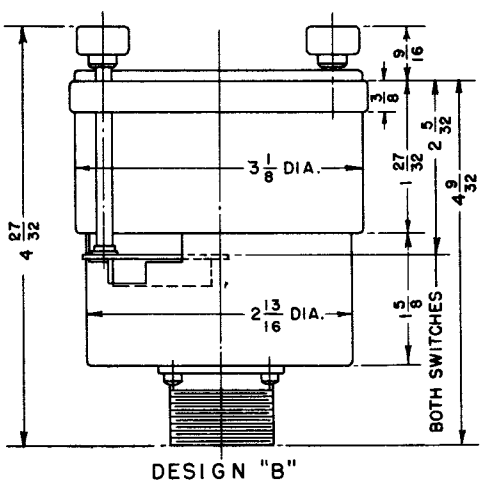


Figure 24—Mounting Base ★MT-14/ARN-1, Outline (P-255418)





DIFFERENT DIMENSIONS AS SHOWN—
OTHERWISE EQUIVALENT TO DESIGN "A"

TABLE OF MANUFACTURERS

MFR. CODE	DESIGN	NAME	ADDRESS
CG	"A"	GENERAL ELECTRIC COMPANY	WEST LYNN, MASS.
CAR	"A"	ROLLER-SMITH COMPANY	BETHLEHEM, PA.
CAY	"B"	WESTINGHOUSE ELECTRIC & MFG. CO.	NEWARK, N. J.

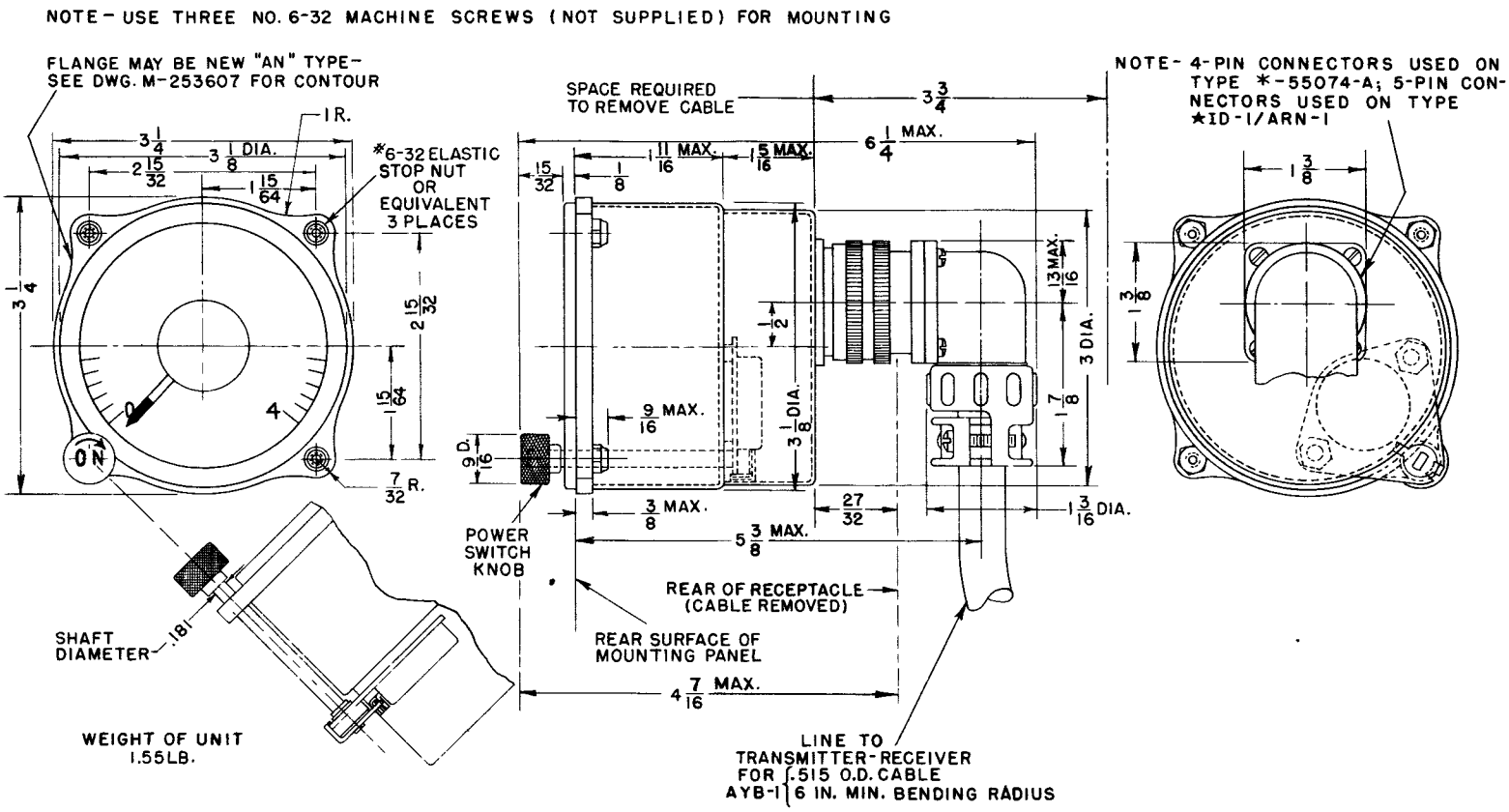
ALTITUDE INDICATORS

★ID-14/APN-1, ★ID-14A/APN-1 & ★ID-14B/APN-1

FOR ★AN/APN-1, ★AN/APN-1B & ★AN/APN-1X — SEE EQUIPMENT DIAGRAM T-256081

WEIGHT OF UNIT
1.8 LB.

Figure 25—Double-Range Altitude Indicator ★ID-14/APN-1, ★ID-14A/APN-1 or ★ID-14B/APN-1, Outline (P-255413)

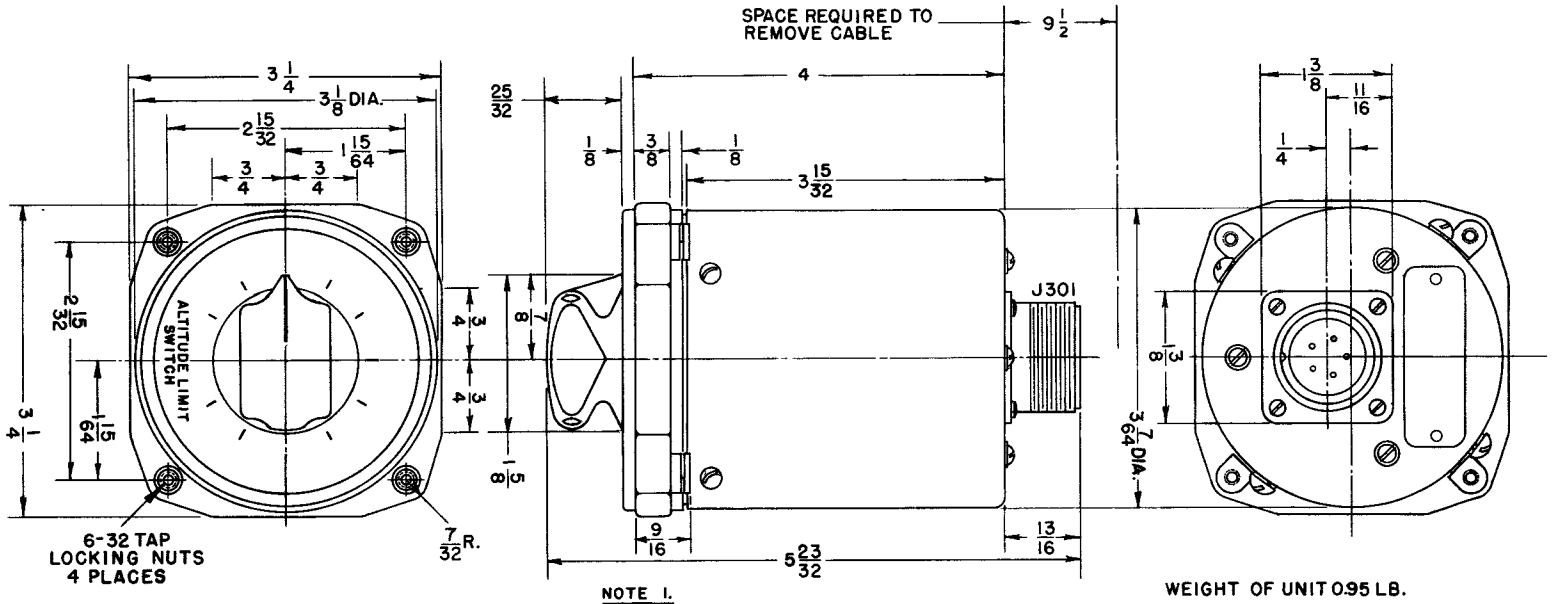


ALTITUDE INDICATORS
FOR AYB-1, AYD SERIES, ★AN/ARN-1 & ★AN/APN-1A

ALTITUDE INDICATOR		EQUIPMENT APPLICATION		
NAVY TYPE NO. OR ANB NO.	MFR. CODE	EQIPMENT MODEL NO.	MFR. CODE	EQUIPMENT DIAGRAM
*-55074-A	CRV	AYB-1& AYB-2	CRV	P-255140
	CG OR CAR	AYD & AYD-2	CRV	P-255275
★ID-1/ARN-1	CG,CAR OR CDL	AYD-3 & ★AN/ARN-1	CDL	P-255247
	CG,CAR OR CRV	★AN/ARN-1	CRV	
		★AN/APN-1A	CRV	T-256081

*MANUFACTURER'S CODE PREFIX

Figure 26—Single-Range Altitude Indicator ★ID-1/ARN-1, Outline (M-253155)



NOTE 1.

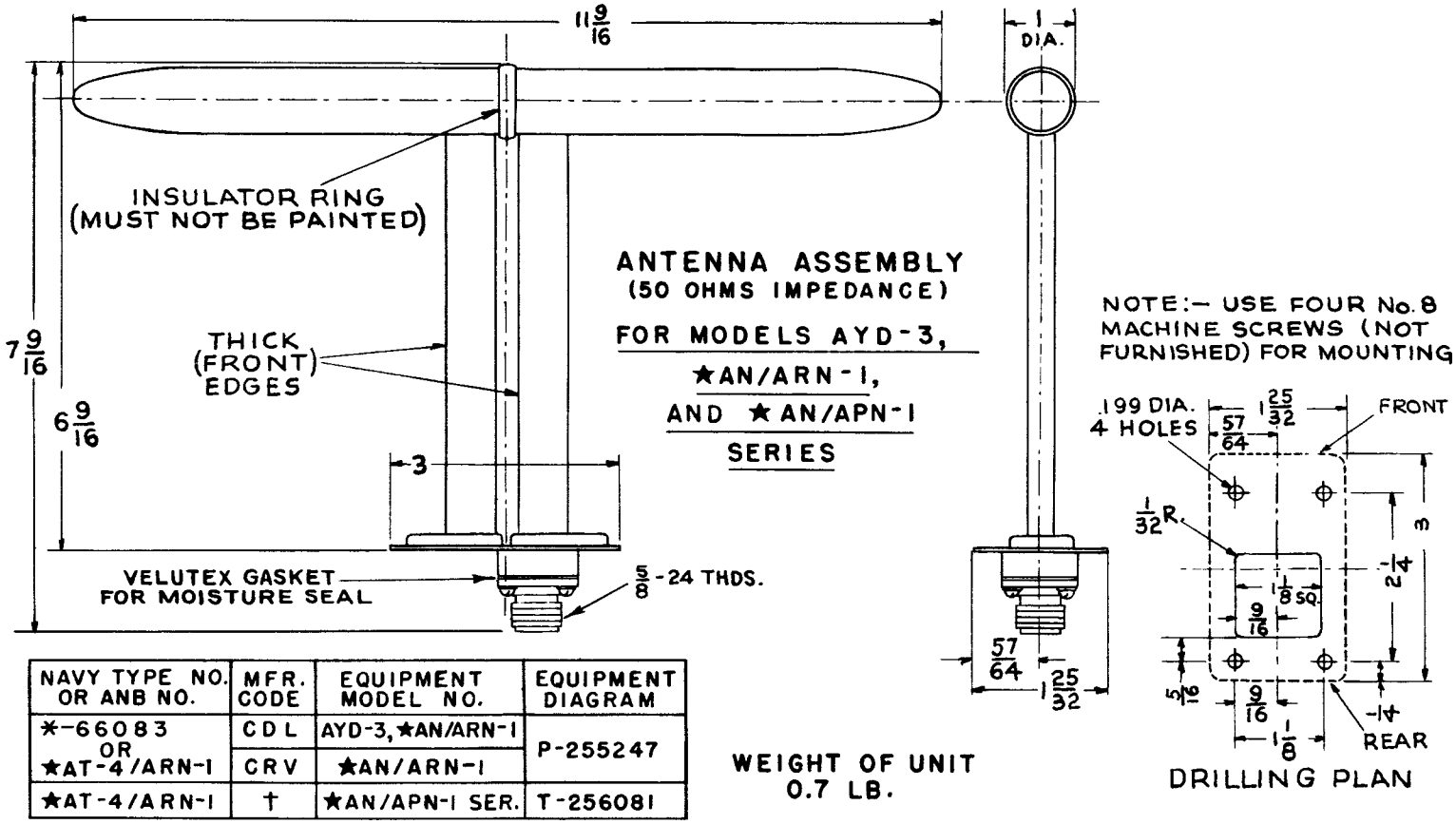
★SA-1A/ARN-1 (SAME AS ★SA-1/ARN-1 EXCEPT FLUORESCENT MARKINGS ON DIAL AND KNOB ARE PALE YELLOW INSTEAD OF PALE GREEN) REPLACES ★SA-1/ARN-1 IN ★AN/APN-1 SERIES EQUIPMENTS OF LATER PRODUCTION.

NAVY TYPE NO. OR ANB NO.	MFR. CODE	EQUIPMENT MODEL NO.	EQUIPMENT DIAGRAM
CRV-24130	CRV	AYD, AYD-2	P-255275
★SA-1/ARN-1 (SAME AS NAVY TYPE *24130 EXCEPT NAMEPLATE) (SEE NOTE 1)	CDL	AYD-3, ★AN/ARN-1	P-255247
	CRV	★AN/ARN-1	
	*	★AN/APN-1 SERIES	T-256081

ALTITUDE LIMIT SWITCH
FOR AYD SERIES, ★AN/ARN-1, AND ★AN/APN-1 SERIES

*SEE EQUIPMENT DIAGRAM.

Figure 27—Altitude Limit Switch ★SA-1/ARN-1, Outline (M-253607)



NAVY TYPE NO. OR ANB NO.	MFR. CODE	EQUIPMENT MODEL NO.	EQUIPMENT DIAGRAM
*-66083 OR ★AT-4/ARN-1	CDL	AYD-3, ★AN/ARN-1	P-255247
	CRV	★AN/ARN-1	
★AT-4/ARN-1	†	★AN/APN-1 SER.	T-256081

*MANUFACTURER'S CODE PREFIX.
†SEE EQUIPMENT DIAGRAM.

WEIGHT OF UNIT
0.7 LB.

Figure 28—Antenna ★AT-4/ARN-1, Outline (K-252401)

AN-08-10-265

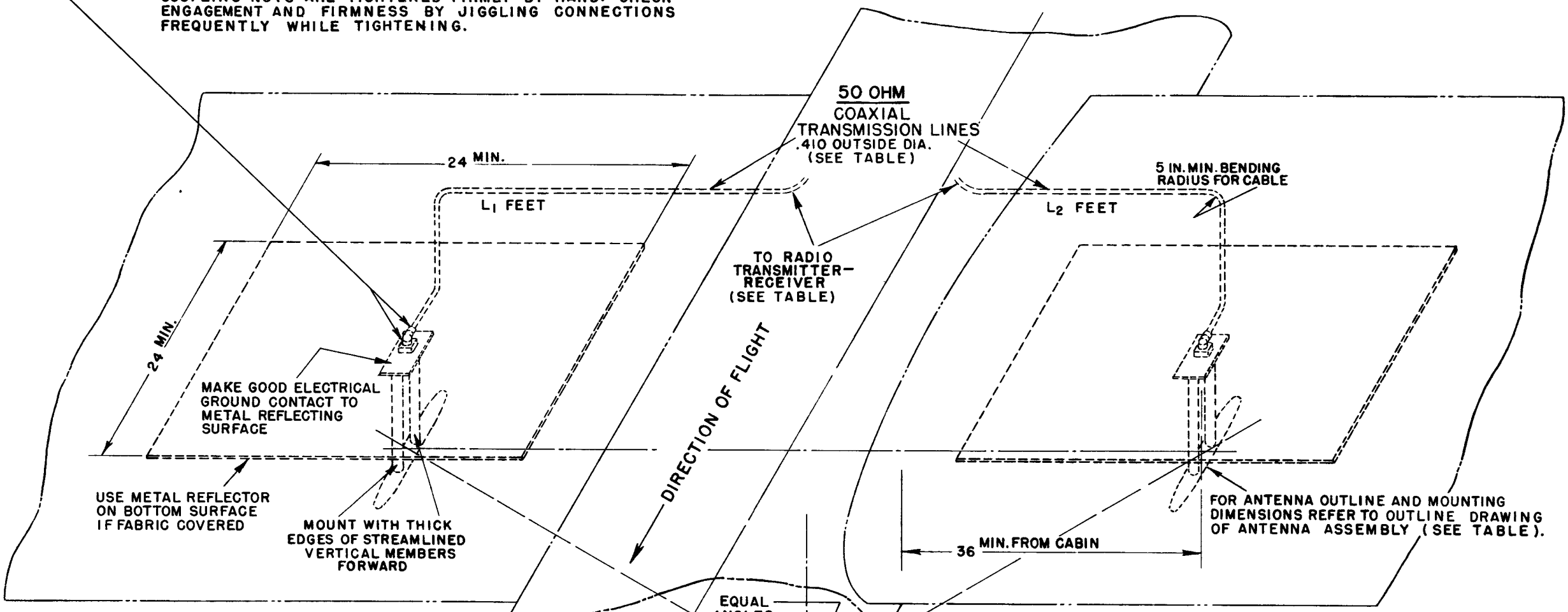
ANTENNA INSTALLATION DIAGRAM
FOR
AYD-3, ★AN/ARN-1, ★AN-APN-1 SERIES

NOTE:
WITH AXES OF TRANSMITTER AND RECEIVER ANTENNAS PARALLEL AS SHOWN, INTERMEDIATE SHIELDING IS REQUIRED AND IS NORMALLY PROVIDED BY METAL FUSELAGE.

THE TWO ANTENNAS CAN ALSO BE INSTALLED UNDERNEATH FUSELAGE APPROXIMATELY 7 FT. APART ON A COMMON AXIS APPROXIMATELY PARALLEL TO AXIS OF FUSELAGE. THIS METHOD DOES NOT REQUIRE SHIELDING AND IS RECOMMENDED IN ALL CASES WHEN FUSELAGE IS FABRIC COVERED.

SEE ANTENNA INSTALLATION INSTRUCTIONS

IMPORTANT — MAKE SURE THAT TEETH AT MALE ENDS OF FITTINGS ARE ENGAGED WITH NOTCHES AT FEMALE ENDS BEFORE THE COUPLING NUTS ARE TIGHTENED FIRMLY BY HAND. CHECK ENGAGEMENT AND FIRMNESS BY JIGGLING CONNECTIONS FREQUENTLY WHILE TIGHTENING.



INSTALLATION DRAWING REFERENCES

EQUIPMENT MODEL NO.	EQUIPMENT DIAGRAM	TRANSMITTER -RECEIVER (OUTLINE)	ANTENNA ASSEMBLY (OUTLINE)	TRANSMISSION LINES (OUTLINE-ASSEMBLY)
AYD-3 & ★AN/ARN-1	P-255247	P-255248	K-252401	P-255246
★AN/APN-1 SERIES	T-256081	P-255414	K-252401	P-255415

FUNDAMENTAL REQUIREMENTS FOR ANTENNA PLACEMENT

(1) SHORTEST GROUND REFLECTION PATH BETWEEN ANTENNAS MUST BE UNOBSTRUCTED AT ALL FLYING POSITIONS FOR WHICH ALTIMETER OPERATION IS REQUIRED.

(2) DIRECT "FEED-THROUGH" OF SIGNALS FROM TRANSMITTER ANTENNA TO RECEIVER ANTENNA, EITHER BY DIRECT COUPLING OR INDIRECTLY BY REFLECTION FROM OBJECTS ON OR SURFACES OF THE AIRCRAFT, MUST BE AVOIDED.

(3) RESIDUAL ALTITUDE GIVEN BY $A_{RO} = 0.76\,(L_1 + L_2) + \frac{D_1 + D_2}{2}$ SHOULD NOT EXCEED 58 FEET.

SEE "INSTALLATION" INSTRUCTIONS FOR DETAILED INFORMATION.

Figure 29—Antenna Installation Diagram (P-255249)

AN-08-10-265

R-F TRANSMISSION LINES FOR ★AN/APN-1 SERIES

NOTE - FOR ALL SOLDERING, USE ONLY NON-CORROSIVE ROSIN CORE SOLDER.

WIRING AND ASSEMBLY INSTRUCTIONS

1. CUT BULK TRANSMISSION LINE (ITEM 3) TO LENGTHS REQUIRED FOR THE PARTICULAR INSTALLATION (SEE EQUIPMENT DIAGRAM, DWG. T-256081. TRIM BOTH ENDS OF EACH CABLE AS SHOWN IN FIGURE A. HOT TIN DIP INNER CONDUCTOR EXTENSIONS AND TIN OUTER CONDUCTOR BRAID TO WITHIN 1/8 INCH FROM VINYLITE JACKET. AVOID SURPLUS SOLDER AND EXCESSIVE HEATING OF SOLID DIELECTRIC AND VINYLITE JACKET. SWAGE TINNED BRAID, IF NECESSARY, TO 11/32 DIAMETER MAXIMUM.

2. DISASSEMBLE PLUGS (ITEM 4). IF PLUGS ARE OF THREE-PIECE CONSTRUCTION, SLIP TAPERED SLEEVE AND COUPLING NUT OVER EACH END OF CABLES IN THE RELATION SHOWN AT LEFT IN FIGURE B. IF PLUGS ARE OF TWO-PIECE CONSTRUCTION (AS SUPPLIED BY AMERICAN PHENOLIC CORP., THEIR CATALOG NO. 83-1SP), SLIP COUPLING SLEEVE OVER CABLE WITH KNURLED PORTION TOWARD END OF CABLE, AS SHOWN AT LEFT IN FIGURE C.

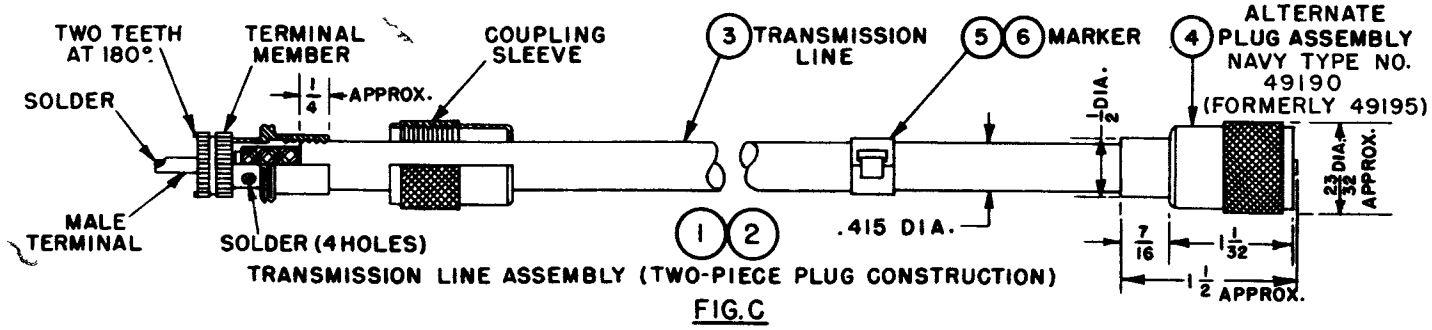
3. FEED ENDS OF CABLE INTO PLUG TERMINAL MEMBERS SO THAT END OF INNER CONDUCTOR IS APPROXIMATELY FLUSH WITH TIP OF HOLLOW TERMINAL AND TINNED BRAID EXTENDS SLIGHTLY BEYOND THE FOUR SOLDERING HOLES IN THE NECK, AS SHOWN IN FIGURES B AND C. BOTH TYPES OF PLUGS HAVE INTERNAL THREADS WHICH ENGAGE THE VINYLITE OUTER JACKET OF THE CABLE. THE TYPE SHOWN IN FIGURE B IS SLOTTED TO PERMIT EXPANSION FOR INSERTION OF CABLE. THE TYPE SHOWN IN FIGURE C IS NOT SLOTTED AND MUST BE TURNED SO AS TO THREAD ONTO VINYLITE JACKET. AT LEAST 1/4 INCH OF JACKET SHOULD ENTER THREADED PORTION OF TERMINAL MEMBER.

4. USING NON-CORROSIVE FLUX OR ROSIN CORE SOLDER, CAREFULLY SOLDER END OF INNER CONDUCTOR TO TERMINAL TIP AND SOLDER BRAID TO NECK OF TERMINAL MEMBER AT FOUR HOLES. AVOID EXCESS SOLDER AND REMOVE ALL SOLDER ON OUTER PERIPHERY OF HOLLOW PIN TERMINAL TO PREVENT MATING INTERFERENCE. SNIP OFF CONDUCTOR EXTENSION (IF ANY) FLUSH WITH TIP OF TERMINAL.

5. REASSEMBLE PLUGS AS SHOWN AT RIGHT OF FIGURES B AND C. IF PLUG IS OF THREE-PIECE CONSTRUCTION (FIGURE B), DRAW TAPERED SLEEVE OVER SLOTTED MEMBER AND TIGHTEN SETSCREW FIRMLY AGAINST SOLID METAL PORTION OF NECK, AFTER ADJUSTING FOR MINIMUM CLEARANCE WHICH WILL ALLOW COUPLING NUT TO TURN FREELY. IF PLUG IS OF TWO-PIECE CONSTRUCTION (FIGURE C), THREAD KNURLED COUPLING SLEEVE ONTO TERMINAL MEMBER UNTIL THREADS DISENGAGE.

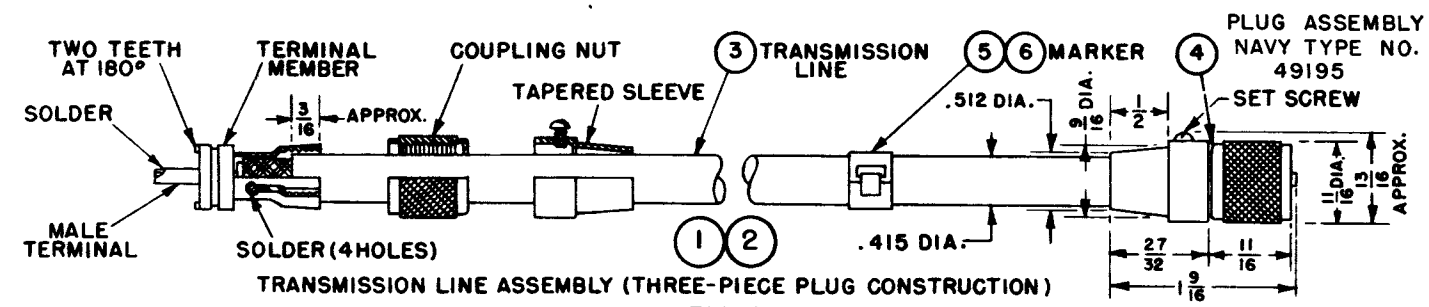
6. ATTACH CABLE MARKERS 5 AND 6 TO RECEIVER AND TRANSMITTER ANTENNA TRANSMISSION LINES W501 AND W502 RESPECTIVELY, AS SHOWN IN FIGURES B AND C.

7. THE ELBOW ADAPTERS (ITEM 7) MAY BE INTERPOSED BETWEEN TRANSMISSION LINES AND RECEPTACLES J101 AND J102 OF TRANSMITTER-RECEIVER AND J401 AND J402 OF ANTENNAS, AS INDICATED ON DWG. T-256081 OR TRANSMISSION LINES MAY BE CONNECTED TO RECEPTACLES DIRECTLY. IF ADAPTERS ARE TO BE USED, COUPLE FEMALE END OF ADAPTER TO MALE PLUG AT EACH END OF TRANSMISSION LINES. MAKE SURE THAT TEETH AT FRONT RIM OF PLUGS ARE ENGAGED WITH NOTCHES AT RIM OF ADAPTER BEFORE COUPLING NUTS ARE FIRMLY TIGHTENED.



TRANSMISSION LINE ASSEMBLY (TWO-PIECE PLUG CONSTRUCTION)

FIG.C



TRANSMISSION LINE ASSEMBLY (THREE-PIECE PLUG CONSTRUCTION)

FIG.B

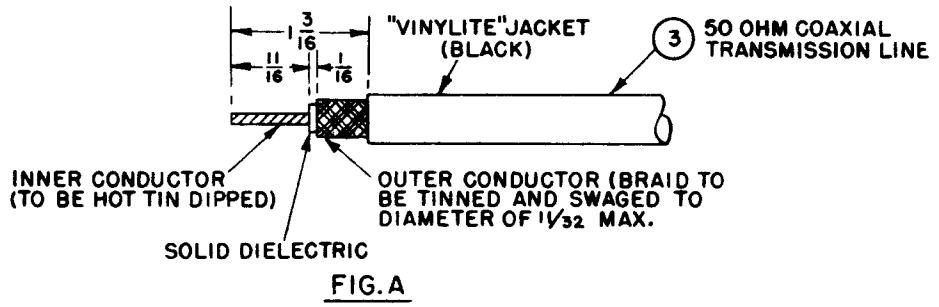


FIG.A

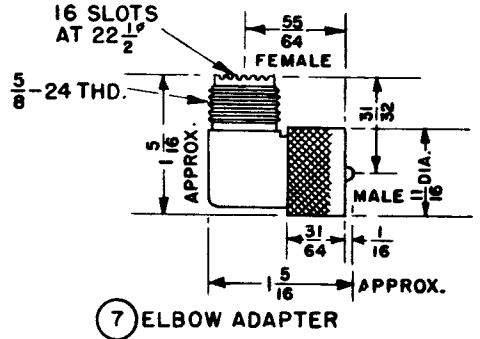


FIG.D

TRANSMISSION LINE MATERIALS AND FITTINGS—FURNISHED UNASSEMBLED

ITEM NO.	ALL SYMBOL DESIGNATIONS	DESCRIPTION	NAVY TYPE NUMBER	RCA DRAWING	UNIT WEIGHT (POUNDS)	QUANTITY W501	QUANTITY W502
1	W501	RECEIVER ANTENNA TRANSMISSION LINE ASSEMBLY		THIS DWG.		X	
2	W502	TRANSMITTER ANT. TRANSMISSION LINE ASSEMBLY		THIS DWG.			X
3	W501A, 502A	50 OHM COAXIAL TRANSMISSION LINE	A-N NO. RG-8/U†	K-99208-1†	0.10/FT.	*	*
4	P101, 102, 401, 402	COAXIAL PLUG, MALE	49195	P-255223-9	0.06	2	2
5		CABLE MARKER (RECEIVER ANTENNA ★AN/APN-1)		29631-2	NEGLIGIBLE	1	
6		CABLE MARKER (TRANSMITTER ANTENNA ★AN/APN-1)		29631-3	NEGLIGIBLE		1
7	E507, 508, 509, 510	COAXIAL ELBOW ADAPTER	49192-A △	K-252666-1	0.08	X	X

X SEE EQUIPMENT DIAGRAM T-256081 FOR QUANTITY SUPPLIED PER EQUIPMENT.
* FURNISHED IN CONTINUOUS LENTHS OF 200 FEET ON REELS. SEE EQUIPMENT DIAGRAM T-256081 FOR TOTAL LENGTH SUPPLIED PER EQUIPMENT.
△ ORIGINALLY "CSX-49192" (SELECTAR) — DO NOT SUBSTITUTE NAVY TYPE NO. 49192 ADAPTER OF ANY OTHER MAKE (APPROVED ALTERNATE-GEPHARDT MFG. CO. NO. 19192).
† NAVY-TYPE NO. CASSF-50-1 (RCA DWG. K-871757-2) 50-OHM COAXIAL CABLE MAY BE SUPPLIED AS ALTERNATE FOR ITEM 3 ON SOME CONTRACTS.

NOTE - TRANSMISSION LINES W501 AND W502 FOR ★AN/APN-1 SERIES ARE SAME AS FOR AYD-3 AND ★AN/ARN-1 (SEE DWG. P-255246) EXCEPT FOR CABLE MARKERS.

Figure 30—Antenna Transmission Lines W501 and W502, Outline-Assembly (P-255415)

AN-08-10-265

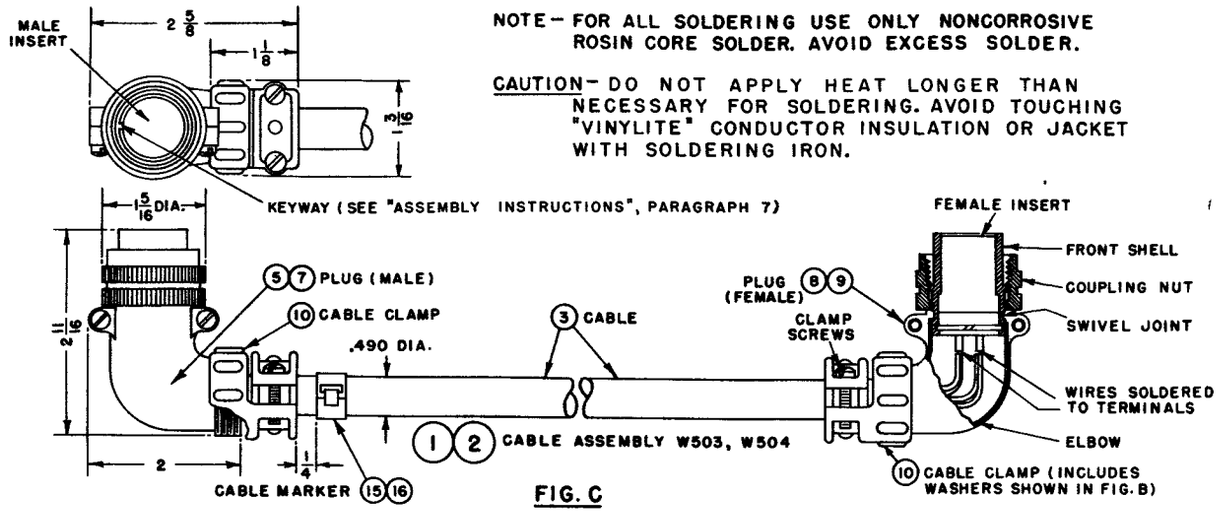


FIG. C

NOTE – FOR ALL SOLDERING USE ONLY NONCORROSIVE ROSIN CORE SOLDER. AVOID EXCESS SOLDER.

CAUTION – DO NOT APPLY HEAT LONGER THAN NECESSARY FOR SOLDERING. AVOID TOUCHING "VINYLITE" CONDUCTOR INSULATION OR JACKET WITH SOLDERING IRON.

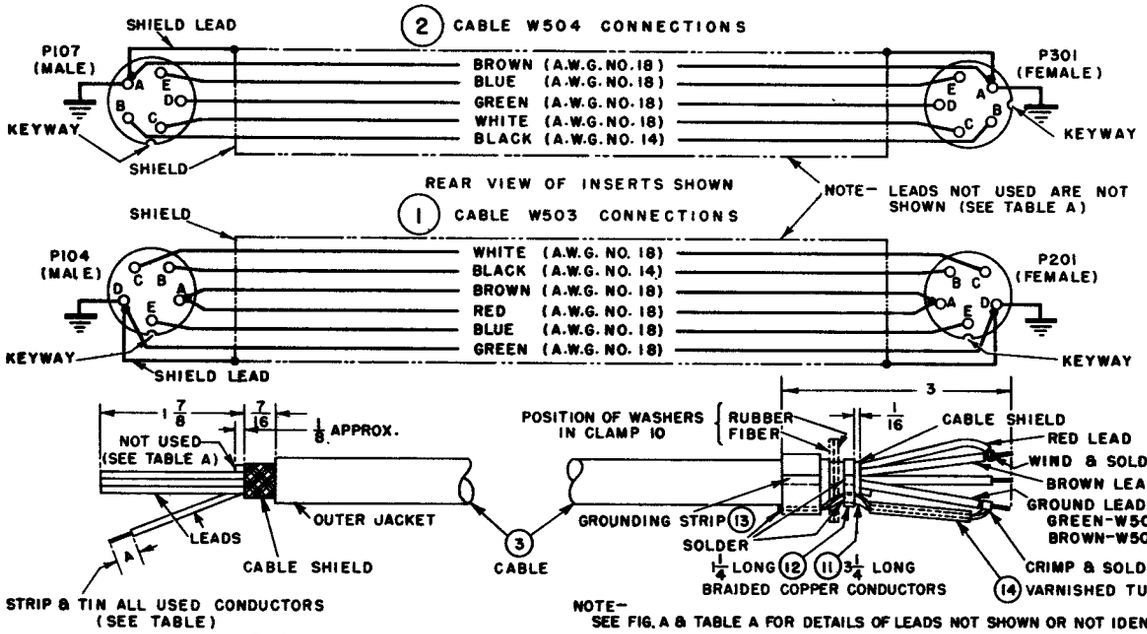
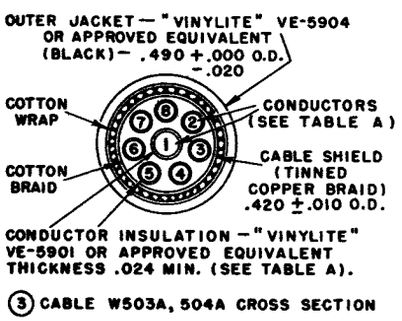


FIG. A
CABLE W503 OR W504 (BOTH ENDS)

FIG. B
CABLE W503 OR W504 (BOTH ENDS)



3 CABLE W503A, 504A CROSS SECTION

TABLE A – CONDUCTOR SPECIFICATIONS FOR W503A, W504A

LEAD NO.	SIZE A.W.G.	STRANDING (BARE COPPER)	LEAD IDENTIFICATION	DIMENSION "A" (INCHES) W503	W504
1	14	37-41/.010	BLACK	1/4	1/4
2	18	16-19/.010	WHITE	1/4	1/4
3	18	16-19/.010	WHITE (RIDGE TRACER)	NOT USED	NOT USED
4	18	16-19/.010	BLACK (RIDGE TRACER)	NOT USED	NOT USED
5	18	16-19/.010	BROWN	3/8	3/8
6	18	16-19/.010	RED	1/4	NOT USED
7	18	16-19/.010	BLUE	1/4	1/4
8	18	16-19/.010	GREEN	3/8	1/4

CABLE MATERIALS AND FITTINGS — FURNISHED UNASSEMBLED

ITEM NO.	REF. SYMBOL	DESCRIPTION	DRAWING OR SPECIFICATION	UNIT WEIGHT (POUNDS)	QUANTITY W503	W504	MISC.
1	W503	ALTITUDE INDICATOR CABLE ASSEMBLY	THIS DRAWING	–	X		
2	W504	ALTITUDE LIMIT SW. CABLE ASSEMBLY	THIS DRAWING	–		X	
3	W503A W504A	8-WIRE SHIELDED CABLE	RCA DWG. P-255421-4 (AN TYPE WM-1/U)	0.16/FT.	*	*	
4	P103**	PLUG - ELBOW, 3 CONTACTS, FEMALE (BATTERY INPUT CONNECTOR)	RCA DWG. M-253474-8 (AMPHENOL AN-3108-18-5S)	0.15			X
5	P104	PLUG - ELBOW, 5 CONTACTS, MALE	RCA DWG. M-253474-16 (AMPHENOL AN-3108-18-20P)‡	0.13	1		
6	P105**	PLUG - ELBOW, 5 CONTACTS, MALE (LIMIT INDICATOR CONNECTOR)	RCA DWG. M-253474-10 (AMPHENOL AN-3108-18-20P)†	0.13			X
7	P107	PLUG - ELBOW, 5 CONTACTS, MALE	RCA DWG. M-253474-12 (AMPHENOL AN-3108-18-3(P)‡	0.13		1	
8	P201	PLUG - ELBOW, 5 CONTACTS, FEMALE	RCA DWG. M-253474-15 (AMPHENOL AN-3108-18-3OS)‡	0.15	1		
9	P301	PLUG - ELBOW, 5 CONTACTS, FEMALE	RCA DWG. M-253474-14 (AMPHENOL AN-3108-18-20S)†	0.15		1	
10	E511, E512, E513, E514	CABLE CLAMP	RCA DWG. P-255073-34 (AMPHENOL 97-3057-10-6)	0.06	2	2	
11		BRAIDED COPPER CONDUCTOR	RCA SPEC. PS-499 - 1/8 72-.005 TINNED (3-1/4 LONG)	NEGLIGIBLE	2	2	
12		BRAIDED COPPER CONDUCTOR	RCA SPEC. PS-499 - 1/8 72-.005 TINNED (1-1/4 LONG)	NEGLIGIBLE	2	2	
13		COPPER STRIP	RCA SPEC. PS-21 SOFT - 1/2 X .010 TINNED (1-3/4 LONG)	NEGLIGIBLE	2	2	
14		VARNISHED TUBING	RCA SPEC. PS-50 BLACK - .133 I.D. (1-3/8 LONG)	NEGLIGIBLE	2	2	
15		CABLE MARKER (ALTITUDE INDICATOR ★AN/APN-1)	RCA DWG. 29631-1	NEGLIGIBLE	1		
16		CABLE MARKER (ALT. LIMIT SWITCH ★AN/APN-1)	RCA DWG. 29631-4	NEGLIGIBLE		1	

SEE CABLE W504 NOTE

X – SEE EQUIPMENT DIAGRAM FOR QUANTITY SUPPLIED PER EQUIPMENT.

* – FURNISHED IN BULK ON REELS. SEE EQUIPMENT DIAGRAM FOR LENGTH SUPPLIED PER EQUIPMENT.

** – OUTLINE DIMENSIONS SAME AS SHOWN IN FIGURE C FOR P104 (ITEM 5).

† – PLUG INSERTS WERE FORMERLY DESIGNATED "683P" OR "683S" INSTEAD OF "20P" OR "20S", RESPECTIVELY.

NOTE 1 – ALT. IND. CABLE W503 IS INTERCHANGEABLE WITH CORRESPONDING CABLE OF MODEL ★AN/ARN-1. ALT. LIM. SW. CABLE W504 IS INTERCHANGEABLE WITH CORRESPONDING CABLE OF AYD SERIES AND ★AN/ARN-1 MODELS. SEE INSTRUCTION BOOK FOR MODELS AYD-3 AND ★AN/ARN-1 (CABLE DRAWING P-255243, ITEMS 1B AND 2) FOR ALTERNATE CONSTRUCTION USING FLANGE TYPE PLUGS (SEE TABLE B) AND/OR BULK CABLE OTHER THAN SPECIFIED IN ITEM 3 ABOVE.

‡ – AMPHENOL DESIGNATIONS WERE FORMERLY AS FOLLOWS:

ITEM NO.	REF. SYMBOL	AMPHENOL CATALOG NO.
5	P104	97-3108-18-20P-POS. 3 †
7	P107	97-3108-18-20P-POS. 2 †
8	P201	97-3108-18-20S-POS. 3 †

CABLES W503 & W504 ASSEMBLY INSTRUCTIONS

1. CUT BULK CABLE 3 TO W503 AND W504 LENGTHS REQUIRED FOR THE PARTICULAR INSTALLATION (SEE EQUIPMENT DIAGRAM). TRIM CABLE ENDS IN ACCORDANCE WITH FIG. A AND TABLE A.
2. ADD GROUNDING CONNECTIONS AT BOTH ENDS OF CABLE, AS SHOWN IN FIG. B, THUS: SOLDER BRAIDED CONDUCTOR 11 TO GROUNDING STRIP 13, THEN WRAP LATTER AROUND OUTER JACKET OF CABLE IN POSITION SHOWN. WRAP BRAIDED CONDUCTOR 12 OVER CONDUCTOR 11 AND AROUND CABLE SHIELD. SOLDER BOTH BRAIDED CONDUCTORS TOGETHER AND TO SHIELD. SLIP VARNISHED TUBING 14 OVER CONDUCTOR 11. CRIMP END OF LATTER AROUND TINNED END OF GROUND LEAD OF CABLE ADJACENT TO INSULATION, AND SOLDER.
3. AT BOTH ENDS OF CABLE W503 ONLY, WIND TINNED END OF RED LEAD AROUND TINNED END OF BROWN LEAD ADJACENT TO INSULATION, AND SOLDER (SEE FIG. B).
4. LOOSEN SCREWS OF CLAMPS 10 AND SLIP ONE CLAMP ONTO EACH END OF CABLE (SEE FIG. C) AFTER MAKING SURE THAT CLAMPS CONTAIN THE FIBER AND RUBBER WASHERS AS INDICATED IN FIG. B.
5. DISASSEMBLE ELBOW PLUGS 5 AND 8 (FOR W503) OR 7 AND 9 (FOR W504) BY REMOVING TWO SCREWS HOLDING SPLIT SHELLS TOGETHER. NOTE - IF PLUGS ARE OF THE FLANGE TYPE ALTERNATE CONSTRUCTION (SEE NOTE 1 AND TABLE B), REMOVE FOUR SCREWS AT FLANGE AND SLIP ELBOW PORTIONS OVER ENDS OF CABLE.
6. SOLDER CABLE LEADS TO PLUG TERMINALS ACCORDING TO PROPER CONNECTION DIAGRAM FOR CABLE 1 (W503) OR CABLE 2 (W504).
7. REASSEMBLE PLUGS AND TIGHTEN SCREWS FIRMLY AFTER ADJUSTING THE FRONT SHELL KEYWAY POSITION AS REQUIRED FOR THE PARTICULAR INSTALLATION.
8. SCREW CABLE CLAMPS FIRMLY TO PLUG ELBOWS – AVOID TWISTING CABLE LEADS. ALIGN CLAMPS 10 WITH GROUNDING STRIPS 13 (FIG. B), THEN TIGHTEN CLAMP SCREWS TO ANCHOR CABLE AND TO GROUND CONNECTOR SHELL TO CABLE SHIELD AT EACH END OF CABLE.
9. ATTACH CABLE MARKER 15 OR 16 AT MALE PLUG END OF CABLE W503 OR W504, RESPECTIVELY (FIG. C).

TABLE B – ALTERNATE PLUGS (FLANGE TYPE)

ITEM NO.	REF. SYMBOL	RCA DRAWING NUMBER	AMPHENOL CATALOG NO.
4	P103	P-255073-52	97-3106J-18-6S
5	P104	P-255262-46	97-3106J-18-20P-POS. 3 †
6	P105	P-255073-51	97-3106J-18-20P †
7	P107	P-255262-37	97-3106J-18-20P-POS. 2 †
8	P201	P-255262-47	97-3106J-18-20S-POS. 3 †
9	P301	P-255073-53	97-3106J-18-20S †

CABLE W504 NOTE

FOR ASSEMBLY OF CABLE W504 USING THE STRAIGHT PLUG P301 (AN-3106-18-20S) SUPPLIED IN LATER PRODUCTION, REFER TO OUTLINE ASSEMBLY DWG. T-256405.

FOR ★AN/APN-1 SERIES

SEE EQUIPMENT DIAGRAM T-256081

Figure 31—Control Cables W503 and W504, Outline-Assembly (T-256082)

AN-08-10-265

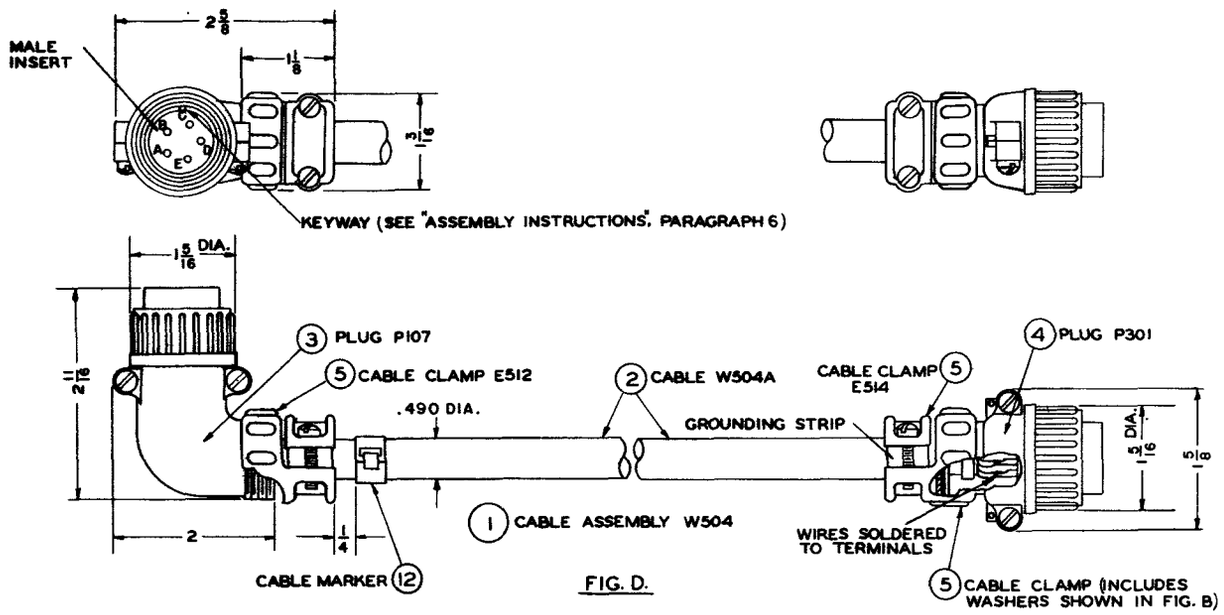


FIG. D.

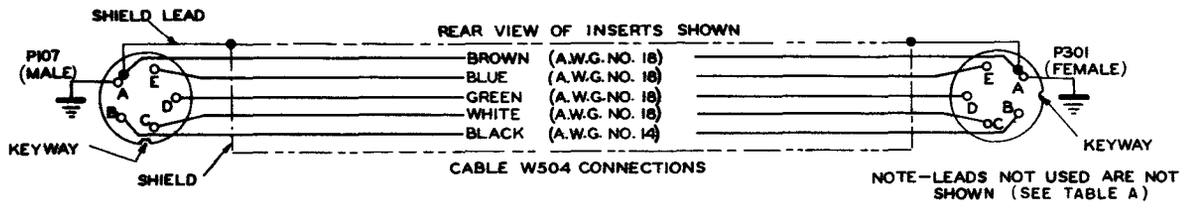


FIG. C.

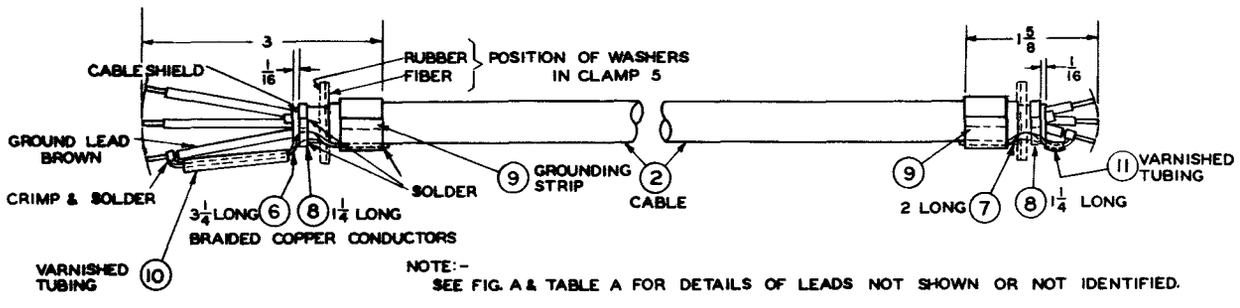


FIG. B.

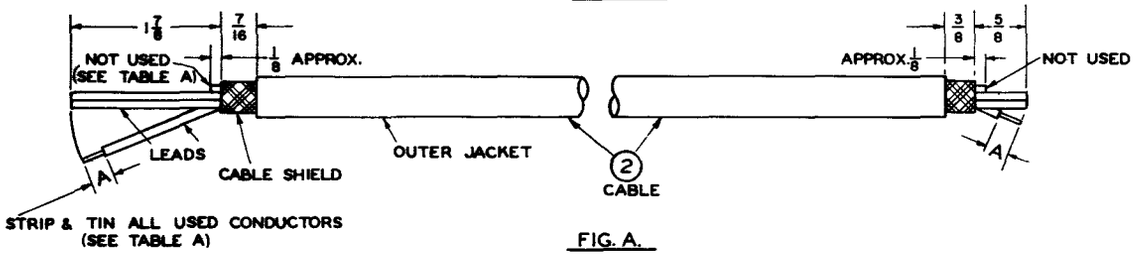
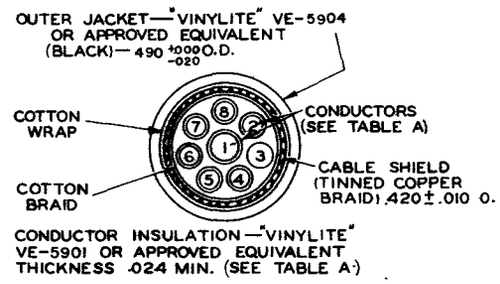


FIG. A.

CABLE MATERIALS AND FITTINGS — FURNISHED UNASSEMBLED

ITEM NO	REF. SYMBOL	DESCRIPTION	DRAWING OR SPECIFICATION	UNIT WEIGHT (POUNDS)	QUANTITY
1	W504	ALT. LIM. SWITCH CABLE ASSEMBLY	THIS DRAWING	—	X
2	W504A	8-WIRE SHIELDED CABLE	RCA DWG P-255421-4 (AN TYPE WM-1/U)	0.16/FT.	*
3	P107	PLUG-ELBOW, 5 CONTACTS, MALE	RCA DWG. M-253474-12 (AMPHENOL AN-3108-18-3IP †)	0.13	1
4	P301	PLUG-STRAIGHT, 5 CONTACTS, FEMALE	RCA DWG. M-430523-2 (AMPHENOL AN-3106-18-20S †)	0.10	1
5	E512 E514	CABLE CLAMP	RCA DWG. P-255073-34 (AMPHENOL 97-3057-10-6)	0.06	2
6		BRAIDED COPPER CONDUCTOR	RCA SPEC PS-499-1/8 72-.005 TINNED (3-1/4 LONG)	NEGLIGIBLE	1
7		BRAIDED COPPER CONDUCTOR	RCA SPEC. PS-499-1/8 72-.005 TINNED (2 LONG)	NEGLIGIBLE	1
8		BRAIDED COPPER CONDUCTOR	RCA SPEC. PS-499-1/8 72-.005 TINNED (1-1/4 LONG)	NEGLIGIBLE	2
9		COPPER STRIP	RCA SPEC. PS-21 SOFT-1/2 X.010 TINNED (1-3/4 LONG)	NEGLIGIBLE	2
10		VARNISHED TUBING	RCA SPEC. PS-50 BLACK-.133 I.D. (1-3/8 LONG)	NEGLIGIBLE	1
11		VARNISHED TUBING	RCA SPEC. PS-50 BLACK-.133 I.D. (3/8 LONG)	NEGLIGIBLE	1
12		CABLE MARKER ALTITUDE LIMIT SWITCH ★AN/APN-1	RCA DWG. 29631-4	NEGLIGIBLE	1

× SEE EQUIPMENT DIAGRAM FOR QUANTITY SUPPLIED PER EQUIPMENT.
* FURNISHED IN BULK ON REELS. SEE EQUIPMENT DIAGRAM FOR LENGTH SUPPLIED PER EQUIPMENT.
† DESIGNATION OF P107, ITEM 3, WAS FORMERLY "97-3108-18-20P-POS. 2" OR "97-3108-18-683P-POS. 2."
‡ DESIGNATION OF P301, ITEM 4, WAS FORMERLY "AN-3106-18-683S."



(2) CABLE W504A CROSS SECTION

TABLE A.— CONDUCTOR SPECIFICATIONS FOR CABLE W504A

LEAD NO.	SIZE A.W.G.	STRANDING BARE COPPER	LEAD IDENTIFICATION	DIMENSION A (INCHES)
1	14	37-41/.010	BLACK	1/4
2	18	16-19/.010	WHITE	1/4
3	18	16-19/.010	WHITE- RIDGE TRACER	NOT USED
4	18	16-19/.010	BLACK- RIDGE TRACER	NOT USED
5	18	16-19/.010	BROWN	3/8
6	18	16-19/.010	RED	NOT USED
7	18	16-19/.010	BLUE	1/4
8	18	16-19/.010	GREEN	1/4

CABLE W504
ASSEMBLY INSTRUCTIONS

1. CUT BULK CABLE 2 TO LENGTH REQUIRED FOR THE PARTICULAR INSTALLATION (SEE EQUIPMENT DIAGRAM). TRIM CABLE ENDS IN ACCORDANCE WITH FIG. A AND TABLE A.
2. ADD GROUNDING CONNECTIONS AT BOTH ENDS OF CABLE AS SHOWN IN FIG. B THUS: SOLDER BRAIDED CONDUCTOR 6 OR 7 TO GROUNDING STRIP 9 THEN WRAP LATTER AROUND OUTER JACKET OF CABLE IN POSITION SHOWN. WRAP BRAIDED CONDUCTOR 8 OVER CONDUCTOR 6 OR 7 AND AROUND CABLE SHIELD. SOLDER BOTH BRAIDED CONDUCTORS TOGETHER AND TO SHIELD. SLIP VARNISHED TUBING 10 OR 11 OVER CONDUCTOR 6 OR 7 RESPECTIVELY. CRIMP END OF LATTER AROUND TINNED END OF GROUND LEAD OF CABLE ADJACENT TO INSULATION, AND SOLDER.
3. LOOSEN SCREWS OF CLAMPS 5 AND SLIP ONE CLAMP ONTO EACH END OF CABLE (SEE FIG. D) AFTER MAKING SURE THAT CLAMPS CONTAIN THE FIBER AND RUBBER WASHERS AS INDICATED IN FIG. B.
4. DISASSEMBLE ELBOW PLUG P107 (ITEM 3) AND STRAIGHT PLUG P301 (ITEM 4) BY REMOVING TWO SCREWS HOLDING SPLIT SHELLS TOGETHER.
5. SOLDER CABLE LEADS TO PLUG TERMINALS ACCORDING TO CONNECTION DIAGRAM FIG C.
6. REASSEMBLE PLUGS AND TIGHTEN SCREWS FIRMLY. (BEFORE TIGHTENING SCREWS OF P107, ADJUST THE FRONT SHELL KEYWAY POSITION AS REQUIRED FOR THE PARTICULAR INSTALLATION.)
7. SCREW CABLE CLAMPS FIRMLY TO PLUGS—AVOID TWISTING CABLE LEADS. ALIGN CLAMPS 5 WITH GROUNDING STRIPS 9 (FIG. B), THEN TIGHTEN CLAMP SCREWS TO ANCHOR CABLE AND TO GROUND CONNECTOR SHELL TO CABLE SHIELD AT EACH END OF CABLE. SEE FIG. D.
8. ATTACH CABLE MARKER 12 ADJACENT TO PLUG P107 AS SHOWN IN FIG. D.

FOR ALL SOLDERING USE ONLY NONCORROSIVE ROSIN CORE SOLDER. AVOID EXCESS SOLDER.

DO NOT APPLY HEAT LONGER THAN NECESSARY FOR SOLDERING. AVOID TOUCHING VINYLITE CONDUCTOR INSULATION OR OUTER JACKET WITH SOLDERING IRON.

NOTE

FOR ASSEMBLY OF CABLE W504 USING THE ELBOW PLUG P301 (AN-3108-18-20S) SUPPLIED IN EARLY PRODUCTION, REFER TO OUTLINE-ASSEMBLY DRAWING T-256082 ITEM 2.

FOR ★ AN/APN-1 SERIES
SEE EQUIPMENT DIAGRAM T-256081

Figure 32—Altitude Limit Switch Cable W504—Alternate Construction Using Straight Plug P301, Outline-Assembly (T-256405)

AN-08-10-265

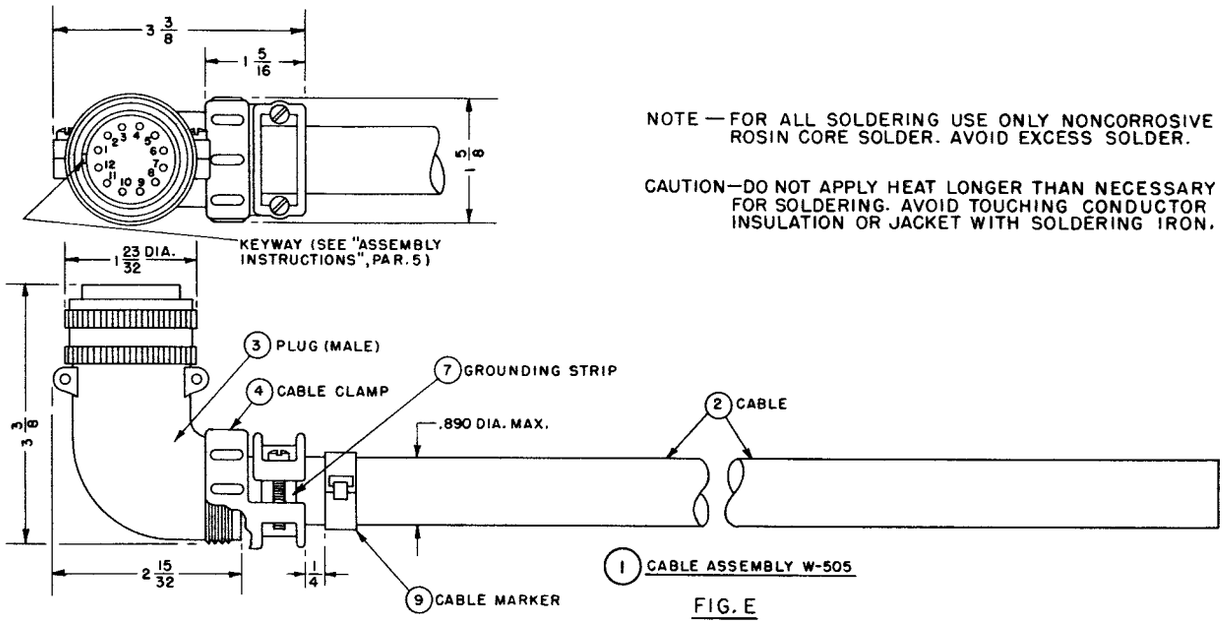


FIG. E

NOTE — FOR ALL SOLDERING USE ONLY NONCORROSIVE ROSIN CORE SOLDER. AVOID EXCESS SOLDER.

CAUTION—DO NOT APPLY HEAT LONGER THAN NECESSARY FOR SOLDERING. AVOID TOUCHING CONDUCTOR INSULATION OR JACKET WITH SOLDERING IRON.

CABLE MATERIALS AND FITTINGS — FURNISHED UNASSEMBLED

ITEM NO.	SYMBOL DESIG.	DESCRIPTION	DRAWING OR SPECIFICATION	UNIT WEIGHT (POUNDS)	QUANTITY
1	W505	AUTOMATIC PILOT CABLE ASSEMBLY	THIS DRAWING	—	X
2	W505A	10-WIRE SHIELDED CABLE	RCA DWG. M-253911-1	0.5/FT. APPROX	*
3	P106	PLUG-ELBOW, 12 CONTACTS, MALE	RCA DWG. M-253474-21 (AMPHENOL AN-3108-24-19P)	0.25	1
4	E515	CABLE CLAMP	RCA DWG. M-253375-7 (AMPHENOL AN-3057-16)	0.09	1
5		BRAIDED COPPER CONDUCTOR	RCA PS-499-1/8 72-.005 TINNED (4 LONG)	NEGLIGIBLE	1
6		BRAIDED COPPER CONDUCTOR	RCA PS-499-1/8 72-.005 TINNED (2-5/8 LONG)	NEGLIGIBLE	1
7		COPPER STRIP	RCA PS-21 SOFT 1/2 X .010 TINNED (3-1/8 LONG)	NEGLIGIBLE	1
8		VARNISHED TUBING	RCA PS-50 BLACK .133 I.D. (2-1/4 LONG)	NEGLIGIBLE	1
9		CABLE MARKER ★ AUTOMATIC PILOT AN/APN-1B	RCA DWG. 29678-1	NEGLIGIBLE	1

X — SEE EQUIPMENT DIAGRAM FOR QUANTITY SUPPLIED PER EQUIPMENT.
* — FURNISHED IN BULK. SEE EQUIPMENT DIAGRAM FOR LENGTH SUPPLIED PER EQUIPMENT.

CABLE W505
ASSEMBLY INSTRUCTIONS

1. CUT BULK CABLE 2 TO LENGTH REQUIRED FOR THE PARTICULAR INSTALLATION (SEE EQUIPMENT DIAGRAM). PREPARE ONE END AS SHOWN IN FIGURE A.
2. SPOT-SOLDER SIX INDIVIDUAL CONDUCTOR SHIELDS TO EACH OTHER AND TO OUTER CABLE SHIELD AS SHOWN IN FIGURES B AND C.
3. ADD GROUNDING STRIP AND FLEXIBLE CONNECTION TO CABLE SHIELD AND BLACK-BROWN LEAD AS SHOWN IN FIGURE B, THUS: SOLDER BRAIDED CONDUCTOR 5 TO GROUNDING STRIP 7, THEN WRAP LATTER AROUND CABLE BODY IN POSITION SHOWN. WRAP BRAIDED CONDUCTOR 6 OVER BRAIDED CONDUCTOR 5 AND AROUND OUTER SHIELD. SOLDER BOTH CONDUCTORS TOGETHER AND TO SHIELD. SLIP VARNISHED TUBING 8 OVER BRAIDED LEAD 5, CRIMP END OF LATTER AROUND TINNED END OF BLACK-BROWN LEAD ADJACENT TO INSULATION, AND SOLDER.
4. LOOSEN SCREWS OF CLAMP 4 AND SLIP ON END OF CABLE (SEE FIGURE E) AFTER MAKING SURE THE CLAMP CONTAINS THE FIBER AND RUBBER WASHERS AS INDICATED IN FIGURE B.
5. DISASSEMBLE ELBOW PLUG 3 BY REMOVING THE TWO SCREWS HOLDING SPLIT SHELLS TOGETHER. SOLDER CABLE LEADS TO PLUG TERMINALS ACCORDING TO CONNECTION DIAGRAM, FIGURE D. REASSEMBLE PLUG AND TIGHTEN SCREWS FIRMLY AFTER ADJUSTING THE FRONT SHELL KEYWAY AS REQUIRED FOR THE INSTALLATION (SEE FIGURE E).
6. SCREW CABLE CLAMP FIRMLY TO PLUG ELBOW—AVOID TWISTING CABLE LEADS. ALIGN CLAMP 4 WITH GROUNDING STRIP (FIGURE B). THEN TIGHTEN CLAMP SCREWS TO ANCHOR CABLE AND TO PROVIDE GROUND CONNECTION TO CABLE SHIELD.
7. ATTACH CABLE MARKER 9 IN POSITION SHOWN IN FIGURE E.

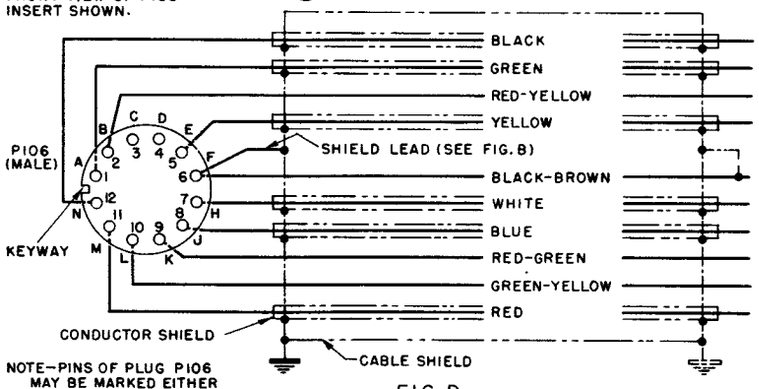


FIG. D

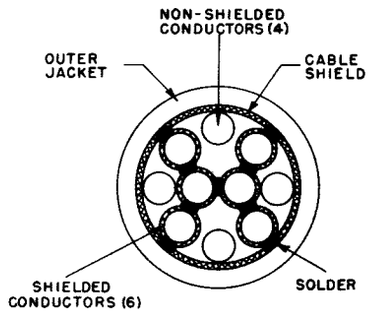
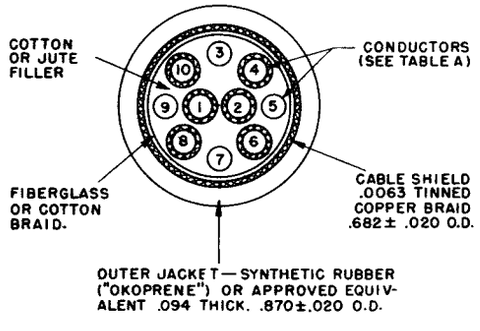


FIG. C

NOTE—ALL CONDUCTORS INSULATED WITH .031 THICK RUBBER ("OKONITE" OR APPROVED EQIVALENT) AND COVERED WITH RAYON BRAID. CONDUCTORS 1, 2, 4, 6, 8 & 10 INDIVIDUALLY SHIELDED WITH .0063 TINNED COPPER CLOSED BRAID.



2 CABLE W505A CROSS SECTION.

TABLE A—CONDUCTOR SPECIFICATIONS FOR W505A

COND. NO.	SIZE A.W.G.	STRANDING TINNED COPPER	BRAID COLOR	DIMENSION "A" INCHES
1	18	19/.0092	BLACK	1/4
2	18	19/.0092	WHITE	1/4
3	18	19/.0092	GREEN-YELLOW	1/4
4	18	19/.0092	GREEN	1/4
5	18	19/.0092	RED-YELLOW	1/4
6	18	19/.0092	YELLOW	1/4
7	18	19/.0092	BLACK-BROWN	3/8
8	18	19/.0092	BLUE	1/4
9	18	19/.0092	RED-GREEN	1/4
10	18	19/.0092	RED	1/4

★AN/APN-1 SERIES
SEE EQUIPMENT DIAGRAM T-256081

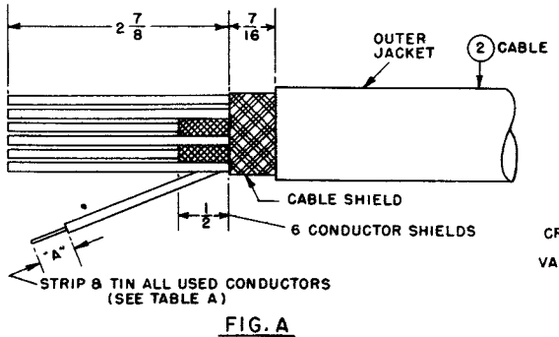


FIG. A

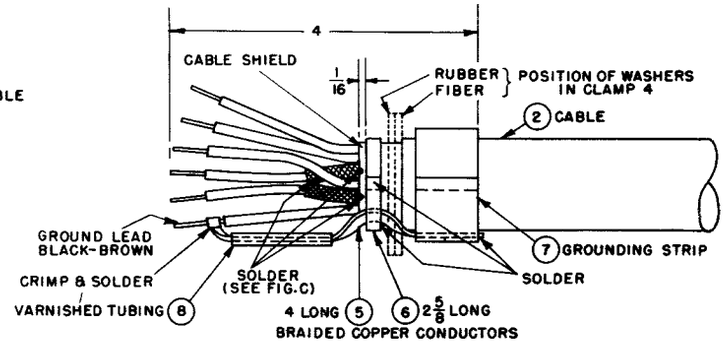
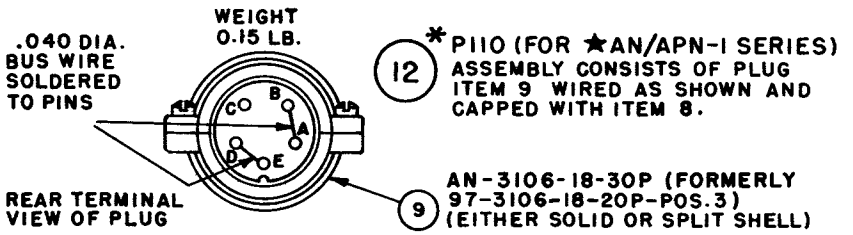


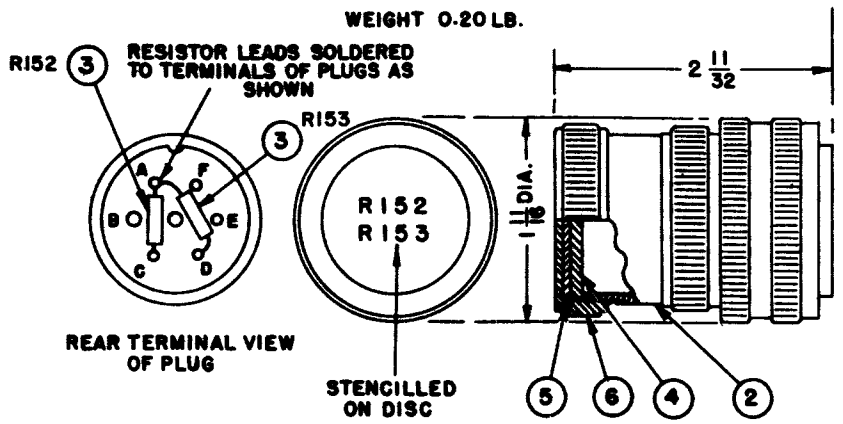
FIG. B

Figure 33—Automatic Pilot Cable W505, Outline-Assembly (T-256282)

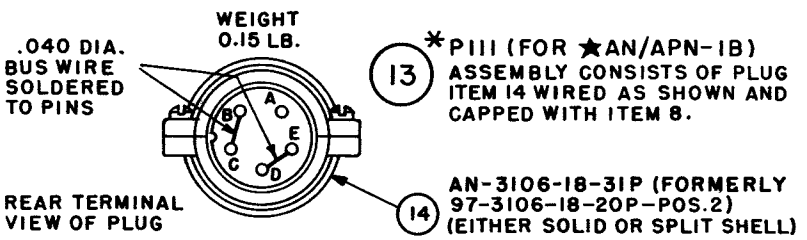


(12) * P110 (FOR ★AN/APN-1 SERIES)
ASSEMBLY CONSISTS OF PLUG ITEM 9 WIRED AS SHOWN AND CAPPED WITH ITEM 8.

(9) AN-3106-18-30P (FORMERLY 97-3106-18-20P-POS.3) (EITHER SOLID OR SPLIT SHELL)



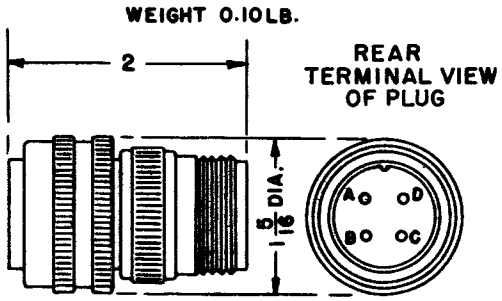
(1) P108
RESISTOR-PLUG ASSEMBLY FOR J106
FOR AYD, AYD-2, AYD-3, ★AN/ARN-1



(13) * P111 (FOR ★AN/APN-1B)
ASSEMBLY CONSISTS OF PLUG ITEM 14 WIRED AS SHOWN AND CAPPED WITH ITEM 8.

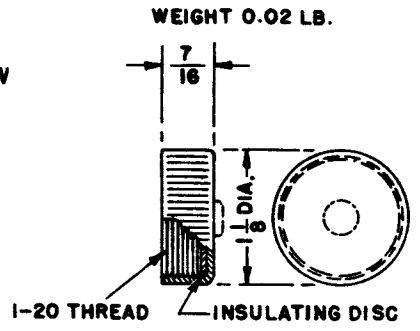
(14) AN-3106-18-31P (FORMERLY 97-3106-18-20P-POS.2) (EITHER SOLID OR SPLIT SHELL)

MODELS	EQUIPMENT DIAGRAM
AYD, AYD-2	P-255275
AYD-3, ★AN/ARN-1	P-255247
★AN/APN-1 SERIES	T-256081

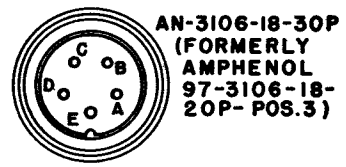


(7) P109 (FOR AYD, AYD-2)
AUXILIARY PLUG FOR J104

SHORT CIRCUIT OR SWITCH CONNECTION REQIRED BETWEEN TERMINALS B AND C TO COMPLETE BATTERY INPUT CIRCUIT. TEST MILLI-AMMETER (0-10 M-A FULL SCALE) CAN BE CONNECTED BETWEEN TERMINALS A AND D (CONNECT POSITIVE TERMINAL OF METER TO D AND NEGATIVE TO A).



(8) * E506
CAP FOR USE WITH ITEMS 7 AND 9 — ALSO PART OF ASSEMBLY ITEMS 12 AND 13.



(9) * P109 (FOR AYD-3, ★AN/ARN-1, ★AN/APN-1 SERIES)
DIFFERENT INSERT— OTHERWISE SAME AS ITEM 7.

USE TERMINALS A AND B TO CLOSE BATTERY INPUT CIRCUIT. CONNECT TERMINAL E TO POSITIVE AND D TO NEGATIVE OF TEST MILLI-AMMETER (0-10 M-A). CONNECT TERMINALS A AND C FOR HIGH-RANGE OPERATION OF ★AN/APN-1 SERIES.

NOTE— MODEL REFERENCES SHOWN FOR THE FOLLOWING ITEMS INDICATE EQUIPMENTS WITH WHICH THESE ITEMS CAN BE USED. THESE AUXILIARY PLUGS ARE NOT SUPPLIED WITH ALL REFERENCED MODELS— SEE EQUIPMENT DIAGRAM OF PARTICULAR MODEL.

	ITEM NO.	REF. SYMBOL	DESCRIPTION	DRAWING OR SPECIFICATION	QUANTITY P108		P109		E506	P110	P111
FOR AYD, AYD-2, AYD-3, ★AN/ARN-1	1	P108	RESISTOR-PLUG ASSEMBLY	RCA DWG. K-251872-501	X						
	2	P108A	PLUG, STRAIGHT, 7 CONTACTS, MALE	RCA DWG. P-255262-35 (AMPHENOL AN-3106-24-3P)	1						
	3*	R152 R153	RESISTOR - COMPOSITION, PIGTAIL, INSULATED, 47,000 OHMS ±5%, 1/2 WATT	RCA DWG. K-82283-199 (ALLEN-BRADLEY, TYPE EB-1/2)	2	2					
	4*		RUBBER GASKET, 1/8 THICK, 1-43/64 O.D., 3/4 I.D.	RCA DWG. K-251873-7 (AMPHENOL 9771-16)	1	1					
	5*		ALUMINUM DISC, .032 THICK, 1/2 HD, 1-3/8 DIA.	RCA DWG. K-251875-1	1	1					
	6*		KNURLED NUT (1" CONDUIT SIZE)	RCA DWG. K-251874-7 (AMPHENOL AN-3054-16)	1	1					
FOR AYD, AYD-2	7	P109	PLUG, STRAIGHT, 4 CONTACTS, MALE	RCA DWG. P-255073-55 (AMPHENOL AN-3106-18-4P)			X				
FOR ★AYD SERIES, ★AN/ARN-1 AND ★AN/APN-1 SERIES	8*	E506	KNURLED CAP, ALUMINUM, 1-20 THREAD	RCA DWG. K-251728-2 (AMPHENOL TYPE 9760-16 LESS STUD AND CHAIN - HOLE OMITTED OR FILLED WITH DUMMY STUD)					X	1	1
FOR AYD-3, ★AN/ARN-1, ★AN/APN-1 SERIES	9*	P109	PLUG, STRAIGHT, 5 CONTACTS, MALE	RCA DWG. P-255262-48 (SEE ITEM 9 DETAIL VIEW)			X			1	
FOR ★AN/APN-1 SERIES	10*	P108	RESISTOR-PLUG ASSEMBLY	RCA DWG. K-251872-502		X					
	11*	P108A	PLUG, STRAIGHT, 12 CONTACTS, MALE	RCA DWG. P-255262-49 (AMPHENOL AN-3106-24-19P)		1					
FOR ★AN/APN-1 SERIES	12*	P110	CONNECTOR ASSEMBLY	RCA DWG. M-254020-501						X	
FOR ★AN/APN-1B	13*	P111	CONNECTOR ASSEMBLY	RCA DWG. M-254020-502							X
	14*	P111A	PLUG, STRAIGHT, 5 CONTACTS, MALE	RCA DWG. M-253476-31 (SEE ITEM 13 ASSEMBLY VIEW)							1
						*		*	*	*	*

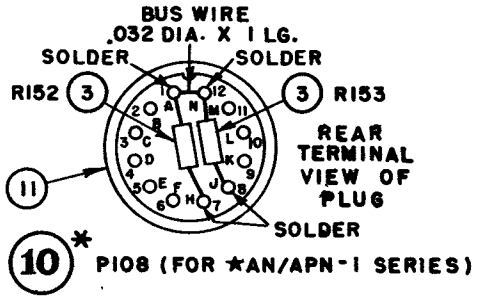
X — FOR QUANTITY SUPPLIED SEE EQUIPMENT DIAGRAM.

*ITEMS APPLICABLE TO ★AN/APN-1 SERIES.

AUXILIARY PLUGS FOR MODELS AYD, AYD-2, AYD-3, ★AN/ARN-1, ★AN/APN-1 SERIES

NOTE— PLUGS OF SPLIT-SHELL CONSTRUCTION, INTERCHANGEABLE WITH THOSE SHOWN, MAY BE FURNISHED, AS FOLLOWS:

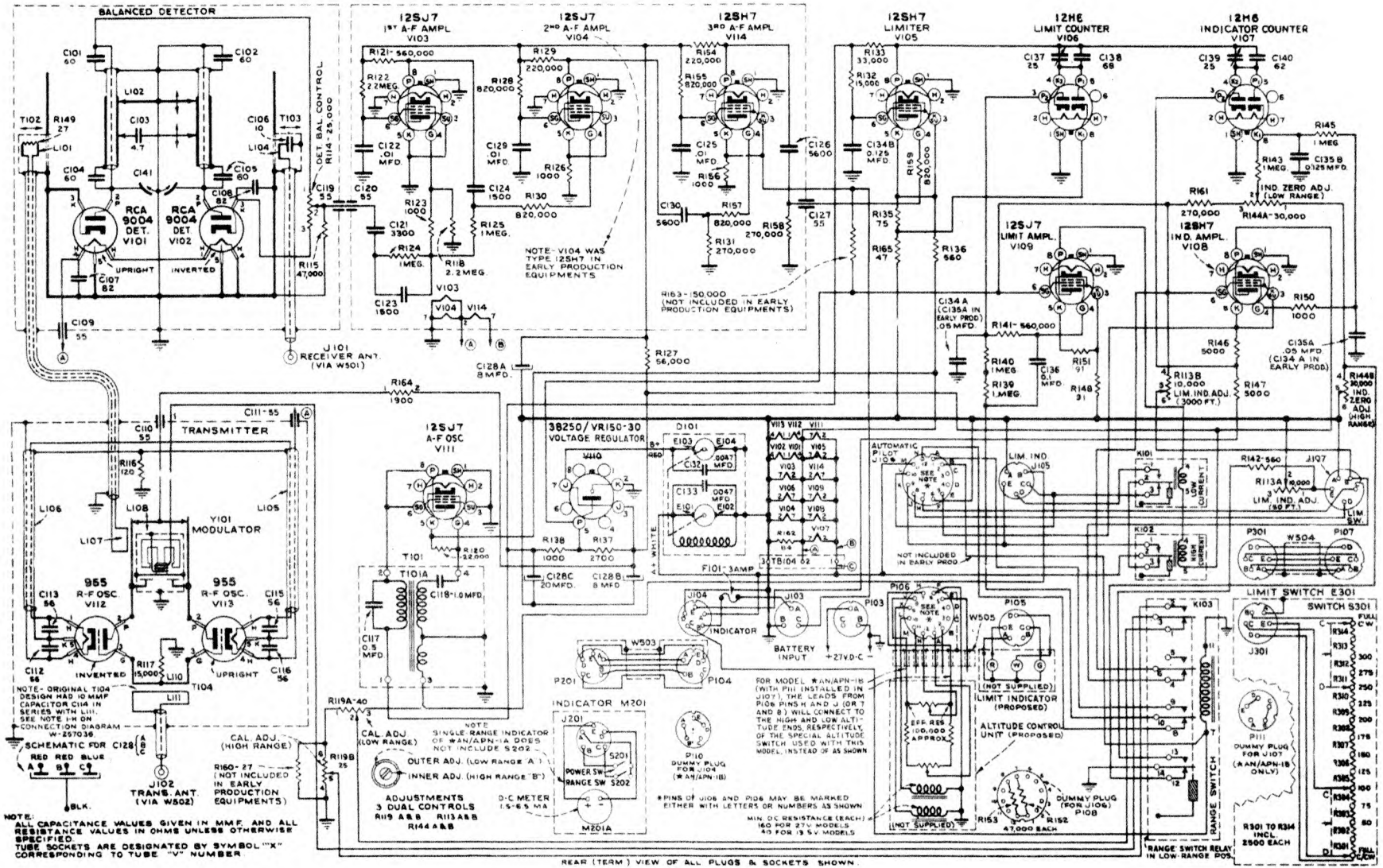
ITEM NO.	REF. SYMBOL	RCA DRAWING NO.	AMPHENOL NO.
2	P108A	M-253476-11	AN-3106-24-3P
7	P109	M-253476-12	AN-3106-18-4P
9*	P109	M-253476-10	SEE ITEM 12 ASSEMBLY VIEW
11*	P108A	M-253476-18	AN-3106-24-19P



(10) * P108 (FOR ★AN/APN-1 SERIES)
DIFFERENT INSERT AND CONNECTIONS-OTHERWISE SAME AS ITEM 1.

NOTE- P108 PINS MAY BE EITHER LETTERED OR NUMBERED AS SHOWN.

Figure 34—Auxiliary (Dummy) Plugs, Outline-Assembly (P-255321)



SCHEMATIC DIAGRAM RADIO ALTIMETER APN-1