

ROIF

RADIO OPERATORS' INFORMATION FILE



RESTRICTED

Table of Contents . . . DATED JUNE 1945

RADIO OPERATORS' INFORMATION FILE

In accordance with the provisions of AAF Regulation 62-15, dated 24 November 1944, all AAF communications officers and radio operator-mechanics in the domestic area will certify that they have read and understand all instructions and information in the Radio Operators' Information File.

They will do so by signing in the space provided at the end of the Table of Contents. After it has been signed it must be forwarded to your Base Operations Officer for placement in your record file.

Subjects preceded by an asterisk (*) have been revised or added to ROIF since March 1945. Be sure your copy of ROIF contains all amendments. Read them carefully before signifying compliance on Form 24RA.

Check regularly to be sure you have all current amendments to ROIF and the correct Table of Contents. The Table will be revised quarterly and distributed on the same basis as the File revisions.

KEEP THIS
FORM 24R IN
YOUR ROIF
UNTIL YOU RECEIVE
A NEW TABLE OF
CONTENTS DATED
SEPTEMBER 1945

AUTHORITY FOR ROIF—AAF REGS. 62-15; 15-24

TABLE OF CONTENTS—AAF FORM 24R

SUBJECT	ROIF No.	SUBJECT	ROIF No.
SECTION ONE ★ General			
*Radio Operator's Responsibilities	1-1	Unsatisfactory Reports	1-5
Crew Coordination	1-2	Form 1A	1-6
How to Use Your ROIF	1-3	Army-Navy Nomenclature System	1-7
Technical Orders	1-4		
SECTION TWO ★ Tactical Operation			
*Effects of High Altitude	2-1	*Physical Fitness	2-5
*Oxygen Equipment	2-2	*Vision at Night	2-6
*Oxygen Emergencies	2-3	*Climate and Health	2-7
*Dangerous Gases	2-4	*Flak Suits	2-8
SECTION THREE ★ Radio Operating Procedure			
Army Airways Communications System	3-1	Weather Codes	3-9
Civil Aeronautics Administration	3-2	Message Authentication	3-10
Body Signals	3-3	Phonetic Alphabet	3-11
Combined Panel System	3-4	Time Zones and Signals	3-12
Signal Lamp	3-5	Signal Operation Instructions	3-13
Recognition Signals	3-6	Radio Logs	3-14
Direction Finding	3-7	Q Signals	3-15
Cryptographic Publications	3-8	Prosigns and R/T Prowords	3-16

SUBJECT	ROIF No.	SUBJECT	ROIF No.
---------	----------	---------	----------

SECTION FOUR ★ Liaison Equipment

*AN/ART-13 Transmitter Equipment.....	4-1	SCR-211 Frequency Meter.....	4-4
SCR-287 Transmitter Equipment.....	4-2	RL-42-A, BC-461, Reel and Control.....	4-5
SCR-287 Receiver	4-3		

SECTION FIVE ★ Command Equipment

*SCR-274-N Command Equipment.....	5-1	Test Equipment IE-19-A.....	5-3
*SCR-522 Command Equipment.....	5-2	Test Equipment IE-36.....	5-4

SECTION SIX ★ Navigational Equipment

*SCR-269 Radio Compass.....	6-1	Radar, IFF	6-4
*AAF Instrument Approach System.....	6-2	Interphone, Radio Range Filter.....	6-5
*RC-43 and RC-193 Marker Beacon Receivers	6-3		

SECTION SEVEN ★ Climatic Extremes

Arctic, Tropic, Desert, High-Altitude Operation and Maintenance.....	7-1
---	-----

SECTION EIGHT ★ Emergencies

Distress Procedures	8-1	Parachutes	8-8
Panel Signals	8-2	Life Preserver Vest	8-9
Smoke Grenades	8-3	Swimming Through Fire	8-10
SCR-578 Gibson Girl	8-4	Emergency Kits	8-11
Emergency Exits	8-5	*Fire Fighting in Flight.....	8-12
Forced Landings	8-6	*First Aid Kits.....	8-13
Ditching	8-7	First Aid in Flight.....	8-14

I CERTIFY THAT I HAVE READ AND UNDERSTAND ALL SUBJECTS IN THE RADIO OPERATORS' INFORMATION FILE LISTED IN FORM 24R, DATED JUNE 1945.

Signed _____

Rank _____ ASN _____

Organization _____ Crew No. _____

Date _____

When you receive a new Form 24R (dated September 1945) remove this form, sign it, and forward it to your Base Operations Officer.



SECTION

1



GENERAL

RADIO OPERATOR'S RESPONSIBILITIES

Equipment



G FILE

The G file is the Technical Order file in your airplane. It should contain T.O.'s on all the airplane's radio equipment. Be sure your section of the file is up to date, and that all the necessary T.O.'s and wiring diagrams are in it.

LOCATION OF EQUIPMENT

Know the locations of all:

- | | |
|------------------|---------------------|
| 1. Major units. | 3. Dynamotors. |
| 2. Tuning units. | 4. Antenna systems. |

FUSE LOCATIONS

Know the locations of all fuses. Be sure there are spares, and know where these are kept.

OPERATION OF EQUIPMENT

Know how to operate all the radio equipment in your airplane. Consult your Communications Officer for instructions on radar operation.

MINOR MAINTENANCE

Be sure you know:

1. What is required in a preflight inspection.
2. How to take care of your dynamotors.
3. How to use Form 1A.

EMERGENCY OPERATIONS

1. Know how to operate on a minimum number of tubes.
2. Know how to substitute equipment in an emergency.



Planning



BRIEFING

1. Be sure you understand thoroughly everything covered at your briefing.
2. Ask questions about anything not absolutely clear to you.

SOI

1. Be familiar with every extract your SOI contains.
2. Check your flimsy before every mission to make sure that it is complete and up to date.
3. Refer to it whenever you are in doubt.

OPERATING PROCEDURES

1. Have a thorough working knowledge of all the procedures authorized in your area.
2. Know the locations, call signs, frequencies, and services of all the direction-finding facilities in the area.
3. Know all the distress frequencies and procedures of the area.

Operation

Remember:

Flying is an exacting, serious business. It demands everything you have of knowledge, effort, and skill. Mistakes are costly. Don't make your crew mates pay for your mistakes.

TUNING

1. Know all the tuning procedures for your equipment.
2. Tune your frequencies accurately.
3. Don't jam frequencies while you are tuning.

RADIO LOG

Keep an accurate and complete log of all your own transmissions, and of those on the frequency you are guarding.

RADIO DISCIPLINE

1. Maintain a constant listening watch on your assigned frequency.
2. Monitor the frequency you intend to use before you begin transmission.
3. Maintain strict radio silence whenever you are ordered to do so.



CREW COORDINATION

Crew teamwork is the foundation of successful air operations. You, as radio operator, are an important member of your crew and unless you know your job, and have learned to cooperate and coordinate with your pilot, your copilot, and your navigator, you will fail in your job.

Strive for good teamwork in training and it will come easy in combat where it pays off the dividends. Remember, a great measure of the success, or failure, of every mission you fly will depend on you. If you fail you are short-changing your crew mates.

Personal proficiency is part of teamwork. Know your duties, know your equipment, and keep abreast of new techniques and procedures.

Aid from the Crew

The primary aids the various crew members are able to supply are as follows:

PILOT

Correct flying technique while you are taking radio bearings; furnish you with heading information if navigator is not available.

CO-PILOT

Give necessary heading information; make minor adjustments on command-radio equipment.

BOMBARDIER

Monitor stations if you must leave your position.

NAVIGATOR

Furnish you with any necessary information concerning radio navigation; operate radio compass if you have other duties.

ENGINEER

Take over your position for relief; check the calibrations of remote equipment.

GUNNERS

Keep you abreast with the progress of your formations; warn you of any emergencies so you can send distress messages for your own or any other plane in the formation.

★
★
HOW TO USE YOUR★
ROIF**General**

The Radio Operators' Information File is a manual of instructions and information of a general nature, with which all airborne radio operators and communications officers in the Continental United States are required to comply, in accordance with the provisions of AAF Regulation 62-15.

ROIF is designed to keep you informed of matters affecting your operational efficiency and your personal safety. It contains basic material not discussed in detail in Technical Orders or other publications available.

Familiarize yourself with the Radio Operators' Information File. Check frequently to be sure that you have read and understand the information in it.

How Subjects Are Numbered

Each subject listing is numbered. *The first number indicates the section. For example, 5, which is the COMMAND EQUIPMENT section. The second number refers to the subject. For example, 5-2, SCR 522 COMMAND EQUIPMENT. The third number lists the page, thus the third page of SCR 522 COMMAND EQUIPMENT will be marked 5-2-3.*

Revisions

It is particularly important that you keep all of the subjects and pages in your book in proper order, so that you may use your ROIF as a quick reference guide.

To make the process as simple as possible, you receive revisions in an envelope upon which is printed a list of the pages you are to remove from your copy of ROIF before you put the new revisions into the book.

Important

You must follow the directions printed on the envelope in which you receive your revision sheets. You must first remove and destroy the pages listed on the envelope to keep your File correct. To comply with the regulation you must keep your File currently correct.

Revised sheets bear a new date line at the top of the page thus: REVISED March 1, 1945. If the page is new and does not replace an old one, it will bear a line thus: ADDED March 1, 1945.

Once in awhile, a whole subject will be revised completely and the revised pages may number more or less than the pages they replace. In such cases,

WANTED: YOUR CORRECTIONS AND CRITICISMS OF ROIF

May we call your attention to the provision of Paragraph 3 of AAF Regulation 62-15, which directs all AAF establishments to submit items they desire to have included to the address at the right. This also means any criticism of material already in ROIF—corrections, questions of interpretation, and mistakes which may have inadvertently crept into the text or the art.

In any case we welcome free criticism and prompt correction of mistakes from you.

Our aim is to keep ROIF accurate, current, and fully useful. If you can help us do that, we will appreciate it. Write direct to:

OFFICE OF FLYING SAFETY,
INFORMATION FILES BRANCH,
BUHL BUILDING,
DETROIT 26, MICHIGAN

all the pages will merely bear the REVISED notation, with the date. So don't become confused if you have more or fewer pages than you have removed.

Revisions and additions will be issued regularly through your operations office. Make a habit of checking with your operations office periodically.

To Comply with Revisions

When you receive a set of revision sheets, it will be accompanied by a temporary certificate of compliance (Form 24RA).

Before you sign it to certify that you have read and understand all the revisions and/or additions, be sure you do read the revised pages.

You will find that often only minor changes have been made on some pages. There is no special indication to show what sentences or paragraphs have been revised. It is felt that you should re-read the whole page in order to get the context of the old material in relation to the new.

Index

An index is provided which lists alphabetically the principal items treated in ROIF. It is revised from time to time to keep it as useful and up-to-date as possible. You may find occasionally, however, that an index listing is in error; but by using the Table of Contents you will be able to trace almost any item you are looking for.

When a revised index is printed, it will be distributed along with the regular quarterly revisions.

Distribution of Revisions

Revisions are distributed to individual communications officers and radio operator-mechanics by Base Operations Officers who receive the revisions automatically from the publisher of the File.

If any operations officer does not receive the correct number of revisions (plus a 10% overage) he will communicate at once with

Office of Flying Safety,
Information Files Branch,
Buhl Building,
Detroit 26, Michigan,

stating the number of revisions required at his station. He will also send a letter request to the above for any copies he may need of the complete File.

Operations officers will also report promptly on the activation or deactivation of any station.

The Table of Contents (Form 24R)

Every three months you will receive a new Table of Contents in the envelope with the revisions for that month. The new Table of Contents is published on the first of March, June, September, and December.

In order that you may identify it, and be sure that you have the current table in your ROIF, the following color key is used:

JUNE	: YELLOW	SEPTEMBER	: BLUE
DECEMBER	: GRAY	MARCH	: RED

Check your copy of ROIF against the Table of Contents regularly.

Subjects preceded by an asterisk (*) contain material revised or new since the last Table of Contents was issued.

You will find that all the pages of any one subject may not bear the same date. But the date following the subject listing in the Table of Contents is the latest revision date for any of the pages included in that subject.

Don't Destroy Table of Contents

When you replace the Table of Contents with a new one, don't destroy the old one. Sign it to show that you have read and understand all the subject matter it lists. Then turn it over to your operations officer. It is the record of your compliance with ROIF in accordance to provisions of AAF Regulation 62-15.

Base Operations Officers' Responsibilities

1—Operations officers are responsible for seeing that every communications officer and radio operator-mechanic attached to his base receives a copy of ROIF and all subsequent revisions.

2—That every communications officer and radio operator-mechanic on his base signs a compliance form certifying that he has read and understands all material contained in ROIF and revisions and additions thereto.

3—That the compliance certificates (Form 24RA and Form 24R) are placed in the record files of the individuals concerned.

When communications officers and radio operators turn in their Forms 24R at the end of the three-month period for which the Forms are the current Tables of Contents for ROIF, the operations officer will see that previously dated Forms 24R and 24RA which are in the Form 5 Files are removed and destroyed.

Keep Up to Date

No matter where you are, at your home station or on cross-country, ask for any new ROIF revisions.

Never fail to ask for new material. You must keep your File up-to-date.

TECHNICAL ORDERS

All radio operators must know how to use the Technical Order files. Use of the RADIO OPERATOR'S INFORMATION FILE does not obviate the need for using Technical Orders. The R.O.I.F. contains material of a general nature and does not attempt to supply the specific engineering, maintenance and supply information contained in technical orders.

For detailed information on specific pieces of equipment or higher echelon maintenance instructions the technical orders should be consulted.



WHAT ARE TECHNICAL ORDERS?

AAF Technical Orders are directives published by order of the COMMANDING GENERAL, Army Air Forces, for the purpose of issuing specific instructions and information of a technical nature covering the operation, maintenance, storage and inspection of AAF equipment and materials, and for the establishment of a uniform system of files wherein such technical data will be readily accessible.

T. O. NUMBERING SYSTEM

Technical Orders are numbered by a group of three numbers, separated by dashes.

The **first number** always has two digits. It corresponds to the AAF property classification number. For instance, if the first number in the designation is 08 the Technical Order contains information about electrical equipment and supplies; 01, airplanes and maintenance parts; 00 series contain information of a general nature such as distribution, inspection system, kits and such matter. The first numbers are assigned property class numbers as follows:

- | | |
|--|--|
| 01 Airplane and maintenance parts. | 16 Balloon equipment and supplies. |
| 02 Engines and maintenance parts. | 17 Machinery, shop and warehouse equipment. |
| 03 Aircraft accessories. | 18 Special tools. |
| 04 Aircraft hardware and rubber materials. | 19 Flying field and hangar equipment. |
| 05 Aircraft instruments. | 21 Cordage, fabrics and leathers. |
| 06 Fuels and lubricants. | 22 Woods. |
| 07 Dopes, paints and related material. | 23 Metal and composition material. |
| 08 Electrical equipment and supplies. | 24 Chemicals. |
| 09 Aerial targets and gliders. | 25 Office equipment and supplies. |
| 10 Photographic equipment and supplies. | 26 School equipment. |
| 11 Aircraft combat material. | 27 Excess and surplus property. |
| 12 Fuel and lubricating equipment and supplies. | 29 Commercial hardware and miscellaneous supplies. |
| 13 Clothing, parachutes, equipment and supplies. | 30 Publications, processed motion picture films and film strips. |
| 14 Hangars and demountable buildings. | |

A COMPLETE BREAKDOWN OF THESE CLASSES MAY BE FOUND LISTED IN T.O. 00-35A-1

The **second number** represents the SUB DIVISION of the general property class identified by the first number. It is impractical to list all the sub divisions of each property class, but to explain the system a few examples are shown here. Since the radio operator is mainly concerned with electrical equipment and supplies the 08 series will be used:

- 08-5 Aircraft Radio Equipment and Accessories
- 08-10 Signal Corps Publications
- 08-15 Radio Aids to Navigation

The **third number** in most cases is merely the serial number of the Technical Order concerning the general subject or title identified by the first two numbers:

Elec. Equip. and Sup.		Signal Corps		SCR 274 N
08	—	10	—	50

The third number is a definite identification in the 01 series Technical Orders:

Airplane and Maint. Parts		Boeing	Bomber	Model
01	—	20	E	G

- 1—Handbook of Flight Operating Instructions
- 2—Erection and Maintenance
- 3—Structural Repair Manual
- 4—Parts Catalog

The location of all radio equipment and fuses in an airplane may be found by consulting the section on COMMUNICATION EQUIPMENT in the 01 series Technical Orders.

TECHNICAL ORDER INDEX

The index is the only exception to the numbering system. It contains only two sets of numbers, and is referred to as the 00-1 or the first Technical Order in the complete library. The property classes, 01-08, etc., are listed in numerical sequence in the front part of the index. Immediately behind it is a numerical index of Technical Orders.

TO USE THE INDEX

Locate in numerical sequence the first number 08, the second number 10, then run through to the third number until you find the subject title. The Technical Order bearing the corresponding number will contain information on the subject. All Technical Orders are listed numerically.

Section II
AN 08-10-157

RESTRICTED
T. O. No. 00-1

ELECTRICAL EQUIPMENT AND SUPPLIES

Number	Title	Date
08-10	SIGNAL CORPS PUBLICATIONS (Form 3070-4, C-32, F-12) (CONT)	
AN 08-10-157	Handbook of Maintenance Instructions—Radio Receivers—BC-1033-A, -1033-B.....(Rev. 17 Aug 43)	3 Apr 43
AN 08-10-158	Handbook of Maintenance Instructions—Radio Set SCR-AS-183.....	29 Jun 43
AN 08-10-159	Handbook of Maintenance Instructions—Radio Set SCR-718-A.....	19 Jun 43
Radio Receiving Equipment—AN/ARR-3.....	30 Apr 43
		17 Apr 43
		5 Jul 43

WHERE TO FIND A TECHNICAL ORDER

Each station, base or sub-depot has four complete files, assigned to the supply office, engineering office, technical inspector's office and transient aircraft crew. Complete information about Technical Order files in overseas theaters is given in T.O. 00-25-3.

AIRPLANE FILES

The following Technical Orders and current amendments thereto must be maintained in each airplane.

- 1—T.O. 00-201A visual inspection system for airplanes.
- 2—T.O. 00-20A-2 airplane maintenance instruction form.
- 3—Pilot's Handbook Of Instructions for the particular airplane model.
- 4—Erection And Maintenance Manual for the particular airplane model.
- 5—Engine Handbook Of Service Instructions.
- 6—Handbook Of Weight And Balance Data.
- 7—T.O. 08-15-1 Radio Facility Charts.
- 8—T.O. 08-15-2 Radio Data and Flight Information.
- 9—T.O. 08-15-3 Instrument Approach Procedures.
- 10—A 08-10 T.O. for all radio equipment contained in the particular airplane model.

COMPLIANCE IN

COMBAT AREAS

Compliance with Technical Orders and Technical Radiograms in combat areas will be subject to local conditions involving tactical employment of all equipment and at the discretion of the respective Air Force or Task Force commanders concerned.

UNSATISFACTORY REPORTS

WAR DEPARTMENT
AAF FORM NO. 54
(Revised 2-15-43)

TO BE FILLED IN BY STATION
STATION SERIAL No. 14-008 DATE SUBMITTED 6-11-44

WAR DEPARTMENT
ARMY AIR FORCES
UNSATISFACTORY REPORT
(See AAF Reg. 15-54 for Information on Proper Use of this Form)

LEAVE BLANK
A. S. C. SERIAL No. REFER TO CLASS

STATION Scott Field, Ill.

SUBJECT OF REPORT Property Class—Name 08 PL 108 Four Connector Plug ORGANIZATION 94th Sub Depot

AIRCRAFT—Model & AAF Serial No. B-17F 20-176470 CASING—Model & AAF Serial No. Manufacturer Signal Corps AAF Order or Shipping No.

AIRCRAFT REPORTS ONLY LAST O. L. R.—Date UNIT OR ACCESSORY—Type, Model and Serial No. PL 108

ENGINE REPORTS ONLY LAST OVERHAUL—Date Date Flying Time Since Total Flying Time

NAME Plug PL 108 Reps and Hours At Each Previous Overhaul

Time in Use 75 Hrs. Quantity on Hand 25 Quantity Known Defective 1 Part Drawing, Serial and Specification No. SPEC. NO. 5C-D-2203

Indicate by "X" Disposition of Exhibit ☒ Photographed and Prints Enclosed ☐ Sent Under Separate Cover ☐ Sent in Attached Package ☐ Replaced and Returned to Service ☐ Disposed of (Explain Below) ☐ To Overhaul Facility (INITIALS)

NO. PREVIOUS FAILURES 15 Manufacturer Signal Corps Inspector's No. or Identification

GIVE COMPLETE DETAILS, PROBABLE CAUSES AND RECOMMENDATIONS BELOW:
(Use Only Applicable Space Above—Avoid Unnecessary Repetition)

EXPEDITE

DESCRIPTION OF TROUBLE
1. Subject plug shorted to ground because it was inserted improperly causing the put transformer in the radio compass burn out.

Information concerning even the smallest failure may be of great value if reported to proper authorities in time. Everyone is encouraged to submit Unsatisfactory Reports whenever he sees an opportunity to contribute to greater efficiency by suggesting correction of faults.

As a radio operator, you are in close touch with both procedures and equipment. A great ground organization is behind the men who fly. But both flying and ground operations always can be improved. Unsatisfactory Reports are designed to speed improvements and to permit the individual to present a maintenance problem and his suggested correction, through channels.

Unsatisfactory Reports usually fall into these general classes:

- 1—Failure of equipment.
- 2—Unsatisfactory design.
- 3—Defects due to faulty material, workmanship, or inspection.
- 4—Unsatisfactory maintenance or supply methods, systems, or forms.

How to Prepare a U. R.

AAF Form No. 54, obtainable from the Engineering Officer, is used for Unsatisfactory Reports.

Each report must be a complete description of an individual case. It must explain the unsatisfactory condition, including all pertinent information, to enable investigation and correction of the trouble reported without the need for further requests for information. See AAF Regulation 15-54 for details about how to file different types of U. R.'s.

Coordination

All Unsatisfactory Reports originating at a station are routed through the Engineering Officer, who investigates and enters his endorsement. He sends the U. R. to the Commanding General, Air Service Command at Patterson Field, Fairfield, Ohio.

FORM 1A

AIRPLANE FLIGHT REPORT - ENGINEERING

 WAR DEPARTMENT
 A. A. F. FORM NO. 1A
 REV. 11 JAN. 44

INSPECTION STATUS				SERVICING AT STATION OF TAKE-OFF (CHECK IMMEDIATELY BEFORE TAKE-OFF)												RADIATOR CHECKED
DATE OF HOURS DUE	BY	INSPECTED TODAY		SERVICE	FUEL (GALLONS)		OIL (QUARTS)				NO. 4 SERV- ICED IN TANKS	NO. 4 IN TANKS				
		STATION			SERV- ICED	IN TANKS	SERV- ICED	IN TANKS	SERV- ICED	IN TANKS						
PREFLIGHT	8-26-44	S	Scott	1ST	1150	2300	15	100	20	100	22	100	18	100		
DAILY	8-26-44	S	Scott	2ND												
25 HOURS	148:00			3RD												
50 HOURS	150:00			4TH												
100 HOURS	200:00			5TH												
INSPECTION OF AUXILIARY EQUIPMENT				STATUS TODAY		EXPLANATION: <i>Rough bearing on landing gear assembly.</i>										
EQUIPMENT	SYMBOL	INSPECTED BY	STATION	1.	2.											
BOMBARDMENT	—			3.	4.											
GUNNERY	—			WHEN THE "STATUS TODAY" IS INDICATED BY A RED SYMBOL, AND AN "EXCEPTIONAL RELEASE" HAS NOT BEEN GRANTED BY AN AUTHORIZED MAINTENANCE OFFICER, THE PILOT OF THE AIRCRAFT WILL SIGN THIS RELEASE BEFORE FLIGHT.												
CHEMICAL	B	Sgt. Burns	Scott	RELEASED FOR FLIGHT		1. <i>John Doe</i>										
COMMUNICATIONS						2. <i>John Doe</i>										
PHOTOGRAPHY						3. <i>John Doe</i>										
NAVIGATION						4. <i>John Doe</i>										
REMARKS: PILOTS AND MECHANICS - SEE INSTRUCTIONS INSIDE FRONT COVER.				AIRCRAFT AND ENGINE TIME RECORD (ENTER IN HOURS AND MINUTES)												
#1 LEFT BRAKE WEAR - <i>John Doe 1st LT CC</i> #2 Defective Interphone dynamotor - <i>Loose</i> <i>disconnecter cord for microphone RAD app</i> <i>1/3pt. J. Davis</i> 695 IFF INSTALLED #1 Serviced by <i>Sgt. A. Jones Scott 2d 8-26-44</i> #2 Serviced by <i>Sgt. J. Burns 94th 12pt 8-26-44</i>				ENGINE	NO. 1	NO. 2	NO. 3	NO. 4								
				HOURS TO DATE	143:00	143:00	143:00	143:00								
				HOURS TODAY	5:00	5:00	5:00	5:00								
				TOTAL	148:00	148:00	148:00	148:00								
				OIL CHANGE DUE	H.T.	H.T.	H.T.	H.T.								
AIRCRAFT				CUMULATIVE CLEANING DUE	150:00	150:00	150:00	150:00								
				HOURS TO DATE	143:00											
				HOURS TODAY	5:00											
				TOTAL	148:00											

Form 1A is a daily maintenance report. Its purpose is to indicate to the ground crews defects in the equipment which have been noticed during flight. The crew chief is responsible for its complete execution, but it is the radio operator's job to see that any defects in the radio equipment are recorded on the

form. Defects in highly classified radio or radar equipment should be indicated with red pencil on the Form 1A. Be sure the radio operator's part of the remarks column is properly filled in. When making remarks about equipment defects, use brief, concise terminology.

REMEMBER—It is the radio operator's job to make all remarks concerning airborne communications equipment on Form 1A.

JOINT ARMY-NAVY

NOMENCLATURE SYSTEM

The Army-Navy nomenclature system known as the AN system has been developed to establish one standard plan of nomenclature for communications and the associated equipment of the two services.

POLICY OF SYSTEM

A nomenclature will be assigned to: 1) Complete sets and major special designed equipment. 2) Component parts of complete or major equipment. 3) Major units, usually not a part of any set.

COMPLETE EQUIPMENT NOMENCLATURE

(Basic Indicator)

The major title of the equipment follows a slant bar after the letters AN. Usually this title contains three letters and sometimes a number.

Example:

AN/ART-13—The first letter of the title indicates the type of installation (A—Airborne). The second letter indicates the type of equipment (R—Radio). The third letter indicates the general purpose of the equipment (T—Transmitting). The number 13 indicates that it is the 13th Airborne radio transmitter to which this nomenclature has been assigned. The type of installation, type of equipment, and general purpose of the equipment will be found in the proper sequence in APPENDIX A for Basic Indicators.

COMPONENTS NOMENCLATURE

(Component Indicator)

The component parts of a complete set are designated by one, two, or three letters called Component Indicator and a number followed by a slant bar and a Basic Indicator. The slant bar indicates that the item is a part of or used with the set indicated by the Basic Indicator.

Example:

Test equipment designed to be used specifically with one certain radio set would be indicated as follows: TS-2/ARC-5. This indicates that TS-2 was designed to be used with AN/ARC-5.

If test equipment is designed to be used with several airborne radio communications sets it would be indicated as follows: TS-1/ARC. All the component indicators will be found in APPENDIX B.

MAJOR UNITS NOMENCLATURE

Since a Major Unit is not a Basic Indicator or a Component Indicator, it must be dealt with differently. A Major Unit may, however, be a component of any set, yet it will be capable of performing a major function by itself.

The type of number for a major unit consists of a Component Indicator and a number followed by a slant bar and a Basic Indicator. The Basic Indicator is used here to indicate the general installation, type, and purpose for which the unit is to be used.

Example:

Microphone Amplifying Equipment AM-1/URC comprises an amplifier with cords, plugs, tubes, and mountings for amplifying the output of low level microphones. AM is the Component Indicator for amplifiers and /URC is the Basic Indicator which indicates that the equipment is used for General Utility Radio Communications as found in APPENDIX A.

TRAINING EQUIPMENT

The letter T is added to the Basic Indicator if the equipment is designed for training purposes.

Example:

If the AN/APG-1 were made for training purposes it would be designated as AN/APGT-1.

MODIFICATIONS

If a set has been modified, a letter denoting the modification will follow the Basic Indicator number.

Example:

If the AN/ART-13 were modified for the first time it would be an AN/ART-13A.

HOW TO WORK THE SYSTEM

An appendix A is provided to determine the meanings of the Basic Indicators. Three columns are provided in the Appendix. The basic indicator is found by using the first column for the first letter, the second column for the second letter and the third column for the third and last letter.

EXAMPLE:

RESTRICTED		
APPENDIX A		
LETTER SYMBOLS USED IN MAKING BASIC INDICATORS		
Installation	Type Equipment	Purpose
A—Airborne (installed and operated in aircraft).	G—Telegraph or teletype (wire).	C—Communications, receiving and transmitting.
C—Air transportable (designed to be air transportable as stated in specification or military characteristics).	I—Interphone and public address.	D—Direction finder.
	N—Sound.	G—Gun directing.
	P—Radar.	

The letters APG as taken from the Appendix A, and as used for a Basic Indicator will designate: *Airborne Radar Gun Directing Equipment.*

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C Air transportable (designed to be air transportable as stated in specification or military characteristics).	I Interphone and public address.	D Direction finder.
U General utility, includes two or more general installation classes, airborne, shipboard, and ground.	N Sound.	G Gun directing.
	P Radar.	M Maintenance and test assemblies (including tools).
	R Radio.	N Navigational aids (including altimeters, beacons, compass, and instrument landing).
	T Telephone.	Q Special.
	V Visual and light.	R Receiving.
	X Facsimile or television.	S Search and/or detecting.
		T Transmitting.
		W Remote control.
		X Identification and recognition.

APPENDIX B

TABLE OF COMPONENT INDICATORS USED IN THE AN SYSTEM

COMPONENT INDICATORS	FAMILY NAME	DEFINITIONS OR EXAMPLES
AB	Antenna base	Mast bases and antenna supports.
AM	Amplifier	Power, audio, interphone, radio frequency, panoramic, etc.
AS	Antenna system	Complex: arrays, parabolic type, etc.
AT	Antenna	Simple: wire, whip or telescopic, loop di-pole, etc.
BA	Battery, dry	Dry-battery packs, B-batteries.
BB	Battery, storage	Lead-acid, Edison.
C	Control box	For: radio, interphone, antenna, remote antenna tuning reel, etc.
CM	Comparator	Analyzes or compares two or more input signals.
CN	Compensators Regulators	Electrical and/or mechanical compensating or regulating apparatus.
CP	Computer	Basic component of electronic equipment.
CR	Crystal units	Crystal in crystal holder.
CU	Coupling units	Special impedance matching or coupling devices.
CV	Converter (Electronic)	Detectors and other electronic apparatus for phase or frequency changing, or changing direct current to alternating current.
CW	Cover	Field protective covers for protecting equipment from dust and weather.
CW	Cord	Interconnecting cords complete with plugs or other type terminals.
CY	Case	Rigid and semi-rigid structure for housing or carrying equipment.

(Continued)

TABLE OF COMPONENT INDICATORS USED IN THE AN SYSTEM

COMPONENT INDICATORS	FAMILY NAME	DEFINITIONS OR EXAMPLES
DY	Dynamotor unit	Plug-in type, separate dynamotor power unit when a major component.
F	Filters	Band pass, noise, telephone.
G	Generators (see PU)	Electrical generators without prime movers.
H	Headsets, handsets, head and chest sets	
ID	Indicator	Azimuth, plan position, elevation.
J	Junction, jack and terminal boxes	
KY	Keyers, copers and interrupters	Mechanical and automatic.
LS	Loudspeaker	Separately housed loudspeakers.
M	Microphone	Radio, telephone, throat, hand.
MD	Modulator	Devices for varying amplitude, frequency or phase of an alternating current.
MK	Maintenance kit	Radio, telephone, general utility.
MT	Mountings	Mountings, racks, frames, stands, etc.
MX	Miscellaneous	Mechanical and electrical equipment not otherwise classified.
O	Oscillator	Master frequency, audio, beat frequency, or heterodyning.
PP	Power packs	Non-rotating machine types such as vibrator packs, rectifier, battery chargers, etc.
PU	Power units and motors	Rotating power equipment with prime mover except dynamotors. Includes converters, inverters, etc.
R	Radio receiver	Radio receiver, compass unit, responsor, combined receiver-indicator, etc.
RD	Recorder	Type, facsimile.

(Continued)

TABLE OF COMPONENT INDICATORS USED IN THE AN SYSTEM

COMPONENT INDICATORS	FAMILY NAME	DEFINITIONS OR EXAMPLES
RE	Relay assembly	
RF	Radio frequency unit	Isolated radio frequency apparatus.
RL	Reel assembly	
RT	Radio receiver and transmitter	Transceiver, responder, transponder (may include integral antenna).
S	Shelter	Enclosure for transportable radio sets. Housing for ground electronics equipment.
SA	Switching assembly	Matching switching assemblies.
SN	Synchronizer	
R	Radio transmitter	Range, marker beacon, interrogator (may include integral antenna).
TD	Timing device	Mechanical and electrical timing devices.
TK	Tool kits	
TN	Ignition unit	For: receiver, transmitter, antenna.
TS	Test and measuring apparatus	Field intensity, frequency meter, analyzer, portable ammeter, ohm-meter, etc.
VS	Visual signaling equipment	Flag sets, aerial panels, signal lamp equipment.
*WD	Wire, cable or cordage	Double conductor.
*WF	Wire, cable or cordage	Four conductor.
*WM	Wire, cable or cordage	Multiple conductor (more than 4).
*WS	Wire, cable or cordage	Single conductor.
*WT	Wire, cable or cordage	Three conductor.

*The terms wire, cable or cordage are restricted in meaning to cover these items in bulk without terminals.

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TACTICAL OPERATION



Subjects in Section 2

Effects of High Altitude, 2-1

Oxygen Equipment, 2-2

Oxygen Emergencies, 2-3

Dangerous Gases, 2-4

Physical Fitness, 2-5

Vision at Night, 2-6

Climate and Health, 2-7

Flak Suits, 2-8

Tactical operation demands all the mental and physical strength you can bring to it. High altitudes and night flying, for instance, impose special strains on you. So, of course, does actual combat. Heat and cold, jungle and arctic regions present you with problems of health and survival. Remember, the AAF flies and fights in all parts of the world, and you must be prepared to cope with all possible climates and terrains. Learn to build your strength and to conserve it. Be at your best when the zero hour approaches. Be prepared to take care of yourself if you are forced down in strange or uninhabited territory.

EFFECTS OF HIGH ALTITUDE



When you ascend into the atmosphere the air pressure drops. The higher you go the less dense the atmosphere becomes. At 18,000 feet the pressure is only $7\frac{1}{2}$ pounds per square inch, or one-half of what it is at sea level. With increasing altitude the air also gets colder, up to 35,000 feet. Decrease in pressure on the body results in:

- Oxygen want (Anoxia)
- Expansion of trapped gases
- Decompression sickness

Oxygen Want (Anoxia)

The air we breathe always contains the same proportion of oxygen—21%. When the air pressure drops, however, the oxygen pressure drops correspondingly. Oxygen pressure is necessary for maintaining the proper amount of oxygen in the blood. At sea level, the pressure is sufficient to keep the blood at least 95% saturated with oxygen. This degree of saturation is necessary for peak mental and physical efficiency. When the percentage of oxygen in the blood drops, your efficiency falls off. This condition is known as anoxia or oxygen want.

In flight, oxygen want begins to affect you at altitudes above 5000 feet. It does not seriously affect efficiency, however, below 10,000 feet, except at night or on long flights. Its effect is so gradual you may not notice it. In fact, you usually feel exceptionally good in the early stages. This is one of the things that makes oxygen want so dangerous.

Unless the deficiency in oxygen is made up, your mind becomes dull; your memory, judgment, and muscular control grow worse and worse; vision and hearing are poor. Fatigue and sleepiness set in; you may have fits of laughing and crying; and finally unconsciousness and even death may occur. Above 20,000 feet anoxia causes most people to lose consciousness within a short time.

The higher you fly, the longer you stay, the more you exert yourself, the more likely you are to suffer anoxia, unless you are wearing your oxygen mask.

The only way to avoid oxygen want, unless your cabin is pressurized, is to use your oxygen equip-

ment on all flights above 10,000 feet. On all flights of 4 hours or longer use oxygen above 8000 feet. Don't depend on your feelings. You can't rely on them to tell you when you need oxygen. Regulations require using oxygen any time you fly above an **indicated altitude of 10,000 feet above sea level**. This may not agree with the reading of your altimeter if you have set it to zero for a given field.

If you ever suffer from oxygen want, see your Flight Surgeon immediately afterward.

On night flights you should use oxygen (Auto-Mix ON or NORMAL OXYGEN) from the ground up. This helps improve your night vision (See ROIF 2-6-1).

Expansion of Trapped Gases

Expansion of body gases occurs in the stomach, intestines, sinuses, and middle ear with increasing altitude. As the outside pressure decreases, these gases tend to increase in volume and cause pain when they can't be released.



The volume of gas in the stomach and intestines tends to expand these organs like a balloon, and may cause cramps when you ascend to high altitudes. You can obtain relief by belching or passing wind. Otherwise it may be necessary to descend to a lower altitude. Gas troubles can be controlled, at least partially. When you are flying frequently, avoid gas producing food such as beans, cabbage, and carbonated beverages. Remember what foods give you trouble in flight and avoid them. Don't chew gum before or during high altitude flights. You swallow too much air when you chew.

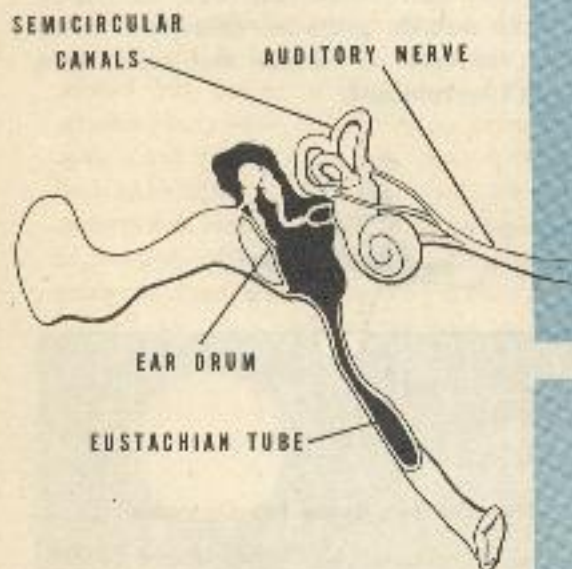
The Ears

The sinuses and middle ear are bony spaces in the head which contain air. These spaces have a moist lining like the nose and mouth. Ordinarily air leaves and enters the sinuses easily by way of small openings into the nose as you ascend and descend. As the air in the middle ear expands it pushes on the ear

drum and makes your ear feel full. At intervals while you are gaining altitude the air slips out of the middle ear through a slit-like opening called the Eustachian tube. Each time this opens you hear a click and the pressure is equalized. During descent, however, you must make an effort to clear your ears. You can do this by swallowing, yawning, or pinching your nose and blowing gently with your mouth shut. This lets the air back in and equalizes the pressure. Practice clearing your ears. If you do this, it will increase the rate of descent you can stand comfortably.

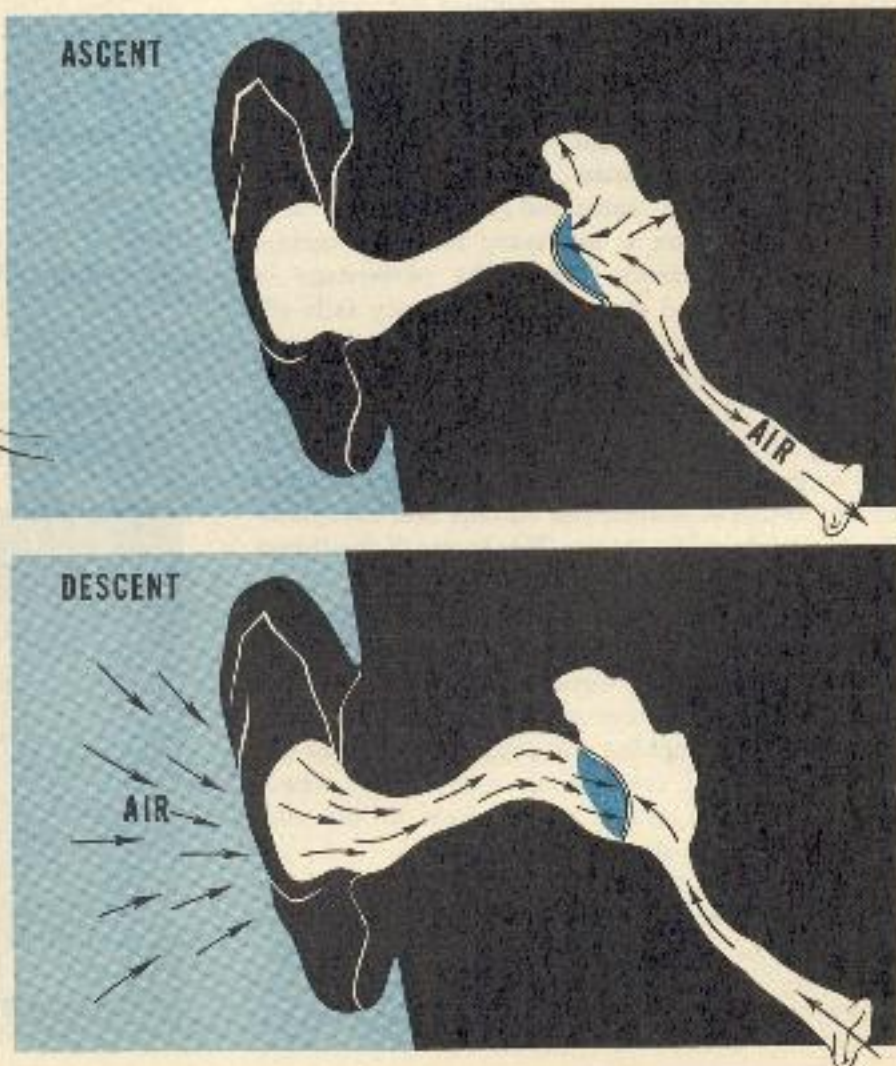
When you have a cold the linings of the sinuses and the Eustachian tube are swollen. It may then be difficult or impossible to clear your ears, and you may suffer great pain as you lose altitude. Your ear drums may even rupture. Pressure changes in the sinuses are also painful. Therefore don't fly when you have a cold, unless it is absolutely necessary. If you have to fly, see your Flight Surgeon first.

INSIDE THE MIDDLE EAR



During a climb air leaves the middle ear with comparative ease. During descent you must clear your ears to equalize the pressure; otherwise your eardrums stretch. That's what makes them hurt.

RESTRICTED



REV. No. 2

ASCENT TO 25,000 FEET WITHOUT OXYGEN

A sample of normal hand-writing in flight at 20,000 ft

Control specimen of normal handwriting.

10,000 ft - breathless

No apparent effect.

*15,000 ft - feel uneasy generally
punch feeling some numbness
in leg and hands*

Beginning muscular incoordination.

18,000 ft - very bad

Definite physical and mental inefficiency.

*20,000 ft - faint - numbness
in legs - vision fading*

Last zero off both 18,000 and 20,000—marked incoordination.

*22,000 ft - pale or red-
back to me feel better*

Feeling better? Evidence of false feeling of well-being.

*23,000 ft - feel good except
for heavy head and numb legs
numbness*

Feel good. Insight, judgment and coordination exceedingly faulty.

*24,000 ft - Capillary
circulation -*

Mental and physical helplessness.

25,000 ft - oxygen turned on

Improvement with few breaths of oxygen.

*26,000 ft - very last
lighter - hearing returning
feet OK, nose -*

Last zero left off—general improvement, but not completely normal.

Be sure that your oxygen equipment is functioning perfectly, that you know how to use it, that your mask fits properly, and that you know what to do in an emergency. Sudden removal of your oxygen supply at 30,000 feet will produce great mental and physical inefficiency in 30 to 60 seconds and unconsciousness in 30 to 90 seconds.

See your Personal Equipment Officer for proper operation of your oxygen equipment.

Decompression Sickness

Not only do body gases expand when atmospheric pressure decreases, but nitrogen gas in solution in the body tissues tends to escape and form bubbles. This reaction is similar to what happens when you take the cap off a bottle of soda. The pain and discomfort which result are known as **decompression sickness** or **aeroembolism**.

Trouble seldom develops below 30,000 feet. However, you're more likely to get it the higher you go above this altitude, the longer you stay there, the faster you climb, and the more you exercise. Then the nitrogen in your body forms bubbles, which frequently appear about the joints and in the tissues. Pain results. This condition is called **the bends**. Sometimes a feeling of weight on your chest occurs, together with tightness and pain when breathing. This is known as **the chokes**. Your skin may feel irritated and begin to itch. This is called **the creeps**.

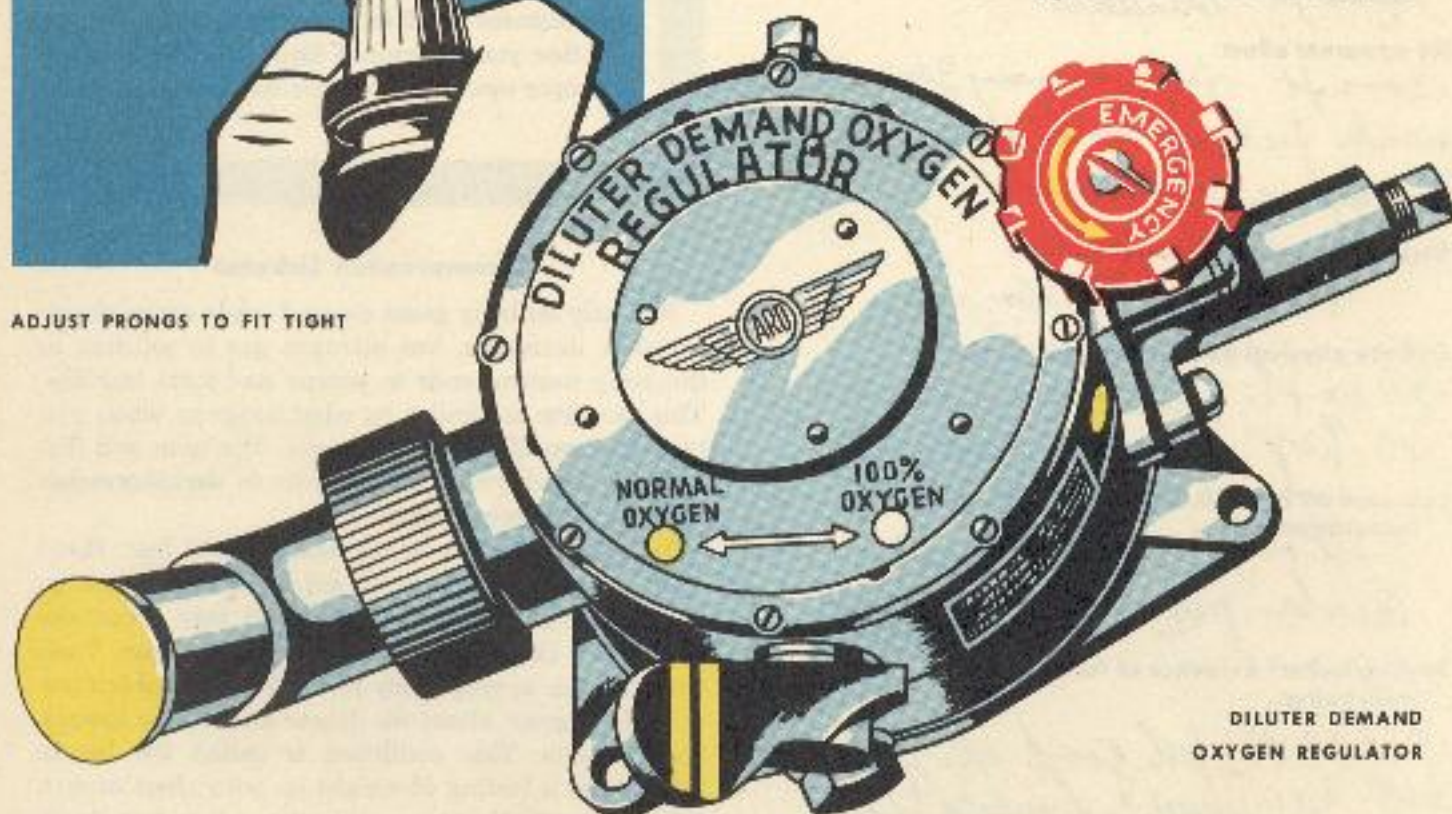
All of these conditions are relieved by descent to 20,000 feet or lower. If you ever have them, see your Flight Surgeon as soon as possible.

Five Golden Rules for Oxygen

1. Use oxygen for all flights above 10,000 feet.
2. Use oxygen from ground up on all night flights.
3. Use oxygen on all flights above 8000 feet if in excess of 4 hours.
4. Judge your need for oxygen by your altitude; don't rely on your sensations.
5. Check all oxygen matters with your Personal Equipment Officer.



ADJUST PRONGS TO FIT TIGHT



DILUTER DEMAND
OXYGEN REGULATOR

General—Oxygen Systems

Oxygen systems are of two general types:

1. Demand System.
2. Continuous Flow System.

The demand system is automatic. It furnishes oxygen only when you breathe and in just the right amount at each altitude. Every time you draw a breath, oxygen is supplied with the proper mixture of air. Most combat aircraft have demand oxygen equipment.

The continuous flow system supplies oxygen in a constant flow. To insure delivery of the proper mixture for each altitude, you must adjust a dial manually on the A-9A regulator to correspond with the altimeter reading. The A-11 regulator, used for passengers, is automatic.

Demand System

The demand oxygen system includes a demand type mask, diluter-demand regulator, pressure gage, and ball or blinker type flow indicator. In addition, a portable recharger hose is supplied at each crew position in heavy bombardment aircraft for recharging portable (walk-around) oxygen equipment from the oxygen system of the airplane.

Two types of demand oxygen masks are available—Type A-10A and Type A-14. They are used with the demand type regulators, the A-12 or AN-6004-1 regulator for permanent installations within the airplane, and the A-13 or A-15 regulator for portable use. The demand regulator is essentially a diaphragm-operated flow valve which opens by suction when you inhale and closes when you exhale. Types A-12 and AN-6004-1 are provided with two manual controls for use under special conditions—

the Auto-Mix or oxygen control lever, and the Emergency Valve.

With the Auto-Mix lever in the NORMAL OXYGEN or ON position, the A-12 and AN-6004-1 diluter-demand regulators automatically mix just the right amount of oxygen with the air for the altitude at which the plane is flying. This is accomplished by an aneroid control like the one in the altimeter. At sea level the aneroid is fully contracted and the air intake port is wide open while the oxygen port is closed. As the altitude increases and the pressure decreases, the aneroid expands and gradually closes the air intake port. Finally, at an altitude of 30,000 to 34,000 feet the air intake port is entirely closed. The oxygen port is wide open and delivers pure oxygen to the mask.

Remember, the normal position for the Auto-Mix lever is NORMAL OXYGEN or ON. When it is in that position the regulator automatically furnishes the proper amount of oxygen for all altitudes. When the Auto-Mix lever is in the 100% OXYGEN or OFF position, the air intake port is closed and pure oxygen is supplied at all altitudes.

The Type A-15 regulator, for portable use, is not

provided with an Auto-Mix lever; the mixing of air and oxygen is entirely automatic.

When the red Emergency Valve knob on the regulator is turned on, the oxygen by-passes the demand mechanism in the regulator and enters the mask in a steady flow, regardless of breathing and of altitude. This valve, therefore, should not be opened except in emergency, as the oxygen supply will be exhausted quickly.

Precautions

Preflight Check:

1. Make sure mask fits properly. Check for leaks by holding thumb over end of hose and inhaling gently. Have your Personal Equipment Officer check size and fit with his special test set or Demand Mask Leak Detector, whenever possible.

2. Check the pressure of the oxygen system. It should not be less than 400 pounds per square inch.

Caution: When the Emergency Valve is open do not pinch the hose or block the outlet, for this causes the regulator diaphragm to blow out. Then be sure to close the valve tightly.

3. Check knurled collar and hose at outlet end of



A-14 DEMAND MASK



A-10A DEMAND MASK

regulator. They should be tight.

4. Check rapid-disconnect fitting on mask hose. Be sure rubber gasket is in place. Make sure male end of fitting fits tightly into the regulator hose. It should withstand a pull of 10 to 20 pounds. Your tubing may have the C-ring type disconnect; if so, check it the same way.

5. Clip oxygen-supply hose to clothing or parachute harness so that it allows movement of head without kinking or pulling the hose.

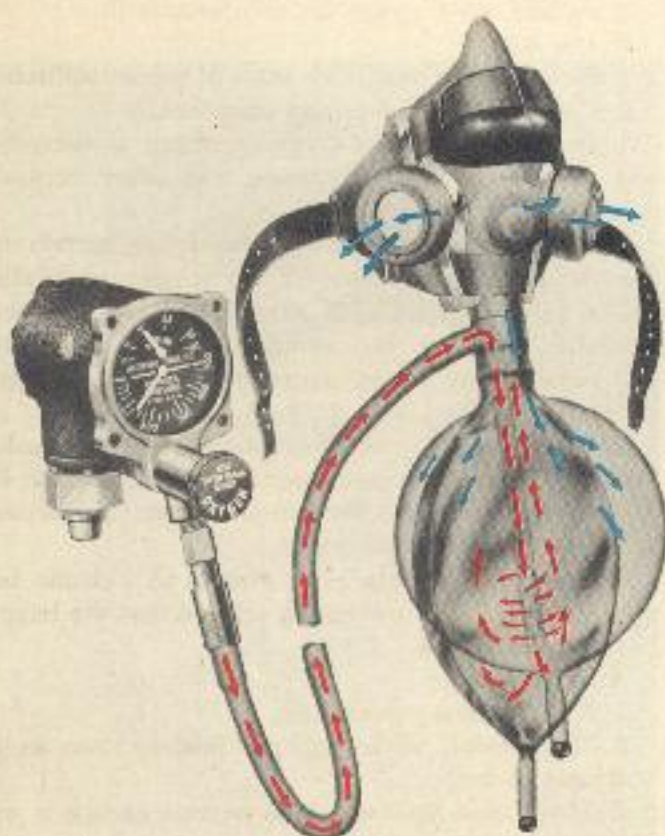
6. Be sure the Auto-Mix lever is in the NORMAL OXYGEN or ON position.

7. Turn Emergency Valve off tight.

In the Air:

1. Check the mask as soon as you put it on, by holding thumb on end of hose and inhaling gently.

2. Manipulate the mask at frequent intervals when the temperature is low, to free it of any ice that may form. Some masks have rubber flap (inhalation baffle) inside to prevent accumulation of moisture in oxygen inlet ports. **Know how to handle your mask if it freezes. Your life depends on it.** If possible, obtain a mask heater or carry an extra mask. See your Personal Equipment Officer.



A-9A CONTINUOUS
FLOW REGULATOR

A-8B OXYGEN MASK

Use the Auto-Mix lever in the OFF or 100% OXYGEN position only:

For the treatment of shock or hemorrhage, at any altitude.

For protection against fumes.

For protection against the bends, if your Flight Surgeon advises breathing pure oxygen from the ground up in special cases. For symptoms of anoxia.

3. Check the oxygen pressure gage frequently. The regulator does not function properly with a pressure of less than 50 psi.

After a Flight:

Wipe the mask dry. Wash it frequently with soap and water, rinse well, and dry thoroughly. Masks with microphones should not be immersed in water; they should be wiped with a wet cloth.

Inspect mask and hose for cracks and punctures.

Don't lend your mask to anyone except in an emergency.

Continuous Flow System

Some of the older airplanes which do not operate at extremely high altitudes are still equipped with continuous flow oxygen equipment. The A-8B mask is used with the A-9A regulator in the continuous flow system.

The A-8B mask is a re-breather type. The bag helps conserve oxygen from the exhaled air. The mask contains 2 sponge-rubber disks in the turrets of the face piece. When you are exposed to freezing temperatures, squeeze the disks to free them of moisture; otherwise ice may block them.

The A-9A regulator is entirely different from the demand regulators. You get a continuous flow of oxygen by opening the valve until the needle on

Turn on Emergency Valve only:

To revive an unconscious crew member.

If regulator fails, **Watch flow indicator.**

When removing mask at altitude.

If mask slips during a pullout.

If a hole is shot in the oxygen tube.

To Remove Mask at Altitude

1. Unhook mask on right side, but hold tightly against face.
2. Turn on Emergency flow.
3. Take 3 or 4 deep breaths.
4. Hold breath and drop mask.
5. Don't breathe outside air.
6. Replace mask and start to breathe.
7. Turn off Emergency flow.

You can repeat this procedure, if necessary, but don't breathe outside air.

the dial corresponds to the altimeter reading. If you adjust this valve to correspond to the altitude you always get the proper amount of oxygen. During ascent or periods of unusual activity, keep valve setting about 5000 feet higher than your altitude.

In cargo type aircraft, passengers are supplied from an automatic continuous flow system. In this system the A-11 regulator supplies oxygen for 1 to 15 passengers. Passengers are equipped with A-8B or A-7A masks.

Precautions**Maintenance:**

Have rate-of-flow checked every 10 days with a ground flow check-meter.

Keep all parts free of oil, grease, and dirt.

Check entire system for leaks. Pressure should be maintained overnight with all regulators in the OFF

Warning

Be extremely cautious not to contaminate your oxygen equipment with oil, grease, or hydraulic fluid. Fire or explosion may result if even slight traces of oil or grease come in contact with oxygen under pressure.

Be sure that all lines, fittings, instruments, and other parts are free of oil, grease, and other foreign matter.

NEVER USE LUBRICANTS ON ANY PART OF THE OXYGEN SYSTEM

position, if there has been no appreciable change in temperature.

Make certain that the valve adjustment knob of the regulator has enough resistance against turning to prevent it from being accidentally moved during flight. If it is loose, tighten the valve gland packing nut.

Preflight Check:

1. Check the cylinder pressure. It should show 400 pounds per square inch.
2. Open regulator flow valve wide and be sure needle registers maximum flow.
3. Make sure rubber gasket is present at end of mask hose.
4. Check connections between mask, bag, and connecting tube.
5. Make sure bayonet connection is locked.
6. Check re-breather bag for holes. Be sure plug is in bottom of bag.
7. See that exhalation disks are in place.
8. Carry extra sponge-rubber disks and protective shields for exhalation turrets or a protective fabric bag for entire mask. Take along an extra mask if you go to altitudes above 20,000 feet, in case the one you are wearing freezes.
9. Adjust mask straps for comfortable fit.

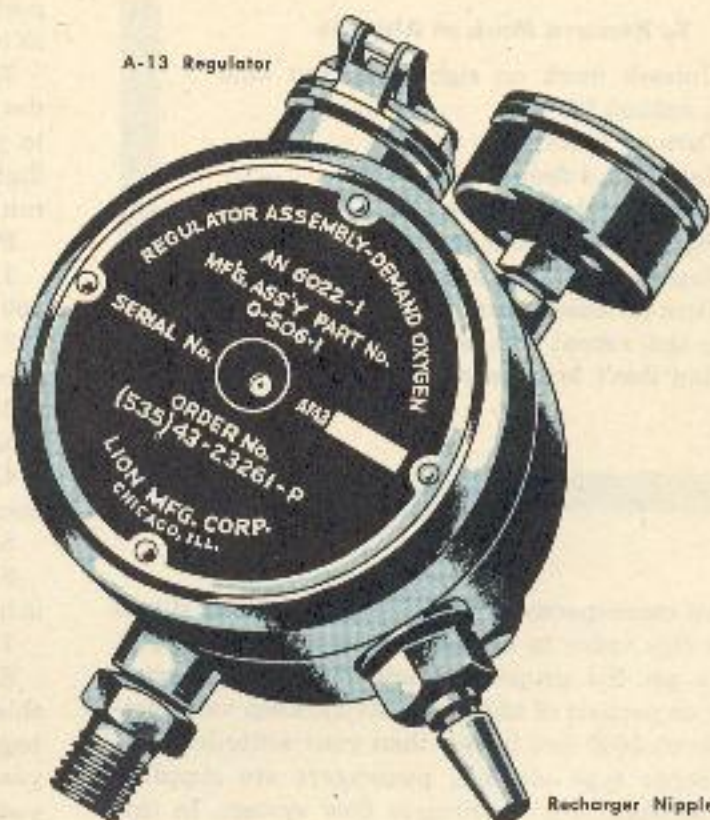
In the Air:

1. Be sure your regulator is set at proper altitude.
2. Check cylinder pressure occasionally.
3. Breathe normally. Over-breathing is dangerous; it may produce dizziness and other serious effects.
4. Put protective shields on exhalation turrets or use the fabric bag whenever the temperature falls below 10°F (-12.3°C). If shields and bag are not available, examine the sponge disks at intervals and remove any ice by squeezing them, or change the sponges.
5. Above 30,000 feet the re-breather bag should never be completely collapsed when you inhale. If it does collapse, open the valve further, no matter what the flow indicator reads.
6. After you change your station at altitude be sure the regulator is properly set and that the bayonet fitting is locked.

After a Flight:

1. Shut all flow valves tight.
2. Wash mask with soap and water, rinse well, and hang to dry.
3. Don't lend your mask to anyone except in an emergency.
4. Keep your mask in a safe place and away from sunlight.

PORTABLE OXYGEN EQUIPMENT



Walk-Around Bottle

Large airplanes are provided with portable oxygen equipment consisting of walk-around oxygen cylinders and regulators. This equipment allows you to walk away from your oxygen station in the plane and provides an emergency source of oxygen.

Three types of portable assemblies are in use:

1. The A-4 cylinder and A-13 regulator. Duration of supply, 3 to 8 minutes.

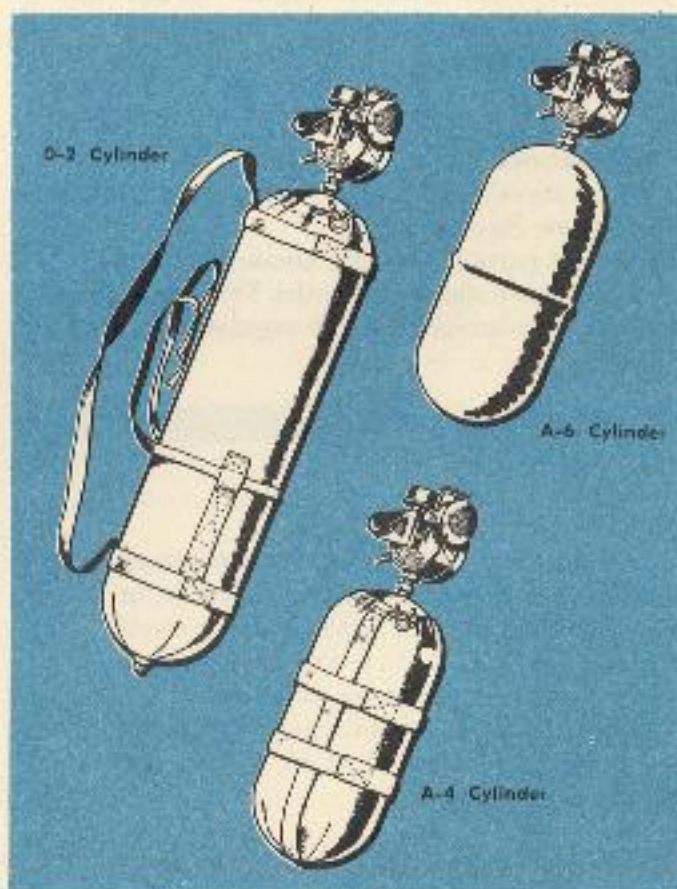
2. The D-2 cylinder, which has a harness for the shoulder, and A-13 regulator. Duration of supply, 20 to 50 minutes.

3. The A-6 cylinder and A-15 regulator, which has clip for attachment to the clothing or parachute harness and an Auto-Mix mechanism (but no lever). Duration of supply, 15 to 40 minutes.

The duration of supply is variable, depending upon the altitude and how much work you are doing. The only safe rule for using walk-around equipment is to watch the gage. Fill your cylinder before take-off and refill it from the plane's oxygen system whenever the pressure falls below 100 pounds per square inch.

To Use the Portable Unit

1. First check the pressure gage to make sure the pressure is at least that of the airplane's oxygen





H-2 BAILOUT BOTTLE

system. If it is not, recharge the cylinder by means of the portable recharging hose at each oxygen station.

2. Take a deep breath, hold it, then disconnect mask hose from regulator hose.

3. Quickly lift spring cover on walk-around regulator and plug in tight the male fitting of your mask hose.

4. Now start to breathe again.

5. Fasten unit to yourself by means of clip or shoulder strap.

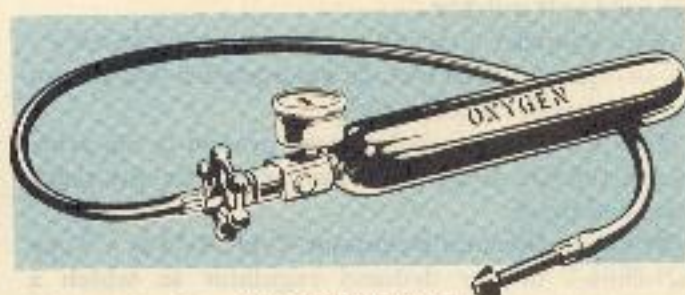
On all flights above 30,000 feet. Keep your bailout bottle connected to your oxygen mask. This gives you most protection in an emergency.

Oxygen for Ditching

If you have to ditch, prepare for underwater escape from your plane by wearing your oxygen mask connected to your walk-around bottle and A-13 regulator. The duration of the A-4 portable cylinder is short under water, but with the D-2 portable cylinder you can breathe for about 6 minutes at a water depth of 10 feet.

6. Watch for twisting or kinking of hose.
7. **Keep bottle filled! Refill at 100 pounds!**
8. Never leave your oxygen station at high altitude without a walk-around bottle.

BAILOUT OXYGEN CYLINDERS



H-1 BAILOUT BOTTLE

Two bailout oxygen cylinder assemblies are available for parachute descents from high altitudes. Both are completely self-contained units with pressure gage and release valve.

Either cylinder must be tightly fitted and securely tied in a pocket sewn to the flying suit or harness.

Before takeoff, check the cylinder's pressure gage. It should read at least 1800 pounds per square inch. Either cylinder assembly can be used in parachute descents above 30,000 feet. Sometimes it is used as an emergency oxygen supply in fighter aircraft if the regular oxygen supply suddenly fails.

Type H-1: Before jumping, grip pipe stem between your teeth and completely open flow valve.

Type H-2: Before jumping, pull the release to open flow valve. Then, disconnect the main oxygen tube and tuck it inside your jacket. If this is impossible hold your left hand over the free end. Then jump, keeping free end of main oxygen tube covered until parachute opens.

OXYGEN EMERGENCIES

If crew mate is unconscious:



1. Make sure of your own oxygen supply.



2. Check his mask-to-regulator connections carefully.



3. Check his oxygen cylinder pressure.

If pressure is below 50 psi:



1. Connect his mask to walk-around bottle.



2. Keep his bottle filled from yours or from another recharger hose.



3. Check his mask for possible leaks or obstructions.

If pressure is above 50 psi:



1. Open his Emergency Valve (with pressure demand regulator, set dial on SAFETY).



2. Check his mask for any leaks or obstructions.



3. When he comes to, turn the Emergency Valve off.

If he still doesn't come to, check these points:



1. Breathing (Give artificial respiration; ROIF 8-14-4).



2. Bleeding (Apply local pressure or tourniquet).



3. Can the pilot fly lower?

DANGEROUS GASES

The air you breathe while in flight should be free of all other gases except the oxygen from your mask. Exhaust gases, gasoline vapors, hydraulic fluid fumes, smoke, or poison gas may contaminate the cabin air. In sufficient concentration, any of these is dangerous. You can protect yourself from them by knowing when to suspect their presence and by observing the necessary precautions.

Exhaust Gas

Exhaust gas is a mixture of several substances. Among them are carbon monoxide and oxides of nitrogen, both of which are poisonous. In exhaust mixtures, carbon monoxide is the more important, for it is present in larger amounts. Carbon monoxide acts by combining with the red cells of the blood and making them useless for carrying oxygen to the body tissues. This results in oxygen want or anoxia. As you ascend from sea level the dangers resulting from carbon monoxide increase, even below 10,000 feet, unless you use your oxygen mask.

In Flight:

The effects of carbon monoxide poisoning are similar to those caused by oxygen lack—shortness of breath, headache, nausea, dizziness, dimming of vision, poor judgment, weakness, unconsciousness, and death. The higher the concentration of the gas, the longer you breathe it, the higher the altitude (unless you use your oxygen mask), and the greater your activity, the more severe are the symptoms.

Like anoxia, carbon monoxide poisoning may give

gas. The only safe rule for protecting yourself against carbon monoxide in flight is to wear your oxygen mask with the Auto-Mix in the OFF or 100% OXYGEN position whenever you smell exhaust gases. In this way you get pure oxygen to breathe and are completely protected from any gases in the cockpit. If you had any unpleasant sensations during flight see your Flight Surgeon as soon as possible. Your pilot will report the trouble to the Engineering Officer.

Exhaust heaters should not be used during combat. Enemy gun fire may cause dangerous leaks of exhaust gas into the cabin.

On the Ground:

Carbon monoxide is always present in poorly ventilated hangars and garages when engines are running. Therefore, no kind of engine should be run longer than necessary inside closed hangars and garages. Ventilate such places as much as possible. If the doors must be kept closed, don't stay inside any longer than necessary.

In cold regions where gasoline or oil stoves and lamps are used in closed buildings or tents, carbon monoxide is formed whenever fuel is burned. Cross-ventilation is your only reliable protection.

Gasoline Vapors

Gasoline vapors in aircraft cabins may cause serious trouble. Aviation gasoline contains special compounds which make its vapors more dangerous than those of ordinary gasoline. One gallon produces 30 cubic feet of vapor at sea level. These vapors are heavier than air.

Breathing gasoline vapors is harmful because the vapors are easily absorbed by the lungs. Even one-tenth of the concentration of gasoline vapor which is necessary to support combustion is dangerous if inhaled for more than a short time. Symptoms may include dizziness, nausea, headache, burning and watering of the eyes, restlessness, excitement, disori-



entation, disturbances of speech, vision, and hearing, convulsions, and unconsciousness.

One gallon of gasoline produces 1600 cubic feet of explosive vapor at sea level and has the blasting power of 83 pounds of dynamite.

If a gasoline leak occurs in your airplane, or if any crew member smells gasoline vapors during flight:

Leave all electrical and radio equipment switches just as they are; the slightest spark may cause an explosion.

Ventilate the cabin if possible.

Put on your oxygen mask with Auto-Mix in OFF or 100% OXYGEN position. This excludes contaminated air from the lungs.

Stop smoking; put on goggles, if available, to protect eyes from irritation; roll down sleeves and put on gloves, helmet, and other articles of clothing for protection against burns in case of fire.

Hydraulic Fluid Vapors

Some types of hydraulic fluid contain substances which are dangerous when their vapors are inhaled. They cause irritation of the eyes and breathing passages, headaches, dizziness, and disturbances of judgment and vision. These harmful effects are increased by altitude or by high temperatures. Use your oxygen mask with Auto-Mix OFF (100% OXYGEN) if hydraulic fluid leaks into the cockpit.

A spray of hydraulic fluid ignites easily and spreads its flames rapidly. Be on guard against fire if a hydraulic leak occurs.

Smoke

Smoke may arise in the airplane from a variety of sources such as hot oil fumes, a break in the coolant fluid lines, or from signal flares. Some types of smoke are dangerous to breathe, but all smoke irritates your eyes and throat and makes you cough. Don't take chances. Wear your goggles and use your oxygen mask with the Auto-Mix OFF and breathe 100% oxygen until you clear the cabin of smoke.

Poison Gas

The poison gases which were known at the end of the last war are all heavier than air and tend to collect near the ground. Most of them have a distinctive odor:

Phosgene and Di-Phosgene (Odor of musty hay or decaying leaves).

Chlorpicrin (Sweetish smell, like licorice).

Mustard gas (Smells like garlic or onion).

Lewisite (Geranium-like odor).

Accurate identification of these gases may be impossible, because of the use of mixtures or of newly developed agents. Most of them cause irritation of the eyes and lungs.

A gas mask, of course, is the ideal protection against these poisons. When a gas mask is not available, your oxygen mask, together with goggles, provides the best type of protection. But be sure to keep the Auto-Mix OFF (100% OXYGEN).

Phosgene is formed when the carbon tetrachloride in your fire extinguisher comes in contact with fire. Ventilate aircraft thoroughly after extinguishing fire, to avoid unnecessary exposure to phosgene, or protect yourself by means of gas mask or oxygen mask.

First Aid

If a man is overcome, begin first aid at once:

1. Remove him from the source of the gas.
2. Give him pure oxygen to breathe, if available (turn on emergency flow).
3. Begin artificial respiration immediately (See ROIF 8-14-4).
4. Keep him warm.
5. Send for a medical officer.
6. Never exercise a person who has been overcome by gas. This only makes him worse.

References: AAF Ltr 52-9, AAF Reg. No. 55-20

SMOKING IN AIRCRAFT IS PROHIBITED

During all ground operations.

During and immediately after takeoff.

During fuel transfer operations.

Immediately before and after landing.

Any time any occupant detects gas fumes.

In bomb bay or fuselage section containing auxiliary gas tanks.

In the passenger compartment of C-87 type aircraft at all times.

In the C-54 type aircraft when fuselage tanks are installed.

At any time or place whenever aircraft commander deems such action necessary for safety.

PHYSICAL FITNESS

Good food, sufficient sleep, rest, and relaxation are important if you are to be efficient at your post. Exercise is essential.

The importance of physical fitness is obvious. You can't operate efficiently with poor radio equipment. Neither can you do justice to your job on a mission if you are in anything less than good physical shape. Air combat requires perfection.

Haphazard exercise is of little value. Exercise regularly and get the most in fun and relaxation out of what you do. Take advantage of the regular physical training periods your unit provides. Make the most of them. You should be really tired out when you have finished.

Join in and encourage regular crew activities—touch football, soccer, volleyball, softball, and baseball are excellent forms of exercise that stimulate teamwork as well.

During Flight

When you remain in one position for several hours during a flight, your body gets tired and you are less alert. A few simple exercises, done periodically, will break the monotony, ease your tensed muscles, relieve the stiffness, and keep you more relaxed. When cruising on long flights, when you can't leave your post to stretch, do the exercises shown on this page at least once every hour.



NECK: Move head backward, squeezing muscles back of neck—Hold it—Relax.



SHOULDERS: Shrug shoulders—Hold it—Let go. Now move shoulders forward, up, back—Hold it—Let go.



BACK: Arch back—Hold—Let go.



ARMS, ABDOMEN, AND BUTTOCKS: Clench fists and tighten muscles of buttocks, pressing lower back against back support—Hold it—Let go.



LEGS: Tighten leg and thigh muscles—Hold it—Relax. Now move knees close together—Hold it—Relax.

Take time for exercise daily. Good physical condition is essential to combat efficiency. It increases your resistance to anoxia, the bends, cold, and blackout, and better your chances for survival under emergency conditions.



Some animals can see as well at night as they do in the daytime. Unfortunately, man cannot. But your effectiveness and efficiency in night combat depend on your night vision. Learn how to improve it, particularly if you are assigned to double in brass as a gunner.

Because of the actual mechanics of the eye, night vision differs from day vision. In daylight, the center of the retina, or lining, is the most sensitive part of the eye. At night, however, the center of the retina can't see at all. It is called the night blind spot. In dim light, the off-center parts of the retina are the most sensitive. Try it! You see best at night when you look slightly off center or to the side of the object you want to see. The off-center parts of the retina also detect movement more easily than the central part.

When searching the sky, the earth, or the surface of the sea at night, the most effective and simple method is scanning. Keep your line of sight fixed in one direction for about a second. Then move your eyes or head in jumps of from 10 to 20 degrees, as in reading a book, and pause for a second or two at the end of each jump. In this way, you cover the entire field in a series of eye or head movements and pauses. Use this method when searching for enemy aircraft during night gunnery.

If you remain in a dark room, your eyes gradually see things which they could not see at first. This is known as dark adaptation. By adapting your eyes to darkness, you increase their sensitivity 10,000 times. That is, after only 30 minutes in the dark you can see a light 10,000 times dimmer than you could have seen in a bright light. Keep this in mind when on missions. You need light to operate your equipment, but keep your lights dim and avoid

looking directly into an unshielded light. Try to keep your dark adaptation at a maximum under operating conditions; you will be able to see better when the time comes to man your gun.

Aids to Night Vision

Be sure you have an adequate supply of oxygen. The retina of your eye is highly sensitive to oxygen lack. Without oxygen, your night vision is impaired at an altitude of only 5000 feet, and is only half as efficient at 12,000 feet.

Eat foods rich in Vitamin A. Vitamin A is a chemical factor essential to good night vision. Eggs, butter, cheese, liver, apricots, peaches, carrots, squash, peas, and especially cod liver oil and all types of greens are rich in Vitamin A. Eat them liberally. Too much Vitamin A does not harm you.

Practice off-center glances at night. Look to one side of the things you want to see. Scan, don't stare. Let your eyes rove.

When caught in searchlight beams, close one eye and avoid looking at the light source. The eye which is kept closed retains its ability to see in the dark.

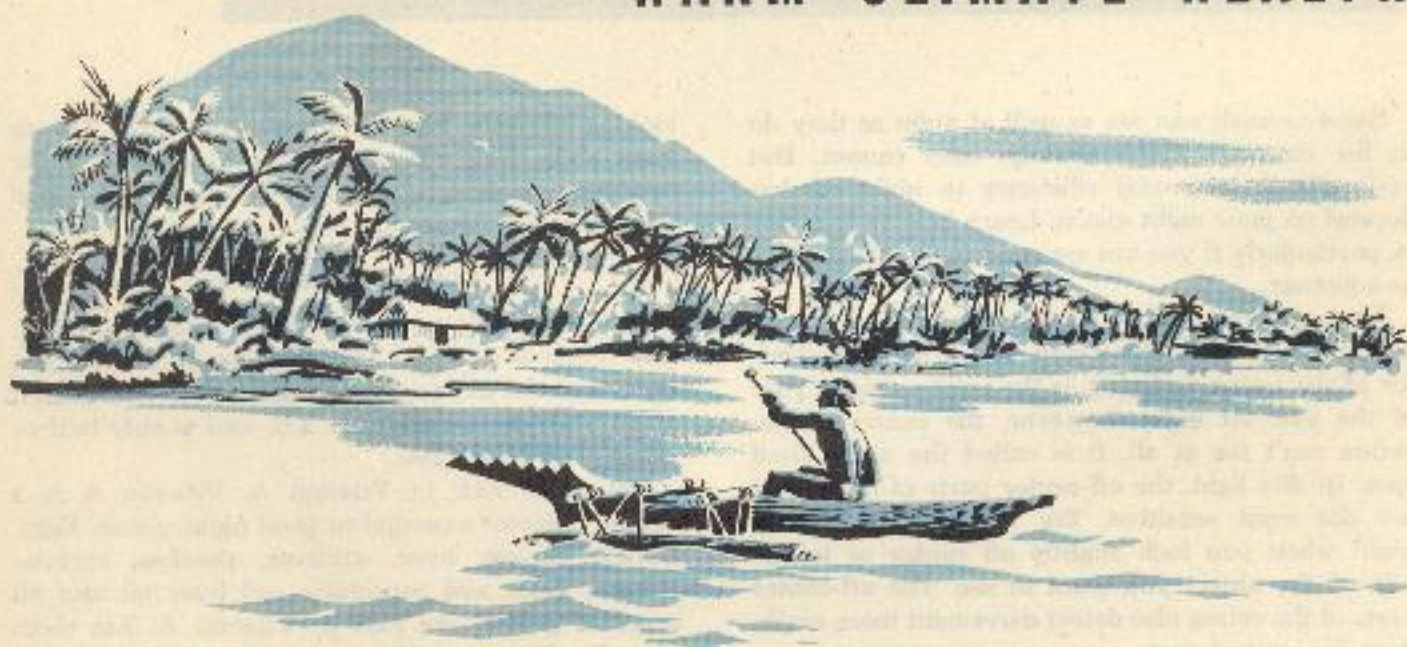
Keep your lights as dim as possible. Keep all non-essential lights turned out. Adjust the necessary lights in such a way as to reduce panel and table reflections to a minimum.



CLIMATE AND HEALTH

The AAF has circled the earth. Its flying operations are conducted over every type of terrain, desert, jungle, and Arctic, where the temperatures range from higher than 130°F to lower than -50°F. Each region presents special problems in living. Learn what they are and how to cope with them.

WARM CLIMATE HEALTH



In warm regions such as the tropics, desert, or jungle several weeks may be required for your body to become completely adapted to the heat. During this period protect yourself from sunstroke or heatstroke by following a few simple rules.

Clothing

During the daytime protect yourself from the severe burns which may result from exposure to the intense rays of the sun. Wear a cap or sun helmet and lightweight clothing which exposes as little of the body as possible. Clothing should be loose and porous to permit evaporation of sweat. This helps cool you. Get in the habit of shaking out your clothes before putting them on, so as to rid them of flies, insects, and snakes. Tinted goggles or sunglasses protect your eyes from the glare of the sun;

also from dust and sand. Protect exposed areas of body with sunburn protective ointment.

Don't sunbathe right away. It's dangerous, unless you develop a tan gradually. A good plan for sunning yourself is 5 minutes' exposure the first day, increased by 5 minutes each day until you are thoroughly tanned. Don't get burned!

Although the temperature may be intensely hot on the ground, the air is cooler the higher you climb; at high altitudes it is extremely cold. So be prepared to add or remove clothing according to the temperatures you encounter.

Even on the ground, nights are frequently cold in the desert. Anticipate rapid changes in temperature by having warm clothing available at night. Woolen socks are best for general use; they provide the greatest comfort because they absorb moisture well

and are good insulators. Wear GI shoes. They keep out sand and protect your feet better than oxfords. You can also walk home in them.

Water and Salt

If your water supply is limited, you must use it sparingly. With care you can get along on surprisingly little.

Keep physical exertion at a minimum. Exertion makes you sweat; sweating makes you thirsty. Stay out of the sun as much as possible. Do your heavy work in the shade and during the cooler hours of late afternoon, evening, or early morning. Cut down on your smoking as it makes you thirsty; chew gum instead. Rest as much as possible, and take advantage of the breeze. Go easy on alcoholic drinks. They increase your body's need for water.

If you find yourself sweating heavily, salt your food liberally at meals to help make up for the salt lost through sweat. Your Flight Surgeon may advise taking salt tablets in addition. Check with him on the dosage, for salt tablets may do more harm than good if your water ration is limited.

If your body loses too much salt through sweating, you may get **heat cramps** in your muscles.

Sunstroke is usually caused by prolonged exposure to the direct rays of the sun, although it may occur even in cloudy weather. It is a serious condition. Symptoms may include headache, dizziness, red spots before the eyes, and vomiting.

Heatstroke is a similar condition resulting from exposure to excessive heat from any source.

All of these conditions can be prevented by avoiding sun, sweat, toil, and salt-loss as much as possible. A victim of sunstroke or heatstroke must have prompt treatment. Give him a bath in cold water, cover with wet sheets, or simply pour cold water over his clothes and fan him.



Disease

In the tropics and desert, certain diseases are usually present. Know what they are, how they are transmitted, and precautions to take, so you can avoid getting them. Guard constantly against:

Insects

Contaminated food and water

Breaks in the skin's surface

Insects



Mosquitoes in the tropics are your greatest danger. They transmit malaria, yellow fever, dengue, and other diseases which can lay you low as surely and effectively as an enemy bullet. Mosquitoes breed in water. They usually rest in the shade during the



day and bite at night. In dense jungles or dark rooms, however, they may bite during the day.

Keep yourself covered at night. Wear long trousers, sleeves, gloves, and headnet. Smear exposed surfaces of the skin, such as your face and neck, with mosquito repellent every 3 or 4 hours during late afternoon and night. Apply carefully, as mosquitoes will find and bite every small untreated spot even though it is completely surrounded by repellent. After dusk stay away from native villages and swamps. In heavily infested areas, wear clothing

which has been treated with mosquito repellents.

Sleep under a bednet. Inspect and spray inside it to kill mosquitoes before entering. Tuck net under blanket or mattress. Keep it mended.

Use mosquito spray (Aerosol or DDT) liberally in your tents and buildings.

Malaria. This is one of the most widespread diseases in the world. It is a major military problem in South America, the Indies, Africa, the Middle East, India, Burma, Thailand, Indo-China, China, and Malaya. It is carried by the anopheles mosquito, which injects the malarial parasite into your blood.

The disease takes different forms with symptoms appearing about 2 weeks after infection. You may then experience headache, chills, fever, and other symptoms, depending on the type and severity of the disease. Prevention of malaria is largely up to you. Don't give the mosquitoes a chance. In certain regions you may be advised to take atabrine to help prevent malaria. If so, take it regularly, according to local directives and the instructions of your Flight Surgeon.

Other diseases transmitted by mosquitoes include:

Yellow Fever. Confined at present to Eastern and Central Africa and the bulge of South America. Vaccinations against this disease protect you.

Dengue (Breakbone fever) occurs in tropical regions, chiefly at the end of the rainy season. Symptoms consist of muscle and joint pains, backache, fever, and rash. The mosquito which transmits it bites mostly during the daytime. You must protect yourself from it to avoid the disease.

Besides mosquitoes there are other pests you should steer clear of:



Flies. They breed in filth and transmit the germs of dysentery and typhoid from human waste to your food. Protection against flies requires screening of latrines and kitchens, proper disposal of garbage, and frequent spraying with Aerosol or DDT. Special types of flies may transmit other diseases, such as sand-fly fever, yaws, and sleeping sickness.



Mites. Small six-legged insects about the size of a pinhead, sometimes known as red bugs or chiggers. They transmit typhus or scrub typhus (Tsutsugamushi fever). This disease is prevalent in the Southwest Pacific and the China-Burma-India theater. It results in headaches, chills, and fever. Cover the body, avoid sleeping on the ground, and wear clothing impregnated with anti-mite fluids or insect repellents, for protection.



Lice. They carry the germs of typhus fever and relapsing fever. Lice hide in the seams of dirty clothing and spread from one person to another. Boil infested clothing or sterilize with chemicals.



Fleas. Most fleas are harmless. In India and South China, however, rat fleas transmit the deadly disease called plague. Avoid this threat by spraying your quarters with Aerosol or DDT and keeping rats out.

Food and Water

In warm climates foods spoil quickly. There is danger also of contamination of food and water by germs which cause typhoid, dysentery and cholera. You can prevent typhoid and cholera, to a large

extent, by immunization injections. The dysenteries, however, cannot be prevented in this way. You must rely instead on sanitary measures and precautions. Know what foods are safe and how to protect yourself against those that may not be.

The safest food is served in Army messes. If canned rations are used they should be eaten soon after opening or stored in a cool place under fly-proof covers.

Food obtained from natives should be thoroughly cooked before eating. Thick-skinned fruits which can be peeled need not be cooked. Lettuce, radishes, celery, salad greens, melons, and strawberries are likely to carry disease germs. Never eat them raw. The natives commonly soak melons in water, often polluted, to increase their weight. Never use milk products such as butter, cheese, and ice cream, which are sold by the natives.

In desert and tropical regions, water also is important in transmitting intestinal infections. Consider all surface water unsafe, whether in streams, wells, fountains, ditches, or cisterns. Don't wash in it, don't brush your teeth with it, and above all don't drink it! Don't even put ice in your drinks unless the ice has been prepared by the Service. Native ice may harbor germs of dysentery or typhoid.

Water of questionable purity should always be sterilized before you use it. You can sterilize water in any one of three easy ways:

1. Boil it for at least 5 minutes.
2. Use Water Purification Tablets (Halazone). Add one tablet to the pint, shake, and wait a half-

hour before drinking.

3. Add three drops of iodine to the quart, shake, and wait a half-hour before drinking.

Care of the Skin

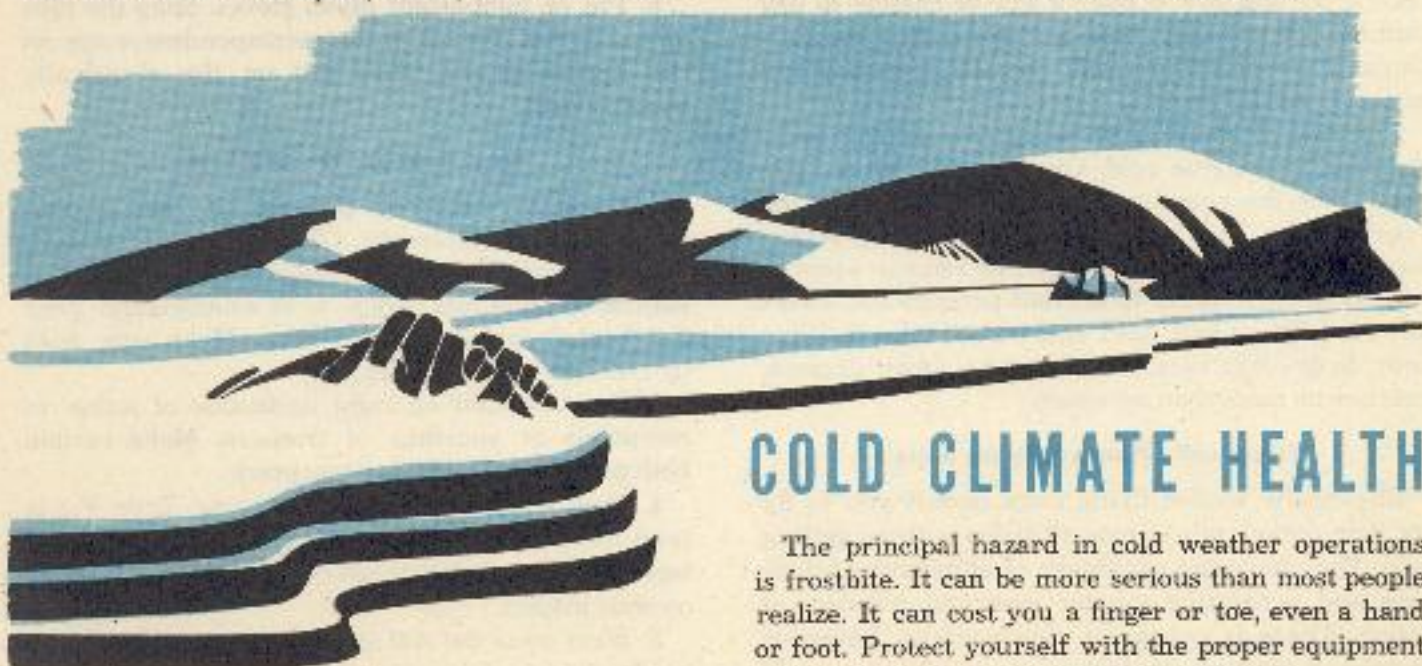
In hot climates skin troubles are common. Treat even trivial cuts, scratches, and bites promptly (See ROIF 8-14-1) or serious infection may result. Don't hesitate to see your Flight Surgeon. The following precautions will help keep you out of trouble:

Never walk about with bare feet in warm climates. Floors are likely to harbor the germ that causes athlete's foot. Consider all native areas infected. Small worms in the soil may burrow into the skin and cause infections such as hookworm or bilharziasis. Don't go swimming on beaches near native villages. The water may be contaminated with the flukes which cause schistosomiasis.

Bathe yourself and change your socks and underwear as often as possible. Keep the skin folds between the toes, in the armpits, and the groin clean and dry to prevent fungus infections like ringworm. Powder these parts liberally with GI foot powder.

Venereal Diseases

In the tropics, venereal diseases are common among prostitutes and most native women as well. In addition to syphilis and gonorrhea, large numbers of them are infected with chancroid, lymphogranuloma venereum, and granuloma inguinale. Don't give them a chance to give it to you. The treatment of these diseases is longer than their names.



COLD CLIMATE HEALTH

The principal hazard in cold weather operations is frostbite. It can be more serious than most people realize. It can cost you a finger or toe, even a hand or foot. Protect yourself with the proper equipment and by observing a few simple principles.

Clothing

All clothing should fit loosely. This applies particularly to your socks, boots, and gloves. Tight-fitting clothing interferes with the blood circulation and makes you more susceptible to frostbite. Individual garments should be light and porous. Wear several layers if possible. Two light garments afford better insulation than a single heavy one. Wear long woolen underwear on all flights over cold regions. Wear two or three pairs of loose-fitting woolen socks in sub-zero climates, but be sure that your boots fit loosely over them.

Leather shoes are dangerous in extreme cold. They not only afford poor protection, but may cause harm if they fit tightly over your socks. Don't wear ordinary GI shoes inside your winter flying boots. Use woolen socks and felt liners or electrically heated shoes instead.

If possible wear two pairs of gloves or mittens—a rayon or other light pair inside heavier ones (either A-9's, A-12's or electric gloves). Mittens are better than gloves, for they allow your fingers to come in contact with each other and help keep them warm.

Keep your socks and underwear clean. After they have become soiled by body oils and excretions, they lose much of their insulation value.

Keep Your Clothing Dry

Wet clothing is almost worthless in protecting you from the cold. If any part of your clothing becomes moist, either by accident or through perspiration, take it off and dry it over a fire or change to dry clothing immediately. Wet feet and hands are particularly dangerous in cold climates for they fall easy prey to frostbite.

Exercise to keep warm but guard against overexertion in extreme cold. Overexertion makes you sweat and the perspiration may turn to ice inside your clothing. This is dangerous. If necessary to perform much physical work, open or remove some of your clothing in order to prevent perspiration. Don't put on a heavy suit until just before takeoff. Wipe your body dry; then dress slowly. Once dressed, exercise no more than necessary.

Electrically Heated Flying Suits

Electrically heated flying suits permit you to fly for long periods at extreme altitudes without getting cold. They have the advantage of eliminating bulkiness and permitting greater ease and freedom of action. There is one great disadvantage, however, in relying on them while flying over cold regions. If

your electric system fails, if you are forced down, or if you have to bail out, you are left without adequate protection against the cold. Always carry additional heavy clothing with you on such flights.

Know how to use your electrically heated suit, and treat it carefully. The electric heating elements are fragile. Hang your suit up to dry between flights, if possible, and have it tested by your Personal Equipment Officer. Two types are now in use, the F-2 and the F-3. They will protect you down to -40°F . If lower temperatures are encountered, add other flying clothing.

How to Wear the F-2 Suit

1. Wear your F-2 electrical suit over long woolen underwear. (If your suit is the F-1 type, wear additional clothing over it as well.) The F-2 suit affords adequate protection down to -40°F . If operating at lower temperatures, add other flying clothing.

2. Put on the shoes with inserts over lightweight woolen socks. Then connect the snap fastener tabs on the trouser leg to the corresponding snaps on the shoe insert. **Be sure that both pairs of snaps are properly connected.**

3. Connect the tab at the top of the trousers to the corresponding snap fasteners on the inside of the jacket at the right. Make certain both pairs of snaps are securely snapped together. Connect 6-foot lead cord to jacket pigtail.

4. Put on regulation flying helmet and auxiliary equipment. Protect your neck from the cold by wearing a wool or silk scarf.

5. Put on lightweight rayon gloves. Snap the tabs on the jacket sleeves to the corresponding snaps on the heated gloves. Then put on the electrically heated gloves.

How to Wear the F-3 Suit

1. Begin to dress by putting on long woolen underwear, woolen socks, GI trousers, and shirt.

2. Then add the F-3 electrically heated trousers. Adjust the shoulder straps to fit comfortably. Your F-3 heated jacket goes on next. Make sure both trousers and jacket fit properly.

3. Connect cord on right underside of jacket to receptacle at waistline of trousers. **Make certain both prongs of plug fit into receptacle.**

4. Now put on heated shoe inserts. Type F-2 is used for both F-2 and F-3 suits. **Connect both snap fasteners on each leg of the heated trousers to snaps on shoe inserts.**

5. Next come the A-9 alpaca-lined trousers. Reach inside right or left pocket and pull electric cord or



pigtail through. Then put on the B-10 jacket.

6. Now, the finishing touches: outer boots, helmet, and scarf. Connect 6-foot lead cord to pigtail.

7. Check all previous steps. Then add your gloves: first, the rayon or silk gloves; then snap tabs on sleeves of heated jacket to snaps inside gauntlets of electrically heated gloves. Now put on your heated gloves. Take along a pair of A-9 mittens, in case of emergency.

8. You can plug an oxygen mask heater or electrically heated goggles into the connecting block on

the front of your trousers.

Connect your extension plug in the left receptacle of the built-in rheostat before takeoff and be sure that the suit is working properly. The plug can be locked into position by a simple clockwise twist. When in flight, keep the rheostat at the lowest comfortable heat. Don't ride hot, it will make you sweat.

Never rely on electrically heated suits alone when flying over cold regions. They are safe for use over temperate or tropical zones where cold is experienced only at high altitudes.



F-3 ELECTRICALLY HEATED FLYING SUIT



MAKE CONNECTIONS PROPERLY

Your complete F-3 wardrobe should contain the following items of clothing:

1. Jacket, Alpaca lined, Type B-10.
2. Jacket, Heated, Type F-3
3. Trousers, Alpaca lined, Type A-9
4. Trousers, Regulation GI
5. Trousers, Heated, Type F-3
6. Helmet
7. Shoes, outer felt or Type A-6
8. Gloves, Heated, Type F-2
9. Gloves, rayon or silk
10. Mittens, Type A-9
11. Scarf
12. Lead Cord
13. Shirt, Regulation GI
14. Socks, Regulation Wool
15. Long underwear

Check your suit after each flight. Look for excessive wear at all flexion points where electric wires might short out or break. If an ohmmeter is available, check the resistance of your suit at frequent intervals. The resistance in ohms is marked on the trousers, jacket, and each shoe and glove. If the ohmmeter shows the resistance to be more than 10% off, turn in the item for a new one.

Frostbite

Frostbite occurs most commonly in the fingers,

toes, nose, ears, chin, and cheeks. It may set in gradually and painlessly and without your being aware of it. Numbness, stiffness, and a whitish discoloration of the affected part are among the first signs. Wrinkle your face frequently when exposed to cold air; if it feels numb, warm the affected part with your ungloved hand until sensation returns.

Crew members should watch each other's faces and be on the alert for areas of blanching. In this way serious trouble can be prevented. Frostbitten tissues may later become painful. Such tissues should



Warm hands by placing inside clothes under armpit

never be rubbed. Never apply snow or ice to a frostbitten part. If your hand becomes cold or numb, warm it by placing it inside your clothing or under your armpit. Frostbitten tissues should always be thawed gradually. When possible, thaw them at ordinary room temperature. They should never be placed near a heater or immersed in warm water or in kerosene.

If frostbite occurs, cover the frostbitten area with a loose sterile bandage. Keep the patient comfortably warm with blankets or a sleeping bag and by giving him hot drinks; and give him 100 per cent oxygen to breathe (Auto-Mix OFF or 100% OXYGEN).

In extremely cold weather never touch cold metal with your bare hands, even for a moment. Your skin may freeze to it. If by accident this should happen, thaw your skin loose from the metal by warming the latter or by urinating upon it—don't pull your fingers loose.

Don't spill gasoline on your exposed skin—the rapid evaporation will cause almost immediate frostbite.



Don't touch cold metal with bare hands

Snowblindness

Snowblindness is caused by exposure of your eyes, even for brief periods, to the glare which exists in snow-covered regions. The resultant damage to your eyes may cause intense pain and seriously interfere with your vision for several days—sometimes even longer. The hazard of snowblindness is particularly great on sunny days, but the glare



Wear colored goggles or sunglasses

which results from a bright overcast is almost as dangerous. Always protect your eyes by wearing colored goggles or sunglasses. In the Arctic, snowblindness may be brought on by merely lifting your goggles a half dozen times.

Body Heat

Eat an abundance of fatty foods while in cold regions. Fats are rich in calories, which help you maintain body heat. Take hot drinks such as coffee, tea, cocoa, or soup in thermos jugs along with you on all flights. These also add to your body warmth.

Never drink alcoholic beverages to keep warm. They give you a false sensation of warmth but may do great harm by actually robbing you of your body heat, since they cause flushing of the skin. This loss of heat, together with the false sense of security which alcohol produces, makes alcoholic beverages dangerous to anyone who is exposed to cold.



Don't eat snow! Melt it and drink the water

FLAK SUITS

Flak suits consist of armored vest and apron assemblies. They are not personal issue, but they should be delivered to the plane before the flight and picked up afterward for inspection. You couldn't carry one anyway, with everything else you're lugging. Report to the pilot if you don't find a flak suit in the plane for you.

Be sure you are wearing the suit when you approach the target area. It's heavy but it's guaranteed that you won't notice the weight when the fight begins to get hot.

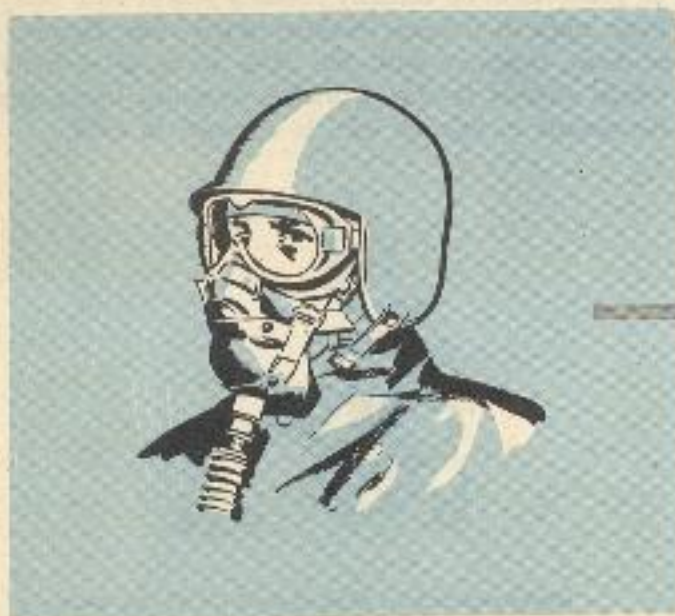
Note: Ask your Personal Equipment Officer if he will have a tab sewed onto your flak suit for your oxygen mask hose clip.



The radio operator's flak suit has full armor. When he pulls ripcord at suit's center, entire suit falls off.

FLAK HELMETS

The flak helmet is an item of personal issue. If you have worn both your flak suit and flak helmet on the mission, you have a good chance of returning the helmet to the supply room **personally** after the flight.





SECTION

3



RADIO

OPERATING PROCEDURE



RADIO OPERATING PROCEDURE

TABLE of CONTENTS

Army Airways Communications System	3-1
Civil Aeronautics Administration	3-2
Body Signals	3-3
Combined Panel Signals	3-4
Signal Lamp	3-5
Recognition Signals	3-6
Direction Finding	3-7
Cryptographic Publications	3-8
Weather Codes	3-9
Message Authentication	3-10
Phonetic Alphabet	3-11
Time Signals and Zones	3-12
Signal Operating Instructions	3-13
Radio Logs	3-14
Q-Signals	3-15
Prosigns	3-16



THE USE OF PROPER RADIO-OPERATING PROCEDURE IS A MUST. IT IS
UP TO YOU TO FURNISH ALL OUTSIDE INFORMATION TO YOUR CREW
MEMBERS. KEEP UP-TO-DATE ON ALL PROCEDURES AND KNOW WHERE
AND WHEN TO GET INFORMATION VITAL TO YOUR MISSION.

ARMY AIRWAYS COMMUNICATIONS SYSTEM

AACS



The Army Airways Communications System is responsible for airways communications and navigational aids to facilitate the operation of Army service aircraft over military airways covering the entire globe. AACS operates point-to-point and ground-to-air radio telegraph and radio telephone communications (manual, automatic, or radio teletype). It also operates control towers, direction finding stations, instrument approach systems, weather reporting and weather broadcast systems, radio ranges, beacons, land line teletype, cryptographic units and message centers.

These stations will relay traffic to any point by radio, teletype, interphone, dispatch mail, or any other available method. They will also relay to other Government agencies such as the Civil Aeronautics Administration, and the Navy Department. In providing the communications necessary for flights along army airways, the AACS accomplishes the following: It maintains contact with military aircraft to provide information regarding weather, traffic in the air and on the ground, and any other subject that may be required. In this way AACS makes possible continuous control of army air traffic through Communications along the airways.



For frequencies consult your facility charts, route guide, or flimsy.

REMEMBER

The operator at a ground station may be having difficulties. Try calling another station if you are sure your equipment is operating properly.

It also maintains contact with point-to-point stations in order to permit the handling of freight, military aircraft, and personnel being moved from one place to another.

The primary purpose of AACS is to safeguard life and property. Make use of their facilities whenever you need them; be familiar with their facilities offered.

While AACS facilities are used by the aircraft of the U. S. Army, Navy, Marines, and Allied Forces, the two largest users of its services are the Air Transport Command and the Army Air Forces Weather Service.

TO PREARRANGE A CHANNEL

Before departing from a base where an AACS station is located you may file a message at that station to notify airways stations along your scheduled route and at your destination to stand by on any air-ground channel.

AACS stations guard continuous wave (CW), modulated wave (MCW), or voice channels.

Consult your facility charts, route guide, or flimsy for the frequencies of the nearest AACS station.

CONTACTING AACS STATIONS

The following procedure may be used when contacting AACS stations by wireless telegraphy (W/T).

WYF V 7321 QTC K

If the net is congested, indicate the number of messages you have to send. If no answer is received to the first call, repeat the same procedure, except

make the call sign of the station called twice; the prosign V; and the call sign of your station twice; and then the ending prosign K thus:

WYF WYF V 7321 7321 K

Before starting any transmission monitor the frequency you are going to use; thus avoiding transmitting simultaneously with another station. If no answer is received after making a second call, check the operation of your equipment; and check the frequency of both your transmitter and receiver. After all the equipment has been checked, call again as shown in the second example until an answer is received.

Use the following procedure when contacting AACS stations by radio telephone (R/T):

SCOTT ARMY AIRWAYS THIS IS ARMY SEVEN THREE ONE OVER

If no answer is received, make the same call with the exception that the station call is made twice as follows:

SCOTT ARMY AIRWAYS SCOTT ARMY AIRWAYS THIS IS ARMY SEVEN THREE ONE OVER

All answers to calls by voice (A-3) will be made on 4220 kc unless you have definite information that some other frequency is being used.

When contact has been established, speak slowly and distinctly. Some letters and phrases sound the same by radio telephone. If any of these words or phrases are encountered, accentuate them. If necessary spell out the words using the phonetic alphabet. When transmitting code or cipher messages use the phonetic alphabet to assure accurate reception.

There are 19 different types of stations scattered throughout all theaters of allied operations. These are listed as follows:

A—Airways Communications Station providing two simultaneous channels: point-to-point and ground-to-air (two operating positions), plus Airdrome Control Tower.

B—Airways Communications Station providing two simultaneous channels: point-to-point and ground-to-air (two operating positions).

C—Airdrome Control Tower.

D—Direction Finding Station.

E—Weather Reporting Station.

G—Ground Control Approach System.

ILa—Instrument Landing Unit (mobile).

ILb—Instrument Landing Unit (fixed).

LS—Long Range Air-Navigation Station.

P—Direction Finding Evaluation Station.

R—Radio Range, Fan Marker, Radar Beacon (Racon), Radio Station, point-to-point (one operating position), or Homing Beacon.

RT—Radio-teletype Station (one operating position).

T—Teletype Station (one operating position).

X—One additional operating position added to either a class A or class B station.

Y—Automatic Radio-Telegraph Station.

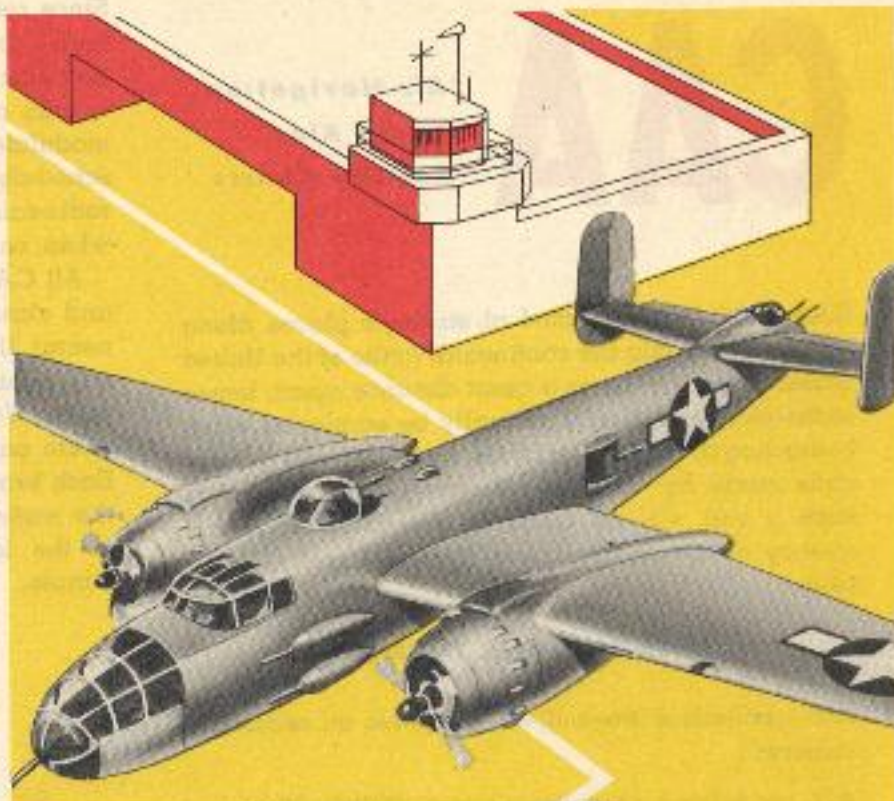
Z—One additional operating position added to Radio-Teletype Station.

I—Cryptographic Section where traffic volume normally requires more than 8 cryptographers.

II—Cryptographic Section where traffic volume normally requires less than 8 cryptographers.

MC—Message Center.

CAA



Civil Aeronautics Administration

CONTACTING CAA STATIONS

CAA stations guard 6210, 3105, and 4495 kc (others on request). An asterisk (*) in the remarks column of the Radio Facility Charts indicates that the station guards 6210, 3105, 4495. If any other frequencies are guarded by that station they will be indicated alongside the asterisk.

The answer to any call will be by type A-3 (voice) emission, on the frequency the station has been assigned. The frequency can be found by reference to the correct facility chart.

The above frequencies are normally used for radio-telephone communications, but they may be used for continuous wave in an emergency. (See information on CW communication with CAA.)

Standard radio-telephone procedure should be used for all contacts.

The CAA maintains and operates radio-range and beacon stations. Most CAA stations have facilities for voice transmissions. By reference to the facility chart for the section in which the particular station is located, it will be noted that the frequency and call sign of the station are given. If the station is not equipped with voice facilities the frequency will be underlined. CAA stations will furnish weather information for any station, airway, or region.

There are facilities available for relaying traffic to other Government agencies through inter-phone and teletype circuits. Change of flight plan or requests for clearance will be relayed to the Airways Traffic Control (ATC) and position reports will be relayed to the point of departure, destination, or both. When information relative to the flight of your aircraft is necessary, the Civil Aeronautics Administration is the most logical outlet.

CAA

Air Navigation Radio Aids Facility Charts

CAA stations are located at strategic places along all airways within the continental limits of the United States. They are never a great distance apart, hence radio-telephone should normally be employed when contacting them. CAA stations, however, will answer calls made by wireless telegraph. The answer to such a call will be made on the radio-range frequency of the station, using Type A-3 (voice) emission.

TYPES OF SIGNAL EMISSIONS

- A-1**—continuous wave (CW). (Requires an oscillating receiver.)
- A-2**—modulated continuous wave (MCW). (Does not require an oscillating receiver.)
- A-3**—voice modulated wave. (Does not require an oscillating receiver.)

Since radio receivers at CAA stations are used normally for voice reception, they do not use a beat frequency oscillator for monitoring. Therefore when calling a CAA station by CW, always use a tone modulated signal (MCW), unless a prearranged schedule has been made for CW operation. The radio-range identification letters should be used when calling.

All CAA radio-range stations, regardless of class, and class H radio beacon stations within the continental United States having voice facilities broadcast their local weather report hourly in uncoded voice. For security reasons these broadcasts are made on the 29th minute of the hour or not at all. Each broadcast is started with the announcement of the station immediately followed by the statement of the local time correct to the nearest quarter minute.

REMEMBER

**ALL ANSWERS WILL BE MADE BY VOICE
UNLESS OTHERWISE PREARRANGED**

STATION CLASS DESIGNATION

- AC**—Approach Control Tower, CAA
- B**—Scheduled Broadcast Station (29 min. after only)
- C**—Control Tower, CAA
- CA**—Control Tower, Army
- CI**—Control Tower (City, Country, Private, etc.)
- CN**—Control Tower, Navy
- D**—Distantly Controlled
- FM**—VHF Fan Type Marker (100 Watts)
- H**—Non-directional Radiobeacon (Homing) Power 50 Watts or Greater
- IM**—VHF Inner Marker
- LFM**—VHF Fan Type Marker Low Powered (5 Watts Not Over 10 Miles From Range)
- MH**—Non-directional Radiobeacon (Homing) Power Less Than 50 Watts
- ML**—Range (Loop Radiators) Power 50 Watts or Less

- MRA**—Range (Adcock, Vertical Radiators) Power 50 to 150 Watts
- MRL**—Range (Loop Radiators) Power Greater Than 50 Watts; Maximum 150 Watts
- OM**—VHF Outer Marker
- P**—Point-to-Point Radio
- RA**—Range (Adcock, Vertical Radiators) Power Greater Than 150 Watts
- RL**—Range (Loop Radiators) Power Greater Than 150 Watts
- S**—Simultaneous Transmission of Range Signals and Voice
- T**—Teletype
- TX**—Principal Teletype
- V**—Voice Communication With Aircraft
- W**—Without Voice Facilities
- Z**—VHF Station Location at a Range Station
- ZM**—VHF Station Location Marker, Not at a Range Station

Body Signals

If a rescue plane flies low and circles your location and you are sure that you have attracted the pilot's attention, messages can be transmitted by the emergency body signals shown on this page. When performing the signals stand in the open, make sure that the background as it will be seen from the plane is not confusing, make the motions deliberately and slowly, and repeat each signal until the pilot indicates that he understands.



NEED MEDICAL ASSISTANCE-URGENT (Lie prone)



ALL O.K.
DO NOT WAIT



CAN PROCEED SHORTLY-
WAIT IF PRACTICABLE



NEED MECHANICAL HELP
OR PARTS-LONG DELAY



PICK US UP-
PLANE ABANDONED



DO NOT ATTEMPT
TO LAND HERE



LAND HERE (Point in
Direction of Landing)



OUR RECEIVER
IS OPERATING



USE DROP
MESSAGE



AFFIRMATIVE (Yes)



NEGATIVE (No)

HOW PLANE ANSWERS

The pilot of the rescue plane will answer your messages either by dropping a note or by dipping the nose of his plane for the affirmative (yes) and fish-tailing his plane for the negative (no).



AFFIRMATIVE (Yes) DIP NOSE OF PLANE



NEGATIVE (No) FISHTAIL PLANE

COMBINED PANEL SYSTEM

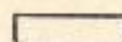
The combined panel system was designed to facilitate communications between aircraft and ground troops not equipped with radio transmitters, or when it is inadvisable for security reasons to use radio.

Panel display grounds are usually located near radio stations. This enables radio operators to use the panels whenever necessary.

The panel signalling equipment issued to a unit consists of 13 panels measuring 12 feet in length and 2 feet 4 inches in width. Each panel is provided with grommets so they may be staked to the ground. These panels are usually black or white, depending on the background available.

The illustration outlines the way in which the numerals, indicators, and special signs are joined using panel strips.

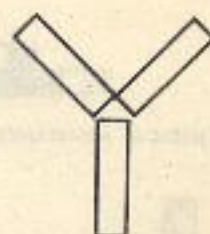
INDICATORS



Flash Index



Letter Indicator



Numeral Indicator

NUMERALS

1



2



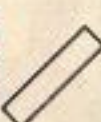
3



4



5



NUMERALS

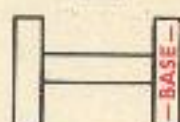
6



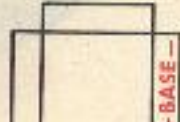
7



8



9

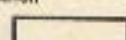
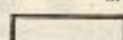


0



SPECIAL SIGNS

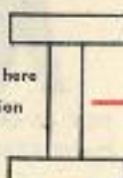
In this direction



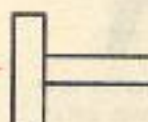
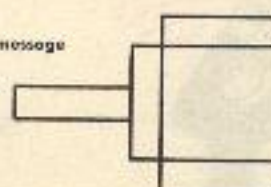
Wind direction



Wind direction

Pick up message here
Wind in direction
indicated

Wind

Dropped message
not found

Hostile aircraft near you

VOCABULARY—Essential Battle Messages

- 0—OK to land here.
- 1—We are attacking.
- 2—Do not land or drop here.
- 3—Require food.
- 4—Require water.
- 5—Require small-arms ammunition.
- 6—Require medical supplies.
- 7—Require gasoline (petrol) and lubricants.
- 8—Have gained objective.
- 9—OK to drop here.

INFORMATION—FRIENDLY ACTION

- 00—
- 01—Our attack has failed.
- 02—In position and ready to attack.
- 03—We are taking up defensive position in this area.
- 04—Held up by anti-tank obstacle (in direction indicated).
- 05—Our troops at—(followed by coordinates).
- 06—We are surrounded.
- 07—We are withdrawing.
- 08—We intend to move (direction or coordinates of new location may be indicated).
- 09—Am moving headquarters. (May be followed by coordinates of new location).

PROSIGNS

- 10—Wait (figures may follow to indicate time).
- 11—I have a message for you.
- 12—Message received.
- 13—Repeat message.
- 14—Cancel last display.
- 15—Separative sign.
- 16—Nothing more to communicate.
- 17—No or negative.
- 18—Yes or affirmative.
- 19—

COMMUNICATIONS

- 20—I am not receiving your signals.
- 21—Your signals are weak.
- 22—Radio not ready or unserviceable.
- 23—Your message not understood.
- 24—Are you receiving my signals?
- 25—I have no other means of communication.
- 26—Use visual.
- 27—Message understood.
- 28—
- 29—

ARTILLERY OBSERVATION

- 30—Not ready to fire.
- 31—Ready to engage target.
- 32—Cannot engage target.
- 33—Check my reference.
- 34—I have no further need of you.
- 35—
- 36—
- 37—
- 38—
- 39—

SPECIAL REQUIREMENTS

- 40—Require—(letter groups follow).
- 41—Require reinforcements.
- 42—Require mortar ammunition.
- 43—Require anti-tank ammunition.
- 44—Require artillery ammunition. (Numbers following code groups 42, 43, and 44 denote caliber.)
- 45—Require instructions for further action.
- 46—
- 47—
- 48—
- 49—

INFORMATION—ENEMY ACTION

- 50—Enemy attacking.
- 51—Enemy in possession of landing ground.
- 52—Enemy at—(followed by coordinates).
- 53—Enemy attack has broken through.
- 54—Enemy attack has failed.
- 55—Enemy preparing to attack.
- 56—Enemy aircraft reported approaching.
- 57—
- 58—
- 59—

INSTRUCTIONS TO AIRCRAFT

- 60—Reconnoiter—(in direction indicated).
- 61—Following is a compass direction (letter or figure groups follow denoting bearing).
- 62—Request direct air support.
- 63—Target of opportunity in direction indicated.
- 64—If you can see any of our forces, circle and fly in their direction.
- 65—Report my position to headquarters.
- 66—
- 67—Indicate nearest water by circling and flying in that direction.
- 68—Do not attack.
- 69—Drop message here.


PANEL OPERATING PROCEDURE

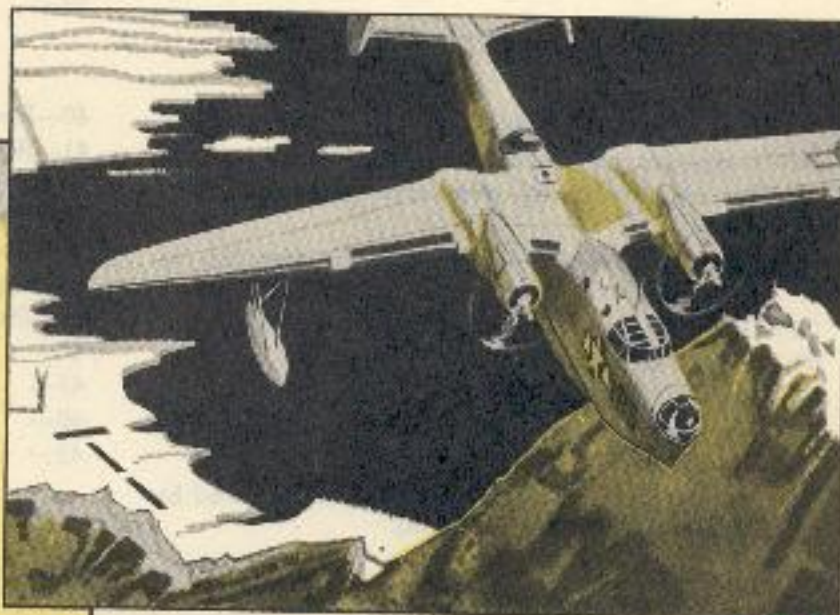
The FLASH index is a single panel laid at right angles to and centered above the base panels of the numerals. It is the last panel laid out upon completing a display, and indicates that the display is ready to read.


The FLASH index alone indicates that the numerals below will be read as a code group. Code groups may be translated by reference to the vocabulary furnished in this section.

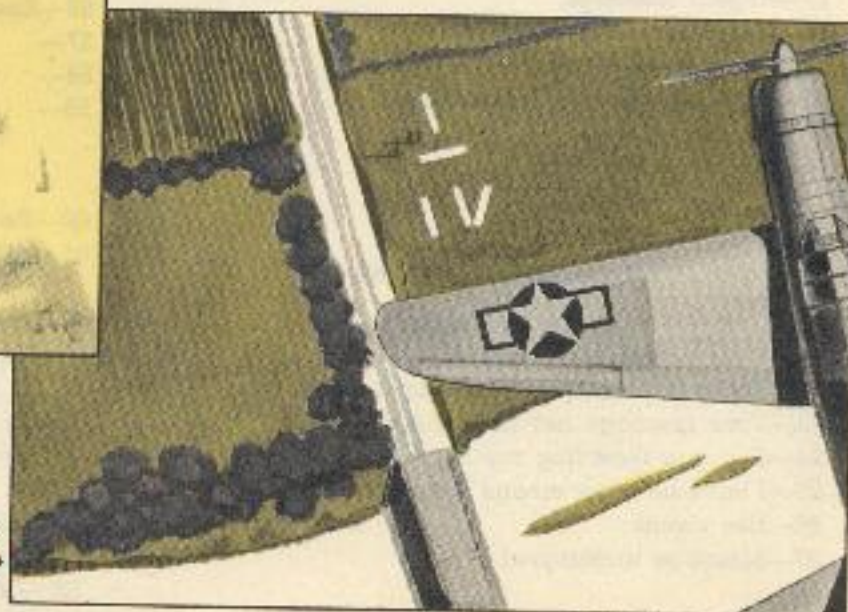
The FLASH index preceded (one-half panel length above) by the letter Y indicates that the display will be read as numerals. 1 to 26 represent respectively the 26 letters of the alphabet. The FLASH index preceded (one-half length above) by the numeral 1 indicates that the display will be read as letters.


Following are illustrations of the way in which the display will be joined when they are to be read as codes, numerals, or letters.

 Number 7



Code Group 11 

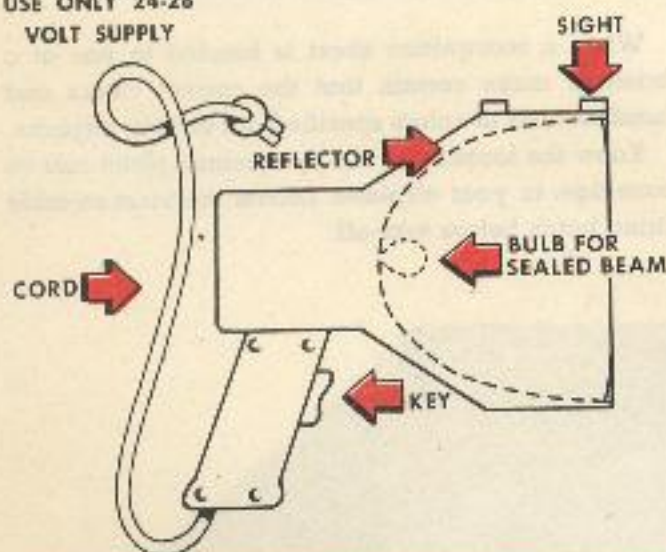


Letter D 

SIGNAL LAMP

ACCURATE SIGHTING IS ESSENTIAL

USE ONLY 24-28
VOLT SUPPLY



WARNING—Do not flash the signal lamp using a red filter when signalling another aircraft. It might be mistaken for gun fire.

There is a variety of signal lamps in current use. The lamp illustrated is known as the Aldis Lamp (C3-A).

Basically each lamp is composed of a light bulb, a reflector, a sighting device, and a method for keying. The keying is accomplished either by making and breaking the light circuit or by opening and closing the shutter on the front of the lamp while the lamp remains lighted during use. There are four color filters available for use with the signal lamp, namely, red, green, amber, and violet.

Red and green filters are usually used for safety signals. The violet filter is designed to be used primarily for night operation of the lamp; the amber for brilliant sunlight conditions.

Identification to approaching airplane or surface vessels is made by flashing the proper signals for such craft.

An airplane should identify itself upon approaching a surface vessel. Flashing signals must be promptly answered with the proper signal, otherwise the plane unable to identify itself will be fired on.

The chart indicates the method used for visual recognition. It covers one day's operation. Pyrotechnic pistol cartridge colors are also indicated. Their abbreviations are, R for red, G for green, and Y for yellow.

VISUAL RECOGNITION CHART

DATE	TIME GMT	BLINKER CHALLENGE OR REPLY		PYROTECHNIC PISTOL COLORS
		SURFACE CRAFT	AIRCRAFT	
11-15-44	0004	B	N	R-R
	0408	Y	S	G-Y
	0812	T	O	R-G
	1216	X	V	Y-Y
	1620	R	Z	R-Y
	2024	N	H	G-G

Recognition Signals

PYROTECHNIC PISTOL—Aircraft Type

This type of pyrotechnic pistol is designed especially for airborne operation. The barrel of it is equipped with a locking device which permits it to be fired from a special firing hatch in the airplane.

The firing hatch prevents flarebacks into the airplane and absorbs the recoil, which permits the pistol to be fired with one hand. If there is no firing hatch in your airplane, great care must be exercised when firing the pistol. It should be fired straight up or down. The bomb-bay doors or upper hatches are the best positions from which to fire. In some medium bombers, a flare chute or flare hatch may be provided. These also make excellent firing hatches. Be

sure cartridges will clear the airplane before firing. The pistol could be held in one hand without the use of a firing hatch, but due to its severe recoil, it is recommended that both hands be used. The cartridges are discharged by percussion, hence they should be protected from moisture so their non-metallic cases do not become softened.

When a recognition sheet is handed to you at a briefing, make certain that the correct colors and combinations of colors specified are in your airplane.

Know the location of the pyrotechnic pistol and its cartridge, in your airplane. Locate the most suitable firing hatch before take-off.



AIRCRAFT TYPE



DIRECTION FINDING

There are four types of Direction Finding. They are classified according to the frequency the radio operator uses to reach the DF station.

1. Low-frequency (LF/DF) 30 kc to 300 kc
2. Medium-frequency (MF/DF) 300 kc to 3000 kc
3. High-frequency (HF/DF) 3000 kc to 30 mc
4. Very-high-frequency (VHF/DF) 30 mc to 300 mc

Direction finding facilities are available to you in all theaters of operations. In the AAF, these facilities consist of fixes (QTF), magnetic course to steer (QDM), and true course to steer (QUJ).

When you request a fix, a master control station alerts a net and instructs it to sense bearings on your airplane. The net stations report these bearings at once to the master control station. There the operator projects them on a map, and transmits to you the position at which the lines intersect. This was your approximate position at the time the bearings were taken.

The DF station also specifies the degree of accuracy of any bearing or position (fix) it gives you. For this purpose, both bearings and fixes are divided

into three classes and designated A, B, or C. Here are the limits within which you can regard these classes as accurate:

Bearings

- A . . . Plus or minus 2 degrees
- B . . . Plus or minus 5 degrees
- C . . . Liable to an error exceeding plus or minus 5 degrees.

Positions (Fixes)

- A . . . Within 5 miles
- B . . . Within 20 miles
- C . . . Liable to an error of more than 20 miles. If the error exceeds 50 miles you will be told so.

DF stations may refuse to give you a course or position if you fail to give them proper authentication, or otherwise transmit unsatisfactory information. However, if you give them as much help as possible, they will always furnish you the best information they can.

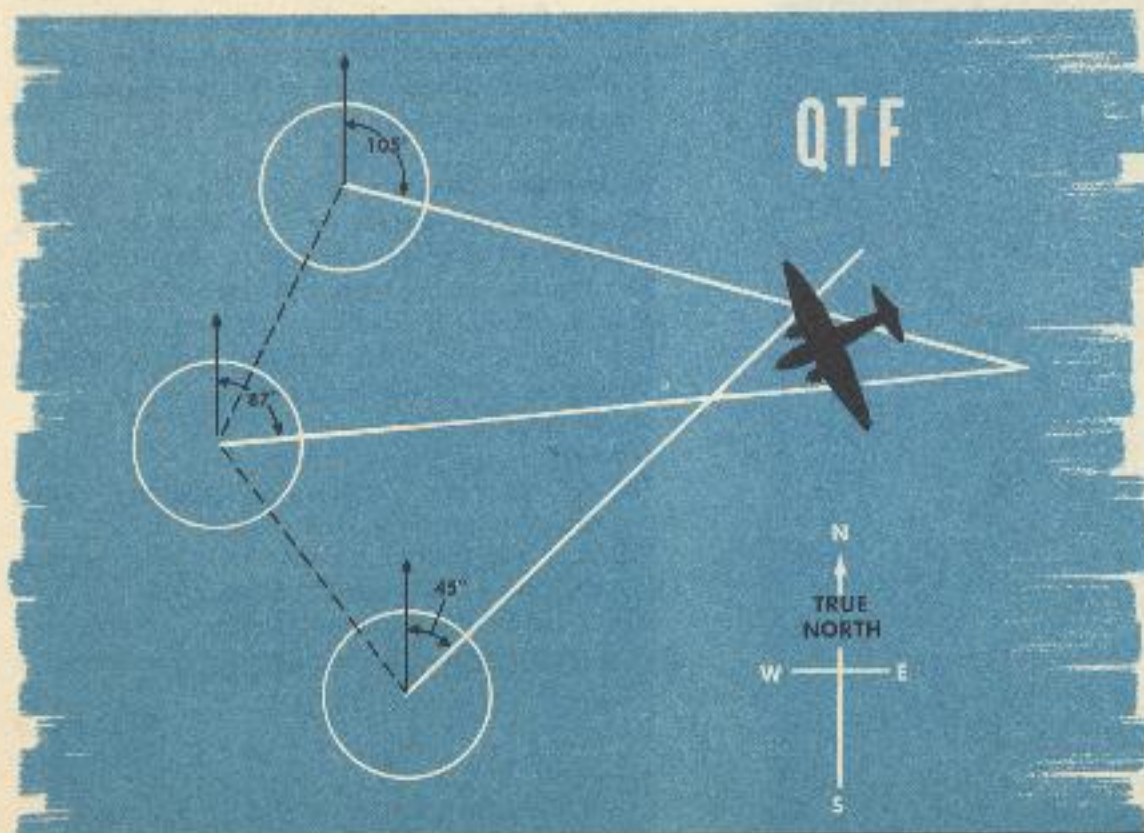
If a DF station is not ready to give you a course or fix, the operator will tell you to wait. As soon as he can handle your request, he will notify you.

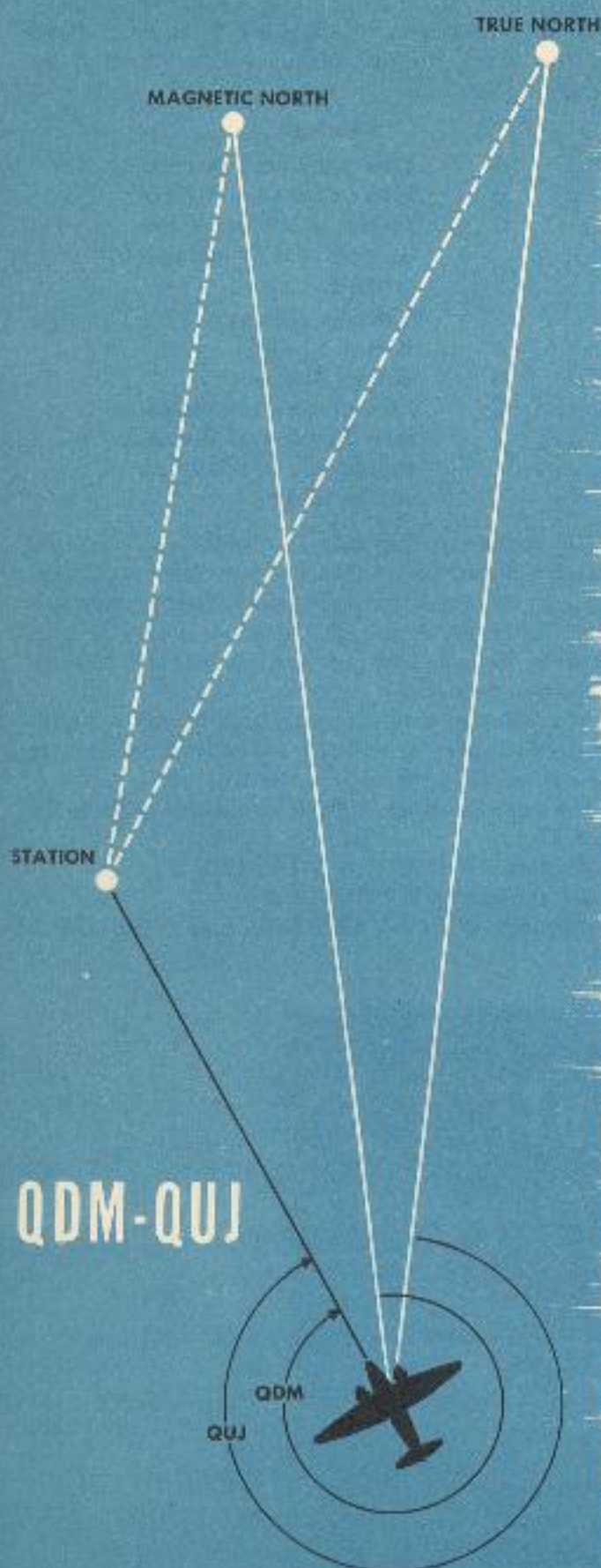
Here is an example of how to obtain a position fix by CW:

Airplane: WYYY V 9WV INT QTF K

DF station: 9WV V WYYY K

Airplane: WYYY V 9WV (20-second dash) 9WV K





DF station: 9WV V WYYY AS AR (indicates airplane is to wait while fix is plotted).

DF station: 9WV V WYYY QTF 3315N 733ØW A 1745Z IMI QTF 3315N 733ØW A 1745Z K

Airplane: WYYY V 9WV QTF 3315N 733ØW A 1745Z K

DF station: 9WV V WYYY C AR

If the DF station is busy or must be alerted and cannot give you an immediate fix, it will reply to your original call as follows: 9WV V WYYY AS AR. When the station is ready, it will transmit the message 9WV V WYYY K.

Here is an example of the CW procedure for obtaining a QDM (magnetic course to steer with zero wind to reach the ground station) or a QUJ (true course to steer).

Airplane: WYYY V 9WV INT QDM (or QUJ) K

DF station: 9WV V WYYY K

Airplane: WYYY V 9WV (20-second dash) 9WV K

DF station: 9WV V WYYY QDM (or QUJ) Ø75 A 1745Z K

Airplane: WYYY V 9WV QDM (or QUJ) Ø75 A 1745Z K

DF station: 9WV V WYYY C AR

Note that your call sign is transmitted after your 20-second dash. If a DF station requires more than one dash it will ask for them by sending 9WV V WYYY QTN2 (or 3, etc.) K.

The airplane replies with WYYY V 9WV (20-second dash) 9WV (20-second dash) 9WV K.

When the DF station comes back with 9WV V WYYY AS AR, follow the initial contact procedure.

Use one of the following procedures to request a course or fix by **voice**. In this example **Viola** is the airplane call word and **Ginger** is that of the station.

1. **Airplane:** Ginger—this is Viola—Request fix (or magnetic or true course). Over.

(Or)

2. **Airplane:** Ginger — this is Viola — Request Queen Tare Fox (or Queen Dog Mike, or Queen Uncle Jig). Over. (Use of Q signals is optional.)

The DF station gives any necessary instructions, and says, "Transmit for fix (or course). Over."

The airplane replies, "Ginger—this is Viola—Transmitting for fix (or course). Over."

To transmit for a fix:

On VHF, count 1 to 5 and back.

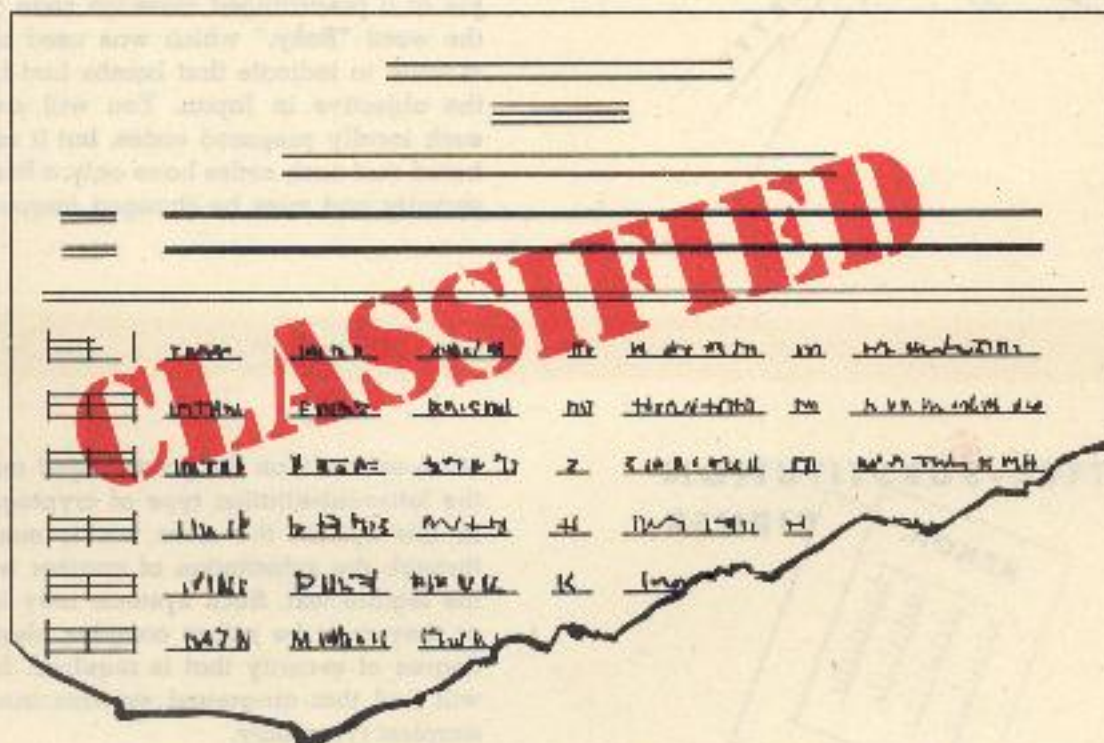
On HF, transmit a 20-second dash by holding down the microphone button switch.

When authentication is required, be sure you know and follow the system locally in use.

Check with Base Communications Officer, and SOI or Route Guide for further DF procedures.

Cryptographic

PUBLICATIONS



Normally the average radio operator considers that air-to-ground communication is simply a conversation either by radio-telegraph or radio-telephone to a ground station. However, to achieve surprise it is necessary to conceal from the enemy the contents of messages.

The concealment of the clear text of a message is performed through the use of a cryptographic system. A cryptographic system may be extremely simple and locally prepared, or it may be more elaborate and afford a very high degree of security.

A cryptographic system will enable you to advise the ground station of the: type and number of enemy aircraft; the condition of your operating equipment; the nature of an objective; your exact position; or the amount of enemy resistance encountered. It may enable the unit commander at the ground station to

give the aircraft a bearing, furnish additional combat information or intelligence, advise of enemy aircraft which might intercept the mission, or simply cancel the mission and advise the aircraft to return.

There are three fundamental types of systems which are employed in theaters of operations for air-ground communications. Possibly, you, as a radio operator, will encounter all three of these systems. It is the intent of this document to furnish you as much information as possible concerning these systems. The complete details of the structure, method of operation, and procedure employed, unfortunately, cannot be explained in a document bearing this Restricted classification.

In your service as a radio operator you may find yourself assigned to a theater of operations in which all three of the fundamental types of cryptographic systems are employed.

CODE SYSTEMS

★ PREARRANGED MESSAGE CODE



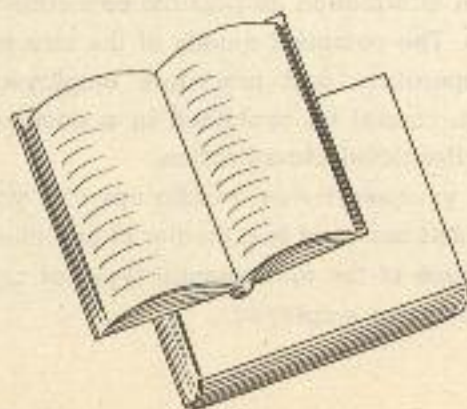
The prearranged message code is usually prepared locally and consists of one, two, or more random selected letters or numerals which represent a complete sentence or thought. Thus a prearranged message code might have a symbol "RUG" which, when transmitted by the radio operator will indicate to the ground station "Bombs away on primary objective. Opposition nil. Returning." Another famous example of a prearranged message code was the use of the word "Betty," which was used by a B-29 commander to indicate that bombs had been loosed on the objective in Japan. You will encounter many such locally prepared codes, but it must be remembered that such codes have only a limited amount of security and must be changed frequently.

★ LETTER-SUBSTITUTION CIPHER



More secure than the prearranged message code is the letter-substitution type of cryptographic system. In this system the clear text is made unreadable through the substitution of another letter for one in the legible text. Such systems may be very simple or they may be rather complex, depending on the degree of security that is required. In general, you will find that air-ground systems are limited to the simplest types only.

★ VOCABULARY CODE



The vocabulary code is the type most often met and used by radio operators in certain theaters. This type of code consists of a book which resembles an abridged or shortened dictionary with two columns, one in code and the other in clear text, words, or messages. The words in this vocabulary are best suited to meet the tactical and operational needs of military aircraft in flight and in combat. The security of a vocabulary code depends very much on the amount of use that is made of it. In some theaters a vocabulary is changed every 10 days; in others every 5 days, and in one very active theater the vocabulary codes are changed daily.

SAFEGUARDING CLASSIFIED MATERIAL

Military information and devices are classified as top secret, secret, confidential, or restricted. All classified material is clearly marked with its classification. If it is not so marked, it is unclassified. Treat all classified material as follows:

Top Secret

May be read or handled only by specifically designated persons. No one may have access to it merely because of his rank or office. Special procedures for handling top secret material are covered by letter instructions to the people concerned.

Secret

Only persons directly concerned should read it. It should be discussed only with those who may read it. It must be kept in a 3-combination safe when not in use. It must be mailed in two envelopes, an inner envelope addressed properly and marked or stamped Secret; an outer envelope addressed properly, but with no marking to indicate its classification. Send it by registered mail.

To destroy secret or confidential material, burn it, or use an approved shredding machine. Until you can do one or the other, tear it in small pieces and safeguard it as you would the original material.

Confidential

May be read only by persons in the military establishment and by civilians whose duties require that they read it. It may be discussed with those authorized to read it, but never over the telephone. Mail and guard it the same as secret material.

Restricted

May be read by, and discussed with anyone whose loyalty is unquestioned. It is never to be released for publication, or discussed with the general public.

It is to be kept in a guarded area, behind locked doors, or in a safe.

Mail by first class mail unmarked.

To destroy, tear up the material before throwing it into a wastebasket.

Inspection

At every Headquarters an inspection will be made each day immediately before closing to insure that classified material is properly taken care of.

Classified Equipment

When forced down in or near enemy-held territory, destroy all classified equipment, either by using detonators if installed, or by manual means. Make certain that the essential parts of such equipment are destroyed beyond recognition.

Codes and Ciphers

You, as radio operator, have control of the one contact between the airplane and ground stations. You must be sure that what you transmit is properly enciphered and encoded, and that you follow the correct radio procedure. Don't give the enemy any clue to the purpose of your mission, or any other information that will be helpful to him.

Codes, ciphers, and certain other classified materials are issued to you by the pilot. You are responsible to him for their safety.

Remember that these codes and ciphers are being used by many planes operating in your own theater, and even in others. Therefore, the safety of many lives and missions depends on your safeguarding the material entrusted to you.

Always report the loss, or compromise, of any document immediately. Compromised codes and ciphers are usually useless, and other units employing them must be notified quickly.



WEATHER CODES

Weather reports are transmitted by code whenever the military situation makes it necessary to classify them. You are concerned primarily with two types of weather code:

1. **In-flight** weather reports, which relay weather observations from plane to ground stations. Aircraft Weather Reports and United Nations Ferimet are used for this purpose.

2. **Landing** reports, which relay weather information about landing conditions from ground stations to the airplane. For this, you generally use UCO (Universal Landing Code) forms or its simplified version UCOPAC.

IN-FLIGHT WEATHER REPORTS

WAF-2 Forms

The master Aircraft Weather Report form is called WAF-2. Usually an extract or modification of it, rather than the form itself, is carried in the airplane. There are a number of modifications of WAF-2 since different portions of the form are needed in different theaters. The forms most widely used are WAF-3 and the 25-Series (25P, 25Q, 25R, etc.).

False Subtraction

In order to use WAF codes, you must understand the principle of false subtraction. In false subtraction, each of the lower digits is subtracted directly from the digit above it. If the lower digit is the smaller, subtract in the normal way. If the lower digit is the greater, add 10 to the upper digit, and subtract. For example, if 3 is to be subtracted from 2, the result is $2 + 10 - 3$, or 9. Treat each column individually, even though the numbers may contain 2 or 3 digits.

3	11	123
7	72	467
6	49	766

False subtraction is not required when the upper digit is already larger than the lower digit, for example:

9	37	428
3	23	216
6	14	212

In some cases, both normal and false subtraction are called for in the same problem. Handle each column by itself, using whichever kind of subtraction is necessary.

29	93	123	747
33	27	217	392
96	76	916	455

Use of WAF Code Forms

The section of a WAF form with which you are chiefly concerned is shown on page 3-9-2. The top line of this section consists of standard weather symbols (YY for the date, LLL for latitude, Ill for longitude, etc.). These are not coded symbols, but are in general use as weather symbols.

The second line contains the **cipher** numbers, entered in red by the weather station officer before you take off.

During the flight, the pilot or navigator fills in the third line (or furnishes you) with the coded numbers of his weather report.

The numbers of the fourth line are the difference by false subtraction, between the coded weather report numbers and the cipher numbers above them. This is the message you transmit.

	YY LLL	III GG	Q hhh F _c	B dd vv	ww WW V	1 C n HH	2 C n HH	3 C n HH
CIPHER	09 352	706 91	2 474 5	9 22 18	77 96 4	3 9 8 01	5 0 8 62	7 9 2 41
REPORT	14 227	559 15	1 109 1	1 14 14	10 81 7	1 7 3 25	2 7 3 08	3 2 8 12
TRANSMIT: 15092	95 135	257 86	1 375 4	8 18 04	67 15 7	2 2 5 86	3 3 5 64	4 7 4 39

4 C n HH	6 P _d d _w TT	8 I _c ww D _w	9 D F S D _k	0 PPPP	
2 3 9 21	7 7 6 32	4 0 95 6	1 7 8 6 3	0 2579	CIPHER
4 2 8 14	6 4 5 04	8 0 81 6	9 1 2 3 1	0 0000	REPORT
8 1 1 17	1 3 1 38	6 0 14 0	2 6 6 3 2	0 2579	15092 TRANSMIT

To send the message:

1. Start the text of your message with the cipher indicator, a 5-letter group entered in red at the left of the TRANSMIT line of the form.
2. Send the results of the false subtraction, in 5-letter groups.
3. Repeat the cipher indicator.

Note that there are as many figures for each weather element as there are letters assigned to it in the standard symbols of the top line. Thus, YY (date of the month) would be encoded 01 for the first day of the month; GG (time) could be encoded 08 for 0800 GCT, etc. Encoding tables appear on the forms.

Here is an explanation of the data included in the first five weather groups of the WAF-3 form at the top of the page.

Date — 14 — encode YY as 14.

Latitude — 227 — encode LLL as 227.

Longitude — 155.9 — encode III as 559.

Time — 1455 GCT — encode GG as 15.

Octant — 1 — encode Q as 1.

Altitude — 10,900 ft. — encode hhh as 109.

Flight conditions — contact flight — encode F_c as 1 below clouds.

Turbulence — slight — encode B as 1.

Wind direction — 145° from north — encode dd as 14.

Wind velocity — 14 knots per hour — encoded vv as 14.

Present weather — precipitation within sight — encode ww as 10.

Past weather — moderate showers — encode WW as 81.

Visibility — 8 miles — encode V as 7.

Note: On the backs of WAF forms there are spaces in which you can enter any terminal conditions or forecasts you request from stations along your route.

United Nations Formet

This is a simplified, automatic enciphering form used to record and report weather during flight. Enter the following items in this way:

Wind direction: Record the nearest 10 degrees.

Wind force: Record in knots.

Cloud conditions: Amount of cloud both above and below the airplane.

Weather conditions: Report hazardous conditions.

Time of observation: Enter the nearest 10 minutes, omitting the final zero.

Remarks: Enter additional information not covered by other entries.

Circle the correct figure for each weather element.

Enter these figures in the proper columns at the bottom of the form.

Transmit the horizontal row of figures. This is your weather report.

AIRCRAFT LANDING CODE FORMS

Universal Landing Code

The Universal Landing Code (or UCO) forms are used to encode weather observations made at ground stations and transmitted on request to airplanes in flight. Reports are filed at the station, and the operator can answer requests immediately.

Each WAF form is marked with its proper classification. Be sure you know and observe the regulations for safeguarding it.

UCOPACARDS are classified. Their classification always appears on them. Treat them accordingly.

correct weather information on the UCOPAC frame, which carries partial instructions for its use.

Consult your weather briefing officer for more detailed instructions on this and other weather codes.

To request a UCOPAC weather report:

Call the ground station in the usual way. If you

want a weather report from the station you are calling, send the word UCOPAC, then the day number (twice) of your UCOPACARD. That is, if the card is for the 16th of the month, send UCOPAC 16 16.

If you want a weather report from a station **other than the one you are calling**, follow the date with its name, thus: UCOPAC 16 16 BRISBANE.

If you want an individual UCOPAC item, add the number of the item as it appears on the UCOPAC frame, thus: UCOPAC 16 16 ITEM 4.

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MMS.	28.50	965	.60	970	.70	975	.80	980	.90	985	29.00	990	.10	995	.20	1000	.30	1005	.40	1010	30.00	1015	.10	1020	.20	1025	.30	1030	.40	1035	30.50	1040	.60	1045	.70	1050	.80	1055	.90	1060	31.00	1065	.10	1070	.20	1075	.30	1080	.40	1085	31.50	1090	.60	1095	.70	1100	.80	1105	.90	1110	32.00	1115	.10	1120	.20	1125	.30	1130	.40	1135	32.50	1140	.60	1145	.70	1150	.80	1155	.90	1160	33.00	1165	.10	1170	.20	1175	.30	1180	.40	1185	33.50	1190	.60	1195	.70	1200	.80	1205	.90	1210	34.00	1215	.10	1220	.20	1225	.30	1230	.40	1235	34.50	1240	.60	1245	.70	1250	.80	1255	.90	1260	35.00	1265	.10	1270	.20	1275	.30	1280	.40	1285	35.50	1290	.60	1295	.70	1300	.80	1305	.90	1310	36.00	1315	.10	1320	.20	1325	.30	1330	.40	1335	36.50	1340	.60	1345	.70	1350	.80	1355	.90	1360	37.00	1365	.10	1370	.20	1375	.30	1380	.40	1385	37.50	1390	.60	1395	.70	1400	.80	1405	.90	1410	38.00	1415	.10	1420	.20	1425	.30	1430	.40	1435	38.50	1440	.60	1445	.70	1450	.80	1455	.90	1460	39.00	1465	.10	1470	.20	1475	.30	1480	.40	1485	39.50	1490	.60	1495	.70	1500	.80	1505	.90	1510	40.00	1515	.10	1520	.20	1525	.30	1530	.40	1535	40.50	1540	.60	1545	.70	1550	.80	1555	.90	1560	41.00	1565	.10	1570	.20	1575	.30	1580	.40	1585	41.50	1590	.60	1595	.70	1600	.80	1605	.90	1610	42.00	1615	.10	1620	.20	1625	.30	1630	.40	1635	42.50	1640	.60	1645	.70	1650	.80	1655	.90	1660	43.00	1665	.10	1670	.20	1675	.30	1680	.40	1685	43.50	1690	.60	1695	.70	1700	.80	1705	.90	1710	44.00	1715	.10	1720	.20	1725	.30	1730	.40	1735	44.50	1740	.60	1745	.70	1750	.80	1755	.90	1760	45.00	1765	.10	1770	.20	1775	.30	1780	.40	1785	45.50	1790	.60	1795	.70	1800	.80	1805	.90	1810	46.00	1815	.10	1820	.20	1825	.30	1830	.40	1835	46.50	1840	.60	1845	.70	1850	.80	1855	.90	1860	47.00	1865	.10	1870	.20	1875	.30	1880	.40	1885	47.50	1890	.60	1895	.70	1900	.80	1905	.90	1910	48.00	1915	.10	1920	.20	1925	.30	1930	.40	1935	48.50	1940	.60	1945	.70	1950	.80	1955	.90	1960	49.00	1965	.10	1970	.20	1975	.30	1980	.40	1985	49.50	1990	.60	1995	.70	2000	.80	2005	.90	2010	50.00	2015	.10	2020	.20	2025	.30	2030	.40	2035	50.50	2040	.60	2045	.70	2050	.80	2055	.90	2060	51.00	2065	.10	2070	.20	2075	.30	2080	.40	2085	51.50	2090	.60	2095	.70	2100	.80	2105	.90	2110	52.00	2115	.10	2120	.20	2125	.30	2130	.40	2135	52.50	2140	.60	2145	.70	2150	.80	2155	.90	2160	53.00	2165	.10	2170	.20	2175	.30	2180	.40	2185	53.50	2190	.60	2195	.70	2200	.80	2205	.90	2210	54.00	2215	.10	2220	.20	2225	.30	2230	.40	2235	54.50	2240	.60	2245	.70	2250	.80	2255	.90	2260	55.00	2265	.10	2270	.20	2275	.30	2280	.40	2285	55.50	2290	.60	2295	.70	2300	.80	2305	.90	2310	56.00	2315	.10	2320	.20	2325	.30	2330	.40	2335	56.50	2340	.60	2345	.70	2350	.80	2355	.90	2360	57.00	2365	.10	2370	.20	2375	.30	2380	.40	2385	57.50	2390	.60	2395	.70	2400	.80	2405	.90	2410	58.00	2415	.10	2420	.20	2425	.30	2430	.40	2435	58.50	2440	.60	2445	.70	2450	.80	2455	.90	2460	59.00	2465	.10	2470	.20	2475	.30	2480	.40	2485	59.50	2490	.60	2495	.70	2500	.80	2505	.90	2510	60.00	2515	.10	2520	.20	2525	.30	2530	.40	2535	60.50	2540	.60	2545	.70	2550	.80	2555	.90	2560	61.00	2565	.10	2570	.20	2575	.30	2580	.40	2585	61.50	2590	.60	2595	.70	2600	.80	2605	.90	2610	62.00	2615	.10	2620	.20	2625	.30	2630	.40	2635	62.50	2640	.60	2645	.70	2650	.80	2655	.90	2660	63.00	2665	.10	2670	.20	2675	.30	2680	.40	2685	63.50	2690	.60	2695	.70	2700	.80	2705	.90	2710	64.00	2715	.10	2720	.20	2725	.30	2730	.40	2735	64.50	2740	.60	2745	.70	2750	.80	2755	.90	2760	65.00	2765	.10	2770	.20	2775	.30	2780	.40	2785	65.50	2790	.60	2795	.70	2800	.80	2805	.90	2810	66.00	2815	.10	2820	.20	2825	.30	2830	.40	2835	66.50	2840	.60	2845	.70	2850	.80	2855	.90	2860	67.00	2865	.10	2870	.20	2875	.30	2880	.40	2885	67.50	2890	.60	2895	.70	2900	.80	2905	.90	2910	68.00	2915	.10	2920	.20	2925	.30	2930	.40	2935	68.50	2940	.60	2945	.70	2950	.80	2955	.90	2960	69.00	2965	.10	2970	.20	2975	.30	2980	.40	2985	69.50	2990	.60	2995	.70	3000	.80	3005	.90	3010	70.00	3015	.10	3020	.20	3025	.30	3030	.40	3035	70.50	3040	.60	3045	.70	3050	.80	3055	.90	3060	71.00	3065	.10	3070	.20	3075	.30	3080	.40	3085	71.50	3090	.60	3095	.70	3100	.80	3105	.90	3110	72.00	3115	.10	3120	.20	3125	.30	3130	.40	3135	72.50	3140	.60	3145	.70	3150	.80	3155	.90	3160	73.00	3165	.10	3170	.20	3175	.30	3180	.40	3185	73.50	3190	.60	3195	.70	3200	.80	3205	.90	3210	74.00	3215	.10	3220	.20	3225	.30	3230	.40	3235	74.50	3240
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AUTHENTICATE



Plane to Plane



Plane to Ground



Ground to Plane

MESSAGE AUTHENTICATION

Message authentication is a means of assuring a station that messages it receives come from friendly sources. It is also used to assure transmitting stations that their messages have reached friendly stations.

Some method of authentication is used in most theaters of operations. Local conditions determine whether or not all messages must be authenticated. Those containing instructions, for example, usually require it. In combat areas, however, **any message you send or receive** must be authenticated by the system locally in effect. Remember that the enemy is monitoring your messages. He may try to mislead you. **Be sure you are in contact with a friendly station.**

Types of message authentication vary considerably. In general the procedure is to send the operating signal QKA, followed by an authentication group based on the time (usually the time of transmission), and certain prescribed letters of the text or message heading. You can find the proper group by taking these variables and consulting the authentication table currently in force. Each type of table is designed to serve a particular purpose, and to allow for enough variety within itself to afford security from the enemy.

Some theaters do not require each message to be authenticated by a procedure such as the one above. Instead, they provide a pre-arranged table of challenges and replies which radio stations exchange when there is any doubt of their identity.

Always find out from your briefing officer the authentication procedure you must use. **Never** start on a mission without obtaining from him the effective authentication code.

THE PHONETIC ALPHABET

Below are the words of the phonetic alphabet. They are of utmost importance and should be learned thoroughly. When necessary to identify any letter of the alphabet or to spell a word, use the phonetic alphabet.

LETTER	SPOKEN AS	LETTER	SPOKEN AS
A	Able	N	Nan
B	Baker	O	Oboe
C	Charlie	P	Peter
D	Dog	Q	Queen
E	Easy	R	Roger
F	Fox	S	Sugar
G	George	T	Tare
H	How	U	Uncle
I	Item	V	Victor
J	Jig	W	William
K	King	X	X-ray
L	Love	Y	Yoke
M	Mike	Z	Zebra

Difficult words will be both spoken and spelled, for example: "Solved—I spell— Sugar Oboe Love Victor Easy Dog—Solved."



PRONUNCIATION OF NUMBERS

When you transmit numbers by radio telephone use the following standard procedure.

NUMERAL	SPOKEN AS	NUMERAL	SPOKEN AS
0	Ze-ro	5	Fi-yiv
1	Wun	6	Six
2	Too	7	Seven
3	Thuh-ree	8	Ate
4	Fo-wer	9	Niner

STATEMENT OF TIME

State time in exactly 4 numbers using the 24 hour clock. State the hour by the first two numbers and the minute by the last two numbers.

TIME	STATEMENT
0000 (midnight)	Time, zero zero zero zero
0920 (9:20 A.M.)	Time, zero nine two zero
1643 (4:43 P.M.)	Time, one six four three

TIME

Zones & Signals

TIME ZONES

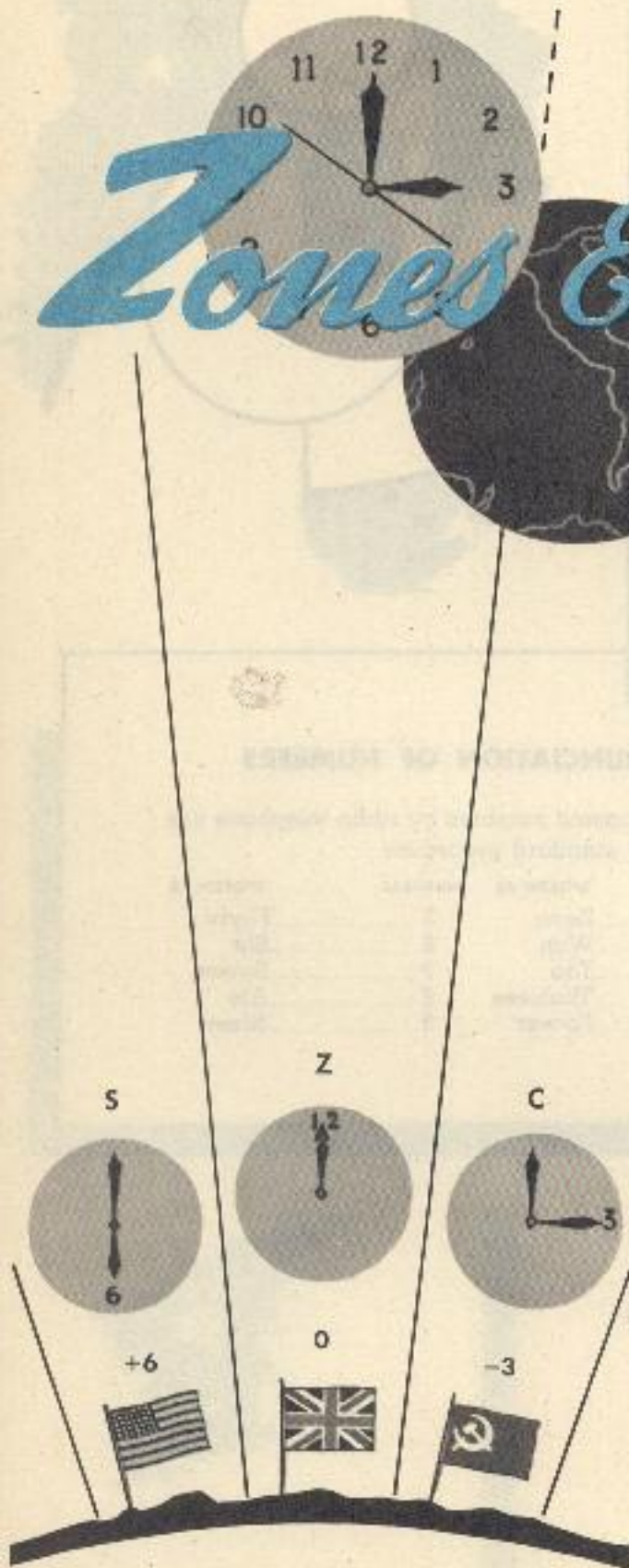
For the purpose of computing time, in military communications, the world is divided into 25 zones. Each zone is given a letter designator to be used in conjunction with a correction chart, for the purpose of converting time in the various zones to Greenwich Civil Time.

In this system of computing time, Greenwich, England, is considered zero meridian. The area $7\frac{1}{2}$ degrees east and west of 0 meridian, covered by Greenwich Civil Time, is designated Zone Z.

By reference to the time chart, the time-zone designator and correction to be applied to the local time in any given zone, to convert it to GCT, may easily be determined.

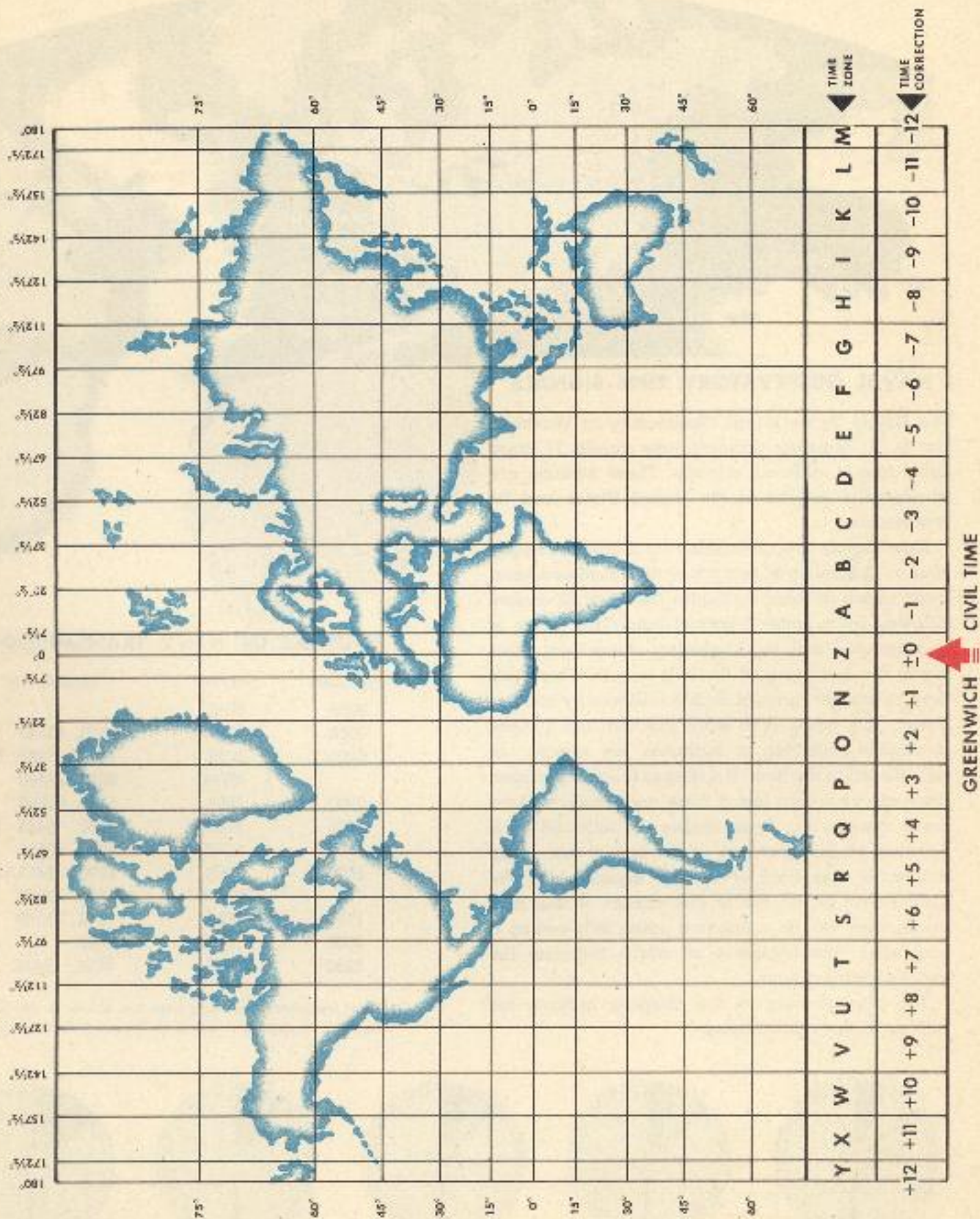
TIME SIGNALS

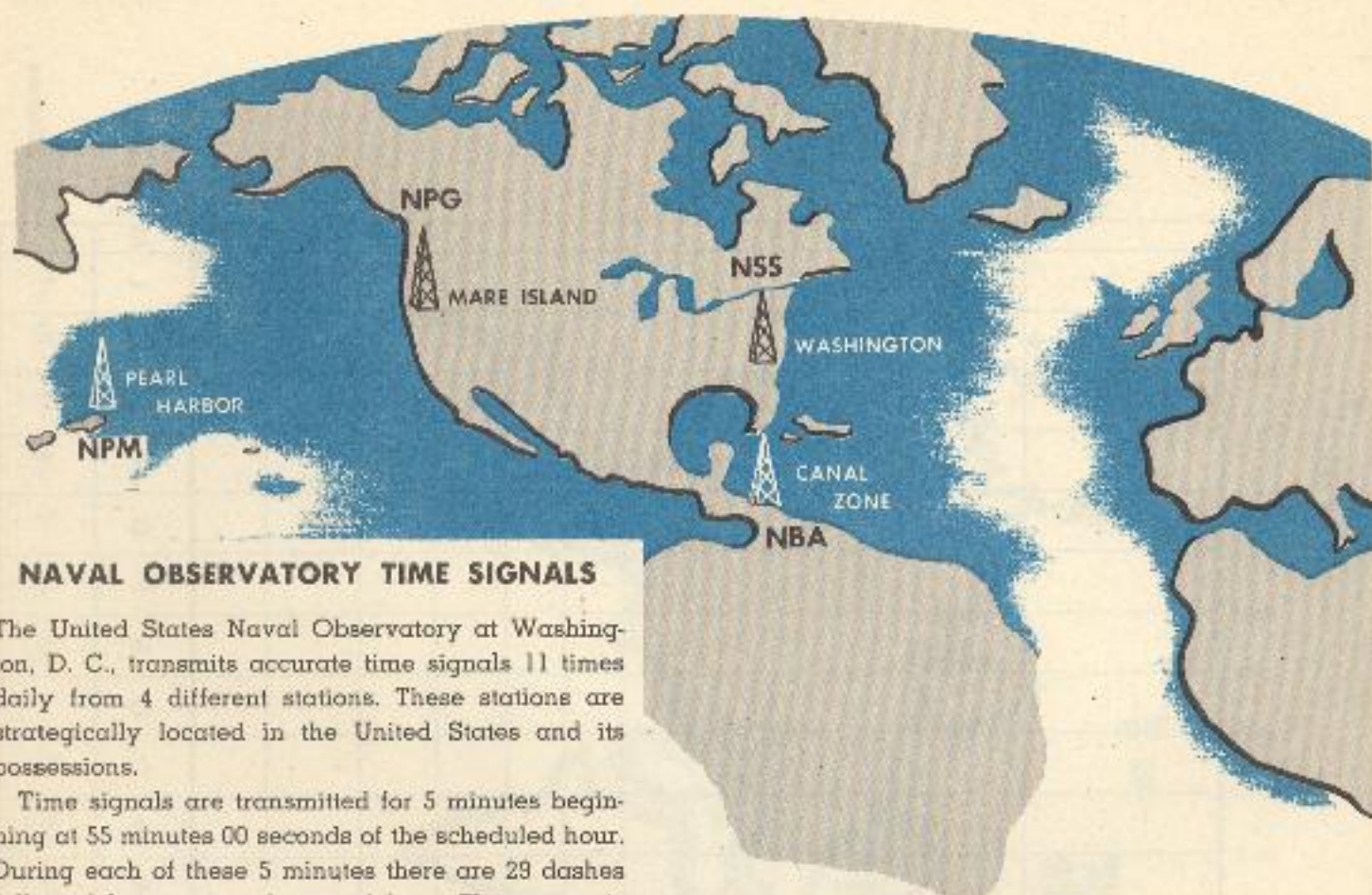
There are various sources of correct time available to the radio operator. The most frequently used, Bureau of Standards and Naval Observatory Times, are outlined in detail for your convenience.



West

East





NAVAL OBSERVATORY TIME SIGNALS

The United States Naval Observatory at Washington, D. C., transmits accurate time signals 11 times daily from 4 different stations. These stations are strategically located in the United States and its possessions.

Time signals are transmitted for 5 minutes beginning at 55 minutes 00 seconds of the scheduled hour. During each of these 5 minutes there are 29 dashes followed by a pause 1 second long. This pause is to warn you that the beginning of the next dash marks the beginning of the half minute. There will then be another series of dashes followed by another pause. This pause is to warn you that the number of dashes following it indicates the number of minutes left in the hour. If 4 dashes follow the pause, there are 4 minutes left; if there are 3 dashes, there are 3 minutes left; these dashes are followed by a 4-second pause. The dash at the end of this pause marks the beginning of another minute. After the 51st second of the 5th or last minute of this time check there will be a 9-second pause followed by a long dash, the beginning of which indicates the exact scheduled hour.

The blue portions in the diagram indicate the pauses in the transmission.

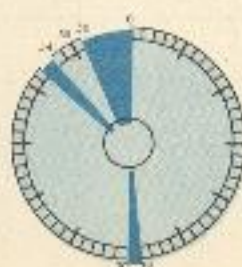
SCHEDULE OF NAVY TRANSMISSIONS

TIME (GMT)	STATION	FREQUENCY KC
0000	NPG	
0300	NPG	9090, 12540
0400	NSS	4390, 9425, 12630
	NPM	9090, 12540
0500	NBA	5540, 11080
1000	NSS	4390, 9425, 12630
1500	NPG	9090, 12540
1600	NSS	4390, 9425, 12630
	NPM	9090, 12540
1700	NBA	5540, 11080
2000	NPM	9090
2200	NSS	4390, 9425, 12630

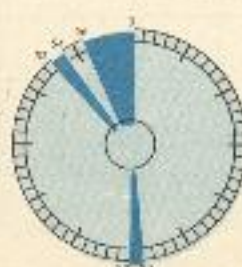
These frequencies and schedules are subject to change by the Navy Department at any time. Consult your facility charts.



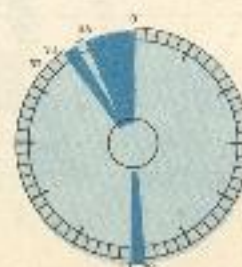
FIRST MINUTE



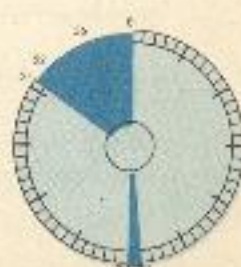
SECOND MINUTE



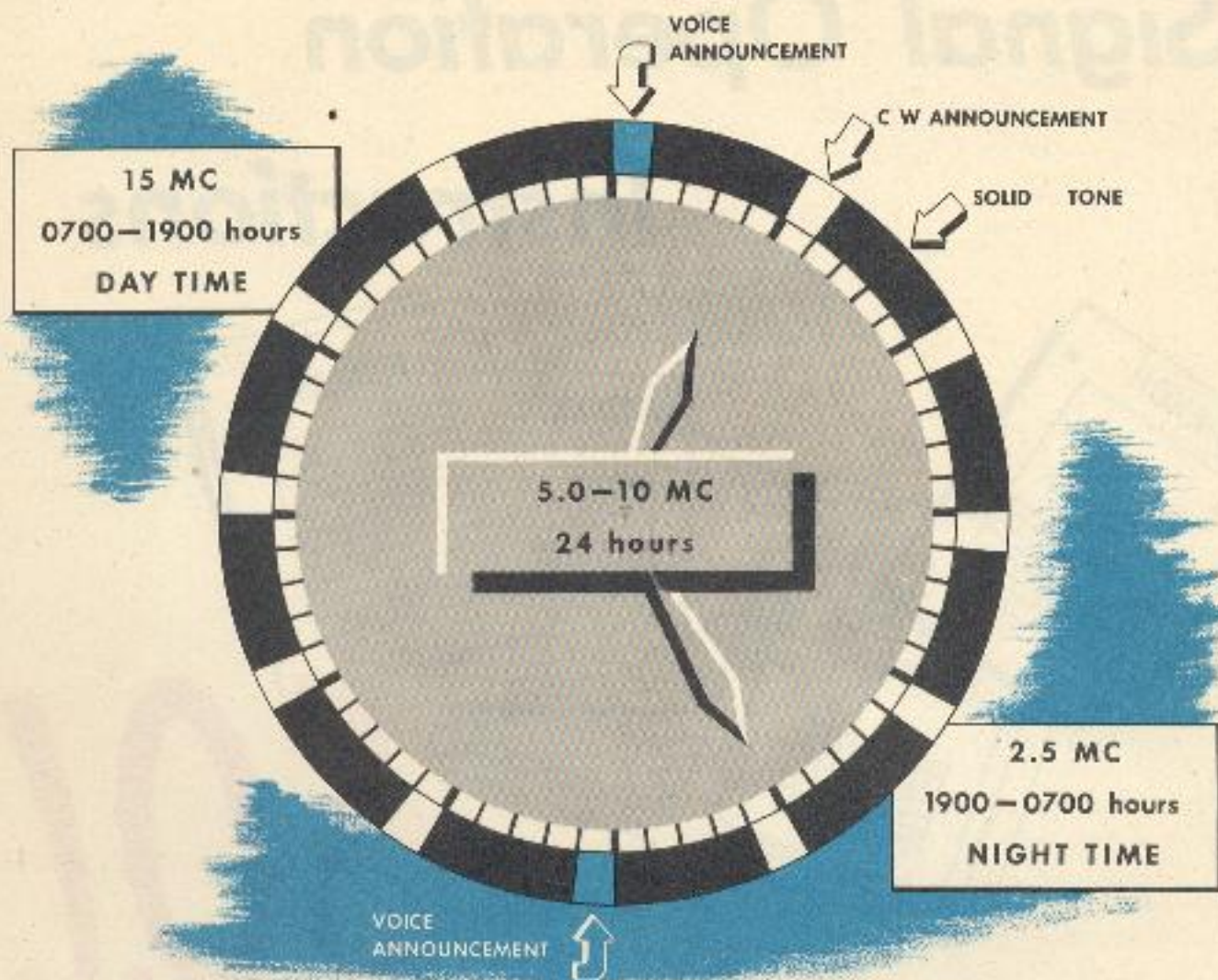
THIRD MINUTE



FOURTH MINUTE



FIFTH MINUTE



U. S. BUREAU OF STANDARDS

The United States Bureau of Standards radio station WWV provides an accurate time service 24 hours daily. The primary purpose of WWV is to transmit a frequency standard by which all radio stations in the United States may calibrate their frequencies. WWV's transmitting frequencies are accurate to one part in ten million.

Four different frequencies are used for transmitting these signals. They are 2500 kc, 5000 kc, 10000 kc, and 15000 kc.

The 2500-kc frequency is transmitted from 1900 to 0700 hours. The 15000-kc frequency is transmitted from 0700 to 1900 hours. The 5000- and 10000-kc frequencies are transmitted for the entire 24-hour period. The carrier is modulated with a 440-cycle tone (standard musical pitch A above middle C). In addition there is a 4000-cycle pulse which is heard as a faint tick every second except the 59th. This tick may be used for timing whenever such timing is required.

TIME CHECKS

The 440-cycle tone signal begins exactly 1 minute after each hour, continues for 4 minutes, and ends at exactly 5 minutes past each hour. The call sign WWV is given in code twice. The steady tone then begins again at exactly 6 minutes past each hour and continues for 4 minutes ending at exactly 10 minutes after each hour. This sequence of a 4-minute transmission with a 1-minute pause for station identification continues throughout the 24-hour period.

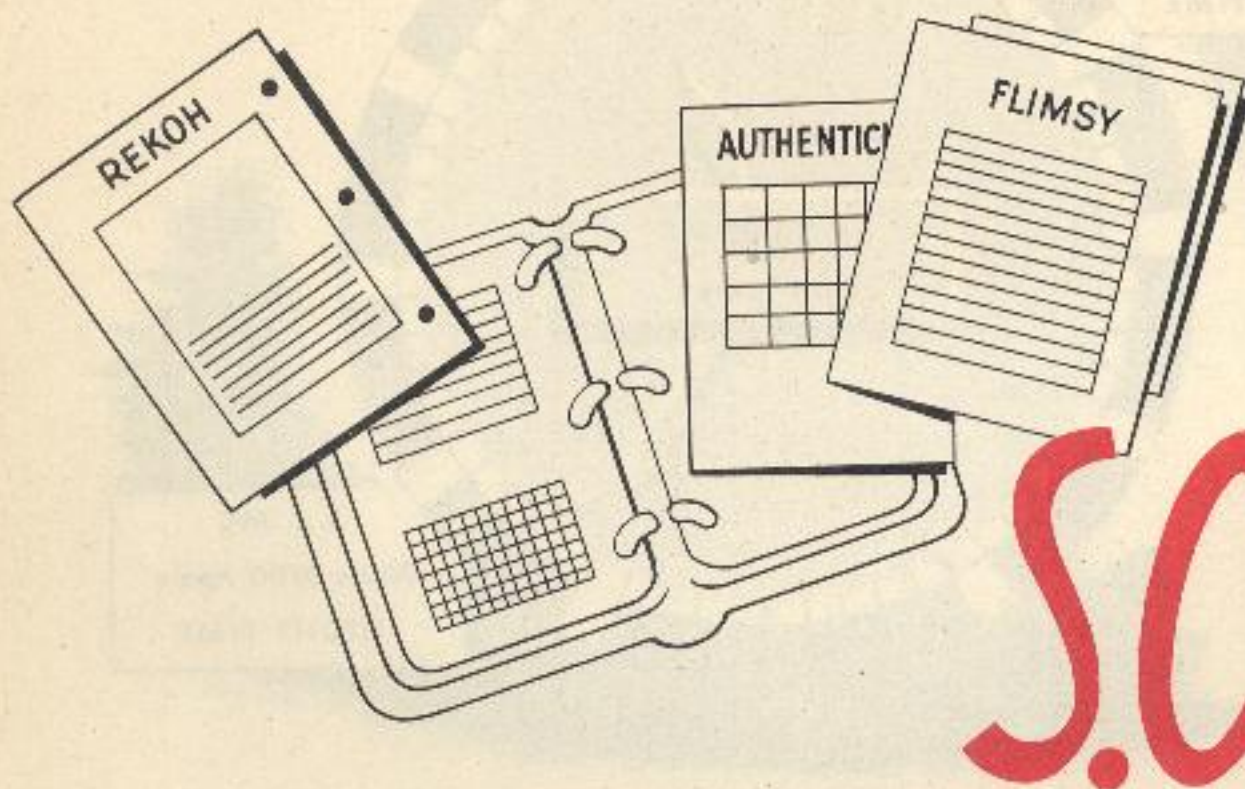
A voice announcement giving the call letters and complete information on the facilities of WWV is made on the hour and half-hour. Because the modulating tone is of a very low percentage, it is advisable to use the BFO of your receiver to locate the carrier. Once located, however, the BFO must be turned off. Otherwise it would be difficult to determine when the tone signal started or stopped. Keep in mind that the carrier of WWV is on continuously.

SCHEDULE OF TONE SIGNALS

A chart is included to show the exact sequence of these transmissions.

Signal Operation

Instructions



It is important that radio operators have at their disposal for immediate reference all frequencies, call signs, authenticators, pyrotechnic charts, IFF stud settings, maps and all other information that facilitate the handling and security of highly classified communications in the area or theater in which they will operate.

Complete signal operation instructions are usually compiled in loose-leaf booklet form. This complete booklet is usually kept in the Post Operations office. Supplements of the SOI pertaining to a particular mission are handed to you at briefing in the form of a flimsy. The flimsy consists of one or more sheets of rice paper on which the operations for the day are printed. The proper use of an accurate, complete, and up-to-date flimsy may determine whether or not your crew accomplishes its mission, whether or not you find your way home after completing a mission, or whether or not you are shot down by your own anti-aircraft guns upon attempting to land at your home base.

If you are forced down over enemy territory be sure to destroy the flimsy. Since flimsies are printed on rice paper, they may be effectively destroyed by swallowing. Be sure to weight down your flimsy while in flight. If you are on a mission with the side-hatches and bomb bay doors opened a strong gust of wind might blow it out of the airplane.

REMEMBER

**Before every flight check your flimsy
for correctness and completeness.**

RADIO LOGS

A neat, accurate, and complete log is certain evidence of a radio operator's ability and efficiency.

In combat zones a good operator spends most of his time listening to, or monitoring, his assigned frequency. Everything he hears should be entered in his log in complete detail. Some of the things he records may mean little to him, but in the right hands these entries may be extremely valuable information.

Since the requirements for keeping logs vary in the different theaters and air forces, no attempt will be made here to list them.

The standard radio log, AAF Form 35, is usually available and should be used whenever possible.

RADIO LOG		PAGE NO.	
1		1	
RADIO LOG OPERATOR: 9APQ NAME: PETER QUEEN POSITION: DATE: 11/11/44		RADIO LOG DATE: 11/11/44	
TIME	TO	FROM	REMARKS
2300			ENGINES STARTED RADIO ON
02	KINGSWILL	9APQ	6440 A3
04	"	"	"
05			AIRBORNE
08	"	"	"
13			CHANGING CONTROL (TOWER TO CW)
15			IFF ON CKED
17	TB9	9APQ	4575 A1
45			500
50		WWV	5000 A2
0000			
13			
15			500
17	9APQ	TB9	4575 A1
0100	9APQ	PNL	4575 A1

NOTES: 1. COPIES OF THIS LOG SHOULD BE MAINTAINED IN THE LOGS OF THE OPERATOR AND THE LOGS OF THE OPERATOR.

THIS REVERSE IS TO BE DESTROYED BY COPY.

OPERATOR: James H. Manker



Listed below, with their meanings, are the Q signals most commonly used in operating, authentication, and direction finding procedures. These signals, preceded by INT, become interrogative. Preceded by QQZ they become negative.

Refer to Air Extract FM 24-13 for a more complete list of Q signals.

DEPARTURE AND DESTINATION

- QAA** I expect to arrive at..... (time). (ETA.)
QAL I am going to land at..... (or land at.....).

MESSAGE HANDLING

- QRJ** I cannot receive you. Your signals are weak.
QRK The readability of your signals is..... (1 to 5).
QRM I am being interfered with. (.....).
QRS Send more slowly (..... words per minute).
QRU I have nothing for you.
QSA The strength of your signals is..... (1 to 5).
QTC I have..... messages for you (or for.....).
QMM I have (or..... has) messages (numeral indicating number of messages may be followed by O, OP, or D to indicate precedence other than routine) for you (or.....).

FREQUENCY AND TUNING

- QHF** Your frequency is slightly (or..... ke's) high.
QLF Your frequency is slightly (or..... ke's) low.
QMF Your frequency is correct.
QSV Send a series of V's.

Change to transmission on.....kc's without changing the type of wave (or change to transmission on another wave).

Zero beat your transmitter to my frequency (or freq. of.....).

AUTHENTICATION

Check your authentication of last transmission (or message.....).

Authentication of this message or transmission (or message.....) is.....

Authentication challenge is.....(based on time in the zone indicated by the suffix letter.....).

WEATHER AND WEATHER ELEMENTS

QAM Here is the latest meteorological weather report for.....(place of observation).

QFE The present barometric pressure not reduced to sea level, at the surface of airdrome (name of airdrome) is.....

BEARING AND DIRECTION FINDING PROCEDURE

QDL I intend to ask for a series of bearings.

QDM The magnetic course to steer, with zero wind, to reach me (or.....) is.....degrees at.....(time).

QDY The magnetic course to steer, with zero wind, to reach me (or.....) is.....degrees at.....(time). There is a balloon barrage within 60 miles of me on that track.

QPN Increase height to enable more accurate bearing to be completed.

QTF The position of your station according to the bearings taken by the D/F stations which I control is.....latitude,longitude.

QTH My position is.....latitude.....longitude (or by any other way of showing it).

QTG I will send my call for fifty seconds followed by a dash of ten seconds on.....kc's in order that you may take my bearing.

QTN Send a 20 second dash followed by your call sign (repeated.....times).

QUJ The true course to steer, with zero wind, to reach me (or to reach.....) is.....degrees at.....(time).

AIR RAID SIGNALS

QQQ1 Warning.

QQQ2 In progress.

QQQ3 All Clear.

PROSIGNS

Prosigns are used to convey, in standard condensed form, certain orders, instructions, requests, reports, and information which appear regularly in communications. The prosigns and their uses are listed below.

A	Originator's sign.
AA	Unknown station.
AA	All after.
AB	All before.
AR	End of transmission.
AS	Wait.
B	More to follow.
BT	Long break.
C	Correct.
D	Deferred.
EEEEEEEE	Error.
F	Do not answer.
G	Repeat back.
GR	Group (s).
HM HM HM	Emergency silence. To cancel silence, send silent sign preceded by QQZ.

II	Separative sign.
IMI	Repeat.
INT	Interrogatory.
IX	Execute to follow.
IX (5 second dash)	Executive signal.
J	Verify and repeat.
K	Go ahead.
N	Not received, or exempted.
NR	Station serial number.
O	Urgent.
OP	Operational priority.
P	Priority.
R	Received (also, routine).
T	Transmit to.
V	From.
W	For information to.
WA	Word after.

R/T VOICE PROWORDS

Radio telephone voice prowords are used to simplify traffic handling, to direct net operation, or to convey certain instructions from the originator of a message.

Here is a list of the authorized procedure phrases, which it is your responsibility to know and use correctly. In some cases, where the meaning is unmistakable, it has been omitted from the right-hand column.

Acknowledge	Used between originator and addressee: "Let me know that you have received and understand this message."
All after	Used in conjunction with verification, repetition, and correction to indicate portion of message. (Equivalent to AA.)
All before	Used in conjunction with verification, repetition, and correction to indicate portion of message. (Equivalent to AB.)

Break	"I hereby indicate the separation of the text from other portions of the message." To be used only when there is no clear distinction between the text and other portions of the message. (Equivalent to BT.)
Correction	"An error has been made in this transmission (or message indicated). The correct version is _____."
Disregard this transmission	To be followed by "Out" and means, "This transmission is in error. Disregard it."
Do not answer	"Stations called are not to answer this call or to receipt for this message, or otherwise to transmit in connection with this transmission." (Equivalent to F.)
Groups	"The number of groups in this message is _____." (Equivalent to GR.)
How do you hear me?	
I read back	"The following is my response to your instructions to read back."
I say again	(Equivalent to IML.)
I spell	
Message for	"I wish to transmit a message to _____."
Numerals	"Numerals follow."
Out	"This is the end of my transmission to you and no response is required or expected." (Equivalent to AR.)
Over	"Go ahead. Transmit. This is the end of my transmission to you and a response is necessary." (Equivalent to K.)
Read back	"Repeat the text of this message back to me exactly as received, after I have given 'Over'."
Relay to	"Transmit this message to the station indicated." (Equivalent to T.)
Roger	"I have received your last message." (Equivalent to R.)
Say again	"Say again all of your last transmission." Followed by identification data, means "Say again your message or portions indicated." (Equivalent to IML.)
Send your message	
Silence	"Cease radio telephone transmission immediately until message which follows has been transmitted." Where an authentication system is in force, a station must always authenticate itself when the proword "Silence" is used.

Speak slower

Stand by to write "A message which will require a permanent record is about to follow."

That is correct (Equivalent to C.)

This is "This transmission is from the station whose call sign or other identification follows." (Equivalent to V.)

Time Used as a prefix to the time group of message being transmitted.

Verify "Verify entire message (or portion indicated) with the originator, check cryptographing, and send correct version." (Equivalent to J.)

Wait If used by itself: "I must pause for a few seconds." If the pause is to be longer than a few seconds, "Wait-Out" shall be used. If "Wait" is used to prevent another station from transmitting, it must be followed by the ending "Out." (Equivalent to AS.)

Wilco Used between addressee and originator only: "Your last message (or message indicated) received and understood, and will be complied with."

Word after Used in conjunction with verification, repetition, and correction to indicate portion of message. (Equivalent to WA.)

Words twice (As a request.) "Communication is difficult. Please send every phrase (or every code group) twice." (As information.) "Since communication is difficult every phrase (or every code group) in this message will be sent twice."

Wrong "What you have just said is incorrect. The correct version is _____."

For more complete voice or CW procedures consult CCBP 2-2, CCBP 3-2, CCBP 7; FM 24-10, FM 24-13, and FM 1-46.

Remember: The use of standard R/T procedures is the responsibility of all radio operators.

★ LIAISON EQUIPMENT



SECTION 4

LIAISON EQUIPMENT

Subjects in Section 4

AN/ART-13 Transmitter Equipment, 4-1

SCR-287 Transmitter Equipment, 4-2

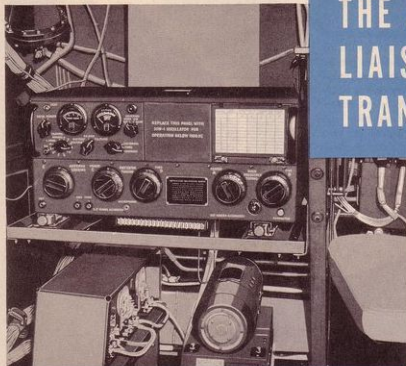
SCR-287 Receiver, 4-3

SCR-211 Frequency Meter, 4-4

RL-42-A, BC-461, Reel and Control, 4-5



The liaison radio equipment installed in your airplane is designed for long-range communication, and is intended solely for your use. You must be thoroughly familiar with whatever type of equipment you have. Learn the functions of each control, and how to use it. Learn your tuning procedures. Practice them until they become second nature to you. A radio operator must be able to tune his sets quickly and accurately under difficult conditions. He must understand what performance he can expect from them, and how best to get it. He must know how to keep his equipment working when, in an emergency, it is partially disabled, and his ingenuity alone can prevent a radio blackout.



THE AN/ART-13A LIAISON TRANSMITTER

FOR LONG RANGE RADIO COMMUNICATION

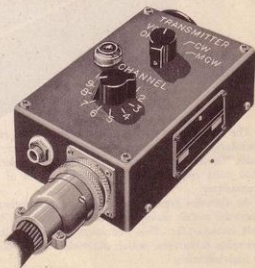
The AN/ART-13A transmitter has a frequency range of 2000 to 18100 kc. You can pre-set any one of its 10 channels to any frequency within this range. The Autotune system, a built-in, automatic tuning device, controls all the transmitter dials. With it, you can make a complete channel change in approximately 25 seconds.

The transmitter operates on VOICE, CW, or MCW.

REMOTE CONTROL UNIT

There is a remote control unit in the pilot's compartment. It functions only when the LOCAL-REMOTE switch on the transmitter panel is set to REMOTE. The pilot's control box has a channel switch, an emission switch, and a key mounted on top of the box.

When the remote unit has control of the equipment, its red light glows. However, the light will not come on while the Autotune motor is operating.



CRYSTAL FREQUENCY INDICATOR

A crystal frequency source is built into the transmitter. It is used to calibrate the master oscillator for accurate tuning. The crystal has a fundamental frequency of 200 kc. There are two types of crystal indicator. The most common one is illustrated here. An audio signal results from the difference between the crystal oscillator frequency and the master oscillator frequency. This signal, fed into the sidetone circuit, enables you to monitor your transmissions.

CRYSTAL CHECK POINTS ARE SHOWN IN HEAVY BLACK TYPE ON THE CALIBRATION CHARTS.



DYNAMOTOR

The dynamotor unit has two high-voltage commutators, one delivering 400 volts, the other 750 volts. These are connected in series to provide the 1150 volts required for the normal output of the transmitter.

At altitudes greater than 25,000 feet, a pressure-operated switch disconnects the output of the 400-volt commutator. This reduction of total voltage prevents flashovers, which otherwise would occur at high altitudes.

A 1-ampere fuse on the connection end of the unit protects the 400-volt output.

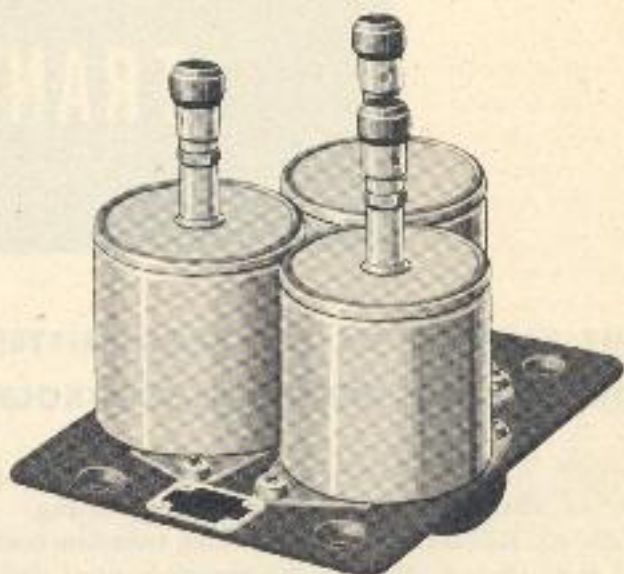
There are two thermal-type overload relays in the dynamotor unit. One controls the dynamotor input circuit. The other controls the transmitter's low-voltage circuits. The contacts of these relays open automatically as a result of excessive heat. When they have opened, return them to their normal positions by pressing the RESET buttons on the filter unit.

ANTENNA SHUNT UNIT

The antenna shunt unit allows you to operate on a short fixed-wire antenna at frequencies from 2000 to 3000 kc. This unit consists of three 25-mmfd capacitors mounted on a plate which serves as a common connection to one terminal of each capacitor. The capacitors can be connected separately or in parallel, so that you can use 25, 50, or 75 mmfd of capacitance. You can connect them in the circuit by a knife switch (or SA/22) if the frequency at which you are operating requires them. However, the capacitors should not be in the antenna circuit on any other frequency.

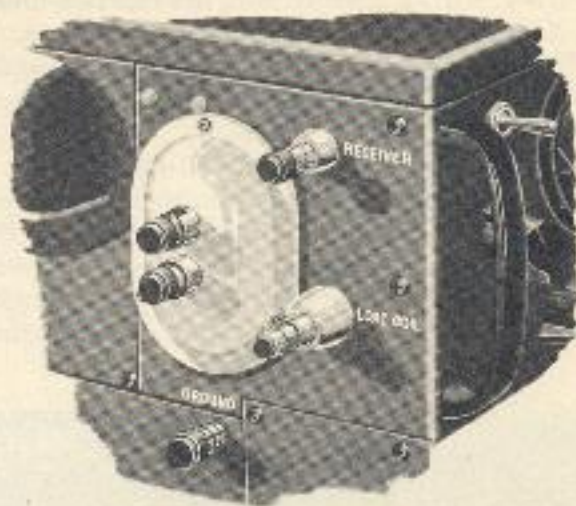
Consult the chart (ROIF 4-1-8) or your operating handbook to find how much capacitance you need.

Remember: Use these capacitors only when you must operate on a frequency that requires them.



ANTENNA CONNECTIONS

Five binding posts on the left end of the transmitter provide you with all the necessary antenna connections. Keep the leads as short as possible. Keep the insulators clean.



DUMMY LOW-FREQUENCY OSCILLATOR

If your transmitter does not have a low-frequency oscillator, a dummy oscillator will be installed in its place. This unit includes duplicate low-frequency oscillator plugs, a 28-ohm, 10-watt filament-substitute resistor, and a blank panel assembly. With the dummy oscillator in the set you can operate normally in every way in the 2000 to 18100 kc frequency range.



TRANSMITTER CONTROLS

THIS SECTION OF THE TRANSMITTER CONTAINS THE OPERATING CONTROLS:

TEST: A spring switch which closes the keying circuits. Must be held in position during testing.

LOCAL-REMOTE: A switch which transfers control from your position to the remote control unit.

CHANNEL: A selector switch which lets you select any one of the 10 pre-tuned frequency channels. The L. FREQ. position does not function unless there is a low-frequency oscillator in the set.

ANTENNA CURRENT METER: A thermocouple-type ammeter which shows the amount of current feeding into the antenna system.

BATTERY VOLTAGE-PA GRID-PA PLATE: A selector switch controlling the functions of the combination milliammeter and voltmeter above it. The meter registers power-amplifier plate current, power-amplifier grid drive, or the airplane's battery voltage, depending upon the setting of the switch.

CALIBRATE - TUNE - OPERATE: A selector switch performing the following functions:

1. **CALIBRATE** switches in the crystal-frequency indicator, disables the power-amplifier and multiplier stages, and connects sidetone circuits.

2. **TUNE** reduces the power-amplifier plate voltage to keep the power-amplifier tubes from being damaged during preliminary tuning.

3. **OPERATE** gives you normal operation. Leave the switch in this position except when you are calibrating or tuning the transmitter.

EMISSION: A switch which allows you to select VOICE, CW, or MCW emission. It also switches the battery power into the transmitter equipment.

The TS jack is a connection for an external throttle switch. You can simplify tuning by inserting a shorted PL-68 (disconnecter-cord plug) here to close the keying circuits and let you use both hands for tuning. **Remove the plug when you finish tuning, or if you rotate the E dial through the spaces between 0 and 100 or 100 and 200.**



In order to tune and operate the set efficiently,
you must understand exactly what each control does.
The transmitter panel has been divided into
sections, here, to clarify these functions.



THIS SECTION OF THE TRANSMITTER CONTAINS THE TUNING CONTROLS.

These dials control the master-oscillator, power-amplifier, and antenna-loading circuits. All five controls are connected to the Autotune system. This is an electrically-controlled mechanical system of setting the transmitter tuning elements for any one of 10 frequency channels. These channels can be tuned to any frequency between 2000 and 18100 kc. The Autotune is driven by a reversible electric motor.

The Autotune mechanism allows considerable play in the dials. Because of this you must use the following method when you set them:

After you have determined the proper dial setting:

1. Rotate the dial to the left of the determined setting about a quarter of a turn.
2. Then rotate the dial to the right until it reaches the exact setting.

If you find you have passed the exact setting, repeat the procedure. Never back up to a setting if you have passed it.

Remember, always approach the final setting through clockwise rotation.

Here are the uses of the individual controls:

Dial A is the coarse tuning control of the master oscillator. It also selects the proper frequency-multiplier circuits.

Dial B is the fine tuning control of the master-oscillator and frequency-multiplier circuits.

Note: When you position the B dial, use the small counter dial at its lower left to set hundreds, and the B dial itself to set tens and digits. That is, for a reading of 514, set 5 on the counter dial and 14 on the B dial. The vernier adjustment on the newer transmitters lets you set dial B more accurately.

Dial C selects the most suitable type of antenna-matching network for tuning and coupling the power amplifier to the antenna system.

Dials D and E are power-amplifier tuning and antenna-loading controls. Their functions depend on the setting of the C dial, as follows:

1. When C is set below 8, E tunes the power amplifier and D loads the antenna.
2. When C is set at 8 or above, D tunes the power amplifier and E loads the antenna.

TUNING PROCEDURE

PREPARATION

Here are the steps preparatory to tuning the transmitter.

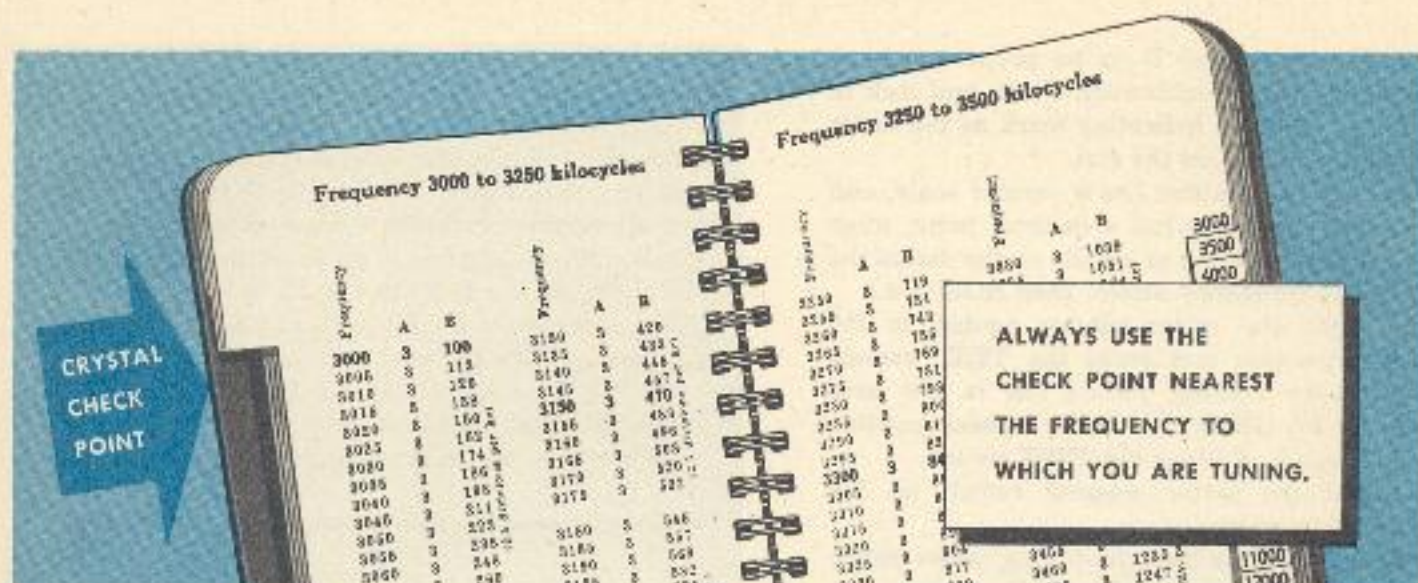
Before you begin, make sure that the antenna change-over knife switch (or its equivalent) is closed to the antenna you intend to use.

1. Set the LOCAL-REMOTE switch on LOCAL position.
2. Set the CALIBRATE-TUNE-OPERATE switch on TUNE.
3. Turn the EMISSION switch to VOICE. (The transmitter is now turned on, but the dynamotor will not run until the TEST switch, the microphone button, or the key is closed, or the shorted plug inserted.)
4. Turn the meter selector switch to BATTERY VOLTAGE position. The meter reading should fall within the narrow shaded area labeled BATTERY. See your crew chief if the battery voltage is low.
5. Select a channel number for the frequency you are going to tune, and set the CHANNEL switch on it.
6. Unlock the Autotune dials by turning the locking bars to the left about a quarter of a turn. Hold the dial with one hand and loosen the locking bars with the other.

THE SELECTED CHANNEL IS NOW READY TO BE CALIBRATED.



TRANSMITTER CALIBRATION



Before you can tune the transmitter accurately, you must check the calibration of the master oscillator. Check it for each channel you tune.

This is the purpose of the built-in calibration frequency indicator. By using harmonics of the crystal frequency indicator, you can check the transmitter at various points throughout its range. These harmonics are called **crystal check points**.

Crystal check points are printed in heavy type on the calibration charts. You can find these charts either in the transmitter's operating manual or in T.O. AN 08-30 ART 13-3.

Always use the check point nearest the frequency to which you are tuning.

There are two types of calibration charts. The one illustrated at the top of this page gives dial settings at 2-ke intervals from 200 to 500 kc, at 5-ke intervals from 500 to 8000 kc, and at 10-ke intervals from 8000 to 18100 kc.

The other chart lists all frequencies in single-kilo-cycle steps. Heavy ruled lines, appearing at intervals, help you select the proper check point accurately. Always use the check point listed between the same heavy lines as the frequency on which you are to operate.

If you must tune to a frequency between any two given on a chart, use one of these methods:

1. For the chart illustrated, find the difference between the frequency you want and the **next lower frequency** listed. Multiply this difference by the number in parentheses at the right of the column and add the result to the B-dial setting for the lower

frequency. For example:

$$3003 - 3000 = 3$$

$$3 \times 2.5 = 7.5$$

$$100 - 7.5 = 92.5, \text{ or the B-dial setting.}$$

2. For the single-frequency charts:

	Freq.	A	B	
Desired	3410	3	1114.1	Difference between these is 2.4
frequency,	3411	3	1116.6	
	3412	3	1119.0	
3411.5	3413	3	1121.5	

$$2.4 \times .5 = 1.20$$

$$1.20 + 1116.60 = 1117.80, \text{ the B-dial setting.}$$

After you have selected the proper crystal check point, calibrate the transmitter as follows:

1. Place control A on the correct position, as shown on the calibration chart. Approach this setting through a quarter turn of clockwise rotation, then tighten the locking bar.

2. Align the moving indicator of the B dial (or 0 on the vernier scale) with the stationary indicator. Use the CORRECTOR knob to do this.

3. Leave the EMISSION switch on VOICE, and turn the CALIBRATE-TUNE-OPERATE switch to CALIBRATE position.

4. With your headphones plugged into the jack SIDETONE 1, adjust control B for a zero beat. If the dial does not indicate the exact B-dial setting for your check point frequency, adjust the movable indicator (or 0 on the vernier scale) until it does.

5. Return the CALIBRATE-TUNE-OPERATE switch to TUNE. Set EMISSION switch on CW

The channel is now ready to be tuned.

FINAL TUNING PROCEDURE

1. Rotate control B to its proper position, as shown in the calibration chart, and lock it. Use the movable indicating mark as the index against which to set the dial.

If your transmitter has a vernier scale, and the B-dial reading has a decimal point, align the decimal reading as you do on the dial of the SCR-211 frequency meter. (See ROIF 4-4.)

2. Turn the meter-selector switch to PA GRID position and press the TEST switch. The meter reading should fall in the area labeled PA GRID. If it doesn't, check position of control A. Release the TEST switch.

3. Put the meter selector switch on PA PLATE position.

4. Refer to the antenna-tuning tables below for the approximate C, D, and E settings.

The tables below give you a quick-reference guide for tuning the antenna-matching network and power-amplifier controls, C, D, and E. They are approximately correct for any airplane using these antenna lengths. If no D setting appears on the chart, set the D control on 50.

The settings for the U. S. Emergency and Safety Frequency, 8280 kc, are listed in red.

Include the lead-in and the down-lead in calculating the total length of an antenna. With an L-type antenna, figure the length of the longest leg.

You must know the overall length of your antenna.

B-17 ANTENNA—LENGTH APPROXIMATELY 27.5 FEET. 75mmfd. (three sections) of shunt capacitance must be connected to the antenna circuit to permit tuning in the 2000-to-2600 kc range.

B-17	KC	C	D	E	KC	C	D	E	KC	C	D	E
	2600	1	—	0	9100	7	100	200	9000	11	45	40
	3000	2	—	75	9000	10	59	10	10000	11	40	140
	3500	3.4	—	110	9500	10	57	80	12000	11	55	195
	4000	4.5	—	130	10000	10	55	110	14000	11	75	200
	5000	6	—	150	11000	10	60	175	16500	11	95	200
	6000	6.7	—	165	12000	10	65	185	16000	13	0	180
	8000	7	70	190	14000	10	80	195	17000	13	45	190
	8280	7	75	185	15500	10	100	195	18000	13	60	195

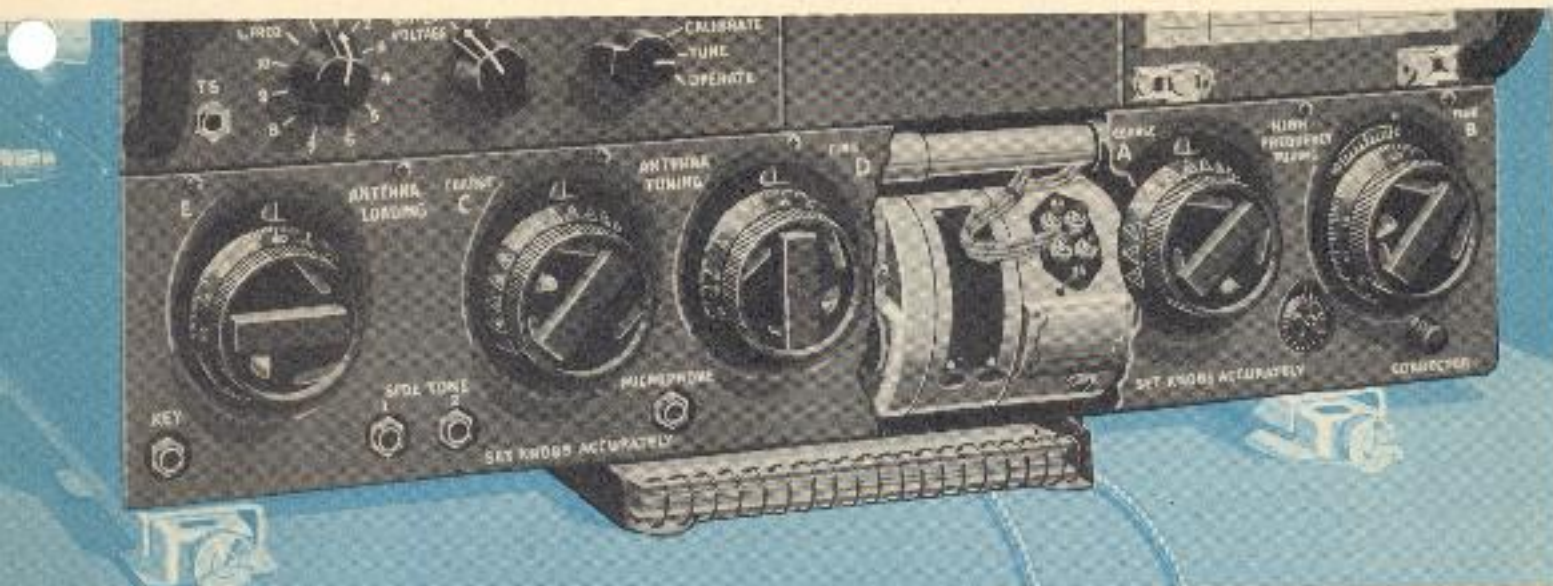
B-24 ANTENNA—LENGTH APPROXIMATELY 50 FEET. NO SHUNT CAPACITANCE REQUIRED.

B-24	KC	C	D	E	KC	C	D	E	KC	C	D	E
	2100	1-2	—	0	5500	7	100	180	11000	11	53	200
	2500	3.4	—	19	6000	8	38	90	12000	11	72	200
	3000	4.5	—	55	6210	8	42	110	13000	13	82	200
	3105	—	—	65	7000	8	48	148	14000	13	100	0
	4000	6.7	—	120	8000	8	65	152	15000	13	52	125
	4220	6.7	—	130	8280	8	70	150	16000	13	69	136
	4495	7	—	140	9000	8	85	148	17000	13	71	164
	5000	7	—	160	10000	11	40	200	18000	13	68	184

B-29 ANTENNA—LENGTH APPROXIMATELY 62 FEET. NO SHUNT CAPACITANCE REQUIRED.

B-29	KC	C	D	E	KC	C	D	E	KC	C	D	E
	2000	2	26	0	6000	8	42	140	12000	11	71	156
	2500	4	69	17	6290	8	48	140	13000	11	77	178
	3000	5	100	77	7000	8	61	140	14000	11	87	168
	3100	6	32	73	8280	8	85	100	15000	3	56	140
	3500	6	76	117	9000	9	76	132	15500	13	73	115
	4000	7	37	154	10000	10	77	3	16000	13	86	40
	4495	7	75	170	10500	12	48	16	17000	13	91	122
	5000	8	14	103	11000	11	69	72	18000	13	97	127

Consult your Operating Manual or T.O. for other antenna-tuning charts.



You must now use one of two procedures to tune the power amplifier and load the antenna circuit.

Use these steps
if control C is
set anywhere
from 1 through 7

5. Hold the TEST switch closed and seek a plate-current dip by rotating control E. If you do not find a resonance dip, place control C on the next higher position and rotate control E again. Repeat this process until you find a resonance dip.

6. Turn CALIBRATE-TUNE-OPERATE switch to OPERATE, and load the power amplifier with control D, re-resonating each time with E, until the dip falls within the area labeled CW. If you rotate D throughout its range and the meter reading is still low, move control C to the next higher position and adjust D again. Repeat the procedure until the meter reading is correct.

Caution: Notice that the calibrations of the E dial are divided into two sections (0 to 100 and 100 to 200) separated by short blank spaces. Do not move the dial through these blank spaces while the TEST switch, microphone button, or key is closed, or the shorted plug inserted. You will damage an internal switch if you do.

Use these steps
if control C is set
anywhere from
8 through 13

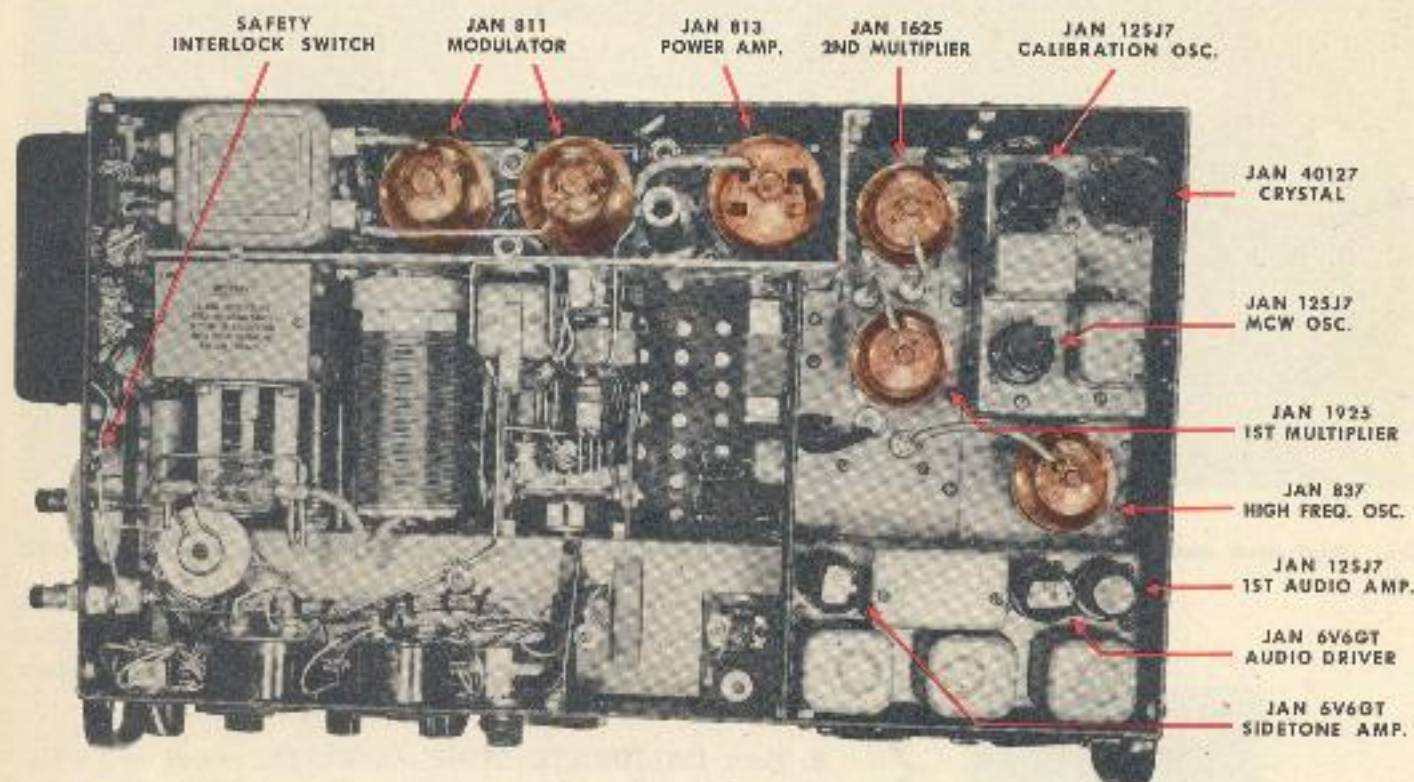
7. Hold the TEST switch closed, and seek a plate-current dip by rotating control D. If you do not find a resonance dip, place control C on the next higher position and rotate control D again. Repeat this process until you find a resonance dip.

8. Turn the CALIBRATE-TUNE-OPERATE switch to OPERATE, and load the power amplifier with control E, re-resonating each time with D, until the dip falls within the area marked CW. If you rotate E throughout its range and the meter reading is still low, move control C to the next higher position and adjust E again. Repeat the procedure until the meter reading is correct.

For VOICE or MCW, set the EMIS-
SION switch accordingly. The meter
should read about 150 ma for voice
operation, and up to the MCW por-
tion of the scale for MCW.

9. Lock C, D, and E. Observe their settings closely before you
back them off to start locking. To make sure they have not
slipped, turn the CHANNEL switch to a different channel, then
back. The Autotune thus makes a complete cycle, and afterward
the meter should still read CW. If it doesn't, repeat the locking
procedure. Be sure to lock the dials before you change channels,
or you will disturb the settings of the channels already tuned.

EMERGENCY OPERATIONS



TUBE FAILURE

If certain of the transmitter's tubes fail, you can still operate on CW, using a minimum number of tubes. CW operation is possible without any of these: audio, calibration-frequency-oscillator, MCW-oscillator, and sidetone-amplifier tubes.

If you replace the speech-amplifier tube with either an MCW or a calibration-frequency-oscillator tube, CW and VOICE operation are still possible. However, the calibration-frequency oscillator and the MCW oscillator will be disabled.

The six tubes illustrated in color must be intact to permit any emergency operation.

SWITCHING UNIT FAILURE

Connect the ANT post on the transmitter directly to the antenna lead-in. This lets you carry on high-frequency operation.

VACUUM SWITCH FAILURE

Remove the wire from the ANT post and connect it to the COND post. Connect a wire from the RECEIVER post on the transmitter to the antenna you

are not using (either fixed- or trailing-wire). Be sure the trailing-wire antenna is reeled out.

This operation may damage the receiver, especially if you are using the same frequency for transmission and reception. To prevent possible damage, disconnect the wire from the ANT post on the receiver while you transmit.

AUTOTUNE FAILURE

If the Autotune should fail to set all the tuning dials properly:

1. Turn all the incorrectly-set controls counter-clockwise as far as they will go. Then turn them clockwise until they stop.

2. If that fails, put the CHANNEL switch on MANUAL and set the controls on the proper positions for the frequency at which you are to operate.

Don't loosen the locking bars when you are tuning manually; you'll de-tune all the pre-set channels.

Notes: B-29 installations include a coupler (CU-92/ARN) which lets you use the LORAN antenna if the liaison antenna is disabled. LORAN reception is cut off only when you use the transmitter.

A safety interlock switch is now part of this set and will be installed in all units in the future.

SCR 287—HIGH-POWERED LIAISON EQUIPMENT

TRANSMITTER EQUIPMENT

FREQUENCY RANGE

200 to 500 kc

1500 to 12500 kc

for high- and
low-frequency
LONG-RANGE
communication



The entire frequency range of the transmitter is covered by seven interchangeable TRANSMITTER TUNING UNITS. Therefore the operating frequency range in the airplane depends upon the number of TRANSMITTER TUNING UNITS carried.

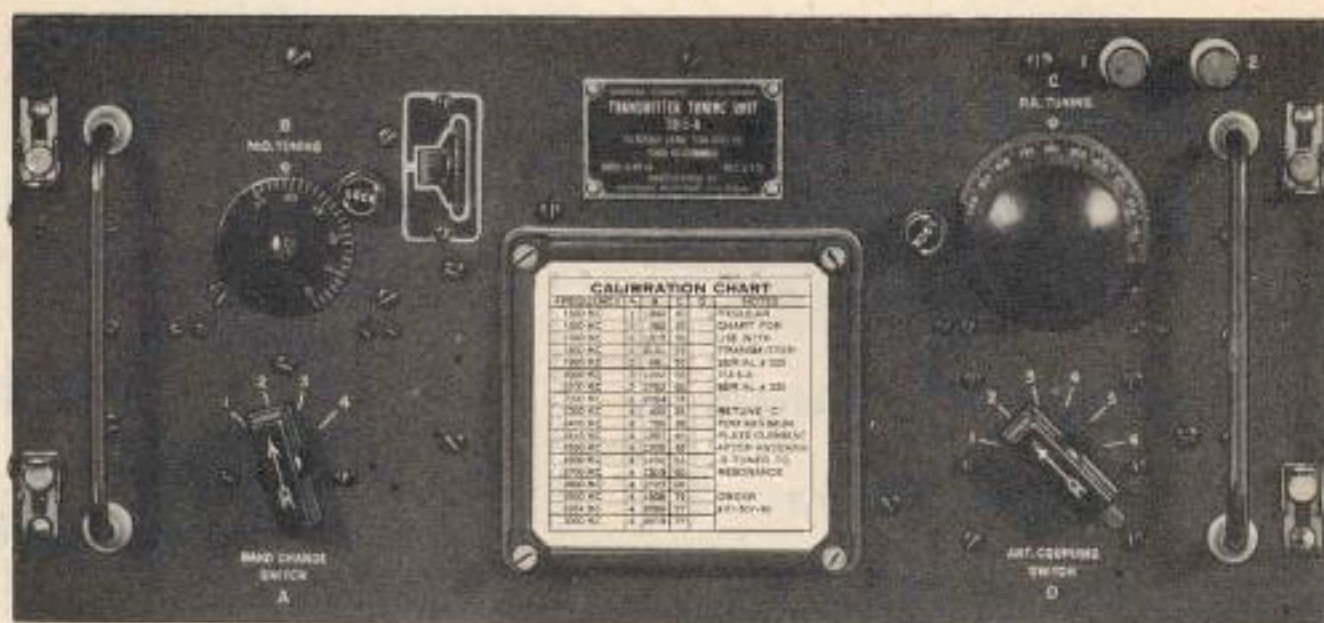
The transmitter may be operated using VOICE,

CW, or MCW emission on any frequency within its range.

In some airplanes the transmitter may be operated from either the pilot's, co-pilot's, or radio operator's interphone jackbox.

TRANSMITTER TUNING UNITS

The TRANSMITTER TUNING UNIT contains the tuning circuits for the master-oscillator and power-amplifier. This unit plugs into the transmitter forming a part of the transmitter's front panel.



Seven of these units cover the frequency range of 200 to 500 kc and 1500 to 12500 kc. They are as shown in chart.

TU-5-B	1500 to 3000 kc
TU-6-B	3000 to 4500 kc
TU-7-B	4500 to 6200 kc
TU-8-B	6200 to 7700 kc
TU-9-B	7700 to 10000 kc
TU-10-B	10000 to 12500 kc
TU-26-B	200 to 500 kc

ANTENNA TUNING UNIT BC-306-B

This unit provides sufficient loading to permit tuning on frequencies from 150 to 500 kc. It consists of a tapped inductance, with a variometer in series, plus a condenser one side of which is grounded and the other side connected to a terminal on top of the unit. The extra condenser provides for operation of the transmitter into a fixed-wire antenna on frequencies as low as 250 kc.



Never use voice or tone emission on frequencies below 1500 kc while operating into a fixed-wire antenna.

Satisfactory CW operation can be obtained up to altitudes of approximately 15,000 feet when operating below 1500 kc into a fixed-wire antenna.

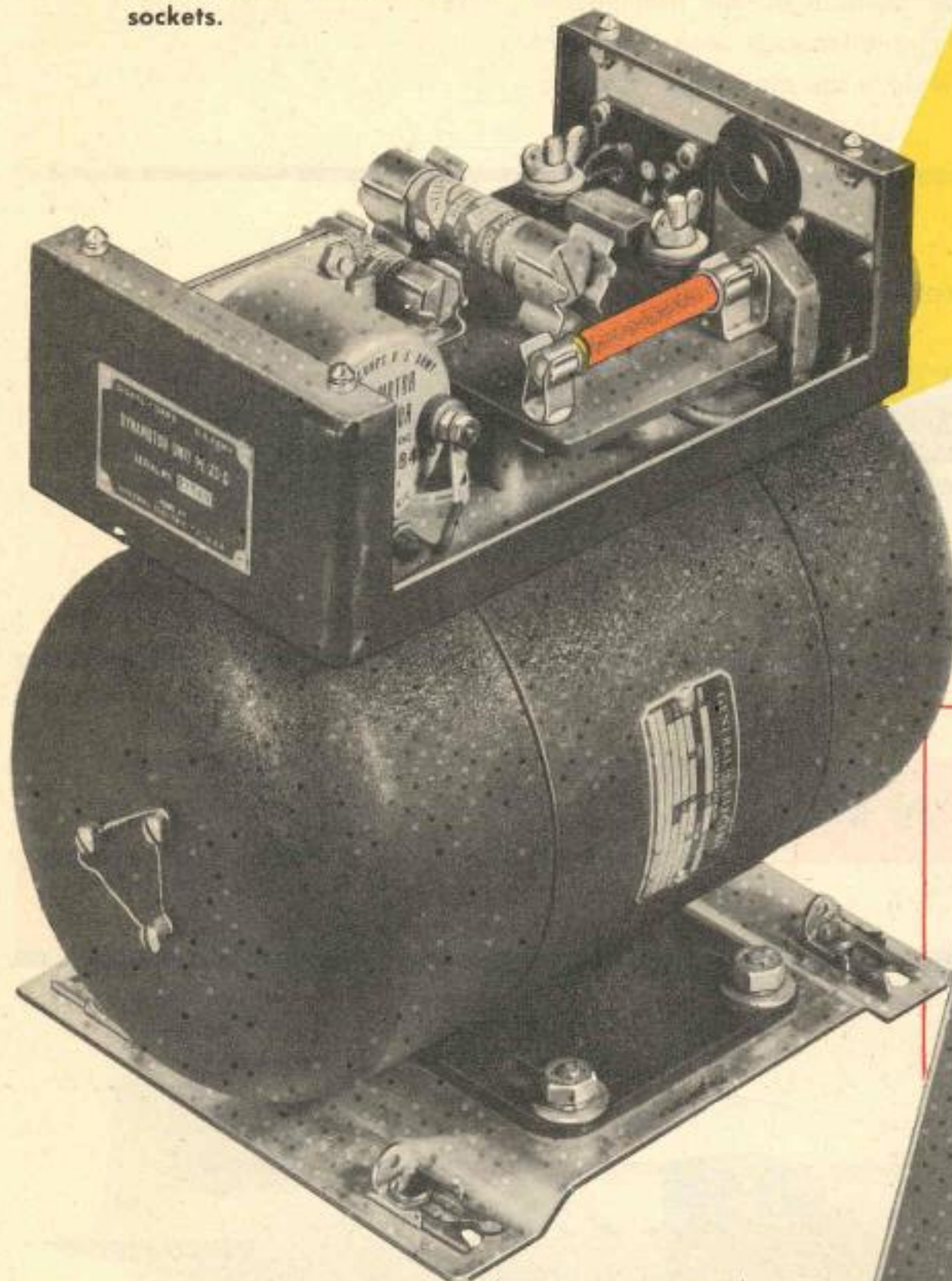
Because of the type of insulation used in this unit occasional flashovers will not be injurious.

In general, instructions for antenna tuning unit BC-306-A are also applicable to the BC-306-B. The BC-306-B is modified for use with a fixed-wire antenna at lower frequencies. It operates normally as an A-type when used with a trailing-wire antenna.



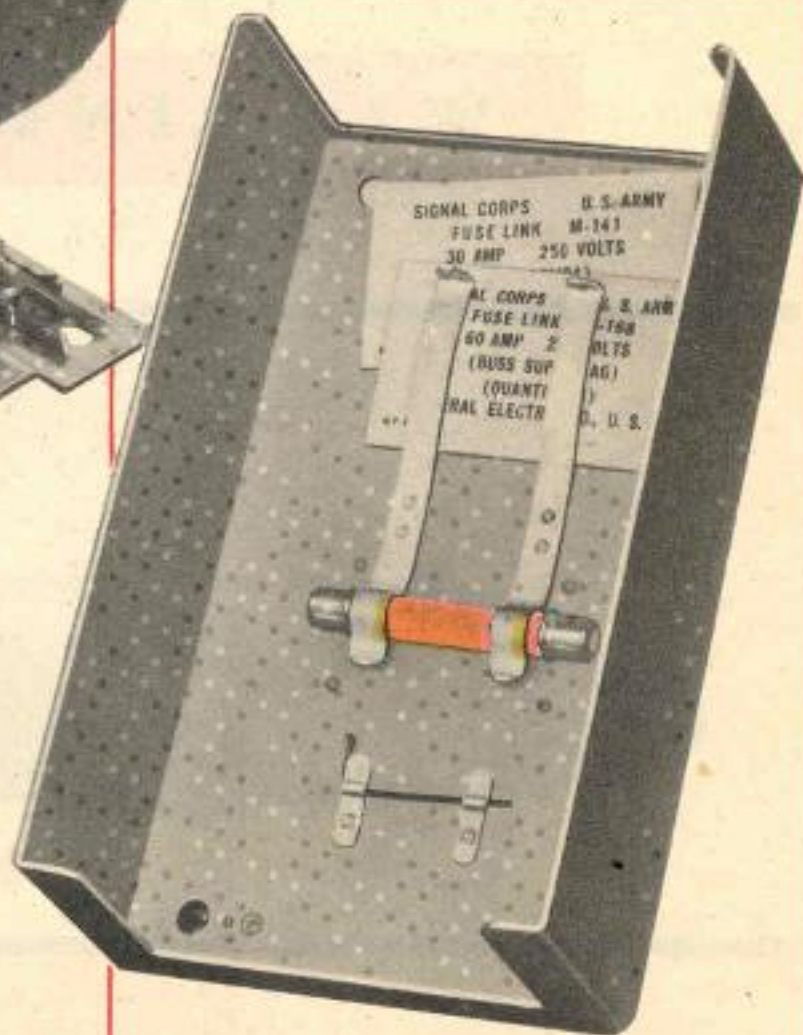
DYNAMOTOR UNIT PE-73

The dynamotor unit consists of a dynamotor and a box, containing a contactor unit, fuses, filter condensers, and connector sockets.



The output of the dynamotor is approximately 1,000 volts. A radio-frequency interference filter is included to eliminate objectional brush noises in the receiving equipment within the airplane. The filter consists of condensers connected so as to by-pass the various sources of radio-frequency interference voltages generated by the commutators.

All transmitter fuses, except one, are located in the top of the unit. These include the starting fuse (60-ampere), the transmitter low-voltage-circuit fuse (30-ampere), and a dynamotor high-voltage fuse (1-ampere). An additional high-voltage fuse ($\frac{1}{2}$ -ampere) is located inside the transmitter.

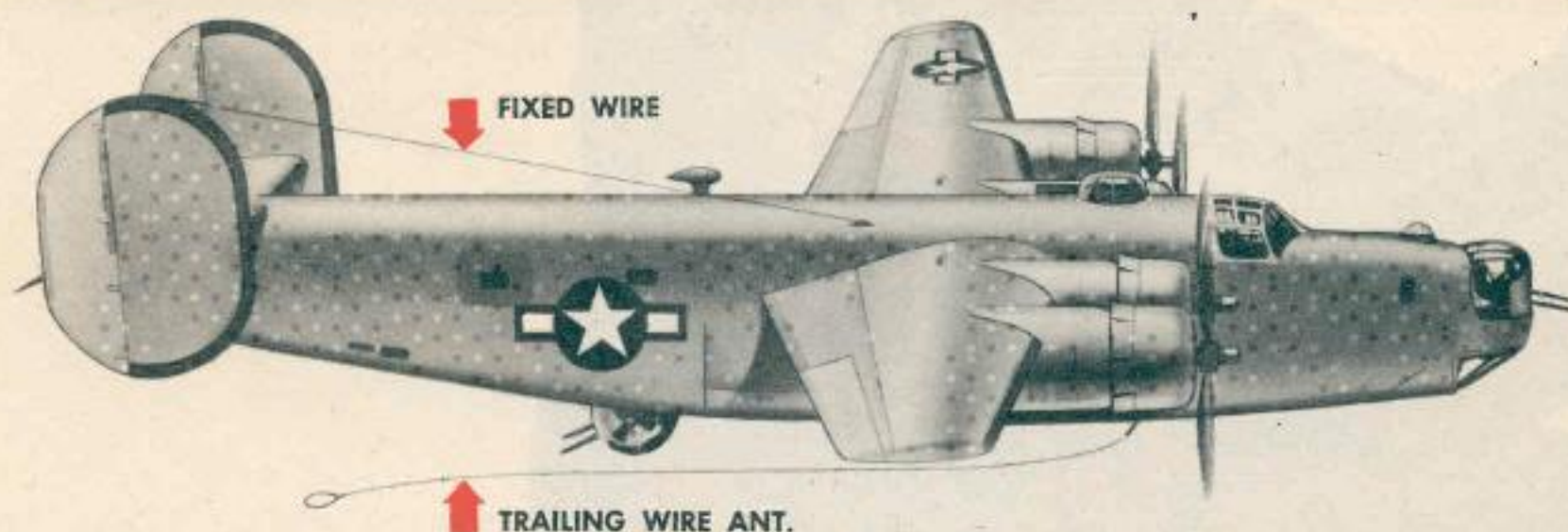


A spare high-voltage fuse, spare fuse links, and a hex wrench are carried in clips inside the cover. The hex wrench is for making brush-holder adjustments.

ANTENNA SYSTEM

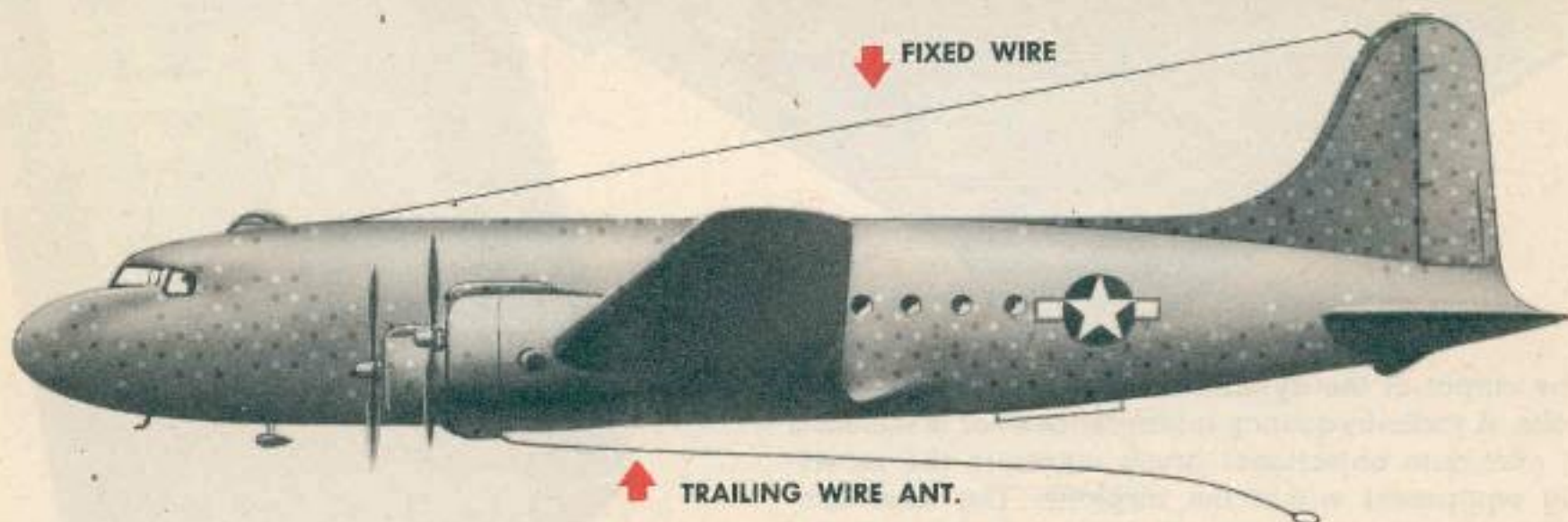
Two types of antenna systems are provided for the liaison equipment on all aircraft so equipped. The fixed-wire type is used for formation flying and medium- or high-frequency operation. The trailing-wire type is used for long-range transmission on medium or low frequencies.

On some types of airplanes a skin-type antenna is used instead of a fixed-wire type. The skin antenna employs the airplane's wing surface for the antenna.



WARNING

The trailing-wire antenna must be reeled in before landing or when not in use. Never reel it out at speeds exceeding 240 mph.



REMEMBER

Know the length of the antennas with which you are operating. Full transmission mileage may save the life of your crew.

TRANSMITTER CONTROLS



TEST KEY is a spring-return, plunger-type switch used to close the keying circuits of the transmitter.

TONE-CW VOICE switch controls the type of emission used by the transmitter.

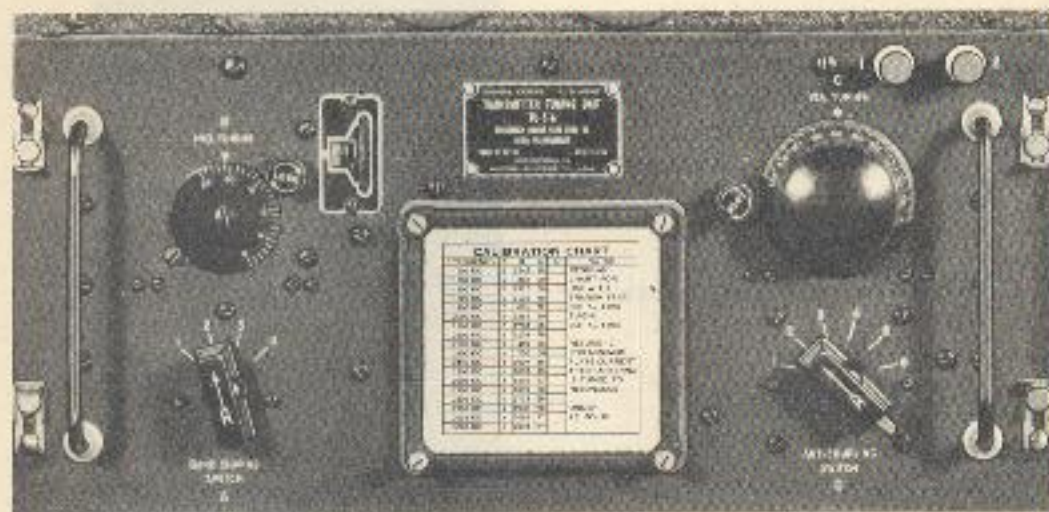
ON-OFF switch controls the input (central-power-system) voltage applied to the dynamotor unit.

TOTAL PLATE-CURRENT meter is used primarily for tuning the power-amplifier.

FIL-VOLTAGE meter registers the filament voltage applied to the transmitter tubes.

CW FIL-MOD FHL toggle makes it possible to measure the filament voltage when operating with or without the two modulator tubes.

RED LIGHT, when lighted, indicates the equipment is turned on.



The B settings are all reasonably accurate if the serial numbers on the tuning units correspond with those on the transmitter.

The transmitter tuning-unit panel, provides the necessary controls for tuning the master-oscillator and power-amplifier circuits.

The A control is a **BAND-CHANGE SWITCH**. This control is not found on all tuning units. It is provided only when the tuning controls do not cover the complete frequency range.

The B dial controls the Master-Oscillator's operating frequency. On the small round dial 0-25, the calibration numbers are indicated in hundreds. The

drum tuning provides for finer adjustment and is calibrated in unit numbers.

The C or PA TUNING dial is the power-amplifier plate-tank tuning control.

ANTENNA COUPLING SWITCH (D) controls the amount of coupling from the power-amplifier tank to the antenna circuits within the transmitter.

The **CALIBRATION CHART** gives the settings for all of the tuning controls on the unit. The C settings are all approximate.

ANTENNA TUNING CONTROLS

The antenna tuning equipment in the transmitter is designed to resonate airplane antennas at any frequency from 1500 to 12500 kc. Over this range it is necessary to resonate antennas above and below their fundamental operating frequencies. Therefore, the circuit constants may be selected so as to permit either current ($\frac{1}{4}$ wave length) or voltage ($\frac{1}{2}$ wave length) tuning of the antenna.

ANTENNA CIRCUIT SWITCH N

selects either a series (current) or parallel (voltage) resonant circuit for tuning the antenna system. There are four positions as follows:

- 1—First position (voltage) for very long antennas when operating at higher frequencies, usually 10000 to 12500 kc.
- 2—Second position (current) for antennas approximately correct in length for the operating frequency.
- 3—Third position (current) for antennas slightly too short.
- 4—Fourth position (current) for very short antennas.

ANTENNA IND TUNING M

A rotating inductor provided to compensate for slight variations in the inductive reactance of the antenna.

ANTENNA CAP TUNING O

A variable condenser used to provide for any variations in the capacitive reactance of the antenna. This control must be varied when tuning on the first or second positions of switch N. Satisfactory operation may be obtained by leaving it on 50 for the third and fourth positions of switch N.

ANTENNA IND SWITCH P

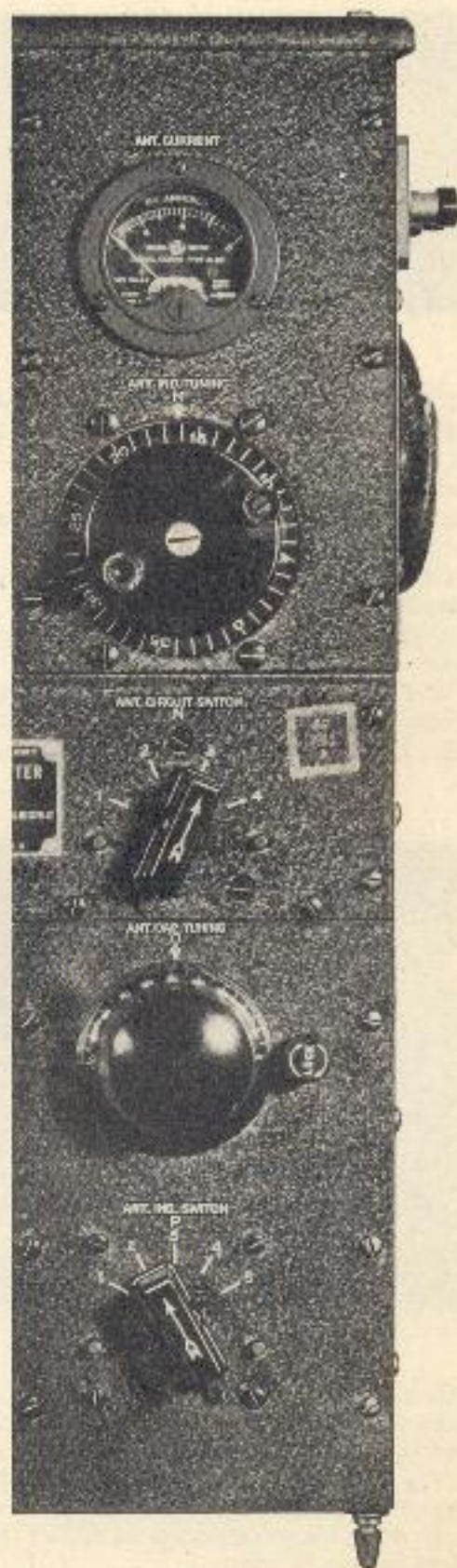
A tapped inductor. It provides additional inductance only when switch N is on position 4.

When switch P is not in the circuit, it should be placed on position 2 for TRANSMITTER TUNING UNITS 5, 6 and 7 and on position 5 for units 8, 9, and 10.

ANTENNA CURRENT METER

A thermocouple-type meter. It indicates the radio-frequency current feeding into the antenna system. **Always figure the length of antenna required and compare it with the length of the antenna on the airplane.** Use the following formula for determining the required length: (for $\frac{1}{4}$ wave length antenna)

$$\text{Length in feet} = \frac{234}{\text{frequency in mc}}$$



MEDIUM-HIGH FREQUENCY TUNING

800-12500 KC

1. Select the TRANSMITTER TUNING UNIT that covers the operating frequency you want, and put it into the transmitter.

2. Set controls A, B, and C according to the calibration chart, and put D on position 1. If the operating frequency falls between those shown on the chart, you must interpolate to find the correct B-dial (master oscillator) setting. (See ROIF, page 4-2-8.)

3. Turn the TONE-CW-VOICE switch to CW.

4. Put the E switch of the BC-306 ANTENNA TUNING UNIT on position 1.

5. Set the N switch according to the length of your antenna. The chart below gives you approximate settings for the antennas of several common airplanes. It is also applicable to any other airplane using an antenna of the same length.

6. Adjust the O control as required, if the N switch is on positions 1 or 2. If it is on positions 3 or 4, set control O on 50.

7. If you are using TUNING UNITS 5, 6, or 7, put the P switch on position 2. With units 8, 9, or 10, put the P switch on 5.

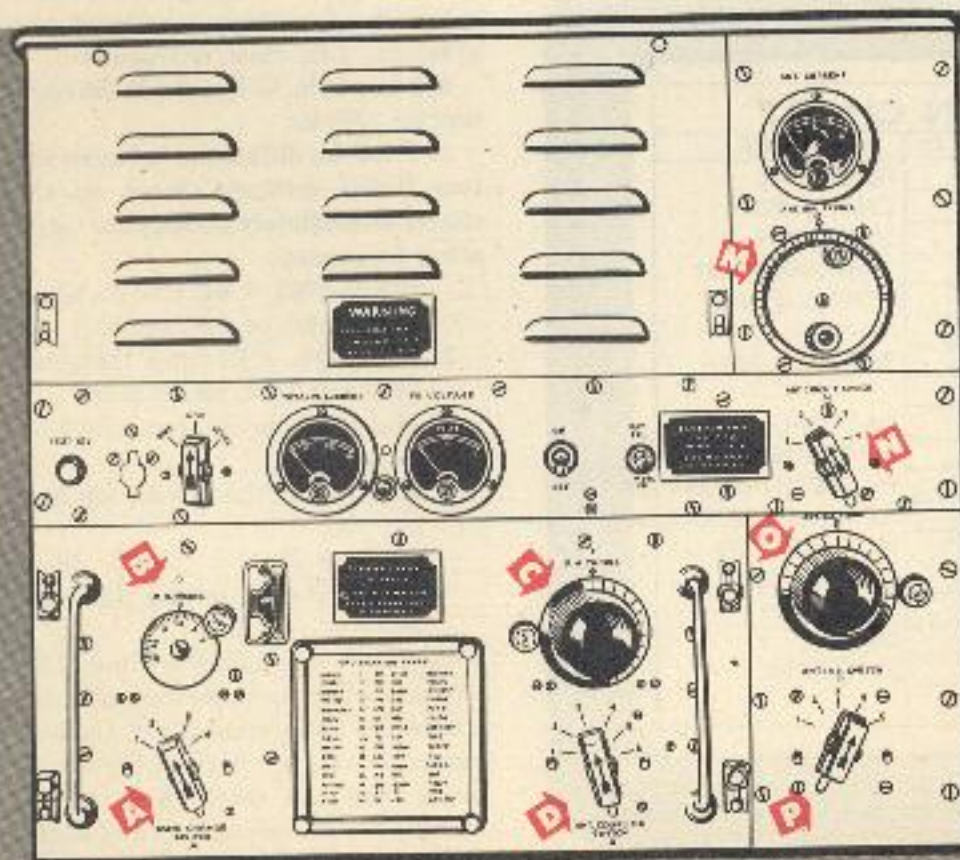
8. Turn the ON-OFF switch ON, and open the antenna change-over knife switch.

9. Press the TEST KEY, and adjust the C dial until you have a **minimum** reading on the plate current meter.

10. Close the antenna change-over knife switch. Make sure it is in the proper position.

11. Rotate the M inductor for maximum plate current (200-220 ma). If the meter reading does not reach this value, increase the power-amplifier coupling, by setting the D switch to a higher value. Do not exceed 230 ma.

12. Repeat steps 9, 10, and 11 until any movement of the C control produces an **increase** in plate current, and any movement of the M control produces a **decrease** in plate current.



B-26 and C-47, approx. 40 ft.
1500-2000 kc—N on 4
2000-5800 kc—N on 3
5800-12500 kc—N on 2

B-17 and B-25, approx. 30 ft.
1500-2000 kc—N on 4
2000-7800 kc—N on 3
7800-12500 kc—N on 2

B-24, approx. 50 ft.
1500-1800 kc—N on 4
1800-4600 kc—N on 3
4600-12500 kc—N on 2

INTERPOLATION

If the frequency on which you wish to operate does not appear on the chart, but falls between two others shown there, you must interpolate to find the proper B-dial setting. To do this:

On the calibration chart, find the frequencies directly above and below the one you want to use.

Find the number of B-dial divisions per kilocycle between these frequencies.

Find the difference between your operating frequency and the listed frequency below it.

Multiply this difference by the number of divisions per kilocycle, and add the result to the B-dial setting for the lower frequency.

Interpolation is possible only when the A (band switch) setting is the same for both listed frequencies.

Example:

To find the B-dial setting for 2585 kc.

1. Subtract the nearest listed B-dial settings (100 kc apart) above and below 2585:
 $1292 - 1038 = 254$ (for 100 kc) or 2.54 divisions per kc.
2. Find the difference between 2585 and 2500:
 $2585 - 2500 = 85$.
3. Multiply the above difference by 2.54:
 $85 \times 2.54 = 215.9$.
4. Add this to the setting for 2500 kc:
 $1038 + 215.9 = 1253.9$, the B-dial setting for 2585 kc.

Extrapolation

When the A settings above and below the frequency you want are different, you must extrapolate.

For example, to find the B-dial setting for 2260 kc:

1. Find the difference between the two B-dial settings (listed on the chart) immediately above your operating frequency.

$(2204 - 1763 = 441$ dial divisions per 100 kc, or 4.41 per kc.)

2. Find the difference between 2260 and 2200, which is 60.

3. Multiply this difference by 4.41, to get 264.6.

4. Add this to the setting for 2200 kc.

$(2204 + 264.6 = 2468.6$, which is the B-dial setting for 2260 kc.)

Note: If it is impossible to interpolate or extrapolate by these methods, use a different calibration chart. Usually several charts are back of the one in place. You can reach them by removing the four thumb screws of the chart frame.

CALIBRATION CHART

FREQUENCY	A	B	C	D	NOTES
1500 KC	1	1242	48		REGULAR
1600 KC	2	362	20		CHART FOR
1700 KC	2	1312	50		USE WITH
1800 KC	2	2101	75		TRANSMITTER
1900 KC	3	681	32		SERIAL # 235
2000 KC	3	1262	50		TU-5-A
2100 KC	3	1763	65		SERIAL # 235
2200 KC	3	2204	78		
2300 KC	4	439	26		RETUNE "C"
2400 KC	4	758	36		FOR MINIMUM
2495 KC	4	1027	45		PLATE CURRENT
2500 KC	4	1038	45		AFTER ANTENNA
2600 KC	4	1292	53		IS TUNED TO
2700 KC	4	1519	60		RESONANCE
2800 KC	4	1723	66		
2900 KC	4	1908	72		ORDER
2994 KC	4	2069	77		# 51-NY-40
3000 KC	4	2079	77		

LOW FREQUENCY 200-800 KC

TUNING PROCEDURE

- 1—Insert the TRANSMITTER TUNING UNIT, covering the desired operating frequency, in the transmitter.
- 2—Place controls A, B, and C to the settings indicated on the calibration chart. Set D on position 1.
- 3—Place TONE-CW-VOICE switch on CW position.
- 4—Place N switch on position 3.
- 5—Start switch E (on BC-306) on position 2.
- 6—Place O control on 50.
- 7—Place transmitter ON-OFF switch on ON position.
- 8—Press TEST KEY and tune C for minimum plate-current reading.
- 9—Tune VARIOMETER F control (on BC 306) for maximum plate-current reading. **If no rise in plate current can be obtained increase E control until the correct reading can be obtained with F.**
- 10—Adjust switch D until a plate-current reading of from 200 to 220 ma is obtained.
- 11—Recheck C dial setting. Any change in C should cause an increase in plate current. Any change in F should cause a decrease.

VOICE OPERATION—Transmitter must first be tuned up on CW

- 1—Note total plate-current reading for CW operation.
- 2—Place TONE-CW-VOICE switch to VOICE position.
- 3—Remove front tube cover from transmitter.
- 4—Place transmitter ON-OFF switch on ON position.
- 5—Press TEST KEY. Insert a screwdriver in the MOD BIAS adjustment and rotate until an increase of from 20 to 35 ma in the total plate current is obtained.
- 6—Speak or whistle a sustained note into the microphone with the button pressed, and note the rise in total plate current. It should read 300 ma. If it does not, adjust the INPUT LEVEL until a reading of approximately 300 ma is obtained.

THE TRANSMITTER WILL NOT REQUIRE ANY ADDITIONAL ADJUSTMENT FOR TONE OPERATION—TOTAL PLATE CURRENT ON TONE SHOULD BE FROM 300 TO 350 MA.

TRAILING-WIRE ANTENNA

TUNING PROCEDURE

If necessary, the trailing-wire antenna can be used to extend the transmitting range on the lower frequency ranges.

The following procedure is recommended for use with the trailing-wire antenna:

- 1—Request the pilot's permission to reel out the antenna.
- 2—If the reel control-box indicator does not read 000, set it there by means of the reset knob on left side of the control box.
- 3—Make certain the antenna-changeover knife switch is in the trailing-wire-antenna position.
- 4—Place N switch on position 3 and D switch on position 2.
- 5—Set ANT IND TUNING M at 10.
- 6—Press TEST KEY and turn the trailing-wire antenna control box OFF-IN-OUT switch to OUT position. Watch for a rise in plate current (each rise indicates resonance on an odd quarter-wave length).
If a rise is not found the first time, reel the wire in and place D switch to position 3 and try again.
- 7—Stop the wire as closely as possible to the rise in plate current. This will minimize the amount of loading necessary and will result in greatly increased power output.
- 8—Rotate M indicator for maximum plate-current reading. **Do not exceed 230 ma.** If maximum plate current is less than 210 ma move control D to the next highest number.

The following tables give approximate antenna lengths and their respective counter readings for the most common operation frequencies.

For frequencies below 1500 kc, use full length of the trailing wire.

There may be more than one point at which a rise in plate current is found. Best operation is obtained when the rise in plate current employing the greatest length of wire is used.

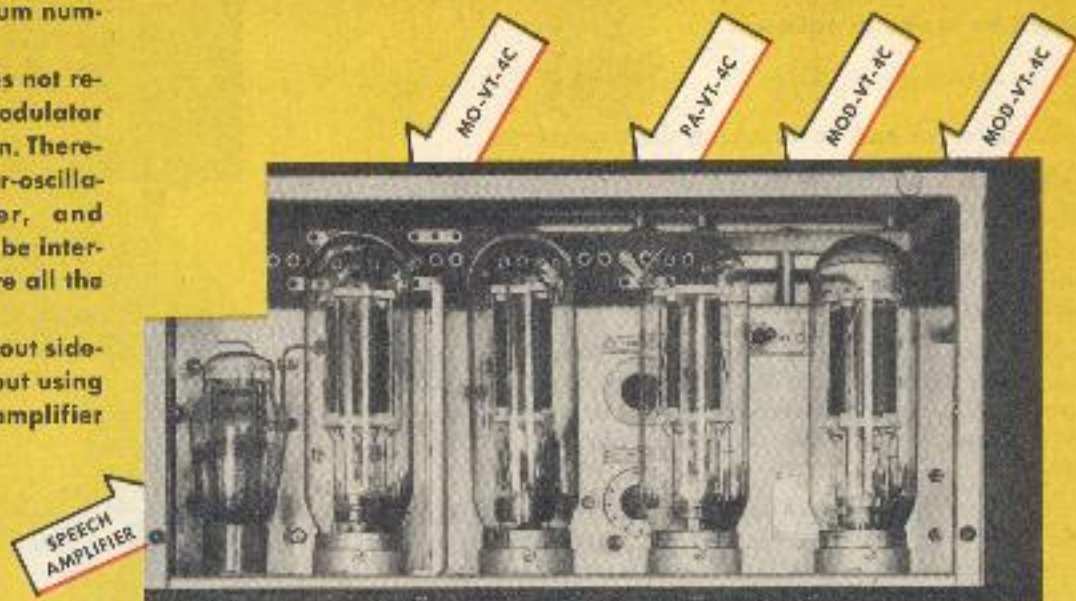
KC	$\frac{1}{4}$ WAVE LENGTH		$\frac{3}{4}$ WAVE LENGTH	
	Length (feet)	Counter reading	Length (feet)	Counter reading
2000	123	108		
2000	82	72		
4000	62	54		
5000	49	44	147	130
6000	41	36	123	108
7000	35	30	105	92
8000	31	28	93	82
9000	27	24	81	72
10,000	24	22	73	64

EMERGENCY OPERATION

In case of tube failures the transmitter may be operated on CW using a minimum number of tubes.

The transmitter does not require the use of the modulator tubes for CW operation. Therefore the VT-4C master-oscillator, power-amplifier, and modulator tubes may be interchanged since they are all the same type.

CW operation, without side-tone, is possible without using the VT-25 speech amplifier tube.



ANTENNA SYSTEM

By carrying a spare piece of wire with battery clips on both ends the command-equipment antenna can be connected to the liaison equipment and be used as a substitute in an emergency.

KEYING

The transmitter can be keyed by using the TEST KEY on its front panel, or by plugging a microphone into the jack on the left side of the transmitter and using the hand switch of the microphone for a key.

MAINTENANCE AND INSPECTIONS

To insure proper transmitter operation a routine check on the condition of the transmitter equipment should be made daily.

The following checks are recommended:

- 1—Check all connecting cords for breaks and for frayed bonding or shielding.
- 2—Inspect the antenna system thoroughly. Wipe insulators clean. Be sure the antenna leads are not bent close to metallic objects where high antenna voltages might cause sparkovers.
- 3—Inspect the microphone and key circuits.
- 4—Give the transmitter a complete operating check.

Note the total plate- and antenna-current readings. If they are not normal make further checks to determine why they are not.



FUSES

The high-voltage circuits within the transmitter are protected by a ½-ampere 1,000-volt fuse.

Two spare high-voltage fuses are carried in clips inside the transmitter.

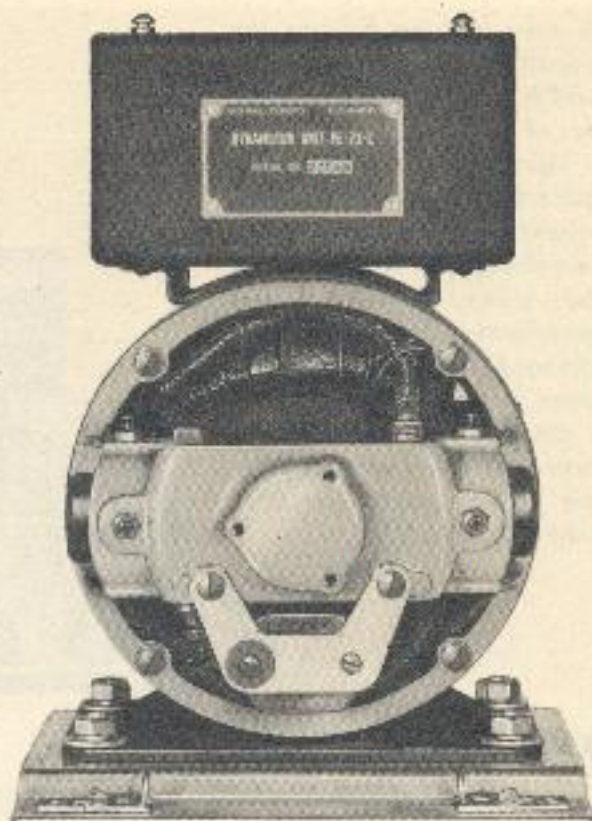
A safety interlock switch is provided to turn the dynamotor off when a tuning unit is removed.

CAUTION: Be sure the dynamotor has stopped running before replacing a high-voltage fuse. Be sure the main switch is in the OFF position. The high voltage present while the dynamotor is running at full speed is dangerous to life.

DYNAMOTOR

The transmitter dynamotor must be checked at periodic intervals to insure proper operation. This should be made as follows:

- 1—Remove the end covers from the dynamotor.
- 2—Remove the brushes from one end at a time, being very careful to note their polarity markings.
- 3—If gasoline or kerosene is available clean the brushes thoroughly. **Do not clean them with carbon-tetrachloride.**
- 4—Note the condition of the commutator. Wipe it clean with a lintless rag. Remove scum with carbon-tetrachloride. **Do not attempt to remove the polished discoloration. This indicates normal operation.**
- 5—If the commutator is rough or pitted it should be sanded smooth with 00 sandpaper. Determine the cause of the rough or pitted commutator. This condition is usually caused from poor brush contact, loose brush springs, or defective brushes and brush holders.
- 6—Check the condition of the brushes thoroughly. **Replace any brush less than $\frac{1}{4}$ inch in length.** Be sure there are no hard spots or chipped corners on the brushes.
- 7—Spin the armature. It should spin freely. If it does not, check for cracked or dirty bearings or oxidized grease in the bearings.



LUBRICATION

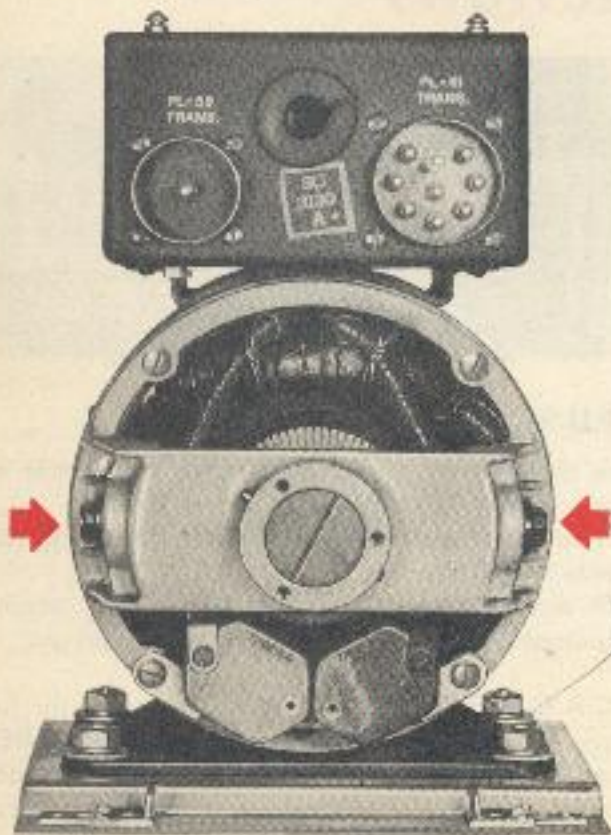
Under normal operating conditions the bearings should be greased after 5,000 hours of operation. If the bearing brackets are equipped with oil holes three drops of SAE 20 oil should be inserted every 1,000 hours or at 6-month intervals. Refer to technical orders for more complete instructions.



WARNING:

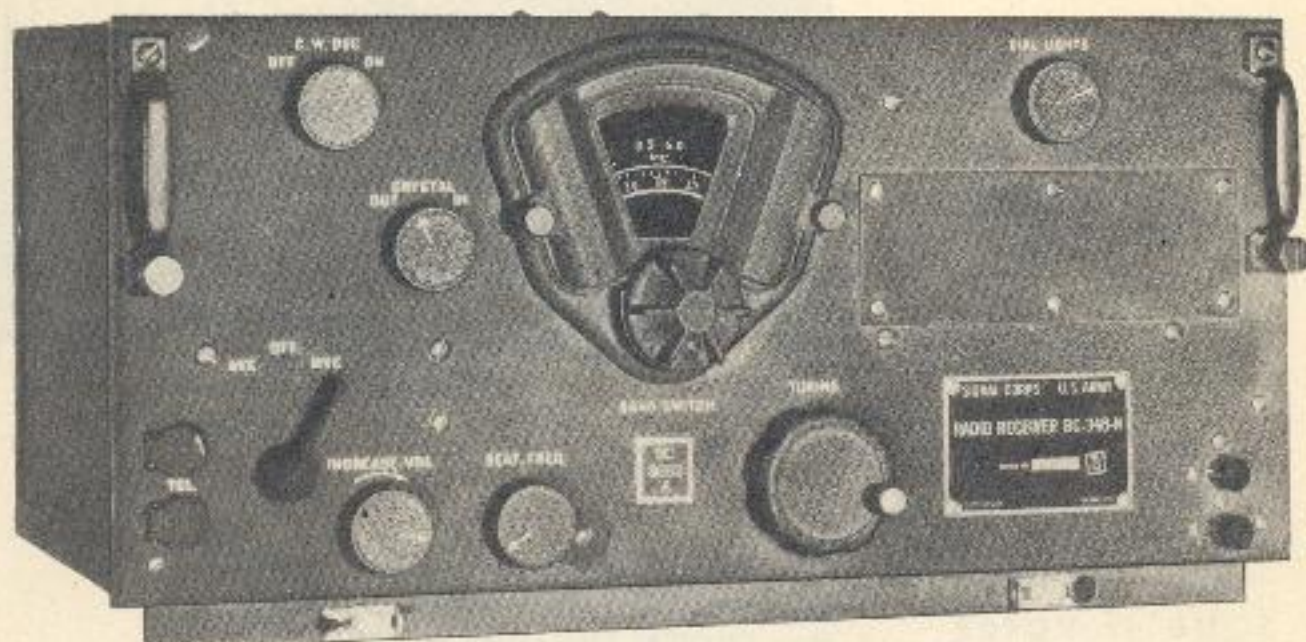
Never use emery cloth or a file for cleaning the commutator. Do not allow carbon-tetrachloride to come in contact with the brushes.

Do not allow any cleaning fluids to splash on armature or field windings. Do not lubricate too frequently.



SCR 287 HIGH-POWERED LIAISON EQUIPMENT

LIAISON RECEIVER



The BC 348 Receiver is a six-band, eight-tube super-heterodyne designed for operation with the BC 375 or the AN/ART-13 transmitter equipment. It is capable of receiving CW, MCW, or VOICE signals with MANUAL or AUTOMATIC VOLUME CONTROL. A built-in dynamotor is provided to furnish the high voltage necessary for its operation.

AVC-OFF-MVC

switch applies power to the receiver and selects either AUTOMATIC or MANUAL VOLUME CONTROL.

INCREASE VOL

control is a sensitivity adjustment when on MVC, and an output level adjustment when on AVC operation.

TUNING

control rotates tuning condensers to select desired operating frequency.

BAND SWITCH

selects the desired frequency band and changes the dial mask so that it indicates the operating-frequency range.

CW-OSC ON-OFF

toggle switch controls the operation of the CW oscillator as well as the automatic volume-control time constant for CW reception.

BEAT FREQ

varies the pitch of the CW signal being received. When tuning the receiver it should be set in zero-beat position (pointer straight up).

CRYSTAL OUT-IN

control permits insertion of a CRYSTAL FILTER when extreme selectivity is desired.

DIAL LIGHTS

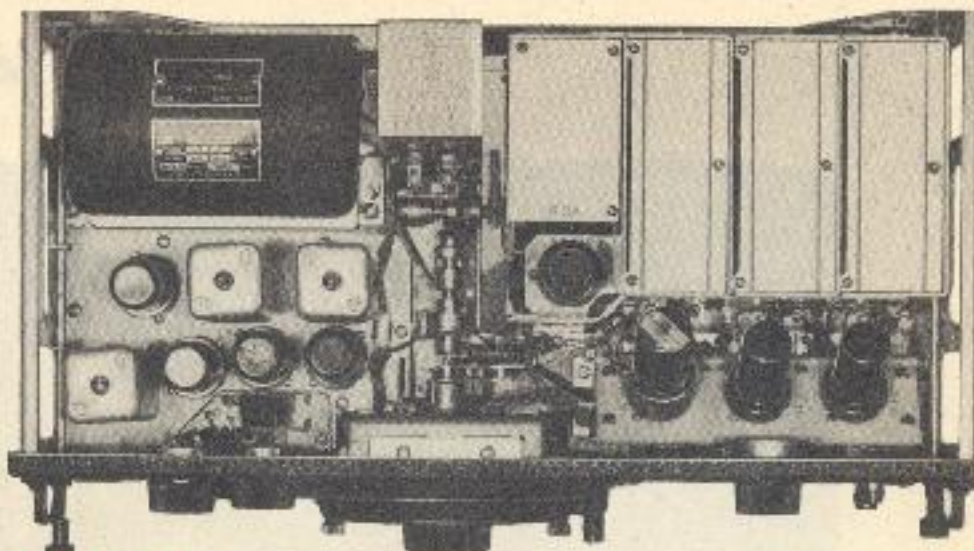
knob permits control of the intensity of the dial-light illumination.

ANT ALIGN

control aligns the input circuits of the receiver to a given antenna for maximum operating performance.

DYNAMOTOR

The high voltage is supplied by a dynamotor unit mounted on the receiver chassis.



RECEIVER OPERATION

TONE or VOICE RECEPTION

- 1—Place AVC-OFF-MVC switch on MVC position.
- 2—Place CW OSC toggle switch on OFF position.
- 3—Place CRYSTAL filter switch on OUT position.
- 4—Place BAND SWITCH on desired frequency range.
- 5—Tune in the station with TUNING control. Always tune for maximum volume of the signal being received.

CW RECEPTION

- 1—The procedure is the same as outlined for tone or voice with the exception that the CW OSC switch is ON, and the BEAT FREQ control is set with the arrow pointing straight up.
- 2—After the signal has been received the BEAT FREQ control may be varied until the pitch of the signal is desirable to the ear.
- 3—When extreme selectivity is desired to minimize interference the crystal filter should be switched to IN position. A slight readjustment of the TUNING and BEAT FREQ controls may be necessary after this is done.

NOTE: The CRYSTAL FILTER is intended primarily for CW reception. However, the added selectivity may prove helpful in receiving modulated signals through heavy atmospheric interferences.

AVC should not be employed while tuning in a signal—Initial tuning should always be accomplished in MVC position with the VOL control set to a comfortable output level. The volume control must not be turned to maximum-volume position while tuning. A strong signal will block reception.

ANTENNA ALIGNMENT

The ANT ALIGN control may be adjusted for maximum background noise at approximately 500 kc. This will align the receiver for all frequencies.

It is recommended, however, that this control be adjusted for maximum signal strength at the frequency of the signal being received.

MAINTENANCE AND INSPECTIONS

To insure proper operation, the receiver should be given a daily operational check as follows:

- 1—Place AVC-OFF-MVC switch on MVC position. Check dial lamps.
- 2—Check for proper operation on all bands with CW OSC switch ON. This test can be made by listening to background noise with the volume control near its maximum position.
- 3—Check the ANT and GND connections. Be sure they are secure.

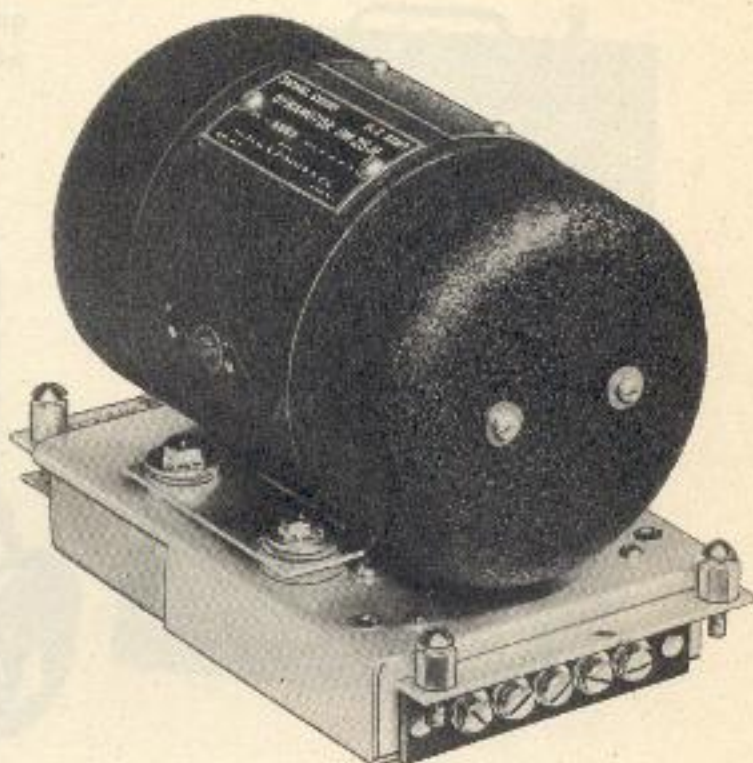
DYNAMOTOR

The dynamotor requires lubricating after 1,000 hours or approximately 6 months of ordinary service.

Complete lubricating instructions will be found inside the end covers.

To Remove from Receiver

- 1—Remove receiver from case by loosening the two thumbscrews under the handles on the front panel.
- 2—Remove the five spade terminals from the dynamotor-terminal strip (under the chassis).
- 3—Loosen the four screws from the top of the dynamotor assembly, and lift the assembly out of the receiver.



DIAL LIGHTS

The dial lights are located behind the dial-mask cover. These lights are wired in series, which means if one burns out the other will not light.

They are easily accessible by removing the dial-mask cover, which is removed by loosening the two small thumbscrews on each side of the cover.

FUSE The receiver is protected by one 5-ampere, 25-volt fuse located under the chassis near the front and center.

SCR 211

FREQUENCY METER

Frequency meter SCR 211 is a portable, self contained instrument for accurately checking the frequency of a radio receiver or transmitter. It operates within the frequency range of 125 to 20,000 kc.



Low Band 125 to 2000 kc
High Band 2000 to 20,000 kc



FREQUENCY COVERAGE

There are two frequency ranges, namely 125 to 250 kc and 2000 to 4000 kc. By the use of the 2nd, 4th, and 8th harmonics of the low-frequency range any frequency between 250 and 2000 kc can be obtained. By the use of the 2nd, 4th, and 5th harmonics of the high-frequency range any frequency between 4000 and 20,000 kc can be obtained.

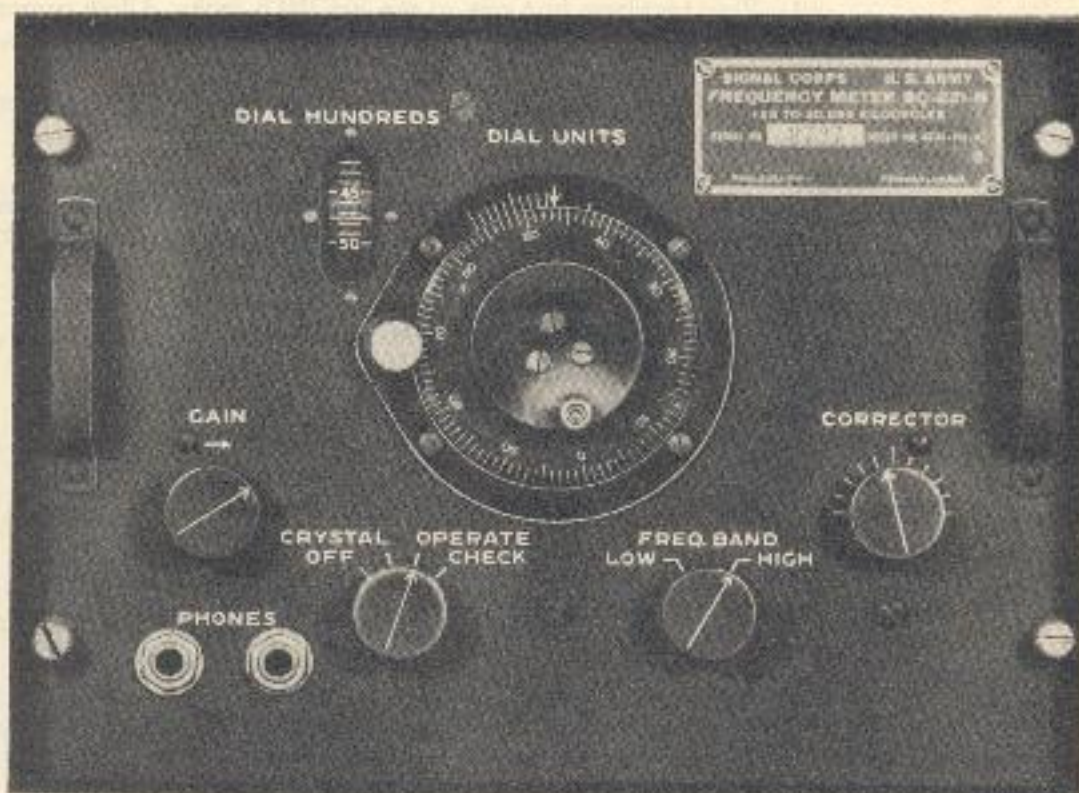
The crystal (check) oscillator has a fundamental frequency of 1000 kc with a rich harmonic output. Therefore, heterodyne frequency oscillator can be checked at a number of points in each band by using the harmonics of the crystal oscillator.

CALIBRATION BOOK

The calibration book contains dial settings and crystal check points for the low- and high-frequency bands. The first half of the book contains the low-band calibration; the last half contains the high-band calibration. A complete index will be found in the center of the book. Operating instructions are printed in the back part.

NOTE: Make sure the serial numbers of the calibration book and the frequency meter correspond before using.

FREQUENCY METER CONTROLS



TUNING DIAL

The tuning dial controls the frequency of the heterodyne frequency oscillator. It consists of three parts: a drum marked DIAL HUNDREDS, a disk dial marked DIAL UNITS, and a vernier scale immediately above the dial units.

Each division on the DIAL HUNDREDS dial corresponds to one full rotation of the DIAL UNITS dial which has 100 divisions. The vernier scale reads in tenths of one division on the DIAL UNITS dial. The vernier scale has ten divisions which occupy the same space as nine divisions on the DIAL UNITS scale. If the DIAL UNITS dial is set so that the vernier index arrow points between two divisions on the scale, there will be some line on the vernier scale which coincides or very nearly coincides with a line on the DIAL UNITS dial. The number of vernier divisions between the index arrow and the coincident mark denotes tenths of a dial division.

Example: The dial reading on the control panel shown is 4746.6.

CORRECTOR

The CORRECTOR knob is a fine-adjustment control of the heterodyne frequency oscillator.

OFF-CRYSTAL-OPERATE-CHECK

This switch permits the insertion of the crystal oscillator for checking purposes. It is also the power switch.

FREQ BAND LOW-HIGH

This switch selects the band on which the frequency meter will operate.

PHONES

PHONES jacks are for two headsets. They also control the filament circuit. The headsets must be plugged in to complete the filament circuit.

CAUTION: Be sure power switch is off and headsets are not plugged in these jacks when the equipment is not in use.

OPERATION

- 1—Plug headsets into one of the PHONES jacks. Allow approximately 2 minutes for the tubes to heat. (For extreme accuracy 15 minutes will be required.)
- 2—Refer to the INDEX in the center of the CALIBRATION BOOK for the page on which the desired frequency appears.
- 3—Turn to the proper page in the CALIBRATION BOOK. Note the CRYSTAL CHECK POINT at the bottom of the page. Place the TUNING DIALS on the CHECK POINT frequency.
- 4—Place the FREQ BAND low-high switch to the proper band depending upon the operating frequency.
- 5—Place OFF-CRYSTAL-OPERATE CHECK switch on CHECK position.
- 6—Rotate GAIN control fully clockwise.
- 7—Adjust CORRECTOR knob for zero beat in the headsets.
- 8—Place OFF-CRYSTAL-OPERATE CHECK switch on OPERATE position.
- 9—Rotate the TUNING DIALS to the setting for the desired operating frequency. This setting is also found in the CALIBRATION BOOK. The frequency meter is now ready for operation.

ZERO BEATING

TRANSMITTER TO FREQUENCY METER

Calibrate and tune the frequency meter to the desired operating frequency. Place frequency meter so that its antenna is near the transmitter's antenna but not touching it. Tune the transmitter on CW by use of the transmitter's calibration chart. Key the transmitter and vary master-oscillator control B on the transmitter until a zero beat is obtained in the frequency-meter headsets.

RECEIVER TO TRANSMITTER

Place MVC-OFF-AVC switch on receiver on MVC position. Place CW OSC ON-OFF toggle switch on ON position. Rotate the BEAT FREQ control to zero-beat position, arrow straight up. Tune the receiver to the approximate frequency of the transmitter. Vary the tuning control until a zero beat is obtained. *Caution: If the receiver's VOL control is tuned to a high level (fully clockwise) all reception might be blocked.*

TRANSMITTER TO RECEIVER

Zero beat the receiver to a net station. Tune the transmitter to the approximate frequency desired. Place MONITOR switch on MONITOR position (no sidetone position). Vary the master oscillator control on the transmitter until a zero beat is obtained in the phones plugged into the receiver.

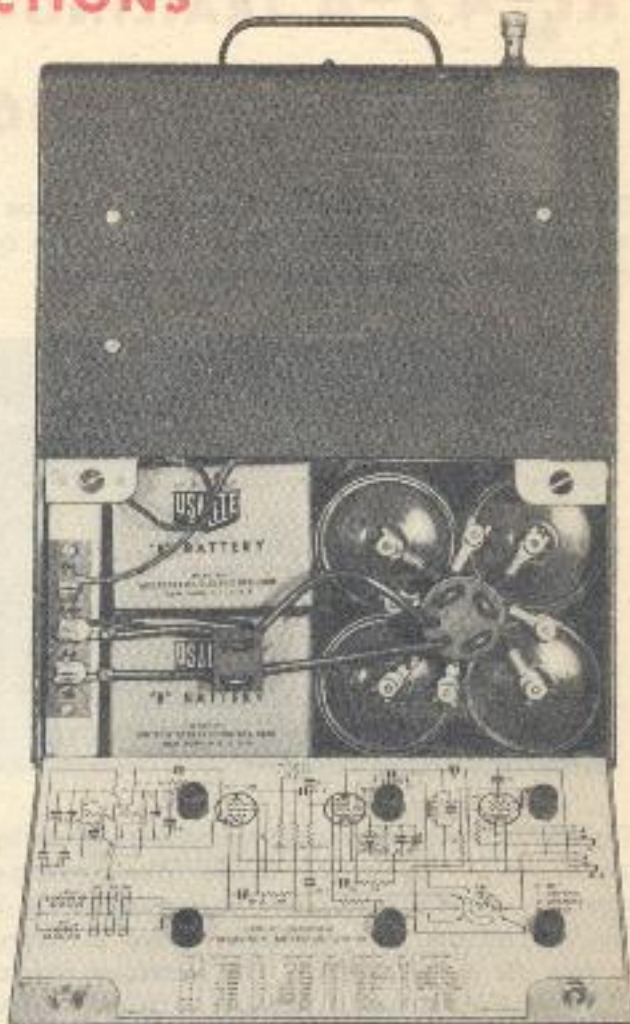
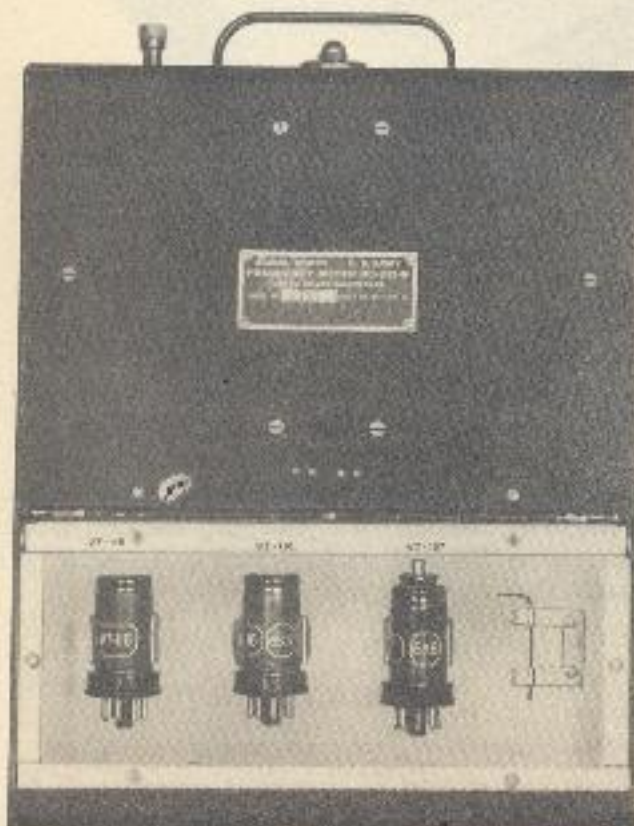
MAINTENANCE AND INSPECTIONS

BATTERIES

The frequency meter contains A and B batteries for its operation. Four (BA-23) A batteries furnish the 6 volts required for the filament circuit; and six (BA-2) B batteries furnish the 135 volts required for the high-voltage circuits. In each case the batteries are connected in series. The batteries should be replaced whenever they show a 10-per cent decrease in their rated voltages.

SPARE PARTS

TUBES. A spare set of tubes is carried in the compartment in front of the frequency meter. This compartment is readily accessible by loosening the screws on the lower front panel and removing the cover from the case.



CRYSTAL. A spare crystal is furnished with each frequency meter. It is mounted in the bottom of the chassis.

Faulty operation of the frequency meter may be caused by failure of either the crystal circuits or the heterodyne oscillator circuits. The following tests may be made to isolate troubles.

- 1—To check crystal circuits: Place operating knob on CRYSTAL position. Under normal operating conditions a signal should be heard in the receiver at 1000 kc when the receiver's CW OSC is ON.
- 2—The heterodyne oscillator circuits can be tested by placing the operating knob on OPERATE and making the above test. If either of the above tests indicate a defective circuit, replace the crystal or the tubes with the spare parts provided.

RL-42-A TRAILING-WIRE ANTENNA REEL

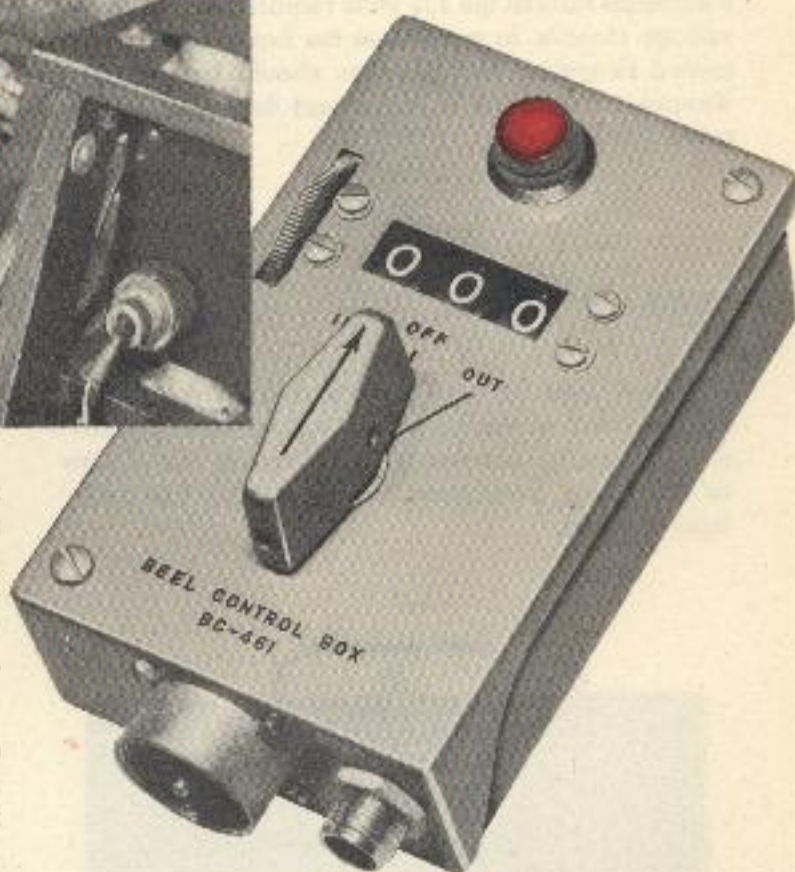
BC-461 REMOTE-CONTROL BOX

The RL-42-A Reel and BC-461 Remote-Control Box are designed to control remotely the trailing-wire antenna system; the control box registers the approximate number of feet of wire extended.



The reel consists of an insulated bobbin driven by a geared-down, high-speed motor. The reeling-out speed in a moving airplane is approximately 300 feet per minute. The reeling-in speed is approximately 130 feet per minute. The maximum capacity of the bobbin is about 500 feet of wire. However, usually only 250 feet of wire are used.

The reel is equipped with special limit switches which will not allow the wire to reel out if the lead weight (fish) is missing. These switches also turn off the reel when the wire is reeled into the position where the lead weight is snug against the fair-lead bell. A red warning light on the control box indicates whether or not the motor is energized.



MAINTENANCE AND INSPECTIONS

A preliminary check of the reel operation should be made with the airplane on the ground. This check can be made as follows:

- 1—Place the IN-OFF-OUT switch on the control box on OUT position. The wire should reel out until the lead weight touches the ground, at which time the reel should stop. The red warning light should be on.
- 2—Place the IN-OFF-OUT switch on IN position. The reel should reel in the wire until the lead weight is snug against the fairlead, when it will stop and turn the warning light off. The IN-OFF-OUT switch should then be placed in the OFF position.

A further check on the condition of the wire may be made by reeling it out, carrying the lead weight back 150 to 175 feet, and inspecting the wire as it is reeled in.

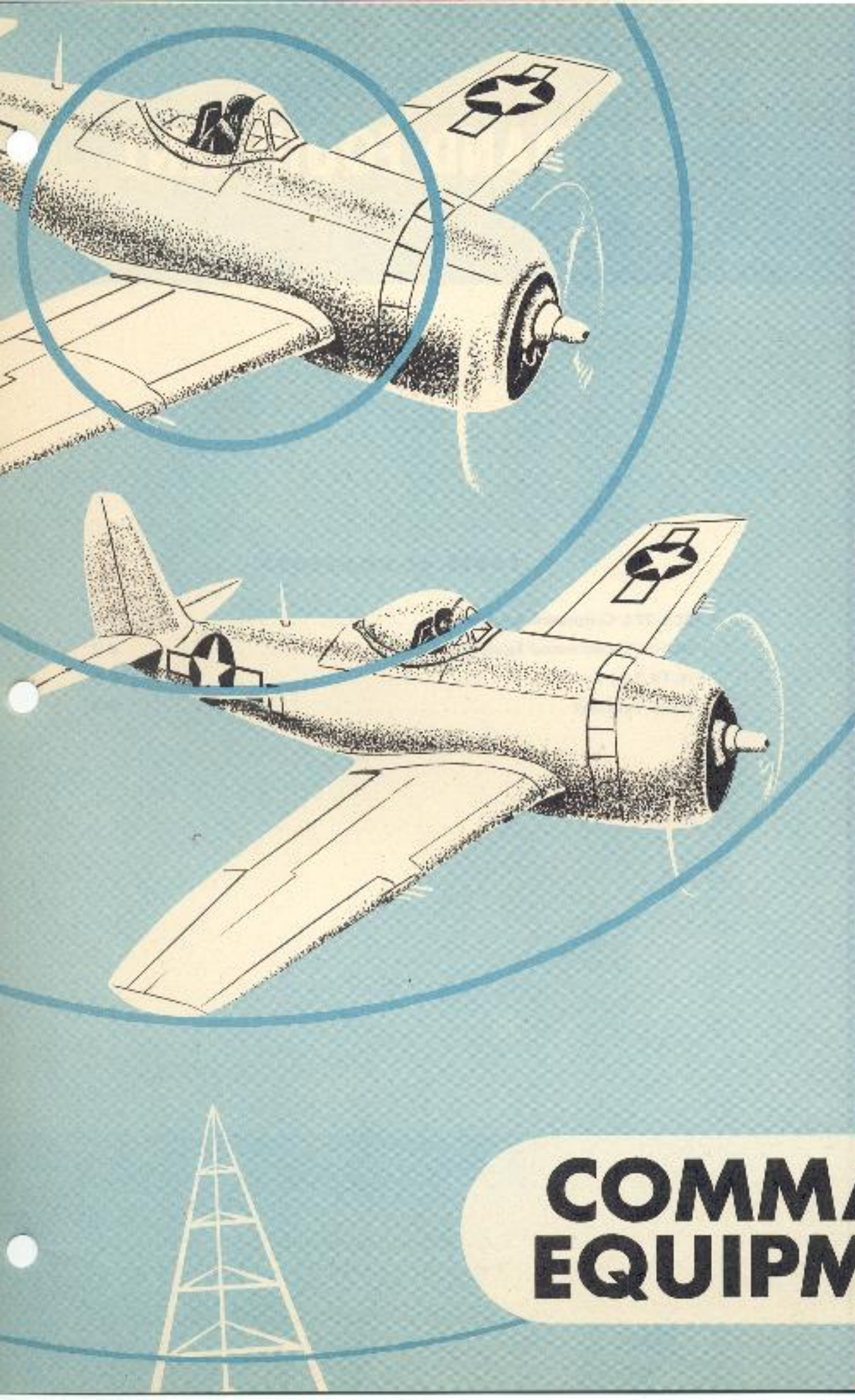
LUBRICATION

The inspection plate on the side of the reel box should be removed occasionally and a small amount of lubricant applied to the worm gear. Care should be exercised not to apply the lubricant to the worm itself.



SECTION

5



**COMMAND
EQUIPMENT**

COMMAND EQUIPMENT

TABLE of CONTENTS

SCR-274 Command Equipment	5-1
SCR-522 Command Equipment	5-2
IE-19 Test Set	5-3
IE-36 Test Set	5-4

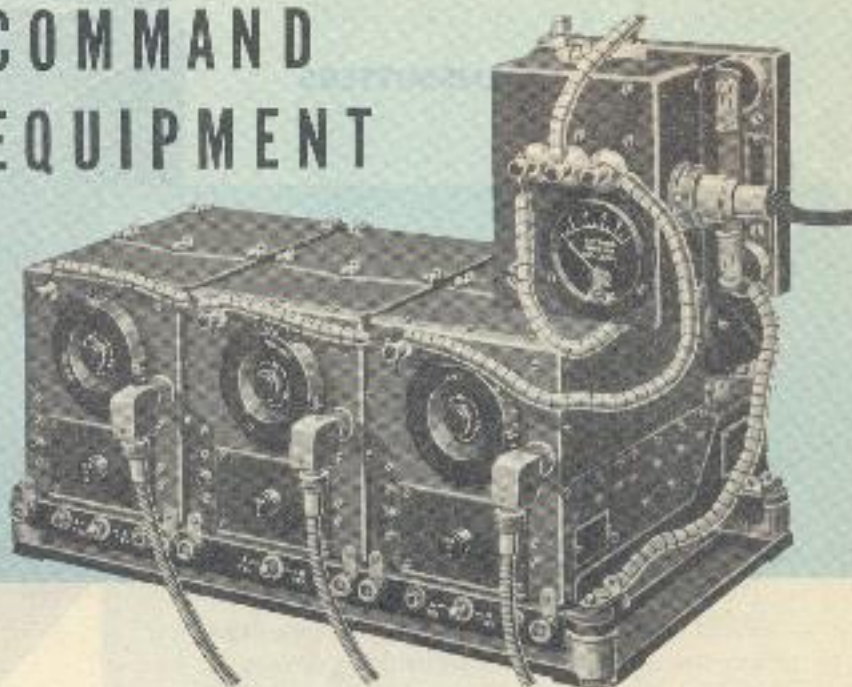


COMMAND SETS ARE USED BY THE PILOT MAINLY FOR PLANE-TO-PLANE
AND PLANE-TO-GROUND COMMUNICATIONS. IT IS YOUR RESPONSIBILITY
TO SEE THAT THEY ARE MAINTAINED AT THE HIGHEST POSSIBLE
STANDARDS AT ALL TIMES.

SCR

-274-N
COMMAND
EQUIPMENT

Both the receivers and the transmitters of the SCR-274-N command set are remotely controlled from the pilot's compartment. In an emergency this equipment can serve as an auxiliary liaison set, or be used for interphone communication.



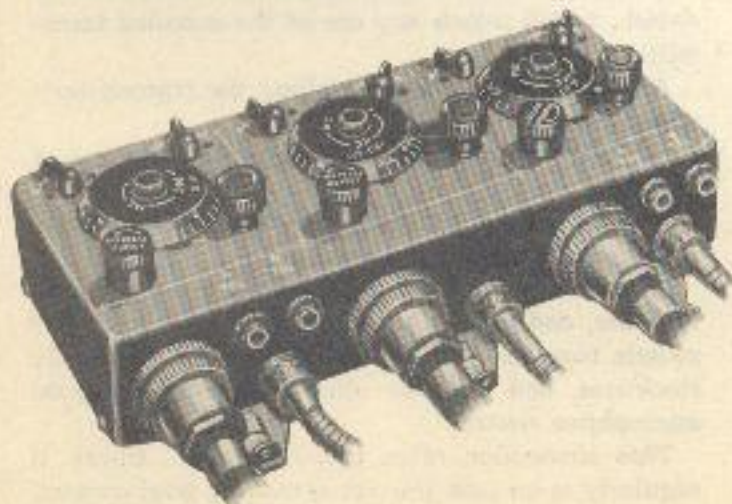
RECEIVING EQUIPMENT

Three receivers covering different frequency ranges are installed in most airplanes. They are:

BC-453.....	190 to 550 kc
BC-454.....	3000 to 6000 kc (3.0 to 6.0 mc)
BC-455.....	6000 to 9100 kc (6.0 to 9.1 mc)

The receivers are all six-tube superheterodynes with built-in beat-frequency oscillators for CW reception. Each receiver has its own dynamotor for supplying the required high voltage.

RECEIVER CONTROLS



An A-TEL B-TEL line is controlled by the A-B selector switch on the panel of each receiver. This switch parallels the outputs of all the receivers into one line or splits them into two. Normally the A-B switches of all receivers are on the A position. The A line is connected to the COMMAND position of the interphone jackbox.

Whenever two frequencies must be guarded simultaneously, the pilot or copilot uses the B line. To do this, he turns the selector switch of the receiver he is using to B, and plugs his headset into the B-TEL jack on the control box.

The CW-OFF-MCW switch turns the set on and controls the type of reception.

The INCREASE OUTPUT knob controls the volume manually. A built-in signal suppressor prevents strong signals from blocking reception.

TRANSMITTER EQUIPMENT

TRANSMITTERS

The SCR-274-N has four transmitters covering different frequency ranges. These are:

BC-696	3000 to 4000 kc (3.0 to 4.0 mc)
BC-457	4000 to 5300 kc (4.0 to 5.3 mc)
BC-458	5300 to 7000 kc (5.3 to 7.0 mc)
BC-459	7000 to 9100 kc (7.0 to 9.1 mc)

Most airplanes have only two of these sets in operation and carry a third one stowed.

The dials are calibrated directly in megacycles. Each transmitter has a built-in, crystal-controlled, frequency-checking device.



CONTROL BOX



All transmitters are remotely controlled from the pilot's compartment. The control unit includes:

A four-position TRANSMITTER SELECTION switch, which selects any one of the installed transmitters.

An ON-OFF switch controlling the transmitter's power input.

A TONE-CW-VOICE switch to control the type of emission.

A test key, on top of the control box, which can be used for keying the transmitter.

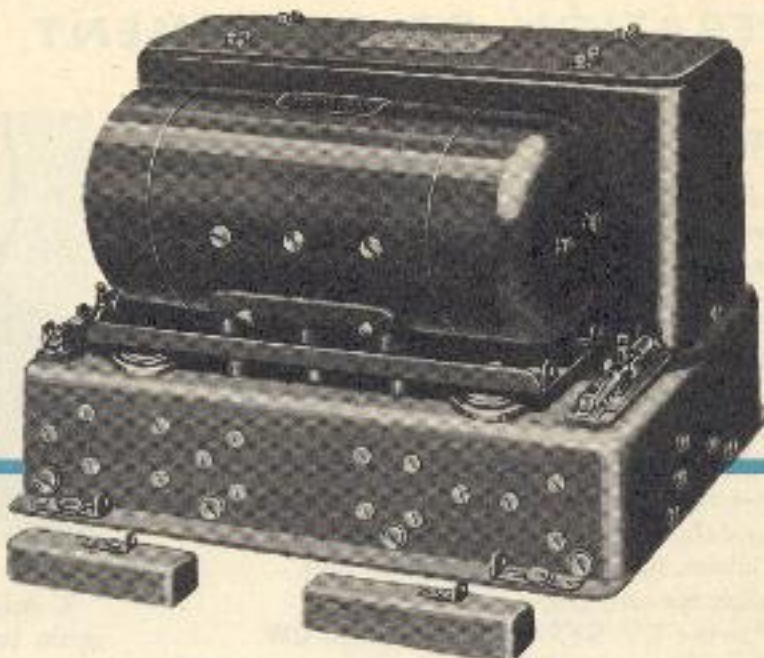
If the microphone is plugged directly into the control box, and you want to use an external throttle switch, turn the knurled nut on the MIC jack fully clockwise, and tape, or otherwise seal, the usual microphone control.

This connection often causes trouble. Check it regularly to be sure the nut is making good contact.

MODULATOR UNIT

A separate modulator unit (BC-456-A) furnishes high voltage and modulating power to whichever transmitter is in operation.

This unit contains the tone-oscillator, speech-amplifier-modulator, and voltage-regulator tubes. It also contains the transmitter fuses.

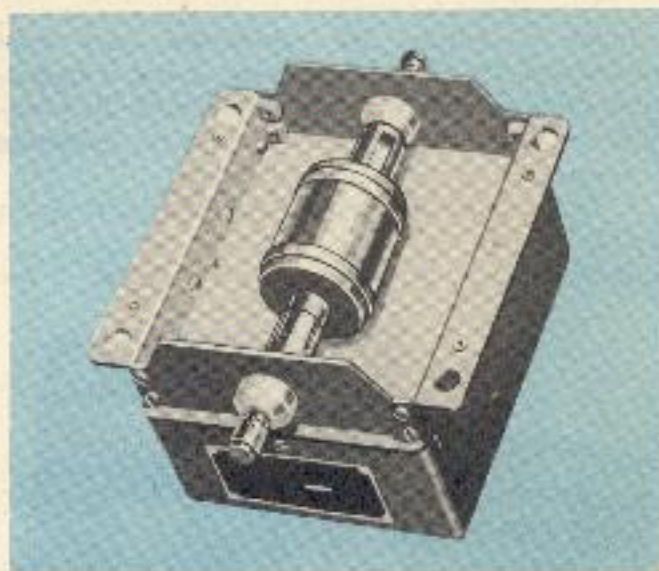


ANTENNA-SWITCHING RELAY UNIT

Normally the command antenna is connected to the receivers. This unit switches it to the transmitters whenever the keying circuit is closed.



A high-voltage vacuum condenser (50 mmfd) is connected between two terminals, one on the front and one on the back of the relay unit. The condenser shortens the command antenna electrically for the higher frequency ranges of the transmitters. The antenna post of the BC-459 (the 7.0 to 9.0 mc transmitter) is usually connected to this condenser.



There is a thermocouple ammeter in the circuit to register antenna current. Some relay units have a LOCAL-REMOTE switch which lets you get antenna-current readings from a remote ammeter. However, this switch has been eliminated from most installations.

OPERATION OF EQUIPMENT

RECEIVER TUNING

Be sure that the frequency calibrations of the receivers are exactly aligned with those of the remote-control dials. This is important. If they do not correspond, you must re-align the dials of the remote unit. To re-align:

1. Carefully note the setting of the receiver's tuning dial. To be absolutely accurate, make a sketch of it.

2. Loosen the knurled nut at the center of the remote-control dial, and set this dial to the reading that appears on the receiver's tuning dial.

3. Tighten the knurled nut finger-tight.

To align the antenna:

1. Put the CW-OFF-MCW switch on CW.

2. Turn the tuning dial to the high-frequency end of the band.



3. Adjust the ALIGN INPUT control for maximum background noise. If the receiver is tuned to a squadron frequency, adjust ALIGN INPUT for maximum background noise at that frequency.

TRANSMITTER CALIBRATION

Before you tune the transmitter, you must calibrate it. The built-in frequency device is crystal-controlled, and you must therefore check the transmitter's dial setting against the crystal's operating frequency. Here are the steps to follow:

1. Turn on the transmitter and allow it to warm up for one minute.

2. Open the hinged cover at the top rear of the

transmitter, placing it so that the mirror on the cover reflects the tuning indicator tube.

3. Turn the transmitter dial to the lowest frequency that causes the three-cornered shadow to appear on the green resonance indicator.

At this point, the dial reading should correspond with the frequency of the crystal. You may encounter spurious responses, but they always occur at readings higher than the fundamental frequency of the crystal.

Here are the crystal-check-point frequencies for each of the four transmitters:

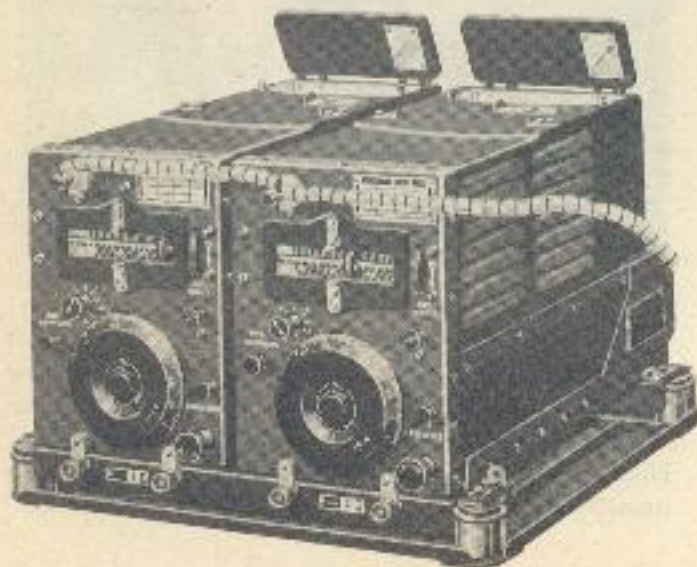
Transmitter	Check-point frequency
BC-696 (3.0 to 4.0 mc).....	3.5 mc
BC-457 (4.0 to 5.3 mc).....	4.6 mc
BC-458 (5.3 to 7.0 mc).....	6.2 mc
BC-459 (7.0 to 9.1 mc).....	8.0 mc

If dial setting differs from crystal frequency:

1. Set the dial to the crystal-check-point frequency.

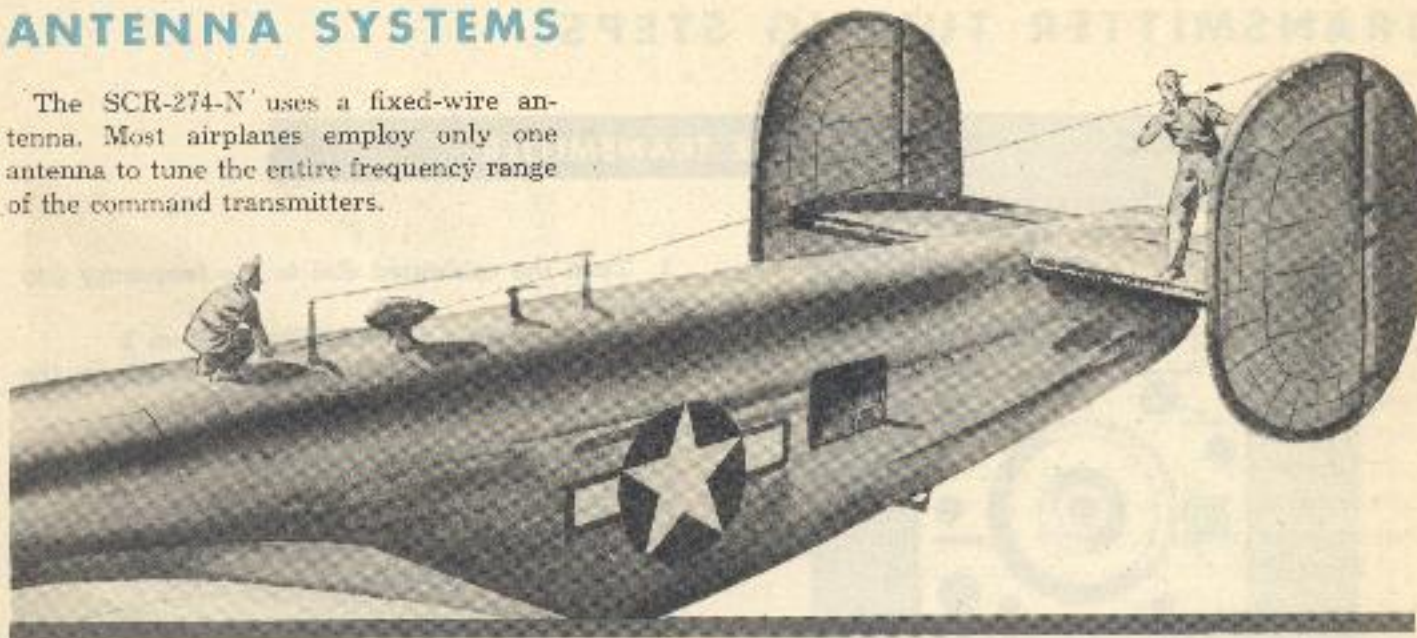
2. With a small, thin screwdriver, turn the calibration trimmer fully clockwise, then turn it counter-clockwise until the first shadow appears on the resonance indicator.

The transmitter setting should now be approximately correct at all points on the dial.

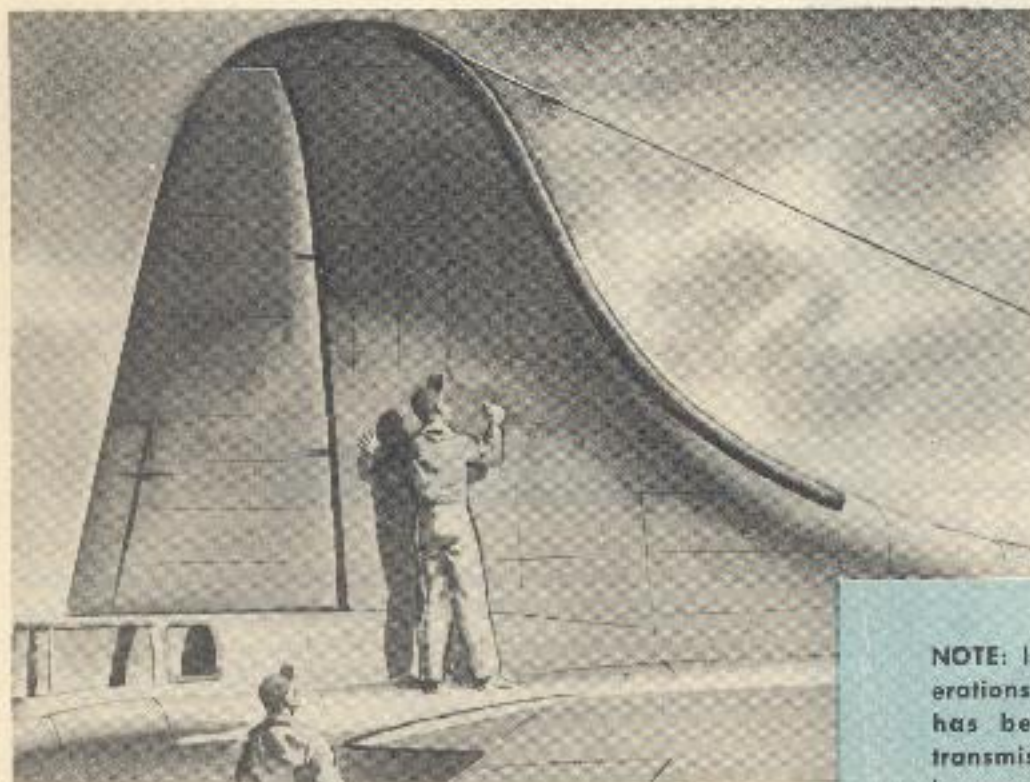


ANTENNA SYSTEMS

The SCR-274-N uses a fixed-wire antenna. Most airplanes employ only one antenna to tune the entire frequency range of the command transmitters.



Know the length of your antenna system, **including the lead-in**. If you do, you can greatly simplify the process of tuning the transmitter.

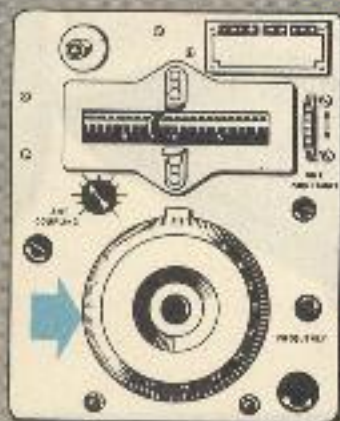


See that this insulator is more than **two feet** from the airplane's tail surface. This gives you the best results when you operate on the higher frequencies.

NOTE: In some theaters of operations the command antenna has been modified to limit transmission distances. If this happens to be the case in your area, be sure to consult your Communications Officer for full information about it.

TRANSMITTER TUNING STEPS

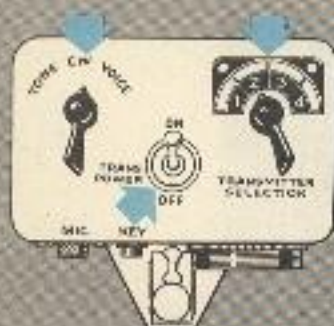
AT THE TRANSMITTER



1. Turn the calibrated dial to the frequency you want.
2. Set the ANT COUPLING control on 3.
3. If there is a LOCAL-REMOTE switch on the antenna relay unit, set it on LOCAL.

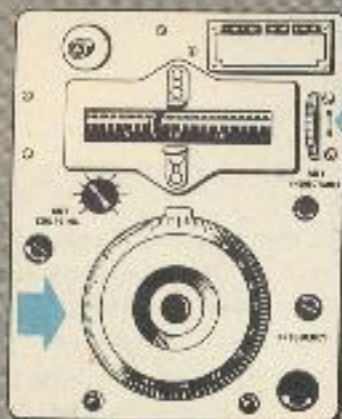
Remember! Be extremely careful not to jam operational frequencies while you are tuning the transmitter.

IN THE PILOT'S COMPARTMENT



4. Select the proper transmitter with the TRANSMITTER SELECTION switch.
5. Set the TONE-CW-VOICE switch on CW.
6. Turn the TRANS POWER switch ON. Be sure that neither the microphone switch nor the test key is closed.
7. If the transmitter cannot be keyed from the interphone jackbox, have someone hold down the test key on the control box, or lock the key yourself by turning it clockwise.

AT THE TRANSMITTER



To lock the transmitter controls, turn the LOCK knobs clockwise.

8. Resonate the antenna circuit by adjusting the ANT INDUCTANCE control for a maximum antenna-current reading.
9. Vary the ANT COUPLING until you get maximum antenna current.
10. Re-trim ANT INDUCTANCE for maximum antenna current. **Do this carefully.**

If you are using a remote antenna-current meter, you must set the toggle switch on the relay unit to REMOTE.

Never re-trim for maximum antenna current on TONE or VOICE positions. The transmitter cannot be properly modulated if you do.

EMERGENCY OPERATIONS

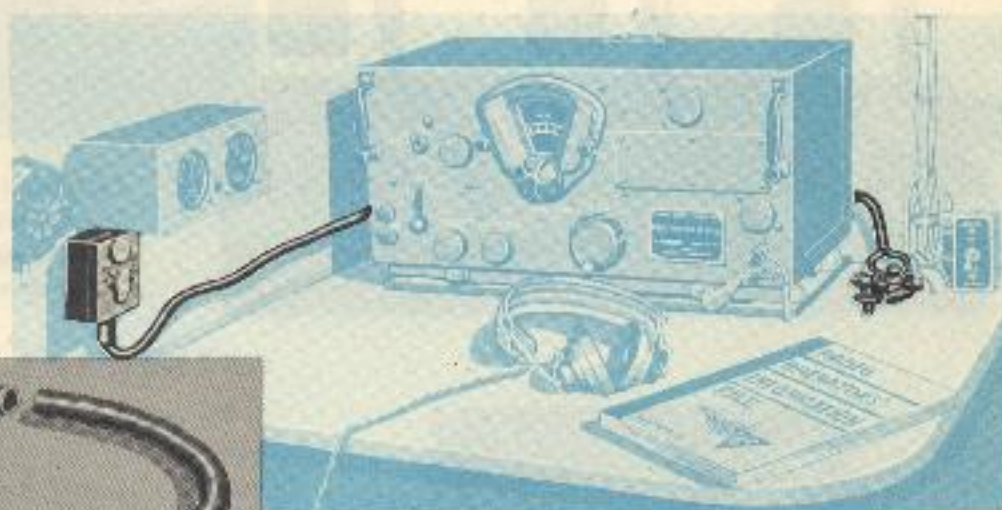
INTERPHONE

In an emergency, the sidetone from the modulator unit of the SCR-274-N can be used for interphone communication.

1. Make sure that one of the A-B switches on the receiver control box is turned to the A position.
2. Put the TRANSMITTER SELECTION switch on position 3 or 4.
3. Put the interphone jackbox on COMMAND.

Consult your G file to find out which interphone positions key the command transmitters.

AUXILIARY LIAISON



When the command transmitter is properly tuned to its antenna system, it has a possible output of 40 watts. This is approximately half the power of the BC-375 liaison transmitter. The range of the command set, using CW, is great enough to let it be used for liaison operation.

Here is the way to key the command transmitter on CW from the radio operator's position:

Make up a special cord with a PL-68 and about 6 feet of two-conductor cable.

Plug the PL-68 into the MIC jack on the interphone jackbox.

Remove the liaison key terminals and fasten the terminal ends of the special cord to the key terminals.

You can connect the command transmitter to the trailing-wire antenna (or to another of the proper length) by using a 12-foot piece of insulated wire with battery clips on each end.

Calculate the proper antenna length by this formula:

$$\text{Length in feet} = \frac{234}{\text{Freq. in mc}}$$

You need not use more than one decimal place. For example, if the frequency is 3105.75 kc, use 3.1 mc, and your calculations will be accurate enough.

You can operate the transmitter on CW without using any of the modulator-unit tubes.

If a transmitter tube fails, replace it with one from another transmitter. The tubes in all three transmitters are identical.

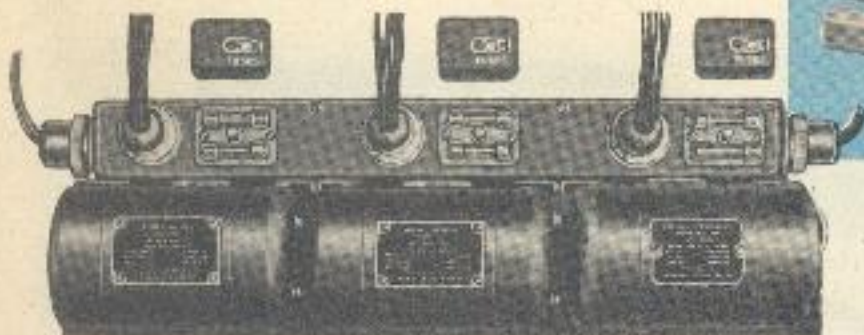
Do not send more than 12 words a minute when you use the command transmitter for code messages.

FUSES

Take care not to short the metal fuse covers from the ground to the live side of the fuse clip when you remove or replace them.

The locations of the transmitter and receiver fuses are shown in the accompanying illustrations.

The modulator unit contains one 20-ampere fuse for each of the transmitters. There are two spare fuses on the opposite side of the unit. **Don't let the fuse touch the center post when you replace it. This post is grounded.**



Each receiver uses a 10-ampere fuse. A spare fuse is kept under the same cover.

TRANSMITTER CONTROL SWITCH

Be sure the pilot's microphone is switched to the 274 equipment if the transmitter is to be modulated from his compartment. Set the 274-522 switch to 274, or the MED FREQ-VHF switch to MED FREQ. These switches are usually mounted next to the receiver control box or alongside the pilot's interphone jackbox. There are several variations of this switching arrangement. The most recent jackboxes, for instance, have a VHF position. (See ROIF, 6-5.)

R-IN R-OUT SWITCH

R-IN R-OUT switch on top of the pilot's transmitter control unit furnishes either 3 or 6 volts to the microphone. R-IN supplies 3 volts, and R-OUT, 6 volts.



FOR FURTHER MAINTENANCE INSTRUCTIONS CONSULT YOUR TECHNICAL ORDER FILES

MAINTENANCE AND INSPECTIONS

TRANSMITTER AND RECEIVER

If the transmitter is properly calibrated the dial settings should be accurate to within $\pm 0.05\%$ of the indicated frequency—to make certain this calibration is correct check it against the SCR 211 frequency meter.

If a transmitter or receiver fails to operate properly, look for simple causes of troubles first.

See that all switches are in their proper positions.

Check cords and plugs—be sure that they are properly tightened.

Check antenna and ground connections.

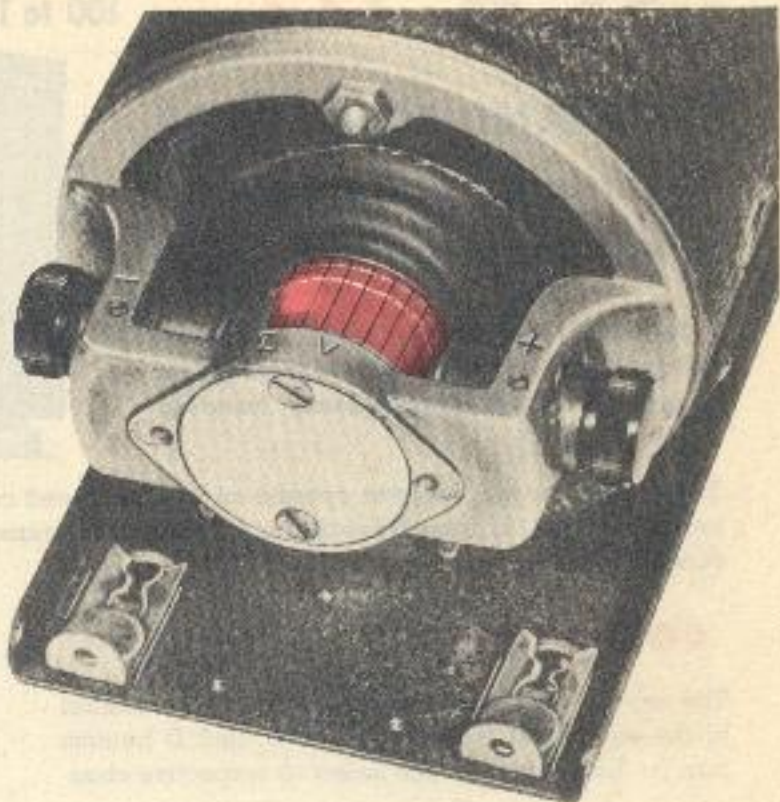
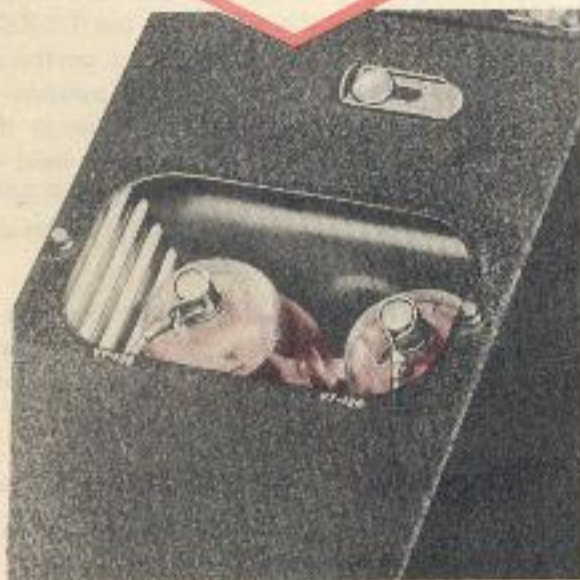
Rack connections, dynamotors, receivers, transmitters, and other component parts may be checked by substitution.

Every advantage of substitution of parts should be taken before considering the 274 command equipment inoperative.

Relays may be checked by listening for clicks when keying.

Danger 600 Vc

Extreme caution must be observed when working around the transmitters or the modulator unit, the top connection on VT-136 tubes is the plate or high voltage lead.



DYNAMOTORS

The transmitting and receiver dynamotors should be routinely checked as follows:

Remove the end caps and check the condition of the brushes and the commutator. The brushes should slide freely in their holders. Carbon and copper dust must be removed from around the holders and commutator.

An even band of brown discoloration around the commutator is an indication of normal operation—this should not be removed.

Always check the tension on the brushes, replace them if they are cracked, worn or contain hard spots.

Lubrication is required after every 1,000 hours of use. Instructions will be found printed inside one of the end caps.

FREQUENT SANDINGS OF COMMUTATORS, MANIPULATION OF BRUSHES OR EXCESSIVE GREASING WILL DO MORE HARM THAN GOOD.

SCR 522

Very-High Frequency
100 to 156 MEGACYCLES

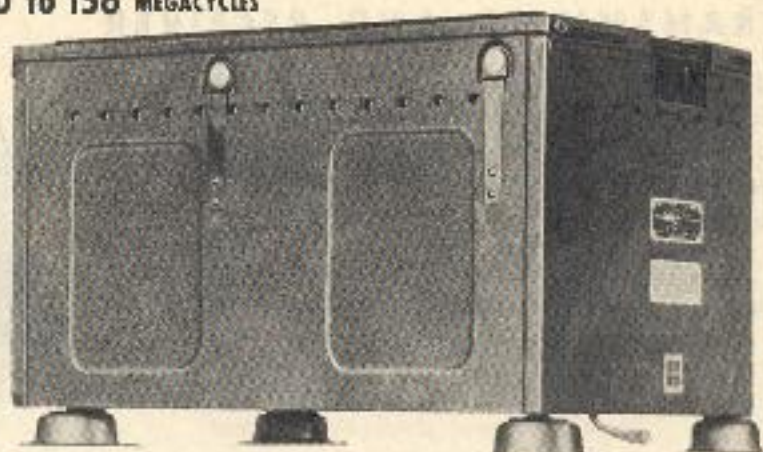
COMMAND EQUIPMENT

REMOTELY CONTROLLED

The SCR 522 command equipment is used for:

Two-way, line-of-sight voice communication from plane to plane and from plane to ground. Very-high-frequency homing.

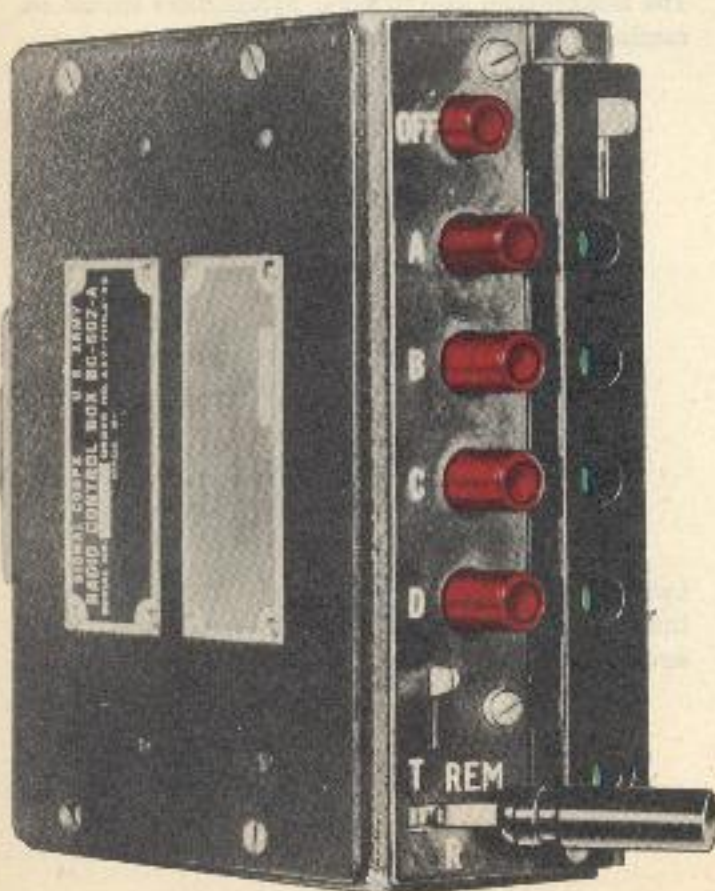
The transmitter and receiver operate on four pre-tuned crystal-controlled channels. Any one of the channels may be selected remotely from the pilot's compartment.



CONTROL BOX

The control box provides complete remote control of the equipment functions. A, B, C, and D buttons turn on the equipment and select its respective chan-

nels. The green lamp alongside the buttons indicates the channel selected. The OFF button turns the equipment off.



FUNCTIONS OF T-R-REM SWITCH

When this switch is at T, the equipment is in transmitting position. When switch is at REM position, the equipment is normally in receiving position, but switches to transmitting position when the microphone switch is closed.

The lever tab directly above the T-R-REM switch has two positions. When the tab is up, the T-R-REM switch may be turned to any of its three positions. When the tab is turned down the REM position is blocked and a spring is inserted which keeps the switch on R position unless it is manually held at T position. The white lamp alongside the T-R-REM switch lights up when the equipment is in receiving position.

The lever tab opposite the OFF button, controls a dimmer mask which prevents glare from the channel lights. The mask is in position when the lever tab is down.

NOTE: In the future, some airplanes will have the control wired so that the T-R-REM switch will function as though it were in REM regardless of its position.

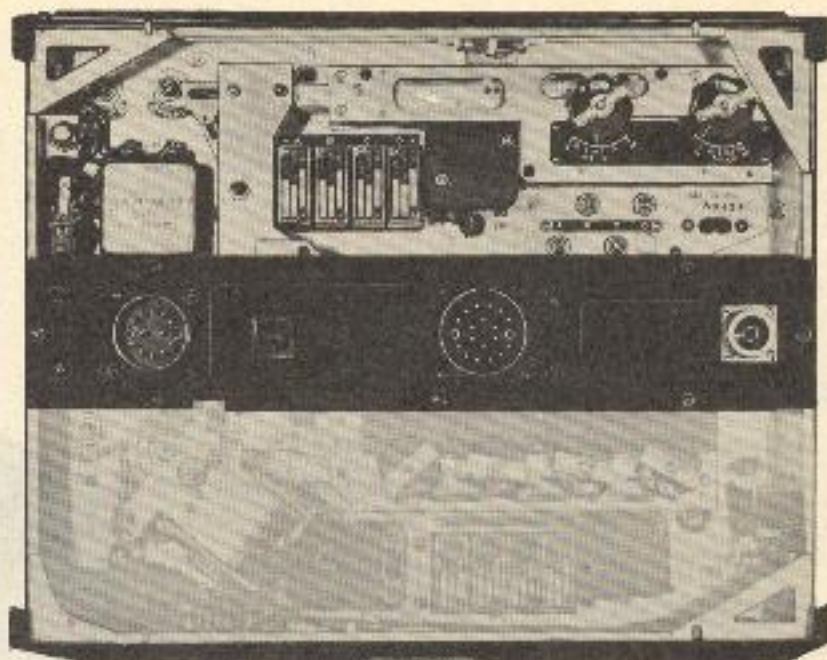
RECEIVER BC-624

The receiver is a 10-tube superheterodyne. It is crystal-controlled by one of four crystal circuits which operate from the 11th to 18th harmonic. Thus four crystal-controlled channels operating anywhere between 100 and 156 mc may be made available for selection.

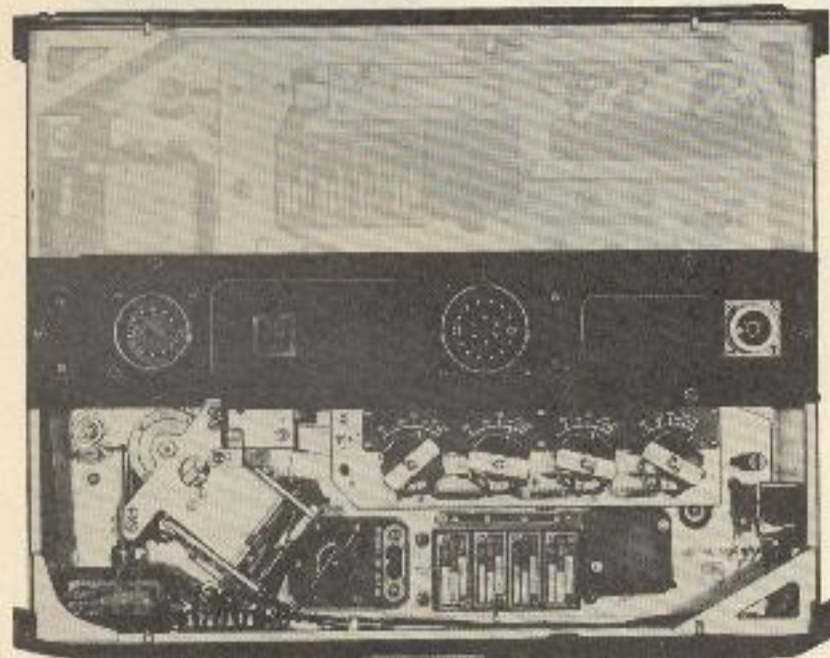
The audio input section of the receiver is energized by a special bridge network from the microphone circuit of the transmitter to make interphone operation possible and to furnish sidetone. Interphone operation is not possible in all airplanes.

A squelch system is built into the receiver to eliminate undesirable noises when no signals are being received. It also enables noise-free interphone and sidetone operation.

The intermediate frequency of the receiver is 12 mc.



TRANSMITTER BC-625



The transmitter operates on four crystal-controlled channels of from 100 to 156 mc.

The output frequency is always 18 times the fundamental crystal frequency.

**The transmitter is designed to operate on
VOICE only.**

It is possible to key channel D to obtain an MCW signal for homing purposes.

TUNING SYSTEM

The receiver and transmitter are automatically tuned by a special, synchronized slider system. This slider mechanism is actuated by an interrupter-type ratchet

motor. It places in position the receiver and transmitter-tuning condensers and selects the proper operating crystal.

DYNAMOTOR UNIT PE-94B

The dynamotor unit is the source of three regulated voltages required for operation of the transmitter and receiver.

Three commutators supply the following output voltages:

- 1—Plus 14.5 volts for filament and keying circuits.
- 2—Minus 150 volts for fixed grid bias.
- 3—Plus 300 volts for plate and screen high voltages.

A special carbon-pile regulator keeps the output voltage constant under widely varying input voltages.

A fan is mounted on one end of the armature shaft to provide forced-air cooling.

Dynamotor unit PE-94-A differs from the PE-94B in mechanical construction. The operating characteristics, however, are the same.



CRYSTALS

The frequencies of the 522 command equipment are controlled by crystals for frequency stabilization.

Since it is not possible to design a stable crystal to operate at VHF, both the transmitter and receiver operate on harmonics of low-frequency crystals.

The receiver will operate anywhere between the 11th and the 18th harmonic of the fundamental crystal frequency. Twelve megacycles must always be added to the harmonic to determine the operating frequency.

The transmitter always operates on the 18th harmonic of the crystal frequency.

The fundamental frequency of each crystal furnished with the transmitter and receiver appears on the name-plate of the crystal.



TWO TYPES OF CRYSTALS ARE AVAILABLE FOR USE WITH THE EQUIPMENT

RECEIVER TUNING

Remove the top covers of the receiver-transmitter case by turning the DZUS fasteners counterclockwise.



Before attempting to tune the receiver, the proper operating crystal must be selected.

It must be remembered that the crystal controls the heterodyne-oscillator frequency which is always 12 mc less than the frequency to be received. The fundamental operating frequency of this oscillator is from 8.0 to 8.8 mc.

A harmonic generator and amplifier are used to generate the required operating frequency from the fundamental frequency of the crystal.

The harmonic generator and multiplier are tuned to a harmonic of this fundamental frequency. This harmonic ranges from the 11th to 18th depending upon the frequency of the signal to be received.

THE TABLE FOR DETERMINING THE PROPER OPERATING HARMONIC FOLLOWS:

FREQUENCY TO BE RECEIVED (MC)	HARMONIC	FREQUENCY TO BE RECEIVED (MC)	HARMONIC
100 to 108	11	132 to 140	15
108 to 116	12	140 to 148	16
116 to 124	13	148 to 156	17
124 to 132	14	156	18

Crystal Frequency Formula (for determining fundamental crystal frequency):

$$\text{Frequency crystal (F}_x\text{)} = \frac{\text{Frequency received (F}_r\text{)} - 12 \text{ mc}}{\text{harmonic (H)}}$$

$$\text{or } F_x = \frac{F_r - 12}{H}$$

F_x and F_r are both in mc.

Since the frequencies are stamped on the crystal holder in kc, the resultant frequency should be converted into kc by multiplying by 1000, or

$$F_x = \frac{F_r - 12}{H} \times 1000$$

To determine the proper crystal to be used for any one channel subtract 12 mc from the frequency to be received on that channel and divide the remainder by the proper harmonic.

Example: F_r = 120 mc

$$F_x = \frac{120 - 12}{13} = 8.30769 \text{ mc}$$

or 8.30769 x 1000 = 8307.69 kc

RECEIVER CHANNEL TUNING

PRELIMINARY—Connect either an output meter (0- to 30-volt) or a pair of headsets to the output of the receiver, this is the **COMMAND** position on the interphone jackbox in most airplanes. However, the 522 might be connected to the **LIAISON** position on all jackboxes except the radio operator's.

A tone-modulated signal must be available for tuning the receiver. This can be obtained from one of three possible sources:

1—Signal generator I-130-A.

2—Channel D on any transmitter tuned to the proper frequency.

3—Signal generator (buzzer) IE-36.



TUNING STEPS

- 1—Press **CHANNEL PUSHBUTTON** on control preceding the channel to be tuned.
- 2—Press **CHANNEL RELEASE BUTTON** on rack.
- 3—Loosen **TUNING CONTROL LOCKNUTS** until only a slight pressure remains on the cams.
- 4—Press **CHANNEL BUTTON** on control to the channel to be tuned.
- 5—Turn **OSCILLATOR TUNING SCREW** of channel being tuned so that three, four, or five threads extend above the sleeve.
- 6—Rock **TUNING DIALS** across the frequency to be received and locate the point of maximum output. If no signal is found, turn out the oscillator tuning screw one turn at a time and repeat the rocking procedure until the maximum signal is located.
- 7—Turn the **OSCILLATOR TUNING SCREW** clockwise until the signal drops off abruptly.
- 8—Turn **OSCILLATOR TUNING SCREW** slowly counterclockwise about a three-quarter turn beyond the point at which the signal reappears.
- 9—Carefully adjust both **TUNING CONTROLS** for maximum output.

USE THE SAME PROCEDURE FOR TUNING THE REMAINING CHANNELS

Before pressing another channel pushbutton hold the tuning controls with your fingers and tighten the locknuts just enough to exert a slight pressure on the cams. This lessens the possibility of disturbing the channels already tuned.

After the required number of channels have been tuned, press the channel-release button and tighten the tuning-control locknuts. Tighten the locknuts as tightly as possible with your fingers. Do not use pliers.

Remove the test cord from the antenna socket on rack and replace the plug from the airplane's antenna.

AUDIO AND RELAY ADJUSTMENTS

The **AUDIO** control should be left in its maximum clockwise position unless the pilot complains of too much volume.

The **RELAY** control should be the last adjustment made and should be made with the airplane's antenna connected and with no signal being received.

Adjust it as follows: turn **RELAY** control counterclockwise until a noticeable drop in background noise results. Then turn the control a very small fraction of a turn further. This adjustment is very critical. When tuning is completed press at least two different channel bushbuttons before pressing the **OFF** pushbutton.

Do not use the relay to suppress high ignition noises. This would affect the operating range of the receiver.



This is a new antenna-coupling adjustment. It is non-locking, and has five steps. Don't try to tighten it by turning it past its limits. It will not slip out of adjustment.



TRANSMITTER TUNING

The transmitter always operates on the 18th harmonic. To find the proper crystal frequency, divide your operating frequency by 18. For example, if the operating frequency is to be 126.18 mc, the crystal frequency should be $\frac{126.18}{18} = 7.010$ mc, or 7010 kc.

Channel Tuning Steps

1. Press the remote-control channel button which precedes the one you are going to tune. When you tune channel A, press the D button.
2. If you are using the IE-36 test set, turn its T-R-REM switch to T. If you are not, put the T-R-REM switch of the remote-control unit on T.
3. Press the channel release button.
4. Loosen the transmitter tuning-control locknuts, leaving only a slight pressure on the cams.
5. Press the remote-control channel button for the channel you want to tune.
6. Set all four of the transmitter tuning controls approximately on your operating frequency.
7. Adjust the four tuning controls in the following order:

Meter-Switch

Tuning Control	Position	Meter Reading
1	1	Maximum
2	2	Maximum
3	3	Maximum
4	3	Minimum
3	3	Maximum
4	3	Minimum

After all channels have been tuned, note which channel gives you the highest meter reading. Select this channel and adjust the antenna coupling until you have a reading of not more than 0.65 ma.

You must never have a final reading of more than 0.65 ma on the highest-reading channel. Higher readings cause tube failures.

ANTENNA-COUPLING ADJUSTMENT

Make this adjustment only on the channel with the highest meter reading.

If the meter reading for this channel is too high, loosen the antenna-coupling lock screw and move it away from the controls until you get the correct reading (0.63 ma).

If the reading is too low, move the lock screw toward the controls.

Tighten the lock screw when the adjustment is complete. **Take great care when you do this. If you make the lock screw too tight, you will seriously damage the coil mounting.**

Put the meter switch on position 3, and readjust tuning dial No. 4 for a minimum meter reading.

You can get satisfactory results with a meter reading as low as 0.45 ma on the higher frequencies.

You must use the airplane's antenna when you make this adjustment.

Before you press another channel pushbutton, be sure that you hold the tuning controls with your fingers and tighten the locknuts until there is just a slight pressure on the cams. This helps to protect the channels you have already tuned. After you have tuned whatever channels you need, press the channel release button and tighten the tuning-control locknuts.

TO CHECK CHANNEL TUNING

Turn the METER SWITCH to position 3, and check the meter reading for each channel.

Re-tune any channel which does not show a reading between 0.45 and 0.65 ma.

TO RE-SET A SINGLE CHANNEL

When you re-set a single frequency channel, you must avoid disturbing the settings of the others. Always follow these steps:

1. Press the remote-control channel pushbutton which precedes the one you want to tune. When you tune channel A, press the D button.

2. Press the channel release button, and loosen the locknuts, leaving a slight pressure on the cams.

3. Press the remote-control channel pushbutton for the channel you want to tune.

4. Re-tune the tuning controls properly.

5. Press the channel release button. Tighten the locknuts as tightly as possible with your fingers. Don't use pliers.

6. Press the channel release button again. This re-engages the channel being tuned.

NEVER

Loosen or tighten the tuning locknuts unless the tuning slides are released.

Turn the equipment off when the slides are released.

Remove either the transmitter or receiver from the rack unless the slides are released.

Use pliers to tighten locknuts.

After your channels are tuned, check them for stability, to make sure the equipment will operate properly during flight. To do this, press the channel pushbuttons in rotation eight or ten times. Then re-check the meter readings.

GAIN-CONTROL ADJUSTMENT

Make this adjustment after all the channels are tuned. Do it while the airplane's engines are running. Use any channel.

The gain (or percentage of modulation) of the transmitter usually will be satisfactory after you have:

Turned the GAIN control counter-clockwise as far as it will go.

Rotated it a half turn clockwise.

If you find you pick up too much noise from the airplane, turn the control slightly counter-clockwise.

You can make a further check by getting in contact with another airplane or with the control tower.

ANTENNA SYSTEM

The VHF command equipment uses a stub-mast antenna, AN-104. Its general length is 29¾ inches. Its conductible length is 21½ inches. The most durable kind of stub mast is made of sugar maple treated with phenol-formaldehyde. The conducting surface is a thin coating of either iron or copper.



MICROPHONE ADAPTER UNIT

This unit (Microphone Adapter, M-299) makes it possible to use a T-17 or T-30 microphone with the VHF command set.

The unit is mounted in the most convenient place in each airplane. The airplane's entire 522 installation requires only one of these adapters.

MAINTENANCE AND INSPECTIONS

The milliammeter reading of the I-139-A test indicator, obtained with the transmitter's meter switch on position 3, gives you an excellent indication of the general functioning of the set. This reading directly reflects dynamotor, antenna, relay, and tube defects. Take it on the lowest frequency channel. **Keep a daily record of it. Investigate any deviation from normal meter readings.**

Checking the Antenna System

Moisture and grease, which collect around the rubber mounting of the antenna, absorb a great deal of radiation. Defective coaxial cables often cause trouble, too. To detect such conditions, **check the transmitter's antenna output with a field-strength meter.**

Field-Strength Meter I-95-A

The I-95-A shows you the relative field strength and frequency of the antenna's radiation. Use it **within 25 feet of the VHF command antenna.**

Normally the meter needle deflects to about the middle of the scale. A modulated signal increases the deflection. This additional deflection is in proportion to the amount of modulation.

The pilot's control-box lamps show you whether or not the transmitter channels are operating properly. When the channels are making complete cycles, the green lamps flash on in rotation. The white receiver light, alongside the T-R-REM switch, gives you a quick check of the antenna change-over switching relay.

Homemade Meter

If you can't get an I-95 field-strength meter, you can make the simple but accurate indicator shown in the illustration. It consists of:

A 44-inch wooden or fiber rod, and

Two 22-inch pieces of wire, taped to the rod and connected to a bulb (2 volts, 60 ma) at the center.

Use this meter approximately 10 feet from the antenna.



TRICYCLE LANDING GEAR

In some cases an airplane's tricycle gear adds capacitance to the antenna and tends to de-tune the transmitter. This condition is sometimes offset by adding an equal amount of capacitance to the circuit during flight. **If you do not add this capacitance in flight, tune the transmitter to a maximum of 0.50 ma on the highest-reading channel. Whenever you can, check this channel during flight.**

DYNAMOTOR

Brush connections, especially low-voltage ones, should be checked periodically for looseness. **Loose low-voltage brush connections give you poor regulation and high output voltages.**

Brushes should be checked thoroughly for free movement in their holders, sufficient tension, chipped corners, hard spots, or uneven wear.

Brushes can be replaced without disassembling the dynamotor. The two end plates can be removed and the dynamotor lifted high enough for the brushes to be reached.

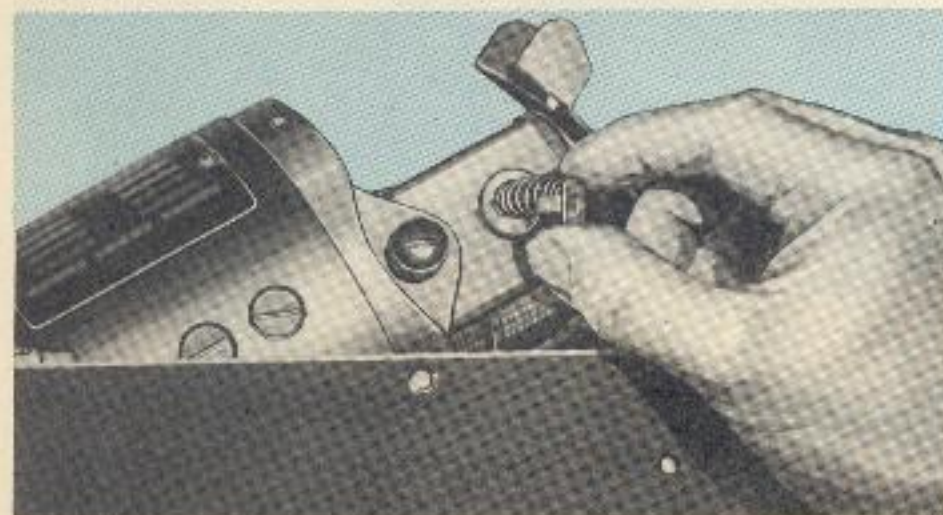
Keep the brush holders and commutators free from dirt and grease by cleaning them with a rag saturated in carbon tetrachloride. Remove the brushes when you do this. **Do not clean the brushes with carbon tetrachloride. Use gasoline or kerosene.**

Brushes are stamped either plus or minus. The stamped side of the brush must face the corresponding stamp on the end of the bracket.

You can check brush noise by using a .01 mfd condenser in series with either a headset or an output meter. An output-meter reading should not exceed 2.5 volts.



Always keep your antenna clean.



Remember

The efficiency of
the entire equipment
depends upon
proper dynamotor
performance.

TEST EQUIPMENT IE-19-A

To tune the 522 command equipment properly in the airplane, test equipment IE-19-A should be used. The components pertinent to tuning are the only ones listed in the following paragraphs.

TEST SET I-139-A

Test set I-139-A is a direct reading 0-to-1 millimeter used for measuring currents of the tuning circuits in the receiver and transmitter.

A cord with a special plug to fit the transmitter and receiver meter sockets is attached to the meter.

Remove coaxial cable and insert in antenna socket on rack.

Space for Signal
Generator I-130-A
Field Strength Meter
I-125-A

Space for Test Set
I-139-A

Battery Box Bx-33-A

Set of Special Tools
Instruction Book



SIGNAL GENERATOR I-130-A

Signal generator I-130-A generates a 1000-cycle tone-modulated signal at any crystal controlled frequency from 100 to 156 mc. For tuning the receiver, the generator output frequency is 18 times that of the fundamental crystal frequency.

Power is supplied to the signal generator from a type BX-33-A battery box.

Preparation for Use:

- 1—Insert a transmitter crystal of $1/18$ th the receiver frequency to be tuned.
- 2—Connect the cord provided from the RF output socket to the antenna socket on the rack. Connect test set I-139-A to the signal-generator meter socket.
- 3—Set MO-CRYSTAL switch to CRYSTAL position.
- 4—Turn OUTPUT CONTROL to MAX and OUTPUT STEPS to step No. 5.

5—After allowing about 1 minute for the tubes to heat, adjust the CRYSTAL TUNING control for the frequency to be tuned. A small dip should be noted in the meter. Adjust MEGACYCLES dial control for an additional dip. (This should be about the same setting as that of the receiver channel being tuned.) Remove the plug-on meter I-139-A. The signal generator is now ready to use.

After the signal appears in the receiver, the output steps should be lowered to position 2 or 3 to allow for more accurate tuning of the receiver.

TEST EQUIPMENT IE-36

Test equipment IE-36 reproduces the operating functions of the 522 control box and the interphone jackboxes. It also provides a signal generator (buzzer) for receiver tuning, a phantom antenna for transmitter tuning, and the necessary connecting cords and plugs.

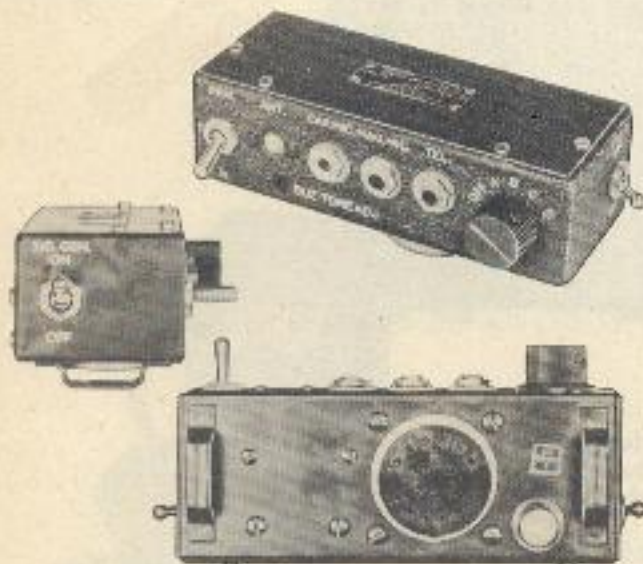
A spanner wrench and lamp extractor are included as part of the test set. Space is provided in the carrying case for Test Set I-139-A. The test set, however, is not furnished as part of the IE-36 equipment.



CONTROL UNIT BC-1303

Control Unit BC 1303 plugs directly into the receiver-transmitter rack. It is equipped with all the controls necessary to allow complete tuning and operational checking of the 522 equipment.

The top and rear comprise the cover, which is removable. On the bottom is the 18-contact rack plug, and a pilot lamp.

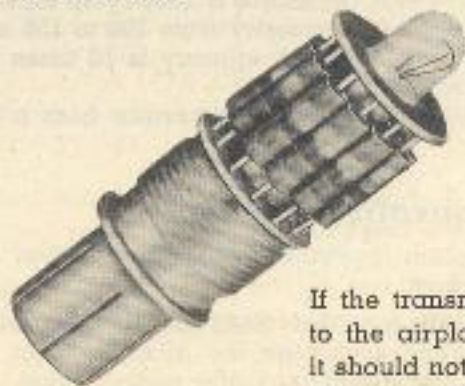


On the front from left to right, a T-R-REM toggle switch, an ANT jack for coupling the SIG GEN buzzer signal to the antenna socket on the rack, a BUZ TONE ADJ, a CAR MIC and a MAG MIC input, a TEL output and an OFF-A-B-C-D channel selector switch.

The SIG GEN ON-OFF switch is mounted on the left side of the control. A CONT ON-OFF switch, for testing the contactor circuit of the transmitter is mounted on the right side of the control.

PHANTOM ANTENNA-29

Phantom Antenna A-29 is designed to be used as an aid in testing the transmitter. This phantom antenna consists of 12 resistors, each 820 ohms, connected in parallel. A bayonet-base pilot lamp, mazda-type 44, is connected in parallel with the resistors. The antenna plugs into the antenna socket on the rack.



If the transmitter is tuned to the airplane's antenna, it should not be retuned to the phantom antenna because the capacitance and reactance of the two antennas differ.

CORD CD-1169

Cord CD-1169 is an adapter cord made up of four wires connecting a jack JK 49 to two plugs PL-55. It is designed to receive the plug from the British-style combination helmet, headset, and throat microphone. One pair of wires connected to the plugs PL-55 are marked MIC, the other pair are marked TEL. By using this cord or a direct connection to the control unit, any combination of microphones and headsets in the airplane may be tested.

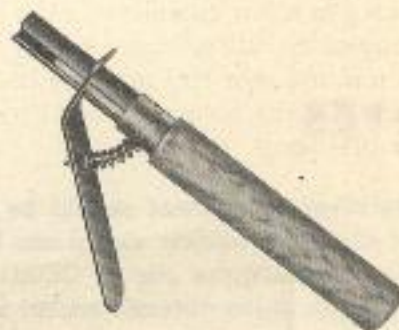
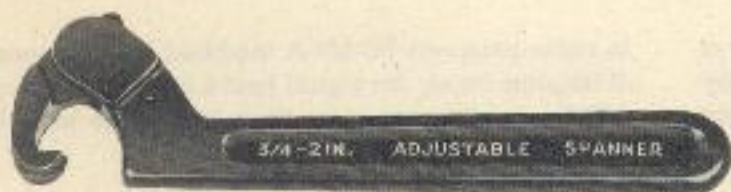
**CORD CD-1170**

Cord CD-1170 is made up of approximately 3 feet of 1/8-inch cord with an alligator clip on one end and a pin probe on the other. It is used to couple the SIG GEN to the antenna socket on the rack.

**SPANNER WRENCH AND LAMP EXTRACTOR**

The spanner wrench, type 471, is continuously adjustable to fit adequately the various plugs used with the 522 equipment.

The lamp extractor is for removal of the small lamps in the control box.

**CAPABILITIES**

Test equipment IE-36 provides a means for making the following tests on the SCR 522.

- 1—A test of the starting and stopping mechanisms.
- 2—A test of the channel selection circuits.
- 3—A test of the T-R-REM switching functions.
- 4—A test of contactor circuit operation in the transmitter.
- 5—A test of relative modulation and output of the transmitter as indicated by the brightness of the phantom antenna lamp.
- 6—A test on the condition of the jackbox positions, by eliminating the jackboxes as necessary in trouble shooting.

CAUTION: When tuning the receiver BC-624-A with the buzzer, avoid tuning to an undesired harmonic by making certain that the receiver tuning controls are turned to the desired frequency on the calibrated scale. It is essential

that these tuning dials indicate within plus or minus 3 mc of the desired operating frequency. A greater error than this may mean that the receiver has been tuned using the wrong harmonic.

SIGNIFICANCE OF METER READINGS

In general, a meter reading on Test Set I-139-A greater than 0.75 with the transmitter METER SWITCH in position 1, 2, or 3, indicates a defect in the equipment or improper adjustment.

The following chart shows the significance of these meter readings:

Position	Normal	Trouble
1	0.4	Greater than 0.75
2	0.5	Greater than 0.75
3 (Average for channels A, B, C, D.)	0.63	Greater than 0.75
5	Full Scale	Less than 0.5
6	OFF	

NOTES

Final receiver adjustment should be made using a weaker signal. A weaker signal can be obtained by removing the alligator clip of CORD CD 1770 from the center pin of the antenna socket on the rack.

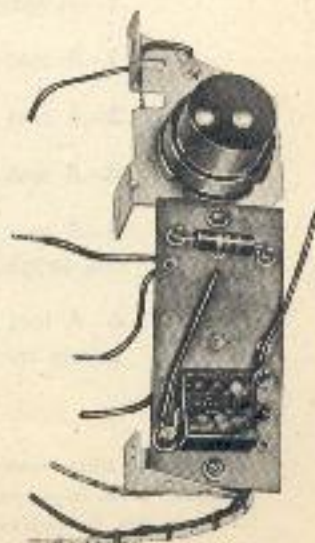
In radio receivers BC-624-A modified for suppression of impulse noise, the signal heard in the headphones will be considerably less than before the modification.

For modified receivers, most accurate tuning is obtained if the tuning controls are peaked, using only circuit noise or hiss and with the SIG GEN switch in the OFF position. This fine adjustment should be made after the signal has been received with the SIG GEN switch in the ON position.

NOISE SUPPRESSION KIT

A noise-suppression kit is now available for the BC-624-A receiver. When properly installed, this kit will permit satisfactory reception in the presence of all manner of pulse-like interference such as ignition noise. The major performance characteristics of the receiver will not be materially changed. The most obvious change in performance will be a reduction of approximately 3 or 4 to 1 in the intermediate frequency amplifier gain.

This kit is distributed by the Signal Corps. The Signal Corps stock number is 2C-4424 A/K1.





NAVIGATIONAL EQUIPMENT



SECTION

6

NAVIGATIONAL EQUIPMENT

6

Subjects in Section 6

SCR-269 Radio Compass, 6-1

AAF Instrument Approach
System, 6-2

RC-43 and -193 Marker Beacon
Receivers, 6-3

Radar, IFF, 6-4

Interphone, Radio Range
Filter, 6-5



Successful navigation is dependent upon radio aids. The success of radio aids depends largely upon you. You must know the operation of all such equipment as the radio compass, the marker beacon receivers, the receivers of the instrument approach system. It is also vital that you have a sound basic understanding of the uses to which these radio aids are put by your navigator and pilot. The pilot's equipment must always be in good condition. The navigator needs your help in taking bearings and establishing fixes. Teamwork with your pilot and navigator is always essential to a successful mission.

SCR-269 AND AN/ARN-7

RADIO COMPASS UNITS

The radio compass is used to take bearings, to home on radio stations, and to receive radio range or other navigational signals. Such operations require the use of both directional (loop) and non-directional (whip or fixed-wire) antennas.

Basically the radio compass sets SCR-269 and AN/ARN-7 are the same.

They are both 8-tube superheterodyne receivers having the additional stages necessary for automatic radio compass operation. This gives each set a total of 15 tubes. Both sets have CW modulation for the reception of CW signals. Their frequency ranges are:

SCR-269	AN/ARN-7
200—410	100—200
410—850	200—410
850—1750	410—850
	850—1750

The AN/ARN-7 differs from the SCR-269 in that it has a 100 to 200 kc band, no threshold sensitivity adjustment, and no shield binding post. The CW-VOICE switch is on the control box rather than on the receiver unit.



COMPASS CONTROL BOX

The control box provides complete control of the radio compass from a remote position. Most airplanes have dual control systems.

The OFF-COMP-ANT-LOOP switch controls the functions of the radio compass. Here are the purposes of each position, the number of tubes involved, and the antennas used:

COMP—Automatic position-finding or visual homing. 15 tubes. Both antennas.

ANT—General reception, control tower, range, etc. 8 tubes. Whip or fixed-wire antenna.

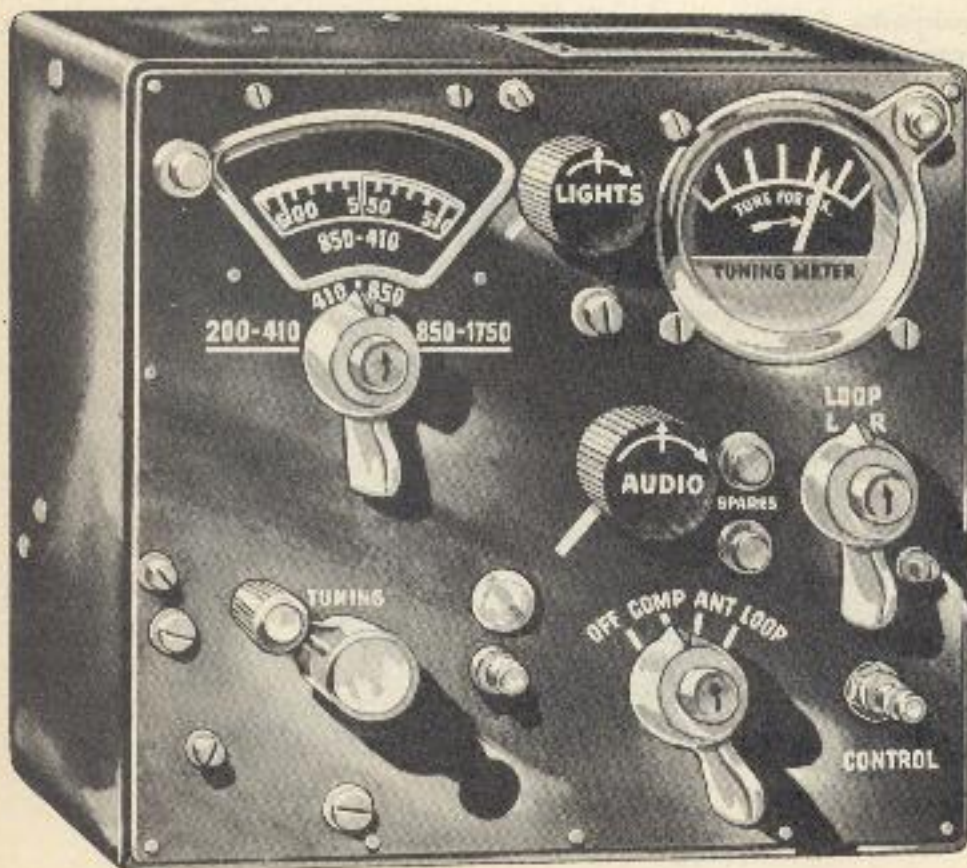
LOOP—Bad weather reception, aural null homing, or position-finding. 10 tubes. Loop antenna.

The LOOP-L-R switch controls the movement of the loop antenna when the function switch has been set on LOOP position. You can rotate the loop at a higher speed by pressing down on the switch as you turn it.

The TUNING METER shows maximum deflection when a station is properly tuned.

The AUDIO control regulates the volume of the signal in the headphones.

The CONTROL pushbutton transfers control of the compass from one control box to the other. The green light burns on the box which has control. There are spare bulbs for the light in the compartments so marked.



The C4/ARN-7 control box has an additional low-frequency band, 100-200 kc.



The CW-VOICE switch of the C4/ARN-7 is on the bottom of the control box and to the right.

INDICATOR I-81-A (PILOT'S)

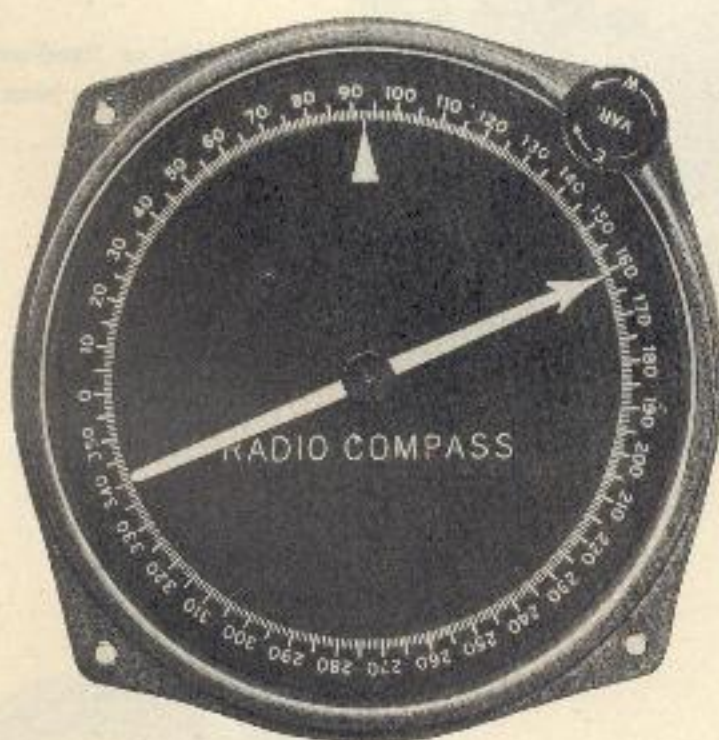
Indicator I-81-A is located on the pilot's instrument panel. It is used primarily for Visual Homing.

When the indicator points to zero, the airplane is headed directly toward the transmitting station.

The scale is graduated in 5-degree intervals.



INDICATOR I-82-A (RADIO-OPERATOR'S) (NAVIGATOR'S)



Indicator I-82-A will be found either in the radio operator's or navigator's position.

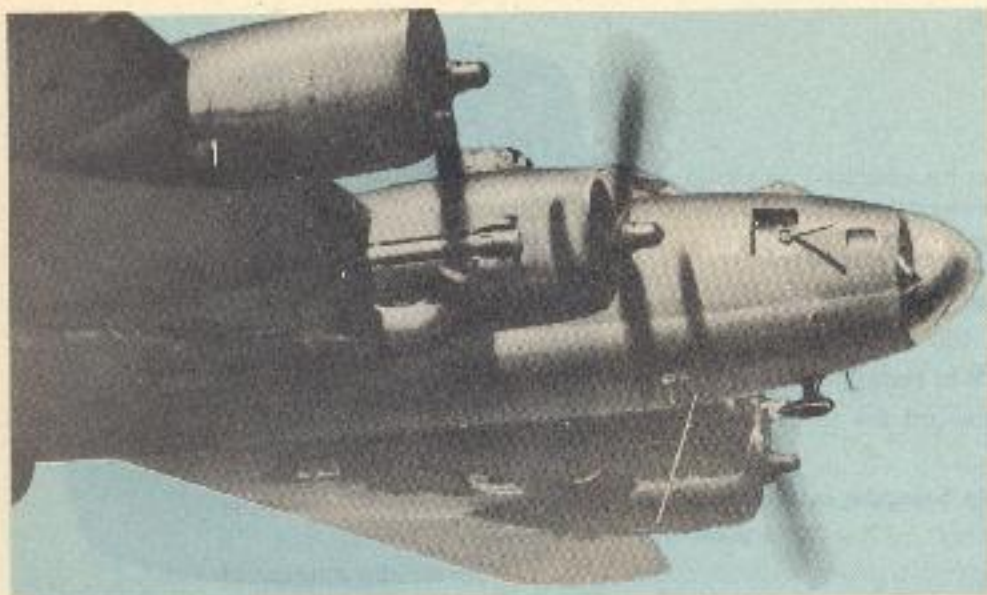
By use of the VAR knob the graduated AZIMUTH scale can be rotated so that the TRUE HEADING of the airplane can be set up at the INDEX TRIANGLE.

The scale is graduated in 1-degree intervals.

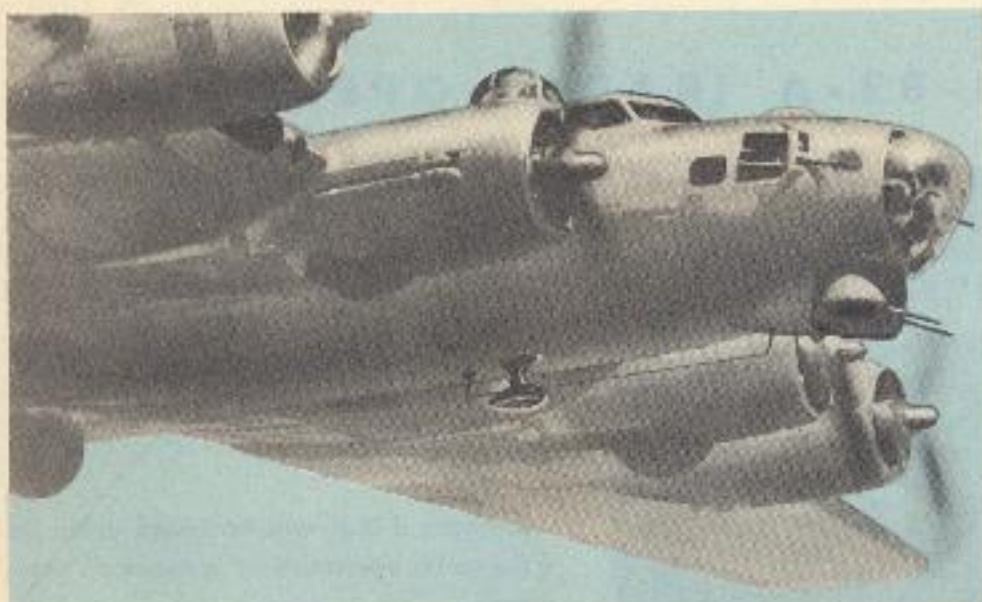
POWER SOURCES

Two input power sources are required for operation of the radio compass. They are 24 to 28 volts from the central-power system and 115 volts, 400 cycles. This is obtained from an inverter unit.

ANTENNA SYSTEM



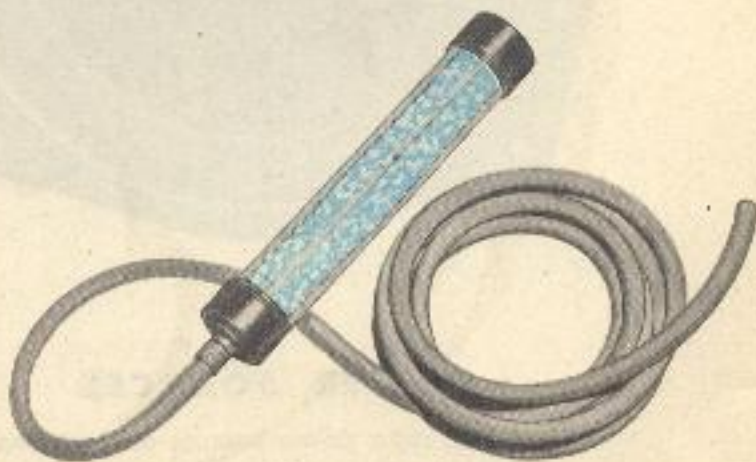
The antenna system for the radio compass includes a motor-driven loop antenna and a vertical whip or fixed-wire antenna.



The whip or fixed-wire antenna must be at least 3 feet from the loop.

DEHYDRATOR UNIT

The dehydrator unit consists of a plastic tube filled with silica gel which has been impregnated with cobalt chloride. It is connected to the loop assembly by a rubber hose. Any moisture in the air entering or leaving the loop assembly is absorbed by this unit. The gel is dark blue when dry and light blue or pink when moist.



VARIATION

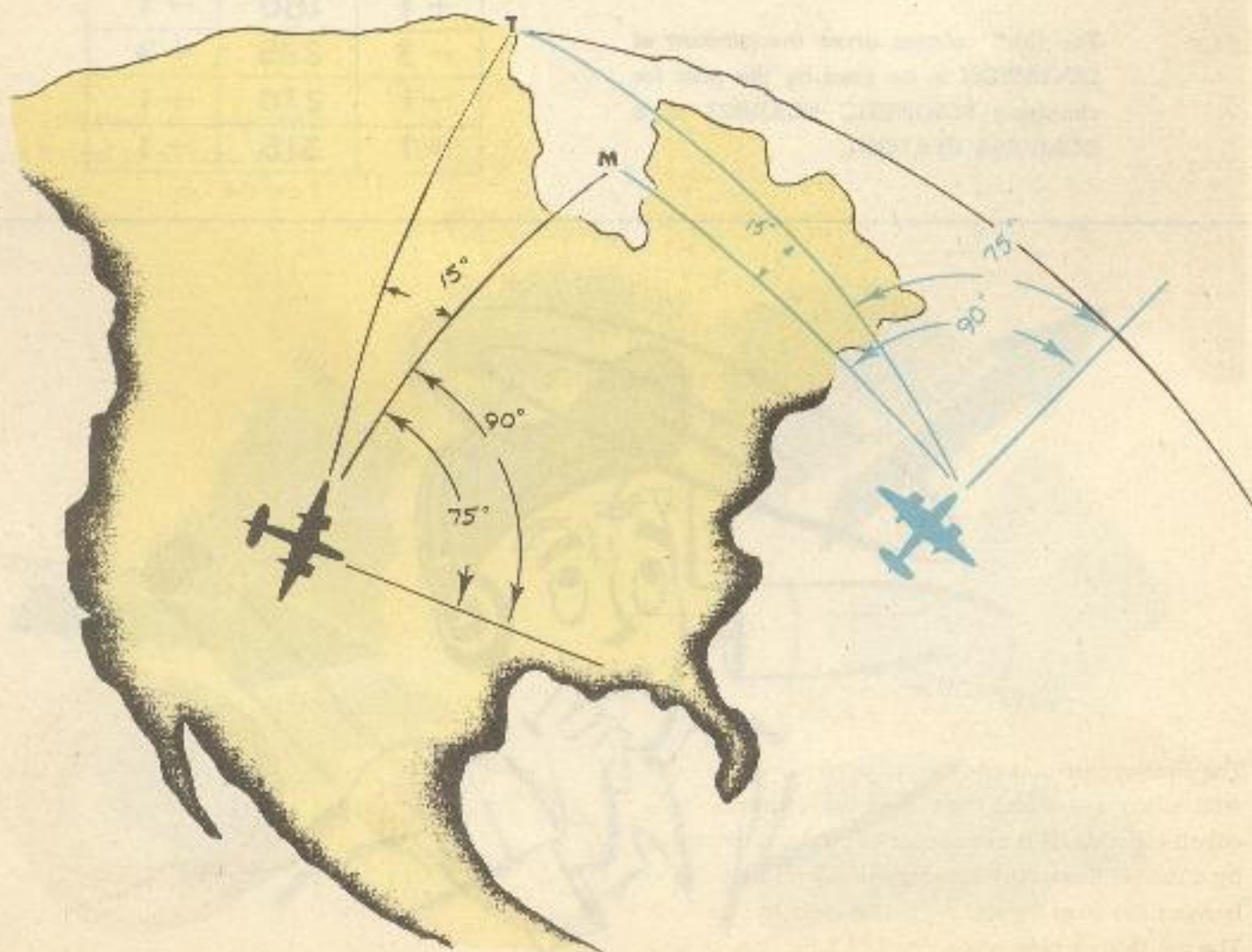
Before bearings can be obtained on radio stations, the **TRUE HEADING** of the airplane must be determined. **TRUE HEADING** is the direction the airplane is pointing as measured clockwise from true north.

The magnetic compass is used to obtain the **TRUE HEADING** of the airplane. However, since the magnetic north and the true north do not coincide, the magnetic compass will give the **MAGNETIC HEADING** or the heading of the airplane with respect to magnetic north. The angle between true north and magnetic north is called **VARIATION**.

If the magnetic compass points east of true north, **VARIATION** is said to be east. If it points west of true north, **VARIATION** is said to be west.

East VARIATION must be added to the **MAGNETIC HEADING** to obtain the **TRUE HEADING**. **West VARIATION must be subtracted**.

Aeronautical charts are provided with dotted lines to indicate the amount of east or west **VARIATION**.



DEVIATION

The magnetic compass should point to **MAGNETIC NORTH** but because of influences within the airplane, it may be pulled to the east or west of **MAGNETIC NORTH**. This error in the magnetic compass is called **DEVIATION**.

The center column of the card contains the compass reading.

The first column, C to M, gives the **DEVIATION** to be used when changing a **COMPASS HEADING** to a **MAGNETIC HEADING**.

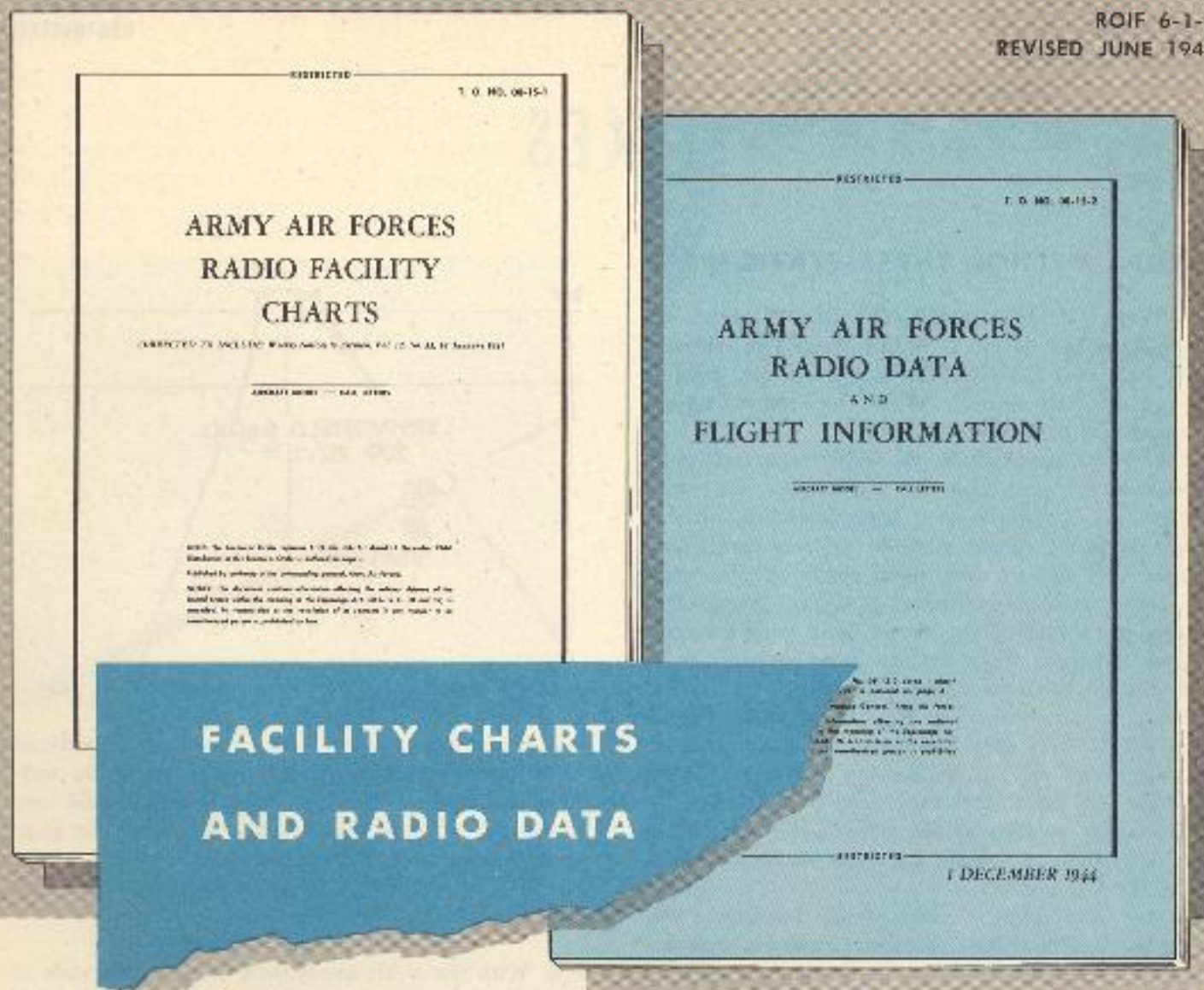
Example: If magnetic compass reads 45 degrees, it is reading 3 degrees too high. Therefore 3 degrees must be subtracted from that **COMPASS HEADING** to obtain the actual **MAGNETIC HEADING** which would be 42 degrees.

The third column gives the amount of **DEVIATION** to be used by the pilot for changing **MAGNETIC HEADING** to a **COMPASS HEADING**.

The amount of **DEVIATION** must be predetermined by swinging the airplane on several different headings. These values are placed on a **COMPASS CORRECTION CARD** which is mounted in the airplane near the magnetic compass.

C to M		M to C
+1	000	-1
-3	045	+3
+1	090	-1
+2	135	-2
+1	180	-1
-3	225	+3
-1	270	+1
+1	315	-1





TECHNICAL ORDER 08-15-1

Army Air Forces Facility Charts (T.O. 08-15-1) contains information on radio range stations and their associated facilities. It is revised every month to include all data available by the 15th of that month. Any later changes are published in **Weekly Notices to Airmen**. Enter all such changes in the **Record of Correction** printed in the T.O.

These facility charts give you such information as:

The names, identifications, and frequencies of radio range stations.

The magnetic bearing of each radio range course toward the station. *

The magnetic bearing and distance in miles from station to airport.

The airport tower frequency and field elevation.

In addition to this and much other information, the T.O. gives you the VHF facilities available in the continental United States, planning and mileage charts, and an index to all radio facility charts.

TECHNICAL ORDER 08-15-2

Army Air Forces Radio Data and Flight Information (T.O. 08-15-2) contains important data for pilots and radio operators to use during flight. Among other items there are:

A list of many of the broadcasting stations in the United States. These are stations which operate between 550 and 1550 kc and may be helpful in air navigation. A number of stations are omitted, since their low power and the presence of nearby stations on the same frequencies decidedly limit their usefulness as aids to navigation.

An index to the aeronautical charts (sectional, regional, and radio direction finding) of the United States.

Daylight and darkness tables.

Civil Air Regulations.

A time-and-distance graph.

Emergency and taxiing signals.

Fuel and oil locations in the United States.

FIXES

VISUAL METHOD THREE-STATION FIX

1. Turn the OFF-COMP-ANT-LOOP switch on the control box to ANT. If the green light doesn't come on, push the CONTROL button, and hold it for two or three seconds. When the light comes on, your unit controls the set.

2. Locate three stations, 30° to 150° apart, on your aeronautical chart. Log the dial reading for each. Try to use low-frequency, high-powered stations, such as radio range stations or non-directional beams. You can identify them easily. If you must use commercial broadcasting stations, try to find clear-channel ones. These are stations using frequencies to which no other stations have been assigned.

3. Tune in each station and identify it.

Note: Be sure you make this check on ANT position. COMP will give you poor reception and increased wear on the indicators. When you have identified all three stations, switch to COMP.

Check the position of the CW-VOICE switch before you tune in a station. For some stations, it must be on the CW position.

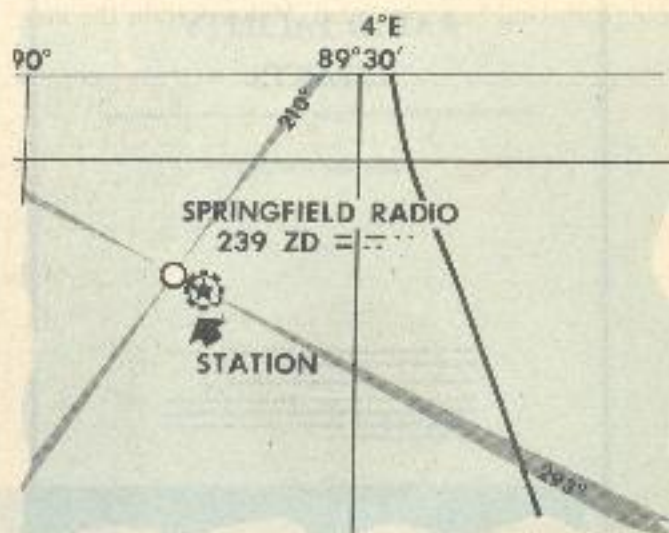
4. Ask your pilot to hold a steady heading. From the magnetic compass, get the airplane's **compass heading**. Apply deviation to the compass heading to obtain the **magnetic heading**. For example, in the illustration here:

$$\begin{array}{r} 85^\circ = \text{Compass Heading} \\ +3^\circ = \text{Deviation} \\ \hline 88^\circ = \text{Magnetic Heading} \end{array}$$



C to M		M to C
+1	000	-1
-3	045	+3
+3	090	-3
+2	135	-2
+1	180	-1
-2	225	+2
-1	270	+1
+1	315	-1

COMPASS HEADING OR - DEVIATION



5. Consult your aeronautical chart for the amount of east or west **variation**, and apply this to the magnetic heading to find the **true heading**. Add east variation, subtract west. In the chart on this page the variation is 4° E. Therefore:

$$\begin{array}{r} 88^\circ = \text{Magnetic Heading} \\ +4^\circ = \text{Variation} \\ \hline 92^\circ = \text{True Heading} \end{array}$$

6. With the VAR knob, turn the azimuth scale of the I-82-A indicator until the value of this true heading is set at the **index triangle**.



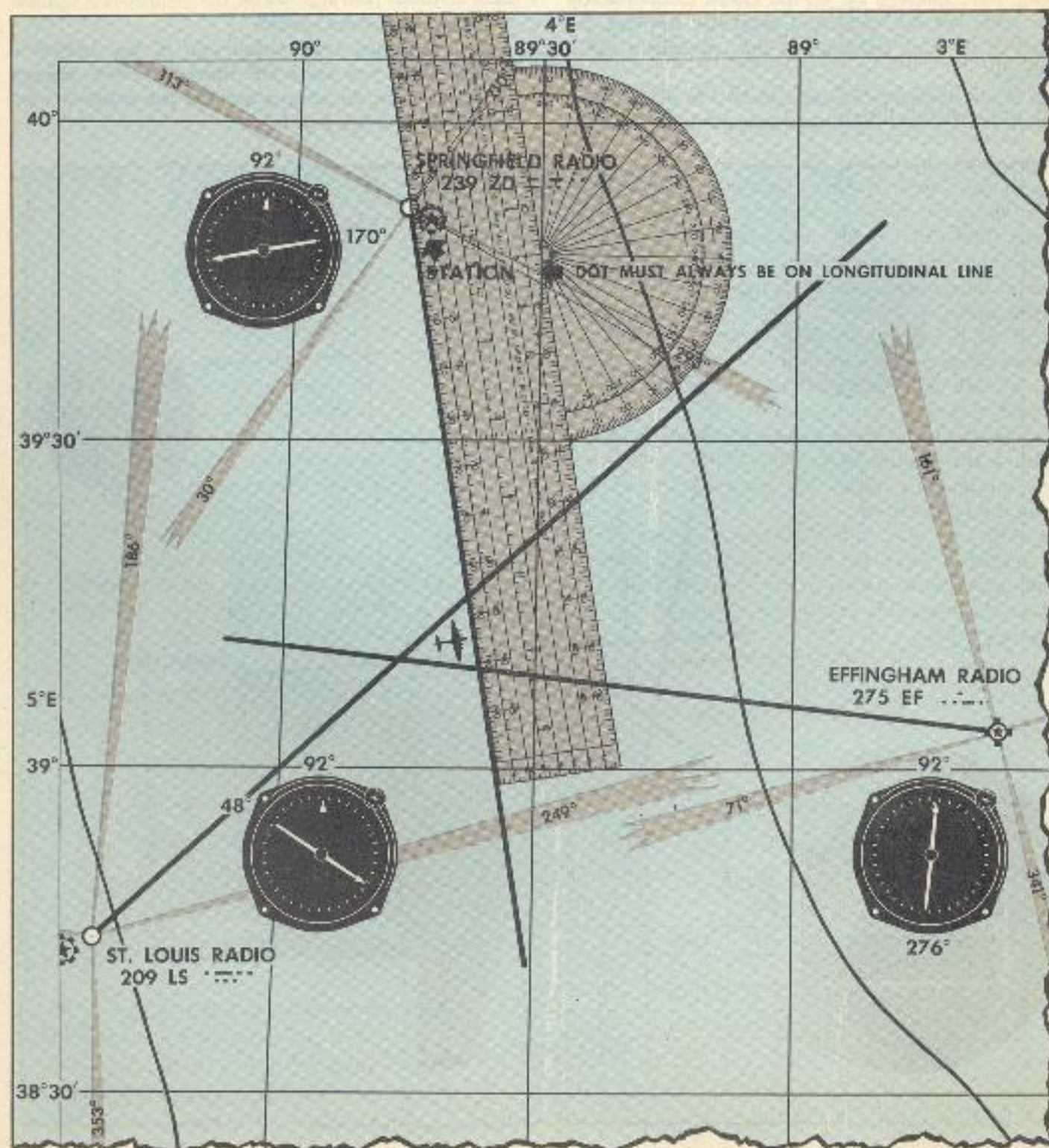
Be sure your radio compass has been compensated for quadrantal error before you try to take bearings. See T.O. 01-1-152 or 08-5-30.

7. Be sure the selector switch is on COMP position, then tune in the first station. Write down the reciprocal bearing, which is the reading you get from the tail end of the indicator pointer.

8. Tune in the two remaining stations and record their reciprocal bearings, also. **Make certain the air-**

plane's heading does not change while you take these bearings!

9. Plot these three reciprocal bearings from the meridians of your aeronautical chart. Use a Weems Plotter. The plotted lines intersect at your approximate location.



USE OF DF CHARTS FOR DIRECTION FINDING

On DF (Radio Direction Finding) charts, each radio station has around it a compass rose oriented to magnetic north. In other words, variation has already been allowed for on the chart. Consequently you must set the airplane's **magnetic heading**, instead of its true heading, at the indicator's index triangle.

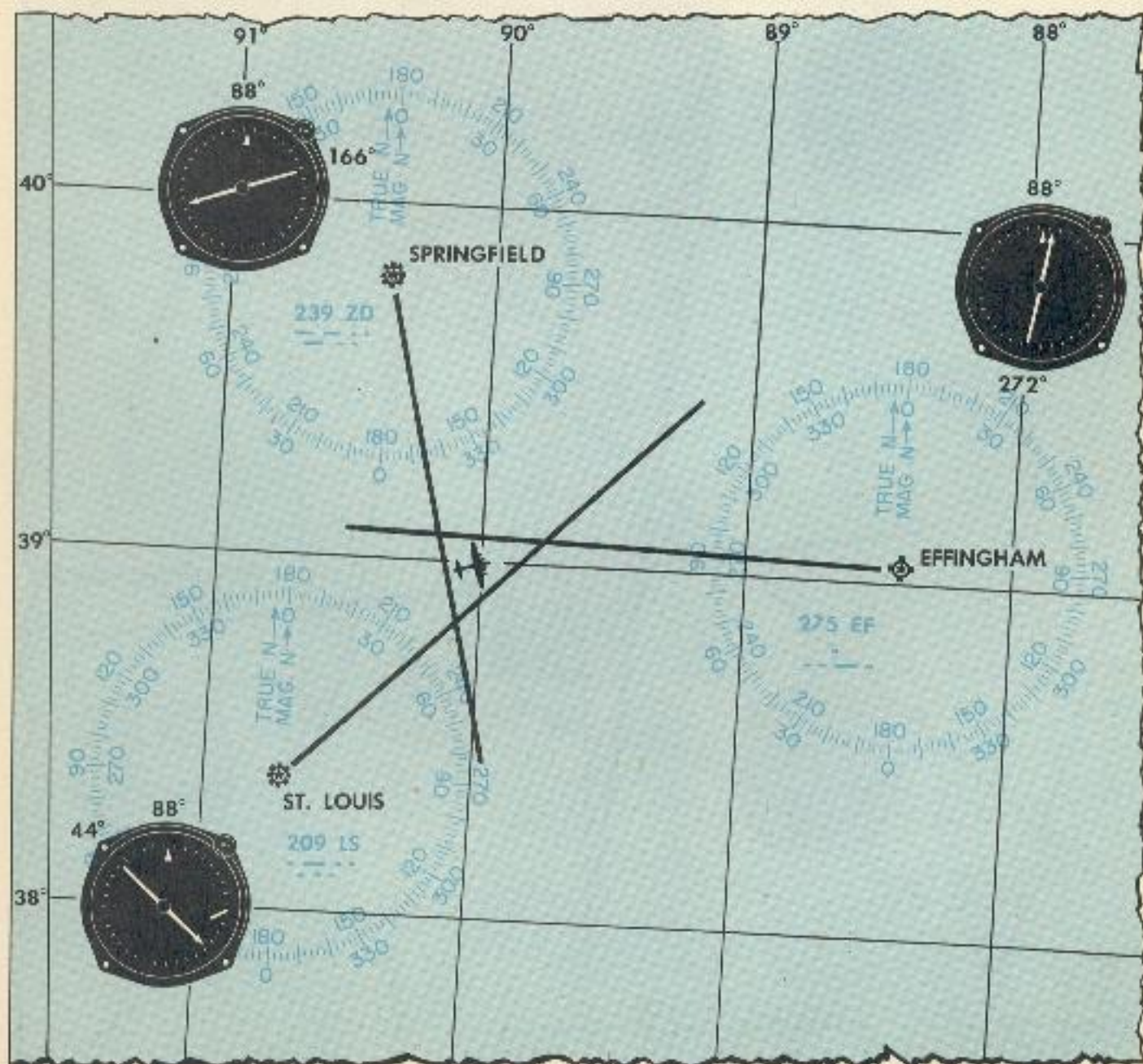
It is not necessary to use a plotter to plot a bearing on a DF chart. You need only draw a line from

the station through the proper graduation on the compass rose.

The outer figures on the rose show you the **magnetic direction of the station** from any given point. You get these bearings from the pointed end of the indicator needle.

The inner scale of figures shows you the **reciprocals** of these bearings. Read the reciprocals against the **blunt end** of the needle.

You can thus read either end of the indicator needle when you use a DF chart. However, **always** be sure to use the proper scale of the compass rose when you plot the bearing.



AURAL NULL THREE-STATION FIX

When the atmospheric conditions make the compass needle fluctuate so badly that its indications are unreliable, you can still take a fix by the aural null method.

1. Follow the first five steps of the visual method. Remember, however, that if you use a DF chart you must set the airplane's magnetic heading at the index triangle.

2. Place the OFF-COMP-ANT-LOOP switch on LOOP position.

3. Tune in the first station.

4. With the LOOP-L-R switch, rotate the loop until you get minimum volume in your earphones. If this signal null exists over too wide an angle, turn the AUDIO knob fully clockwise and look for the dip in the TUNING METER. You can also decrease the width of the null by putting the CW-VOICE switch on CW.

5. Write down the reciprocal bearing, the reading shown by the blunt end of the pointer.

6. Tune in the other two stations, again rotate the loop to a null position, and record these bearings.

7. Plot the fix as you would in the visual method, except that here you must extend the first bearing line through the station for some distance. This is necessary because, when you are on LOOP, your reading may be 180° off. Then, if the plotted lines from the other stations lead away from the first line, draw their reciprocals instead, so that they intersect it and form a triangle.

**JAMMING****ENEMY ACTION****Jamming**

The enemy jams a beacon by transmitting on its frequency. You can detect this easily because you hear the jamming note above that of the beacon, and the compass indicator needle searches frantically.

There are several kinds of jamming signals. Sometimes they are a hash or hum, sometimes a four-toned musical note.

Meaconing

This form of enemy interference is usually harder to detect, and therefore more dangerous, than jamming. When the enemy meacons, he keys a transmitter on the same frequency as one of our beacons and in step with it. You hear no extraneous signal, and if the meaconing is strong enough you may actually home on the wrong signal.

The indications by which you can detect meaconing are much like those of night effect. They are:

- Fading of signals.
- Widening of null.
- Displacement of null.
- Swinging of null.
- Duplication of null.

The best test for meaconing is to look for a duplication of the null. Do this while you are getting the first bearing.

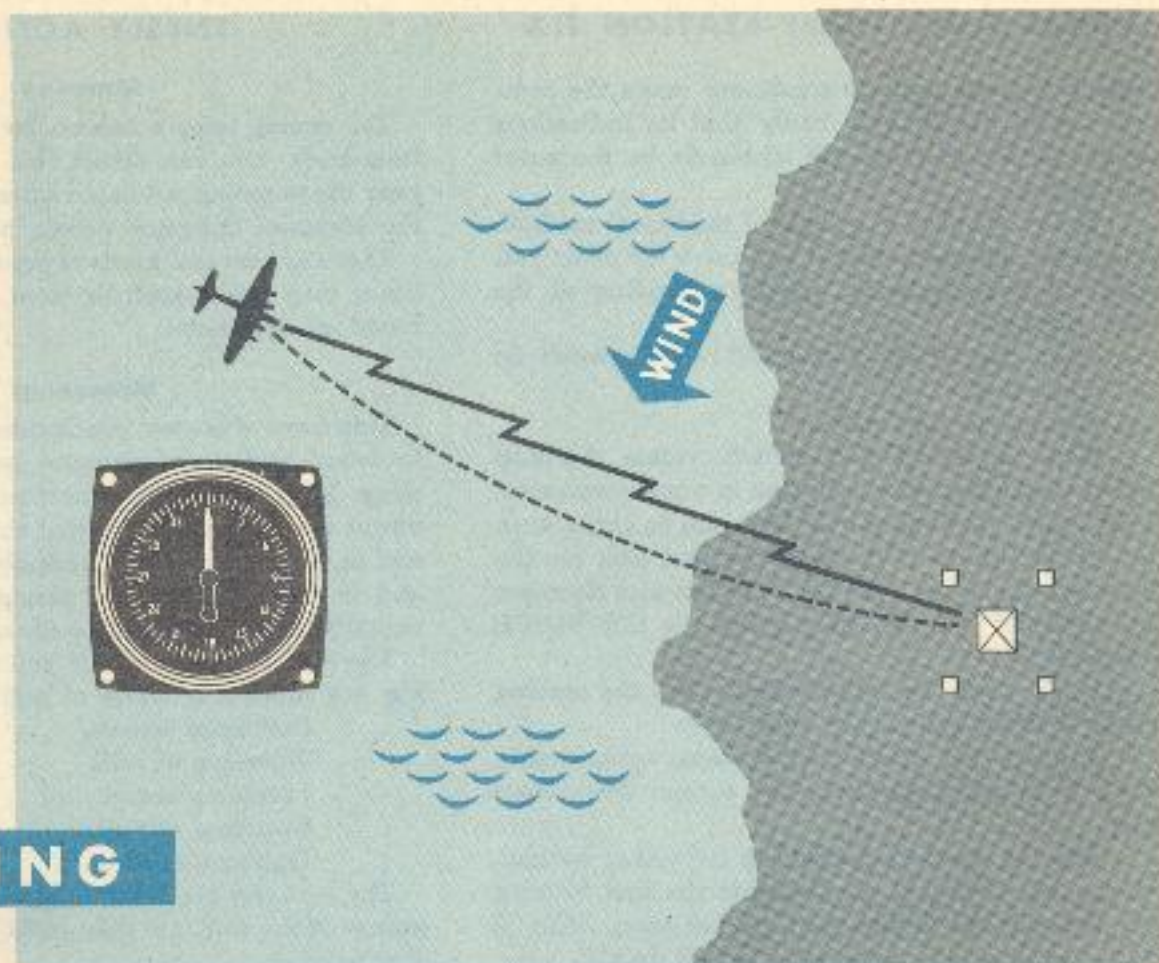
1. Put the compass in LOOP position.

2. With the LOOP-L-R switch, rotate the loop through 180°. If you find three nulls, the beacon is meaconed.

Another good way to check is to switch quickly to a different frequency used by the same splasher site. (A splasher site is a transmitting unit.) If this bearing agrees with the first, the beacon is probably not being interfered with.

In the United Kingdom, splashers are monitored, and when the monitors discover meaconing they mutilate the beacon signal with a series of dots. This service is available with splasher systems only. Multi-beacons are also subject to meaconing.

There are several kinds of jamming signals. Sometimes they are a hash or hum, sometimes a four-toned musical note.



HOMING

The radio compass can be used for either visual or aural-null homing. When the pilot's indicator points to 0° , the airplane is headed toward the radio station. If it points to the left of 0° , the station is to the left of the airplane. If it points to the right of 0° , the station is to the right.

An airplane homing on the radio compass ultimately will arrive over the radio station's antenna regardless of drift. However, if there are crosswinds its flight path will be a curved line. Consequently it will be difficult for the pilot to coordinate with ground fixes or landing fields along the route. By trial and error, he can fly a relatively straight course if he offsets his heading to compensate for wind. A decreasing magnetic heading shows that the wind is from the left. An increasing magnetic heading shows a wind from the right.

Visual Method

1. Tune in the station to be used for homing, and put the OFF-COMP-ANT-LOOP switch on COMP.
2. The pilot then turns the airplane until his compass indicator points to 0° .

Aural-Null Method

If, for any reason, visual homing is impossible, use the aural-null method. Set the controls this way:

1. Tune in the station to be used for homing. Place the OFF-COMP-ANT-LOOP switch on LOOP position.
2. With the LOOP-L-R switch, align the indicator pointer to 0° on the index.
3. The pilot turns the airplane until there is a minimum signal in the earphones. He then holds it on the same course, keeping the signal at this null.

NOTE:

Do not home on a radio range course and fly the course aurally at the same time. With the switch on COMP position, the automatic volume control circuits make the course seem much broader than it is.

RECEIVER OPERATION

ANTENNA RECEPTION

For general reception, turn the OFF-COMP-ANT-LOOP switch to COMP. Tune in the station for best headset volume and maximum deflection on the TUNING METER.

Use ANT position when you fly a radio range in good weather by the aural method. Use manual volume control when the switch is in this position.

LOOP RECEPTION

It is best to use loop reception when you fly in severe static conditions. Set the switch on LOOP position and rotate the antenna with the LOOP-L-R switch until you get best headset volume and maximum deflection on the TUNING METER.

Polarization Errors

The radio compass was designed to serve primarily as a navigational aid in flying. So long as it is used in this capacity and its limitations recognized, it is a useful and valuable device. Unfortunately, in actual flight, there are certain periods when the instrument's indications are not correct. This is caused by radio wave polarization errors. Failure to recognize these errors can throw you far off course, and make you mistrust the compass.

The principal polarization error is **night effect**. Other causes of faulty bearings are **mountain effect**, **shore-line effect**, and **magnetic disturbances**, such as those found in auroral zones of polar regions.

Ordinarily, for homing, the radio compass receiver depends on reception of vertically polarized radio waves. However, when these waves are reflected from the sky they may change polarity and become horizontally polarized. These horizontally polarized waves conflict with the vertically polarized waves and cause fluctuations in the reading of the radio compass indicator.

Night Effect

Since radio waves are reflected in greater strength by night than by day, the opposition of horizontally opposed waves is stronger at night. Errors caused by this phenomenon are called night effect.

Polarization errors may flare up for a few seconds at intervals through the day, and cause the needle to hunt more than normally about the bearing. Real night effect causes hunting of more than 30 seconds' duration. Variations in the intensity of this hunting

may be classified conveniently into two types.

In less severe form, the indicator hunts over a total angle of 15° or less around the true bearing; and often you can take a bearing with an accuracy of 5° by computing a mean reading. In more severe cases the indicator moves constantly, usually through a wide angle and not around the proper bearing. Therefore, it is not possible to take an average of the fluctuations. You sometimes encounter short periods of nearly normal operation during these periods of extreme instability.

The times at which night effect begins vary considerably, even on the same station. Usually, the first and last disturbances appear during the periods just before sunset and just after sunrise. The errors increase with an increase in frequency, or in the distance of the airplane from the station.

Remedies

Night effect recurs frequently. However, there are definite steps with which to combat it. First, recognize it by remembering that a period of fluctuation in the bearing indications lasting more than 30 seconds is a sure sign. Then try the following:

1. Check the bearings by other methods.
2. Ask pilot to increase altitude.
3. Average the fluctuations if possible.
4. Select a station of lower frequency.
5. Remember that comparatively large errors are tolerable for purposes of homing, since accuracy increases as the distance diminishes.

Other Effects

You may notice fluctuations when flying across coast lines when the radio waves cross the coast at acute angles. Errors may occur, also, when you are flying over certain mountainous regions, and, to a limited extent, through cold fronts.

Precautions

If the loop is in the null position when you are flying on a radio range course, the signal may fade in and out and be mistaken for a cone of silence.

Cone-of-silence indications are not reliable on loop-type range stations when the receiver is on LOOP. The signal may surge strongly instead of disappearing when you are directly over the station.

Never use COMP position for flying the radio range; the course may appear broader than it is!

Do not take bearings on a station unless you can identify it by the headset signal on COMP position.



ADJUSTMENTS AND INSPECTIONS

Automatic Sensitivity

The AUTO SENS control is on the front panel of the receiver. With it you adjust the sensitivity of the loop-control circuits so that the antenna will respond to small changes in the bearing of a transmitting station. It also controls the amount of hunting to which the loop antenna is susceptible. AUTO SENS adjustment instructions are on the front panel.

Threshold Sensitivity

The THRES SENS control is also on the front panel of the receiver, where instructions for its use are printed. This control governs the noise output of the receiver when you are tuning between stations.

Tuning-Dial Alignment

Complete instructions for aligning the dial are printed on the receiver panel. Make certain that both control boxes are properly aligned.

Dehydrator Unit

The crystals of the dehydrator unit should be replaced or reactivated when approximately half of

them have turned pink. Reactivate them by heating them in a shallow pan at a temperature of 350° to 400° Fahrenheit until they assume their deep blue colors. This should take about two hours. Stir occasionally.

Do not exceed a temperature of 400° F, or the activity of the silica gel may be permanently impaired. As soon as the crystals have cooled, pour them back into the tube and re-assemble and re-mount it.

Be sure the tape is removed from the air hole on the end cover.

The AN/ARN-7 does not have a threshold sensitivity control. This adjustment is already set in the receiver. The AUDIO knob is the only manual sensitivity control on this unit.

Fuses

If the radio compass fails, check its fuses. There are two, a 5-ampere and a 3-ampere fuse, both in the BK-22 relay unit. Also, check the inverter, and if it is not running check its fuse. Ask your crew chief where this fuse (usually 20 amperes) is located.

AAF INSTRUMENT APPROACH SYSTEM

The AAF Instrument Approach System (SCS-51) has two airborne components. They are:

1. The localizer receiver (RC-103-A).
2. The glide-path receiver (AN/ARN-5A).

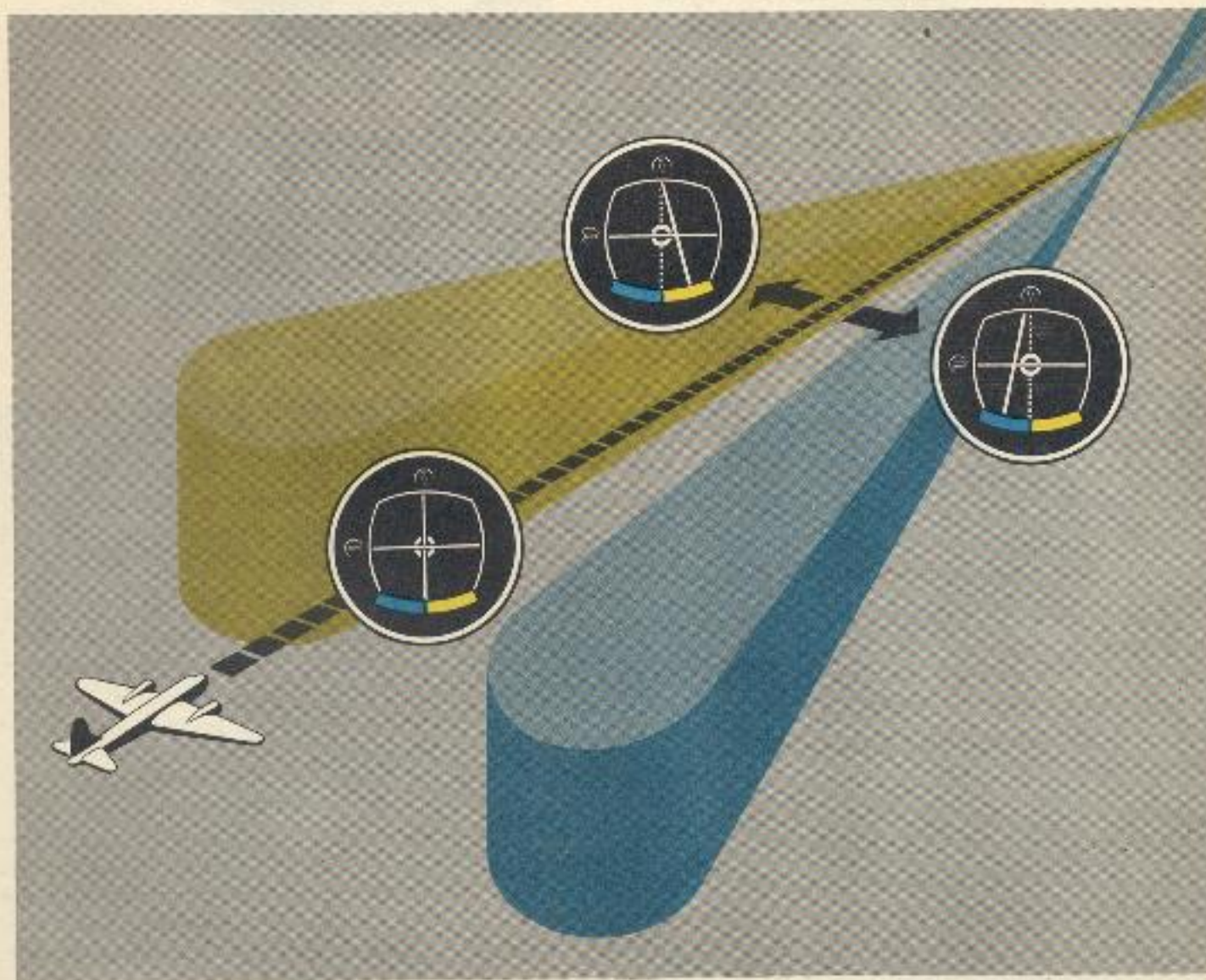
The marker beacon (see ROIF 6-3) is used in conjunction with the instrument approach system.

The localizer receiver gives the pilot lateral guid-

ance, showing him whether he is on or off course during his instrument approach.

The glide-path receiver gives him vertical guidance, showing him whether he is making his approach too high or too low.

The marker-beacon signals indicate the airplane's distance from the runway.



LOCALIZER RECEIVER

Radio Receiver BC-733 is a crystal-controlled superheterodyne. It operates on any one of six channels:

108.3 mc	109.1 mc	109.9 mc
108.7 mc	109.5 mc	110.3 mc

The signal the set receives (radio frequency) contains 90- and 150-cycle modulations. This signal is amplified, then detected. The resultant 90- and 150-cycle output is fed into a jack on the control box, or to COMMAND position on the interphone jack-box, and you can receive it aurally. This output is also applied to a special audio-filter and rectifier network, which gives you visual indication. The network separates the 90 and 150 cycles, then rectifies them. The leads which carry the rectified signals are connected to the visual-indicator terminals. Dynamotor DM-33 supplies the set's high voltage. It is mounted on the back of the receiver box.

The normal range of the localizer beam is more than 25 miles at an altitude of 2500 feet. The range increases with altitude.

Visual Indications

The visual-indicator pointer shows, by swinging to the right or left, which of the two signals is the stronger. Since the two signals are equally strong at the center of the runway, the indicator remains centered when the airplane is on course. Any deviation



of the pointer from center shows the position of the airplane **relative to the center of the runway**. The indicator does not tell you the airplane's heading.

When the airplane is approaching for a landing, and the pointer moves to the **blue** area of the indicator, it means the plane is to the **right** of the runway. If the pointer moves to the **yellow** area, the plane is **left** of the runway.



VHF GLIDE PATH, AN/ARN-5A

This equipment shows the pilot whether he is on, above, or below his glide-path during an instrument approach.



RECEIVER

Radio Receiver R-89/ARN-5A is a crystal-controlled superheterodyne. It operates on any one of three channels: 332.6, 333.8, or 335.0 mc.

The electrical characteristics of the R-89 are similar to those of the localizer receiver. This receiver does not require high voltage, however.

Earlier models of the glide-path equipment use an R-57/ARN-5 receiver. This set has no relay-switch-

ing equipment. It is a single-channel receiver with two other crystals mounted under the cover. You must remove the cover to change the channel frequency. This receiver operates directly from the 24-volt power supply.

Visual Indications

When the airplane is above the glide path, the set receives a predominantly 90-cycle signal. The horizontal pointer then drops below center.

When the airplane is on the glide path, it meets the intersection of the two signals. The set now receives equal 90- and 150-cycle signals, and the pointer is centered.

Below the glide path, the pointer rises above center. The amount of deflection depends on how far the airplane is from the glide path. The receiver is highly sensitive. The pointer shows a full-scale deflection if the airplane is 0.3° above the glide path, or 0.5° below it.

NOTE:

The glide-path receiver has a built-in automatic alarm system. If the receiver is on, but is receiving no glide-path signal, the indicator needle reads in fly up position.



CONTROL BOX, BC-732

This unit controls the operation of both the localizer and glide-path receivers.

The ON-OFF switch controls power input to both receivers. The INCREASE VOLUME knob regulates the strength of the audio signals. The U-V-W-X-Y-Z switch selects the channel frequency circuits of both receivers. The channel frequencies in megacycles are:

CHANNEL	RC-103	AN/ARN-5
U	108.3	332.6
V	108.7	333.8
W	109.1	335.0
X	109.5	332.6
Y	109.9	333.8
Z	110.3	335.0



VISUAL INDICATOR, I-101

The indicator consists of two micro-ammeters mounted in the same case. One is mounted vertically, the other horizontally.

The vertical pointer is connected to the localizer receiver, and registers the signals it receives in the blue-and-yellow area.

The horizontal pointer registers the relative strength of the glide-path transmitter signals.

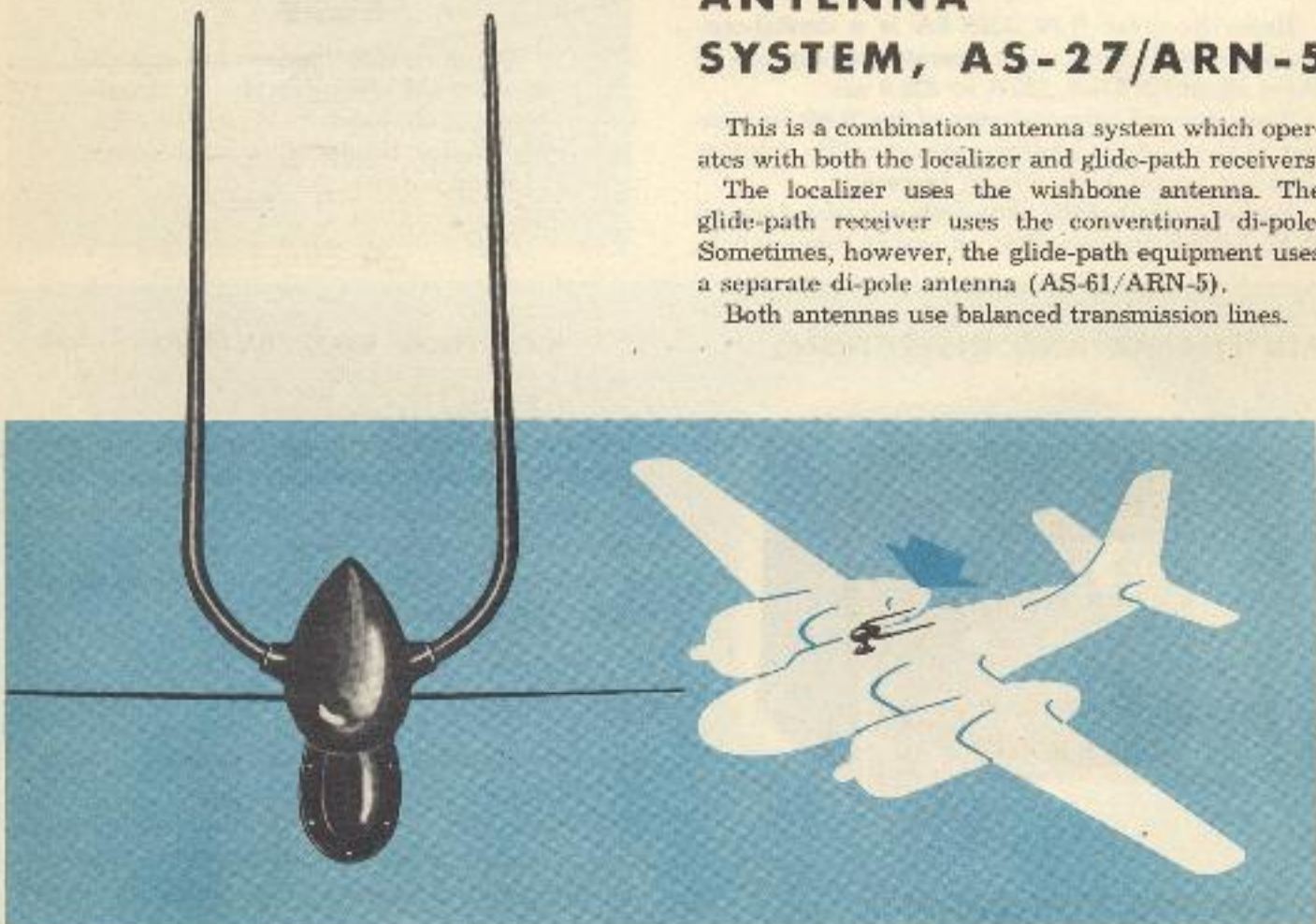
Both pointers should line up with the dots along the scale when the equipment is turned off. If they don't, center them by adjusting the screws on the front of the meter.

ANTENNA SYSTEM, AS-27/ARN-5

This is a combination antenna system which operates with both the localizer and glide-path receivers.

The localizer uses the wishbone antenna. The glide-path receiver uses the conventional di-pole. Sometimes, however, the glide-path equipment uses a separate di-pole antenna (AS-61/ARN-5).

Both antennas use balanced transmission lines.



RC-193 MARKER-BEACON RECEIVER

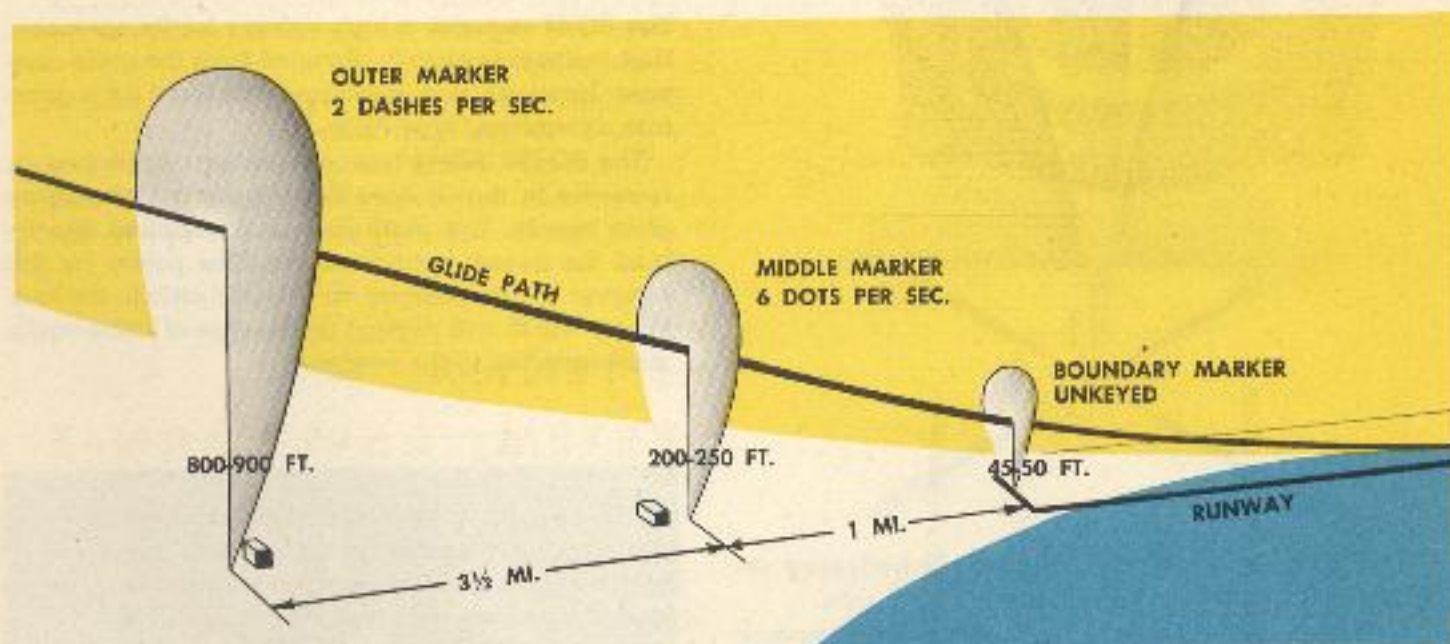
Sometimes the marker-beacon equipment is used with the SCS-51 system to give visual indications of the distances the airplane is from the runway when making an instrument approach landing. There are three marker stations located along the glide path. They are referred to as the *outer marker*, *middle marker*, and *boundary marker*.

The outer marker is placed 4½ miles from the

approach end of the runway and is keyed at two dashes per second. The middle marker is placed 1 mile from the approach end of the runway and is keyed at six dots per second.

The boundary marker is located near the approach end of the runway. It is unkeyed.

The marker-beacon signals are modulated with 1300 cycles.



MAINTENANCE AND INSPECTIONS



DYNAMOTOR UNIT DM-53

There are two dynamotor units available for use with RC-103 equipment: the A model for 24-volt

operation and the AZ model for 12-volt operation. A 12-volt AZ model receiver may be converted to a 24-volt A model, or vice versa, by changing the dynamotor units. Provisions are made in the plug of DM 53 AZ to convert the receiver for 12-volt operation. The voltage stamped on the dynamotor determines the operating voltage of the set.

Lubricate after every 300 hours of dynamotor use with a recommended type of lubricant.

FUSE

The fuse is usually located in the receiver's junction box.

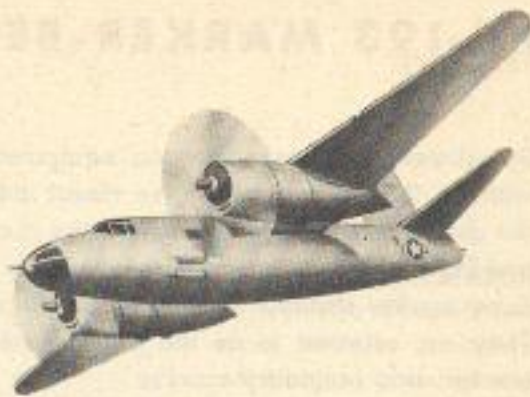
The wiring diagrams in the G file should be consulted for the exact size and location of the fuse.

A 5-ampere fuse should be used for the 24-volt A model.

A 10-ampere fuse should be used for the 12-volt AZ model.

MARKER BEACON

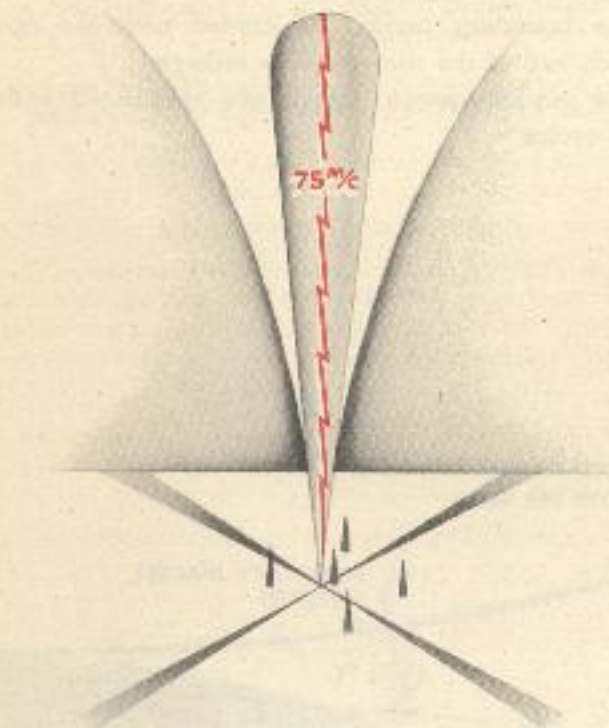
RC-43 RC-193 RECEIVERS



POWER SOURCES

The RC-43 requires a high voltage for its operation. High voltage is usually obtained from the radio compass. However, it is sometimes furnished by a separate dynamotor, type PE-86.

The RC-193 differs from the earlier marker-beacon receivers in that it does not require a high-voltage plate supply. The plate voltage is supplied directly from the 24-volt battery supply. The power for this receiver is controlled by an ON-OFF switch, the location of which will depend on the type of radio equipment installed in the airplane.



The RC-43 is a two-tube, tuned radio-frequency receiver. It employs a VT-153 and a VT-104 tube.

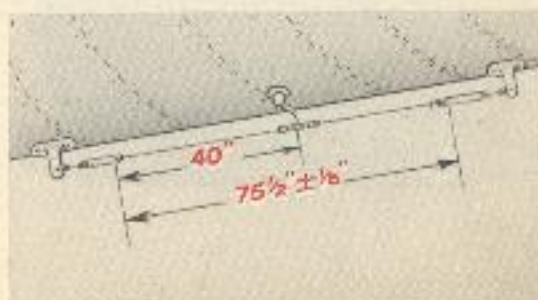
The RC-193 is a three-tube, tuned radio frequency receiver. It employs a 6SH7-6SL7GT and a 12SN7GT tube.

Both receivers are tuned to receive horizontally polarized 75-mc signals modulated at 3000 cycles. The received radio-frequency signal is amplified, then detected. The resultant audio frequency, usually 3000 cycles, is amplified then detected. The final output is direct current. The direct current is applied to a relay which controls the MARKER BEACON visual indicator on the pilot's instrument panel.



ANTENNA SYSTEM

The antenna is a resonant, fixed-wire type. It is tapped slightly off center to obtain an impedance match to a concentric transmission-line lead in.



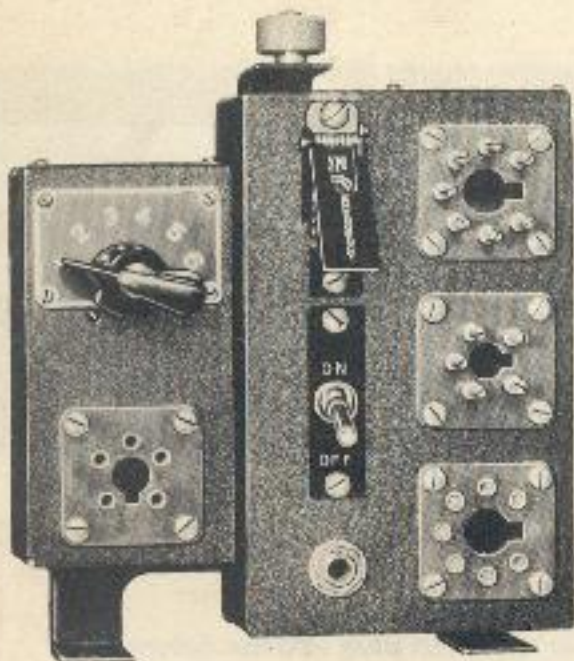
Since the antenna is resonant, its length is very critical.

RADAR IFF

IDENTIFICATION OF
FRIEND OR FOE

IMPORTANT

Be sure you know how and when to use your IFF equipment. Consult your Communications Officer prior to each mission.

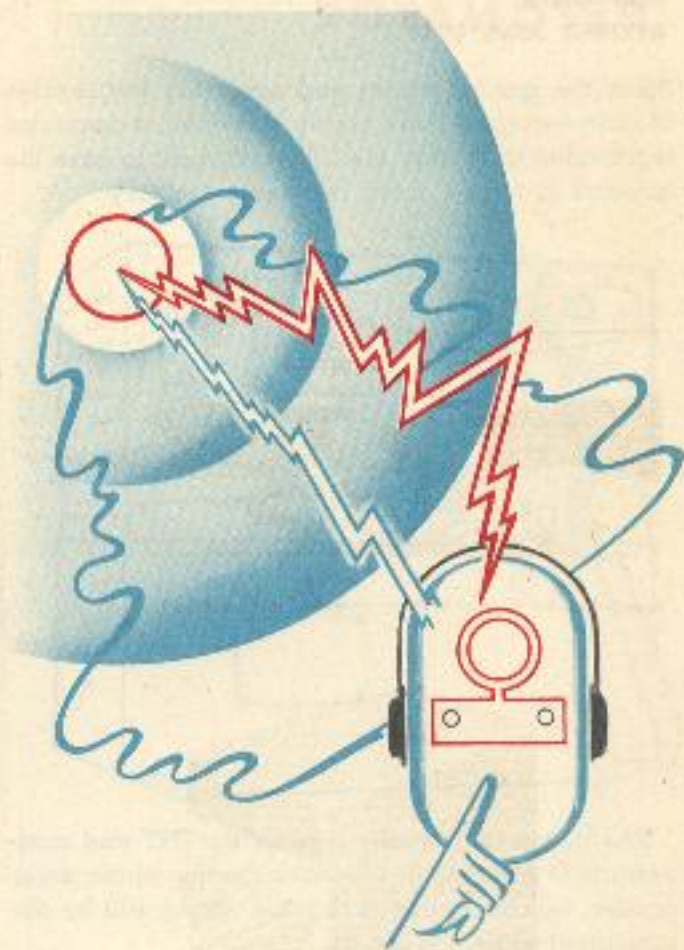


OPERATION

Place the six-position coding switch to the position indicated on the SOI flimsy. If no specific information is given, set it to number 1 position.

The EMERGENCY switch, with spring-hinged guard, is used to operate a special emergency signal.

Details of this may be obtained from the communications officer. This switch is usually safety-wired to OFF position.



Place the ON-OFF switch on the control box to ON position. The pilot is also furnished with an ON-OFF switch.



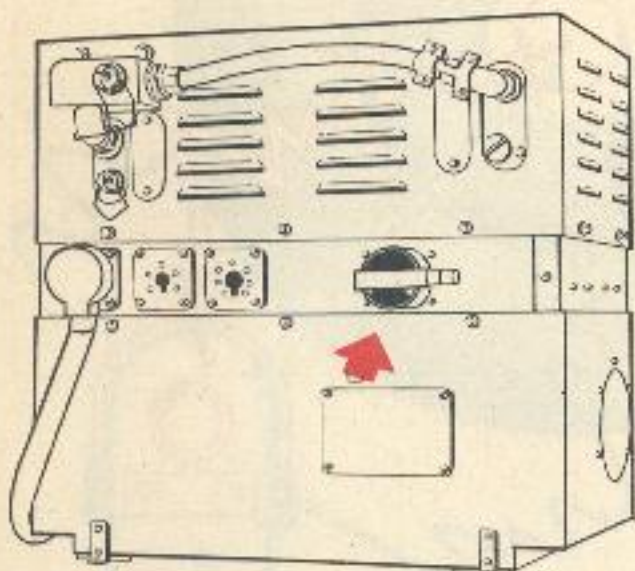
The phone jack provided on some of the controls makes it possible to monitor the IFF equipment. If the set is operating, background noise should be heard; if it is challenging, a note should be heard.

REMEMBER!

Before operating the EMERGENCY switch be sure the equipment is turned on.

DETONATOR

Since the special wiring and operating frequencies of radar equipment are highly classified, a detonator is provided to destroy the IFF equipment in case the airplane is forced down in enemy territory.



The detonator (usually containing TNT and magnesium) is mounted in the center portion of the transponder. It is so arranged that the wiring will be disintegrated when it is set off.

The detonator unit is energized when the required voltage (14 volts for AZ, 28 volts for A models) is placed across its terminals.

This voltage is obtained through a 20-AMP fuse, directly from the airplane's batteries.

There are two types of switches in this circuit.

1. PUSH BUTTONS



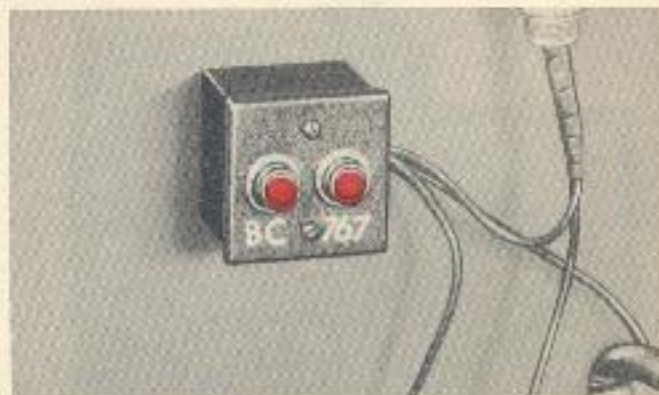
These two buttons are mounted in the red safety box. They must be pressed simultaneously to energize the detonator.

2. INERTIA SWITCH



The inertia (or impact) switch is used to destroy the equipment in case of crash landing in enemy territory.

A pair of red warning lights (located near the transponder) are connected across the detonator plug to indicate voltage present at the plug.



Caution!

Do not insert plug into the detonator if there is voltage present. Bodily harm will result.

Reset the inertia switch. After resetting tap it on the side to be sure it is properly set. The plug should be inserted in the detonator as soon as the airplane enters enemy territory. When the airplane returns to friendly territory, remove the plug. This is important because a rough landing will sometimes cause the inertia switch to trip. More complete details will be contained in your SOI filmsy.



INTERPHONE JACK BOX

The interphone jackbox is used for communication between crew members and for switching the microphones and headsets to the various equipment installed in the airplane.

JACKBOX POSITIONS

Compass

The COMP position is used to listen to the radio compass receiver. You cannot transmit with the jackbox in this position. The compass does not include transmission facilities.

Liaison—VHF

In this position you may transmit or receive with the liaison equipment. To transmit press microphone switch. To receive, release microphone switch.

In some airplanes all other jackboxes in the plane will have the VHF command set wired to LIAISON-VHF position.

Command

Operation is the same when in LIAISON-VHF position, except that the command equipment is being controlled.

Consult the airplane's G file for wiring diagrams to determine whether it is possible for you to key the command transmitters through your jackbox.



Inter

Use this position when you want to communicate with any other crew member whose jackbox is also on this position. Press microphone switch to talk. Release it to listen.

Call

When you want to call another crew member to the INTER POSITION use CALL. To operate you must hold the jackbox switch in the CALL position, and at the same time press the microphone switch. After calling, immediately return the jackbox to INTER while awaiting an answer. CALL position blocks all other reception and gives precedence to the person calling. To answer, the person called switches to INTER and proceeds with normal interphone communication.



USE YOUR MICROPHONE PROPERLY

- 1—The microphone should fit firmly about your throat with the buttons spaced equally on each side of your Adam's Apple and slightly above it.
- 2—Place the strap slightly higher than the microphone level to maintain this position.
- 3—Don't allow clothing to get between the microphone buttons and your throat.

4—You will get better reception by placing the positioning clip between the buttons.

5—Be sure the proper ends of the buttons are against your throat.

6—Speak as loudly as you can, but don't shout.

If you are using a T-17 hand-held microphone, observe the following steps for proper operation:

a. Hold the microphone squarely in front of your

mouth, with your lips slightly touching the mouth-piece when speaking.

b. Speak as loudly as you can, but don't shout.

Always use your Oxygen-Mask Microphone when flying at high altitudes.

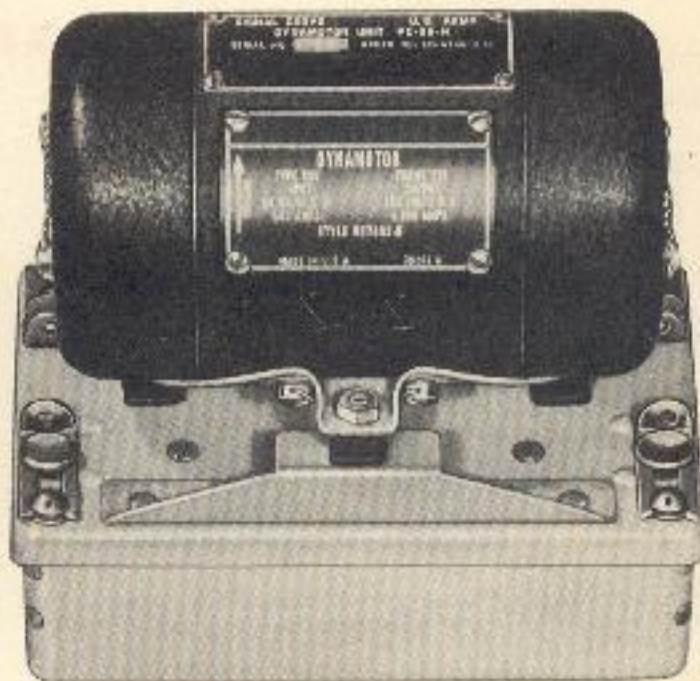
CAUTION: Interphone operation will be impaired if more than one microphone switch is closed at a time. **Don't attempt to speak while someone else is using the system unless your message is urgent.**

AMPLIFIER AND DYNAMOTOR



A separate interphone amplifier is provided for the interphone system.

Most installations employ a separate dynamotor to furnish the necessary high voltage.



TURNING ON EQUIPMENT

Since the interphone amplifier requires 24 to 28 volts for its filaments and 150 to 250 volts for its plate supply it must be turned on at two different points.

1—LOW VOLTAGE—is turned on when the airplane's battery and master switches are turned on.

2—HIGH VOLTAGE—is obtained from one of three possible sources:

(1) Command-(283) receiver dynamotor.

(2) Liaison-receiver dynamotor.

(3) A separate dynamotor similar to the command-receiver dynamotor.

If the command- or liaison-receiver dynamotor is used that receiver must be turned on to make interphone operation possible.

If a separate dynamotor is used it will be connected to the same source as the low voltage.

MAINTENANCE AND INSPECTIONS

Weak or noisy reception is often encountered in interphone reception. This is due to excessive vibration of the tube. Trouble of this sort can usually be eliminated by remounting the amplifier on rubber or other vibration absorbing material.

Loose or corroded microphone contacts will also cause weak reception.

If trouble is encountered in any one of the jackboxes, they can easily be removed or replaced by removing the two screws on the front cover and pulling the front of the box straight out. All jackboxes are interchangeable.

Disconnecter cords should be thoroughly checked by slightly flexing them near the plugs and checking for loose connections or shorts.

While operating, loose connections and shorts can

be detected by listening for cracks and pops in your headsets while flexing the cords.



RADIO RANGE FILTER RC-32



The Radio Range Filter System is designed to separate the 1020-cycle range signal from voice transmissions.

The unit comprises two filter systems contained in the same box. One system passes 1020 cycles, the other rejects 1020 cycles. The filter is connected to the outputs of the pilot and co-pilot interphone jackboxes. Therefore it may be used with their interphone jackboxes on any position.

The system is installed only in the pilot and co-pilot positions.

A switch is provided to control the functions of the filter. Its functions are as follows:

RANGE—position allows only the 1020-cycle radio range signal to be passed.

VOICE—position rejects the 1020-cycle range signal so weather broadcasts or other voice transmissions may be received.

BOTH—position allows normal operation, no filter is employed in this position.

OPERATION

Since the filter is designed to separate voice and range signals, it should be used only during periods of simultaneous transmissions of these signals.

Normally the filter switch should be in the **BOTH** position for interphone operation; although the **VOICE** and **RANGE** positions may be used to advantage under the following conditions:

(a) Use of the **VOICE** position for voice reception from stations other than range stations will reduce interference of range signals on adjacent frequencies.

(b) With the switch in **RANGE** position, the filter tends to reduce objectionable static noises.

BEFORE FLIGHT—Always warn the pilot and co-pilot against having both their filters on **RANGE** position. This would make interphone operation between them and the rest of the crew practically impossible.

NOTE—The RC-32 Filter System was designed to operate with the H5-23 high-impedance headsets. Therefore, if low-impedance headsets are used it will be necessary to use the high- to low-impedance adapters.



CLIMATIC EXTREMES



SECTION

7

CLIMATIC EXTREMES



Subjects in Section 7

Arctic, Tropic,
Desert, High-Altitude
Operation
and Maintenance, 7-1

Arctic cold and ice, desert sand and heat, tropic moisture, all affect the general state of your radio equipment. They also alter your operating conditions. The lowered barometric pressures of high altitudes, too, affect your radios. It is important that you understand just what effects these extreme conditions produce and how you can best go about combatting them. Learn to protect your radio and radar equipment from the elements. Take all the precautions you know when you encounter adverse climates. Neglect is dangerous, but care and watchfulness will always contribute to the success of your missions.



ARCTIC
TROPIC
DESERT
HIGH ALTITUDE

★ Operation ★ Maintenance

Experience has proved that a systematic plan of preventive maintenance is the way to secure maximum performance from RADIO and RADAR equipment, and is also the simplest way to prolong the life of

such equipment under adverse climatic conditions.

For quick reference, the operations and maintenance problems created by arctic, tropic, desert, and high-altitude conditions are covered separately.

ARCTIC

Little difficulty is experienced with RADIO or RADAR equipment in the Arctic until temperatures drop below the freezing point. However, at temperatures below freezing many precautions must be taken. The troubles experienced are often difficult to overcome because of the personal discomforts and inconveniences involved. All work takes longer to do in cold weather than in warm. Simple operations such as applying safety wire or checking dynamotor brushes may become heartbreaking experiences because there are two evils to choose from—either one risks metal burned (frozen) fingers or one must wear bulky gloves and wrestle awkwardly with a pair of pliers.

Clothing—Wear your underclothing loose so that it provides plenty of air space. Several layers of light underclothing are much warmer than a single heavy-weight layer.

Footgear—The mukluk boot is the most practical and serviceable footgear for extremely cold weather.

Gloves—Because cold metal sticks to flesh in sub-zero weather, some type of hand protection must be worn which will not impede work too much. The most satisfactory compromise is to use basic silk, rayon, or light cotton gloves, plus the D-3 mechanics gloves, which have knit-wool inner linings with outer horsehide covers. They are hung around the neck by a thong and used for warming as required.

PRECAUTIONS

Don't Sweat—Sweating is dangerous; it causes ice to form in damp clothing so that your body freezes more readily. To avoid sweating, remove articles of clothing as necessary. Take every opportunity to dry out your socks and underclothing. If you perspire indoors, dry your body and change or dry your clothes before going outside.

Don't get gasoline or cleaning fluids on your skin—Gasoline spilled on the hands or clothing in sub-zero weather has an effect similar to liquid air. It will freeze flesh in a few seconds after contact.

Don't touch cold metal without gloves—The moisture of your hand will freeze to a metal surface or the metal may freeze the part of the hand in contact with it. Don't try to force separation of skin from metal; you'll tear your skin. Warm the metal first; if possible, have someone help you by pouring water heated to body temperature on the metal at the point of contact.

Tools—Insulate your tools with cloth covers or wrap them with twine. Choose tools that lend themselves to cold-weather use, such as end wrenches, and insulated screwdrivers.

ARCTIC MAINTENANCE

Antennas—Remove ice and snow before takeoff. Insulators should be wiped clean and dry if possible.

Storage Batteries—At sub-zero temperatures storage batteries must be kept fully charged and as warm as possible. The specific gravity should always be above 1.260. At -40° F. the capacity of a battery is approximately 20 percent of its normal capacity; at 0° F. its capacity is 65 percent of normal. Never operate radio equipment directly off the battery's supply while the airplane is on the ground. Use a fully-charged battery cart or a gasoline-driven generator.

Dry-Cell Batteries—Dry-cell batteries should be stored so that they are not exposed to temperatures below 0° F. Under normal drain conditions the capacity of dry cells at 0° F. is approximately 25 percent that of normal, and at -10° to -20° F. they become inoperative. If the batteries are exposed to below-zero temperatures they should not be used. When their internal temperatures again reach normal, the batteries will regain their normal operating characteristics and ordinarily will show no permanent injuries.

Electric cables—Interconnecting cables become very stiff at low temperatures. They should not be bent quickly or at sharp angles. Coaxial cables should not be flexed at sub-zero temperatures; such flexing will result in fracture of the internal dielectric material as well as the cable covering. Sub-zero temperatures have no effect on the dielectric properties of the cable.

Condensers—Paper and mica condensers are not likely to fail at low temperatures. However, electrolytic condensers are subject to a considerable variation in capacity and in effective resistance, especially at temperatures below 0° F. As capacity decreases, resistance increases. At temperatures below -40° F. electrolytic condensers have very little value as

audio by-pass or power-filter condensers because of their greatly reduced capacitance. They will usually return to normal when the temperature rises above zero.

Dynamotors—Dynamotor circuits should be provided with heavier fuses than normally required. This is made necessary by the lowered resistivity of the dynamotor windings at lower temperatures which results in a heavier current flow, and also by the additional starting torque required to loosen up the grease in the bearings. The specific Technical Order instructions for greasing should be followed.

Flexible mechanical shafts—In some cases, tuning shafts have been found frozen. The grease should be removed from such shafts, and they should be re-lubricated with a small amount of light oil.

Microphones—Heavy coatings of frost caused by moisture from the breath collect and freeze in the small holes of the caps of hand or oxygen-mask microphones. Thin rayon-impregnated protective caps have been devised to overcome this difficulty in the most popular types of microphones.

Use cover M-368 for the T-17 hand microphones and cover M-369 for T-44 or ANB-M-CL mask microphone.

REMEMBER—Allow the tube filaments plenty of time to warm up the rest of the equipment before operating.

Be sure the proper type of grease is being used in all movable parts. All equipment or components that have been modified for low-temperature operation are marked with conspicuously-located yellow dots not smaller than $\frac{1}{4}$ inch in diameter.

TROPIC

RADIO and RADAR equipment receive their most severe tests in the tropics and it is there that the necessity for continual preventive maintenance is greatest. Here as in the Arctic, much can be done by wearing the proper type of clothing and by understanding the effects of the climate on equipment so that the problems encountered may be approached and overcome with greatest effectiveness.

Clothing—The trick in tropic maintenance and operations is to keep cool, and yet to wear clothing that protects the body from the sun and from disease-carrying insects. Generally speaking, long-sleeved shirts and long pants are the most practical clothing in areas where disease-carrying mosquitoes are found. While shorts may be worn in the daytime, long clothing has further advantages in affording protection against skin cuts and burns caused by contact with hot metal surfaces. It is desirable to wear underclothing which helps trap the sweat long enough to allow evaporation to produce a cooling effect.

Effect of moisture—Most equipment failures are due to prolonged exposure to warm moist air. The tem-

perature variations which result in evening condensation cause moisture to penetrate small cracks or minute holes in the protective covering of component parts.

The primary effects of moisture on equipment are:

- 1—Resistance leakages in insulators and wire insulations.
- 2—Corrosion of metal parts.
- 3—Electrolytic corrosion of fine wires.
- 4—Collapse of wood construction.

Effect of fungus growth—Fungus growth causes decay and accelerates the deterioration of insulating materials. The fungus itself acts as a conductor and causes the surface resistance of insulators to become lowered so that wherever high voltages are present arc-overs will result. Under the most favorable conditions for its formation, fungus will develop within a day or two of exposure; most species will survive at temperatures from 50° F. to 100° F.

Effect of insects—In most tropical regions, insects are numerous enough to be a frequent cause of equipment failure. One of the worst pests is the white ant or termite. Termites invade and thrive on practically every kind of wood. The numerous tropical spiders may build masses of moisture-collecting webs in equipment. Many insects take a fancy to impregnating waxes and varnishes and eat away these types of insulation; they also die in the equipment and their bodies cause corrosion.

GUARDING AGAINST MOISTURE AND FUNGUS

Drying methods—From the foregoing, it is apparent that in order to prevent failures, it is vital to keep equipment as dry as possible. Apart from frequent checking and cleaning of components, usually some method must be devised for drying components which are continually exposed to the humid atmosphere. If a suitable oven is available—or if one can be improvised from empty drums, scrap metal, or empty packing cases—components can be dried thoroughly. Such drying is especially helpful for components which are used intermittently and which are not kept sufficiently dry by the heat that develops when electric power is dissipated in their operation. It should be remembered that equipment may absorb moisture slowly over a period of weeks or perhaps months before failures occur. Therefore thorough drying is required. Usually it is necessary to heat the equipment to about 160° F. for a period of 2 to 3 hours, allowing adequate ventilation for the escape of moisture.

Any method which keeps equipment warmer than the surrounding air—even by a few degrees—usually will prevent moisture condensation and fungus formation.

When heating is impracticable, free circulation of air over the equipment will reduce somewhat the rapid condensation of moisture during hours of darkness.

For the removal of fungus growth, it is advisable to wipe the affected surface with a cloth saturated with a solution of 50 to 70 percent ethyl alcohol in fresh water. This treatment should not be applied to textile insulating materials. Experience has indicated that even though a textile insulator is immediately and thoroughly dried after removal of fungus growth with ethyl alcohol solution, the growth will reappear and develop even more rapidly when high humidity again occurs. Fungus growth and mildew in the case of textile insulating materials can best be retarded by the use of genuine camphor gum.

Condensation and fungus growth can be controlled further by the use of silica gels. This is practical only in equipment having closely fitting covers.

TROPIC MAINTENANCE

Antennas—Remove all moisture from stub-mast-type antennas. All insulators must be kept dry. If fungus growth or moisture is present arc-overs will result whenever high voltages are involved. Make frequent checkups on the condition of the silica-gel dehydrator unit used with the radio-compass loop antenna.

Storage batteries—Storage batteries will operate satisfactorily if specific gravity of the electrolyte is maintained at the recommended level of 1.275 to 1.300. All contacts and terminals should be kept clean and free of corrosion.

Dry-cell batteries—The only dry batteries that have given satisfactory service in the tropics are those in which both inner and outer cases are well-impregnated with wax. Batteries which are mounted in cases should be separated from metal surfaces with a high-quality moisture-resistant insulation. The output of dry cells is increased at high temperatures. In general, dry cells will not be damaged by operation at high temperatures until a point is reached where the sealing compound begins to melt.

Electrical cables—The insulation on some types of wire will decompose because of prolonged exposure to moisture. Always replace these cables with cellophane-insulated or spun-glass insulated wires.

Coaxial cables should be checked frequently for tightness at their connecting points. The ends must be well sealed. Moisture in the cables will lower their dielectric qualities.

Condensers—All types of condensers are subject to failure because of moisture. Variable condensers should be cleaned frequently and kept well lubricated. Paper, mica, and electrolytic condensers should be treated with impregnating waxes to prevent leakages.

Dynamotors—In many cases the high-voltage output connection has been found shorted to the frame because of poor wire insulation. Where there is excessive leakage, arc-overs will occur, resulting in burned-out armature windings.

Failures of this sort can be eliminated by the use of better insulation and by rearranging the high-voltage leads so that they are kept away from the frame or other areas of ground potential. Proper greasing of the bearings is also very important. Soft greases with high melting points are usually the most satisfactory.

Mechanical flexible cables—Flexible cables must be kept well greased and oiled to prevent corrosion. Mountings should also be checked for corrosion. Keep the cables away from dissimilar types of metals as dissimilar metals tend to accelerate corrosion by an electrolytic process.

Insulating materials—Certain sheet fibers and hygroscopic materials will warp and yield. These characteristics, together with differential expansion, will result in misalignment of component assemblies and will cause consequent changes in circuit constants. All insulating materials should be kept as dry as possible. Any troublesome insulating material should be replaced by airplane plexiglas, which is very suitable and can be found in scrap form around most airfields.

Microphones—The same cover as used for the Arctic should be employed to prevent excessive moisture from packing the carbon granules or corroding the inside of microphones.

Resistors—Bakelite resistors, even when thoroughly dried after exposure to moisture, will be found to retain resistance leakages. When arc-overs occur along bakelite strips, they must be replaced. Minute deposits of carbon along the arc-over path will cause subsequent and repeated breakdowns.

Soldering—Proper soldering is of great importance. Many failures will be avoided if corrosion of soldered connections is prevented. Always use rosin-core solder. The soldering iron should be tinned by filing clean and applying rosin-core solder.

DESERT

In the dry climate of the desert, high temperature is the primary factor affecting the performance and life of the equipment. The life of equipment is reduced largely by the progressive deterioration of most types of seals and impregnated components. Another cause of equipment failure is the presence of large quantities of sand and dust which attack all moving parts.

The clothing and precautions recommended for the tropics also apply to the desert regions.

DESERT MAINTENANCE

Antennas—Fixed-wire antennas will require more frequent inspections. Sand and dust will blast off the copper plating and also decrease the tensile strength of the wire.

Storage batteries—Water is the main battery problem in the desert. It is usually difficult to obtain suitable water and distilled water frequently is not available. Rain water is more suitable than water from springs or creeks because the latter usually contains objectionable mineral matter.

Dry-cell batteries—The performance and life of dry cells is greatly affected by high temperatures. Tem-

peratures above 70° F. will increase the voltage both in open and normal-drain circuits. Although the output tends to be increased, it is more than offset by the increased depreciation that results at temperatures above 95° F.

Condensers—Condensers of wax-impregnated paper construction with end seals are not suitable for high-temperature operation. Only hermetically-sealed condensers should be used for replacements.

Dynamotors—Most dynamotor failure is due to the injurious action of sand and dust. When mixed with oil or grease this dust becomes an efficient grinding agent. The brush holders, commutator, and bearings must be inspected frequently and continuously. Lubricate the bearings sparingly and only where absolutely necessary. Sacrifice lubrication rather than risk the abrasive action of sand and dust. This abrasive action will also wear down brushes much faster than normal. Remove sand and dust with compressed air if it is available.

Relays—Most relays are susceptible to injury by dust. Every attempt should be made to protect relays and all types of switching mechanism from dust entry.

Moving parts of such equipment should be inspected and cleaned at regular intervals.

HIGH ALTITUDE

The lowered barometric pressures at high altitudes are responsible for several types of equipment failures.

The barometric pressure at 35,000 feet is about one-fourth that at sea level. Under this lowered pressure, components protected against moisture develop a considerable internal pressure which subjects the seals and bushings to unusual strains. Another major effect of low barometric pressure is to reduce the insulating strength of insulating materials. High-voltage arc-overs occur at about one-half the voltage normally required to break down insulating materials. The lower density of the air at high altitudes reduces the rate of heat transfer. Heating is usually found to be greater, even though the ambient temperature is lower.

A reduction in physical coordination, primarily in speech, is also the cause of some troubles experienced at high altitudes.

HIGH ALTITUDE MAINTENANCE

Antennas—Transmitting-antenna insulators and switches must be kept clean to prevent arc-overs. The lead-in wires should be kept as far as possible from metal parts within the plane. Avoid sharp edges on all high-voltage wiring and terminal connections.

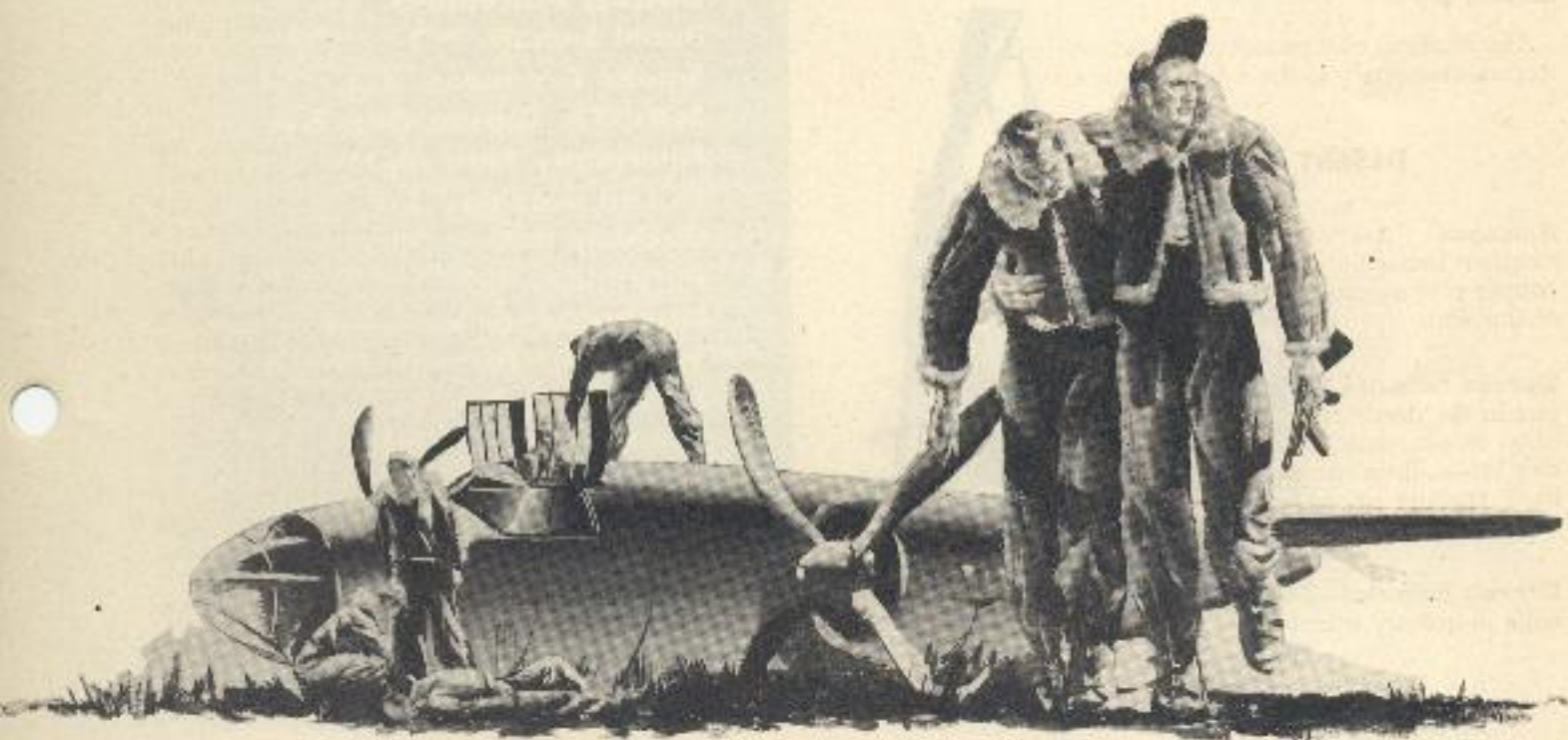
Dynamotors—Since reduced pressure causes increased intensity of arc-over, commutator brush wear is greatly increased at altitudes above 15,000 feet.

More frequent checks should be made on all dynamotor brushes.

Interphone—Recent tests have shown that failures in interphone operations at high altitudes are often due to improper use of microphones and headsets. These troubles can be minimized by using the type ANB-M-C1 oxygen-mask microphone and the type ANB-H-1 headsets in the NAF 1092 helmets.



EMERGENCIES



SECTION

8

EMERGENCIES

8

Subjects in Section 8

Distress Procedures, 8-1
Panel Signals, 8-2
Smoke Grenades, 8-3
SCR-578, Gibson Girl, 8-4
Emergency Exits, 8-5
Forced Landings, 8-6
Ditching, 8-7
Parachutes, 8-8
Life Preserver Vest, 8-9
Swimming Through Fire, 8-10
Emergency Kits, 8-11
Fire Fighting in Flight, 8-12
First Aid Kits, 8-13
First Aid in Flight, 8-14



Emergencies happen suddenly. They give you little time to think. You must therefore be quick and sure in whatever you do. You must conserve your energy and use it where it will be most effective. Above all, you must prepare yourself as thoroughly as possible for any sort of emergency. Learn what to do both in your capacity as radio operator and, in general, as a member of an aircrew. This section gives you a summary of your most important emergency measures. Study them carefully before the time comes for you to use them.

RESTRICTED

DISTRESS PROCEDURES

Distress frequencies, procedures, and call signs, and the geographical locations of rescue units vary among theaters of operations. Study and know all those in force in your theater. Make a list of them and keep it in your airplane.

In general, distress signals should first be transmitted on your assigned air-to-ground frequency. If you can't make contact using this frequency, use the following:

1. The U. S. Emergency and Safety Frequency, 8280 kc. This is guarded by the AAF, Navy, and Coast Guard.
2. The International Distress frequency, 500 kc. By international law, all surface vessels maintain a watch on 500 kc for 3 minutes after the first and third quarters of each hour.
3. Any other available frequency on which you can make contact.

There are three basic types of distress signals.

1. **Security:** Used when your pilot is uncertain of his position, or when an emergency is expected, but when you can proceed, or can land at a suitable field with the aid of a ground station. On CW, use the International Safety signal, TTT. On voice, use the word SECURITY.

Example (for CW)

Airplane: TTT TTT TTT V ABC ABC ABC INT QTF K
Station: ABC V DEF R K
Airplane: DEF V ABC (20-second dash) ABC K
Station: ABC V DEF QTF 3315N 7330W A 1745Z K

Example (For voice)

Airplane: Security, Security, Security. This is Shoeblack. This is Shoeblack. This is Shoeblack. Request fix. Over.
Station: Shoeblack. This is Michael. Transmit for fix. (Here station transmits any special instructions.) Over.
Airplane: Michael. This is Shoeblack. Transmitting for fix. (For VHF, count 1 to 5 and back. For HF, depress microphone button for 20 seconds.) This is Shoeblack. Over.
Station: Shoeblack. This is Michael. Your position is three three one five North—Seven three three zero West. Able. Time one seven four five Zebra. Over.

Airplane: Michael. This is Shoeblack. Roger. Out.

2. **Urgent or Emergency:** Used when the airplane is in trouble and requires immediate navigational aid.

If you are on CW, contacting an unknown station, use the International Urgent signal XXX, following the same procedure as you would in asking for TTT. Or, call a known ground station in the normal way, using the precedence prosign O.

If you are on voice, use the International Urgent signal PAN or EMERGENCY. Proceed in the same way as you would in asking for SECURITY.

Request your fix (or course) and:

On CW transmit a 20-second dash and your call sign.

On voice, VHF, give your call sign.

On voice, HF, depress the microphone button for 20 seconds before continuing voice transmission.

Include in your transmission:

Your best estimated position and the time it was calculated.

Course, speed, and altitude.

The pilot's estimate of the time he can remain airborne, and whether he means to ditch, bail out, or crash land.

3. **Distress:** Used when your airplane is threatened with serious or imminent damage, and you need immediate help.

On CW, use the International Distress signal, SOS, in this way: SOS SOS SOS V ABC ABC ABC (20-second dash) ABC K. Listen, and if there is no reply, repeat.

On voice, VHF, transmit MAYDAY three times, followed by the call sign of your airplane three times.

On voice, HF, transmit MAYDAY three times followed by the call sign of your airplane three times, then depress your microphone button switch for 20 seconds, and give the call sign once more.

Before ditching turn the IFF EMERGENCY switch ON.

Just before ditching, bailout, or crash, screw down the key.

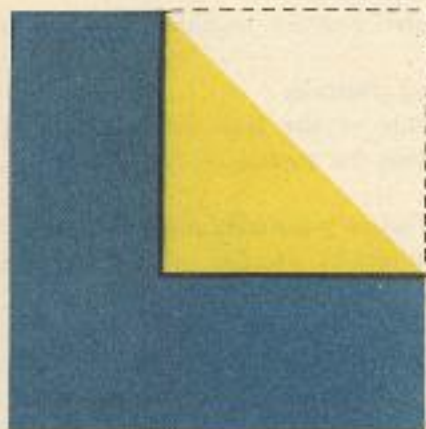
If you are no longer in distress, send a message immediately on the same frequency cancelling the state of distress.

Take special care to authenticate cancelled messages in areas where an authentication system is used.

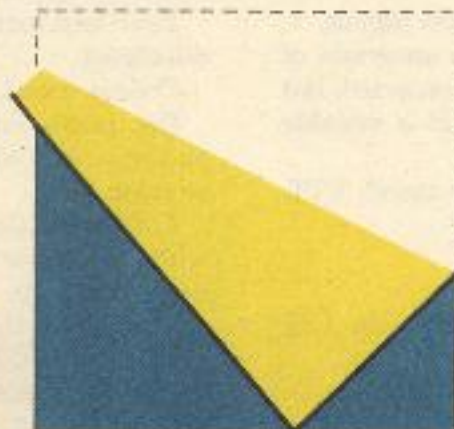
Panel Signals

Many of the emergency kits now supplied contain a large signal panel (roughly 10 ft. by 10 ft.). It is one side fluorescent yellow on one side and blue on the other. Immediately after you are forced down this panel should be spread out on the ground flat—yellow side up on dark backgrounds and blue side up on light backgrounds—the color will help rescue pilots to find you. Once a rescue pilot has located you, messages can be transmitted by folding the panel as indicated in the illustrations on these pages. If it is windy, hold the folds in place with rocks, sand, sticks, or improvised stakes if it is necessary. If several messages are to be transmitted don't change the folds too quickly—allow enough time for the pilot of the rescue plane to read each signal and indicate that he understands it (generally by dipping the nose of his plane several times). These same signals can be transmitted with the square yellow-and-blue sail now a part of the equipment supplied with the large inflatable rubber life raft.

The emergency signal panel also can be used as a tent since its blue side is coated with a waterproof compound. Also, the blue side can be used as an excellent camouflage cover for a life raft if enemy aircraft are sighted.



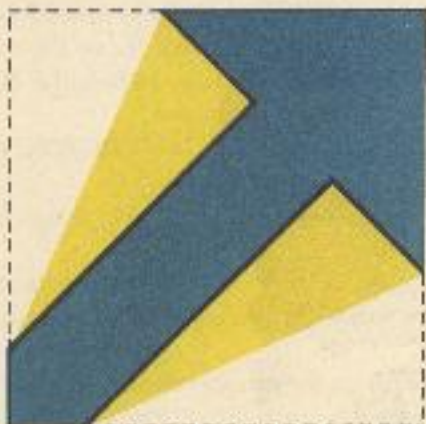
Need Gasoline and Oil,
Plane is Flyable



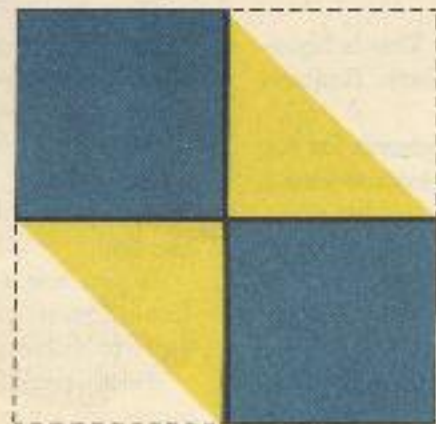
Need Tools,
Plane is Flyable



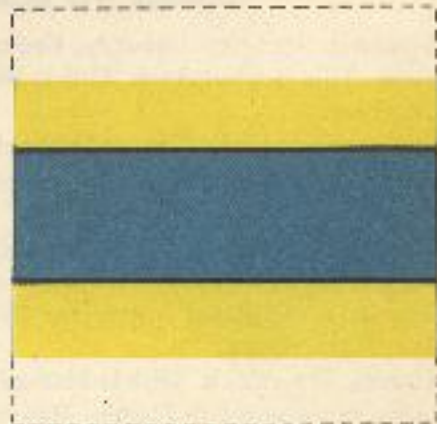
Need Medical Attention



OK to Land, Arrow
Shows Landing Direction



Do Not Attempt
Landing



Indicate Direction of
Nearest Civilization



Need First-Aid
Supplies



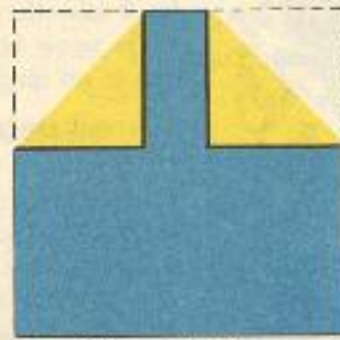
Need Quinine or
Atabrine



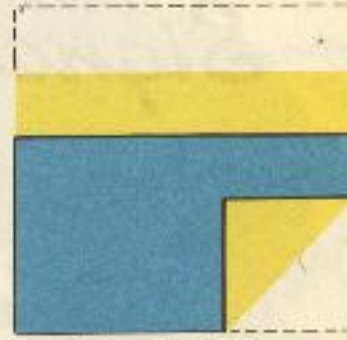
Should We Wait
For Rescue Plane?



Need Food and Water



Need Warm Clothing



Have Abandoned Plane,
Walking in This Direction ➡



SMOKE GRENADES



Airplanes to be flown over sparsely settled regions on cross-country, patrol, or ferry missions will be equipped with either an M8 or an M3 smoke grenade. In the event of a forced landing, use the grenade as a marker to aid searching parties in locating the airplane which otherwise might be difficult to find.

Radio Operators observing smoke of the type produced by M8 or M3 smoke grenades will immediately attempt to locate the source.

The M8 smoke grenade burns about 3½ minutes, giving off a dense gray smoke, and is intended to be used primarily in heavily forested regions. It is easily distinguished from wood fires which give off a blue-gray or black smoke.

The M3 smoke grenade is designed to be used in snow-covered regions. It gives off a dense red smoke for 2 minutes which can be distinguished against a white snow background for about 4 miles by a person in an airplane.

METHOD OF FIRING M8 SMOKE GRENADE

- 1—Grasp the grenade with lever held firmly against grenade body.
- 2—Withdraw safety pin, keeping a firm grip around the grenade and lever.
- 3—Either throw the grenade with a full swing of the arm, or place on the ground and release.
- 4—As the grenade is released from the hand the lever drops away, allowing the striker to fire the primer.

METHOD OF FIRING M3 SMOKE GRENADE

- 1—Pull the 3 vanes on the side of the grenade up and away from grenade body.
- 2—Place grenade in snow so that it is supported by the vanes in an upright position.
- 3—Keep lever held firmly against grenade and withdraw safety pin.
- 4—Release lever.

SAFETY PRECAUTIONS

To avoid a fire, do not throw or place the grenade within 5 feet of dry grass or other readily inflammable material.

After the grenade is ignited, stay at least 5 feet away from the burning grenade, as heavy smoke develops and there is a tendency to throw off hot particles of residue.

Keep these smoke grenades dry. If the chemical contents of a grenade become wet it will ignite. Future procurement of these grenades for the Army Air Forces will be packed in individual waterproof containers.

All smoke grenades will be shipped and handled in accordance with Interstate Commerce regulations. These regulations prohibit the shipment of these smoke grenades in personal baggage.

GIBSON GIRL

DINGHY SCR 578

Emergency Sea Rescue Transmitter

DESCRIPTION

Radio set SCR-578 is a pretuned, automatically keyed distress transmitter operating on the international distress frequency of 500 kc. It is designed primarily for operation from a rubber life raft.



It is also possible to use the set for a hand-powered signal light.

COMPONENTS

TRANSMITTER BC-778

1—**WATERPROOF** cover is sealed by rubber gaskets.

2—**HAND-CRANKED** gear assembly drives a self-contained generator and automatic keying assembly.



SIGNAL LAMP

for visual signaling

One of two types of lamps will be furnished.

**NON-
DIRECTIONAL
TYPE**



Straps under the chin. A spare bulb is carried with this type.

**DIRECTIONAL
TYPE**

Straps around the forehead.

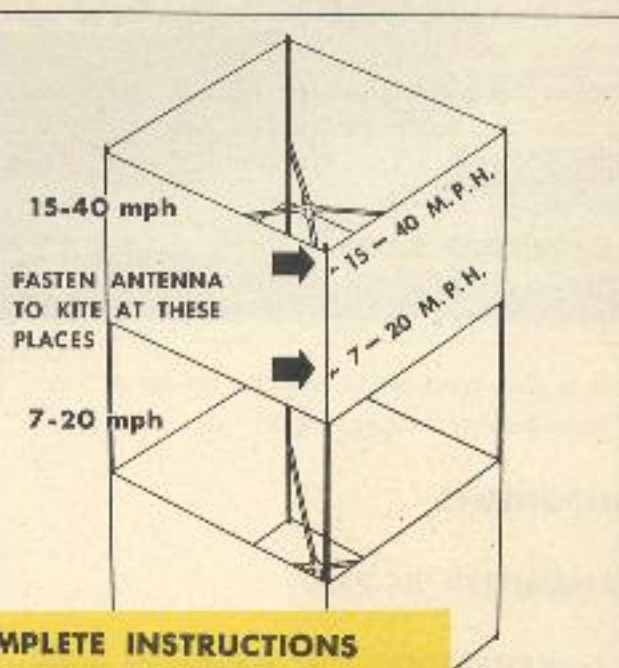
The signal lamp should be used at night if an airplane or surface vessel is heard. Do not waste energy by using light if they cannot be heard.

WHEN TRANSMITTING RADIO SIGNALS 175 TO 300 FEET OF ANTENNA ARE NECESSARY

The following methods are used to fly the antenna:

1-BOX KITE

Collapsible type designed to fly in wind velocities from 7 to 40 mph. The cloth covering is water repellent providing it does not soak continually. There are two types of kites. They differ only in construction. The newer types are hinged so that they will fit into a smaller stowage bag.



COMPLETE INSTRUCTIONS

for assembly of kites will be found in their containers.

Drag the kite out of water as soon as possible. It may require hours to dry if it becomes wet.

2—HYDROGEN BALLOON

Used When Wind Is Too Calm To Fly the Box Kite

There are usually two balloons packed in sealed cans stowed away with each unit.

The balloons are inflated with hydrogen, which is produced by immersion of a chemical generator into water.

Hydrogen is supplied from the generator to the balloon through a special inflating tube.

OPERATING INSTRUCTIONS

Remove the balloon from its sealed container. Care must be taken to avoid tearing it.

Immerse the balloon in water for about 1 minute to insure flexibility. Then gently unfold it.

Remove the top and bottom plugs of the hydrogen generator. Screw the inflating tube into top of the generator. The bottom hole is a water inlet.

Wet the other end of the tube and insert it into the balloon-valve hole. Hold on to the wooden handle of the tube. The chemical contained in the generator will burn the skin or clothing. Wash it off immediately if any splashes on you.

Immerse the generator until its top is level with the water. Wait until the balloon reaches its full diameter of 4 feet.

When the balloon is fully inflated, remove inflating tube and insert the rubber plug tightly in the valve.



NO SMOKING!!!!

Do not smoke while inflating the balloon. Hydrogen is highly inflammable.

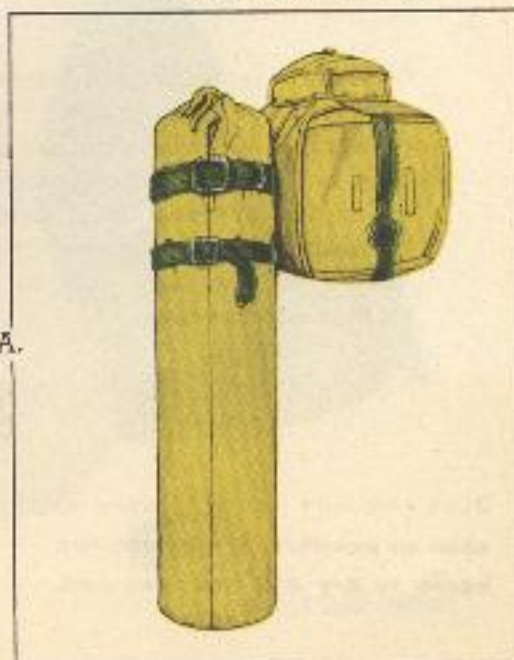
CARRYING BAGS



The SCR-578 will be found stowed in one of two types of bags.

Used with SCR-578-A.

Used with SCR-578-B and later models.





CRANK IN OPERATION POSITION

SPEED INDICATOR LIGHT

TUNE TO BRIGHTEST
INDICATOR

CRANK WELL

CRANK SHAFT CAP

CRANK RETAINING PIN

TRANSMITTER OPERATION

Distress

International law requires all surface vessels to maintain a watch on 500 kc for 3 minutes after the first and third quarters of the hour. Therefore, distress signals are most likely to be picked up if you send them from 15 to 18, and from 45 to 48, minutes after each hour.

Remember to continue your transmissions long enough to allow the stations receiving them to take your bearing.

Radio Transmission

First of all, be sure that you are using the greatest possible antenna length. A length of less than 300 feet will lower the set's operating efficiency.

Unscrew the ground plug and put the wire in the water or earth. Be sure you uncoil and use all of the ground wire.

Put crank in the socket on top of the transmitter. **Make sure it is tight.** There are no spare cranks with the set.

Fasten the strap securely around your legs.

Set the RADIO end of the selector switch to the kind of transmission you want (AUTO 1, 2, or MAN-

UAL). To determine type of transmission, consult the chart on the front panel.

Rotate the crank until the speed indicator on top of the unit glows. It will glow at approximately 80 rpm.

Allow 20 seconds for the tubes to heat, then adjust the TUNE control until you obtain maximum brilliancy in the TUNE TO BRIGHTEST indicator.

Conserve energy. Change hands every few minutes, to ease fatigue.

Ranges

Here are the probable ranges of the transmitter. The transmitting ranges vary with the different methods of grounding.

Be sure your set is grounded properly. This is important.

- | | |
|------------------------------|---------------|
| 1. At sea | 250-500 miles |
| 2. Inland lake | 50-150 miles |
| 3. On edge of lake or stream | 30-50 miles |
| 4. On land | |
| (grounded in moist earth) | 5-10 miles |

WARNING: Do not fly the antenna during an electrical storm.



SIGNAL LAMP OPERATION



Strap the lamp to your head. If you have the non-directional type, fix it so that it shines straight up. Fix the directional type so that it shines along the water, where reflections increase the chances of its being seen from the air.

Put the lamp plug into the **SIGNAL LAMP SOCKET** on the front of the transmitter. Set the **LIGHT** end of the selector switch to either **AUTO 1** or **AUTO 2**, for a continuous light. If you want to key the light, turn the switch to **MANUAL** and use the hand key on the front panel.

Remember: When the selector switch is on **LIGHT** position, no radio signals can be heard.

MAINTENANCE AND INSPECTIONS Monthly

The transmitter should be inspected once a month in this way:

1. Remove the set from its stowage bag, and insert the crank.
2. Connect the dummy antenna to the antenna lead-in and ground wires. This antenna (A-98) is in your squadron communications kit.
3. Set the selector switch to **RADIO** position, and turn the crank at 80 rpm. Allow 20 seconds for the tubes to heat.
4. Adjust the **TUNE** control until you have maximum brilliancy in the **TUNE TO BRIGHTEST** indicator.
5. Check the keying mechanism. There should be a flickering in the **TUNE TO BRIGHTEST** indicator when the key is pressed.

Be sure the crank is rotated monthly. Otherwise grease may pack or freeze in the bearings.

General

The parachute should be repacked every 60 days. Packing must be done only by properly authorized persons.

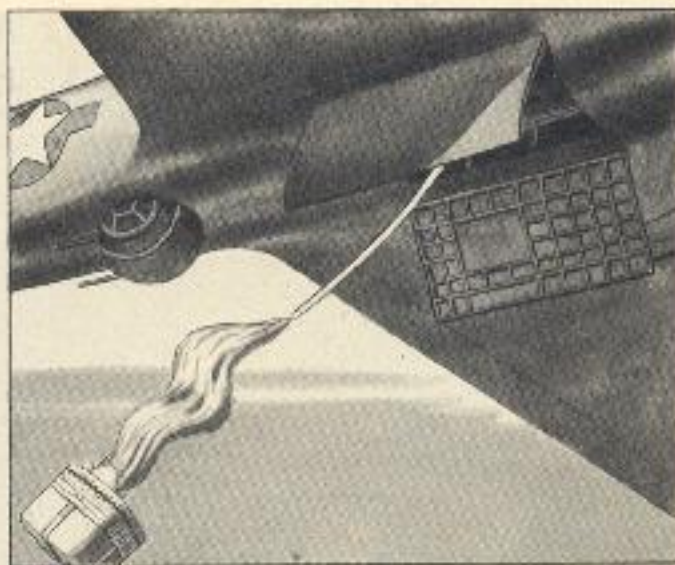
After continued humid weather, the dessicator unit may have to be replaced. Its content is normally bluish. If it has absorbed too much moisture it turns a pinkish white and must be replaced.

The set should be given a thorough visual inspection after each flight to make sure the equipment is in good condition.

You will find additional instructions in T. O. AN-08-10-94.



REMOVAL FROM THE AIRPLANE



In case of a crash landing or normal ditching, never drop the Gibson Girl by parachute. In either event it would be far behind you before you could recover it.

You will have to drop it, however, if the pilot has ordered a bailout. It must also be dropped if your airplane is expected to sink too soon after ditching to allow you to remove the set in the normal way. In this case, throw the Gibson Girl out when you are approximately 200 feet above the water. If you drop it sooner, it may drift out of sight.

If you must drop the Gibson Girl by parachute:

1. Fasten the loose end of the static line to the metal structure of the airplane.
2. Be sure the static line is clear and will not become fouled in other equipment.
3. Throw the set out of the airplane. The static line will open the parachute.

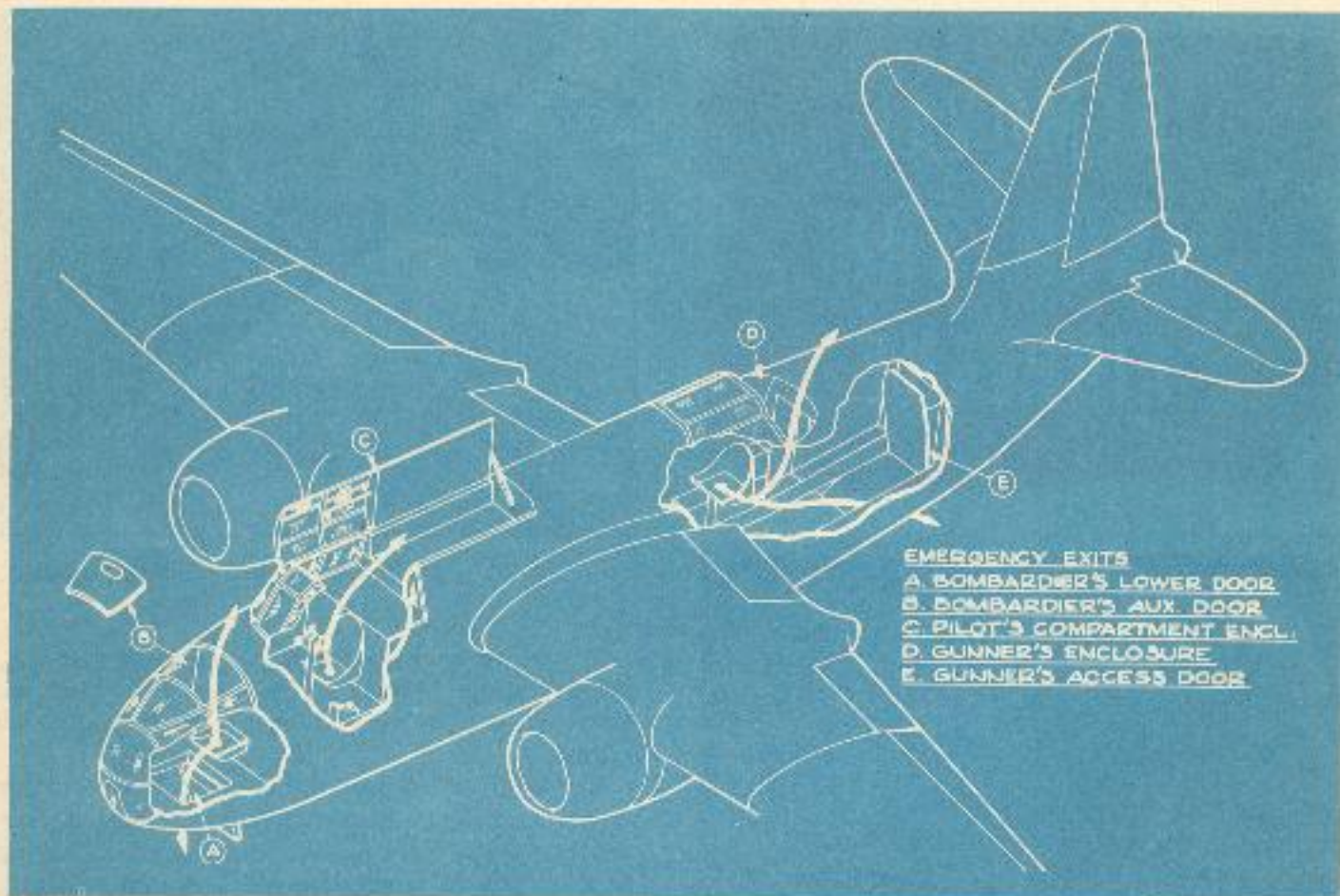
WARNING: Never attach the static line to any part of your body.

When your airplane is to be ditched:

1. Turn the IFF EMERGENCY switch ON.
2. Get the airplane's position from the navigator.
3. Send out the proper distress signals (See ROIF, page 8-1-1.)

4. Screw down the key before you leave your post.

The Gibson Girl will float, and if it is impossible to carry it to the life raft, you can throw it into the water. If you do this, be sure to keep hold of the static line. Attach it to the life raft so that the set will not drift away. Haul it in and begin transmission as soon as you can.



Emergency Exits

All Army Air Forces airplanes contain means for quick exit, in the air, on the ground, or water.

Before you fly, be sure you know:

1. What exit to use.
2. How to use it.
3. When to use it.

All crews must hold frequent practice drills. Teamwork and speed mean a lot in an emergency.

What Exit?

In flight, upper exits are dangerous because of the possibility of being caught by a propeller or of striking the tail. Use lower or side exits whenever possible. Study Handbook of Flight Operating Instructions to learn how to bail out of your particular airplane.

On the ground or water, fasten all lower hatches before landing. Dump all upper ones. They may jam

upon impact and delay is dangerous. In an emergency, you can knock a hole in the skin of the airplane. If a handaxe is provided on the airplane, know where it is and how to remove it.

How to Escape

Emergency exits are provided with quick release red handles. Usually the door or hatch will be blown away by the windstream, if you pull the release and give the exit panel a light push.

For a crash landing on land or water, don't dump lower hatches. Dump the upper hatches, but remember that they may damage the tail assembly.

Learn all you can from practice drills. Be sure you know your exact duties and the meaning of emergency signals by interphone, call light, or warning bell.

When to Escape

Any emergency is unexpected and unusual, so keep your wits about you. Be deliberate, even though hurried. Consider the situation; make a decision; then act.

FORCED LANDINGS



Any crash landing that you can walk away from is a good one. Forced landings in which there is a minimum of damage to the airplane or injury to the crew are the result of forethought, calm execution, and adherence to a few fundamental principles by all crew members. The following suggestions will help you. Think them over. Plan in advance for the day when you are confronted with a forced landing.

1. Stay calm. This is the primary rule for any emergency.

2. Jettison cargo and unnecessary equipment. Throw out all loose objects to prevent injury to crew on impact.

3. Open emergency escape hatches, or they may jam on impact and delay exit. Do not open windows that may slam shut and jam at the time of the impact.

4. Take the position assigned to you in advance for crash landings. It is the one in which you will sustain the least personal injury. It is the pilot's duty to warn you of the impending crash in plenty of time.

5. Take the brunt of the crash through the thickness of your body rather than the length. In general, positions of all crew members for a crash landing are the same as those for ditching. (See ROIF, page 8-7-2.) Brace yourself with a crash, not against it.

Never brace yourself with legs or arms rigidly extended. The bones are strong and you may be speared by your own skeleton.

6. After the airplane has stopped, grab first aid kits and any other necessary equipment and get out fast. Get at least 50 feet away. There may be danger of fire and explosion.





BEFORE TAKEOFF

Some day you may be forced down at sea. You won't have time to look up the answers then, so now's the time to start preparing for such an emergency.

Ditching and dinghy drills will familiarize you with the duties you must perform when the order "Prepare for ditching" is given. If you master these



drills well enough to carry them out in a darkened plane under unfavorable circumstances, your education is at least well begun. However, before you take off on a long over-water mission, there are several other important points you must consider.

1. Be sure all emergency equipment functions properly and that it is properly stowed.
2. Make sure that the nearest escape hatch operates properly.
3. Check your life vest adjustment. Blow the vest up by mouth and check the adjustment of waist and leg straps. Inspect CO₂ cartridges and see that the mouth-tube valves are closed.

BEFORE DITCHING

At the first indication of trouble, it is the duty of the navigator to notify you of the airplane's exact position.

Start emergency radio procedure immediately. Your best chance of being rescued lies in early and correct emergency radio procedure. Specific procedure differs in various theaters of operations. Learn the instructions for your theater.

If you have transmitted ditching signals and then find the pilot can make land, notify the Air/Sea Rescue Unit as soon as possible so as to prevent useless search.

For standard emergency radio procedure, see ROIF, page 8-1-1.

Jettisoning

Lighten the plane by jettisoning guns, ammunition, and anything not essential to the operation of the airplane. Throw out any objects lying loose or likely to be torn loose by the impact. Hold, or firmly secure, emergency equipment that you are going to take with you.

Emergency Exits

Close all lower hatches to keep the water out. Keep open top or upper side emergency exits through which you will escape. If they are closed, they may jam on impact. Close all bulkhead doors to stop the flow of water through the plane.

General Preparations

Remove your oxygen mask as soon as you are below 12,000 feet. Take off your necktie and open your collar. Remove heavy boots, but keep on your flying clothing and helmet for protection. Remove your parachute.



Do not take off your life vest. Keep it on at all times. Do not inflate it until you are out of the airplane.

If you inflate your life vest while you are still in the airplane, you will find it difficult, if not impossible, to get out through the hatches.

Ditching Positions

All crew members must take the standard ditching positions recommended for various planes in the AAF ditching posters and pilot training manuals. If there is no poster in your airplane, or you can't use the positions recommended because of differences of stowage or structural variations, remember the following:

General Rules

1. The best ditching position is to sit facing the tail of the plane, knees drawn up, back and head

braced against a solid structure. If your head extends above the support, clasp your fingers tightly behind it to keep it from being snapped back.

2. The second position is to lie on the floor of the plane, head to the rear and feet firmly braced against a solid structure. Bend the knees slightly. The best position for an injured man depends on his injuries. If the best position is not the injured man's regular one, someone can trade places with him. If there is not enough bulkhead room for all to brace against, if there are extra people in a compartment, it will be necessary for some to sit facing aft, back braced against forward man's shins, feet and knees drawn up, hands clasped behind head.

3. Another position, in airplanes which are equipped with ditching belts, is to brace against the belts.

4. It is the pilot's responsibility to warn you five seconds before the impact, so that you can brace for the shock. Hold your position until the airplane comes to a stop; casualties result when men relax immediately after the initial impact.

Boarding the Life Raft

Launch and board rafts from the wing tips if possible, to avoid damage from jagged edges.

Don't jump into the raft; you'll go through the fabric. Don't get onto an inverted raft; you'll expel the air underneath and make the raft hard to turn over. Right it from the wing of the plane if you can.

Paddle away from the plane and tie all rafts together. Stay near the plane as long as it stays afloat. It will be easier for rescuers to spot you.



Parachutes

All persons aboard Army airplanes will be equipped with standard-type parachutes. Wear your parachute whenever possible. The pilot will see that all persons aboard have parachutes, are instructed in their use, and know the bail-out plan. It is an excellent precaution to carry an extra parachute in multiplace airplanes.



BEFORE THE FLIGHT

Inspect your parachute. Remember, you may have to jump with it! Check the date of the last inspection. The packing interval should not exceed 60 days in the United States or 30 days in the tropics. Open the flap; make sure that the ripcord pins are not bent and that the seal is not broken. A bent pin or jammed wire may make it impossible to pull the ripcord. See that the corners of the pack are neatly stowed so that none of the silk is visible. See that the six or eight opening elastics are tight. Inspect each parachute you draw.

Put your parachute on and be sure the harness fits properly. The shoulder and chest straps should be snug without play; the chest buckle should be twelve inches below the chin. The leg straps should be snug. In fact, the harness should be comfortably snug when you are seated and disagreeably tight when you stand up.

**CORRECT
LANDING
POSITION**

IN FLIGHT

If you find yourself in serious trouble, prepare to put your bail-out plan in operation.

CONSIDER THESE POINTS:

- 1—Note your altimeter reading.
- 2—Check the altitude of the terrain below.
- 3—Decide on a minimum altitude at which you can safely bail out. Take into consideration the flight characteristics of the plane and the kind of trouble you are having. Notify the pilot.
- 4—If you are still in trouble when you reach that minimum altitude—bail out.
- 5—Remember that in general it is safer to jump than to attempt a forced landing on hazardous terrain with a fully loaded plane.
- 6—If you have to bail out, help the pilot pick the best available spot.

THE BAIL-OUT

Know the emergency exits provided for the airplane and understand how and when to use them. Bail-out posters are supplied for most bombardment types of aircraft.

Practice making exits while wearing full equip-

ment when the airplane is on the ground. Drill yourself in a standard bail-out procedure, including warning signals and exit signals.

JUMPING FROM TWIN-ENGINE TRAINERS, BOMBERS, AND TRANSPORTS

You will normally use an escape hatch, the bomb bay, or a door, depending upon circumstances. Slide yourself to the edge of the opening and go out head first and straight down.

DRILL IS ESSENTIAL

**You Must Know When, Where, and
How to Leave the Airplane**

CLEARING THE AIRPLANE

Probably the most important single act, in any parachute jump, is opening the parachute only after you are clear of the plane. Wait until you are well away from the airplane before you pull the ripcord. Keep your eyes open. Look around. If you have enough altitude, wait at least five to ten seconds before pulling the ripcord.



PULLING THE RIPCORD

LOOK AT RIPCORD



USE BOTH HANDS

LESS STRAIGHT

FEET TOGETHER

There is nothing complicated or difficult about getting your parachute safely open. Just:

- 1—Straighten your legs and put your feet together to reduce the opening shock, and to avoid tangling your harness.
- 2—Use both hands to grasp the ripcord pocket.
- 3—Grab the ripcord handle with the right hand, and yank! Keep your eyes open and look at the ripcord as you pull it.

THE DESCENT

About two seconds after you have pulled the ripcord, you will feel a sharp, strong tug as the canopy opens and bites the air.

Look up to see that the chute is fully open. If a suspension line traverses the top, or the lines are twisted, manipulate the lines to remedy the fault.

Do not worry about oscillations. They will almost certainly occur on your way down, but are of minor consequence. Do not attempt to check them or to slip the parachute, as such maneuvers are useful only to experts, and are dangerous below 200 feet.

Make a quick estimate of your altitude by looking first at the ground below and then at the horizon.

You will descend approximately 1000 feet per minute.

Observe your drift by craning your neck forward and sighting the ground between your feet, keeping your feet parallel and using them as a driftmeter.

Face in the direction of your drift.

While you cannot steer your chute, you can turn your body in any desired direction. The body turn is the most useful maneuver you can learn because with it you can make certain that you land facing in the direction of your drift. It is simple and easy. Note carefully exactly how it is done.

STUDY THE PICTURES. Practice the body turn in a suspended harness if you get the chance. This description may sound backward to you. Note with special care how these turns are executed and simply say to yourself:

"To turn right, right hand behind my head."

"To turn left, left hand behind my head."

HOW TO MAKE BODY TURNS

TO TURN YOUR BODY TO THE RIGHT:

1

Reach up behind your head with your right hand and grasp the left risers.



2

Reach across in front of your head with your left hand and grasp the other risers. Your hands are now crossed, the right hand behind, and in each you have two risers.



3

Pull simultaneously with both hands; this will cross the risers above your head and turn your body to the right. You can readily turn 45°, 90°, or 180° by varying the pull.



**To turn to the left,
reverse this procedure**

In the descent, start your body turn high enough to allow you to master it. Once you have made the turn, you will find that you can control your direction of drift perfectly. Hold the turn, or slowly ease up if

necessary, to bring you in facing downwind. Continue to hold the risers, whether you have had to twist them to make a body turn or not, and slide right on into the ground this way:

THE LANDING



NORMAL LANDINGS

Whether you have made a body turn or not, keep your hands above your head, grasping the risers.

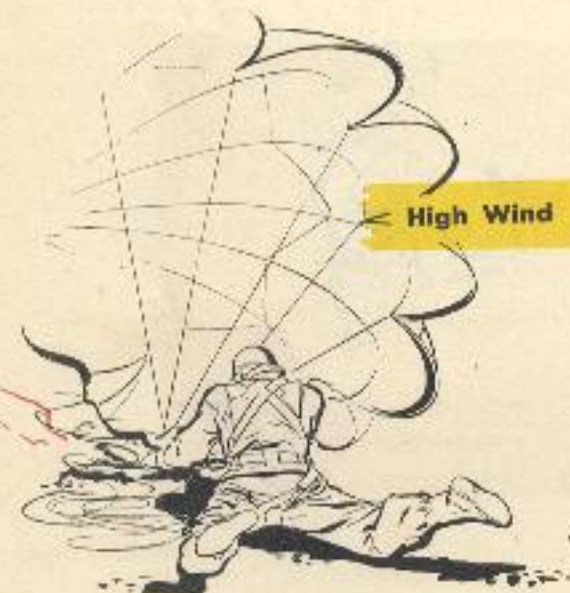
Look at the ground at a 45-degree angle, not straight down.

Set yourself for the landing by placing your feet together and slightly bending your knees, so that you will land on the balls of your feet.

Don't be limp; don't be rigid.

Relax, and keep your feet firmly together with your knees slightly bent, and your hands grasping the risers above. Now hold everything and ride on into the ground, drifting face forward.

At the moment of impact, fall forward or sideways in a tumbling roll to take up the shock.



ABNORMAL LANDINGS

If there is a strong wind blowing across the ground when you land, do two things.

First, make certain that you carry out the procedures described above for a normal landing, including the body turn to face you exactly in your direction of drift.

Second, once you are down, roll over on your abdomen and haul in hand over hand on the suspension lines nearest the ground. Keep right on pulling them in until you grab silk. Then, drag in the skirt of the canopy to spill the air and collapse the chute. If you can't manage this maneuver on your face, go over onto your back, but haul in the suspension lines until you reach the bottom edge of the canopy, then spill the chute.



Tree landings are usually the easiest of all. If you see that you are going to come into a tree, drop the risers, cross your arms in front of your head, and bury your face in the crook of an elbow. You can see under your folded forearm. Keep your feet and knees together. If you get hung up high in a tree, consider first the possibility of immediate rescue before you try to climb down. Failing that, get out of the harness and cut the lines and risers to make a rope for climbing down.

Water landings are safe if you know what to do. The ability to swim is an advantage but not a prerequisite if you are properly equipped and trained. Follow the procedure outlined here for all types of parachutes except the QAC AN6513-1A (which has no risers on pack or harness) and the single point quick release, instructions for which are given separately. Prepare for the water landing as soon as the parachute is open.

1. Throw away what you won't need.
2. Pull yourself well back in the sling by hooking your thumbs in the webbing and forcing the sling downward along your thighs.
3. Undo your chest strap by hooking a thumb beneath one of the vertical lift webs, pushing firmly across your chest to loosen the cross webbing so that you can undo the snap. **This must be done before you inflate the Mae West, as the chest strap cannot be released over an inflated life vest.**
4. When chest strap is undone and you are well back in the sling, unstrap the leg straps by doubling up first one leg and then the other. Then keep your arms folded, or hang onto the risers, so you won't fall out of the harness. If you are unable to unfasten leg straps in the air, remove them in the water by unstrapping them or by working them down over your feet.
5. As soon as you are in the water, inflate your Mae West, one half at a time (either half will support you) and shrug out of the harness. **Remember, never inflate your life vest until you have unfastened your chest strap.**
6. Get clear of the parachute promptly, and stay clear.

Procedure for QAC AN6513-1A (no risers on pack or harness)

Modify the standard procedure as follows:

1. Reach under the pack cover and unfasten the chest strap.



2. Pull yourself well back in the sling and undo the leg straps, if you have time.
3. As soon as you are in the water, release both sides of chest pack from harness and immediately swim upwind, away from the canopy and lines.
4. Inflate the Mae West, one half at a time, but never until the chest strap is unfastened.
5. When clear of the canopy and shroud lines, you can slip out of your harness at leisure.

Water



Procedure for Single Point Quick Release Harness

Modify the standard procedure as follows:

1. Before reaching the water, turn the locking cap 90° to set the release mechanism for immediate operation.
 2. As soon as you are in the water, but not before, pull the safety clip, and press hard on the cap to release the lock. The harness will then slide off.
 3. Inflate the Mae West, one half at a time, but never until the harness has been released.
 4. Stay clear of the parachute.
- See Life Vest, ROIF 8-9-1, Life Rafts, ROIF 8-11-1.

WARNING: The canopy and shroud lines, **not** the harness, may dangerously tangle you after landing in water. When equipped with any quick attachable chest pack, first unstrap the entire pack from the harness, then get away from the canopy and lines before you stop to take off the harness. **Think it through now and you'll be safe later.**

On over-water flights, always carry a sharp, serviceable knife where it is easily accessible. If you experience difficulty releasing yourself from the harness after landing in water, stay calm and cut yourself free.

NIGHT JUMPS

As soon as you are in the chute, prepare for a normal landing. Since you cannot see the ground on a dark night, you want to be ready to make contact at any moment. **Get your feet and knees together, your legs slightly bent. Hang onto the risers above your head and wait for contact.**

HIGH ALTITUDE JUMPS

Bail-outs from high altitudes present special problems. The higher the altitude, the greater the dangers in bailing out. Stay with the airplane as long as you safely can; down to 15,000 feet if possible. If you must leave the airplane at altitudes above 15,000 feet and if you do not have bail-out oxygen equipment, take a deep breath of pure oxygen and hold your breath. Dive out and continue to hold your breath as long as you can before pulling the ripcord.

Except in extreme emergency, do not attempt a bail-out without bail-out oxygen equipment above 30,000 feet.

The chief hazards of high altitude jumping are:

1. Intense cold.
2. Lack of oxygen.
3. High G forces induced by the parachute opening at high altitudes.

If it is necessary to bail out at high altitude, you can reduce the hazard by making a long free fall to about 10,000 feet before pulling your ripcord. A free fall enables you to reach warmer regions more rapidly; it reduces the hazard of anoxia, and insures less shock when the parachute opens.

At high altitudes the opening shock of the para-

chute develops excessive G forces. The higher the altitude, the greater the shock.

Judging Altitude in Free Falls

Do not depend upon counting or timing to judge distance above the ground. In the excitement it is difficult if not impossible to judge time.

Look at the ground and judge your altitude. For instance, at 5,000 feet the earth begins to look green, you can distinguish details, the horizon spreads, and the ground rushes up at you.

Changing Your Falling Attitude

If your falling attitude is such that you can't see the ground, you can alter your position by extending an arm and the resulting turn will give you a look at the ground. Then pull in your arm and legs and straighten out your knees to stop tumbling before you pull the ripcord.

Terminal Speed

Remember that in many emergency jumps you may leave the airplane at speeds so high that an immediate parachute opening would be dangerous. Hence, if you have sufficient altitude, you should wait 5 to 15 seconds to slow down before pulling the ripcord. This will avoid injury to yourself or damage to your parachute. You actually slow down during the first 10 to 15 seconds in a free fall until you reach terminal velocity. The lower the altitude, the lower the terminal velocity. So in making a free fall you do not tend to fall faster the longer you fall. You actually fall slower and slower the lower you get because the air becomes denser. With your parachute open, the rate of descent is also slower the lower you get.

Notice

In all jumps from above 10,000 feet, fall free to 10,000 feet or less before pulling the ripcord if you can. This will reduce your exposure to cold, anoxia, enemy action, and lessen the opening shock of the parachute. If you do not have bail-out oxygen equipment, just hold your breath and dive out. Then continue to hold your breath as long as possible before pulling the ripcord.

Parachute Types



B-7



B-8

BACK-TYPE PARACHUTES

Type B-7 (AN6512)—The chest straps and leg straps have bayonet type or snap fasteners. Note that parachute belt is worn outside harness to hold webbing snug.

Type B-8—Flexible back pack with bayonet type fasteners on chest and leg straps. Older type B-8 parachutes have snap fasteners.

Type B-9—Flexible back pack on single point Quick Release harness. To get out of Quick Release harness turn the cap clockwise 90°, pull safety clip, and strike the cap a sharp blow with the hand.



B-9



Cap is shown in safetied position.



S-1



S-5

SEAT-TYPE PARACHUTES

Type S-1, S-2, AN6510, and AN6511—Harness has back and seat pad. Chest and leg straps have snap or bayonet fasteners.

Type S-5—Same chute as S-1 with single point Quick Release harness.

ATTACHABLE CHEST-TYPE PARACHUTES

Group 1 Assemblies

Type QAC (AN6513-1)—Quick attachable chest-type parachute with square pack. Harness has snap fasteners on chest and leg straps. It has D-rings for attachment of pack.

Type QAC (AN6513-1A)—Quick attachable chest-type parachute with barrel-type pack. Harness has snap fasteners on chest and leg straps. It has D-rings for attachment of pack.

NOTE: On both AN6513-1 and AN6513-1A parachute assemblies the snaps are on the pack and the D-rings are on the harness. Either of these packs can be used with the harness shown.



Group 2 Assemblies

Type A-3—Quick attachable chest-type parachute with barrel-type pack. Harness has bayonet-type fasteners.

Type A-4—Quick attachable chest-type parachute with barrel-type pack and single point Quick Release harness.

NOTE: On the A-3 and A-4 parachute assemblies the rings are on the pack and the snaps are on the harness. This pack can be used with either of the harnesses shown.



Caution!

Parachutes of Group 1 are not interchangeable with parachutes of Group 2.

The pilot is responsible for prevention of mismatching quick attachable chutes in his airplane.

Before the airplane moves for take-off, inspect all attachable parachutes to see that the

pack fits the harness. Snap each pack to its harness to make certain it matches.

If you find any pack which does not fit the harness, change either pack or harness to get the correct assembly.

Each group is to be identified by a color. The same color must be on both pack and harness.

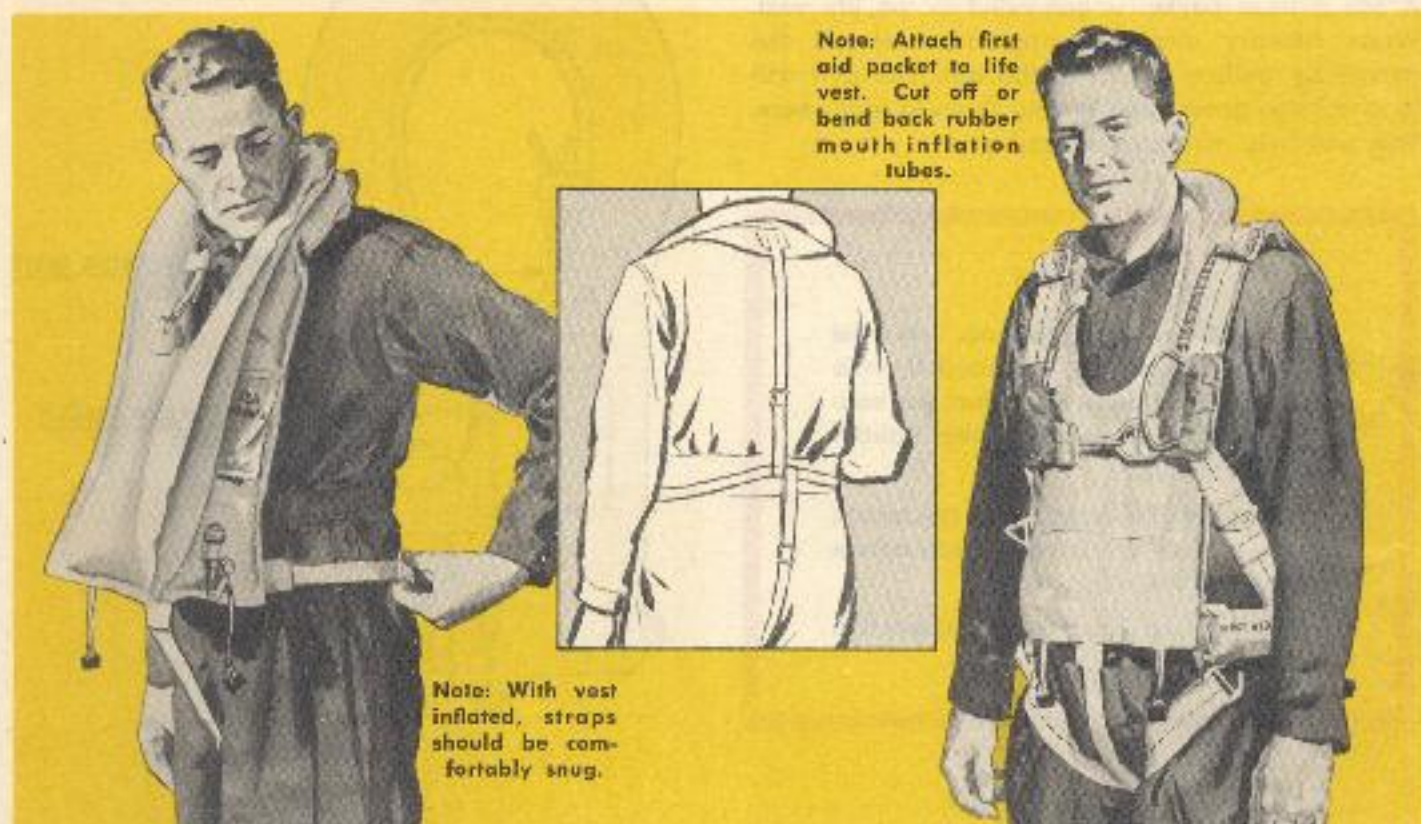
Red identifies Group 1.

Yellow identifies Group 2.

Be sure all packs and harnesses in your plane match.

REFERENCE: Technical Order 13-5-33

LIFE PRESERVER VEST



Wear your life vest whenever you fly over water.

When the vest is issued to you, put it on, inflate it by the mouth tubes. Adjust the straps. With the vest inflated the waist strap should be tight, the crotch strap snug.

Deflate the vest by opening the valves at the base of the mouth tubes. Roll the vest up to deflate completely. Be sure to close the valves tightly to prevent leak on automatic inflation.

Wear the vest over the clothing and under the parachute harness. Tuck the vest under the collar of your flight jacket.

To inflate, pull one cord at a time so that if the mouth valves have been left open you will discover the error before you have discharged both CO₂ cartridges. One compartment will support you and will interfere less with swimming.

If the vest leaks, or fails to inflate completely from the CO₂ cartridge, fill by blowing into the mouth tubes. Open the valves while filling the vest by mouth, then reclose the valves tightly.

Note: cutting off or bending the mouth tubes flush with the retaining loop will prevent possible injury to your eyes at the time your parachute opens.

Before each flight remove the cap from the in-

flator cylinder and inspect the CO₂ cartridge. If the seal at the top is punctured replace the cartridge. With the lever which actuates the puncturing pin in the up position, parallel to the container, insert the new cartridge, seal end down. Always check the container cap to be sure it is screwed down tightly.



Inserting CO₂ inflator. Screw cap down tight.

SEA MARKER PACKET

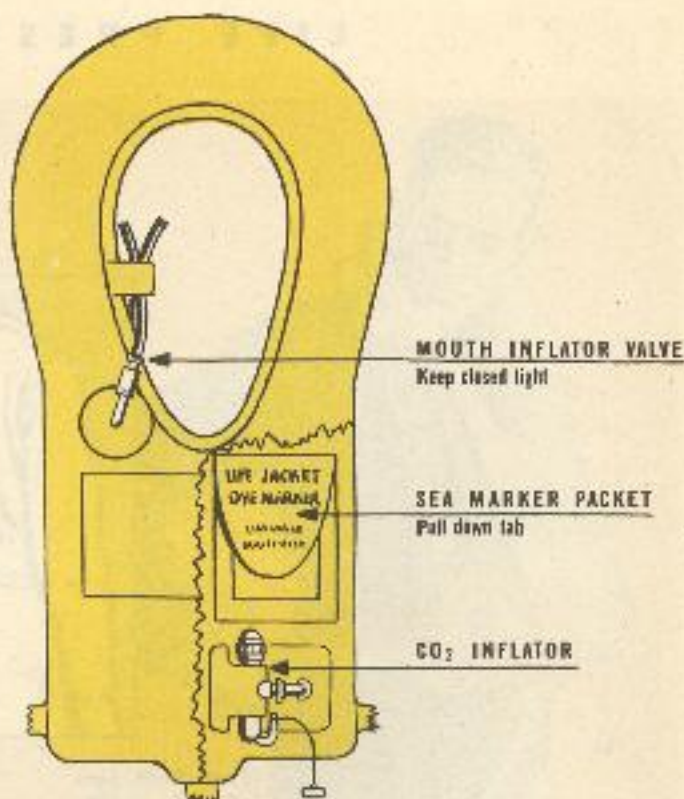
A sea marker packet is cemented to the life vest. When friendly airplanes approach, release the packet by pulling down on the tab. The dye will form a large green area lasting three to four hours. This will help airplanes to find you.

CAUTION

Before take-off be sure your life vest cartridge containers are loaded with live CO₂ cartridges, and that the container caps are screwed down tightly. (See illustration.)

Always make certain that the mouth inflator valves are tightly closed before pulling the inflating cords.

Turn in your life vest for inspection every six months.



WARNING: STAY AWAY FROM YOUR CHUTE IN THE WATER

After parachuting into water you will have a tendency to drift downwind into the fallen parachute as soon as you inflate your life vest. To avoid entanglement with harness and shroud lines, work

upwind, away from the chute, and stay clear. If you have a raft, salvage your parachute for sail, cover, and extra lines. If not, get away from the chute and stay away.

Swimming Through Fire

When an airplane is ditched at sea there is always the possibility that a smashed wing tank and engine will spread flaming oil and gasoline on the water. By using the following procedure, however, you can swim to safety through such a fire, even when you wear a life vest.



1. Jump feet first upwind of your airplane. Cover your eyes, nose and mouth with both hands. Take a deep breath. Hold breath until you rise to the surface.



2. Just before you reach the surface, make a breathing hole in the flames. Swing your arms overhead to splash flames away from head, face, and arms.



3. Swim into the wind. Use the breast stroke. Before taking each stroke splash water ahead and to the sides. Keep mouth and nose close to the water. Duck your head every third or fourth stroke to keep it cool. If there are several men, swim single file. Let the strongest swimmer splash a path so the rest can follow safely in his wake.



Swimming Under Water

If the heat is too intense or flames too high, swim underwater—out of the danger area. To do this:

1. Splash flames away from body.
2. Hold head near water level.
3. Deflate life vest by releasing valves.
4. Take a deep breath but do not inhale fumes.
5. Sink beneath the surface, feet first.
6. Swim upwind as far as possible.
7. Splash away the flames as you come to the surface. Take a deep breath and submerge again. Repeat procedure until you are beyond the fire.
8. Re-inflate life vest by mouth.



EMERGENCY KITS

Vest, Emergency Sustenance, Type C-1, was developed for the use of aircraft crews forced down in isolated regions. It consists of an adjustable vest-like garment, fitted with pockets into which the items of the kit are conveniently stowed. The vest is to be worn under the life preserver vest and parachute.

PROTECT YOURSELF. Before taking off on a flight over inaccessible or mountainous country, the arctic, jungle, desert, or ocean, check your vest and be sure it contains all the necessary equipment. If it does not, check with your Personal Equipment Officer.

The following items of equipment are carried in the pockets of the vest:

- 1 hat (yellow on one side, OD on the other)
- 1 pair Polaroid sun goggles
- 1 signal mirror, with lanyard
- 1 sharpening stone
- 1 fishing-sewing kit, in plastic container
- 1 collapsible spit and gaff
- 1 plastic water canteen (3-pint capacity)

- 1 Boy Scout knife
- 1 large knife (with 5-inch saw and blade)
- 1 package toilet tissue
- 10 yds. bandage (with sulfa powder)
- 1 waterproof match-box with compass
- 20 matches
- 14 fire starting tabs
- 1 burning glass
- 1 signal whistle
- 1 oil container

- 1 waterproof cover for .45 cal. pistol
- 20 .45 cal. shot cartridges
- 1 First Aid Kit
- 1 Survival manual
- 2 vest-kit rations in tin containers
- 2 five-minute signal flares
- 1 mosquito headnet
- 1 collapsible container for boiling water
- 1 pair woolen insert gloves
- 1 pair leather outer gloves

LIFE RAFT KIT

Accessories for multiplace life rafts are carried in a kit and include the following items:

Signal kit (Pyrotechnic projector and 6 flares).

Emergency drinking water, 7 cans. Don't open before flight or water will spoil. Save cans for storing rain water.

Sea marker, 3 cans. When you see a plane, pour a can of marker on the water and stir it with an oar so it will spread. Do this quickly.

Life raft rations, 7 cans.

Flashlight, hand energized.

Knife, floating, attached to raft.
Police whistle, to attract attention.
First Aid Kit (Medical Supply Catalog, #97769001).

Fishing kit. Don't let hooks puncture raft.

Paulin for use as a sail.
Paulin for signal, shade, camouflage, and catching rain water.

Sun protective ointment, 4 tubes.

Emergency signalling mirror.

Wrist compass.

Religious booklets.

Water containers, 4.

Cellulose sponge.

Aluminum oars, 3.

Hand pump and hose.

Repair kit.

Bailing bucket. Use it also for urinating. Don't stand in raft.

Repair plugs, 4.

Ocean charts.

Gatty's Raft Book.

Survival booklet.

Twine, 40 feet. Tie loose equipment to raft.

Sea anchor.

Fire Fighting

IN FLIGHT

Use all extinguishers applicable and always aim at the base of the fire.

Keep your parachute away from the fire. Put it on as soon as possible.

Give the pilot any assistance possible. Inform him of any terrain obstructions in the path of the airplane.

Get your exact location from the navigator. Transmit your position and the ETA to the field toward which you are heading. Make every attempt possible to get the message through.

Stay at your position until a crash seems imminent, then move to your proper bailout station.

Engine Fires

At the first sign of a fire, if conditions permit, the pilot will take all necessary action to control it from the cockpit. His actions will depend upon the type of equipment he has.

In any engine fire your only duty is to stand by and give all necessary information to the pilot.

Fuel Tank and Amphibian Hull Fires

- 1—Try to locate the source of the fire.
- 2—Inform the pilot.
- 3—If fire is accessible, use hand and built-in equipment if possible.
- 4—Transmit your position and ETA to the field toward which you are heading.
- 5—Continue your duties.

Cabin Fires

- 1—Give pilot the necessary information.
- 2—Close windows and all openings.
- 3—Locate source of fire.
- 4—Use all extinguishers available. (Open windows as soon as the flames are extinguished.)
- 5—Continue your duties.

Flare Fires

If flares in the racks ignite, release the flares at once. Pry them loose if they stick in the racks.

Other Fires

The pilot will attempt to extinguish wing fires or drop tank fires by slipping the airplane away from the fire or dropping the tanks.

Your only duty is to give the pilot or navigator any necessary information and continue your duties.

In case of fire, don't open emergency hatches or bomb-bay doors in the air, except for bailout. External fires may be drawn into the cabin. Drafts will cause cabin fires to flare up.

Open emergency hatches just before landing if fire makes a crash landing necessary, to permit escape or rescue.

ON THE GROUND

Always have a member of the ground or air crew stand by with adequate, portable fire extinguishing equipment while the engines are being started.

Starting an engine is a critical fire moment. Back-firing sometimes ignites excess priming fuel in the induction system. Fires spread rapidly.

In case of fire while starting engines:

- 1—Help crew use portable fire-fighting equipment.
- 2—Notify tower to rush crash equipment.
- 3—See that all crew members clear the airplane.
- 4—If there is time, remove classified equipment.



FIRST AID KITS

CONTENTS

OUTSIDE PACKET

Iodine swabs, (1 package)
Bandages, gauze, adhesive, 1 pack

LARGE COMPARTMENT

Dressings, first-aid, large (2)
Dressing, first-aid, small (1)
Bandage, gauze, compress (1)
Morphine tartrate, $\frac{1}{2}$ gr., 2 tubes
Water purification tablets,
halazone, 1 bottle
Scissors, 1 pair
Burn-injury set, boric acid
ointment (1)
Eye-dressing set (1)
Sulfadiazine, 0.5 grm., 8 tablets
Tourniquet (1)

The Kit, First-Aid, Aeronautic is a standard unit in all military aircraft (Medical Department Supply

Catalog No. 9776500). It is designed for use of air-crews and should not be opened by ground personnel unless there is urgent need. The contents of the main compartment are protected by a sealed zipper. Break the seal only when you need the contents of the inner kit for the treatment of injuries. A small packet on the outside of the kit contains iodine swabs and adhesive bandages for the treatment of minor injuries. When the seal has been broken, notify your Personal Equipment Officer or Medical Supply Officer, so that he can check the contents and replace missing items. Keep your kit intact. Make sure it is sealed. Your life may depend upon it.

KIT, FIRST-AID, FOR PNEUMATIC LIFE RAFT

Medical Supply Catalog No. 9776500

This is a part of the life raft kit (See ROIF 8-11-1). It contains morphine syrettes, bandage compresses, sulfanilamide powder, sulfadiazine tablets, and burn ointment.

PACKET, FIRST-AID, PARACHUTE

Medical Supply Catalog No. 9779500

To be attached to the parachute harness or Mae West life vest for constant availability. Should be carried in gun turrets and other cramped spaces where the larger Kit, First-Aid, Aeronautic is not accessible. Contains tourniquet, morphine, wound dressing, and 8 sulfadiazine tablets. You can open the packet by tearing either end of the outer container at the notch.

First Aid In Flight



Your airplane is a good first-aid station. You have the Klt, First-Aid, Aeronautic, and the Packet, First-Aid, Parachute. Oxygen is frequently available. Splints, or splint materials, are at hand. Hot drinks are often carried in thermos jugs. In certain bombers you will be provided with blood plasma. Familiarize yourself thoroughly with the first-aid supplies which you carry, and get clearly in mind just what you can do with them.

WOUNDS AND INJURIES

Wounds and injuries involve one or more of these problems: pain, cuts, bleeding, broken bones, burns, frostbite, shock, and unconsciousness. Generally you will have to deal with combinations of these, such as cuts which are bleeding, burns that cause pain, broken bones associated with cuts or burns, and so on. Shock usually comes on after a good deal of blood has been lost either inside the body (where you may not be able to see it), or on the outside. Shock also accompanies deep or extensive burns. Unconsciousness may be produced by a head injury, may follow shock, or may occur as a result of failure to get enough oxygen.

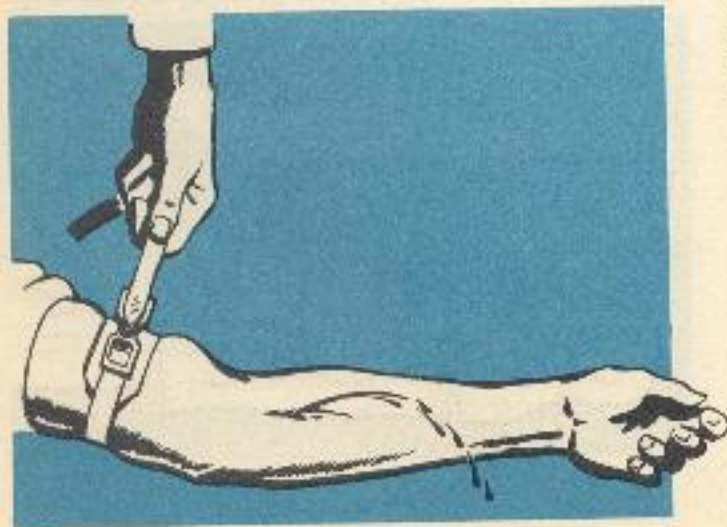
In giving first-aid, try to size up the general situation accurately. Then attend to the most serious problems first. Above all, use common sense.

CUTS AND BLEEDING

- 1—Expose wound by cutting nearby clothing with scissors.
- 2—Cover cuts with sterile dressings and apply firm pressure.
- 3—If this does not stop the bleeding, elevate the bleeding part.
- 4—If these measures fail to stop bleeding in arms or legs, apply a tourniquet in the middle of the upper arm or middle of the thigh. The tourniquet must be released every 15 minutes for at least a few seconds, depending upon the amount of bleeding.

TOURNIQUET (WARNING)

A tourniquet must be removed, or temporarily released, every 15 minutes. Failure to release the tourniquet often enough or long enough to provide an adequate circulation to the blocked portion of the arm or leg may necessitate amputation later.



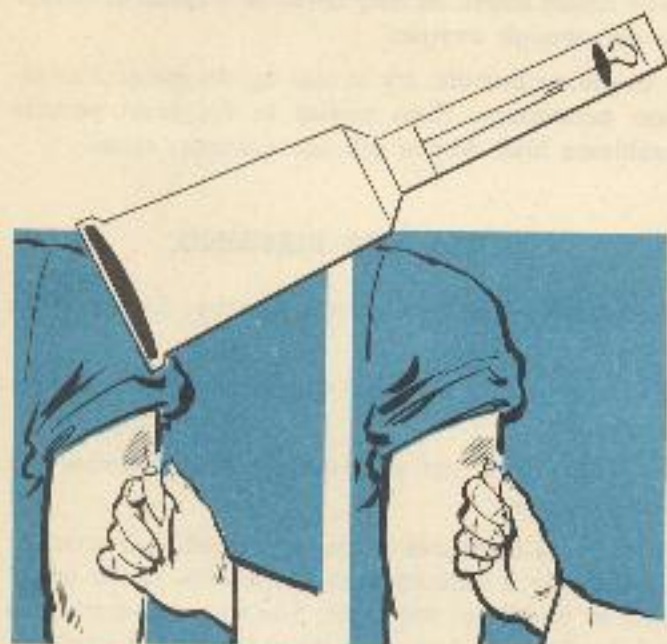
PAIN

Use morphine at once for severe pain. This makes it possible for the patient to lie quietly, preventing aggravation of the injuries. Do not use more than one tube ($\frac{1}{2}$ grain) of morphine at any one time.

When giving morphine, mark down the time and dose on the patient's forehead or clothing with a pencil. Remember that an excess of morphine can be fatal. Do not give morphine to a person who is unconscious, who has a head injury, or who is breathing less than 12 times per minute.

TO GIVE MORPHINE

- 1—Paint any small area of skin with iodine.
- 2—Remove the transparent cover from the morphine syrette.
- 3—Push in the wire loop to puncture the inner seal; then pull the wire out.
- 4—Thrust the needle through the skin, using care not to press morphine out of the tube while doing so.
- 5—Squeeze the tube slowly to inject the morphine.



GIVE MORPHINE:

- 1—To stop pain.
- 2—To decrease shock.
- 3—To facilitate moving the patient.

DON'T GIVE MORPHINE:

- 1—To an unconscious person.
- 2—To a person with a head injury.
- 3—To a person who is breathing less than 12 times per minute.

SHOCK

You can tell when a patient is in shock by the total picture he presents rather than by any single sign. Usually he will have:

- 1—Lost considerable blood, or
- 2—Suffered severe burns, or
- 3—Been subjected to intense pain, or
- 4—Received a head injury.

His skin is pale, cold, clammy, or moist.

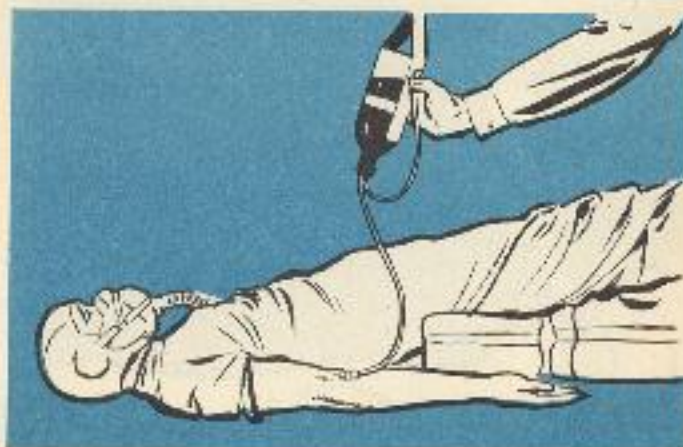
His breathing is shallow, and may be irregular.

His pulse is weak, rapid, thready, and often difficult to find.

Sometimes there is nausea and vomiting.

Treat shock by doing the following things as promptly as possible:

- 1—Stop any obvious bleeding.
- 2—Give pure oxygen to breathe. (Automix "OFF.")
- 3—Give morphine. (Exception: Head injury.)
- 4—Keep the patient warm with blankets, extra clothing, or a sleeping bag, but avoid excessive heat.
- 5—Loosen any tight clothing.
- 6—Place the patient with his head slightly lower



than his feet, to promote better circulation to the brain.

7—Inject plasma, when it is available, in accordance with the directions on the plasma package.

FRACTURES

1—If a broken bone is associated with a cut, sprinkle with sulfa powder and cover with a sterile dressing. If the dressing is firmly bound in place it will almost always stop the bleeding.

2—Give morphine.

3—Apply a temporary splint to the part, using wood, strips of metal, heavy cardboard, or any convenient pieces of equipment such as a machine-gun barrel or fire axe.

4—Do not attempt to set the bone. Manipulation causes shock.

BURNS

For minor burns:

Squeeze burn ointment onto a sterile dressing. Then cover the burn gently with the dressing.

For severe burns:

1—Give morphine.

2—Treat shock. (Oxygen; plasma, if available.)

3—Apply burn ointment on sterile dressings, and bind the dressings gently but firmly in place.

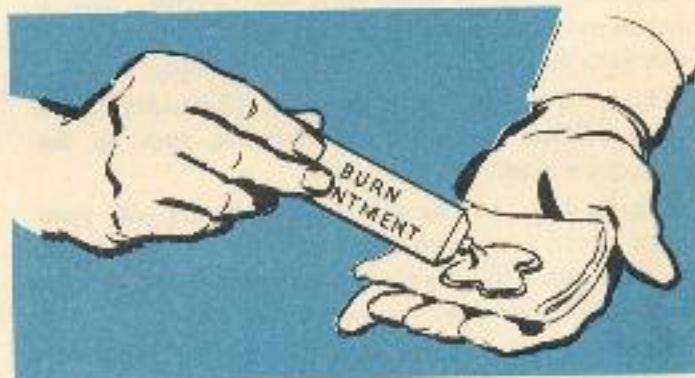
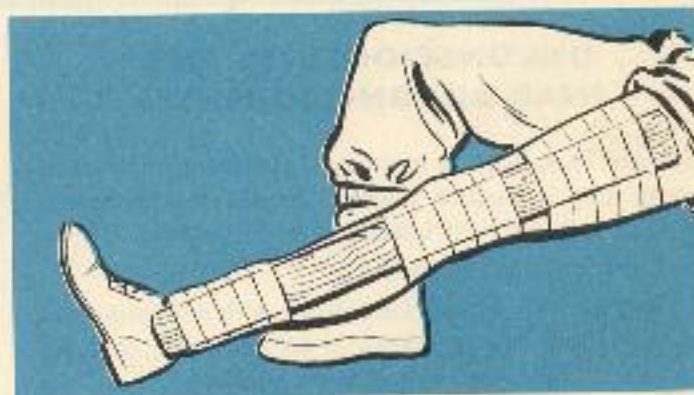
4—Never open blisters resulting from burns.

FOR EYE BURNS

Apply Metaphen ophthalmic ointment directly to the eyeball. Then apply the boric acid ointment to the inner surface of the eyelid. Cover the eye with a dressing and secure in place with adhesive strips, provided the skin around the eye is not burned. Do not touch the eye with your fingers, and do not rub it—either before or after the ointment has been applied.

TRANSPORTATION OF WOUNDED

If it becomes necessary to move an injured crew member improvise a litter with 2 poles and a pair of flying jackets. Turn the sleeves inside out and insert the poles through them. Then close the jacket over the outside of the poles. Additional support can be obtained by using boards or cardboard splints inside the jackets. Litters can also be improvised with poles and blankets. Take great care to be as gentle as possible in moving an injured person onto a litter. Keep his body as flat as possible at all times. Have 3 or more persons move and support him by placing their arms under his legs, buttocks, back, shoulders, and head.





UNCONSCIOUSNESS AND NEAR-UNCONSCIOUSNESS

Oxygen lack, carbon monoxide poisoning, and head injury are important causes. Immediate treatment is vital, especially if breathing has stopped.

1—Give artificial respiration:

First, lay the patient face down with one arm bent at the elbow, his face resting on his hand, and his other arm extended beyond his head.

Second, open his mouth and remove all foreign substances such as false teeth and chewing gum. If his tongue has fallen back into his mouth, grasp it with your fingers and pull it well forward.

Third, give him pure oxygen. (Auto-mix OFF.) If the patient has stopped breathing, turn on the emergency flow.

Fourth, kneel astride the patient's thighs with your knees about even with his. Place the palms of your hands against the small of the patient's back, with your little finger over the lowest rib.

Fifth, with your arms stiff, swing your body forward slowly so that your weight is applied over the patient's back. This should take about 3 seconds.

Sixth, release your hands with a sudden snap and swing backward to remove all pressure from the patient. After about 2 seconds repeat the cycle.

Continue giving artificial respiration without stopping for 2 hours or longer, unless the person to whom it is being given begins to breathe normally.

2—Keep the patient warm.

3—Do not give morphine.

FROSTBITE

1—Fingers, toes, ears, cheeks, chin, and nose are the parts most frequently affected.

2—Numbness, stiffness, and whitish discoloration are the first symptoms.

3—Wrinkle your face to find out if it is numb; watch for blanched faces of your crew mates.

4—If frostbite occurs, warm the affected part gradually. Never rub or attempt to thaw it rapidly.

5—If blisters develop, do not open them. (See HEAT AND COLD, PIP 4-7-3.)

FAILURE OF OXYGEN SUPPLY

If a crew member's oxygen supply fails above 10,000 feet, make every effort to replace his equipment or give him an emergency supply. If this is not practicable, descend to 10,000 feet as fast as safe operation permits. Loss of oxygen above 20,000 feet is critical, but there is no need for panic. Get oxygen, or get down.



WOUND DISINFECTANTS

1—Sprinkle Sulfur powder in open wounds.

2—Use iodine only for small cuts and scratches, which should not be covered by a dressing.

3—Never put iodine on or into large or deep wounds.

RADIO OPERATORS

Information File

INDEX

RESTRICTED

NOV. 1944 IN-1

Airmetco Weather Chart.....	3-9-4
Airmetco Weather Code.....	3-9-3
Alaco Weather Chart.....	3-9-1
Alaco Weather Code.....	3-9-2
Alphabet, Phonetic.....	3-11-1
Antenna Systems,	
Med. Freq. Command.....	5-1-5
VHF Command.....	5-2-7
Liaison.....	4-2-4
Radio Compass.....	6-1-4
SCS-51 System.....	6-2-4
Antenna Tuning Charts.....	4-1-9
Arctic Maintenance and Operations.....	7-1-1
Army Airways Communications System.....	3-1-1, 3-1-2
Army Navy Nomenclature System.....	1-7-1 to 1-7-5
Authentication, Message.....	3-10-1
Autotune System.....	4-1-7
Body Signals.....	3-3-1
Booby Traps and Land Mines.....	2-8-1, 2-8-2
Calibration Charts,	
AN/ART-13 Transmitter.....	4-1-8
BC-375 Transmitter.....	4-2-8
Camouflage.....	2-9-1, 2-9-2
Charts, Direction Finding.....	6-1-8 to 6-1-11
Civil Aeronautics Administration.....	3-2-1, 3-2-2
Codes,	
Alaco Weather.....	3-9-2
Airmetco Weather.....	3-9-3
Cryptographic.....	3-8-2
Combined Panel System.....	3-4-1 to 3-4-3
Command Equipment,	
SCR-274 Med. Freq.	5-1-1 to 5-1-9
SCR-522 VHF.....	5-2-1 to 5-2-9
Compass, Radio.....	6-1-1 to 6-1-14
Crew Coordination.....	1-2-1, 1-2-2
Cryptographic Publications.....	3-8-1 to 3-8-3

RESTRICTED

Desert Operations and Maintenance	7-1-4
Detonator, IFF	6-4-2
Deviation	6-1-6
Direction Finding	3-7-1, 3-7-2
Distress Procedures	8-1-1
Ditching	8-7-1 to 8-7-4
Dynamotor Units,	
AN/ART-13	4-1-2, 4-1-15
BC-375-PE-73	4-2-3, 4-2-12
BC-348	4-3-2
SCR-274 Transmitter's	5-1-3, 5-1-9
SCR-522	5-2-3, 5-2-9
RC-103	6-2-5
Interphone	6-5-2
Effects of High Altitudes	2-1-1, 2-1-2
Effect of Oxygen Want	2-2-1
Emergency Exits	8-5-1
Emergency Operations,	
AN/ART-13 Transmitter	4-1-13
BC-375 Transmitter	4-2-11
SCR-274 Transmitter	5-1-7
Fire Fighting	8-12-1, 8-12-2
First Aid In Flight	8-14-1 to 8-14-4
First Aid Kit, Aeronautic	8-13-1 to 8-13-3
Fix, 3 Station Aural Null	6-1-10
Fix, 3 Station Visual	6-1-8
Flying Suits	2-7-1, 2-7-2
Forced Landings	8-6-1
Form 1-A	1-6-1
Frequency Meter, SCR-211	4-4-1 to 4-4-4
Gibson Girl, SCR-578	8-4-1 to 8-4-7
Grenades, Smoke	8-3-1
High Altitude, Effects of	2-1-1, 2-1-2
High Altitude Operations and Maintenance	7-1-4
Homing	6-1-12
How To Use ROIF	1-3-1, 1-3-2
Hydrogen Balloon, SCR-578	8-4-3
IE-19 Test Equipment	5-3-1
IE-36 Test Equipment	5-4-1 to 5-4-3
IFF Radar	6-4-1 to 6-4-3
Indicators, Visual,	
Radio Compass	6-1-3
SCS-51 Instrument Landing	6-2-4
Interphone Jackbox System	6-5-1 to 6-5-3
Interpolation	4-2-8

Kit, First Aid Aeronautic	8-13-1 to 8-13-3
Kit, Life Raft	8-11-1
Land Mines and Booby Traps	2-8-1, 2-8-2
Liaison Equipment,	
AN/ART-13 Transmitter	4-1-1 to 4-1-15
BC-375 Transmitter	4-2-1 to 4-2-12
BC-348 Receiver	4-3-1 to 4-3-3
RL-42 Reel and Control	4-5-1
Life Preserver Vests	8-9-1, 8-9-2
Life Raft Discipline	8-11-2
Life Raft Kit	8-11-1
Logs, Radio	3-14-1
Maintenance and Inspections,	
Flying Suits	2-7-1, 2-7-2
Oxygen Equipment	2-3-1 to 2-4-1
AN/ART-13 Transmitter	4-1-14, 4-1-15
BC-375 Transmitter	4-2-11, 4-2-12
BC-348 Receiver	4-3-3
SCR-211 Frequency Meter	4-4-4
RL-42 Reel	4-5-1
SCR-274 Command Equipment	5-1-8, 5-1-9
SCR-522 Command Equipment	5-2-8, 5-2-9
SCR-269 Radio Compass	6-1-14
BC-733 Localizer Receiver	6-2-5
RC-43, RC-193 Marker Beacon Receivers	6-3-2, 6-3-3
SCR-695 IFF Radar	6-4-2, 6-4-3
Interphone	6-5-2
SCR-578 Gibson Girl	8-4-6
Marker Beacon Receivers RC-43, RC-193	6-3-1, to 6-3-3
Marker Beacon Locations, SCS-51	6-2-5
Message Authentication	3-10-1
Naval Observatory Time Signals	3-12-3
Night Vision	2-5-1
Noise Suppression Kit, SCR-522	5-4-3
Oxygen Equipment,	
Demand System	2-3-1
Continuous Flow System	2-3-3
Portable	2-4-1
Oxygen Want, Effects of	2-2-1
Panel Signals	8-2-1, 8-2-2
Panel System, Combined	3-4-1, 3-4-2
Parachutes	8-8-1 to 8-8-9
Phonetic Alphabet	3-11-1
Physical Fitness	2-6-1
Prosigns	3-16-1, 3-16-2
Publications, Cryptographic	3-8-1 to 3-8-3

Q Signals	3-15-1, 3-15-2
Radar, IFF	6-4-1 to 6-4-3
Radio Logs	3-14-1
Radio Operators' Responsibilities	1-1-1, 1-1-2
Radio Range Filter System	6-5-3
Receivers,	
Liaison	4-3-1 to 4-3-3
VHF Command	5-2-2, 5-2-4, 5-2-5
Med. Freq. Command	5-1-1, 5-1-2
Radio Compass, SCR-269	6-1-1, 6-1-2, 6-1-13
Localizer	6-2-2
Glide Path	6-2-3
Marker Beacon	6-3-1 to 6-3-3
Recognition Signals	3-6-1
SCS-51 Airborne Equipment	6-2-1 to 6-2-5
Signal Lamp	3-5-1
Signal Operating Instructions	3-13-1
Smoke Grenades	8-3-1
Swimming Through Fire	8-10-1
Technical Orders	1-4-1 to 1-4-3
Test Equipment,	
IE-19	5-3-1
IE-36	5-4-1 to 5-4-3
BE-67	6-3-3
Time Signals and Zones	3-12-1
Time Signals, Naval Observatory	3-12-3
Time Signals, Bureau of Standards	3-12-4
Time Zone Map	3-12-2
Transmitters,	
Liaison AN/ART-13	4-1-1 to 4-1-15
Liaison BC-375	4-2-1 to 4-2-12
VHF Command	5-2-1, 5-2-6, 5-2-7
Med. Freq. Command	5-1-1, 5-1-2, 5-1-3, 5-1-6
Gibson Girl, Dinghy	8-4-1 to 8-4-7
Tropic Operations and Maintenance	7-1-2, 7-1-3
Unsatisfactory Reports	1-5-1
Variation	6-1-5
Vision at Night	2-5-1
Visual Indicators,	
Radio Compass	6-1-3
Instrument Landing	6-2-4
WB-7 Weather Chart	3-9-1
WB-7A Weather Chart	3-9-3
Weather Codes	3-9-2
WWV Bureau of Standards	3-12-4