

CONFIDENTIAL

Catalogue » » » OF
NAVAL RADIO
EQUIPMENT

SHIPS 275

NAVY DEPARTMENT * BUREAU OF SHIPS
WASHINGTON, D. C. 1 AUGUST 1944

CONFIDENTIAL

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NAVAL RADIO
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FOREWORD

BUREAU OF SHIPS,
NAVY DEPARTMENT,
WASHINGTON 25, D. C., 1 August, 1944.

1. SHIPS 275 is a confidential nonregistered publication, and shall be safeguarded in accordance with instructions contained in the current edition of the Registered Publications Manual and the United States Naval Regulations. Periodic accounting is not required.

2. SHIPS 275 replaces ENG 175 and SHIPS 207, and upon receipt hereof, ENG 175 and SHIPS 207 shall be destroyed. No report of such destruction is required.

3. The purpose of this catalogue is to provide a quick means of examining the fundamental technical data and the physical appearances of the major electronic equipments in use by the United States Navy. This edition contains descriptions of transmitting, receiving, transmitting-receiving, direction-finding, homing beacon, and harbor detection equipments. Certain Signal Corps transmitters, receivers, and radio sets are included because of the wide use of these equipments by the Naval Service. Subsequent editions will cover further equipments as material is assembled.

4. It is not the intention of this catalogue to supply complete information on the equipments it covers. For such data it will be necessary to refer to instruction books, installation or maintenance publications, drawings, etc.

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J. B. Dow,
Captain, U. S. N.

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EXPLANATION OF CATALOGUE HEADINGS

The following basic headings as used in this catalogue have the following specific meanings:

Accessories not supplied by contractor.—Listed under this heading are items necessary (or desirable) for operation of the equipment but not supplied under the contract. Materials such as wire, antenna components, conduit, and miscellaneous hardware necessary for installation are not listed. Frequency indicating equipment where it is not self-contained has also been omitted.

Carrier control.—Indicates special switch where provided, to place control of the carrier wave at other than the front panel location, such as the push-to-talk switch on the microphone, voice relay, or remote control.

Emission.—

A₁, continuous wave telegraphy (CW).

A₂, modulated continuous wave telegraphy (MCW).

A₃, radiotelephone (voice).

Descriptions.—Descriptions of different models of series (i. e., TBM-6, TBM-8, and TBM-10) are intended to point out major differences only. Various slight mechanical changes and electrical or mechanical improvements are not explained unless considered outstanding. Power ratings are defined as follows: low power, up to 100 watts; medium power, 100 to 1,000 watts; high power, over 1,000 watts.

Frequency control.—Where crystal frequency control is shown, the number of crystal channels provided is specified. Master oscillator control covers the entire range.

Frequency range.—Frequency range is continuous from upper to lower limit unless otherwise indicated.

Operating control.—Operating control indicates the location of power controls.

Power output.—Nominal values are given for all types of emission.

Power required for locked-key operation.—Indicates input power necessary to provide normal output.

Power required for starting.—Instantaneous starting power and KVA (when available) required from the line are shown. It is not shown for rectifier operation as the approximate value for "locked-key" operation may be used.

Power supplies available.—Lists various sources of power capable of operating the equipment. When an alternate power supply is available under separate contract, it will be listed under "Supplies Optional."

Sensitivity.—Based on a signal to noise ratio of 10 decibels for MCW operation and 20 decibels for CW operation.

Shipping weights and dimensions.—Grouping of the items under this heading shows, where possible, the arrangements under which the units are packed and shipped.

Type of keying.—Type of keying indicates use of relay, vacuum tube, etc. Maximum speed obtainable with each type is listed.

Use.—Indicates the principal use for which the equipment was designed.

Weights, dimensions and Navy type numbers of equipment units included in contract.—Where alternate equipment is available for operation under more than one source of power, all units may be listed.

ABBREVIATIONS AND SYMBOLS

| | |
|----------------|--|
| A (supply) | —filament (low voltage) potential. |
| A ₁ | —continuous wave (CW). |
| A ₂ | —waves modulated by means other than voice (MCW). |
| A ₃ | —voice modulated waves. |
| AC, a-c | —alternating current. 115/3/60—115 volts, 3-phase, 60 cycles. 115/125/3/50/60—115 or 125 volts, 3-phase, 50 or 60 cycles. 115-125/3/50-60—115 to 125 volts, 3-phase, 50 to 60 cycles. |
| AF, a-f | —audio frequency. |
| A. G. C. | —automatic gain control. |
| AM | —amplitude modulation. |
| A. N. L. | —automatic noise limiter. |
| ant | —antenna. |
| A. S. C. | —automatic sensitivity control. |
| A. V. C. | —automatic volume control. |
| B (supply) | —plate (high voltage) potential. |
| BFO | —beat frequency oscillator. |
| C (supply) | —bias (low voltage) potential. |
| CC | —crystal control. |
| CRT | —cathode ray tube. |
| CV | —continuously variable. |
| CW | —continuous wave. |
| db | —decibel. |
| DC, d-c | —direct current. |
| FM | —frequency modulation. |
| gnd | —ground. |
| HF | —high frequency, 3,000 to 30,000 kc. |
| HFO | —heterodyne frequency oscillator. |
| hor | —horizontal. |
| hp | —horsepower. |
| HP | —high power, over 1,000 watts. |
| HV | —high voltage. |
| ICW | —interrupted continuous wave. |
| IF, i-f | —intermediate frequency. |
| IPA | —intermediate power amplifier. |
| kc | —kilocycles. |
| kw | —kilowatts. |
| LF | —low frequency, 30 to 300 kc. |
| LP | —low power, up to 100 watts. |
| LV | —low voltage. |
| ma | —milliamperes. |
| mc | —megacycles. |
| MCW | —modulated continuous wave. |
| MF | —medium frequency, 300 to 3,000 kc. |
| mfd | —microfarad. |

mmfd —micromicrofarad.
 m-g —motor-generator.
 MO —master oscillator.
 MP —medium power, 100 to 1,000 watts.
 mod —modulation, modulator.
 UHF —ultra-high frequency, 300,000 to 3,000,000 kc.
 μ v —microvolt.
 μ v per meter —microvolts per meter.
 mw —milliwatts.
 O. L — output limiter.
 phonograph —phonograph.
 RF, r-f —radio frequency.
 rms —root mean square.
 S-meter —signal strength meter.
 sil —silencer.
 SHF —super-high frequency, 3,000,000 to 30,000,000 kc.
 trf —tuned radio frequency.
 va —volt amperes.
 vert —vertical.
 VHF —very high frequency, 30,000 to 300,000 kc.

CROSS INDEX OF DIRECTION-FINDING EQUIPMENTS

| Equipment | Use | | | | | Frequency | | | | |
|----------------------|----------|------|-------|--------------|----------|-----------|----|----|----|-----|
| | Aircraft | Ship | Shore | Semiportable | Portable | VLF | LF | MF | HF | VHF |
| DAB, -1, -2, -3 | | | X | | | | | X | X | |
| DAE, -1 | | X | | | | | X | X | | |
| DAG, -1, -2 | | | X | | X | | | | | |
| DAQ | | X | | | | | | X | X | |
| DP-12, -13, -18, -19 | | X | | | | | X | X | | |
| DQ-5, -6 | | X | | | | | X | X | | |

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CROSS INDEX OF RECEIVING EQUIPMENTS

| Equipment | Use | | | | | Frequency | | | | |
|---|----------|------|-------|--------------|----------|-----------|----|----|----|-----|
| | Aircraft | Ship | Shore | Semiportable | Portable | VL F | LF | MF | HF | VHF |
| RAA, RAA-1, RAA-2, RAA-3, RAA-4 | | X | X | | | X | X | X | | |
| RAB, RAB-1, RAB-2, RAB-2a, RAB-3 | | X | X | | | | | X | X | |
| RAG, RAG-1 | | X | X | | | X | X | X | | |
| RAH, RAH-1 | | X | X | | | | | X | X | |
| RAJ | X | | | | | | X | X | X | |
| RAK, RAK-1, RAK-2, RAK-3, RAK-4, RAK-5, RAK-6, RAK-7, RAK-8 | | X | X | | | X | X | X | | |
| RAL, RAL-1, RAL-2, RAL-3, RAL-4, RAL-5, RAL-6, RAL-7, RAL-8 | | X | X | | | | | X | X | |
| RAO, RAO-1, RAO-2, RAO-3, RAO-4 | | X | X | | | | | X | X | |
| RAS, RAS-1, RAS-2, RAS-3, RAS-4, RAS-5 | | X | X | | | | | X | X | |
| RAW | | X | X | | | | X | X | | |
| RAZ, RAZ-1 | | X | | | | | X | X | | |
| RBA, RBA-1, RBA-2, RBA-3 | | X | X | | | X | X | X | | |
| RBB, RBB-1, RBB-2 | | X | X | | | | | X | X | |
| RBC, RBC-1, RBC-2 | | X | X | | | | | | X | |
| RBB, RBC CRYSTAL ADAPTOR | | X | | | | | | X | X | |
| RBG | | X | X | | | | | X | X | |
| RBH, RBH-1 | | | | | | | | X | X | |
| RBJ, RBJ-1, RBJ-2, RBJ-3, RBJ-4, RBJ-5 | | | | | | | X | X | X | |
| RBK, RBK-1, RBK-2, RBK-3, RBK-4, RBK-5, RBK-6 | | X | X | | | | | | X | X |
| RBL, RBL-1, RBL-2, RBL-3 | | X | X | | | X | X | X | | |
| RBM, RBM-1, RBM-2, RBM-3 | | X | X | | | | X | X | | |
| RBO, RBO-1 | | X | | | | | | X | X | |
| RBP, RBP-1, RCP | | | X | | | | | | X | |
| RBQ | | | X | | | | | | | X |
| RBS | | X | X | | | | | X | X | |
| RBY | | X | X | | | | | X | X | |
| RBZ | | | X | | X | | X | X | X | |
| RCF | | | X | | | | | X | X | X |
| RCH | | X | X | | | | X | X | X | |
| RCO | | | X | | | | | | | X |
| RCK | | | X | | | | | | | X |
| RDE | | | X | | | | | X | X | |

CROSS INDEX OF TRANSMITTING AND TRANSMITTING-RECEIVING EQUIPMENTS

| Equipment model | Use | | | | | | Power | | | Frequency | | | | Emission | | |
|--------------------|------|-------|--------------|----------|-----------|-----------|-------|----|----|-----------|----|----|-----|----------------|----------------|----------------|
| | Ship | Shore | Semiportable | Portable | Paratroop | Life Raft | LP | MP | HP | LF | MF | HF | VHF | A ₁ | A ₂ | A ₃ |
| MN-1, MN-2, MN-3 | X | X | | X | | | X | | | | | | X | | | X |
| MQ, -1, -2 | X | | | | | | X | | | | X | X | | | | X |
| MU | | | | | X | | X | | | | X | | | | | X |
| MV | | | | | X | | X | | | | X | X | | | | X |
| MW } MP | | | | | X | | X | | | | X | X | | | | X |
| MX | | | | | X | | X | | | | X | X | | | | X |
| MAB | | | | | X | | X | | | | X | X | | | | X |
| TAB-5, -6, -7 | | X | | | | | | X | X | X | | | | X | X | |
| TAJ-8, -11 | X | | | | | | | X | X | X | | | | X | X | |
| TAQ-9 | X | | | | | | | X | X | X | | | | X | X | |
| TBA-6, -9 | X | | | | | | | X | | | | X | | X | | |
| TBA-8, -10, -11 | | X | | | | | | X | | | | X | | X | | |
| TBK-11, -15 | | X | | | | | | X | | | X | X | | X | | |
| TBK-13, -18, -20 | X | | | | | | | X | | | X | X | | X | | |
| TBL-4, -5, -6 | X | | | | | | | X | X | X | X | X | | X | X | X |
| TBL-10, -11 | | X | | | | | | X | X | X | X | | | X | X | X |
| TBM-5, -7, -9, -11 | X | | | | | | | X | X | X | X | | | X | X | X |
| TBM-6, -8 | | X | | | | | | X | X | X | | | | X | X | X |
| TBS through TBS-7 | X | | | | | | X | | | | | X | | X | X | X |
| TBW, -1 | | X | X | | | | X | | | X | X | | | X | X | X |
| TBX through TBX-6 | X | X | | X | | | X | | | X | X | | | X | X | X |
| TBY, -1, -2 | X | X | | X | | | X | | | | X | X | | X | X | X |
| TCA-1 | | X | | | | | X | | | | X | | | | | X |
| TCC-1 | | X | | | | | | X | | | X | X | | X | X | X |
| TCE-1, -2 | X | | | | | | X | | | | X | X | | X | X | X |
| TCJ, -1 | X | X | | | | | | X | | | X | | | X | X | |
| TCK through TCK-6 | X | X | | | | | | X | | | X | X | | X | X | X |
| TCM, -1, -2 | X | X | | | | | | X | | | X | X | | X | X | X |
| TCN, -1 | X | X | | | | | | X | | | X | X | | X | X | X |
| TCO, -1, -2 | X | | | | | | X | | | | X | X | | | | X |
| TCP-1, -2 | X | | | | | | X | | | | X | | | | | X |
| TCR | | X | | | | | | X | | | X | | | | X | X |
| TCS through TCS-14 | X | X | X | | | | X | | | | X | X | | X | | X |
| TCU, -1, -2 | X | X | | | | | | X | | | X | | | X | X | |
| TCY, -1 | X | | | X | | X | X | | | | X | | | | X | |
| TCZ | X | X | | | | | X | | | | X | X | | X | X | X |
| TDD | | X | | | | | X | | X | | X | | | | | X |
| TDE, -1, -2, -3 | X | X | | | | | | X | | | X | X | | X | X | X |
| TDF | | X | | | | | | X | | | X | X | | X | X | X |
| TDH, -2 | | X | | | | | | X | | | X | X | | X | X | X |
| TDO | | X | | | | | | X | | | X | X | | X | X | X |
| TDQ | X | X | | | | | X | | | | | X | | X | X | X |
| TDT | | X | | | | | X | | | | | X | | X | X | X |
| TDU | | X | | | | | | X | | X | X | | | X | | |
| YE-1, -2, -3 | X | X | | | | | X | | | | | X | | | X | |
| YG, -1 | X | X | | | | | X | | | | | X | | | X | |
| 50064 | X | X | | | | | | | | | | | | | | |

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Section I

RADIO DIRECTION-FINDING EQUIPMENTS

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DAB, DAB-1, DAB-2, AND DAB-3 RADIO DIRECTION-FINDING EQUIPMENTS

Use.—Permanent land stations.

Frequency range.—2000-18100 kc. nominal in four bands:

Bearing indications.—Visual, phase comparison.

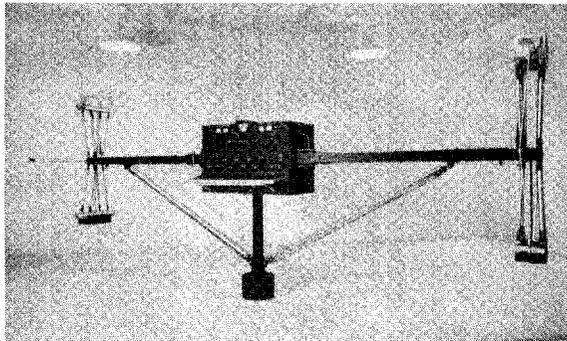
Signal reception.—CW, MCW.

Antenna collector system.—Rotatable, spaced vertical loops for vertical wave detection.

Power.—Supply required—105/110/1/60; allowable variation in line power, ± 10 percent.

Consumption—270 watts.

Description.—The Models DAB, DAB-1, DAB-2, and DAB-3 are identical and incorporate spaced vertical tuned loops with identical "switch" receivers and cathode ray indication. Tuning of the loops has resulted in an increase in the sensitivity of the loop type of antenna, facilitating the detection of weak signals. Precision in bearings is increased by the method of continued connection and cross connection of the two main loops to the receiver channels, thus minimizing the effects due to possible phase shift in the receivers. The rate of change of the two loops from one



Model DAB-3 direction-finding equipment installation.

receiver to the other is approximately ten cycles per second with provision for a small degree of overlap so that the antenna circuits of the two receivers are never open. This equipment is considered one of the more accurate type in direction finding indication.

The equipment consists of a main cabinet structure housing the indicator, electrical circuits and controls, and a collector system mounted on the main cabinet. The entire assembly is elevated on a vertical spindle, permitting complete manual rotation. The cabinet frame is constructed of spot-welded stainless steel, the collector loops and supporting structure of wood and aluminum alloy.

Dimensions and weight of equipment assembled

| Length | Height | Depth | Weight |
|------------------|---------------------|----------------------|-------------|
| 16 feet 7 inches | 7 feet 2 3/4 inches | 5 feet 10 1/4 inches | 852 pounds. |

Space required for installation.—Recommended minimum: 24 x 24 feet, with a clearance of 200 yards radius from trees and metallic obstructions. The

diameter of the circle formed by the swing of the equipment is approximately 17 feet 2 inches.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location (unit) | Circuit function | Number of tubes | Type |
|--------------------------|----------------------------------|-----------------|-----------|
| RF tuner unit A | First r-f amplifier | 1 | 6SK7 |
| | Second r-f amplifier | 1 | 6SK7 |
| | First detector | 1 | 6SJ7 |
| RF tuner unit B | First r-f amplifier | 1 | 6SK7 |
| | Second r-f amplifier | 1 | 6SK7 |
| | First detector | 1 | 6SJ7 |
| Oscillator unit C | H. F. oscillator | 1 | 6J5 |
| | First buffer amplifier | 1 | 6SK7 |
| | Second buffer amplifier | 1 | 6SK7 |
| | Third buffer amplifier | 1 | 6SK7 |
| Mixer unit D | Output amplifier | 1 | 6SK7 |
| | Mixer | 1 | 6SA7 |
| | Input buffer amplifier | 1 | 6SK7 |
| | First i-f amplifier | 2 | 6SK7 |
| IF amplifier unit E | Second i-f amplifier | 2 | 6SK7 |
| | AVC amplifier | 2 | 6J5 |
| | Second detector | 2 | 6H6 |
| | First audio amplifier | 2 | 6J5 |
| Power supply unit F | Plate supply power rectifier | 2 | 5U4G |
| | Plate voltage regulator | 1 | VR-150-30 |
| | Second audio amplifier | 2 | 6SJ7 |
| Audio amplifier unit H | Audio output amplifier | 2 | 6J5 |
| | Differential rectifier | 2 | 6H6 |
| | Keyer amplifier | 1 | 6J5 |
| | Bias supply power rectifier | 1 | 5U4G |
| Monitor unit J | Bias voltage regulator | 1 | VR-150-30 |
| | I. F. oscillator | 1 | 6J5 |
| | I. F. test oscillator | 1 | 6J5 |
| | Carrier strength meter amplifier | 1 | 6J5 |
| Oscilloscope amplifier N | Carrier strength meter limiter | 1 | 6H6 |
| | Carrier strength meter amplifier | 1 | 6J5 |
| | Monitoring amplifier | 1 | 6J5 |
| | Oscilloscope amplifier | 1 | 6SJ7 |
| Total | Oscilloscope | 1 | 902 |
| | | 43 | |

Signal strength.—The signal strength necessary for the equipment to respond to a rotation of plus or minus one degree from the "on bearing" position is as follows:

| Frequency in mc.: | Field intensity μ/m. |
|-------------------|----------------------|
| 2 | 15 |
| 4 | 8 |
| 6 | 5 |
| 8 | 3 |
| 12 | 2 |
| 16 | 1 |
| 18 | 1 |

Bearing resolution.—± 1°.

Frequency bands.—

- Band I: 1950-3550 kc.
- Band II: 3370-6150 kc.
- Band III: 5850-10650 kc.
- Band IV: 10150-18300 kc.

Type of receiver circuits.—Superheterodyne.

Receiver intermediate frequency.—455 kc.

Operating control.—Local.

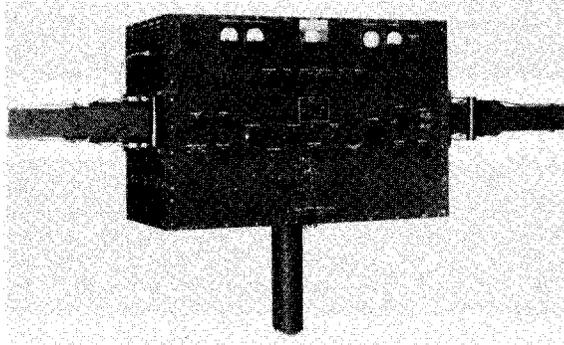
DAB
 DAB-1
 DAB-2
 DAB-3
 DAE
 DAE-1

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Major components included in contract.—DAB direction finding equipment; spare parts (1 set); head phones and plug; arm rest (1); instruction books (2).

Accessories not supplied by contractor.—Constant voltage transformer, required where line regulation is poor.

Shipping weights and dimensions



Main cabinet housing electrical circuits, indicator and controls for Model DAB-3 direction-finding equipment.

| Case | Contents | Size | Gross weight | | Volume |
|------|---|--------------|--------------|------------|--------|
| | | | Pounds | Cubic feet | |
| 1 | Screw drivers, wrenches, instruction books, and accessories | 16 x 22 x 26 | 62 | 5.3 | |
| 2 | Main cabinet and base assembly | 32 x 73 x 65 | 820 | 88.0 | |
| 3 | Beams, compression members, arm rest, and handles | 22 x 26 x 92 | 304 | 30.4 | |
| 4 | Injector loops and main loop assemblies, units P and Q | 20 x 27 x 30 | 123 | 9.4 | |
| 5 | RF tuner—unit A | 16 x 22 x 26 | 80 | 5.3 | |
| 6 | RF tuner—unit B | 16 x 22 x 26 | 80 | 5.3 | |
| 7 | Oscillator—unit C | 16 x 22 x 26 | 83 | 5.3 | |
| 8 | Mixer—unit D | 16 x 22 x 26 | 80 | 5.3 | |
| 9 | IF amplifier—unit E and monitor—unit J | 16 x 22 x 26 | 68 | 5.3 | |
| 10 | Power supply—unit F | 16 x 22 x 26 | 109 | 5.3 | |
| 11 | Audio amplifier—unit H | 16 x 22 x 26 | 77 | 5.3 | |
| 12 | Spare parts | 15 x 18 x 23 | 157 | 3.6 | |

★ ★ ★

DAE AND DAE-1 RADIO DIRECTION-FINDING EQUIPMENTS

Use.—Ship.

Frequency range.—Three bands: 240–2000 kc.

Bearing indications.—Aural null.

Signal reception.—CW, MCW.

Antenna collector system.—Rotatable plain loop, and fixed sense antenna.

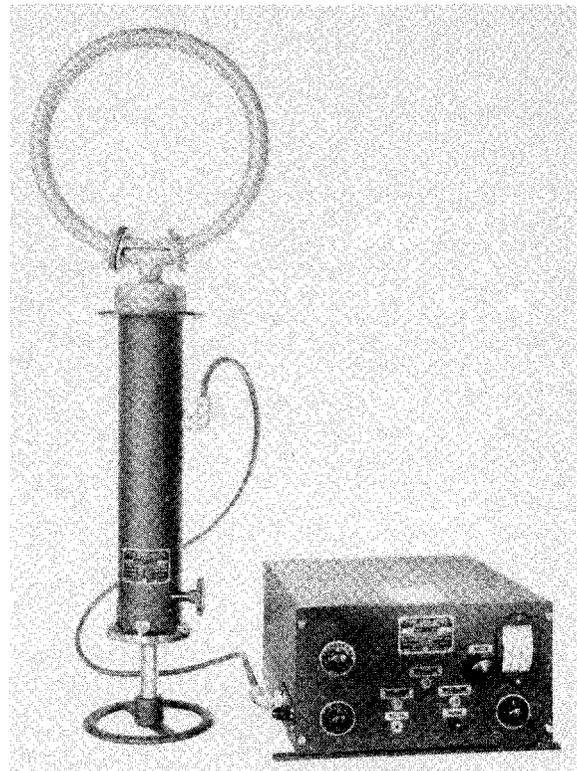
Power.—Supply required—115 volt—60 cycles alternating current. Where this source is not available, rotary converter units can be supplied for 115-, 32-, 24-, and 12-volt direct current sources.

Consumption—35 watts.

Description.—The identical Models DAE and DAE-1 radio direction finding equipments are intended for installation where the loop antenna will have maximum clearance from metallic objects. The loop antenna assembly and receiver are connected by means of an RF cable, of 5 feet maximum length, limiting the distance at which the receiver can be located from the antenna assembly.

The loop antenna assembly is designed so that the drive shaft, enclosed by an “outer tube” with a flange mounting for support of the antenna, may be passed through a 4 inch diameter hole in the deck. The loop is located on the upper side of the deck, and the collector rings and hand wheel are below deck and are accessible respectively for connection to the receiver and control of the antenna. A 5-inch azimuth scale, marked in degrees, is fastened to the loop drive shaft directly below the bottom of the “outer tube.” A fixed pointer, mounted on the “outer tube” and projecting over the azimuth scale, is used to indicate the angular rotation of the loop when taking bearings. The loop drive shaft may be locked when the direction finder is not in use by means of a friction type brake with an adjusting knob which is mounted through the “outer tube” just above the azimuth scale.

The receiver, which may be mounted on a table, shelf, or other rugged support, is housed in a black lacquer finished steel cabinet. Four rubber shock mounts fastened to the base of the cabinet are in turn secured to mounting bars 16 inches wide.

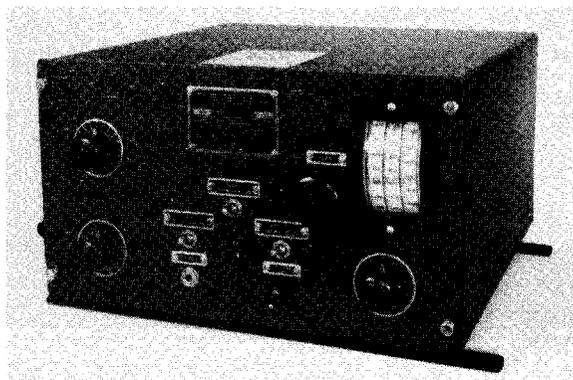


Collector system and receiver for Model DAE direction-finding equipment

CONFIDENTIAL

The *sense antenna* should generally not exceed a length of about 12 feet, with the exact length to be determined during installation. On some vessels a sense antenna constructed of vertical self-supporting rod approximately 6 to 10 feet in height with a base insulator may be used.

The *rotary converter-filter unit* is an accessory which is required for installations where the shipboard power supply is direct current. This unit consists of a small converter mounted on the top of a cabinet housing the various filter components. The receiver requires an input of 40 volt-amperes. However, for conservative operation, the rotary converter has been designed to be capable of supplying an output of 57.5 volt-amperes. Rotary converters supplied for different d-c supply voltages are basically the same.



Type CRM-46153 radio receiver of the Model DAE direction-finding equipment.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Function | Number of tubes | Type |
|--------------------------|-----------------|---------|
| RF amplifier..... | 1 | 6SG7 |
| Converter..... | 1 | 6SA7 |
| First IF amplifier..... | 1 | 6SG7 |
| Second IF amplifier..... | 1 | 6SG7 |
| Detector..... | 1 | 6SJ7 |
| Audio amplifier..... | 1 | 6J5 |
| B. F. O..... | 1 | 6SJ7 |
| Rectifier..... | 1 | 6X5GT/G |
| Total..... | 8 | |

Frequency bands:

- Band (1) 240-520 kc.
- Band (2) 480-1050 kc.
- Band (3) 970-2000 kc.

Type of receiver circuit.—Superheterodyne.

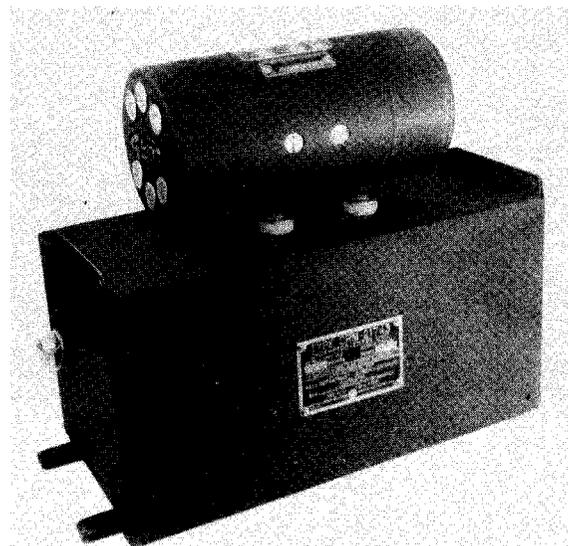
Receiver intermediate frequency.—175 kc.

Audio output power.—6 milliwatts across 600-ohm load.

Dimensions and weights of major equipment units included in contract

| Unit | Height | Width | Depth | Weight |
|--|-----------------|---------------|-----------------|---------------|
| | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Loop antenna assembly..... | 41 | 14 | 15 | 35 |
| Receiver (including set of tubes)..... | 8 $\frac{3}{8}$ | 14 | | 42 |
| Rotary converter-filter units for d-c operated equipments..... | 11 | 14 | 6 $\frac{1}{4}$ | 25 |

Accessories not supplied by contractor.—600-ohm headphones, various sense antenna material.



Type CRM-21743 dynamotor-filter unit for Model DAE direction-finding equipment.

Navy type numbers of units of the DAE and DAE-1 equipments

| Unit: | Type No. |
|--------------------------------|-------------|
| Loop antenna assembly..... | CRM-69074. |
| Receiver..... | CRM-46153. |
| Rotary converter filter units: | |
| 115 volts D. C..... | CRM-21743. |
| 32 volts D. C..... | CRM-211049. |
| 24 volts D. C..... | CRM-21910. |
| 12 volts D. C..... | CRM-211048. |

Shipping weights and dimensions

| Unit | Height | Width | Depth | Weight | Volume |
|-----------------------------------|---------------|---------------|---------------|---------------|-------------------|
| | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> | <i>Cubic feet</i> |
| Entire equipment in one case..... | 52 | 29 | 21 | 210 | 18.32 |

DAG, DAG-1, AND DAG-2 RADIO DIRECTION-FINDING EQUIPMENTS

Use.—Portable—field.

Frequency range.—Three bands: 1.6–18.2 mc.

Bearing indications.—Aural null.

Signal reception.—CW, MCW.

Antenna collector system.—Plug-in rotatable plain loop and plug-in sense antenna.

Power—Supply required.—Any reasonably pure D. C. of 90 volts at 15 ma., 1.5 volts at 450 ma., and 7.5 volts of “C” bias supply.

Supply provided.—Self-contained batteries, type CBR-19045 “A” and “B” packs and one type CBR-19011 “C” battery. An optional power supply utilizing a vibrator power pack and storage cell, to be contained in the regular battery compartment, is under procurement. Provision has been made to charge the storage cell from either 6 volts D. C. or 110 volts A. C.

Battery life.—Approximately 2 weeks when subjected to intermittent use with a net operating time of 8 hours per day.

Description.—The Models DAG, DAG-1, and DAG-2 are identical high frequency portable direction finders suitable for taking bearings on, or locating radio transmitters of unknown location, or inversely, may be used to determine the location of the direction finder with respect to transmitters, by triangulation. As a communications receiver it may be used for the reception of both CW and amplitude modulated signals.

The equipment, with accessories necessary for operation, is enclosed in an aluminum alloy carrying case with a hinged front cover. Openings, protected by chained caps when not in use, are provided on the top of the case for connection of the plug-in loop and sense antenna. For stowage the antennas are contained on the interior of the cover by means of spring clips. The receiver, constructed on an aluminum alloy chassis, occupies the entire upper section of the case, is secured by means of thumbscrews, and is removable for servicing purposes. The battery power supply is located in the lower left section of the case and is accessible by removal of a panel held in place by thumbscrews. An accessory compartment is provided in the lower right section to contain the phones, magnetic compass, and ground wire with stake. A clip is provided on the loop antenna for mounting the (CXD-10210) compass. The only external connection required is to the ground post located on the front panel.

Frequency bands:

Band (1): 1.6–3.6 mc.

Band (2): 3.6–8.1 mc.

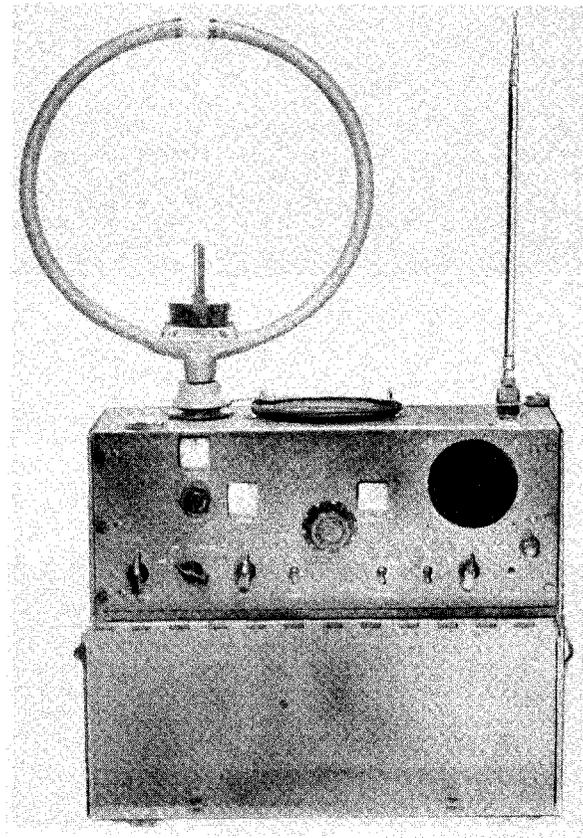
Band (3): 8.1–18.2 mc.

Type of receiver circuit.—Superheterodyne.

Receiver intermediate frequency.—465 kc.

Audio power output.—6 mw (into self-contained permanent magnet dynamic speaker or 600 ohm headphones).

Operating control.—Local.



Model DAG-1 portable radio direction-finding equipment.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|------------------------|-----------------|------|
| Amplifier | 1 | 1T4 |
| Mixer | 1 | 1R5 |
| Oscillator | 1 | 1T4 |
| First I. F. amplifier | 1 | 1T4 |
| Second I. F. amplifier | 1 | 1T4 |
| Second detector | 1 | 1R5 |
| Audio power amplifier | 1 | 1S4 |
| B. F. O. | 1 | 1T4 |
| Total | 8 | |

Dimensions and weights of equipment units included in contract

| Unit | Height | Width | Depth | Weight |
|--|------------|-----------------------|-----------|-----------|
| Equipment contained in carrying case (handle up) | 13½ Inches | 16½ Inches | 7¼ Inches | 32 Pounds |
| Equipment set up: | | | | |
| Sense antenna retracted | 26½ | 16½ | 7¼ | 32 |
| Sense antenna extended | 69½ | 16½ | 7¼ | 32 |
| Sense antenna (detached): | | | | |
| Retracted | 14¾ | ¾ maximum diameter. | | 0.2 |
| Extended | 57¾ | ¾ maximum diameter. | | 0.2 |
| Antenna loop (detached) | 15 | 11½ outside diameter. | | 0.6 |
| Spare parts box | 6 | 9 | 12 | 22 |

Accessories not supplied by contractor.—Headphones (600 ohms impedance).

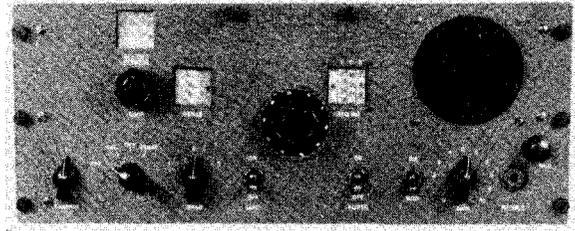
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Type numbers of units of the DAG equipment:

| | |
|--------------------------------|-----------------|
| Unit: | <i>Type No.</i> |
| Receiver in carrying case----- | CIA-46174. |
| Sense antenna----- | CRF-66054. |
| Loop antenna----- | CIA-69077. |
| A and B battery packs----- | CBR-19045. |
| C battery----- | CBR-19011. |

Shipping weights and dimensions

| Contents | Size | Gross weight | Volume |
|---|--|----------------------|--------------------------|
| Complete equipment and spare parts box----- | <i>Inches</i> 13 $\frac{3}{8}$ x 18 $\frac{3}{4}$ x 31 $\frac{1}{16}$ | <i>Pounds</i> 100 | <i>Cubic feet</i> 4.2 |



Receiver panel for the Model DAG-1 portable direction-finding equipment.



DAQ RADIO DIRECTION-FINDING EQUIPMENT

Use.—Ship.

Frequency range.—Four bands: 1.5–22 mc. for bearings; 1.5–30 mc. for reception.

Bearing indications.—Instantaneous, automatic visual null.

Signal reception.—CW, MCW, ICW (simultaneous monitoring).

Antenna collector system.—Fixed crossed loop with goniometer and sense antenna.

Power.—Supply available—115/1/60. Required for starting—0.5 kw. Required for running—0.3 kw. maximum (70 percent power factor). Allowable variation in supply line voltage—± 10 percent, frequency ± 5 percent.

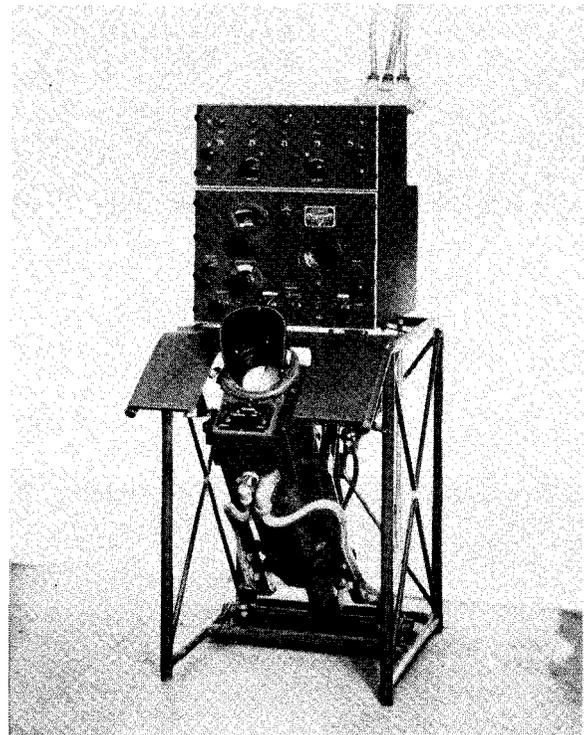
Description.—The Model DAQ employs a self-contained receiving and indicating system intended for installation in the ship radio room or other suitable place, and a crossed loop and sense antenna designed for mounting on the mast. Through the use of a cathode ray tube and motor-driven goniometer this equipment features instantaneous visual bearing indications. The indications are continuous and automatic with simultaneous monitoring of the received signal for CW, MCW, and ICW. Bearings may be obtained as quickly as the various stations are tuned in.

The receiver consists of a fabricated aluminum cabinet equipped with two guide strips on which the aluminum chassis and panel assembly rests. The chassis may be partially withdrawn from the cabinet for inspection of vacuum tubes, or entirely removed by manual disengagement of a stop mechanism provided at either side of this unit. Receptacles are provided at the rear of the chassis for connection to the RF antenna systems, to the bearing indicator system, and to the power line. These receptacles are arranged to project through the rear of the cabinet when the receiver is completely housed.

The rectifier power unit supplies d-c and a-c voltages to the automatic bearing indicator. This unit is of

similar mechanical construction to the receiver and is bolted directly to the top of the receiver cabinet.

The automatic bearing indicator is enclosed in a mechanical housing designed for mounting under the



Rectifier, receiver, automatic bearing indicator and goniometer for Model DAQ direction-finding equipment in operating position.

table on which the receiver and rectifier are located, in such a manner as to maintain the mechanical, optical and electrical parts of the indicator in correct alignment for operation. The bearing indicator assembly includes the following components:

TECHNICAL FEATURES

Design.—Navy.

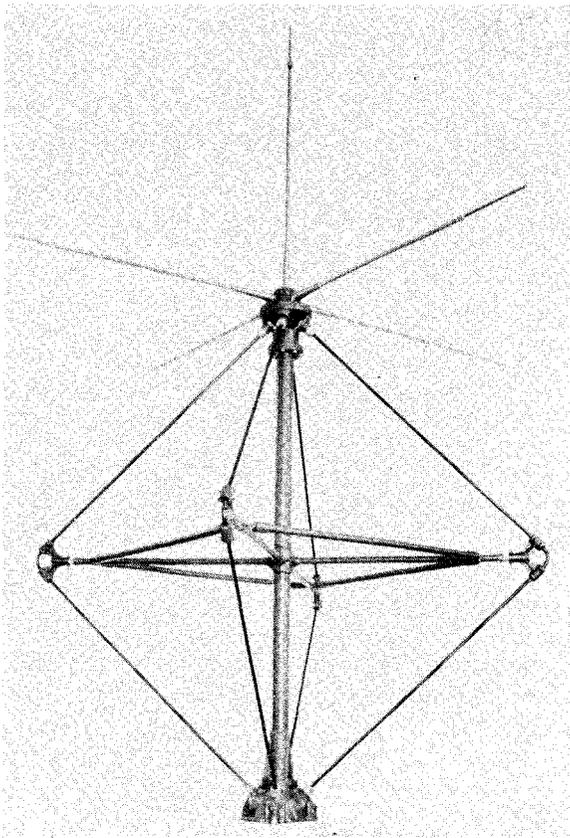
Tube complement

| Location and circuit function | Number of tubes | Type |
|--|-----------------|-----------|
| Receiver: | | |
| First R-F amplifier | 1 | 6SH7 |
| Second R-F amplifier | 1 | 6SK7 |
| Mixer | 1 | 6SA7 |
| First I-F amplifier | 1 | 6SK7 |
| Second I-F amplifier | 1 | 6SK7 |
| Detector and amplifier (A-F channel) | 1 | 6SQ7 |
| AF output | 1 | 6K6GT |
| B. F. Oscillator | 1 | 6SJ7 |
| Detector (indicator channel) | 1 | 6H6 |
| Second I-F (indicator channel) | 1 | 6SK7 |
| Heterodyne oscillator | 1 | 6J5 |
| Sense amplifier | 1 | 6SH7 |
| Rectifier | 1 | 5U4G |
| Voltage regulator | 1 | VR-150-30 |
| Rectifier power unit: | | |
| Deflection amplifier | 1 | 6AC7/1852 |
| Low voltage rectifier | 1 | 6X5GT |
| High voltage rectifier | 1 | 2X2/879 |
| Voltage regulator | 1 | VR-150-30 |
| Automatic bearing indicator: | | |
| Cathode ray tube | 1 | 5BP1 |
| Total | 19 | |
| Target transmitter: | | |
| Oscillator | 1 | 3B7 |
| Audio modulator | 1 | 1R5 |

Over-all sensitivity.—30 microvolts per meter (approx.) for 20 db. signal to noise ratio.

Frequency bands:

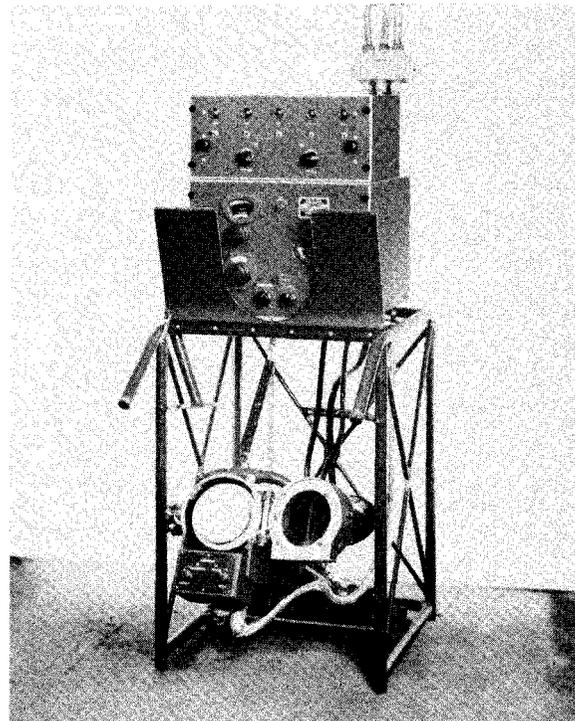
- Band (1): 1.5–3.1 mc.
- Band (2): 3.1–6.6 mc.
- Band (3): 6.6–14.0 mc.
- Band (4): 14.0–30.0 mc.



Collector system and sense antenna for Model DAQ direction-finding equipment.

1. A 1/8 hp. 1140 r. p. m., 3.2 amperes, condenser-starting induction motor which operates from a 110/1/60 power source.
2. A goniometer which is driven by the motor at the motor speed.
3. A set of magnetic deflection coils mounted on a rotating housing which is also driven by the motor. Provision is made for adjusting the relative position of the deflection coils with respect to the motor and goniometer.
4. A cathode ray tube which is positioned inside the rotating deflection coils and their housing.
5. A 360° edge-lighted lucite scale placed around the periphery of the cathode ray tube screen.
6. A control box containing circuits and controls for positioning the image on the cathode ray tube, and for adjusting the intensity and focus.

The *target transmitter* provides a signal at any required frequency within the range of the DAQ equipment, and is designed for spot testing the functioning of the equipment in the field. The transmitter consists of a welded sheet steel chassis and front panel on which all the components including the battery power supply are mounted. This chassis slides into a waterproof welded sheet steel cabinet. A ceramic insulator on top of the cabinet supports the antenna rod. A carrying handle on one side and cushioned feet on the bottom are provided for portability.



Rectifier, receiver, automatic bearing indicator and goniometer for Model DAQ direction finding equipment in folded position.

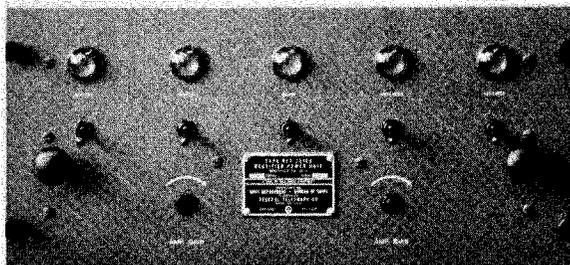
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An overlap between bands of approximately 5 percent (of nominal frequency) is provided, and the frequency calibrated scales are accurate to within 1 percent of the indicated values.

Type of receiver circuit.—Superheterodyne.

Receiver intermediate frequency.—455 kc.

Audio output power.—1.5 watts maximum undistorted, into a 4-ohm loudspeaker; 100 mw., maximum, undistorted, into a 600-ohm headphone.

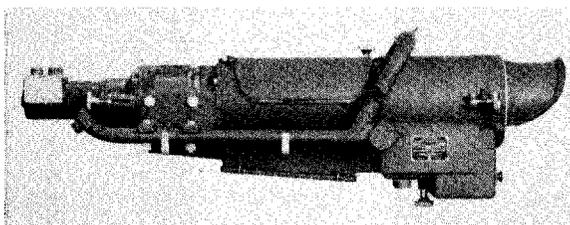


Type CFT-20169 Rectifier power unit for Model DAQ direction-finding equipment.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|--|---------------|----------------------------------|--------------------------------|---------------------------------|---------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Crossed loop and sense antenna assembly | CFT-69083 | 140 ³ / ₄ | 73 | 52 | 95 |
| Loop antenna | | (120-inch diameter circle swing) | | | |
| Control assembly units: | | | | | |
| Rectifier power unit | CFT-20169 | 8 ³ / ₄ | 19 | 13 ³ / ₄ | 45 |
| Receiver | CFT-46194 | 15 | 19 | 20 ⁵ / ₁₆ | 97 |
| Automatic bearing indicator (goniometer mounted) | CFT-55092 | 15 | 15 ¹ / ₈ | 45 | 95 |
| Automatic bearing indicator | | 15 | 15 ¹ / ₈ | 37 ⁵ / ₈ | 91.5 |
| Goniometer | CFT-47263 | 49 ¹ / ₁₆ | 5 ¹ / ₁₆ | 8 ¹ / ₈ | 3.5 |
| Junction box | | Three 100' cables on reel | | | |
| Transmission line assembly | | | | | |
| Interconnecting cables for equipment table | | 40 | 24 | 23 ¹ / ₂ | 85 |
| Equipment table | | | | | 26 |
| Operator's chair | | 13 | 25 | 10 | 15 |
| Spare parts | | | | | |
| Test equipment and tools: | | | | | |
| Target transmitter | CFT-52300 | 74 ³ / ₄ | 8 ³ / ₄ | 10 ³ / ₄ | 20 |
| Demagnetizer | NLA-42970-3 | 3 ¹ / ₂ | 13 ¹ / ₂ | 2 | 1 |
| Spanner | | 2 | 4 | 2 | .25 |
| Test plug assembly | | 4 | 7 | 1 | .50 |
| Test lead assembly | | | | | 7.50 |
| Test cable assembly | | | | | |
| Pint Univis No. 40 oil | | 5 ¹ / ₂ | 8 ¹ / ₂ | 3 ¹ / ₂ | 2.00 |
| Allen wrench No. 10 | | | | | .50 |
| Bakelite screwdriver | | | | | |

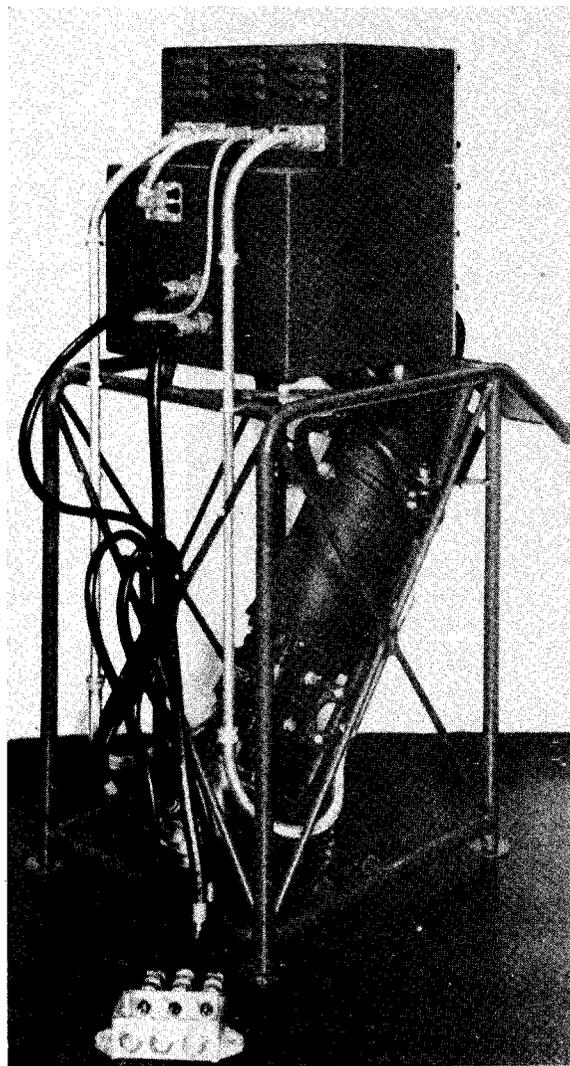
Accessories not supplied by contractor.—Loudspeaker with volume level control, headphones.



Type CFT-55092 automatic indicator unit and goniometer of the Model DAQ direction-finding equipment.

Operating control.—Remote from antenna collector system.

Installation requirements.—A clearance of 4 inches at the back and sides of the control assembly and a minimum ceiling height of approximately 74 inches. The operator's chair requires floor space at least 2 feet 8 inches square.



Direction-finding equipment of the Model DAQ showing coaxial cable (rear view).

Shipping weights and dimensions

| Crate No. | Unit | Size | Gross weight | Volume |
|-----------|--|---------------|---------------|---------------|
| | | <i>Inches</i> | <i>Pounds</i> | <i>Cu.ft.</i> |
| 1 | Antenna and loop | 76 x 56 x 56 | 460 | 140 |
| 2 | Rectifier power unit and radio receiver | 31 x 29 x 37 | 280 | 20 |
| 3 | Equipment table, indicator, and goniometer | 45 x 28 x 38 | 335 | 28 |
| 4 | Chair | 25 x 25 x 19 | 60 | 8 |
| 5 | Tools and test equipment | 49 x 23 x 26 | 260 | 17 |
| 6 | Tubes and accessories | 30 x 19 x 28 | 80 | 9 |
| 7 | Transmission lines | 26 x 18 | 200 | 15 |

DP-12, DP-13, DP-18, AND DP-19 RADIO DIRECTION-FINDING EQUIPMENTS

Use.—Ship.

Frequency range.—100–1500 kc.

Bearing indications.—Aural null.

Signal reception.—CW, MCW.

Antenna collector system.—Rotatable loop and fixed position sense antenna.

Power.—Supply required—115/1/50/60.

Description.—The various DP series equipments have been designed for both shore and shipboard use. The receiver is similar to that used in the DQ series equipments, incorporating the same feature of unicontrol. By this feature, the loop circuit, antenna circuit, RF amplifier, and RF oscillator are all adjusted and tracked so as to tune simultaneously by means of one panel control. The models DP-12/13 differ from previous models of DP direction-finding equipments in that the receiver incorporates an antenna input protective relay and neon protective device. The relay is equipped with contacts which ground the antenna input

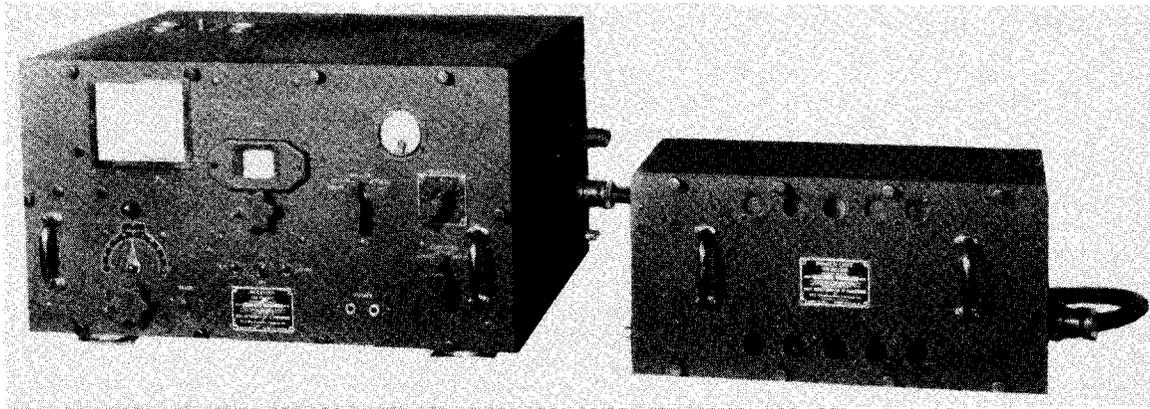
and azimuth scale are mounted is designed so that it may be operated either in an inverted or upright position. This unit and the loop antenna pedestal may be located in the following different positions with respect to one another:

1. Both pedestals on the same deck with the cable drums and drive cables beneath deck.

2. The loop pedestal may be located on the deck overhead or on a platform elevated above the deck on which the operating pedestal is located. A cable drive permits location of the two pedestals at some horizontal distance off axial symmetry, within the limits of non-obstruction to the cable drive.

The deck bearing supplied is always required on the upper or lower end of the drive shaft of the operating pedestal when an installation is made under one of the above conditions.

The receiver design is such that the front panel and chassis may be withdrawn from the cabinet for servicing



Power unit and receiver for Model DP direction-finding equipment.

circuit when the receiver is not in use. The neon protective device bypasses high voltages which may be induced from nearby transmitting antennas when the receiver is in operation. An electric output indicator also has been incorporated to aid in taking bearings on CW signals. The models DP-12 and DP-13 differ only in that two deck bearings and eight deck cribs are furnished for the DP-12, while the DP-13 incorporates one deck bearing and six deck cribs. The models DP-18 and DP-19 are identical, respectively, to the models DP-12 and DP-13.

The equipment *antenna loop assembly* is designed to be mounted as near the keel line as possible with maximum distance from all metallic obstructions. This unit is constructed essentially of nonmagnetic materials and may be placed within 6 feet of the ship's magnetic compass without necessitating the checking of the compass after installation.

The *operating pedestal* on which the loop drive wheel

purposes. This unit is designed to be mounted on a table or desk to the right of the hand wheel and azimuth scale of the operating pedestal.

A *shielded transmission line, loop output box, and receiver input transformer* are supplied for connection between the loop antenna and receiver.

The *power unit*, connected to the receiver by means of an 82-inch cable, may be located on a shelf or suspended beneath the top of the table or desk on which the receiver is mounted. A clearance of approximately 6 inches should be left at the right hand end of the unit for convenience in removing the power cord and plug.

The receiver is designed to operate with a single wire *sense antenna* of 7-strand, No. 18 antenna wire. A vertical antenna is to be preferred and should be as long as practicable, providing the capacity to ground, including the lead-in wire, is between 140 and 500 mmfd. The sense antenna should be spaced at least 4 feet from the loop.

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TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location and function | Number of tubes | Type |
|--------------------------|-----------------|--------|
| Receiver: | | |
| R-F amplifier | 1 | 6D6 |
| First detector | 1 | 6D6 |
| R-F oscillator | 1 | 6C6 |
| First I-F amplifier | 1 | 6D6 |
| Second I-F amplifier | 1 | 6D6 |
| Second detector | 1 | 76 |
| I-F oscillator | 1 | 6C6 |
| First A-F amplifier | 1 | 6C6 |
| Second A-F amplifier | 1 | 76 |
| Electronic Indicator Amp | 1 | 6C6 |
| Electronic Indicator | 1 | 6AF6-G |
| Power unit: Rectifier | 1 | 5Z3 |
| Total | 12 | |

Over-all sensitivity.—Approximately 1 microvolt for standard 6 milliwatt output (across 600 ohm load).

Frequency bands.—Band (1) 100–250 kc.; band (2) 250–550 kc.; band (3) 550–1500 kc.

Type of receiver circuit.—Superheterodyne.

Receiver intermediate frequency.—81.5 kc.

Audio output power.—6 milliwatts (across 600 ohm load).

Operating control.—Semi-remote.

Weights and dimensions of equipment units included in contract.—The installation of the loop assembly and operating pedestal may vary considerably with different installations; the figures given for these units are only approximate.

| Unit | Height | Width | Depth | Diameter | Weight |
|--|---------------|---------------|---------------|---------------|---------------|
| Loop and pedestal assembly: | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Over-all | 77 | | | | 66 |
| Above deck | 50 | | | | |
| Loop | | | | 22½ | |
| Operating pedestal assembly (with handwheel, azimuth scale, deck cribs): | | | | | |
| Inverted mounting | 38¼ | | | | 46 |
| Upright mounting | 27 | | | | 46 |
| Handwheel | | | | 15 | |
| Deck cribs | | | | 14 | |
| Deck bearing | 7¼ | | | 14 | |
| Receiver | 14¼ | 29¾ | 17¾ | | 93 |
| Cable drum | | | | | 13 |
| Power unit | 9¾ | 24 | 8¾ | | 35 |

Shipping weights and dimensions

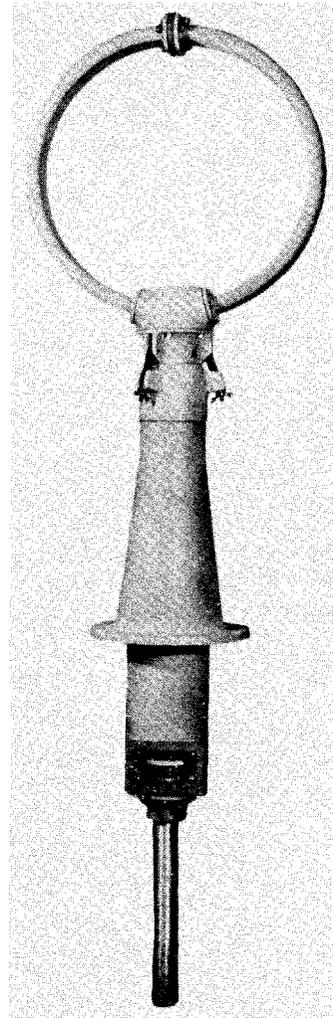
| Case | Unit | Height | Width | Depth | Gross weight | Volume |
|------|--------------------------------------|---------------|---------------|---------------|---------------|-------------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> | <i>Cubic feet</i> |
| 1 | Receiver | 35 | 28½ | 20¼ | 181 | 11.6 |
| 2 | Power unit | 25¼ | 16½ | 15½ | 69 | 3.6 |
| 3 | Loop assembly and accessories | 31½ | 26¾ | 7½ | 65 | 3.56 |
| 4 | Loop and pedestal accessories | 56 | 17¾ | 19 | 173 | 10.82 |
| 5 | Operational pedestal and accessories | 35¼ | 17 | 14½ | 80 | 4.92 |
| 6 | Vacuum tubes | 15 | 10¾ | 8¾ | 10 | .81 |
| 7 | Spare parts box | 18¼ | 14½ | 11 | 35 | 1.68 |
| 8 | Vacuum tube spares | 15 | 10¾ | 8¾ | 10 | .81 |

Accessories not supplied by contractor:

Headphones (600 ohms), 1 or 2 sets.

Receiver cable to azimuth scale lamp.

Remote control drive cable, accessories, and hardware.



Antenna for Model DP.

Type numbers of the major units of the DP-12/13/18/19 equipments:

| Unit: | Type No. |
|-------------------------------|--------------|
| Loop assembly | CRV-69046. |
| Loop pedestal | CRV-69047. |
| Handwheel | CRV-69012-A. |
| Azimuth scale | CRV-69013. |
| Operating pedestal | CRV-69011. |
| Deck bearings | CRV-69008. |
| Cable drums | CRV-69009. |
| Receiver | CRV-46136. |
| Power unit | CRV-20049. |
| Loop output junction box | CRV-62029. |
| Receiver input transformer | CRV-47180. |
| Transmission line and conduit | CRV-62030. |

DQ-5 AND DQ-6 RADIO DIRECTION-FINDING EQUIPMENTS

Use.—Submarine.

Frequency range.—100–1500 kc. (3 bands).

Bearing indications.—Aural null.

Signal reception.—CW, MCW.

Antenna collector system.—Rotatable loop and fixed position sense antenna.

Power.—*Supply required*—115/1/60. *Consumption (current)*—0.5 ampere.

Description.—The Models DQ-5/6 direction-finding equipments feature uni-control. The loop circuit and associated coupling transformers and line loading, antenna circuit, RF amplifier, and RF oscillator are all adjusted and tracked so as to tune simultaneously by means of one panel control located on the receiver unit.

The Models DQ-5 and DQ-6 differ in that the DQ-5 loop and receiver are coupled by means of a transformer, both within the loop and receiver, while the Model DQ-6 omits the transformer incorporated in the loop and slight modifications are made to the transformer located in the receiver. The type CRV-46093 and CRV-46146 receivers employed respectively by the DQ-5 and DQ-6 are otherwise similar. Later models of the DQ-6 employ a type CRV-46146-A receiver which incorporates an electronic output indicator tube to provide visual indication of CW signal levels.

The equipment *antenna loop assembly* is designed to be mounted as near the keel line as possible with maximum distance provided from all metallic obstructions. This unit is constructed essentially of nonmagnetic materials and its placement within 6 feet of the ship's magnetic compass will not require the checking of the compass after installation. The loop location should also permit the convenient installation and operation of the azimuth scale, collector ring, and handwheel below deck.

The front panel and chassis of the *receiver* may be withdrawn from the cabinet for servicing purposes. This unit is designed to be mounted on a table or desk to the right of the handwheel and azimuth scale. The location of the receiver is fixed in respect to the loop antenna by the length of the RF interconnecting cable furnished in 60- or 66-inch lengths.

The *power unit*, connected to the receiver by means of a 60-inch cable may be located on a shelf or suspended beneath the top of the table or desk on which the receiver is mounted.

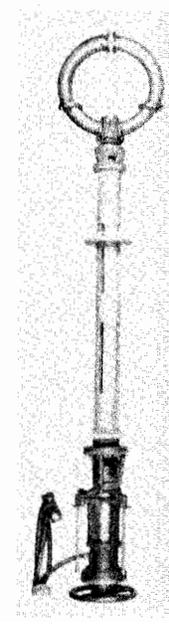
The receiver is nominally designed to operate with a *sense antenna* of 200 mmfds. capacity, 10-ohms resistance, an inductance of 20 microhenries, and having an effective height of 2 meters. Means of compensation is provided within the receiver which will permit the actual capacity to vary between limits of 150–500 mmfds.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location and function | Number of tubes | Type |
|---|-----------------|--------|
| Receiver: | | |
| RF amplifier..... | 1 | 6D6 |
| First detector..... | 1 | 6D6 |
| RF oscillator..... | 1 | 6C6 |
| First IF amplifier..... | 1 | 6D6 |
| Second IF amplifier..... | 1 | 6D6 |
| Second detector..... | 1 | 76 |
| IF oscillator..... | 1 | 6C6 |
| First AF amplifier..... | 1 | 6C6 |
| Second AF amplifier..... | 1 | 76 |
| CRV-46146-A (only) electronic ind. amplifier..... | 1 | 6C6 |
| CRV-46146-A (only) electronic ind..... | 1 | 6AF6-g |
| Power supply: Rectifier..... | 1 | 5Z3 |
| Total..... | 12 | |



Antenna for Model DQ.

Over-all sensitivity.—Approximately 1 microvolt for standard 6 milliwatt output across 600-ohm load.

Frequency bands:

Band 1—100–250 kc.

Band 2—250–550 kc.

Band 3—550–1500 kc.

Type of receiver circuit.—Superheterodyne.

Receiver intermediate frequency.—81.5 kc.

Audio output power.—6 milliwatts across 600-ohm load.

Operating control.—Local.

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Weights and dimensions of equipment units included in contract

| Unit | Height | Width | Depth | Diameter | Weight |
|--|---------------|---------------|---------------|---------------|---------------|
| | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Loop assembly..... | | | | 2 3/4 | 184 |
| Collector ring assembly (including loop-receiver cable)..... | | | | | 49 |
| Receiver..... | 14 1/4 | 29 3/8 | 18 3/4 | | 94 |
| Power unit..... | 8 7/8 | 24 | 9 3/8 | | 35 |
| Spare parts..... | | | | | |

Accessories not supplied by contractor.—Headphones, 600-ohms—1 or 2 sets. Miscellaneous hardware.

Type numbers of the units of the DQ-5/6 equipments

| Unit | DQ-5 type Nos. | DQ-6 type Nos. |
|--|------------------|------------------------------|
| Loop assembly..... | CRV-69051..... | CRV-69073. |
| Pressure hull fitting..... | CRV-69016-A..... | CRV-69016-A. |
| Collector ring assembly (including loop-receiver cable)..... | CRV-69017-A..... | CRV-69017-A. |
| Receiver..... | CRV-46093..... | CRV-46146 or CRV-46146-A. |
| Power unit..... | CRV-20049..... | CRV-20049. |

Shipping weights and dimensions.—Data will be supplied when available.

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Section II

RADIO TRANSMITTING-RECEIVING EQUIPMENTS

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MAB AND MP (MU, MV, MW, AND MX) RADIO TRANSMITTING-RECEIVING EQUIPMENTS

Use.—Paratroops.

Frequency range.—Transmitting and receiving on any one pretuned channel within the following ranges. MP—2300–2800 kc., 2800–3300 kc., 3300–3900 kc., or 3900–4600 kc. MU—2300–2800 kc. (red identification disc). MV—2800–3300 kc. (white identification disc). MW—3300–3900 kc. (blue identification disc). MX—3900–4600 kc. (green identification disc). MAB—2300–4600 kc.

Power output and emission.—0.2 watt, A₃.

Description.—These equipments are designed for use by paratroopers and others requiring two-way telephone communication equipment of maximum operational simplicity, extreme compactness and minimum weight.

The series was originally designated MP, but was later re-designated MU, MV, MW, MX, according to the frequency range covered by the individual model. The MAB covers the entire frequency range of the series. A chicken-leg band on the antenna indicates the frequency range of the MP series, and a colored disc on the top of the case indicates the frequency range of the MU, MV, MW, MX.

The *transmitter-receiver unit* and the power pack fit into a water-tight molded hard rubber or phenolic case. These cases are fitted with matching covers which are equipped with water-tight connector plugs for microphone and antenna connections. The complete unit is designed to be carried in a canvas case as a pack load on the back or chest or in a thigh pocket of the operator. The antenna, connected to the transmitter-receiver unit by a 28½-inch rubber covered cord and breakaway connector, may be carried in a pocket on the back of a paratrooper's uniform, or in a pocket provided on the side of the canvas case when the case is used. The microphone, equipped with a press-to-talk button, and the headphones are connected to the transmitter-receiver unit by means of a rubber covered cable 36 inches long. The "ON-OFF" switch for the equipment is located in this cable. This switch and the press-to-talk button in the microphone are the only controls necessary for the operation of this equipment. The microphone may be suspended about the neck or carried in the breast pocket and the headphones are designed to fit inside the paratrooper's shock helmet.

The *transmitter-receiver unit* is constructed on a small aluminum chassis with the receiver components along one side and the transmitter components on the other. The receiver uses a superheterodyne circuit with crystal control and the transmitter employs a crystal oscillator and power amplifier arrangement in conjunction with a Heising modulator. For maximum simplicity of operation, no meters or exterior controls are provided, and all models are pretuned by screw-driver adjustment.

The *battery pack* supplies power for operation of the transmitter-receiver unit over a period of approximately

10 hours based on a transmission cycle of 2 minutes on and 4 minutes off. The vibrator power pack and the lead-acid wet battery form an assembly of the same dimensions and have the same service life as the battery pack. They are intended for operation where climatic conditions render the dry batteries unsuitable. Both types of power supply furnish 250 ma. at 1.35 volts



Model MP, MAB transmitting equipment, assembled for operation.

30 ma. at 5.5 volts, 2 ma. at 67.5 volts and 14 ma. at 130 volts under load conditions.

The *antenna* consists of seven sections of concentric collapsible brass tubing finished with green lacquer. It collapses into a fibre tube which forms the handle around which is wound the loading coil. A rubber protector covering the antenna coil protects it from mechanical injury. A single breakaway plug connects the antenna lead to the transmitter-receiver unit.

An *alignment oscillator* and a field strength meter are available for tuning the equipment

MAB
MP
MU
MV
MW
MX

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TECHNICAL FEATURES

Design.—Navy.

Tube complement.

MP

| Location | Number of tubes | Type |
|------------------------------------|-----------------|------|
| Mixer | 1 | 1R5 |
| IF amplifier | 1 | 1T4 |
| Detector and first audio amplifier | 1 | 1S5 |
| Audio output | 1 | 1S4 |
| RF oscillator | 1 | 1T4 |
| Power amplifier | 1 | 1S4 |
| Modulator | 1 | 1S4 |
| Total | 7 | |

MU, MV, MW, MX, MAB

| Location | Number of tubes | Type |
|------------------------------------|-----------------|------|
| Mixer | 1 | 1R5 |
| IF amplifier | 1 | 1T4 |
| Detector and first audio amplifier | 1 | 1S5 |
| Audio output | 1 | 3S4 |
| RF oscillator | 1 | 1T4 |
| Power amplifier | 1 | 3S4 |
| Modulator | 1 | 3S4 |
| Total | 7 | |

Frequency control.—Crystal.

Power supplies available.—Dry battery pack. Vibrator pack powered by 6-volt wet battery.

Operating control.—“ON-OFF” switch in microphone cord.

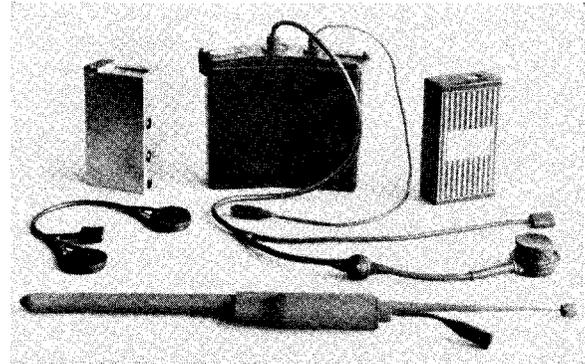
Carrier control.—Push-to-talk button on microphone.

Receiver sensitivity.—15 microvolts per meter for satisfactory response.

Receiver output.—600-ohm headphone circuit.

Operating range.—Approximately 1 mile when used on the ground; greater on aircraft.

Antenna.—Seven collapsible telescoping sections of concentric tubing; loading coil mounted in the handle.



Components of Model MAB transmitting-receiving equipment.

Weights and dimensions of equipment units included in contract

| Unit | Height | Width | Depth | Weight |
|--------------------------------|--------|-------|-------|--------|
| Transmitter receiver | 6½ | 3¾ | 2 | 1.19 |
| Dry battery pack | 6¾ | 3¼ | 1½ | 2.00 |
| Vibrator pack with wet-battery | 6¾ | 3¼ | 1½ | 4.00 |
| Head-set assembly | | | | .38 |
| Microphone and cover assembly | | | | 1.00 |
| Transmitter-receiver case | 9 | 3 | 7½ | 1.44 |
| Canvas carrying case | | | | |
| Antenna (collapsed) | 15 | | | .75 |
| Antenna (extended) | 83¾ | | | |

Navy type numbers

| | MU | MV | MW | MX | MAB |
|-------------------------------|-----------|-----------|-----------|-----------|-----------|
| Transmitter-receiver | CCI-43029 | CCI-43030 | CCI-43031 | CCI-43032 | CCI-43035 |
| Battery pack | CBR-19027 | CBR-19027 | CBR-19027 | CBR-19027 | -19027. A |
| Vibrator power unit | | | | | CRF-20221 |
| Lead-acid storage battery | | | | | -19046 |
| Rubber case | CGN-10133 | CGN-10133 | CGN-10133 | CGN-10133 | |
| Plastic case | | | | | CZF-10162 |
| Head-set assembly | CCI-49214 | CCI-49214 | CCI-49214 | CCI-49214 | CCI-49214 |
| Microphone and cover assembly | CCI-51041 | CCI-51041 | CCI-51041 | CCI-51041 | CCI-51048 |
| Antenna assembly | CCI-66068 | CCI-66069 | CCI-66072 | CCI-66074 | CCI-66081 |
| | | CCI-66070 | CCI-66073 | CCI-66075 | |
| | | CCI-66071 | | CCI-66076 | |
| | | | | CCI-66077 | |

Shipping weights and dimensions.—These equipments are generally shipped in quantity to the Marine Corps Quartermaster for distribution. A typical example of a shipment of 10 equipments follows:

10 complete equipments (less spare batteries and field strength meter) packed two in a box..... Pounds 90

40 spare batteries packed in 2 boxes..... 84

Total gross weight..... 174

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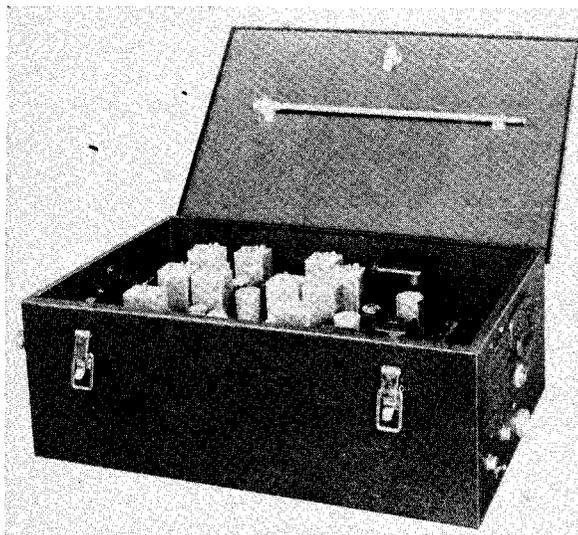
MN-1, MN-2, AND MN-3 RADIO TRANSMITTING-RECEIVING EQUIPMENTS

Use.—Ship-shore.

Frequency range.—30 to 42 mc.

Power required for operation.—115 volts, 50 to 60-cycle single phase 90 watts a. c., or 6 volts 11 amperes d. c.

Description.—The Models MN-1, -2, -3 Radio Equipments are intended to fulfill the need for portable short range, frequency modulated radio telephone communication equipment that can operate on either 115 volts, 50 to 60-cycle, single phase a. c. or 6 volts d. c. The equipment consists of a complete transmitting and receiving system, housed in a weatherproof metal box arranged for convenient handling. Under normal conditions the range of the equipment is approximately 10 miles. Slight variations in the physical make up of the container, constitute the only difference in the three models.



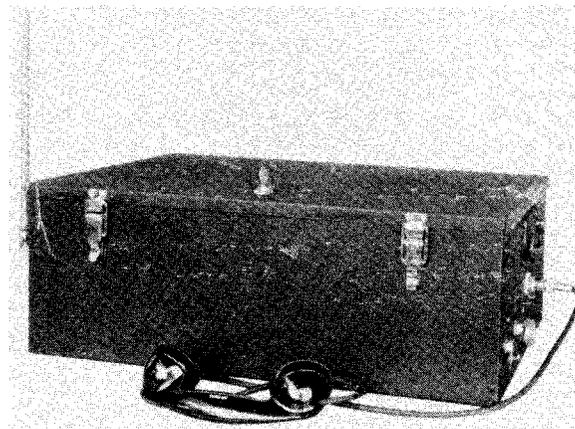
Radio transmitter-receiver MN-1—cover open.

The transmitter part of the equipment utilizes direct crystal control and the phase shift type of modulation. Four low power receiving type tubes are used. The crystal is a low drift quartz plate in a fixed gap holder mounted by means of banana plug pins spaced on 3/4-inch centers. The crystals are AT cut and calibrated at 25° C. with a tolerance of ±0.02 percent from -30° C. to 50° C. The crystal frequency is multiplied 32 times in order to obtain the final operating frequency. The phase shift method of modulation permits both direct crystal control of the carrier frequency and a simple circuit design with no critical tuning adjustments. It is designed for a maximum frequency deviation of ± 15 kc. in its operating range. A multi-contact metering jack and a special test meter permit taking grid current readings in each stage of the transmitter for convenience in making tuning adjustments.

The receiver portion is an 11-tube crystal controlled,

single frequency, frequency modulation superheterodyne receiver designed particularly for the reception of frequency-modulated signals of the type generated by the Models MN-1, -2, -3 transmitters. Two quartz crystals are employed to insure stable receiving conditions under variations of temperature and humidity as well as under the severe vibration encountered in Naval service. The double I. F. system makes possible excellent band pass characteristics with a very favorable image ratio. The same multicontact jack and test meter used for tuning the transmitter are used to read grid currents in the first and second limiters as well as the balance of the discriminator or frequency modulation detector circuit.

The power supply of the radio transmitter-receivers is of the conventional full wave rectifier type utilizing a high vacuum rectifier type tube operating from a high voltage transformer. A nonsynchronous vibrator provides operation from 6 volts d. c. through the same



Radio transmitter-receiver MN-1—operating position.

power and filter components by transferring the power changeover switches from a. c. to d. c. Sufficient filtering is incorporated in the power supply to provide hum-free direct current for the plates and screens of all tubes. The same power supply is used alternately for both the transmitter and the receiver and is switched from one to the other by the antenna transfer relay.

The handset provided with each equipment is a standard telephone type push-to-talk handset and is supplied complete with waterproof cord and plug. The output of the receiver is connected to the earphone of the handset to provide complete communication facilities to the operator with the handset, even when out of audible range of the loudspeaker. The non-locking push-to-talk button is used to energize the transmitter when talking. The speaker provided is a 6-inch waterproof permanent magnet cover type.

The ship antenna is a six section collapsible antenna designed especially for use with this equipment. Its extended length is 6 feet 11 inches or approximately

MN-1
 MN-2
 MN-3

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one-quarter wave length for the frequency range of 30 to 42 megacycles. Its collapsed length is only 18 inches to facilitate storage within the weatherproof equipment case. Its base is terminated with a fitting to match the antenna base mounted on the equipment case.

A test meter unit type 1410 is provided for the purpose of facilitating alignment, service, and field testing. It is so arranged that all meter readings may be taken on the radio transmitter receiver unit, when tests are to be made, by means of a single multiconductor test cord and plug attached to the meter unit. A selector switch mounted on the meter panel makes it possible to select and read the current in any of the several circuits metered. An additional set of test leads is supplied and may be used for circuit and voltage tests.

The radio transmitter receiver unit is contained in a weatherproof case, provided with a shock mounting base as well as all accessory equipment necessary for complete operation.

TECHNICAL FEATURES

Type of receiver.—Crystal controlled, single frequency, frequency modulated, superheterodyne.

Type of transmitter.—Crystal controlled, phase shift type of modulation.

Type of reception and transmission.—Voice.

Power output.—(Transmitter) 0-2 watts.

Power output.—(Receiver) 1 watt maximum.

Sensitivity.—(Receiver) ½ microvolt or better.

Transmitter output impedance.—30-100 ohms into concentric transmission line.

Receiver output impedance.—8 ohms.

Tube complement

| Function | Number of tubes | Type |
|--|-----------------|--------|
| Receiver: | | |
| RF amplifier..... | 1 | 6K7 |
| First detector..... | 1 | 6K8 |
| Crystal oscillator-multiplier..... | 1 | 6V6GT |
| IF amplifier..... | 1 | 6SG7 |
| Second detector: Crystal Oscillator..... | 1 | 6K8 |
| First limiter..... | 1 | 6SJ7 |
| Second limiter..... | 1 | 6AC7 |
| Discriminator..... | 1 | 6H6 |
| Squelch rectifier..... | 1 | 6H6 |
| First audio, squelch..... | 1 | 6SL7GT |
| Audio output..... | 1 | 6V6GT |
| Transmitter: | | |
| Crystal oscillator: Phase Modulator..... | 1 | 6SL7GT |
| First quadrupler..... | 1 | 6AC7 |
| Second quadrupler..... | 1 | 6V6GT |
| doubler and power amplifier..... | 1 | 6V6GT |
| Power supply: | | |
| Rectifier..... | 1 | 6X5GT |
| Total..... | 16 | |

Type of signal.—Frequency modulated.

Frequency deviation.—± 15 kc.

Audio response.—± 1.5 db 300-2,750 c. p. s. 30 db. 3,500 c. p. s. and above.

Weights, dimensions, and Navy type numbers of equipment units

| Unit | Type No. | Height | Width | Depth | Weight |
|---------------------------|----------------|---------------|---------------|---------------|---------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Transmitter-receiver..... | CFL-43034..... | 9 | 12 | 19¾ | 38 |
| Handset complete..... | CW-51032..... | | | | 2 |
| Whip antenna..... | CFL-66080..... | | | | 0.5 |
| Weatherproof case..... | 1410..... | 8½ | 14½ | 24½ | 29 |
| Test meter..... | | | | | |

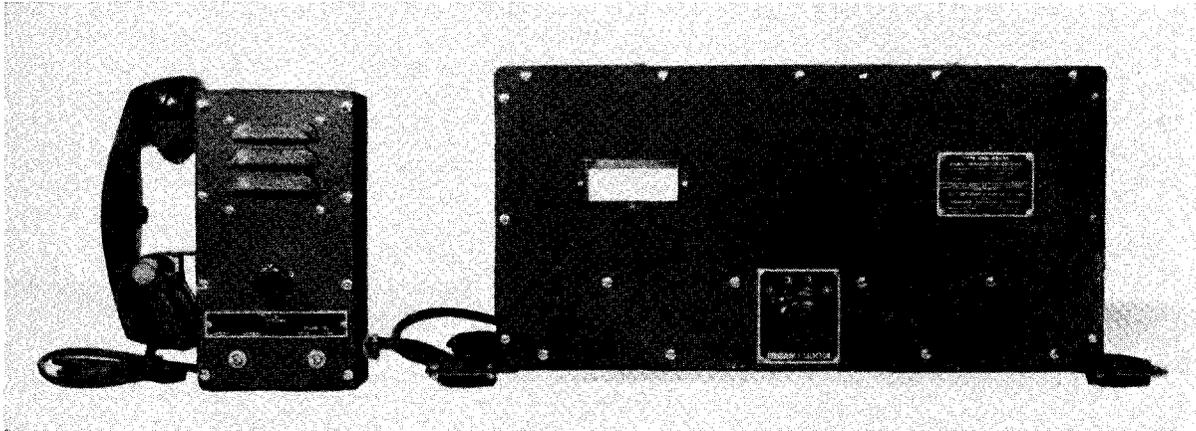
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MQ AND MQ-1 RADIO TRANSMITTING-RECEIVING EQUIPMENTS

Use.—Ship.**Frequency range.**—Transmitter, 2000–3500 kc. (four pretuned channels). Receiver, 2000–3500 kc. (four pretuned channels).**Power output.**—5 watts. (See Antenna under Technical Features.)**Emission.**—A₃.**Description.**—The models MQ and MQ-1 are medium frequency, low power radio telephone equipments designed primarily for two-way communication aboard ship. The equipments consist essentially of two units, a transmitter-receiver with self-contained vibrapack power supplies and a remote control unit. Provision is made so that at a future date a selective ringer may be employed to enable a local coastal harbor station to ring a bell aboard the ship on which the equipment is installed.

The model MQ-1 differs from the model MQ primarily in that the MQ-1 designation includes equip-

the receiver antenna R-F transformer may be removed if a noise-balancer (such as "Whisk noise-balancer type D" as used by U. S. Coast Guard) is employed. The noise-balancer leads may be brought into the rear of the chassis through a hole provided at the back of the cabinet directly behind the link. The remote control unit cable plugs into an octal socket on the right side of the cabinet directly behind the front panel. The equipment is supplied with a dummy octal plug for the selective ringer socket which is also located on the right side of the cabinet towards the back of the cabinet. A four position frequency selector switch is the only adjustable control on the front panel. A calibration card indicates the position to which the frequency selector switch must be set for any one of the four available frequencies.

Each equipment employs two *self-rectifying vibrapacks*. All power is supplied to the receiver through the use of one vibrapack. This vibrapack also supplies

Radio Transmitter-receiver MQ-1.

ment for 12-volt d. c. operation as well as equipment for 6-volt d. c. operation. The later model also incorporates various design improvements—the transmitter-receiver unit is nonradiating and a transmitter filament on-off switch has been provided on the remote control unit. The MQ-1 12-volt d. c. equipment is similar to the Coast Guard TRC-120. Model MQ-2, described separately in this catalog, differs considerably from both the MQ and MQ-1.

The *transmitter-receiver components* are mounted on a steel chassis which is permanently fastened to the front panel. The front panel is attached to a steel cabinet by means of screws. A hinged lid provides access to the interior of the cabinet for installation or servicing of the various parts. The lid is equipped with two thumb screws along the front edge so that it may be held in position when closed. Rubber shock mounts are provided at the bottom corners of the cabinet. The antenna and ground terminals are located at the top rear center of the chassis. The antenna and ground wires connect to these terminals through openings in the back of the cabinet. A link attached to the top of

transmitter oscillator screen and plate power and transmitter power amplifier plate power. The second vibrapack which only operates when the press-to-talk button is pressed, supplies transmitter modulator plate and screen and power amplifier screen power.

The *remote control unit* components, including a built-in permanent magnet type loudspeaker, are contained in a compact steel cabinet. Through the use of this unit the operator has complete control of the equipment after the station selector switch has been placed in the desired position on the transmitter-receiver cabinet. The MQ remote control unit front panel controls include a receiver volume control and on-off switch and a speaker phone switch. In addition to the above controls the MQ-1 incorporates a transmitter filament on-off switch. A handset cradle and handset are provided on the front of the MQ unit and on the side of the MQ-1 unit. The radio transmitter components are completely disconnected and require no power when standing by to receive calls. Removal of the handset from the cradle automatically energizes the transmitter within a period of approximately 15

seconds. However, with the MQ-1 remote control units, the transmitter filament on-off switch provides a means whereby the vacuum tube heaters may be left on when the handset is in the cradle if so desired, so that no waiting time will be required in order to answer an incoming call. The remote control unit is equipped with a 20-foot, seven conductor shielded and rubber covered cable and octal plug for connecting to the transmitter-receiver cabinet.

TECHNICAL FEATURES

Design.—Commercial.

Tube complement.—MQ equipment.

| Function | Number of tubes | Type |
|--|-----------------|------|
| Transmitter oscillator | 1 | 6V6G |
| Transmitter modulators | 2 | 6V6G |
| Transmitter power amplifier | 1 | 6L6G |
| Receiver mixer crystal oscillator | 1 | 6D8G |
| Receiver intermediate amplifier | 1 | 6S7G |
| Receiver second detector and AVC first audio | 1 | 6T7G |
| Second audio amplifier | 1 | 6G6G |
| Total | 8 | |

Tube complement.—MQ-1 equipment.

| Function | Number of tubes | Type |
|--|-----------------|---------|
| Transmitter oscillator | 1 | 6V6GT/G |
| Transmitter modulators | 2 | 6V6GT/G |
| Transmitter power amplifier | 1 | 6L6G |
| Receiver R-F amplifier | 1 | 6SS7 |
| Receiver I-F amplifier | 1 | 6SS7 |
| Receiver converter | 1 | 6K8 |
| Receiver diode detector, AVC and 1st A-F amplifier | 1 | 6ST7 |
| Receiver A-F output amplifier | 1 | 6G6G |
| Total | 9 | |

Frequency control.—Crystal.

Power.—Supplies available: MQ, 6 volts d. c.; MQ-1, 6 volts d. c. or 12 volts d. c.

Requirements

SUPPLY VOLTAGE 6.3 VOLTS D. C.

| Standby (receiving only) | Handset | "Trans. Fil." switch |
|--|------------|----------------------|
| 4.5 amperes | On cradle | Off. |
| 7.0 amperes | On or off | On. |
| Communication | Handset | "Trans. Fil." switch |
| 7.0 amperes (receiving) | Off cradle | On or off. |
| 18.0 amperes (transmitting) ¹ | Off cradle | On or off. |

SUPPLY VOLTAGE 12.6 VOLTS D. C.

| Standby (receiving only) | Handset | "Trans. Fil." switch |
|--|------------|----------------------|
| 2.3 amperes | On cradle | Off. |
| 4.0 amperes | On or off | On. |
| Communication | Handset | "Trans. Fil." switch |
| 4.0 amperes (receiving) | Off cradle | On or off. |
| 12.0 amperes (transmitting) ¹ | Off cradle | On or off. |

¹ Handset push-button pressed and approximately 100 percent voice modulation.

Operating control.—Complete remote control, except for frequency change which is accomplished through the use of a switch on the transmitter-receiver front panel.

Carrier control.—Press-to-talk button on handset.

Receiver.—

Reception.—A₃.

Type of receiver circuit.—Superheterodyne.

Intermediate frequency.—455 kc.

Audio power output.—50 milliwatts.

Output impedance.—5 ohms.

Sensitivity.—15 microvolts or less modulated 30 percent at 400 cycles with a signal to noise ratio of 4-1 or better.

Audio frequencies.—Flat within ±2.5 db between 100-1500 cycles.

Radiation frequencies.—MQ—unsafe all; MQ-1—safe-all.

Antenna.—The transmitter power output will be 2.5 watts with antenna constants of 100 mmfd. capacity and 5 ohms resistance. With antenna constants of 200 mmfd. capacity and 24 ohms resistance the transmitter carrier power will be approximately 10 watts. The antenna may be of the T, L, simple vertical, or sloping type with a suitable ground system. The minimum length in the case of the vertical type of antenna is approximately 23 feet.

Weights and dimensions of equipment units included in contract

| | Height | Width | Depth | Weight |
|-------------------------|--------------------------------|--------------------------------|--------------------------------|---------------|
| MQ units: | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Transmitter-receiver | 9 ³ / ₄ | 21 | 8 ¹ / ₂ | 40 |
| Remote control unit | 8 | 9 | 5 ¹ / ₁₆ | 7 |
| MQ-1 units: | | | | |
| Transmitter-receiver | 10 ³ / ₈ | 23 ⁵ / ₈ | 13 ⁷ / ₈ | 40 |
| Remote control unit | 10 ³ / ₈ | 8 ¹ / ₂ | 4 | 7 |
| MQ and MQ-1 units: | | | | |
| Spare Parts box (metal) | 6 ¹ / ₂ | 12 ³ / ₈ | 7 | 14 |
| Calibration cards (3). | | | | |

Navy type numbers of equipment units

| | |
|-------------------------------------|------------------|
| MQ units: | <i>Type Nos.</i> |
| Transmitter-receiver | CRM-43022 |
| Remote control unit | CRM-23312 |
| MQ-1 units: | |
| Transmitter-receiver 6 volts d. c. | CRM-43023 |
| Transmitter-receiver 12 volts d. c. | CRM-43024 |
| Remote control unit | CRM-23327 |

Shipping weights and dimensions

| | Size | Gross weight | Volume |
|--|-------------------------------|----------------------|--------------------------|
| Complete equipment and spare parts shipped in one case | <i>Inches</i> 35 x 22 x 19 | <i>Pounds</i> 140 | <i>Cubit feet</i> 8.5 |

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MQ-2 RADIO TRANSMITTING-RECEIVING EQUIPMENT

Use.—Ship.

Frequency range.—Transmitter, 2000–3500 kc. (4 pre-tuned channels).

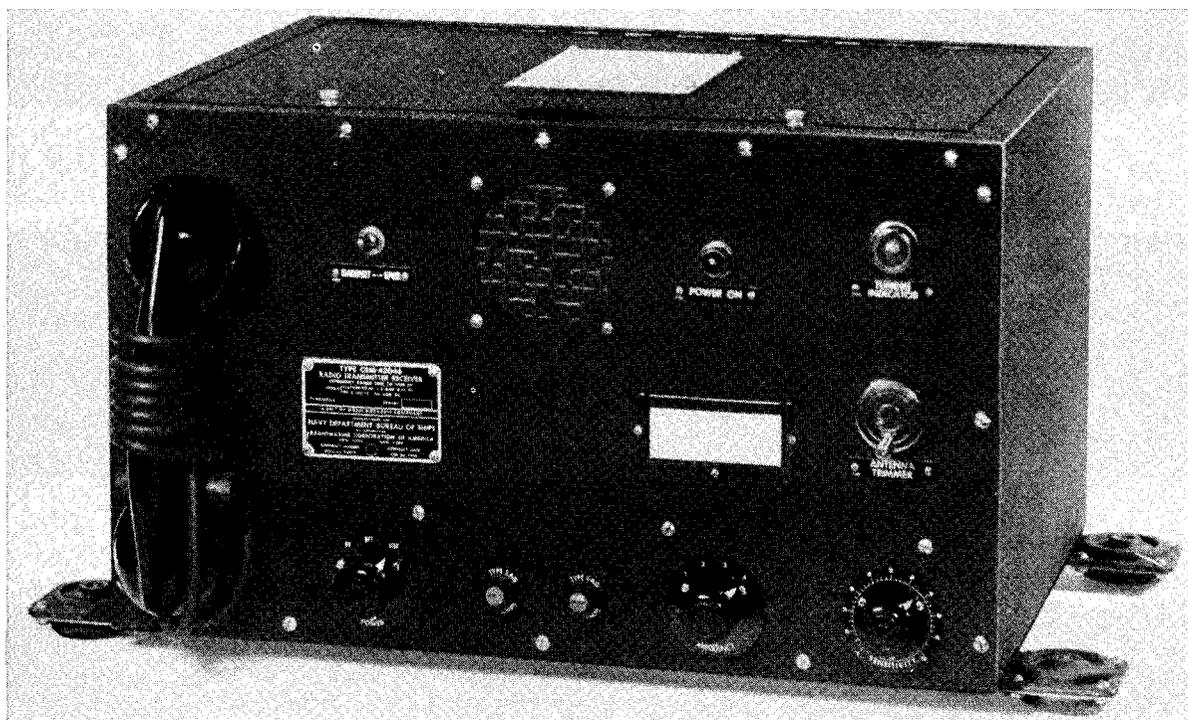
Receiver 2000–3500 kc. (4 pre-tuned channels).

Power output.—5 watts. (See Antenna under Technical Features.)

Emission.—A₃.

Description.—The MQ-2 is a medium frequency low power radio telephone equipment designed primarily for two-way communication aboard ship. The equipment consists essentially of a single compact unit which incorporates the transmitter and receiver components, a built-in loud speaker, a handset and an

vides access to the interior of the cabinet for installation or servicing of the various parts. The lid is equipped with two thumb screws along the front edge so that it may be held in position when closed. Rubber shock mounts are provided at the bottom corners of the cabinet. The antenna and ground terminals are located at the top rear center of the chassis. The antenna and ground wires connect to these terminals through openings in the rear of the cabinet. Two heavy studs with washers and nuts for the 6 volt d. c. battery leads and a recessed polarized receptacle for the 115 volt a. c. power cable are accessible at the lower left rear corner of the cabinet. The front panel of the



Radio Transmitter-receiver MQ-2.

electronic converter and rectifier power supply. The above power supply permits operation of the equipment from either a 6-volt or 115 /1/ 50/60 power source. Provision is made for connection of the equipment to either or both power sources. When connected to both power sources, choice of supply may be made through the use of a 6V.-OFF 115V. switch on the front panel which operates in the 6V. and 115V. positions respectively to open or close the coil circuit of the electronic converter.

The *equipment* is completely self-contained in a steel cabinet. The transmitter-receiver components are mounted on a steel chassis which is permanently fastened to the front panel. The front panel is attached to the cabinet by means of screws. A hinged lid pro-

vides access to the interior of the cabinet for installation or servicing of the various parts. The lid is equipped with two thumb screws along the front edge so that it may be held in position when closed. Rubber shock mounts are provided at the bottom corners of the cabinet. The antenna and ground terminals are located at the top rear center of the chassis. The antenna and ground wires connect to these terminals through openings in the rear of the cabinet. Two heavy studs with washers and nuts for the 6 volt d. c. battery leads and a recessed polarized receptacle for the 115 volt a. c. power cable are accessible at the lower left rear corner of the cabinet. The front panel of the

equipment contains the following controls and parts: A 6V.-off-115V. "Power" switch; a "Power On" pilot light; a four-position "Frequency" switch; a "Sensitivity" control; an "Antenna Trimmer"; a "Tuning Indicator", including lamp and lamp cover; a "Handset-Speaker" switch; a 2-ampere fuse for the 115-volt input; a 3/8-ampere fuse for the electronic converter +B output; a calibration card holder with three cards; a telephone handset and cradle; and a loud speaker. A two-conductor a. c. power cable is furnished in a 10-foot length complete with a standard convenience plug (nonpolarized) and a polarized plug for attachment to the equipment. This cable may be shortened or extended as desired since the line current, is only 1.4 amperes maximum.

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Section III
RADIO RECEIVING EQUIPMENTS

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RAA TO RAA-4 RADIO RECEIVING EQUIPMENTS

Use.—Ship-shore, CW, MCW, and voice.

Frequency range and number of bands.—10-1000 kc. in five bands.

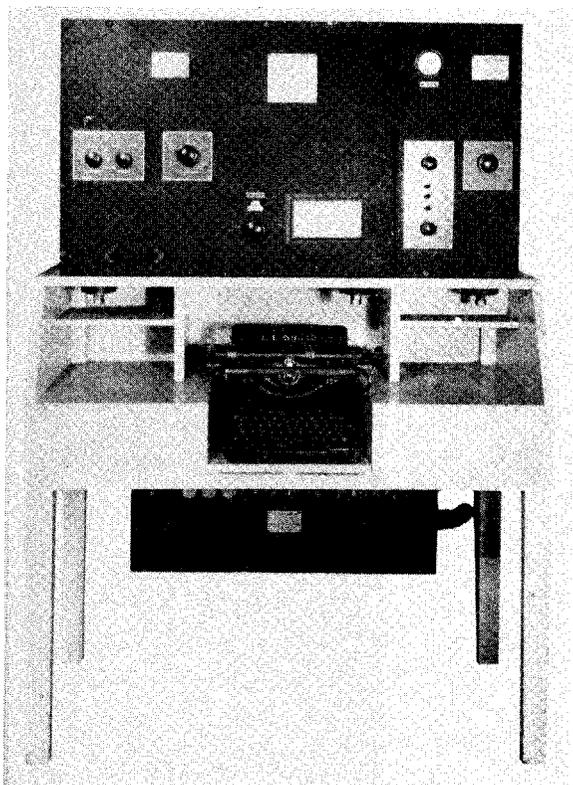
Power.—Required for operation: 110/1/60, 235 watts.

Description.—The Models RAA, RAA-1, RAA-2, RAA-3, and RAA-4 radio receiving equipments are designed for shipboard use and at shore stations. The five models are essentially the same, except for contract and nameplate.

The equipment is designed for the reception of pure, modulated, or interrupted CW or damped waves, or telephone modulated radio frequency signals. It is composed of an RF tuner unit and an IF-AF amplifier

tuner provides for the selection of "close" or "loose" capacitive coupling between the antenna and the first tuned circuit. Tuning is accomplished by a panel control operated five-gang variable capacitor which tunes the first oscillator in addition to the preselector RF amplifier circuits feeding the first detector.

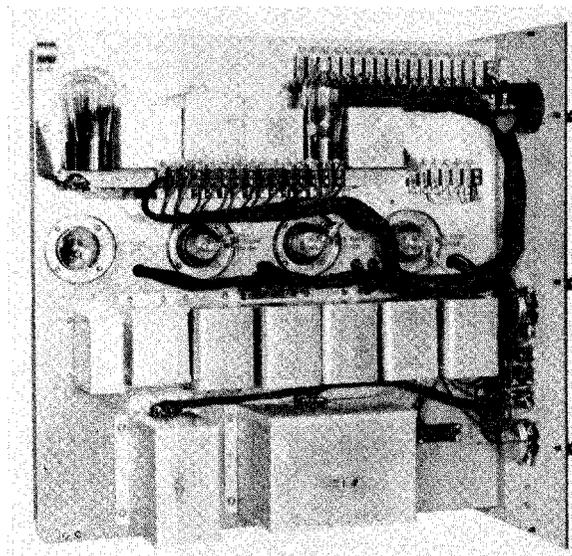
The IF-AF amplifier panel carries a sensitivity (gain) control which varies the control grid potential of the one RF stage and two IF amplifier stages. A control designated as "automatic volume control" is actually an output limiter, audio operated, and consists of a high ratio step-up transformer with a center tapped secondary winding through which the receiver output is fed to two Type 38027 tubes connected as biased half-wave rectifiers. The output level to which the signal is limited may be varied by adjustment of the rectifier



Model RAA radio-receiving equipment RF tuner (left), IF-AF tuner (right) and the power supply unit (below) mounted at operator's desk.

unit combined in a single cabinet. A separate power unit supplies all necessary power for the operation of the complete equipment. A voltmeter on the IF-AF panel indicates when the receiver is in operation and the power supply normal.

Radio signals are received in five bands, any one of which may be selected when the band switch provided on the RF panel is adjusted to connect (by conventional methods) a suitable set of inductances simultaneously into its tuned circuits. An additional "band" switch on the IF-AF unit in a similar manner provides the selection of the proper IF frequency for the particular band. A coupling switch on the panel of the RF



Type CRV 50022-A IF-AF amplifier of the Model RAA radio-receiving equipment (left side view).

bias from a control on the panel. The limiting circuits may be turned on or off by a panel switch.

A low pass filter following the second detector provides substantially flat response from 200 to 4000 cycles and a high degree of attenuation to all frequencies of 5500 cycles and above, thus substantially increasing the signal to noise ratio.

A band pass filter centered at 1000 cycles provides attenuation to all frequencies plus or minus 50 cycles from the center frequency. This filter is connected into the circuit when the audio, "broad-sharp" switch is turned to the "sharp" position, without affecting the low pass filter.

The second (CW) heterodyne oscillator is turned on or off by the panel CW-ICW switch. Different oscillator coils are utilized for each of the four intermediate frequencies, and are switched into the circuit simultaneously with the intermediate transformers by operation of the panel control.

**RAA
RAA-1
RAA-2
RAA-3
RAA-4**

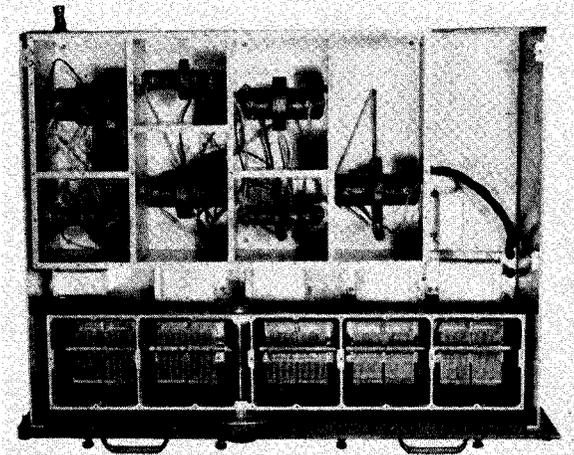
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The output circuit of the equipment is designed for use with from one to four pairs of 600-ohm (impedance) telephone receivers connected in parallel.

Shielding in the equipment is used to minimize radiation over the frequency range.

TECHNICAL FEATURES

Type of receiver.—Superheterodyne.



RF tuner construction (with covers to shielding compartment removed) of the Model RAA radio-receiving equipment

IF frequencies.—37.8, 20, 37.8, 95.5 and 238 kc.

Type of reception.—CW, MCW, and voice.

Input.—Grounded.

Input impedance.—Single line antenna.

Output impedance.—600 ohms, 1-4 telephone headsets in parallel.

Output power.—250 milliwatts.

Tube complement

| Function | Number of tubes | Type |
|---|-----------------|---------|
| RF amplifier..... | 1 | 38035 |
| Detector (mixer and second RF amplifier)..... | 2 | 38024-A |
| HF oscillator..... | 1 | 38027 |
| IF amplifiers..... | 2 | 38035 |
| CW oscillator..... | 1 | 38027 |
| AVC..... | 2 | 38027 |
| First AF amplifier..... | 1 | 38024-A |
| Second AF amplifier..... | 1 | 38027 |
| Rectifier..... | 2 | 38180 |
| Voltage regulator..... | 1 | 38274 |
| Total..... | 14 | |

Band coverage:

| Band number: | Frequency range (kc.) |
|--------------|-----------------------|
| 1..... | 10 - 25 |
| 2..... | 25 - 63 |
| 3..... | 63 - 158 |
| 4..... | 158 - 400 |
| 5..... | 400-1000 |

Weights, dimensions, and Navy type numbers

| | Type No. | Width | Depth | Height | Weight |
|-----------------|------------|----------------|---------------|---------------|---------------|
| RAA: | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| RF tuner..... | CRV-4550 | 27½ | 20¼ | 21⅝ | 220 |
| IF/AF unit..... | CRV-4551 | 10¼ | 20¼ | 21⅝ | 135 |
| Power unit..... | CRV-4554 | 27 | 13½ | 13½ | 110 |
| RAA-1, RAA-2: | | | | | |
| RF tuner..... | CRV-46034 | } Same as RAA. | | | |
| IF/AF unit..... | CRV-50022 | | | | |
| Power unit..... | CRV-20016 | | | | |
| RAA-3, RAA-4: | | | | | |
| RF tuner..... | CRV-46034A | } Do. | | | |
| IF/AF unit..... | CRV-50022A | | | | |
| Power unit..... | CRV-20016 | | | | |

Shipping weights and dimensions.—Data not available.

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RAB, RAB-1, RAB-2, RAB-2a, AND RAB-3 RADIO RECEIVING EQUIPMENTS

Use.—Ship-shore; CW, MCW, and voice.

Frequency range.—1000 to 30000 kc. in eight bands.

Power required for operation.—110/1/60, 235 watts. Allowable voltage variation ± 3 percent.

Description.—The RAB, RAB-1, and RAB-3 are the same except for modifications in the later models.¹ These receivers are in service but are not manufactured any more as they have been superseded by Models RBA, RBB, and RBC. The equipment consists of three sections as follows:

(1) *Radio frequency tuner.*—Two stages of RF amplification, first detector, and HFO.

(2) *IF-AF amplifier.*—The IF stages, second detector, CW oscillator, audio amplifier, and limiter for CW.

(3) *The "power unit."*—Filters, rectifier, and voltage regulator tubes, fuses, etc.

Four tuned RF circuits provide the high degree of preselection necessary for protection against cross modulation from local transmitters operating on frequencies not far removed from the frequency of the desired signals. In addition the tuning coils of the four bands are separated, and connection to the band set in use is made by a movable carriage instead of the band switching arrangement conventionally used. The carriage is moved by panel control and the appropriate RF, IF, and CW coils are connected for a given band.

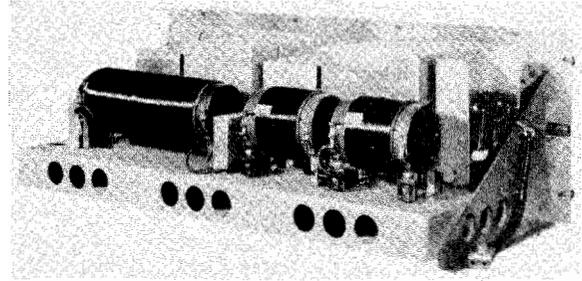
The preselection arrangement and shielding minimizes radiation.

The first and second oscillator filaments are provided with rectified current and their plate voltage is stabilized by means of regulator tube action in the power supply. A panel switch cuts the second oscillator "IN" or "OUT."

Two filters are provided following the second detector to eliminate the undesired radio and audio frequency components of the detector plate circuit, viz: (a) A low-pass filter provides substantially flat response to frequencies from 200 to 4000 cycles and provides attenuation of not less than 40 db. of frequencies of 5500 cycles and above. This filter, together with a radio frequency filter in the detector plate circuit removes substantially all radio frequency potentials from the output circuit; (b) the band pass filter, which may be switched in or out of the circuit from the oper-

ating panel provides attenuation of not less than 40 db. at frequencies above 1600 and below 600 cycles, and not more than 6 db. from approximately 700 to 1300 cycles. This panel switch may be set to audio "broad" or "sharp." The automatic volume control is not of the conventional type and may be termed the automatic output limiter control. It so operates as to lower the effective load in the power output plate circuit to a predetermined value depending on the adjustable setting of bias on the rectifiers. With the "ASC"-"OL" switch in the "Off" or "OL" positions, sensitivity is controlled by variation of the control grid bias on the two RF stages and the first IF stage. With the "ASC"-"OL" switch in the "ASC" position, sensitivity is controlled by automatic variation of control grid bias on the two RF stages and the two IF stages.

The power unit is carefully designed to maintain an accurate calibration of the receiver and a high degree of frequency stability. The power-supply circuit consists essentially of a resistance-capacity RF supply line filter, an electrostatically shielded power transformer, rectifier tubes, two-stage filter, voltage regulator, and volt-



Power unit for the Models RAA and RAB radio-receiving equipment (rear view with the line filter cover removed.)

age divider system. The RF filter is especially designed to substantially eliminate cross talk between equipments operating from one power supply system.

On the panel is also located an output meter and a voltmeter for checking the power supply.

TECHNICAL FEATURES

Tube Complement

| Unit | Number of tubes | Old type No. | New type No. |
|---------------------------------------|-----------------|------------------|--------------|
| RF amplifiers..... | 2 | 38058 | 58 |
| Oscillator..... | 2 | 38064 1 38056 | 861 |
| IF amplifiers..... | 2 | 38035 | 35 |
| Detectors and first AF amplifier..... | 3 | 38024 | 24-a |
| Second AF amplifier and 2-OL's..... | 3 | 38024 2 38174 | 24-a 27 |
| Power rectifier..... | 2 | 38180 | 80 |
| Voltage regulator..... | 1 | 38274 | 874 |
| Total..... | 15 | | |

¹ Substitution of the type 38056 tubes in the place of the 38064 constitutes an essential difference between the RAB-2 and the previous RAB and RAB-1 equipments.

² Type 38174 tube has been renumbered 38274.

¹ The RAB-3 equipment is similar to the RAB-2a equipment. Modifications include changes in the output tube from type 38027 to 38056, improved "sensitivity" control, change in the method of switching ASC (automatic sensitivity control) and OL (output limiter), and electrical interlock between the "ASC-OL" switch and the "CW-ICW" switch. The essential difference between the RAB-2a and the RAB-2 equipments lies in the addition of a carrier operated automatic volume control. In accomplishing this modification, one of the audio limiter tubes has been changed from a type 38027 to a 38057, and used in a "single ended" circuit instead of a "push-pull" arrangement used in the RAB-2 equipments. The other type 38027 audio limiter tube changed to a type 38057, has been incorporated in another circuit and is used as a d-c amplifier in connection with the carrier operated automatic volume control, and the two 38035 IF amplifier stages have been changed to type 38058. The models RAB-2 and RAB-2a differ from the Models RAB and RAB-1 equipments in that the type 38056 tubes have been substituted for the type 38064 in the oscillator stages.

RAB
RAB-1
RAB-2
RAB-2a
RAB-3
RAG
RAG-1

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Type of receiver.—Superheterodyne.

IF frequencies.—Four bands. 600, 1450, 3250, and 7200 kc. on RAB-2.

Type of reception.—Pure CW, MCW, ICW, damped waves, or voice modulated radio frequency signals.

Input.—Low impedance capacitatively coupled to the first tuned circuit, about 600 ohms.

Output.—1 to 4 pair 600-ohm impedance telephone headsets connected in parallel.

Output power.—Variable, 250 mw.

Sensitivity.—5 microvolts for 6 mw. output.

Antenna.—Single length, 50 feet in the clear. No receivers other than the RAB should be used on the same antenna except as an emergency measure. From one to six receivers can be operated on one antenna. A half-megohm static drain resistor should be permanently installed between each antenna and ground. When one or more receivers are connected onto one antenna there should be a 150-ohm, 1-watt resistor in series with antenna leads to the receivers.

Radiation frequencies.—RAB-1 safe up to 23 mc. Unsafe, 23 to 28 mc.

Band frequency table

| Band | 1 E | 2 J | 3 F | 4 K | 5 G | 6 L | 7 H | 8 M |
|-------------------------------------|-----------|-----------|-----------|-----------|------------|-------------|-------------|-------------|
| RF coil assembly designating symbol | 1000-1544 | 1544-2470 | 2470-3956 | 3956-6320 | 6320-10130 | 10130-16190 | 16190-24510 | 24510-30000 |
| RF tuner frequency in kc. | | | | | | | | |
| IF amplifier frequency in kc. | 600 | | 1450 | | 3250 | | 7200 | |
| IF coil frequency designation | A | | B | | C | | D | |

Weights and Navy type numbers

| Unit | Navy type numbers | | | | Weight <i>Pounds</i> |
|---------------------|-------------------|-----------|------------|------------|-----------------------------|
| | RAB | RAB-1 | RAB-2 | RAB-3 | |
| RF tuner | CRV-4552 | CRV-46035 | CRV-46035A | CRV-46035B | 190 |
| IF and AF amplifier | CRV-4553 | CRV-50023 | CRV-50023A | CRV-50023C | 155 |
| Power unit | CRV-4554 | CRV-20016 | CRV-20016 | CRV-20016 | 110 |
| Total | | | | | 455 |

¹ 5 pounds more for the RAB-3 equipment.



RAG AND RAG-1 RADIO RECEIVING EQUIPMENTS

Use.—Ship-shore.

Frequency range.—15 to 600 kc. in four bands.

Power required for operation.—RAG is a battery operated receiver, RAG-1 is a power supply operated receiver. When the proper voltages are supplied either may operate on battery or rectified power. Six volts D. C. at 5.4 amperes and 180 volts D. C. at 0.77 milli-ampere; 105-120/1/58-62 cycles, 112 watts.

Description.—The Models RAG and RAH are associate receivers and when operated together cover the 15 to 23000 kc. range of frequencies. They are designed to operate on separate antennas but an emergency measure provision is made for operating on a common antenna.

The receiver is of the tuned radio frequency type designed primarily for the reception of CW signals and incorporates a tuned input and three tuned RF pentode stages, a triode detector, a heterodyne oscillator, an audio band pass filter, a variable tuning circuit, a triode audio amplifier, a pentode power stage, and a limiter type AVC system. Band selection is effected by means of the ganged band switch which

simultaneously short circuits the next lower band to eliminate absorptive circuits.

The input circuit is designed to operate with an antenna of about 200 mmfd. capacity. In order that satisfactory operation may be had with antennas ranging from 175-600 mmfd., an equalizing condenser is provided to adjust the capacity reflected into the input circuit to approximately 200 mmfd.

A gaseous discharge tube protects the equipment from heavy static surges.

The antenna trimmer condenser is provided to obtain the highest degree of signal to noise sensitivity. With the equalizing condenser properly adjusted, the input circuit may be resonated with the incoming signal at any point within the tuning range of the receiver.

The receiver output is manually controlled by altering the grid bias of the RF amplifier tubes with the resultant change in their amplification.

By band switching, the oscillator maintains a frequency of 1 kc. above the signal frequency at resonance.

An oscillator test switch serves to indicate the proper operation of the oscillator in the absence of an incoming

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signal. When the feed back winding is short circuited causing the oscillations to cease there is an audible click in the headphones.

The audio filter is peaked at 800 cycles with band width of 450 to 1300 cycles. All audio frequencies beyond the pass band are therefore suppressed.

A variable selective circuit, audio tuning, controlled by a three-position switch, provides for a high degree of selectivity within the audio range and thus reduces noise and audio interference. One position gives a broad response, another favors the 450 to 780 band, and the third favors the 780 to 1300 band.

The AVC is the full wave rectifier type. By means of an adjustable bias on the cathode the conductivity of the tube is controlled to hold the output at an approximately constant level, from 300 microwatt minimum to 20 milliwatt maximum.

An output meter, calibrated in db. above and below 6 milliwatts of audio output, is of aid in aligning the receiver in precision tuning, and in the measurement of output power and relative field intensities.

A filament voltmeter serves to indicate that the receiver is "on" and that normal voltage is supplied to the tubes.

Shock mounting is provided for attaching units to a table.

A control unit is provided for operation of two receivers, such as the RAG and RAH, by one operator. By this means the entire frequency range of 15 to 23000 kc may be monitored by one operator.

TECHNICAL FEATURES

Type of receiver.—TRF with AVC limiter.

Type of reception.—CW primarily.

Input.—Grounded.

Output impedance.—600 ohms.

Output power.—250 milliwatts.

Sensitivity.—1-4 microvolts.

Antenna.—Straight grounded wire as high as possible, nominal 200 mmf. capacity.

Tube complement

| Function | Number of tubes | Type |
|------------------|-----------------|------|
| RF amplifier | 1 | 6D6 |
| Do | 1 | 6D6 |
| Do | 1 | 6D6 |
| Detector | 1 | 76 |
| BFO | 1 | 6D6 |
| AF amplifier | 1 | 76 |
| Output amplifier | 1 | 41 |
| AVC limiter | 1 | 84 |
| Rectifier | 1 | 80 |
| Total | 9 | |

Weights, dimensions, and Navy type numbers

| Unit | Navy type No. | Height | Width | Depth | Weight |
|------------------------------------|---------------|---------------|----------------|---------------|---------------|
| RAG: | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Receiver | CHS-46042 | 18 | 18½ | 17½ | 93 |
| Control unit | CHS-23062 | 5¾ | 3¾ | 4½ | 1¾ |
| Receiver to battery cable | | | <i>Feet</i> | | <i>Ounces</i> |
| Receiver to control-unit cable | | | 16 | | 10 |
| Set of vacuum tubes for receiver | | | 8 | | 10 |
| RAG-1: | | | <i>Inches</i> | | <i>Pounds</i> |
| Receiver | CHS-46042 | 18 | 18½ | 17½ | 93 |
| Power unit | CHS-20032 | 8 | 13¾ | 8 | 32 |
| Control unit | CHS-23067 | 5¾ | 3¾ | 4½ | 1¾ |
| Receiver to power-supply cable | | | <i>Ft. In.</i> | | <i>Ounces</i> |
| Receiver to control-unit cable | | | 16 0 | | 12 |
| Power supply to AC supply cable | | | 8 0 | | 10 |
| Power supply to control-unit cable | | | 18 8 | | 12 |
| | | | 16 0 | | 8 |

1 set of vacuum tubes, including 1 for power supply.

Equipment not supplied under contract.—6-volt d.-c. source; 180-volt d.-c. source; 1 or more headsets; antenna and ground system.

Shipping weights and dimensions.—Data to be supplied when available



RAH AND RAH-1 RADIO RECEIVING EQUIPMENTS

Use.—Ship-shore.

Frequency range.—300 to 23000 kc. in seven bands.

Description.—The RAH and the RAH-1 models are similar to the RAG, RAG-1 receivers, except that they cover the higher frequency range.

The RAH, -1 receivers are similar to the RAG except that RAH, -1 have one additional RF stage and the band arrangement is provided by a set of seven inductances of the plug-in type. A case provided holds the seven coil assemblies. Each coil is held in place by two spring catches.

When operated with the associate receiver, RAG or RAG-1 and the control unit, the entire band of 15 to 23000 kc. can be monitored by one operator.

TECHNICAL FEATURES

Listing only those that are different from RAG,-1.

Tube complement.—One additional RF amplifier stage employs another 6D6 tube.

Weights, dimensions, and Navy type numbers

| Unit | Navy type No. | Height | Width | Depth | Weight |
|---|---------------|---------------|---------------|---------------|---------------|
| RAH, -1 Receiver (excluding coils) | CHS-46043 | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Inductance system case (excluding handle) | CHS-47090 | 13½ | 15 | 9½ | 8½ |
| Inductance coil (one of seven) | | | | | ¾ |

RAJ RADIO RECEIVING EQUIPMENT

Use.—Aircraft, CW, MCW, and voice.

Frequency range.—224 to 13575 kc. in 11 bands.

Power required for operation.—115/1/60 (supplied to rectifier) or 48.60 watts at 6 volts D. C. (supplied to dynamotor).

Description.—The Model RAJ radio receiving equipment is a tuned RF receiver using plug in coils to cover a frequency range of 224 to 13575 kc. in 11 bands. The receiver circuits consist of 3 stages of RF amplification, detector, manual or automatic gain control, B. F. O. oscillators, and one stage of AF feeding into a low- and high-impedance output.

Power may be supplied by a 115/1/60 rectifier or with a dynamotor operating on 6 volts D. C.

The receiver mounting base consists of a metal frame with a shockproof cup assembly at each corner. Four snap slides on the receiver mounting brackets engage the four studs which are molded in the soft rubber of the shockproof cup assemblies.

The sensitivity of the receiver is controlled by varying the control grid bias and hence the radio frequency amplification of the three RF tubes. This is done either externally, by a manually operated variable resistor or internally by the AGC (automatic gain control) circuit. The cathode bias resistors are connected to the "auto-manual" switch in such a manner that when the switch is in the "manual" position the amplifier grids are grounded and one variable resistor adjusted by the "volume control" knob varies the control grid bias (cathode bias) on these RF tubes. In the "auto" position the cathodes are permanently grounded and the control grids are disconnected from ground. The grid bias and hence the amplification of the RF tubes is then determined by the a-c voltage developed automatically across a resistor in the plate circuit of the AGC tube. The AGC may be used in the reception of either CW or modulated signals. However, in the "auto" position the volume control element consists of a resistor which is shorted across the terminals of the telephone jack where it has the effect of a level setter, and has no effect upon the automatically controlled sensitivity of the receiver.

A CW switch on the panel opens the plate voltage circuit of the CW oscillator causing oscillations to cease.

The tuning dial is calibrated in a scale of 0 to 100 and controls the four-gang condenser, the three RF and the CW circuits. A calibration chart is supplied for approximate settings on the various bands but it is to be used only as an approximation.

The main tuning dial is actuated by a shaft and worm gear drive to which coupling is made through the type CBY-23022 "local tuner."

Ten coil sets are supplied in a case and one is in the receiver. The first stage is connected to the antenna through a variable condenser controlled by the "align input" knob. This is adjusted for any given receiving antenna, until the series combination of its capacity with the antenna capacity is equal to the desired value for maximum signal.

The high impedance output is fed from the voltage across the primary of a transformer, which constitutes

the plate circuit load of the AF stage, through a condenser. The low impedance output is fed from the secondary of this same step-down transformer which has its primary in the plate circuit of the AF output tube.

A neon tube is connected from the high potential end of the secondary of the first tuned circuit for protection of the first stage in case the set should inadvertently be tuned to a local transmitting equipment. Above approximately 80 volts the tube discharges; below that value the tube is nonconducting.

TECHNICAL FEATURES

Tube complement

| Location | Number of tubes | Type |
|---|-----------------|-----------|
| Receiver: | | |
| First, second, third RF amplifiers..... | 3 | CRP-38078 |
| Detector..... | 1 | CRP-38077 |
| Automatic gain control..... | 1 | CRP-38077 |
| AF amplifier..... | 1 | CRP-38233 |
| Power supply: Full wave rectifier..... | 1 | CRC-38180 |
| Total..... | 7 | |

Type of receiver.—Tuned RF.

Type of reception.—CW, MCW and voice.

Input.—High impedance, grounded.

Output.—High and low impedance.

Output power.—Data not supplied.

Sensitivity.—Data not supplied.

Antenna.—Length not critical, alignment condenser provided.

Band coverage frequency

| Band | Type number | Frequency |
|---------|-------------|------------|
| | | Kc. |
| 1..... | CBY-47065 | 224-350 |
| 2..... | CBY-47066 | 350-545 |
| 3..... | CBY-47067 | 545-850 |
| 4..... | CBY-47068 | 850-1330 |
| 5..... | CBY-47069 | 1330-2040 |
| 6..... | CBY-47070 | 2040-3000 |
| 7..... | CBY-47071 | 3000-4500 |
| 8..... | CBY-47072 | 4000-6000 |
| 9..... | CBY-47073 | 5400-8100 |
| 10..... | CBY-47074 | 8100-12500 |
| 11..... | CBY-47075 | 9500-13575 |

Weights, dimensions, and Navy type numbers of equipment units supplied by contract

| Unit | Type number | Height | Width | Depth | Weight |
|------------------------------------|------------------------|---------------------|--------|--------|--------|
| | | Inches | Inches | Inches | Pounds |
| Receiver..... | CBY-46046 | Data not available. | | | |
| Coil set in receiver..... | CBY-47065 | | | | |
| Receiver mounting base..... | CBY-46011 | | | | |
| Receiver local tuning control..... | CBY-23022 | | | | |
| 10 coil sets..... | CBY-47066 to CBY-47075 | | | | |
| Coil set container..... | CBY-47029 | | | | |
| Power unit..... | CBY-20040 | | | | |
| Dynamotor unit..... | CBY-21173 | | | | |
| Receiver cable 333..... | | | | | |
| Power unit cable 321..... | | | | | |
| Dynamotor unit cable 221..... | | | | | |
| 9 receiving tubes..... | CRP-38078 | | | | |
| 6 receiving tubes..... | CRP-38077 | | | | |
| 3 receiving tubes..... | CRP-38233 | | | | |
| 3 rectifier tubes..... | CRP-38180 | | | | |

Equipment not supplied by contract but required for operation.—Headset and loudspeaker.

NOTE.—Shipping weight and dimensions will be supplied when data is available.

CONFIDENTIAL

RAK SERIES RADIO RECEIVING EQUIPMENTS

Use.—Ship-shore, CW, MCW and voice.¹

Frequency range.—15 to 600 kc. in six bands.

Power required for operation.—Direct current.—6 volts, 2 amperes; 180 volts, 45 milliamperes.

Alternating current.—110–120/1/60, 60 watts, or 200 watts with ballast tube.

Allowable variation in voltage, ± 10 percent.

Description.—The RAK series of radio receiving equipments are used as communication receivers on CW, MCW, and voice. The RAK, and the associate receiver RAL, are often used together to cover a still wider range and for such purpose may be used with the control unit to permit reception with either receiver, or both receivers simultaneously, by one operator.

Beginning with RAK-6 changes are made to eliminate radar interference, and additional changes are made in the RAK-7, RAK-8 such as the concentric plug and jack for the antenna to better shield against interference.

The circuit employed consists of two stages of TRF,

¹ Not recommended for voice as the selectivity is so sharp that considerable distortion results.

one regenerative detector, low pass filter, first AF and audio output connected to a tube sometimes referred to as an AVC but more properly called a limiter.

The set is designed for operation with 250 volts "B" and 6.3 volts "A" supply; however, some economy of operation can be obtained with satisfactory operation by use of 180 volts and 6 volts from batteries.

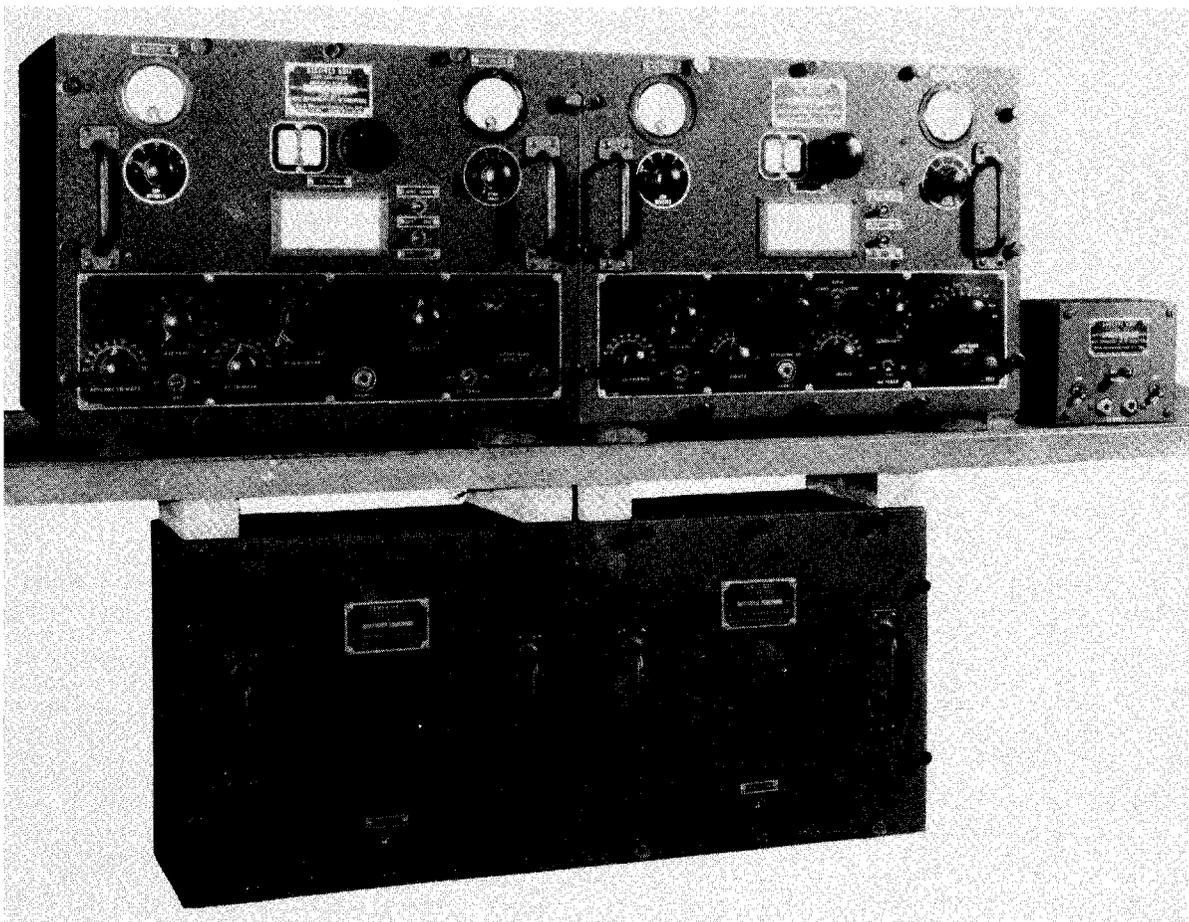
The power unit is very carefully designed in order to maintain an accurate calibration of the receiver unit and a high degree of frequency stability. The power supply circuit includes RF filters on the a-c supply line, a current regulating ballast lamp, an electrostatically shielded power transformer, rectifier tube, two-stage filter, voltage regulator, and a protective bleeder. The set may be operated without the ballast lamp but at a sacrifice of voltage regulation.

Provision is made for rubber type mounting of the receiver and all component units may be bolted in place.

The unit is completely shielded both internally and externally to minimize cross talk between receivers.

All power leads are filtered with resistance capacity

RAK
RAK-1
RAK-2
RAK-3
RAK-4
RAK-5
RAK-6
RAK-7
RAK-8



Receivers, power supplies and control unit mounted for Models RAK/RAL radio receiving equipment.

RAK
RAK-1
RAK-2
RAK-3
RAK-4
RAK-5
RAK-6
RAK-7
RAK-8

CONFIDENTIAL

filters. Interstage shielding is provided to increase selectivity and stability, and to minimize reaction.

The audio system includes two stages of amplification and an output limiter. Filters are provided which increase the effective CW selectivity and improve the signal to noise ratio.

A low-pass filter immediately follows the detector circuit and may be disconnected from the circuit by means of a switch on the front panel.

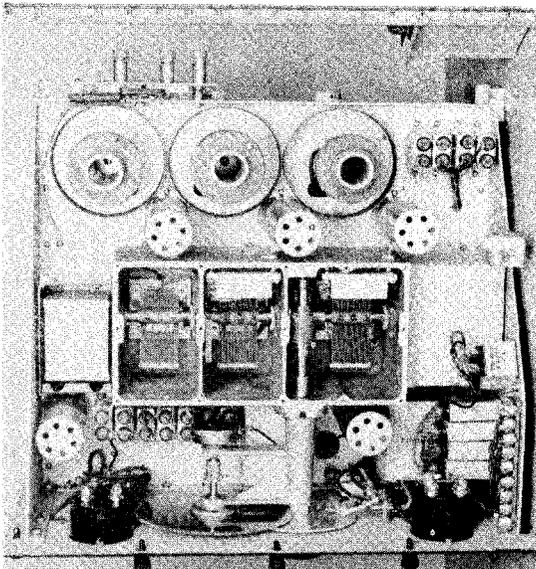
A variable attenuator, which may be switched in or out of the circuit by means of a panel control, follows the low-pass filter. A choice of resonant frequency is obtained by the use of a 10-position switch and a 2-position range switch.

An audio limiter tube is cut in or out of the circuit by a panel switch and its effect is in turn controlled by an

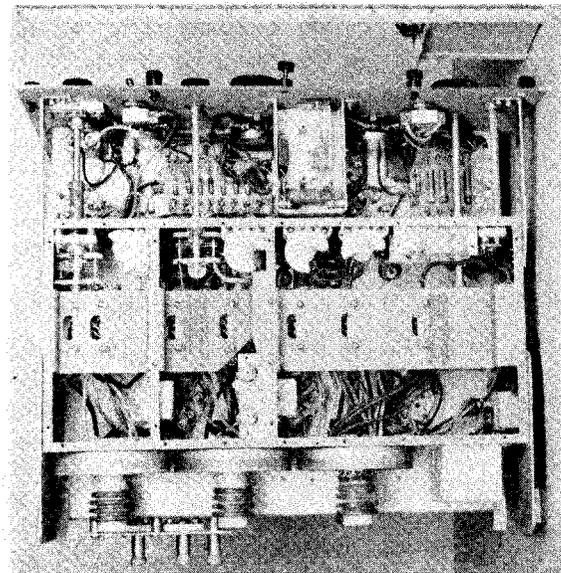
The control unit combines the output of the two receivers. A three-position switch makes available in two headphone jacks, signals from either or both of the receivers. The 115-volt supply feeds through fuses into the control unit and supply cables connect to each receiver.

To permit greater ease in searching and following drifting signals, a very small trimmer capacitor (frequency vernier) controllable from the front panel has been provided. This adjustment makes possible the variation of the autodyne oscillator frequency by an amount between 0.35 and 0.5 percent of its frequency. The greater range of adjustment is obtained at the high frequency end of the various bands.

In order to obtain optimum performance of the equipment under all service conditions, small trimmer



Receiver for Model RAK radio receiving equipment, with tuning capacitor and coil shield covers removed.



Receiver for Model RAK radio receiving equipment, bottom view, with bottom and coil shield covers removed.

adjustable potentiometer located on the panel which determines the bias on the limiter tube.

A rectifier type DB output meter and range switch are provided on the front panel. The meter indicates the audio level delivered to the headphones.

A voltmeter which indicates filament voltage is provided on the front panel.

Unicontrol is accomplished by means of a three-gang variable capacitor tuning the two RF stages and the detector.

A switch on the receiver controls power when supplied by a battery. A switch on the power supply controls power when A. C. is used and the panel switch is inoperative. When the control unit is used the switches in it control power to either set and the panel switch and power supply switches are inoperative.

capacitors adjustable from the front panel are provided on the first and second RF tuned circuits.

The antenna is inductively coupled to the first tuned circuit for maximum energy transfer and the best possible signal to noise ratio. When it may be necessary to operate both RAK and RAL receivers on a common antenna, a lower coupling is desirable. The binding posts have, therefore, been so arranged that a capacitor is placed in series with the antenna coupling coil when connection is made to the "common" binding post. No receivers other than one Model RAL or one Model RAK should be used on the same antenna except as an emergency measure. When RAK and RAL receivers are connected to one antenna, the "common" connection should be grounded through a one-half megohm static drain.

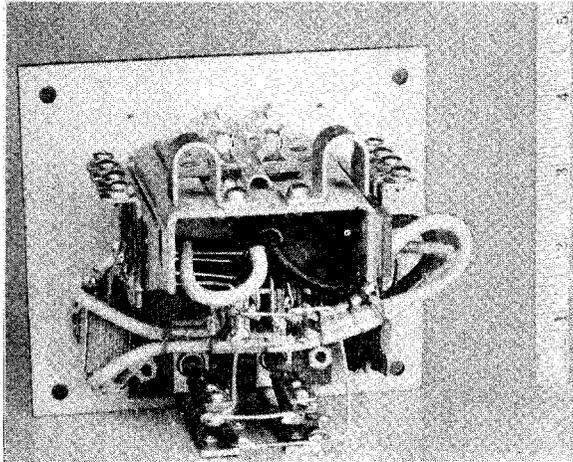
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TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Old type No. | New type No. |
|---------------------------------------|-----------------|--------------|------------------|
| POWER UNIT | | | |
| Rectifier..... | 1 | 38180 | 80 |
| Voltage regulator..... | 1 | 38593 | ¹ 5Z3 |
| Current regulator (ballast tube)..... | 1 | 38274 | 874 |
| | | 38276 | 876 |
| RECEIVER UNIT | | | |
| First RF amplifier..... | 1 | 38646 | 6D6 |
| Second RF amplifier..... | 1 | 38646 | 6D6 |
| Detector..... | 1 | 38646 | 6D6 |
| Output limiter..... | 1 | 38041 | 41 |
| Audio output..... | 1 | 38041 | 41 |
| First audio..... | 1 | 38646 | 6D6 |
| Total..... | 9 | | |

¹ On later models, RAK-4 and on.



Control unit for Models RAK/RAL radio receiving equipment (rear view).

Type of receiver.—Tuned RF with limiter on the audio output.

Type of reception.—Pure, modulated, or interrupted CW; damped radio signals or voice.²

Input.—Single line antenna, inductively coupled to the first tuned circuit.

² Not recommended for voice on account of the selectivity.

Output impedance.—600 ohms.

Power output.—Adjustable, 170 milliwatts.

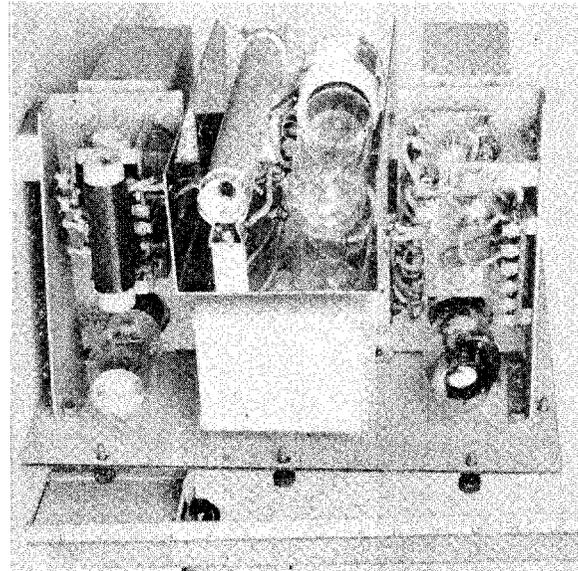
Sensitivity.—2 to 5 microvolts for 6 mw. output.

Antenna.—50 feet in the clear as high as possible, grounded.

Radiation frequencies.—Safe all frequencies.

Band coverage:

| Band: | Frequency range in kc. |
|--------|------------------------|
| 1..... | 15 to 25 |
| 2..... | 25 to 43.5 |
| 3..... | 43.5 to 77.5 |
| 4..... | 77.5 to 153 |
| 5..... | 153 to 308 |
| 6..... | 308 to 600 |



Power unit for Models RAK and RAL radio receiving equipment, top rear view with line filter cover (at left) removed.

Weights, dimensions, and Navy type numbers

| Unit | Navy type | Height | Width | Depth | Weight |
|---------------|------------------------|--|-------------------------------|--|---------------------|
| Receiver..... | ¹ CRV-46155 | <i>Inches</i> 13 ⁵ / ₁₆ | <i>Inches</i> 18 | <i>Inches</i> 16 ³ / ₃₂ | <i>Pounds</i> 74 |
| Power..... | CRV-20131 | 12 ¹ / ₄ | 14 | 8 ⁵ / ₈ | 41 |
| Control..... | CRV-23073 | 4 ³ / ₄ | 5 ³ / ₈ | 3 ³ / ₈ | 2 |

¹ CRV 46044 from RAK to RAK-5.

RAK
RAK-1
RAK-2
RAK-3
RAK-4
RAK-5
RAK-6
RAK-7
RAK-8

RAL
RAL-1
RAL-2
RAL-3
RAL-4
RAL-5
RAL-6
RAL-7
RAL-8

CONFIDENTIAL

RAL SERIES RADIO RECEIVING EQUIPMENTS

Use.—Ship-shore, CW, MCW, and voice.

Frequency range.—0.3 to 23 mc. in 9 bands.

Power required for operation.—Direct current: 6 volts, 2 amperes; 180 volts, 45 milliamperes. Alternating current: 115/1/60, 200 watts. Allowable variation in voltage ± 10 percent.

Description.—The RAL, -1, -2, -3, -4, -5 are general purpose communication receivers which on account of their broad range are especially useful. The RAL with the associate receiver RAK are often used together to reach into a still lower range. When used together with the control unit, monitoring may be done with one or both receivers by one operator.

Beginning with RAL-6 changes are made to eliminate radar interference, and additional changes are made in the RAL-7, RAL-8, such as the concentric plug and jack for the antenna to better shield against interference.

The circuit employed consists of two stages of TRF, one regenerative detector, low-pass filter, first AF and audio output connected to a tube sometimes referred to as an AVC but more properly called a limiter.

The RAL is a battery operated set and each of the others are built for a-c operation. However, it is possible for the receivers to be operated on either, if the required voltage is obtained, as a-c or d-c can be used for the 6-volt supply. No C battery is required.

The power unit is very carefully designed in order to maintain an accurate calibration of the receiver unit and a high degree of frequency stability. The power supply circuit includes RF filters on the a-c supply line, a current regulating ballast lamp, an electrostatically shielded power transformer, rectifier tube, two-stage filter, voltage regulator, and a protective bleeder. The set may be operated without the ballast lamp but at a sacrifice of voltage regulation.

Provision is made for rubber type shock mounting of the receiver and all component units are to be bolted in place.

The unit is completely shielded both internally and externally to minimize cross-talk between receivers. All power leads are filtered with resistance capacity filters. Interstage shielding is provided to increase selectivity and stability, and to minimize reaction.

The audio system includes two stages of amplification and an output limiter. Filters are provided which increase the effective CW selectivity and improve the signal to noise ratio.

A low-pass filter immediately follows the detector circuit and may be disconnected from the circuit by means of a switch on the front panel.

A variable attenuator, which may be switched in or out of the circuit by means of a panel control, follows

the low pass filter. A choice of resonant frequency is obtained by the use of a 10-position switch and 2-position range switch.

An audio limiter tube is cut in or out of the circuit by a panel switch and its effect is in turn controlled by an adjustable potentiometer located on the panel which determines the bias on the limiter tube.

A rectifier type DB output meter and range switch are provided on the front panel. The meter indicates the audio level delivered to the headphones.

A voltmeter which indicates filament voltage is provided on the front panel.

A switch on the receiver controls power when supplied by a battery. A switch on the power supply controls power when A. C. is used and the panel switch is inoperative. When the control unit is used the switches in it control power to either set and the panel switch and power supply switches are inoperative.

Uni-control is accomplished by means of a three-gang variable capacitor tuning the two r-f stages and the detector.

The control unit combines the output of the two receivers. A three-position switch makes available in two headphone jacks signals from either or both of the receivers. The 115-volt supply feeds through fuses into the control unit and supply cables connect to each receiver.

To permit greater ease in searching and following drifting signals, a very small trimmer capacity (frequency vernier) controllable from the front panel has been provided. This adjustment makes possible the variation of the autodyne oscillator frequency by an amount between 0.35 and 0.05 percent of its frequency. The greater range of adjustment is obtained at the high-frequency ends of the various bands.

In order to obtain optimum performance of the equipment under all service conditions, small trimmer capacitors adjustable from the front panel are provided on the first and second RF tuned circuits.

The antenna is inductively coupled to the first tuned circuit for maximum energy transfer and the best possible signal to noise ratio. When it may be necessary to operate both RAL and RAK receivers on a common antenna, a lower coupling is desirable. The binding posts have, therefore, been so arranged that a capacitor is placed in series with the antenna coupling coil when connection is made to the "common" binding post. No receivers other than one Model RAL or one Model RAK should be used on the same antenna except as an emergency measure. When RAK and RAL receivers are connected to one antenna, the "common" connection should be grounded through a one-half-megohm static drain.

CONFIDENTIAL

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Old type No. | New type No. |
|---------------------------------------|-----------------|--------------|--------------|
| POWER UNIT | | | |
| Rectifier..... | 1 | 38180 | 80 |
| | | 38593 | 1 5Z3 |
| Voltage regulator..... | 1 | 38274 | 874 |
| Current regulator (ballast tube)..... | 1 | 38276 | 876 |
| RECEIVER UNIT | | | |
| First RF amplifier..... | 1 | 38646 | 6D6 |
| Second RF amplifier..... | 1 | 38646 | 6D6 |
| Detector..... | 1 | 38646 | 6D6 |
| Output limiter..... | 1 | 38041 | 41 |
| Audio output..... | 1 | 38041 | 41 |
| First audio..... | 1 | 38646 | 6D6 |
| Total..... | 9 | | |

¹ Receivers RAL-4, -5, -6, -7, -8 take a 38593 or the 5Z3.

Type of receiver.—Tuned RF with limiter on the audio output.

Type of reception.—Pure, modulated, or interrupted CW, damped radio signals or voice modulated wave.

Input.—Single line antenna, inductively coupled to the first tuned circuit.

Output impedance.—600 ohms.

Power output.—Adjustable, 170 milliwatts.

Sensitivity.—2 to 5 microvolts per meter for 6 milliwatts.

Antenna.—50 feet in the clear and as high as possible.

Radiation frequencies.—Safe, all frequencies.

Band coverage:

| Band: | Frequency range in mc. |
|--------|------------------------|
| 1..... | 0.3 to 0.49 |
| 2..... | 0.49 to 0.8 |
| 3..... | 0.8 to 1.33 |
| 4..... | 1.33 to 2.08 |
| 5..... | 2.08 to 3.4 |
| 6..... | 3.4 to 5.5 |
| 7..... | 5.5 to 8.8 |
| 8..... | 8.8 to 14.3 |
| 9..... | 14.3 to 23.0 |

Weights and dimensions and Navy type numbers

| Unit | Navy type No. | Height | Width | Depth | Weight |
|---------------|------------------------|--|-------------------------------|--|---------------------|
| Receiver..... | ¹ CRV-46045 | <i>Inches</i> 13 ³ / ₁₆ | <i>Inches</i> 18 | <i>Inches</i> 16 ³ / ₃₂ | <i>Pounds</i> 69 |
| Power..... | CRV-20036A | 12 ³ / ₄ | 14 | 8 | 41 |
| Control..... | CRV-23073 | 4 ³ / ₄ | 5 ³ / ₈ | 3 ³ / ₈ | 2 |

¹ CRV-46156 on RAL-6 and on.



ANTENNA TERMINATION MODIFICATION KITS FOR RAK-6 AND RAL-6 RADIO RECEIVING EQUIPMENTS

Use.—Ship, shore.

Description.—The modification permits the use of a type 49123 concentric patchcord assembly for connecting the receiver unit to the antenna transmission line, thereby providing a completely shielded antenna circuit to reduce interference to an acceptable level.

Each modification kit contains two (2) complete assemblies, one (MI-8531) for the Model RAK-6 and one (MI-8532) for the Model RAL-6. The two assemblies are identical except for the coupling capacitor.

This capacitor has a rating of 300 mmf. on the RAK-6 assembly and 400 mmf. on the RAL-6 assembly. One spare coupling capacitor is furnished for each assembly, and should be placed in the respective receiver spare parts boxes. The two plug buttons supplied with each assembly are to be inserted in the

two binding-post holes in the cabinet which are not required after installation of the new assembly. The modification consists, basically, of removing the present binding-post type antenna terminal board assembly and replacing it with the new concentric jack type assembly.

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet (approx.) |
|--|----------------------------|-------------------------|----------------------|
| Entire equipment including one assembly for RAK-6 and one assembly for RAL-6, shipped in one cardboard carton..... | <i>Inches</i> 9 x 9 x 3 | <i>Lbs. Oz.</i> 2 14 | 0.14 |

594758—44—4

RAL
RAL-1
RAL-2
RAL-3
RAL-4
RAL-5
RAL-6
RAL-7
RAL-8

RAO SERIES RADIO RECEIVING EQUIPMENTS

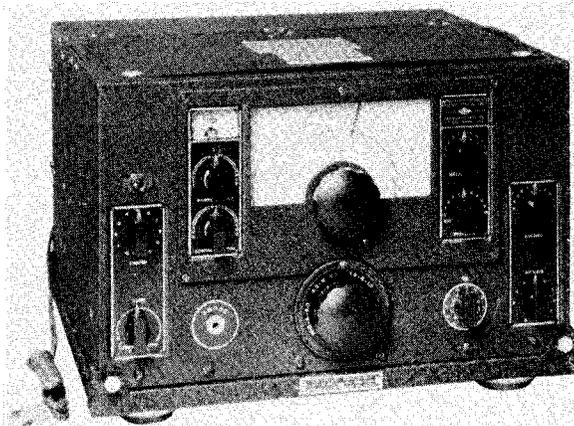
Use.—Ship-shore.

Frequency range.—540 to 30000 kc. continuously in five bands.

Power required for operation.—115¹ (± 10 percent) 1/58-62, RAO 50 watts, RAO-1, 60 watts. Plugs are provided for operation from a d-c source but the A and B units should be insulated from one another. 180 volts at 30 to 40 ma. and 6.3 at 3.45 amperes for d-c operation. Allowable variation in voltage ± 10 percent.

Description.—The models RAO, -1, -2 are basically the same type of radio equipment. Differences include a change in housing and mounting rack and a slight modification of the rectifier. The RAO-1 included a noise suppressor circuit and the RAO-2 added a pre-selector and omitted the loudspeaker. In the RAO-2 the output impedance was dropped from 5,000 to 600 ohms but the loudspeaker terminals are in parallel with the phone jack.

These receivers, with the exception of Model RAO,



Radio receiver in mounting rack of the Model RAO-2 radio receiving equipment (front view).

may be used where radiation from the HFO is required to be less than 400 micromicrowatts at the input terminals.

The shockproof type of mounting base is attached to the table and the receiver is attached to the mounting base.

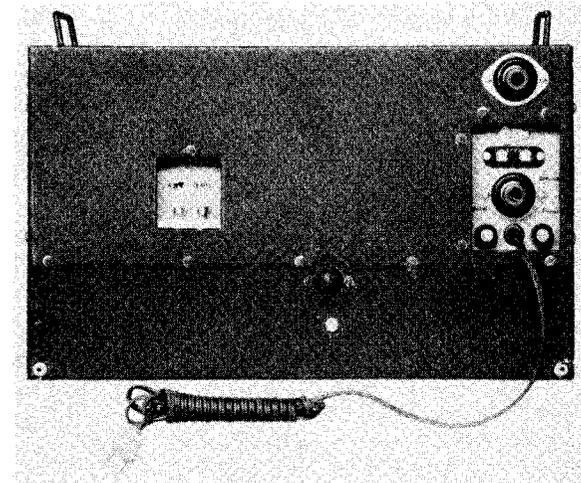
The Model RAO-2 receiving equipment has 11 tubes and comprises the following component circuits: Two stages of RF amplification, mixer, HFO, first and second IF amplifiers (455 kc.), infinite impedance diode detector, noise peak limiter, two stages of resistance coupled amplification, CW oscillator, amplified and delayed AVC, an S meter (1-9 and 0-40 db. range), and crystal filter for both selectivity and phasing adjustments, located between the first detector and the first IF.

All RF transformers are mounted in two cast alumi-

¹ RAO-4 operates on 115 or 230 volts a-c.

num catacombs having a total of 20 shielding compartments and external connections ending in protruding pins. For band set selection the entire assembly of catacombs slide the length of the chassis to make contact between the pins of the band sets and the contact springs mounted on the chassis. A screw at the right holds this band-changing mechanism and should be again used in case of reshipping.

All switches and controls have etched identification except the main tuning dial which is located in the middle of the panel. The band selector is just below the main tuning dial and has detents for aid in exactness of location. Five bands are indicated with the switching. The band in use is indicated by the tip of the pointer. There is an auxiliary to the main dial which has 100 divisions and 10 revolutions are required for 180° of the capacitor. Calibration accuracy is to within ± 3 percent.



Radio receiver in mounting rack of the Model RAO-2 radio receiving equipment (rear view).

The power "on-off" switch is located to the left of the main dial, and controls, in its different positions, the B, the primary, and heater circuits individually so that the receiver may be placed in a stand-by condition.

Located below the power switch is the control selecting AVC, MVC, and CW operation.

In the lower left corner is the tone² control which varies the frequency characteristic of the audio amplifier. "N" admits all frequencies, "low" attenuates all frequencies above 1000 and "high" attenuates frequencies below 100 cycles per second. The limiter control located on the left side of the panel, directly above the tone control, controls the d-c potential going to the limiter tube, providing a threshold at which action starts so that the larger peaks are not passed on to the audio amplifier.

² Not on the RAO but on succeeding models.

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In the lower right-hand corner is the AF gain control which regulates the voltage supplied to the grids of the AF amplifier from the load of the second detector.

Above the AF gain control is the CW vernier control which permits adjustment of the beating frequency.

To the right of the band switch is the RF gain control which regulates bias supplied to the RF tubes.

To the right of the main dial is the selectivity and phasing switch which controls the selectivity of the band pass and balances the crystal bridge circuit for the elimination of interfering signals and heterodynes.

An S meter is included to give an indication of signal strength. A switch is provided to render meter inoperative or operative, as desired.

A headphone jack is on the panel offering an impedance of 600 ohms balanced with respect to the chassis and undistorted power of 0.3 watt. The loudspeaker terminals are in parallel and therefore have the same electrical characteristics.

Antenna length is not critical for a single wire antenna which may vary from a minimum of 50 feet to a maximum of 200 feet. A low impedance transmission line may be used with an impedance of not less than 70 ohms.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|-------------------------------------|-----------------|----------------------|
| RAO-2 receiver: | | |
| First and second RF amplifiers..... | 12 | 6K7 |
| First detector..... | 1 | 6J7 |
| First and second IF amplifiers..... | 2 | 6K7 |
| Second detector and limiter..... | 1 | ² 6C8G |
| First audio amplifier AVC..... | 1 | ³ 6F8G |
| Second audio amplifier..... | 1 | ⁴ 6K6GT/G |
| HF oscillator..... | 1 | ⁵ 6J5 |
| CW oscillator..... | 1 | 6J7 |
| Rectifier..... | 1 | ⁶ 5Z3 |
| Total..... | 11 | |

¹ Only 1 in RAO and RAO-1.
² 6C5 in RAO.
³ 6J7 in RAO.
⁴ 6V6 in the RAO and RAO-1.
⁵ 6J7 in RAO and RAO-1.
⁶ 80 in RAO.

Type of receiver.—Superheterodyne.

Type of reception.—CW, MCW, and voice.

Input.—Grounded or balanced line.

Input impedance.—Not less than 70 ohms for a balanced line.

Output.—RAO and RAO-1, 2 watts at 5,000 ohms and 12 mw. at 600 ohms. RAO-2 600 ohms.

Output power.—0.3 watt undistorted.

Sensitivity.—For 6 mw. of power output. MCW—15 microvolts or better for frequencies below 14000 kc.; 20 microvolts or better for frequencies above 14000 kc. CW—10 microvolts or better for frequencies below 14000 kc.; 15 microvolts or better for frequencies above 15000 kc.

Antenna.—50- to 200-foot single wire or balanced line may be used.

Radiation frequencies.—RAO-1, -2, -3, safe—all; RAO, unsafe—all.

Band coverage:

| Band: | Frequency range (kc) |
|--------|----------------------|
| 1..... | 540 to 1300 |
| 2..... | 1300 to 2800 |
| 3..... | 2800 to 6400 |
| 4..... | 6400 to 14000 |
| 5..... | 14000 to 30000 |

Weights, dimensions, and Navy type numbers

| Unit | Type No. | Height | Width | Depth | Weight |
|---|-----------|---|--|---|---------------------------------|
| RAO-2 Receiver ¹ | CNA-46187 | <i>Inches</i> 17 ³ / ₈ | <i>Inches</i> 10 ¹ / ₃₂ | <i>Inches</i> 17 ¹ / ₄ | <i>Pounds</i> 74 |
| Mounting base ¹ | CNA-10125 | 17 ² / ₃₂ | 12 ¹ / ₃₂ | 17 ¹ / ₈ | 5 ³ / ₄ |
| Loud speaker ¹ (not supplied with this model). | | | | | |
| One set of spare parts (packed) | | | | | 34 |
| Total weight..... | | | | | 113 ³ / ₄ |

¹ RAO: 19" Mounting rack CNA-10032, receiver CNA-46072, height 7 inches; loudspeaker CNA-49092, height 10¹/₂ inches. No shock mounting.
 RAO-1: Mounting rack CNA-10032, receiver CNA-46088, height 11 inches, depth 13 inches, width 17¹/₂ inches, weight 55 pounds, gross 85 pounds; loudspeaker CNA-49106, height 9¹/₂ inches, depth 7³/₈ inches, width 10¹/₄ inches, weight 11 pounds. No shock mounting.
 RAO-3: Mounting base CWQ-10125-A; receiver CWQ-46187-A.
 RAO-4: Shore-mounting base CWQ-10125-A; receiver CWQ-46187-B; and vibrator power supply CNA-20146.



ANTENNA TERMINATION MODIFICATION KITS FOR THE RAO-2, RBH-1 AND RBL-2 RADIO RECEIVING EQUIPMENTS

Use.—Ship, shore.

Description.—The modification permits the use of a type CNA-49490 and a type CNA-49491 concentric patchcord assembly for connecting the receiver unit to the antenna transmission line for the RAO-2, RBH-1, and the RBL-2 radio receiving equipments, respectively. This modification provides a completely shielded antenna circuit to reduce interference to an acceptable level. It consists basically of attaching the antenna jack box assembly to the receiver cabinet. The

insertion of the antenna jack, which is also provided, into the receptacle in the antenna jack box provides the connection between the antenna and receiver unit.

Dimensions and Navy type number

| Unit | Navy type No. | Width | Length | Depth |
|-----------------------|----------------------------|--|---|--|
| Antenna jack box..... | { CNA-49490 CNA-49491 } | <i>Inches</i> 3 ¹ / ₂ | <i>Inches</i> 3 ³ / ₃₂ | <i>Inches</i> 12 ⁷ / ₁₆ |

RAS
RAS-1
RAS-2
RAS-3
RAS-4
RAS-5

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RAS SERIES RADIO RECEIVING EQUIPMENTS

Use.—Ship-shore; primarily shore.

Frequency range.—190 to 30000 kc. in seven bands.

Power required for operation.—110-120/1/50-60, 110-120/1/25 and battery.

Description.—The Model RAS series radio receiving equipments consist of a nine tube rack-mounted super-

one set of elements of a dual triode; the other set of elements is utilized for amplified and delayed automatic volume control. A beat frequency oscillator is coupled to the second detector to provide for CW reception. Seven coil set assemblies cover the frequency range as plug in units.

Two audio-output circuits are provided: (1) A phone jack is mounted on the front panel. This jack is fed from the secondary of the audio output transformer giving 10 mw. of undistorted audio power into a load impedance of 600 ohms. Plugging in the phone jack opens the loudspeaker circuit; (2) from the loudspeaker terminals at the rear of the chassis, a nominal 2 watts of undistorted power is available, when working into an impedance of 5,000 ohms.

Antenna input terminals located at the left side of the chassis and the input circuit are suitable for operation with a single wire antenna or a balanced feed line.

Either power unit provides both plate and filament supply.

The rack mounted loudspeaker has an over-all diameter of approximately 8 inches and is fitted with a 5,000-ohm coupling transformer for impedance matching. Electrical characteristics are the same for the table mounting type. The mounting rack is built to accommodate standard 19-inch relay rack panels and has a total panel capacity of 35 inches. It holds the receiver with one tuning unit at the bottom. Next above is the coil system container which holds 6 plug-in coil sets, and above this is the power unit and the rack mounted type of speaker.

A terminal panel marked "BSW" (B-plus switch) is mounted at the rear of the receiver chassis on which two terminals are provided which are connected in parallel with the B-plus switch. These terminals provide a convenient means for remote control of the equipment by employing a suitable relay or switch.

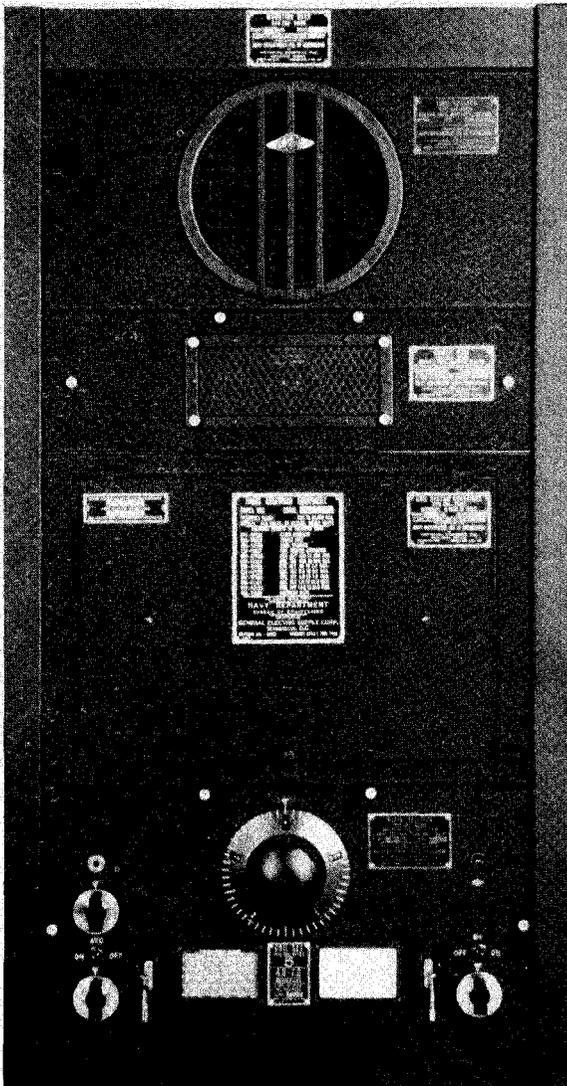
TECHNICAL FEATURES

Tube complement

| Location | Number of tubes | Navy type | Commercial type |
|----------------------------|-----------------|-----------|-------------------|
| First detector | 1 | 38636 | 6C6 |
| HF oscillator | 1 | 38636 | 6C6 |
| CW oscillator | 1 | 38636 | 6C6 |
| First RF amplifier | 1 | 38646 | 6D6 |
| Second RF amplifier | 1 | 38646 | 6D6 |
| First IF amplifier | 1 | 38646 | 6D6 |
| Second IF amplifier | 1 | 38646 | 6D6 |
| Second detector, AVC | 1 | 38768F | 6F8G |
| Audio amplifier | 1 | ----- | ¹ 6V6G |
| Rectifier | 1 | 38593 | 5Z3 |
| Total | 10 | ----- | ----- |

¹ 6V6GT may be substituted.

Antenna.—The dimensions for the single-wire antenna are not critical but 50-foot minimum and 200-foot maximum length is recommended.



Radio receiver, coil container, power supply, loud speaker and mounting rack of the Model RAS-5 radio receiving equipment (front view).

heterodyne suitable for CW, MCW and voice reception by phones or loudspeaker.

The circuit employed on all ranges comprises two stages of radio frequency amplification, first detector, high-frequency oscillator, two stages of intermediate frequency amplification operating at 175 kilocycles, a bias type triode second detector and a resistance coupled audio output stage. The second detector tube utilizes

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Balanced feed line may also be used.
Band coverage.—190 to 30000 kc.

| Band | Type coil set | Frequency range |
|--------|---------------|------------------|
| 1..... | CNA-47156 | 190 to 450 kc. |
| 2..... | CNA-47157 | 450 to 900 kc. |
| 3..... | CNA-47158 | 900 to 2000 kc. |
| 4..... | CNA-47159 | 2.0 to 4.0 mc. |
| 5..... | CNA-47160 | 4.0 to 7.0 mc. |
| 6..... | CNA-47161 | 7.0 to 14.0 mc. |
| 7..... | CNA-47162 | 14.0 to 30.0 mc. |

Type of receiver.—Superheterodyne.

Type of reception.—CW, MCW, and voice; ±5 db. frequency response from 50 to 2,000 cycles.

Input.—Loose coupling to tuned circuits; the input impedance averages 500 ohms when using coil sets types CNA-47159 to 47162, inclusive, having a total frequency range of from 1700 to 30000 kc. Coil sets types CNA-47156 to 47158, inclusive, have higher values but in no case does the impedance exceed 5,000 ohms.

Power output.—10 mw. for 600-ohm phones, 2 watts for 5,000-ohm loudspeaker.

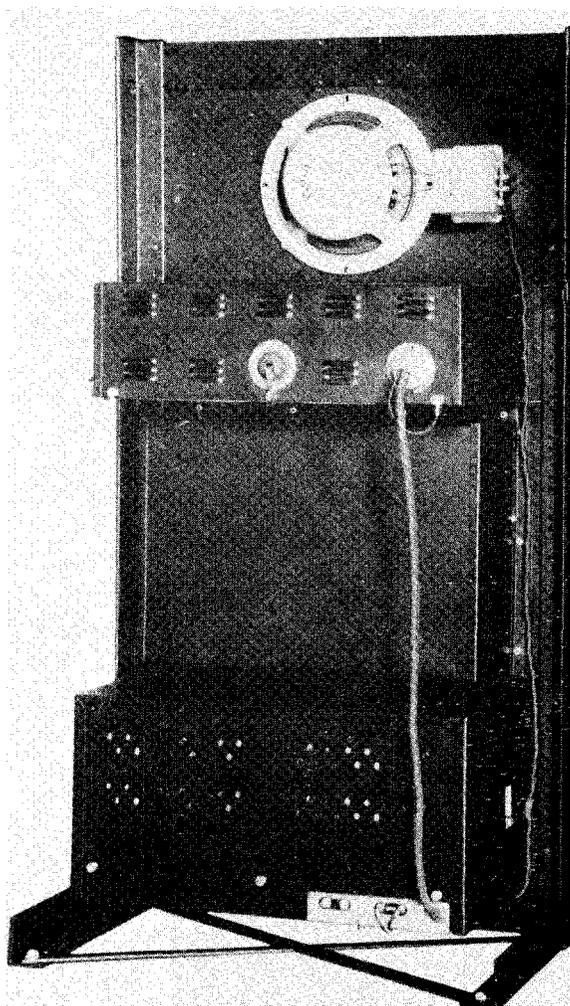
Weights, dimensions, and Navy type numbers of equipment units included in the contract

| Unit | Type No. | Height | Width | Depth | Weight |
|--|-----------|-----------------|-------|--------------------|--------|
| Radio receiver (with 1 coil set)..... | CNA-46080 | 8¾ ¹ | 19.0 | 10½ | 35 |
| Power unit (60-cycle)..... | CNA-20090 | 5¼ | 19.0 | 9¾ | 22 |
| Loudspeaker (rack mounting)..... | CNA-49105 | 8¾ | 19.0 | 4¼ ⁶ | 9 |
| Coil system container (including 6 coils)..... | | 12¼ | 19.0 | 1 5/8 ² | 26 |
| Mounting rack..... | CNA-10036 | 39½ | 20½ | 2 12¼ | 27 |
| Power unit (25-cycle)..... | CNA-20089 | 5¼ | 19.0 | 9¾ | 27 |
| Loudspeaker table mounting..... | CNA-49106 | 9 3/8 | 10¼ | 7¼ | 11 |
| Spare parts packed for equipments with type 20090 power unit..... | | | | | 21 |
| Spare parts packed for equipments with type 20089 power unit..... | | | | | 26 |
| Total weight of equipment, including spare parts with type 20090 power unit..... | | | | | 140 |
| Total weight of equipment, including spare parts with type 20089 power unit..... | | | | | 150 |

¹ Door swings to the front 10½ inches.

² 13¾ including tuning dial of receiver when in place. Base only for floor support 12¾ inches high.

Sensitivity for 6 mw. of output power.—MCW-7 microvolts or better from 0.435 to 30 mc.; CW-12 microvolts or better from 0.19 to 30 mc.



Radio receiver, coil container, power supply, loud speaker and mounting rack of the Model RAS-5 radio receiving equipment (rear view).

I-F MODIFICATION KIT FOR RAS SERIES RADIO RECEIVING EQUIPMENTS

Use.—Ship, shore.

Description.—This modification kit is for the purpose of converting the Navy type 46080 receiving equipment, which has a narrow IF pass band, to the Navy type 46080A receiving equipment which has a wide IF pass band. A typical selectivity characteristic of the type 46080A radio receiver is as follows:

| Attenuation (db.): | Total band width (kilocycles) |
|--------------------|-------------------------------|
| 0..... | 0 |
| 6..... | 13.5 |
| 20..... | 22.0 |
| 40..... | 33.5 |
| 60..... | 51.5 |
| 80..... | 75.0 |

The description contained in the Instruction Book for the Model RAS series equipment is applicable to

the converted equipment except as indicated above. The parts list for the type 46080A radio receiver is the same as for the type 46080 radio receiver except for the following items which are furnished with the modification kits:

Two (2) Navy type 47340 IF transformers to replace the National type IFC-88 transformers in circuit positions T-101 and T-102.

One (1) Navy type 47341 IF transformer to replace National type IFC-89 transformer in circuit position T-104.

One (1) Navy type 481072 capacitor to be connected in parallel with capacitor C-137.

One (1) name plate bearing type designation 46080A to replace the original name plate.

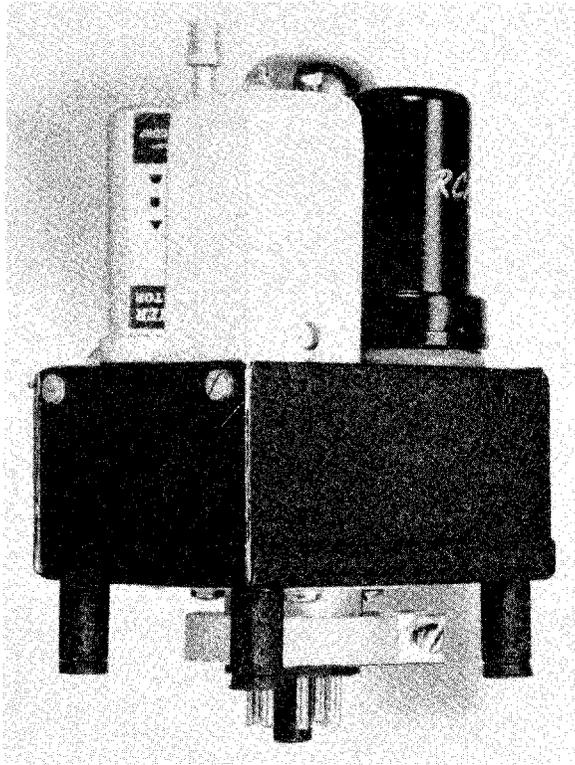
Complete instructions for performing the modification are included with each modification kit.



NOISE PEAK LIMITER KIT FOR RAS SERIES RADIO RECEIVING EQUIPMENTS

Use.—Ship, shore.

Description.—The type 50142 noise peak limiter is an adaptor designed for use in the models RAS series



Noise peak limiter for Model RAS series radio receiving equipments.

radio receiving equipments. Installation of the limiter is a simple operation which can be completed in a few minutes. It requires the removal of the 6F8G second

detector and AVC tube, and placing the adaptor in its socket. The grid connection is placed on a special lug which connects to a shielded tuned circuit through a series capacitor. The adaptor fits in the receiver with satisfactory clearance to the neighboring shield cans. A clamp is provided on the unit to secure it to the receiver chassis, thus preventing the adaptor from working out of the tube socket as a result of vibration and/or shock.

The noise peak limiter is of the series type. Installing the adaptor removes the dual triode 6F8G detector, AVC tube and replaces it with a diode detector of the type 6SQ7. The triode section is used as an audio amplifier to compensate for the gain loss caused by the substitution of a diode for a triode. A 6SN7 double triode has one section connected as the noise limiter and the other section is used to replace the AVC triode section of the original 6F8G.

The operation of the adaptor in the RAS series equipments greatly reduces the effects of pulse type noise picked up by the antenna system. Maximum benefit from the limiter can be secured only if the receiver's RF and AF gain controls are properly set. If the RF gain control is too high, saturation limiting occurs ahead of the limiter action and the limiter appears to be ineffective. If the gain control is set too low, the peaks pass the limiter without becoming clipped. The setting of the controls are not critical but the operator should become familiar with the effective use of the adaptor to obtain proper results.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|--------------------------------|-----------------|------|
| Detector and AF amplifier..... | 1 | 6SQ7 |
| Noise limiter and AVC..... | 1 | 6SN7 |
| Total..... | 2 | |

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RAW RADIO RECEIVING EQUIPMENT

Use.—Ship-shore.

Frequency range.—175 to 400 kc.; 480 to 30,000 kc.

Power required for operation.—110-120/1/50-60, 70 watts; 110-120/1/25, 70 watts; battery 6.2 volts at 3.4 amperes and 180 volts at 55 milliamperes.

Description.—The Model RAW radio receiving equipment is a nine tube superheterodyne suitable for receiving CW, MCW, and voice by headphones or loudspeaker.

Two stages of RF amplification are employed together with first detector, high frequency oscillator, two stages of IF amplification, second detector with delayed AVC and resistance coupled audio output stage. A beat frequency oscillator is coupled to the second detector to provide for CW reception. Seven coil set assemblies cover the entire frequency range as plug-in units.

Two audio output circuits are provided—one of 5,000-ohm impedance delivering 2 watts of audio power for the loud speaker and the other of 600-ohm impedance delivering 10 mw. of audio power for headphone operation. Loudspeaker terminals are located at the rear of the chassis; headphone connection is made by means of a phone jack mounted on the front panel. This jack is so wired that insertion of phone plug renders the loudspeaker inoperative.

The equipments are of the self-supported rack-mounted type with racks suitable for table mounting.

The antenna terminals are located at the left side of the chassis. The input circuit is suitable for operation with either a single wire antenna or a balanced feed line.

Seven four-gang coils cover the frequency range and the mounting rack provides for holding six. The main tuning dial which drives the four-gang tuning capacitor is located in the center of the panel. Each coil set is fitted with a calibration chart showing the relationship between dial reading and frequency.

A terminal panel marked "BSW" (B-plus switch) is mounted at the rear of the receiver chassis on which two terminals are provided which are connected in parallel with the B-plus switch. These terminals provide a convenient means for remote control of the equipment by employing a suitable relay or switch.

TECHNICAL FEATURES

Type of receiver.—Superheterodyne.

Type of reception.—CW, MCW, and voice.

Input.—Loose coupling to tuned circuit; the input impedance averages 500 ohms when using coil sets types CNA-47166 to 47169, inclusive, having a total

frequency range of 2000 to 30000 kc. Coil sets types CNA-47163 to 47165, inclusive, have higher values of input impedance but in no case does the impedance exceed 5,000 ohms.

Tube complement

| Function | Number of tubes | Navy type | Commercial type |
|-------------------------|-----------------|-----------|-----------------|
| First RF amplifier | 1 | 38646 | 6D6 |
| Second RF amplifier | 1 | 38646 | 6D6 |
| First detector | 1 | 38636 | 6C6 |
| HF oscillator | 1 | 38636 | 6C6 |
| First IF amplifier | 1 | 38646 | 6D6 |
| Second IF amplifier | 1 | 38646 | 6D6 |
| Second detector and AVC | 1 | 38768F | 6F8G |
| CW oscillator | 1 | 38636 | 6C6 |
| Audio amplifier | 1 | | 6V6G |
| Rectifier (full wave) | 1 | 38593 | 5Z3 |
| Total | 10 | | |

Power output.—10 mw. for 600-ohm phones; 2 watts for 5,000-ohm loudspeaker.

Sensitivity.—Not given.

Antenna.—Single line antenna or balanced feed line.

Band coverage.—175 to 400, 480 to 30000 kc.

| Band number | Type coil set | Frequency range |
|-------------|---------------|-----------------|
| 1 | CNA-47163 | 175 to 400 kc. |
| 2 | CNA-47164 | 480 to 900 kc. |
| 3 | CNA-47165 | 0.9 to 2 Mc. |
| 4 | CNA-47166 | 2.0 to 4 Mc. |
| 5 | CNA-47167 | 4.0 to 7 Mc. |
| 6 | CNA-47168 | 7.0 to 14 Mc. |
| 7 | CNA-47169 | 14.0 to 30 Mc. |

Weights, dimensions, and Navy type numbers of equipment units included in the contract

| Unit | Type No. | Height | Width | Depth | Weight |
|--|-----------|----------------------|-------|-------|--------|
| Radio receiver | CNA-46081 | Data to be supplied. | | | 35 |
| Power unit | CNA-20090 | | | | 22 |
| Loudspeaker (rack mounting) | CNA-49105 | | | | 9 |
| Coil system container including six coil sets. | CNA-10037 | | | | 26 |
| Mounting rack | CNA-10036 | | | | 27 |
| Power unit | CNA-20089 | | | | 27 |
| Loudspeaker (table mounting) | CNA-49106 | | | | 11 |
| Spare parts packed for equipments with type 20090 power unit 110-120/1/50-60 | | | | | 21 |
| Spare parts packed for equipments with type 20089 power unit 110-120/1/25 | | | | | 26 |
| Total weight of equipment, including spare parts with type 20090 power unit | | | | | 140 |
| Total weight of equipment, including spare parts with type 20089 power unit | | | | | 150 |

RAZ AND RAZ-1 RADIO RECEIVING EQUIPMENTS

Use.—Ship.

Frequency range.—15 to 600 kc. in four bands.

Power required for operation.—115/1/50-60, 40 watts; or 6 volts "A" and 90 volts "B" from batteries. Pre-selector, 6 volts at 0.3 amperes 90 volts at 8.0 ma. (lower drain occurs with reduced volume setting).

Description.—The Models RAZ, -1 radio receiving equipments are designed for medium and low frequency reception. The RAZ equipment was supplied as a receiver for battery operation only. The RAZ-1 equipment includes a rectifier power supply and a preselector unit. Either model may be operated on batteries or power supply with the required source of voltage and current.

The circuit used in the receiver involves four tubes: RF amplifier, regenerative detector, AF amplifier, and AF output. The preselector unit has one stage of RF increasing the preselection gain and reducing the undesirable radiation to a negligible degree.

The rectifier power supply and preselector are separate units to be located on either side of the receiver.

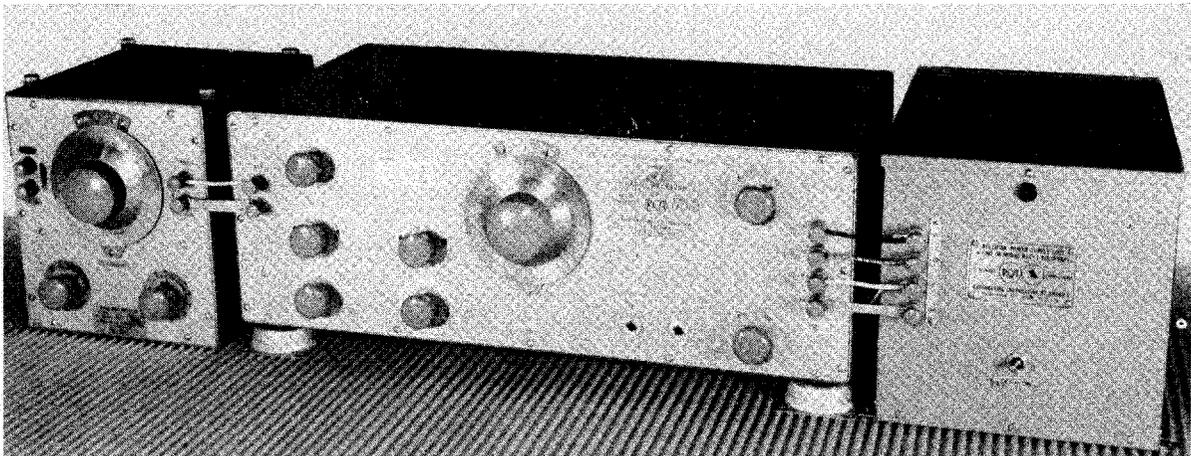
Regeneration control is obtained by means of a second potentiometer which controls the screen voltage on the regenerative detector. Fixed coupling is used between the amplifier plate coils and the detector tickler coils.

Separate coils are used on each band range so that stable operation is obtained without dead spots or other erratic performance which might result from tapped coils.

The "on and off" switch controls the positive side of the 90-, 22-, and 6-volt circuits.

A crystal detector is mounted on the rear of the removable tube door for emergency operation when no spare tubes are available or if receiver power supply is disabled.

The preselector unit has one stage of RF amplification. Front panel controls are as follows: Frequency-range selector switch, main tuning control, and volume control with preselector and "on and off" switch attached. Power for the preselector is taken from the receiver power supply. A shielded cable is provided for connection of the preselector to the receiver.



Model RAZ-1 radio-receiving equipment.

The following controls are provided on the receiver: antenna coupling, volume, regeneration, trimmer, main tuning range selector switches (2), first and second stage AF jacks and "on and off" switch.

There are three tuned circuits and four sets of coils which are built in the receiver to cover the four bands in the frequency range. The main tuning condenser is a three-gang unit and provides for the tuning of a pre-selector circuit which is coupled to the antenna (or preselector unit), the RF amplifier grid circuit, and the RF amplifier plate circuit. A small trimmer condenser adjustable from the front panel is also used in the RF amplifier grid circuit. The antenna (or preselector unit) is coupled to the preselector tuned circuit of the receiver through a small, variable condenser. The preselector circuit is coupled to the RF amplifier grid circuit inductively, using fixed coupling between coils. Volume control is obtained by means of a potentiometer which applies a bias to the cathode of the RF tube.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|--------------------------------|-----------------|-------|
| Receiver: | | |
| RF amplifier..... | 1 | 6K7 |
| Regenerative detector..... | 1 | 6K7 |
| First audio amplifier..... | 1 | 6K7 |
| Second audio amplifier..... | 1 | 6F6 |
| Preselector: RF amplifier..... | 1 | 6SG7 |
| Power supply: Rectifier..... | 1 | 5W4 |
| Total..... | 6 | ..... |

Type of receiver.—Tuned radio frequency with one (RAZ) or two (RAZ-1) stages of preselection.

Type of reception.—CW, MCW, and voice.

Input.—Grounded.

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Input impedance.—20,000 to 100,000 ohms.

Output.—For high impedance telephone receivers of approximately 2,000 to 3,000 ohms on D. C. If low-impedance headphones are to be used, it is necessary to employ an external matching transformer. Such a transformer, when the headphone load is on the secondary, should have a primary impedance of 50,000 to 100,000 ohms with a primary winding capable of carrying 10 ma. D. C.

Output power.—For headphones only.

Sensitivity.—30–500 microvolts for 6 mw. in headphones. Higher values required for range 1 (15 to 40 kc.).

Antenna.—Grounded straight wire 75 to 250 feet; length not critical.

Band coverage:

| | |
|---------------|------------------------------|
| Range: | <i>Frequency range (kc.)</i> |
| 1..... | 15 to 40 |
| 2..... | 40 to 100 |
| 3..... | 100 to 250 |
| 4..... | 250 to 600 |

Weights, dimensions, and Navy type numbers included in the contract

| Unit | Type No. | Height | Width | Depth | Weight |
|------------------------------------|-----------|-------------------------------|--------------------------------|--------------------------------|------------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Receiver..... | CRM-46092 | 8 ³ / ₄ | 20 ¹ / ₂ | 12 ³ / ₄ | 29 |
| Rectifier power supply..... | CRM-20096 | 8 ³ / ₄ | 20 ¹ / ₂ | 12 ³ / ₄ | ----- |
| Preselector unit..... | CRM-50092 | 8 ¹ / ₂ | 7 ³ / ₄ | 9 ¹ / ₁₆ | ----- |
| Complete equipment boxed case..... | ----- | 30 | 22 | 26 | ¹ 135 |

¹ Gross.



RBA SERIES RADIO RECEIVING EQUIPMENTS

Use.—Ship and shore.

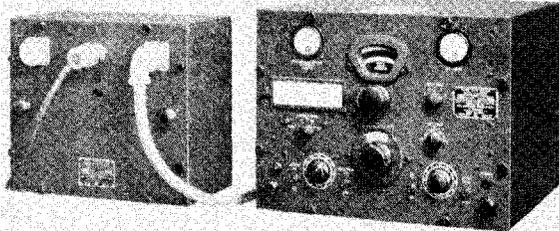
Frequency range and number of bands.—15–600 kc. in four bands (15–38) (38–95) (95–235) (235–600) kc.

Power required for operation.—110/115/120/1/55–65, 66 watts.

Description.—The Models RBA, RBA-1, RBA-2, and RBA-3 radio receiving equipments have been designed for use aboard ship and at shore stations. They are identical, except for nameplates, this difference being due to different contract data.

The equipment is designed for the reception of pure, modulated, or interrupted continuous wave radio frequency signals. Voice reception is possible, but due to the high order of selectivity, and to the characteristics of filters employed in the radio-frequency amplifier, some intelligibility of speech is sacrificed at frequencies below 300 kc. A separate power unit supplies all power necessary for the operation of the equipment upon connection to a suitable power source. A d-c voltmeter on the front panel indicates power supply voltage.

Band selection is accomplished by panel controlled moving switch sections driven by a square shaft through a gear reduction mechanism provided with detents for



Type CFT-46154 receiver and type CRV-20130 rectifier power unit of the Model RBA radio-receiving equipment.

each band. A coupling switch provides for the selection of one of 5 degrees of capacitive coupling between the antenna and first-tuned circuits. By proper adjustment of this switch, and the antenna compensator control, the input circuit may be resonated over a wide range of antenna and transmission line capacitive values.

Tuning is accomplished by a panel-control-operated five-gang variable capacitor which tunes the input, RF amplifier, and heterodyne oscillator circuits. A calibrated frequency scale indicates the frequency of received signals within a limit of plus or minus 1 percent accuracy. A linear vernier dial scale and calibration charts are provided to facilitate station logging.

A manual gain control operates potentiometers in the RF and AF stages tapered in such manner that, as the control is turned clockwise, gain is increased first in the RF stages, and subsequently in the audio frequency unit. Substantially uniform gain over a given band is obtained by a rheostat geared to the main tuning control. Output level is limited in the usual manner, and may be set at a predetermined value by the output level control, or turned off by a panel

switch. An output meter indicates this level correctly for a 600-ohm output impedance.

The audio “broad-sharp” switch provides for switching either of two filters into the circuit just following the detector. The “broad” position selects a low-pass filter which cuts off at approximately 1300 cycles. The band-pass filter selected by the “sharp” position, is 300 cycles wide, and is centered at 1000 cps.

The CW (heterodyne) oscillator is turned “on” or “off” by the panel CW-MOD switch. The desired oscillator coil is selected and tuned by the band switch and main tuning control, respectively.

Negative feedback providing automatic regulation of the receiver output as a function of load resistance, permits from one to twenty 600-ohm headsets to be connected across the output circuit with less than 40 percent change in output voltage.

Shielding in the equipment is sufficient to make it nonradiating. To guard against the entrance of strong radio frequency fields, the rear of the output meter and plate voltmeter are enclosed in shields and all major shafts extending through the front panel are grounded.

Two of these receiving equipments may be operated from a common antenna or transmission line. Additionally, in order to provide for emergencies the power unit is designed and equipped for the operation of two receivers.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|---|-----------------|--------------------|
| Antenna circuit protection (neon bulb)..... | 1 | T-2 (NE-2 bulb) |
| RF amplifiers..... | 3 | 6SK7 |
| Detector..... | 1 | 6J5 |
| Oscillator (heterodyne)..... | 1 | 6SK7 |
| AF amplifiers..... | 2 | 6SK7 |
| AF output amplifier..... | 1 | 6K6-GT |
| Rectifier..... | 1 | 5U4G |
| Voltage regulator..... | 1 | VR105-30 |
| Total..... | 11 | |

Type of receiver.—T. R. F.

Input.—Grounded.

Input impedance: Adjustable over wide range.

Output impedance: 600 ohms.

Power output.—50 milliwatts into 600-ohm load, 500 milliwatts into 30-ohm load.

Radiation frequencies: safe—all.

Weights, dimensions, and Navy type numbers

| Unit | Type No. | Width | Depth | Height | Weight |
|------------------------------|-----------|---------------|---------------|---------------|---------------|
| RBA, RBA-1, RBA-2, RBA-3: | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Receiver unit..... | CFT-46154 | 18½ | 17½ | 13¾ | 95 |
| Power unit..... | CRV-20130 | 15 | 9¾ | 13½ | 52 |

Accessories not supplied by contract.—One headset, with Navy type C-49434 head-telephone plug; one receiving antenna.

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RBB SERIES AND RBC SERIES RADIO RECEIVING EQUIPMENTS

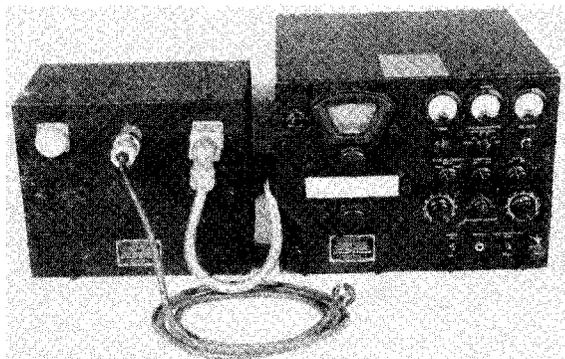
Use.—Ship-shore.

Frequency range.—RBB—0.5 to 4.0 mc.; RBC—4.0 to 27.0 mc.

Power required for operation.—110/115/120/1/55—62 67/100 watts for one receiver, 100/160 watts for two receivers when operated as an emergency measure.

Description.—The Models RBB and RBC equipments are similar in construction employing as many common components and subassemblies as is compatible with the different frequency coverages. Each receiver unit consists of two subassemblies, a preselector RF unit, and an IF/AF unit. These two assemblies are bolted together and housed in a single cabinet. The power units for both classes of equipment are identical.

The two preselector units of both models RBB and RBC are of similar design employing the same panel arrangement except for frequency calibration. They differ as to tube complement, coil boxes, coil box connections and antenna connections. Both units employ unit type construction which offers advantages as to serviceability. IF/AF units of both are identical except for audio filter.



Receiver and rectifier power unit of the RBC radio-receiving equipment

The equipments are designed for bolting to the top of a table using the rubber shock absorber mountings supplied with the receiver unit cabinet. Clearance of at least 4 inches (preferably 5) should be provided at the rear of the receiver units in order to permit removal of cables and provide movement clearances in case of severe shock.

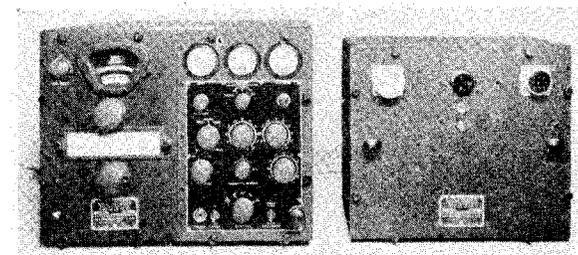
The receiver unit is connected to the power unit by means of the 6 foot, nine conductor, shielded interconnecting cable supplied with the power unit. A shielded cable should be attached to the output plug which connects at the output receptacle in back of the receiver. The cable shield should be bonded to the shell of the plug. The antenna connection should be made with a flexible shielded transmission line, the outer shell being grounded to the metal shell of the plug furnished. A copper-ground strap is recommended for grounding interconnecting cables but sufficient slack should be allowed for free movement of the receiver unit on its shock mountings.

The pre-selector circuit of either Model RBB or RBC includes a two-stage RF amplifier, heterodyne

oscillator, and first detector. Five tuned circuits are used, two preceding the first RF, two as interstage coupling, and one in the HF oscillator. The gain and the selectivity of the RF amplifier stages is properly distributed to insure optimum performance as regards interference from strong signals near resonance and to minimize spurious responses, cross modulation and blocking effects. The RF gain is limited in order to minimize strong signal interference, but is made large enough to insure that there will be no appreciable reduction in the signal-to-noise ratio from the optimum value.

The frequency ranges are covered in four bands. Switching for operation on a particular band is accomplished by means of a gang switch operated from a single control on the front panel.

The RF input connection for the pre-selector units is a concentric jack located at the rear of the unit. This jack connects to a terminal board carrying link connectors for adapting the input circuit to the various operating conditions. For operation of a single equipment from a simple antenna or transmission line, the link connectors provide for connecting the input to either of two input systems designed to match the



Type CRV-46147 receiver and type CRV-20130 rectifier power unit of the Model RBB radio-receiving equipment.

antenna impedance or line impedance as the case may be. For common operation of RBC and RBB equipments from a single antenna, a decoupling capacitor is employed in series with the RBC input circuit. For transmission line input the coupling system for either model consists of separate coupling coils for each band magnetically coupled to the low potential side of the respective first tuned circuits. These coupling coils are designed to match the receiver input to an average of 70 ohms resistance over each frequency band.

For antenna input, the model RBC antenna input coupling system is similar to the line input system except that the coupling coils are designed to match the receiver input to an average of 300 ohms resistance at the low-frequency end of the equipment range and to an average of 400 ohms resistance at the high-frequency end. In the Model RBB equipment the input coupling coils are designed to resonate in conjunction with the antenna at a frequency below the low limit of the particular band and to match the receiver input to impedances varying from approximately 300 ohms at the high-frequency end of the equipment range to 1,500 ohms at the low-frequency end. In addition to

RBB
RBB-1
RBB-2
RBC
RBC-1
RBC-2

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regular trimmers, an additional trimmer capacitor is operated from the front panel "ANT. COMP." control and permits trimming the first tuned circuit for resonance with antennas of 80 to 500 mmfd. capacity. The input circuit is protected from high RF voltages induced by local transmitters by means of a gaseous discharge tube. A trap circuit is employed in the screen circuit of the first RF tube to reduce interference from signals on the IF amplifier frequency.

Special construction provides for oscillator frequency stability and for the prevention of interstage coupling and re-radiation:

The IF/AF unit includes a 400 kc. three-stage IF amplifier, second detector, three-stage audio amplifier, CW oscillator, automatic volume control, noise-limiter circuit, silencer circuit, audio-pass filter, input-meter circuit and output-limiter circuit.

The IF transformers are designed to provide three degrees of selectivity controlled from the front panel "radio selectivity" control through a gang switch. For switching from "broad" to "medium" or "sharp" positions, the transformer design provides for limiting the band center shift to 1000 cycles or less and limiting the change in overall receiver noise level to 6 db. or less.

The diode direct current is made available for test purposes by the provision of a link connector which permits insertion of a microammeter.

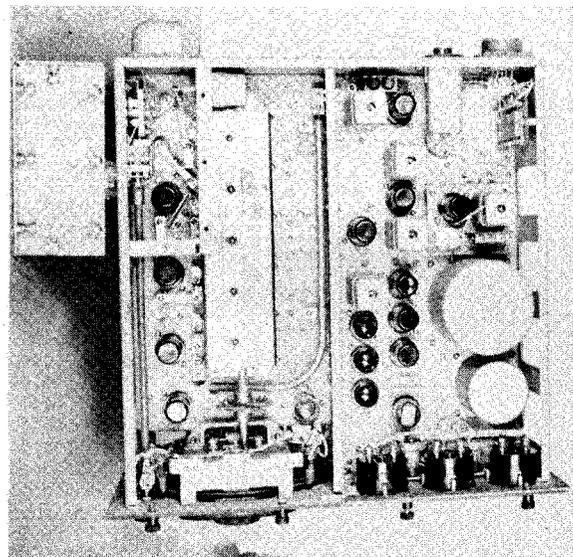
The CW oscillator is similar to the HF oscillator. A front panel "frequency vernier" control operating a capacitor is provided which permits variation of the oscillator frequency and output beat note over a limited range (between 2500 and 3500 cycles total range). The oscillator frequency is set with the vernier control zero (center of its range) at 1000 cycles (plus or minus 5 percent) higher frequency than the IF band center (400 kc.).

The output stage consists of a tube feeding the output transformer, which stage is degenerated for the purpose of holding the output voltage essentially constant for wide variations of plate loading. Thus the output winding of the transformer will supply from 1 to 20 pairs of 600-ohm headphones connected in parallel with not more than 3 db. change in output voltage. The output transformer is provided with an electrostatic shield between primary and secondary and the output winding has a grounded center tap suitable for feeding a balanced 600-ohm line. The output winding is parallel connected to a headphone jack on the front panel and an output receptacle mounted at the rear of the IF/AF unit. Both of these output connections are suitably filtered to minimize pick-up from local transmitters.

The output transformer has a separate secondary winding which is connected to the output meter and output range switch. This secondary winding is so related to the output winding that the output meter indicates zero db. for 60 microwatts into 600 ohms at the output winding with the switch in the "direct" position. The other positions of the switch operate in conjunction with a resistance network to tap the meter down in steps of 10 db., 20 db., and 30 db., and to provide an "off" position which disconnects the meter from the circuit.

A "noise limiter" circuit is included in the IF/AF unit. It is controlled by a switch on the front panel. When in the "on" position a diode tube is in series with the input to the first audio-amplifier stage. Excessive signal cuts off momentarily the output to the audio amplifier. Some distortion is thereby introduced on signals modulated in excess of 40 percent but under conditions of noise interference the overall intelligibility is not seriously affected. Provision is made, for its operation on CW, for it to function on lower noise pulses.

A "silencer" circuit is placed in operation in one position of the "Reception" transfer switch. The diode placed in the circuit is conductive for a carrier of a predetermined value. But the output to the audio is cut off or the plate current is held practically constant



Model RBC radio receiver, top view, shield covers removed.

for values of impulses that are radically above or below the value of the carrier.

The output-limiter circuit is designed primarily for telegraph reception and functions to hold the output constant for wide variations of input. The circuit is instantaneous in operation and limits short keyed characters as well as sustained signal inputs. The circuit employs two diodes connected in the form of a full-wave rectifier in shunt with the plate load of a tube in order to limit both sides of the cycle. A delay bias is applied to the limiter diodes and adjusted by means of a potentiometer operated from the front panel "output level" control. The bias control thus operates as an output-level control.

The audio band-pass filter is connected into the circuit by means of the "audio selectivity" switch on the front panel. The two units differ as to the pass band width, 200 cycles at 6 db. attenuation for the RBB filter and 300 cycles for the RBC, the wider band being used in the RBC equipment to facilitate tuning at the higher frequencies. When the filter is switched out of the circuit a pad resistance is inserted which is

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adjustable and permits adjustment of the gain with the filter in the circuit to between 3 and 5 db. greater than the gain with the filter out.

A "gain" control is provided in the IF/AF unit, which varies the gain of both the IF/AF unit and the pre-selector unit. A dual potentiometer is used having specially tapered resistor elements which operate to reduce the IF gain a certain amount before the RF gain is reduced which permits operation of the RF tubes under optimum conditions for signal-to-noise ratio on weak signals.

An "input" meter is included in the IF/AF unit circuit. The meter is connected through the "reception" transfer switch in such a manner that it is operative only in the "MOD-AVC" and the "MOD-AVC-SIL" positions. In these positions the AVC is operative and varies the bias on the first IF tube in proportion to the input signal level. The tuning meter is connected across the cathode resistor. Variation of the bias results in voltage variations across the resistor due to plate current variation. The deflection on the meter thus indicates signal input level. The meter is calibrated in decibels above one microvolt up to 120 decibels or one volt input.

A master "reception" transfer switch is employed to effect circuit changes as required by the various conditions of reception provided. The switch has five positions "MOD-AVC-SIL," "MOD-AVC," "MOD," "CW," and "CW-OL" and which operates various circuits as shown in the table.

RECEPTION TRANSFER SWITCH

| Circuit | MOD AVC SIL | MOD AVC | MOD | CW | CW OL |
|--------------------------|-------------------|------------|-----|----|----------|
| CW oscillator | O | O | O | X | X |
| Automatic volume control | X | X | O | O | O |
| Output limiter | O | O | O | O | X |
| Output level control | X | X | O | X | X |
| Manual gain control | O | O | X | X | X |
| Silencer | X | O | O | O | O |
| Silencer control | X | O | O | O | O |
| Input meter | X | X | O | O | O |

X—indicates active.

O—indicates inactive.

Weights, dimensions, and Navy type numbers

| Item | Type No. | Height | Width | Depth | Quantity | | Weight |
|--|-----------|---------------------------------------|---------------------------------------|---------------------------------------|----------|-----|------------|
| | | | | | RBB | RBC | |
| Radio receiver | CRV-46147 | Inches 13 ³ / ₂ | Inches 18 ¹ / ₂ | Inches 17 ¹ / ₂ | 1 | | Pounds 334 |
| Do. | CRV-46148 | | | | | 1 | 334 |
| Rectifier power unit ¹ | CRV-20130 | 13 ¹ / ₂ | 15 | 9 ³ / ₄ | 1 | 1 | 52 |
| Interconnecting cable, cable clamp | CRV-49162 | | | | 1 | 1 | |
| Concentric jack | CRV-49120 | | | | 1 | 1 | |
| Concentric plug | CRV-49121 | | | | 1 | 1 | |
| Antenna adapter | | | | | 1 | 1 | |
| Audio output plug | CRV-49160 | | | | 1 | 1 | |
| Screw No. 10-32 x 1 RH brass | | | | | 1 | 1 | |
| Screws 5/16-18 x 3/4 cap, brass | | | | | 4 | 4 | |
| Lockwasher No. 10 stainless steel | | | | | 1 | 1 | |
| Lockwasher 5/16 stainless steel | | | | | 4 | 4 | |
| Screws 5/16-18 x 2 1/4 cap, brass | | | | | 4 | 4 | |
| Washers 3/4 I. D. x 1 1/4 O. D. x 1/16 stainless steel | | | | | 4 | 4 | |
| Nut No. 10-32, brass | | | | | 1 | 1 | |
| Nuts 5/16-18, brass | | | | | 4 | 4 | |

¹ Both receivers may be operated on 1 power supply in an emergency. Model RBB-1a: This receiver is altered to accommodate panoramic adapter (RBU). It requires a 6AB7 tube (amplifier) to couple the units. Receiver is then type CRV-46147-A.

Model RBB-2, same as the RBB-1. The above would apply to the RBC except that it would take the panoramic adapter RBV and the receiver unit would be type CRV-46148-A.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | RBB | RBB/RBC | RBC |
|-----------------------------|-----------------|------|---------|------|
| First RF amplifier | 1 | 6SK7 | | 6AB7 |
| Second RF amplifier | 1 | | 6SK7 | |
| H F oscillator | 1 | | 6AB7 | |
| Detector | 1 | 6AB7 | | 6SK7 |
| Ballast regulator | 1 | | 6-8B | |
| First IF amplifier | 1 | | 6SK7 | |
| Second IF amplifier | 1 | | 6SK7 | |
| Third IF amplifier | 1 | | 6SK7 | |
| CW oscillator | 1 | | 6AB7 | |
| Detector and AVC | 1 | | 6H6 | |
| Noise limiter | 1 | | 6H6 | |
| Silencer and output limiter | 1 | | 6SK7 | |
| First AF amplifier | 1 | | 6SK7 | |
| Second AF amplifier | 1 | | 6AB7 | |
| Output audio amplifier | 1 | | 6K6GT | |
| Full-wave rectifier | 1 | | 5U4G | |
| Antenna protection | 1 | | 991 | |
| Voltage rectifier | 1 | | VR 105 | |
| Total | 18 | | | |

Type of receiver.—Superheterodyne.

Type of reception.—CW, MCW, and voice.

Input.—Two input systems designed to match single wire (300/400 ohms RBC and 300/1500 ohms RBB) antenna or transmission line impedance; 70 and 300 to 1,500 ohms impedance.

Output impedance.—600 ohms.

Output power.—15 mw. into 600-ohm impedance.

Sensitivity.—Data not supplied.

Antenna.—Single wire or transmission line, 80 to 500 mmfd.

Radiation frequencies.—Safe, all.

Band frequency range

| Band | Model RBB (mc.) | Model RBC (mc.) |
|------|-----------------|-----------------|
| 1 | 0.5-0.84 | 4.0 - 6.45 |
| 2 | .84-1.41 | 6.45-10.3 |
| 3 | 1.41-2.37 | 10.3 -16.5 |
| 4 | 2.37-4.0 | 16.5 -27.0 |

CRYSTAL ADAPTOR FOR RBB SERIES AND RBC SERIES RADIO RECEIVING EQUIPMENTS

Use.—Aircraft carriers in connection with fighter direction communications.

Frequency range.—1.41–2.37 mc. and 2.37–4.0 mc. in bands 3 and 4 of the RBB; 4.0–6.45 mc. and 6.45–10.3 mc. in bands 1 and 2 of the RBC.

Description.—The adaptors will permit operation of the Models RBB and RBC equipments with their normal self-excited oscillators for continuous frequency coverage or operation on either of two fixed crystal controlled frequencies. The adaptor for RBB equipments provides for one crystal controlled frequency in band 3 (1.41–2.37 mc.) and one crystal controlled frequency in band 4 (2.37–4.0 mc.). The adaptor for RBC equipments provides for one crystal controlled frequency in band 1 (4.0–6.45 mc.) and one crystal controlled frequency in band 2 (6.45–10.3 mc.).

Actual crystal frequencies for this equipment are in all cases 400 kc. higher than the desired signal frequency.

The adaptor units for RBB and RBC equipment are both of essentially the same design except for the oscillator inductances. The units consist of shielded assemblies containing the crystal oscillator circuit, control switch, and sockets for the tube, crystals, and interconnecting cable. The units are designed to mount in the upper right-hand side of the Model RBB and Model RBC preselector units immediately to the right of the main tuning condenser. The adaptor when installed, covers the receiver trimmer adjustments so that it is necessary to remove the adaptor in case it becomes necessary to adjust the receiver trimmers. The adaptor is supported on the shield partition separating the preselector and IF/AF units of the RBB or RBC equipment. A mounting plate carrying captivated thumb screws is employed to permit easy removal of the adaptor after its initial installation.

Transfer of the receiving equipment to one or two crystal controlled channels or to its normal main master oscillator tuning is effected upon the manipulation of a single panel operated control. The adaptor control switch is arranged for operation from the front panel. The panel control is located directly to the right of the main tuning dial escutcheon. Three switch positions are provided and indicated on a small plate mounted on the panel. The extreme left position of the switch disconnects the crystal oscillator and allows the receiver to operate in its normal manner for continuous frequency coverage. The extreme right position corresponds to the higher frequency crystal controlled band. The switch shaft and indicator plate mount in a single hole in the front panel. The switch knob matches the receiver antenna compensator knob. Electrical connec-

tion of the adaptor to the receiver circuit is accomplished by means of the interconnecting cable furnished. One end of this cable is fitted with a plug to mate with the adaptor unit receptacle. The other end of the cable leads are arranged to connect to the receiver circuit partly by solder connections and partly by spade terminal connections to terminals on the r-f coil unit assemblies.

The adaptors utilize type VC-2-D and VC-2-E crystal units. The VC-2-D unit is suitable for crystal frequencies in the range 1.81 to 7.5 mc. approximately. The VC-2-E unit employs harmonic type crystals suitable for crystal frequencies in the range 7.5 to 10.7 mc. approximately. The crystal oscillator circuit is suitable for either fundamental or harmonic type crystals. The circuit employs a type 6SK7 tube operated as a triode. The crystal is inserted in the grid circuit of the tube and a tuned circuit is employed in the plate circuit. The crystal oscillator output is fed to the receiver circuit from a tap on the crystal oscillator tuned circuit through a low impedance transmission line to the first detector cathode in the receiver.

The adaptor units are designed to permit their assembly into the receiver units with a minimum of operations so that, if desired, the installation may be made in the field.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|------------------|-----------------|-----------------------|
| Oscillator..... | 1 | 6SK7. |
| Band Number..... | | Band coverage..... |
| Adaptor for RBB: | | Frequency range (MC): |
| 3..... | | 1.41–2.37. |
| 4..... | | 2.37–4.0. |
| Adaptor for RBC: | | |
| 1..... | | 4.0–6.45. |
| 2..... | | 6.45–10.3. |

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|--------------------------|---------------|--------------|--------------|--------------|--------|
| Crystal adaptor for RBC. | CRV-35047 | Inches 3½ | Inches 2¼ | Inches 9¾ | ----- |
| Crystal adaptor for RBB. | CRV-35048 | Inches 3½ | Inches 2¼ | Inches 9¾ | ----- |

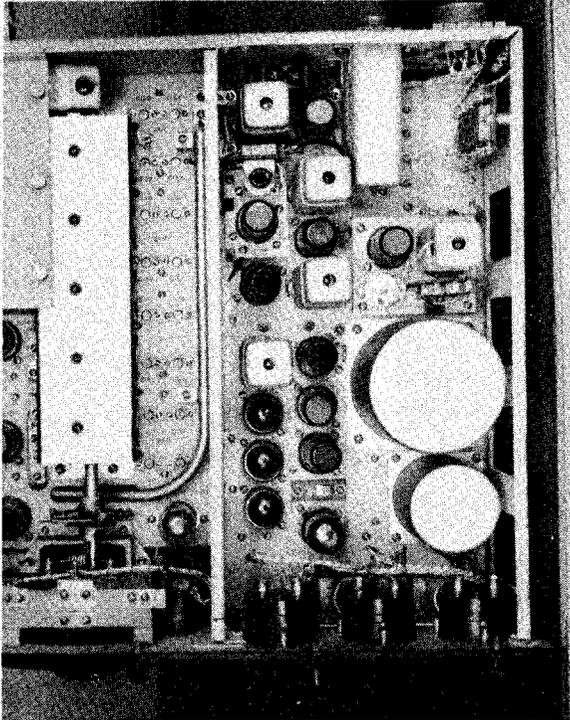
Shipping weights and dimensions.—Information will be included when available.

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PANORAMIC ADAPTOR KIT FOR RBB SERIES AND RBC SERIES RADIO RECEIVING EQUIPMENTS

Use.—Ship, shore.

Description.—The Navy type 10335 adaptor kit contains all the necessary components, items, etc., to



Panoramic adaptor kit installed on a Model RBB radio receiving equipment.

facilitate a modification in the Models RBB or RBC receiving equipments to permit attachment of the Models RBU or RBV panoramic adaptors, respectively. The modification consists of installing a cathode follower and its associated filter network in the Model RBB or RBC to match the high impedance of the first detector plate circuit to the 50-ohm input of the Model RBU or RBV panoramic adaptors, respectively. The additional components required for this modification are mounted on the receiving equipments chassis assembly, as shown on the accompanying photograph. Complete instructions for accomplishing the modification is included with each type 10335 adaptor kit.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|---------------------------|-----------------|------|
| Cathode-coupled amplifier | 1 | 6AB7 |

Output impedance.—50 ohms.

Dimensions and Navy type numbers

| Unit | Type No. | Length | Width | Height |
|----------------|----------|---------------------------------|-------------|-----------------|
| Coil assembly | | <i>Inches</i> | <i>Inch</i> | <i>Inches</i> |
| Cable assembly | | $10\frac{1}{2} \pm \frac{1}{8}$ | | |
| Receptacle | | 1 | 1 | $1\frac{1}{16}$ |

★ ★ ★

RBG RADIO RECEIVING EQUIPMENT

Use.—General service.

Frequency range.—0.54 mc. to 31.0 mc.

Power required for operation.—115/1/50–60, 60 watts.

Description.—The circuit employed comprises one stage of radio frequency amplification, first detector and high frequency oscillator, three stages of intermediate frequency amplification operating at 455 kilocycles, second detector, first audio amplifier and a power-output stage. A beat-frequency oscillator is coupled to the second detector to provide for CW code reception. A full-wave high-vacuum rectifier furnishes plate voltage and a voltage regulator tube is used to stabilize the HF oscillator supply.

A crystal filter, the use of which is optional, is included and provides adjustable selectivity for the reception of signals where the normal noncrystal selectivity of the receiver is insufficient for rejection of closely adjacent interfering signals.

One section of the duplex diode operates as second detector and also provides automatic volume control for the radio frequency amplifier and the first and second intermediate frequency amplifiers. The other diode section is utilized in a limiter circuit which is useful in the reduction of ignition and similar pulse types of interference. The use of the limiter is optional and is controlled by a switch on the front panel.

A tuning meter is provided which indicates relative signal strength, when the receiver is operated on AVC and the sensitivity control is set at maximum. This meter operates on either AVC or manual control as a tuning indicator, the meter reading is maximum at correct tuning of the signal.

The antenna compensator control on the front panel provides correct alignment of the radio-frequency amplifier stage for maximum sensitivity, image rejection, and signal to noise ratio.

Two audio output circuits are provided; a phone jack mounted on the front panel is connected to a balanced winding which will deliver approximately 10 milliwatts of audio power to a 600-ohm load, when the audio output is adjusted to provide 2 watts of audio power to the 5,000-ohm speaker terminals located on the rear of the receiver chassis.

The loudspeaker CHC-49154 is an 8-inch permanent magnet dynamic type, mounted in a metal housing and provided with matching input transformer and phone tipped cable for connection to the pin jack terminals on the rear of the chassis.

The input circuit of the receiver is arranged to be suitable for use with either a balanced feed line or a simple antenna-ground combination. The antenna length is not critical. A good length is approximately 50 feet. The antenna compensator provides correct tuning of the radio frequency stage, which is essential in obtaining maximum signal to noise ratio and image frequency rejection.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|--|-----------------|-------|
| RF, first, second, third, IF amplifier | 4 | 6SK7 |
| HF oscillator and first detector | 1 | 6K8 |
| Second detector and AVC limiter | 1 | 6H6 |
| CW beat oscillator | 1 | 6SJ7 |
| First AF amplifier | 1 | 6C5 |
| AF power amplifier | 1 | 6V6 |
| Rectifier | 1 | 5U4G |
| Voltage regulator | 1 | VR105 |
| Total | 11 | |

Type of receiver.—Superheterodyne.

IF frequency.—455 kc.

Type of reception.—CW, MCW, and voice.

Input.—Tuned circuit with antenna compensator.

Output impedance.—600 ohms for phones and 5,000 ohms for loudspeaker.

Power output.—10 mw. to phones and 2 watts to loudspeaker.

Sensitivity.—Data to be supplied.

Antenna.—Balanced feed line or straight antenna. Antenna length is not critical but approximately 50 feet in the clear is satisfactory.

Radiation frequency.—Band 2: safe; band 1: very close to limit, just above at 540 and 1300 kc; bands 3, 4, and 5: unsafe.

Band coverage:

| Band: | Frequency (mc.) |
|-------|-----------------|
| 1 | 0.54 to 1.32 |
| 2 | 1.32 to 3.2 |
| 3 | 3.2 to 5.7 |
| 4 | 5.7 to 10.0 |
| 5 | 10.0 to 18.0 |
| 6 | 18.0 to 31.0 |

and in addition band spreads are provided within four of the bands as follows:

- (a) 4.0 to 4.6 mc.
- (b) 8.0 to 9.6 mc.
- (c) 12.0 to 13.6 mc.
- (d) 15.0 to 18.0 mc.

Weights, dimensions, and Navy type numbers of equipment units included in the contract

| Unit | Type No. | Height | Width | Depth | Weight |
|--------------|-----------|------------------------|-------|-------|--------|
| RBG receiver | CHC-46140 | } Data to be supplied. | | | |
| Loudspeaker | CHC-49154 | | | | |

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RBH RADIO RECEIVING EQUIPMENT

Use.—Ship-shore: CW, MCW, and voice, by phones or loudspeaker.¹

Frequency range.—300 to 1200 and 1700 to 16000 kc. in five bands.

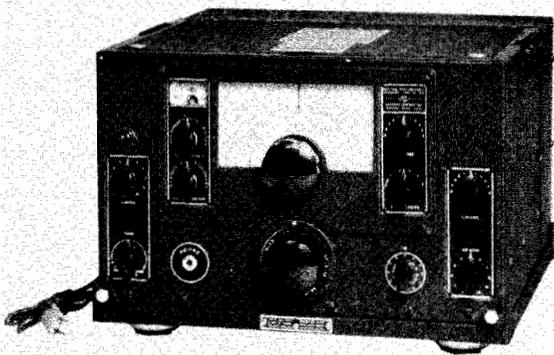
Power required for operation.—115/1/50--60, 70 watts.¹ Allowable variation in voltage, ± 10 percent.

Description.—The Model RBH radio receiver is a 10-tube¹ table mounted superheterodyne. Its circuit consists of one stage of RF¹ amplification, first detector, HF oscillator, two stages of IF amplification at 1560 kc., diode detector, noise peak limiter, CW oscillator, and two stages of resistance coupled audio amplification. Associated with the AVC is a signal strength meter calibrated in S-units from 1 to 9 and in db. above S-9 from 0 to 40 db. A crystal filter, having both selectivity and phasing adjustments, is connected between the first detector and the first IF amplifier tubes. A built-in power supply supplies all voltages required by the receiver. A headphone jack is mounted on the panel

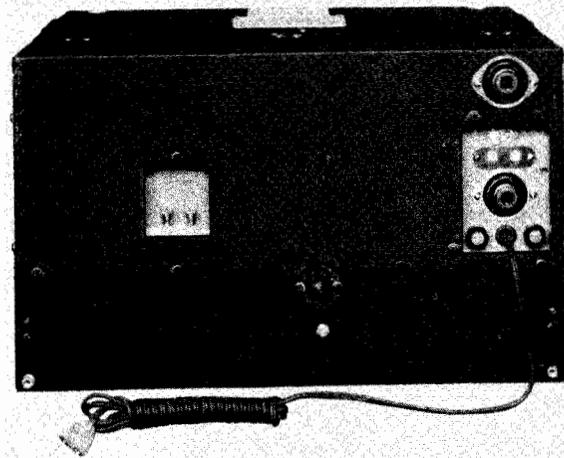
band in use is indicated by the tip of the pointer, which moves radially as the band selector knob is turned.¹ In addition to the frequency-calibrated scales, an auxiliary numerical dial is employed. This dial has 100 divisions and makes 10 revolutions while the tuning capacitor rotates 180°; it is direct reading to 1 part in 1,000.

The power-supply circuits provide 6.3 volts at 3.15 amperes for the heater circuit of the receiver and 240 volts¹ at 70¹ milliamperes for the B supply. A two-section filter is employed. The loudspeaker¹ chassis has a nominal diameter of 8 inches and is of the table mounted type. A coupling transformer having an input impedance of 5,000 ohms is provided to match the voice coil and the receiver output impedances.

The antenna-input circuit is suitable for use with a single-wire antenna, a balanced feed-line or a low im-



Radio receiver of the Model RBH-1 radio receiving equipment (front view).



Radio receiver of the Model RBH-1 radio receiving equipment (rear view).

and a pair of loudspeaker terminals are located on the rear of the chassis. When the headphone is plugged in the loudspeaker circuit is opened.¹

All radio-frequency transformers and their associated trimmer capacitors are mounted in a cast aluminum catacomb having 15 shielding compartments.¹ Each RF transformer and its associated trimmer capacitors is mounted on a low-loss bakelite base fitted with contact pins which protrude from the coil catacomb. Manipulation of the band change knob slides the coil catacomb across the width of the chassis causing the contact pins of each set of RF transformers to engage, in turn, with contact springs mounted on the receiver chassis.

A dial with 5 scales is calibrated in accordance with the frequency response of the 5 bands. The particular

pedance concentric transmission line. The impedance of the antenna or transmission line at the receiver input terminals should not be less than 70 ohms. The antenna input terminals are located at the rear of the chassis near the center. Two insulating binding posts are provided together with a short length of flexible lead permanently attached to the receiver chassis. By means of this lead, either input terminal may be grounded to the chassis if required. It is recommended that the receiver be permanently grounded; the ground wire may be attached directly to the input terminal which is connected to the chassis. The dimensions of the single-wire antenna system are not at all critical; the recommended minimum over-all length of antenna and lead-in is 50 feet; the recommended maximum over-all length is 200 feet.

¹ Indicates differences between RBH and RBH-1. See appended paragraph on RBH-1, page 54.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type No. |
|-------------------------------|-----------------|----------|
| RF amplifier..... | 1 | 6K7 |
| First detector..... | 1 | 6J7 |
| HF oscillator..... | 1 | 6J5 |
| First IF amplifier..... | 1 | 6K7 |
| Second IF amplifier..... | 1 | 6K7 |
| First audio amplifier..... | 1 | 6F8G |
| Automatic volume control..... | | |
| Second detector..... | 1 | 6C8G |
| Limiter..... | | |
| CW oscillator..... | 1 | 6J7 |
| Second audio amplifier..... | 1 | 16V6GT |
| Rectifier..... | 1 | 5Z3 |
| Total..... | 10 | |

Type of receiver.—Superheterodyne.

Type of reception.—CW, MCW, and voice by either phones or loudspeaker.

Output impedance.—600 ohms¹ for phones and 5,000 ohms for the loudspeaker.

Power output.—12 mw.¹ for phones and 2¹ watts of undistorted power for the loudspeaker. Loudspeaker¹ circuit is opened when the phone jack is inserted.

¹ Indicates differences between RBH and RBH-1. See appended paragraph on RBH-1.

Antenna.—Single wire or low impedance transmission line.

Radiation frequencies.—RBH: Safe—all, only when used with preselector.

Band coverage:

| Band: | Frequency range (kc.) |
|--------|-----------------------|
| 1..... | 300 to 600 |
| 2..... | 600 to 1200 |
| 3..... | 1200 to 3900 |
| 4..... | 3900 to 8000 |
| 5..... | 8000 to 16000 |

Weights, dimensions, and Navy type numbers

| Unit | Navy type Nos. | Height | Width | Depth | Weight |
|------------------------------------|----------------|--|--|---|-----------------------|
| Radio receiver..... | CNA-46144 | <i>Inches</i> 12 ¹ / ₃₂ | <i>Inches</i> 17 ³ / ₁₆ | <i>Inches</i> 11 ¹ / ₄ | <i>Pounds</i> 1 55 |
| Loud speaker..... | CNA-49106 | } Data to be supplied when available. | | | } 11 |
| One set spare parts..... |  |  |  |  |  | 19 |
| Total weight of the equipment..... | | | | | 1 85 |

Sensitivity.—For 6 mw. output power. MCW and CW, 10 microvolts or better for all frequencies.



RBH-1 RADIO RECEIVING EQUIPMENT

The chief difference between the Models RBH and RBH-1 lies in the fact that RBH-1 has an added stage of RF for preselection and no loudspeaker is supplied. The Model RBH-1 is then an 11-tube superheterodyne instead of a 10, and, although provided with terminals for a loudspeaker the connection is in parallel and is not affected by the insertion of the phone-plug.

All radio-frequency transformers and their associated trimmer capacitors are mounted in 2-cast aluminum catacombs having a total of 20 shielding compartments. Each RF transformer and its associated trimmer capacitors is mounted on a low-loss bakelite base fitted with contact pins which protrude from the coil catacomb. Manipulation of the band change knob slides the coil catacombs across the width of the chassis causing the contact pins of each set of RF transformers to engage, in turn, with contact springs mounted on the receiver chassis. The band in use is indicated by the band designation that is uppermost on the knob as it is rotated.

TECHNICAL FEATURES

Power required for operation.—60 watts. Power supply circuits provide 6.3 volts at 3.45 amperes for the heater circuits and 290 volts at 55 milliamperes for the B supply.

Tube complement.—The additional stage of RF takes a 6K7 tube and the second audio amplifier is a 6K6 GT/G tube.

Output impedance.—600 ohms.

Output power.—0.3 watts.

Radiation frequencies.—Safe—all.

Weights, dimensions, and Navy type numbers

| Unit | Navy type No. | Height | Width | Depth | Weight |
|--------------------------------|---------------|--|--|---|---------------------------------|
| Radio receiver..... | CNA-46188 | <i>Inches</i> 12 ¹ / ₃₂ | <i>Inches</i> 17 ³ / ₁₆ | <i>Inches</i> 11 ¹ / ₄ | <i>Pounds</i> 74 |
| Mounting base..... | CNA-10125 | } Included in above | | | } 5 ³ / ₄ |
| 1 set spare parts..... |  |  |  |  |  | 20 |
| Total weight of equipment..... | | | | | 99 ³ / ₄ |

CONFIDENTIAL

RBJ
RBJ-1
RBJ-2
RBJ-3
RBJ-4
RBJ-5

RBJ SERIES RADIO RECEIVING EQUIPMENTS

Use.—Ship-shore.

Frequency Range.—40 to 400 kc. and 480 to 30000 kc. in nine bands.

Power required for operation.—The RBJ and RBJ-3 to RBJ-5, inclusive, operate from 230/1/50-60. The RBJ-1 and the RBJ-2 operate from 110/120/1/50-60.

Description.—The RBJ and RBJ-1 models are the same except for difference in power supplies which operate on different line voltages. The circuit involved is that of a nine-tube superheterodyne, with separate power unit. The self-supporting 19-inch rack mounting is employed with racks for table mounting. There are two stages of RF, first detector, HFO, two stages of IF on 456 kc., second detector with amplified and delayed AVC, BFO coupled to the second detector and a resistance coupled audio output. Nine four-gang coil sets, each with calibrated chart, cover the frequency range.

The receiver is located at the bottom of the 35-inch rack. Immediately above is the power supply, then the coil container and a blank panel is at the top. Suitable cables are provided for interconnection.

The power unit is fused and has an "on-off" switch. It supplies 240 volts D. C. at 70 ma. for B supply and 6.2 volts A. C. at 3.4 amps, for the heaters. Satisfactory performance with economy of operation can be had with 180 volts at 50-55 ma. and 6 volts on battery supply.

The main tuning dial is in the center of the panel. The CW oscillator knob is in the lower left hand corner and above it is the AVC-OFF control and above that is the AF gain knob which operates a potentiometer varying voltage on the grid of the output tube. In the lower right hand corner is the RF gain control which adjusts the amplification of the second RF, and the first and second IF stages by varying the grid bias on these tubes. Immediately above is the B "on-off" switch which places the set in the stand-by condition. On the rear is a BSW (B-circuit switch) panel with terminals in parallel with the B switch for remote switch or relay control.

A pilot light operates from the power supply.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|------------------------------|-----------------|------|
| First RF amplifier..... | 1 | 6D6 |
| Second RF amplifier..... | 1 | 6D6 |
| First detector..... | 1 | 6C6 |
| First IF amplifier..... | 1 | 6D6 |
| Second IF amplifier..... | 1 | 6D6 |
| Second detector and AVC..... | 1 | 6F8G |
| Audio amplifier..... | 1 | 6V6G |
| Hf oscillator..... | 1 | 6C6 |
| CW oscillator..... | 1 | 6C6 |
| Rectifier..... | 1 | 5Z3 |
| Total..... | 10 | |

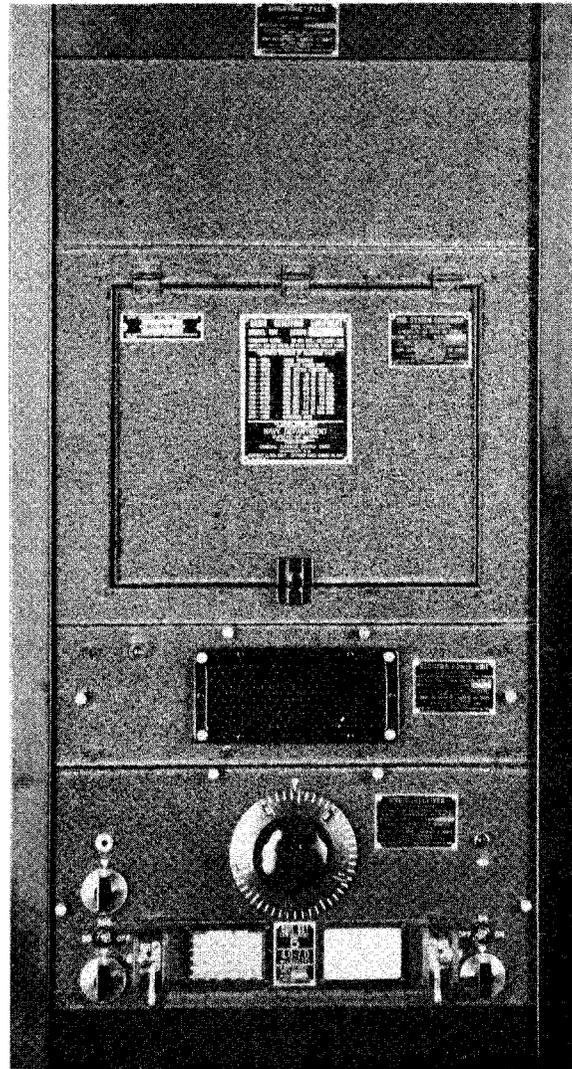
Type of receiver.—Superheterodyne.

IF frequency.—456 kc.

Type of reception.—CW, MCW, and voice by phones or loudspeaker.

Input.—Grounded or balanced line.

Input impedance.—Using coil sets ONA-47163 to ONA-47169 the impedance averages 500 ohms. Below



Radio receiver, rectifier power unit and coil container of the Model RBJ-4 radio receiving equipment, (front view).

2000 kc. frequency the input impedance is higher but in no case does it exceed 10,000 ohms.

Output impedance.—5,000 ohms on loudspeaker at the terminals in the back. 600 ohms on phones at the jack in the panel. Insertion of the phone jack renders the loudspeaker inoperative.

RBJ
RBJ-1
RBJ-2
RBJ-3
RBJ-4
RBJ-5
RBK
RBK-1
RBK-2
RBK-3
RBK-4
RBK-5
RBK-6

CONFIDENTIAL

Output power.—2 watts undistorted on loudspeaker, 10 mw. on phones.

Sensitivity.—For 6 mw. output power. MCW—10 microvolts or better for 175 to 400 kc.; 7.5 microvolts or better for 480 to 30000 kc. CW—12 microvolts or better from 175 to 900 kc. and 14000 to 30000 kc.; 6 microvolts or better from 900 to 14000 kc.

Antenna.—Length is not critical—50 foot minimum to 200 foot maximum or balanced line may be used.

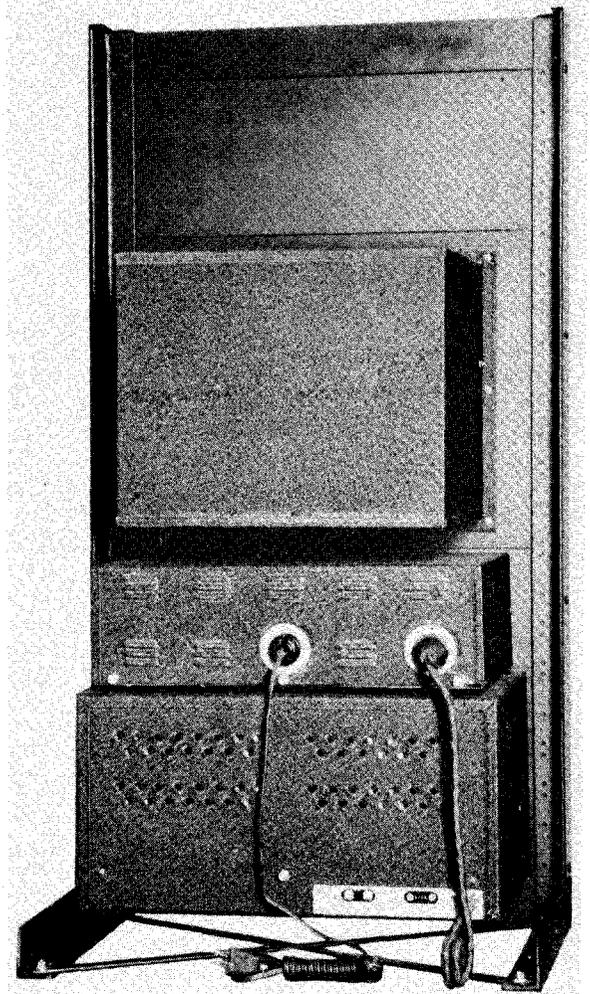
Band coverage

| Band | Navy type No. | Frequency |
|--------|---------------|------------------|
| 1----- | ONA-47181 | 50 to 100 Kc. |
| 2----- | ONA-47182 | 100 to 200 Kc. |
| 3----- | ONA-47183 | 175 to 400 Kc. |
| 4----- | ONA-47164 | 480 to 900 Kc. |
| 5----- | ONA-47165 | 0.9 to 2.0 Mc. |
| 6----- | ONA-47166 | 2.0 to 4.0 Mc. |
| 7----- | ONA-47167 | 4.0 to 7.0 Mc. |
| 8----- | ONA-47168 | 7.0 to 14.0 Mc. |
| 9----- | ONA-47169 | 14.0 to 30.0 Mc. |

Weights, dimensions, and Navy type numbers

| Unit | Navy type No. | Height | Width | Depth | Weight |
|---|---------------|---------------|---------------|---------------|---------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Receiver----- | ONA-46081 | | | | 35 |
| Power unit----- | ONA-20090 | | | | 22 |
| Coil system container (including 8 coil sets)--- | ONA-10075 | | | | 35 |
| Mounting rack----- | ONA-10036 | 39½ | 20½ | 12½ | 27 |
| Blank rack panel----- | ONA | 7 | 19 | | 2 |
| Spare parts (cased)----- | | | | | 24 |
| Total weight of equipment including spare parts----- | | | | | 145 |

Shipping weight and dimensions.—Data to be supplied when available.



Radio receiver, rectifier power unit and coil container of the Model RBJ-4 radio receiving equipment (rear view).

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RBK SERIES RADIO RECEIVING EQUIPMENTS

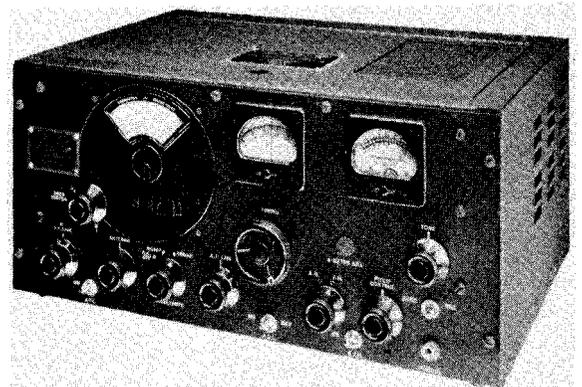
Use.—General service, AM and FM signals.

Frequency range.—27.8 to 143 megacycles in three bands.

Power required for operation.—117/1/60, 80-watt.

Description.—The Model RBK¹ radio receiving equipment consists of a very-high-frequency receiver to be used with headphones or loudspeaker. There is one stage of RF for amplification and preselection feeding into the oscillator-mixer stage followed by the usual IF. From here the signal can be switched to either of two paths consisting of (a) limiter and discriminator for

¹The Models RBK and RBK-2 are commercial Hallicrafter S-27D receivers. The Models RBK-1 and RBK-3 to RBK-6, inclusive, are similar to Hallicrafter S-27D except all electrolytic capacitors over 50 d-c working volts are replaced with hermetically sealed paper capacitors; all other paper capacitors are hermetically sealed and facilities were included for connection of a panoramic adapter.



Type CHL-46130 radio receiver of the Model RBK radio receiving equipment.

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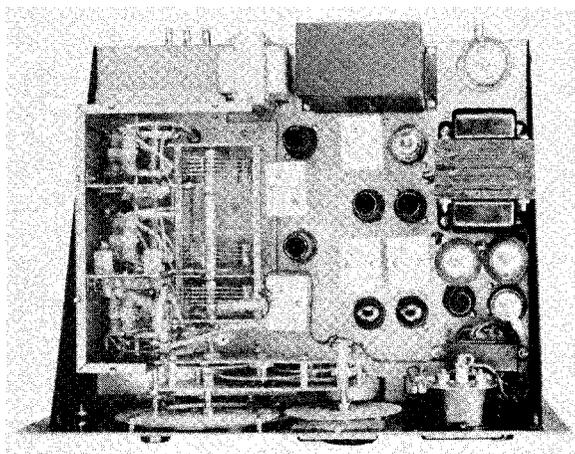
FM signals and (b) a final IF stage, detector and noise limiter for AM signals. The output of either the FM or AM section is amplified by the final audio stage working into a headset or a loudspeaker.

Band switching is accomplished with a specially designed ceramic switch which operates in the antenna, RF, and oscillator circuits.

A "send-receive" switch on the panel prevents the receiver from operating when in the "send" position but permits the heaters to remain on.

Where CW reception is desired or where it is necessary to locate a weak carrier the BFO switch may be placed in the "on" position. The pitch of the resulting beat note may be varied by the operation of the pitch or tone control. The tone control varies the output from bass boost through high fidelity to high frequency cut-off.

An antenna control compensates for misalignment produced in the first tuned circuit by antenna variations. In the presence of ignition or other peaked interference the ANL switch may be placed in the "on"



Radio receiver of the Model RBK radio receiving equipment, top view with RF shields removed.

position if it is found to increase intelligibility of the received signal.

AF gain control and an AVC "on-off" switch is provided for normal reception.

An S-meter indicates strength of carrier input for AM but for FM its pointer swings in one direction when approaching a carrier and in the other direction when the carrier is passed. The zero position of the pointer indicates the correct setting for resonance.

The broad-sharp (selectivity) switch is controlled by the same knob as the A. C. "on-off" switch.

The power supply is fed through a filter to remove interference coming from the power line.

Although regularly mounted in a table cabinet, it may be removed and mounted directly onto a standard rack without any mechanical alterations.

A voltage regulator tube is connected to the power supply for better control of its output.

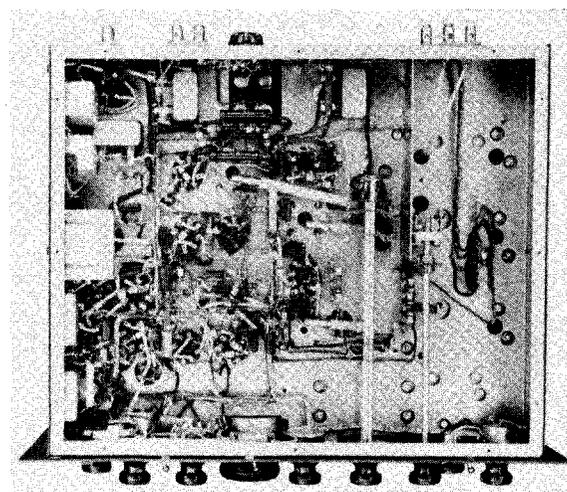
TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|--|-----------------|--------------|
| Radio frequency amplifier..... | 1 | (Acorn) 956 |
| First detector mixer..... | 1 | (Acorn) 954 |
| First IF amplifier..... | 1 | 6AC7 or 1852 |
| Second IF amplifier..... | 1 | 6AB7 or 1853 |
| Third IF amplifier..... | 1 | 6SK7 |
| AM detector and automatic noise limiter..... | 1 | 6H6 |
| Amplitude limiter..... | 1 | 6AC7 or 1852 |
| FM detector..... | 1 | 6H6 |
| Audio amplifier..... | 1 | 6C8G |
| Voltage regulator..... | 1 | VR150 |
| Power audio amplifier..... | 2 | 6V6G |
| Rectifier..... | 1 | 5Z3 |
| Beat-frequency oscillator..... | 1 | 6J5 |
| High-frequency oscillator..... | 1 | 955 |
| Total..... | 15 | |

Type of receiver.—Superheterodyne.

Type of reception.—FM and AM—CW, MCW, voice.



Radio receiver of the Model RBK radio-receiving equipment, bottom view with cover removed.

Input.—Tuned circuit.

Output impedance.—600-ohm phone and 500- or 5,000-ohm loudspeaker.

Output power.—3 watts with less than 5 percent distortion. Audio fidelity is within plus or minus 3 db. from 40 to 10000 cycles.

Band coverage.—Band 1, 27.8 to 47 mc.; band 2, 46 to 82 mc.; band 3, 82 to 143 mc.

Antenna.—Single wire, 75 feet in the clear, doublet, or multiple dipole.

Weights, dimensions, and Navy type numbers

| Unit | Navy type No. | Height | Width | Depth | Weight |
|-----------------------------|---------------|----------------------------------|---------------------------------|----------------------------------|--------|
| Chassis in table cabinet... | CHL-46130 | 9 ³ / ₁₆ | 19 ¹ / ₁₆ | 14 ³ / ₁₆ | 63 |
| Chassis alone..... | CHL-46130 | 1 8 ² / ₃₂ | 19 | 13 ²⁹ / ₃₂ | 48 |
| Speaker..... | CHL-49149 | 9 ³ / ₄ | 10 ³ / ₄ | 7 | 9 |

¹ Height and width are the front panel dimensions. Depth does not include the binding posts protruding from the rear side.

RBL SERIES RADIO RECEIVING EQUIPMENTS

Use.—Ship-shore—general service.

Frequency range.—15 to 600 kc., CW, MCW.

Power required for operation.—115/1/50–60, 45 watts.

Description.—This radio receiver is a seven-tube, table-mounting, tuned radio frequency receiver covering a continuous frequency range of from 15 to 600 kc. in six bands.

The circuit employed on all bands comprises two stages of radio frequency amplification, a regenerative detector, a resistance coupled audio stage, a low-pass filter with two possible cut-off frequencies, a high-pass filter with fixed cut-off frequency, an adjustable audio limiter, and a resistance-coupled audio output stage. A phone jack on the front panel is in parallel with two terminals on the back for a choice of headset or loud-speaker reception. The maximum output is 300 mw. and the impedance of the circuit is 600 ohms.

Antenna input terminals are located at the rear of the chassis on the left as viewed from the rear. The input circuit is so arranged as to be suitable for use with either a relatively high impedance unbalanced feed line or a single wire antenna ground combination. Static drain resistors are incorporated in the receiver for the protection of the antenna series capacitors. An antenna compensator improves reception for either a long or short antenna. The RBL-3 contains a concentric plug for antenna connection.

A built-in power supply provides all necessary voltages. It operates from a 115/1/50–60 supply. A socket is located at the rear which provides a convenient means of connection to a suitable external d-c source of supply. The receiver is built for a 210-volt D. C. at 45 ma. and 6.2 volts at 2.2 amperes, but some economy can be obtained with good performance at 135 volts at 25–30 ma. for "B" and 6 volts "A" for battery operation.

The mounting base is a cradle or framework which is fitted with rubber mounts and may be bolted to the table. The receiver is conveniently removed from the mounting base for servicing.

The power switch is located at the left side of the receiver panel near the top. The main tuning dial is located at the center of the front panel of the receiver. The dial scale is calibrated in accordance with the frequency response of the six bands. An additional auxiliary numerical dial is employed which has 100 divisions and makes 10 revolutions while the tuning capacitor rotates 180°, reading to 1 part in 1,000. The accuracy of the calibration can be relied on to ± 2 percent. The band selector knob is located near the bottom of the front panel at the center, and shifts bands with approximately one-sixth turns. The band in use is indicated by the pointer attached to the band selector knob. A positive detent insures proper positioning of the band-selector-switch contacts.

Directly beneath the power switch is located the audio band-width control switch. In the sharp position the band-pass is approximately 500 cycles wide at 20 db. down with the peak response occurring at 700 cycles

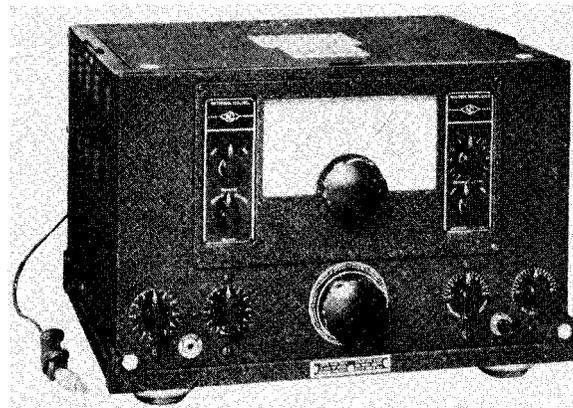
per second. In the broad position the band-pass is approximately 3500 cycles wide at 20 db. down with the peak response occurring at 1100 cycles per second.

The regeneration control is located directly below the audio band-width control. The detector tube may be made to oscillate when the control is sufficiently advanced, thus providing means for heterodyne detection of CW radio telegraph signals.

The RF gain control, located to the left of the regeneration control, increases the amplification of the two RF amplifier tubes.

The antenna compensator control is located at the right of the band selector switch, and tends to detune the first RF stage, compensating for antenna capacity. It should be set for maximum amplification.

The RF trimmer control is located to the right of the antenna compensator. The function of this control is to compensate for unavoidable errors in tracking



Radio receiver of the Model RBL-2 radio receiving equipment (front view).

in the second RF stage and should be adjusted for maximum amplification.

The oscillation test button is located between the antenna compensator and RF trimmer. In the absence of a received signal, this control is useful in determining whether or not the detector is oscillating. The detector slides in and out of oscillation so smoothly that it is often difficult to determine whether or not it is oscillating. If a click is heard in the headphones when the oscillation test button is pressed and another click observed when it is released it indicates that the detector is in the oscillating condition.

The output limiter control is located directly above the antenna compensator control. In the "off" position the limiter circuits are inoperative. In the "on" position the limiter circuits are operative and limit all audio voltage peaks to a definite maximum value determined by the setting of the output level control. The type of limiter employed limits both alternations of an audio frequency cycle to approximately the same peak value.

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The output level control is located directly above the output limiter control. Turning this control in a clockwise direction increases limiter action by decreasing the peak value of audio frequency voltages that appear in the output of the limiter circuit. The limiter may thus be used to limit noise peaks or pulses which are greater than the maximum value that the limiter will pass, or in addition to this action it may be used to provide a means of automatic volume control. The automatic volume control action is obtained by increasing the receiver gain and decreasing the output level by means of the limiter so that when the desired signal fades to the lowest usable level, the limiter still cuts off the desired signal peaks to a slight extent.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|----------------------------|-----------------|---------|
| First RF amplifier..... | 1 | 6SK7 |
| Second RF amplifier..... | 1 | 6SK7 |
| Regenerative detector..... | 1 | 6SK7 |
| First audio amplifier..... | 1 | 6SG7 |
| Audio limiter..... | 1 | 6H6 |
| Power audio amplifier..... | 1 | 6K6GT/G |
| Rectifier..... | 1 | 5U4G |

Type of receiver.—Tuned radio frequency receiver with regenerative detector.

Type of reception.—CW, MCW, and voice.

Input.—Directly coupled to a tuned circuit.

Output impedance.—600 ohms.

Power output.—300 mw.

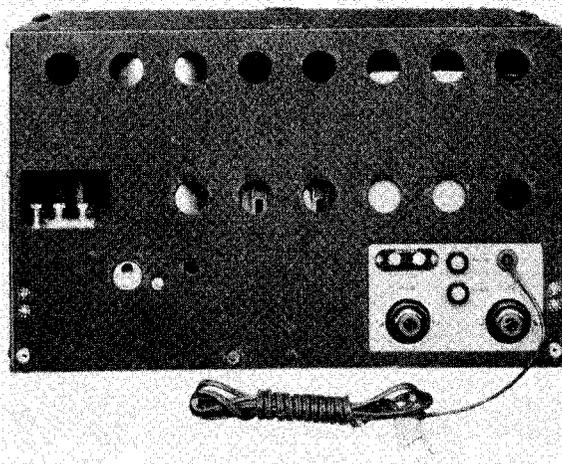
Sensitivity.—For 6 mw. power output. 5 microvolts for cw “sharp,” 10 microvolts for cw “broad.”

Antenna.—High impedance feed-line or a single antenna ground combination directly coupled through series capacitors. Antenna compensator is used in conjunction with a long or short antenna.

Radiation frequencies.—Safe—all.

Band coverage:

| Band: | Frequency in kilocycles |
|--------|-------------------------|
| A..... | 15 to 25 |
| B..... | 25 to 45 |
| C..... | 45 to 80 |
| D..... | 80 to 155 |
| E..... | 155 to 310 |
| F..... | 310 to 600 |



Radio receiver of the Model RBL-2 radio receiving equipment (rear view).

Weights, dimensions, and Navy type numbers

| Unit | Type No. | Height | Width | Depth | Weight |
|--|-----------|--------|--------|--------|--------|
| | | Inches | Inches | Inches | |
| Receiver..... | CNA-46161 | | | | 75½ |
| Mounting base..... | CNA-10124 | | | | 5½ |
| Equipment spare parts (packed in metal box)..... | | 6½ | 19 | 10 | 25 |
| Stock spare parts (packed in metal box)..... | | 9½ | 19 | 13 | 67 |

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RBM SERIES SEMI-PORTABLE RADIO RECEIVING EQUIPMENTS

Use.—Ship-shore.

Frequency range.—MF—200 to 2000 kc. HF—2 to 20 mc.

Power required for operation.—*Portable field operation.*—12 volts D. C. from portable storage batteries supplied as part of the equipments.

Base station operation.—115/1/25, 115/1/60, or 230-volts D. C.

Description.—The Navy Models RBM, RBM-1, RBM-2, RBM-3 semiportable radio receiving equipments are primarily intended for use in portable service which involves transportation over and use in rough and wet country. These equipments are particularly intended for use with complete radio-transmitting equipments of the portable type, in which case they become an integral part of the transmitting-receiving equipment. They are also suitable for independent operation as a receiver only.

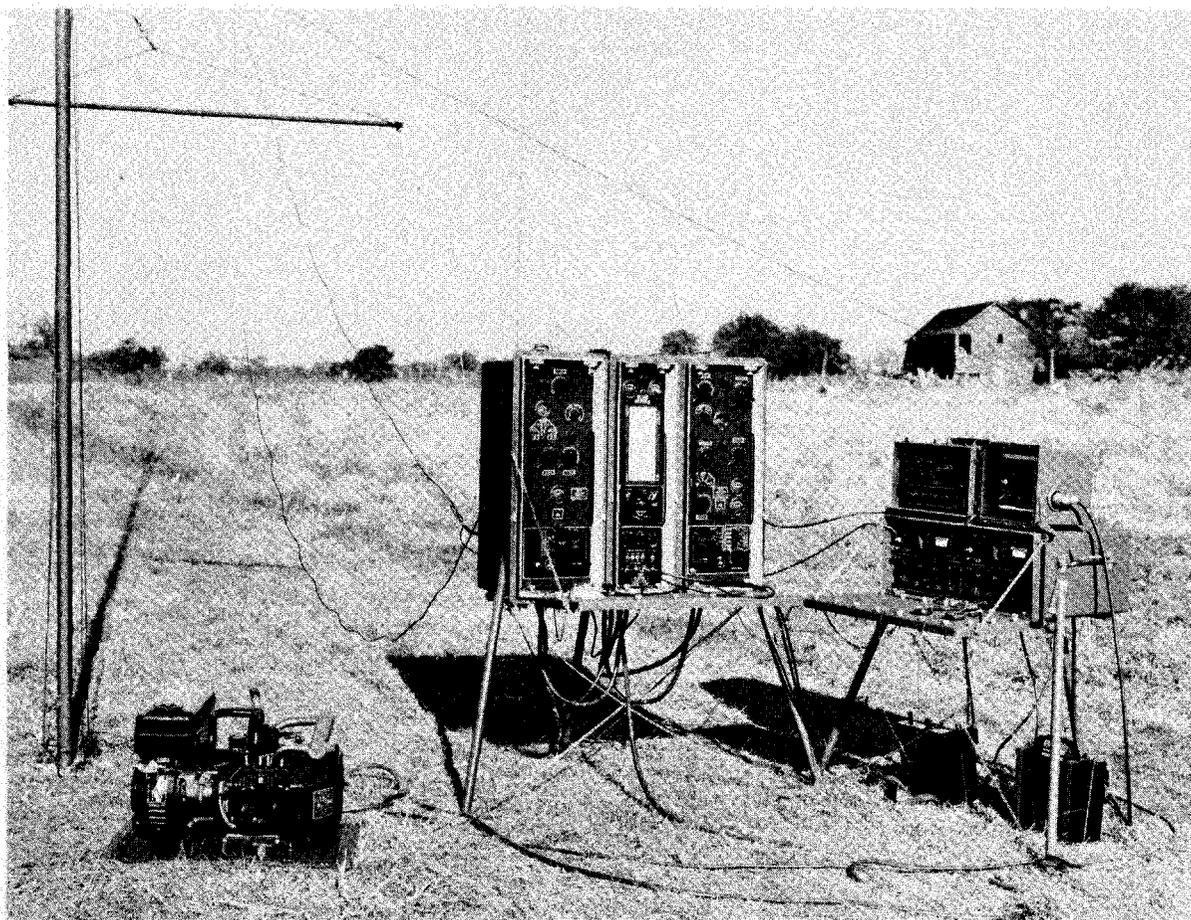
The radio receiver assembly consists of the two receivers, MF and HF together with their transportation case, made strong yet light in weight. This case provides protection and serves as a cabinet when the

equipment is in operation. It is fitted with a watertight cover, and openings in the back for connections are provided with watertight closures. Handles are provided for ease of carrying. The sets are shock-mounted inside the case and three legs permit assembly at operating height. Chain and brackets attach to the cover which serves as an operating table.

The MF and HF receivers are separate and complete for operation, except for accessories not supplied with the contract as shown in table.

The dynamotor assembly is assembled with panel on an aluminum chassis and is enclosed in a watertight carrying case. Operating from the 12-volt battery it provides operating potentials for either receiver or both, simultaneously. The rectifier power unit and control unit are each built on an aluminum chassis with panel, and enclosed in individual cases. The rotary converter, its magnetic controller and pushbutton control station are conventional.

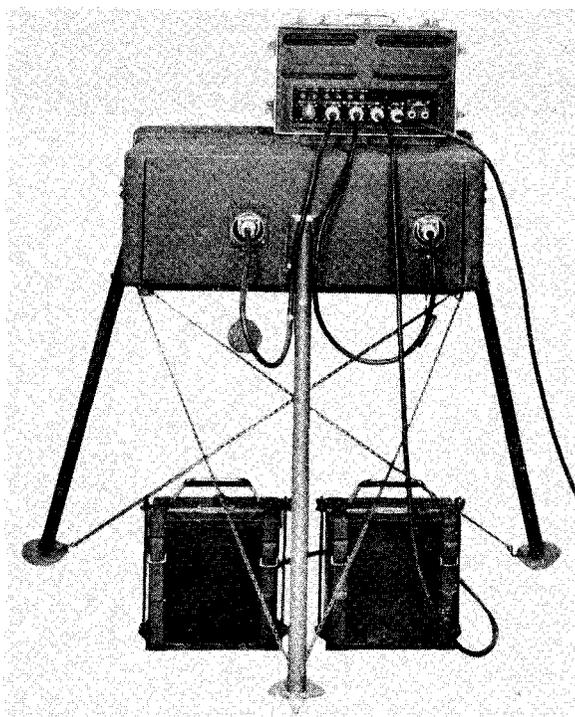
Both receivers are similar in design and being held in place by thumb screws are easily removable from the case. Above the chassis are located the main four-



Field set-up assembly of the models RBM and TBW radio-receiving and transmitting equipment.

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gang tuning capacitor, all vacuum tubes, IF amplifier transformers, BFO transformer, low pass filter reactors, and the output transformer. On the underside of the chassis are the antenna coupling, RF and oscillator transformer assemblies, three main and two smaller resistor-capacitor boards, and all filter and bypass capacitors. Connections to the power receptacles of the receivers are made in the rear through port openings sealed with water tight gaskets and port closures. Controls on the panel are similarly positioned and function in a similar manner. From left to right on the bottom row are selectivity control, gain control, phone jack, noise limiter switch, output and reception controls; and above are antenna compensator (ant. com.) control, frequency band knob, tuning, and beat note

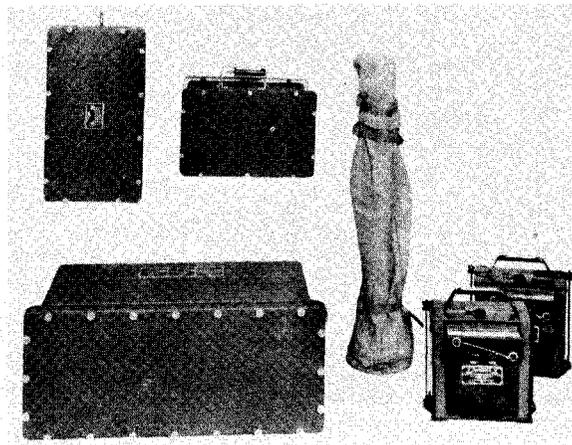


Receiver case on stand, dynamotor, and batteries of the Model RBM radio-receiving equipment (rear view).

controls. At the upper left are the antenna and ground connectors, and the dial-dimmer knob. In the center is the dial escutcheon housing with the dial lights. In the upper right corner is a station log with its control knob. The transparent cover permits making written entries. The control knob rolls the paper in either direction and reference may be made to the log data without lifting the cover. All tubes are accessible by sliding the receiver chassis out of the case and removing the top shield. Sufficient space is available with the top shield removed to permit insertion of an analyzer beneath the tubes.

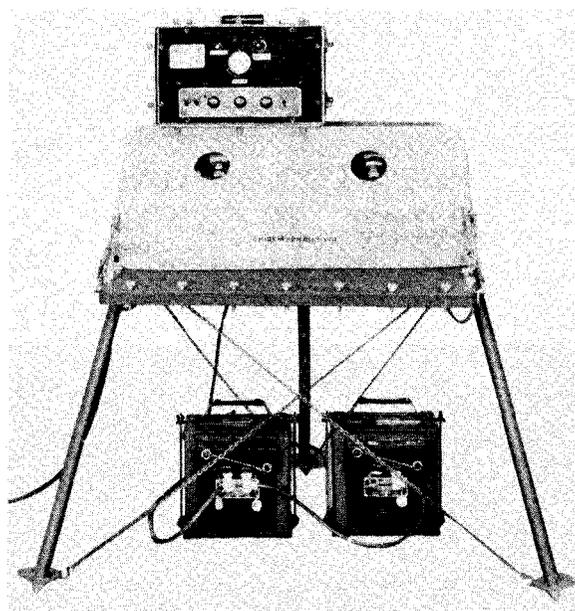
The table light has dimmer control and is located to the right of the upper center of the panel. The opening for viewing the line volts meter is in the center of the panel.

Two portable batteries of the aircraft spillproof type are supplied with each equipment. The top and terminal box covers of these batteries are watertight and the batteries will withstand immersion. Each



Some components of the Model RBM radio-receiving equipment. Note cover construction of floatable cases

battery rests in a tray to which it is clamped by means of threaded hooks and wing nuts. A handle is attached to a webbing strap which completely encircles the battery and its tray. The terminal box is provided



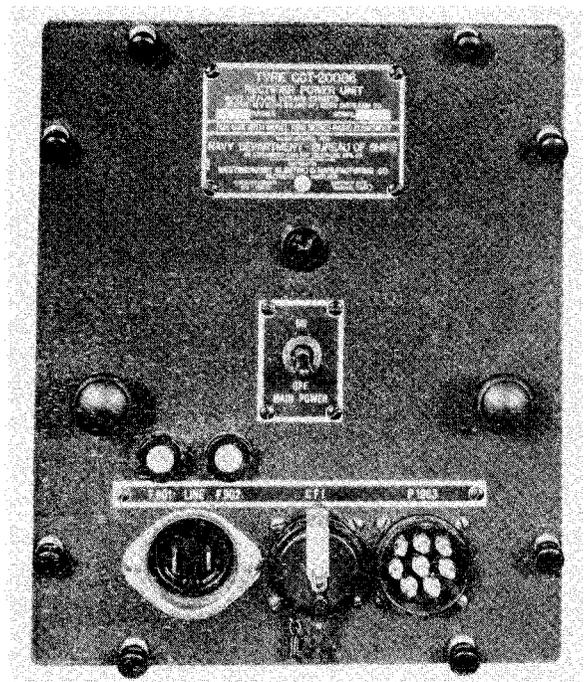
Receivers of the Model RBM radio-receiving equipment showing dynamotor, batteries and weather protective covering to be used while operating.

with two electrical connectors, each having a watertight screw flange and cap. These connectors provide for interconnection of the batteries to the dynamotor assembly. All waterproof caps are secured with swivel chains so they cannot be lost or mislaid.

Slip covers, with flaps, for the receiver assembly permit operation of the controls, and two windows bring the tuning dials into view during operation with the slip covers in place.

In operation, the dynamotor is placed on top of the receiver, where it also serves as a junction box for the interconnecting cables.

Each equipment is provided with two rectifier units for operation at a base station where electric line current is available. They may be placed on top of the receivers or below an operating table. The base sta-



Type CCT-20086 rectifier power unit of the Model RBM radio-receiving equipment

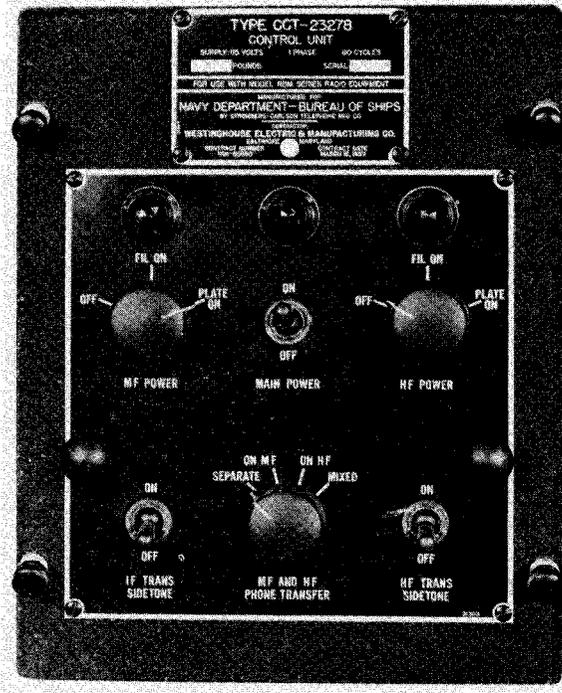
tion power supply consists of a transformer, rectifier tube, and ripple filter circuits providing filament and plate voltages for the operation of one receiver and a crystal frequency indicator.

A special control unit is provided for use in conjunction with the base station receiver power supplies. It serves to interconnect the rectifier power units and the receivers and its operating controls perform the same functions as the operating controls of the dynamotor assembly. In addition, each unit contains a special filament transformer to supply filament power to a crystal frequency indicator in order to maintain it at correct operating temperature even while the filament power to the receivers is turned off.

The rotary converter, magnetic controller, and push-button control station are provided with a few equipments for use where only 230 volts D. C. power is available. It provides 115/1/60 and is used in conjunction with the rectifier power and control units. The push-button control station is to be mounted near the operating position in order to start the converter when operation is desired.

When it is desired to have combined operation of the MF and HF receivers at the base station, the control unit serves as a junction box for the two receivers and their two power supplies. However, by omitting the control unit and connecting each receiver directly to its individual rectifier power unit, the receivers may be operated separately in different locations.

The mobile spare parts and connecting cables are contained in a waterproof metal box with removable cover and carrying handles.



Type CCT-23278 control unit for the Model RBM radio-receiving equipment.

TECHNICAL FEATURES

Tube complement MF and HF ¹

| Function | Number of tubes | Type |
|--|-----------------|--------------------|
| First RF amplifier..... | 1 | ¹ 12SK7 |
| Converter..... | 1 | 12SG7 |
| Oscillator (heterodyne)..... | 1 | 12SJ7 |
| First IF amplifier..... | 1 | 12SG7 |
| Second IF amplifier..... | 1 | 12SG7 |
| Second detector and noise limiter..... | 1 | 12H6 |
| A.V.C..... | 1 | 12H6 |
| Oscillator (CW)..... | 1 | 12SJ7 |
| First AF amplifier..... | 1 | 12SK7 |
| Second AF amplifier..... | 1 | 12SJ7 |
| Third AF amplifier..... | 1 | 12A6 |
| Full wave rectifier..... | 1 | 5U4G |
| Total..... | 12 | |

¹ The equipment is the same except for the First RF amplifier in the HF receiver which takes a 12SG7 tube.

Type of receiver.—Superheterodyne with one stage of RF.

Type of reception.—CW, MCW, and voice.

Input.—Tuned RF circuit with static drain.

CONFIDENTIAL

Output impedance.—600-ohm phones.

Power output.—Adjustable.

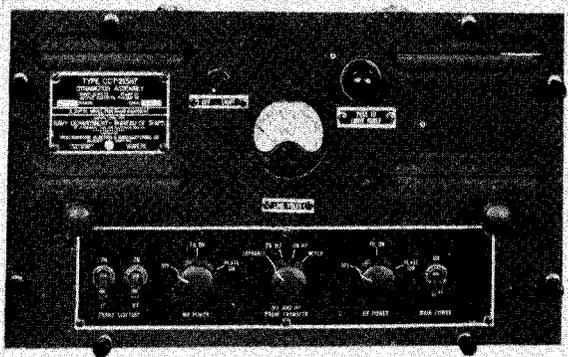
Sensitivity.—Nominal 10 microvolts for 6 mw. output into 600 ohms.

Antenna.—Antenna compensator control makes the sets adaptable to a wide range of open wire antennas.

Band coverage

| Band | MF frequencies (kc.) | HF frequencies (mc.) |
|------|----------------------|----------------------|
| 1 | 200 to 360 | 2.0 to 3.6 |
| 2 | 360 to 650 | 3.6 to 6.5 |
| 3 | 650 to 1140 | 6.5 to 11.4 |
| 4 | 1140 to 2000 | 11.4 to 20.0 |

Accessories not supplied with contract but necessary to the operation of the receiver.—(1) Two pairs of headsets complete with cords and plugs. (2) Frequency measuring equipment. (3) Equipment for charging storage batteries or suitable line power supply. (4) Receiving antenna installation. Additional material needed to complete a transmitter-receiving station: Transmitting equipment and antenna installation.



Type CCT-21387 dynamotor assembly for the RBM radio-receiving equipment.

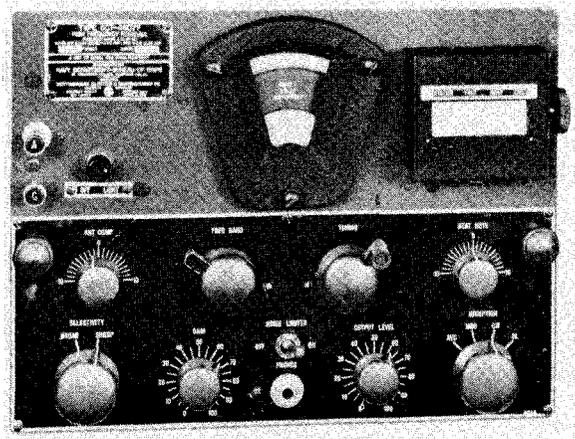
Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type No. | Height | Width | Depth | Weight |
|--|-----------|---------------------------------|---------------------------------|---------------------------------|--------|
| Radio receiving assembly | CCT-46078 | 12 ³ / ₁₆ | 29 ¹ / ₁₆ | 19 ⁷ / ₁₆ | 95 |
| MF component | CCT-46076 | 9 ³ / ₄ | 12 ⁷ / ₁₆ | 17 ¹ / ₁₆ | 2 31 |
| HF component | CCT-46077 | 9 ³ / ₄ | 12 ⁷ / ₁₆ | 17 ¹ / ₁₆ | 2 31 |
| Dynamotor assembly | CCT-21387 | 10 ⁷ / ₁₆ | 16 | 12 | 30 |
| Portable storage battery | CES-19017 | 12 ¹ / ₂ | 11 ³ / ₄ | 8 ³ / ₄ | 41 |
| Mobile spare parts box | CAY-10095 | 12 ³ / ₄ | 21 | 11 ⁵ / ₈ | |
| Rectifier power unit 115/125 | CCT-20085 | 9 ¹ / ₁₆ | 7 ⁷ / ₈ | 14 ³ / ₁₆ | 25 |
| Rectifier power unit 115/160 | CCT-20086 | 9 ¹ / ₁₆ | 7 ⁷ / ₈ | 14 ³ / ₁₆ | 25 |
| Control unit 115/125 | CCT-23277 | 8 ¹ / ₂ | 7 | 8 | 8 |
| Control unit 115/160 | CCT-23278 | | | | 8 |
| Rotary converter 230 volts d-c line supply | CJM-21877 | 7 ¹ / ₄ | 12 | 8 ¹ / ₁₆ | |
| Magnetic controller | CAY-21876 | 8 ¹ / ₂ | 3 ¹ / ₄ | 3 ¹ / ₁₆ | |

¹ Accessories for CCT-46078 in a bag.

² Included in weight of receiver assembly.

Pushbutton control station for use with equipment on 230 volts d-c line supply. Spare parts packed in 4 boxes.



Type CCT-46077 High frequency receiver of the Model RBM radio receiving equipment.

★ ★ ★

RBO AND RBO-1 RADIO RECEIVING EQUIPMENTS

Use.—Ship entertainment—MCW and voice.

Frequency range.—540 to 1600 kc. and 5550 to 15600 kc. in three bands: (540-1600) (5550-9550) (9200-15600).

Power required for operation.—110/1/58-62, 85 watts.

Description.—The Navy Models RBO and RBO-1 are designed for use as entertainment receivers aboard ships of all types. They are specifically designed to provide optimum performance and high-quality reception of voice or tone modulated signals, on all frequency bands for headtelephone or loudspeaker reception. The two models are the same except for minor component differences in the AVC circuit, and the addition of a noise limiter in the RBO-1 equipment.

the gain of RF amplifier, detector, and first IF circuits in proportion to the strength of the incoming signal. The fidelity control adjusts a rheostat which operates, in conjunction with a series connected fixed capacitor, in the plate circuit of the first AF amplifier tube to limit the high-frequency response of the receiver.

Inverse feedback is incorporated, within the audio output circuits, to maintain a relatively constant voltage across the primary of the output transformer, with varied output loads. Four output circuits provide for the use of a 600-ohm head-telephone set with one of three speaker facilities: one to ten 600-ohm speaker amplifiers, one 600-ohm permanent-magnet type loudspeaker, or one 5,000-ohm permanent-magnet type



Type CZC-46139 receiver of the Model RBO radio-receiving equipment.

The equipment is provided with a self-contained rectifier type power unit which supplies all required operating voltages upon connection to a suitable a-c source.

Band switching and tuning are accomplished by conventional methods. Tuning is facilitated by an electron ray indicator on the front panel. The receiver is tuned to resonance with the frequency of the received signals when the "shadow" halves of the indicator approximately meet.

The audio output signal level is adjusted by the volume control, which varies the signal level that is applied to the grid of the first AF amplifier. Automatic volume control provided in the second detector limits

loudspeaker. Facilities are also provided, in the form of separate auxiliary terminals at the rear of the receiver chassis and a suitable switching arrangement, for connecting a phonograph pick-up to the input circuits of the audio-frequency amplifier.

This equipment is especially designed to *minimize radiation* from the high-frequency oscillator. This is accomplished by isolating the antenna input circuits from the first detector and high-frequency oscillator circuits, through the use of extensive shielding and filtering, and by the employment of a type of construction which reduces, to practical limits, undesirable circuit coupling by virtue of circulating currents in common shields.

CONFIDENTIAL

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|-------------------------------------|-----------------|-------|
| RF amplifier..... | 1 | 6K7 |
| HF oscillator..... | 1 | 6J5 |
| First detector and mixer..... | 1 | 6SA7 |
| First and second IF amplifiers..... | 2 | 6SK7 |
| Second detector, AVC..... | 1 | 6H6 |
| First AF amplifier..... | 1 | 6J5 |
| Second AF amplifier..... | 1 | 6SJ7 |
| AF power output..... | 1 | 6K6GT |
| Tuning indicator..... | 1 | 6E5 |
| Rectifier (full wave)..... | 2 | 6X5GT |
| Total..... | 12 | |

Type of receiver.—Superheterodyne.

Type of reception.—MCW and voice.

Input.—Grouped.

Input impedance.—Single-line antenna.

Output impedance.—600 and 5,000 ohms.

Power output.—2 watts to speaker, 30 milliwatts to phones.

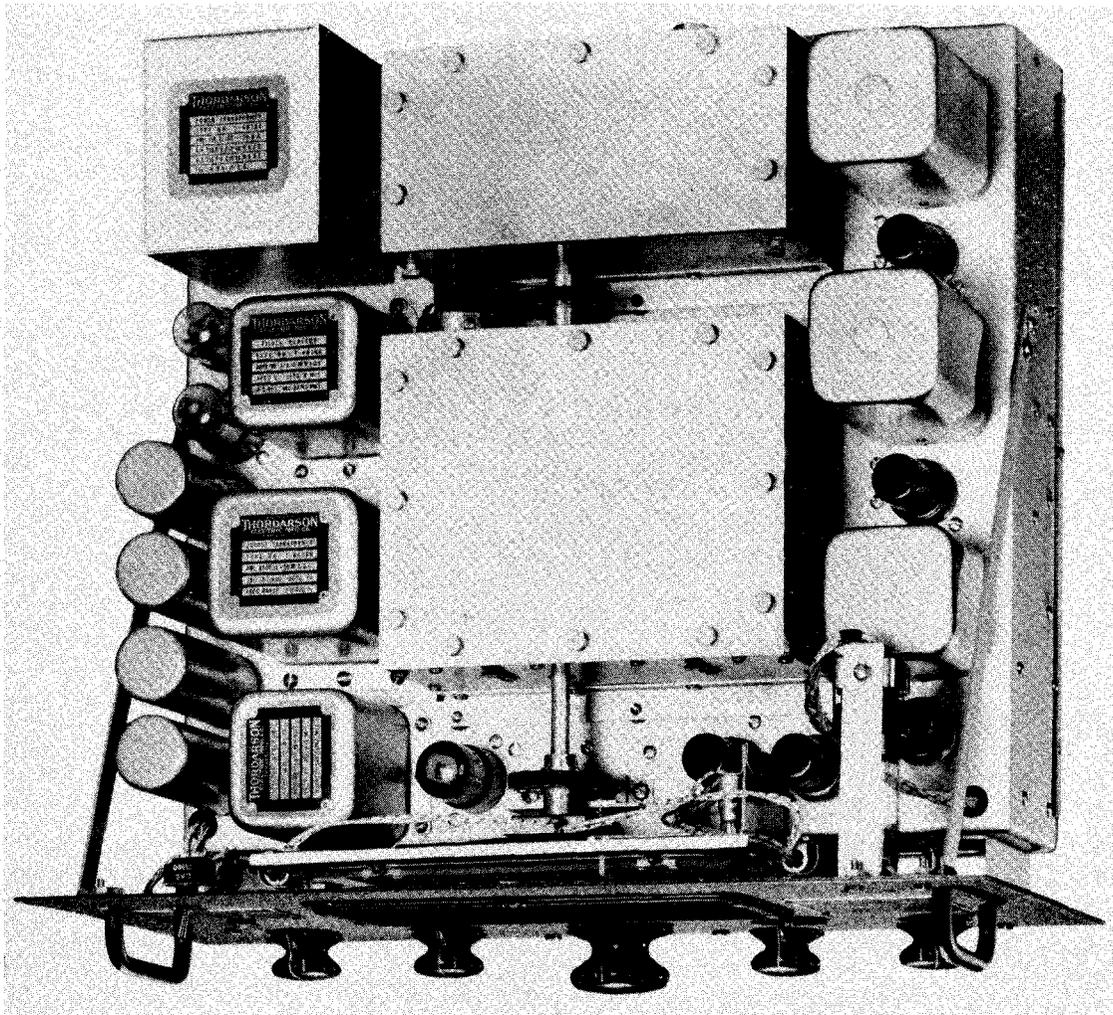
Antenna.—50 to 200 feet maximum single wire.

Weights, dimensions, and Navy type numbers

| | Type | Height | Width | Depth | Weight |
|-----------------------------------|-------------|--------|--------|--------|--------|
| | | Inches | Inches | Inches | Pounds |
| RBO, RBO-1: Receiver unit..... | CZC-46139.. | 12.75 | 20.5 | 18.5 | 130 |
| Equipment (ocean packed)..... | | | | | 165 |

¹Gross.

Accessories.—Not furnished by contract: Antenna, phones, and speakers.



Chassis view (top) of the Model RBO radio-receiving equipment.

RBP, RBP-1, AND RCP POINT-TO-POINT DIVERSITY RADIO RECEIVING EQUIPMENTS

Use.—Shore.

Frequency range.—3 to 24 mc. in 3 bands.

Power required for operating.—110-125/220-240/1/50-60 (voltage regulator covering variations in line voltage from 98 to 125 is standard equipment); 490 volt-amperes are required for each of the two diversity groups of the RBP.

Description.—The space diversity system of reception is based on the fact that a high-frequency signal such as used for long distance communications does not always fade simultaneously at two locations separated by even as little as several wave lengths. With three antennas, spaced approximately 1,000 feet apart in a triangular arrangement, the signal will seldom fade out at all three at the same time. Thus, by feeding the signal from each antenna through a separate receiver and combining the three rectified outputs, a relatively constant output level can be maintained.

The Model RBP, RBP-1¹ radio-receiving equipment is of dual construction, each section being a duplicate of the other. The difference between the two models is only a matter of contract. The complete model RBP, or RBP-1 can be operated to supply 2 three-set diversity signals, 3 two-set diversity signals or six straight-set signals. One-half of an RBP or RBP-1 may be supplied as Model RCP² and is complete for operation by itself.

Each receiver has three bands covering the frequency range of the equipment. Each band has its antenna coupling, three stages of RF amplification, heterodyne oscillator, and heterodyne detector with an output of 450 kc. IF. The IF from any receiver is then passed through two stages of amplification when it is again mixed with the output of a 400-kc. oscillator to produce a 50-kc. signal. It is then filtered through one of three band-pass filters (narrow, medium, or wide) and through an isolation amplifier. There are three stages of amplification in the 50-kc. frequency, then it is taken through a diode driver, diode detectors and filters. Here an auxiliary output is provided for use in auxiliary devices such as automatic control of frequency of either the RF or first IF heterodyne oscillator.

A variable oscillator (nominal 50 kc.) is provided to beat with the signal applied to the detector for an AF output giving an audible cycle note. Meters are provided to balance the output of the three receivers before they are combined or distributed at the signal control panel. The signal is then delivered to keyers, line loads through a limiter or to an AF amplifier for telephone output. In either case, automatic gain control can be used to apply suitable voltages back in the previous stages for control of the output.

¹ A special 500-cycle filter is available for installation in the RBP-1 when ordered specifically to use where greater selectivity is desired than that of the 1, 2, and 4 kc. filters normally supplied.

² The RBP and the RBP-1 are made up in seven racks with power supplies for both sections mounted in the middle rack. The RCP requires four racks; three for the three receivers and the fourth rack for the power supply, which in this case would not be filled completely.

Antennas ordinarily used in the diversity system are not sharply tuned and the so-called optimum frequency is therefore merely the approximate mid-frequency of the band over which the antenna should be used. Where several antennas are available for the desired direction, the one whose nominal frequency rating is nearest the frequency of the desired signal will give the best results. Lead-ins from many antennas are brought to panels at the top of the assembled equipment where various connections to the receivers may be made. The three receivers of each half of the dual units are located on either side at the top of three bays. A middle bay provides space for the power equipment for the right- and left-hand assemblies of receivers. The lower portion of the sections on either side is used for the IF amplifier units, signal control, tone keyers, and AF amplifiers.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|---------------------------|-----------------|-----------|
| RF amplifier unit..... | 9 | 36 |
| | 3 | 37 |
| | 3 | 78 |
| IF amplifier unit..... | 5 | 37 |
| | 13 | 78 |
| AF amplifier unit..... | 2 | 36 |
| | 3 | 37 |
| Tone-keyer unit..... | 2 | 36 |
| | 3 | 37 |
| Rectifier power unit..... | 1 | 83 |
| | 1 | 16 X 897. |
| Total..... | 45 | |

Type of receiver.—Triple detector superheterodyne diversity type with extreme stability, excellent selectivity and very high gain.

IF frequencies.—450 kc. and 50 kc.

Type of reception.—CW, and MCW with provision for special keying or line equipment.

Input.—Matching impedance 125 ohms.

Output.—600-ohm impedance.

Output power.—6 mw. to 6 db. above.

Sensitivity.—Over-all RF gain (mid band minimum); 3,000 voltage gain. Conversion gain, 1-2. Over-all IF gain (average): 25,000 voltage gain.

Antenna.—Fishbone, rhombic, or open V with open 4-wire transmission line of 200 ohms impedance.

Band coverage.—3-6 mc., 6-12 mc., and 12-24 mc.

Band pass filters available.—5 band widths; 1, 2, 4, 6, and 12 kc.

Band pass filters supplied.—3 band widths; 1, 2, and 4 kc.

Noise equivalent (with 4-kc. band width).—Less than 0.8 microvolts.

Image to signal ratio (up to 2 mc.).—Not less than 10,000.

CONFIDENTIAL

Automatic gain control (AGC) regulation provided

| | Slow | Medium | Fast |
|---------------------|------|--------|------|
| AGC time constants: | | | |
| Telegraph..... | 1.0 | 0.1 | 0.01 |
| Telephone..... | | 0.2 | 0.02 |

Telegraph operation.—Keying speed, up to 500 dots per second; sensitivity (keyer), less than 0.15 ma. change for full keying; tone frequency range permissible, up to 5000 cycles; frequency range of internal oscillator, 400 to 5000 cycles; external tone frequency input (maximum): Approximately 0.7 volt r. m. s.

Telephone operation.—Over-all fidelity, commercial;

output (maximum undistorted), 60 milliwatts; hum level, 50 db. below 100-percent modulation; harmonic content (total at full output, 50–5000 cycles), less than 3 percent.

Dimensions

| | Height | Depth | Width | Weight |
|--------------------------------------|---|---|---|------------------------|
| Complete dual equipment, 7 bays..... | <i>Ft. Ins.</i> 6 10 ³ / ₄ | <i>Ft. Ins.</i> 1 1 2 ³ / ₁₆ | <i>Ft. Ins.</i> 11 10 ³ / ₁₆ | <i>Pounds</i> 2,950 |
| Floor space..... | 7 6 | 4 0 | 12 0 | |
| Ceiling height..... | | | | |

¹ Allowance for door opening clearance in floor space as above.

Shipping weights and dimensions.—Data to be supplied.



RBQ RADIO RECEIVING EQUIPMENT

Use.—Shore, used only with radio-communication control links, and with Model TDG transmitter which are both attached to the 42A1 carrier telegraph system.

Frequency range.—Single frequency in the band of 132 to 156 mc.

Power required for operation.—110–120/1/60; 110 voltamperes for the radio equipment and 325 watts for the heating equipment. If the line voltage holds at 125 volts for any large portion of the day, provision should be made for regulation to avoid prematurely shortened tube life. Two amperes for the crystal heaters is intermittent.

Description.—The model RBQ radio receiving equipment is the assembly of apparatus that makes up the radio-receiving terminal of a point-to-point ultra-high-frequency link. It is not for use apart from the associated equipment such as the TDG transmitter and the 42A1 of the carrier telegraph system. The complete assembly is capable of reception of single channel voice, multichannel audio telegraph, or multichannel audio telegraph with two channel audio carrier telephone signals. Output facilities at voice frequencies are arranged for connecting to conventional wire line circuits for either local or remote operation.

All components have been designed for continuous operation in tropical conditions and ambient temperature ranges of -40° C. to $+40^{\circ}$ C. The outdoor cabinet provides gravity ventilation with baffle plates which provide adequate protection of the equipment from weather or meddling.

The antenna consists of a multi-element directional radiator which is sealed and under gas pressure to reduce the losses and make its characteristics independent of weather conditions. Connection from antenna to receiver is by means of low-loss, gas tight, concentric transmission line.

The circuit used includes basically one stage of RF, first detector, HFO, three stages of IF, second detector, AVC, AF, output limiter (optional), carrier indicator with relay (codan amplifier), and audio output. The

HFO is crystal controlled. The crystal oscillator is thermostatically heated to the desired temperature for stabilized operation.

A meter on the panel is connected to a multiposition switch which indicates the current in the grid circuits of the RF, IF, HFO, and the AVC. Readings indicate the tuning of these circuits in alignment procedure.

Two RF panels are provided which may be thought of as equivalent, one being a replacement of the other. The main panel assembly operates in conjunction with either RF panel.

A test oscillator is provided for convenience in servicing. Its power of 220 volts D. C. at 0.005 ampere and 6.3 volts at 1.3 amperes required for heaters is normally supplied by the receiver. The crystal is thermostatically heated and the RF is tuned to the harmonic of the crystal. The BFO is tuned to 1000 cycles and beats with the RF. The output is then controlled by an attenuator giving a 50 db. range of adjustment. The output has a 700-ohm impedance. The power for the test oscillator is supplied from the receiver with each lead filtered. The test oscillator output jack on the receiver is bridged across the 70-ohm antenna circuit through a 700-ohm series resistor with a 20 db. loss inserted between the test oscillator output circuit and the receiver antenna circuit.

If the radio-receiving antenna is in close proximity to an existing radio transmitting antenna it may be necessary to plan the installation so as to have null points in correct relation to the transmitting antenna in order to minimize the effect upon the radio-receiving antenna. It is recommended that the receiving antenna be placed at least 30 feet from transmitting antennas especially when more than one transmitting antenna is used.

Pole mounting and the 9 db. antenna is to be preferred to the 3 db. antenna. Receiving antennas should be placed at least seven feet apart when their null points face each other. A change of frequencies may be employed to reduce inter-reaction when spurious responses are found to exist. Care should be used in erecting

antenna assemblies to avoid damage by bending the antenna. As many as five men on the ground may be needed. Special precautions are required in cutting and soldering components and in the manner in which the coaxial line is run from the antenna into the receiver cabinet. One antenna oriented 90° from another may be placed above the other with nearest elements six feet apart.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Navy type | Commercial type |
|--|-----------------|-----------|-----------------|
| D-151285 radio-frequency panel: ¹ | | | |
| RF amplifier..... | 1 | ----- | 385 A |
| First amplifier..... | 1 | ----- | 385 A |
| First detector..... | 1 | ----- | 385 A |
| Crystal oscillator..... | 1 | 6N7 | 6N7 |
| First frequency multiplier..... | 1 | 6N7 | 6N7 |
| Second frequency multiplier..... | 1 | ----- | 383 A |
| D-150966 radio-frequency panel: ¹ | | | |
| RF amplifier..... | 1 | 717 A | 717 A |
| First detector..... | 1 | 717 A | 717 A |
| Crystal oscillator..... | 1 | 6N7 | 6N7 |
| First frequency multiplier..... | 1 | 6N7 | 6N7 |
| Second frequency multiplier..... | 1 | 717 A | 717 A |
| CW-46168 Radio receiver: | | | |
| First IF amplifier..... | 1 | 6SK7 | 6SK7 |
| Second IF amplifier..... | 1 | 6SK7 | 6SK7 |
| Third IF amplifier..... | 1 | 6SK7 | 6SK7 |
| Second detector, AVC and first audio..... | 1 | 6SQ7 | 6SQ7 |
| Codan amplifier..... | 1 | 6SL7-GT | 6SL7-GT |
| Audio output..... | 1 | 6J5 | 6J5 |
| Power rectifier..... | 1 | 5U4G | 5U4G |
| Bias rectifier..... | 1 | 6X5-GT | 6X5-GT |
| HFO and audio oscillator..... | 1 | 6SL7-GT | 6SL7-GT |
| Peak Load Limiter (when used)..... | 1 | 6H6 | 6H6 |

¹ Only 1 of these panels is used in a particular receiver.

Type of receiver.—Single frequency—superheterodyne.

IF frequency.—6.9 mc.

Type of reception.—MCW, voice, with provision for relay and wire line connection.

Input.—70 ohm impedance; coaxial line connector provided.

Output.—Single frequency into 600-ohm impedance.

Output power.—30 mw. Flat response within 3 db. from 150 to 10000 cycles. Jack for bridging output circuit.

Sensitivity.—Data not available.

Antenna.—Directional radiator type, 9 db. or 3 db. with gastight coaxial line.

Radiation frequencies.—With crystal shield. Safe—harmonics up to 126 mc. Unsafe—above 126 mc. (except 132 mc).

Weights, dimensions, and Navy type numbers of equipment included in contract

| Unit | Navy type numbers | Height | Width | Depth | Weight |
|----------------------------|-------------------|--|--|---|------------------|
| Radio receiver..... | CW-46168 | <i>Inches</i> 13 ³ / ₈ | <i>Inches</i> 17 ¹ / ₂ | <i>Inches</i> 9 ³ / ₈ | <i>Pounds</i> 50 |
| Test oscillator..... | CW-60037 | 3 ¹ / ₂ | 17 ¹ / ₂ | 9 ³ / ₄ | 11 |
| Receiver cable outfit..... | D-150423 | ----- | ----- | ----- | ----- |
| Spare parts panel..... | D-150639 | 3 ¹ / ₂ ^{±2} | 19 | ----- | ----- |
| Outdoor cabinet..... | D-150426 | 67 ⁷ / ₈ | 32 ¹ / ₂ | 18 ³ / ₄ | ----- |
| 3 db antenna..... | D-150427 | ----- | ----- | ----- | ----- |
| 9 db antenna..... | D-150428 | ----- | ----- | ----- | ----- |
| Antenna outfit..... | D-150429 | ----- | ----- | ----- | ----- |

Shipping weights and dimensions will be supplied when available.



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RBS RADIO RECEIVING EQUIPMENT

Use.—Ship-shore, CW, MCW, and voice.

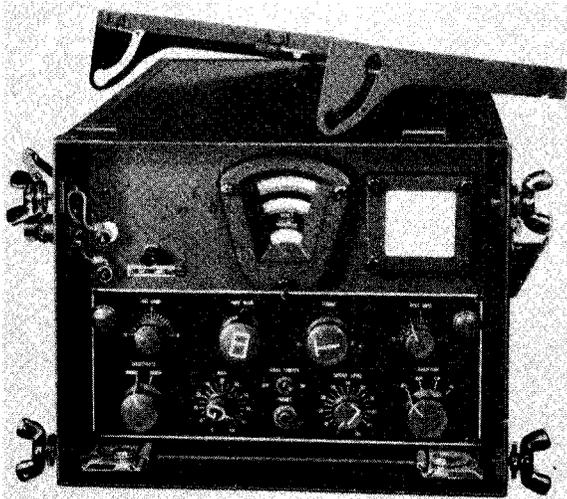
Frequency range.—2 to 20 MC in 4 bands.

Power required for operation.—115 volts, 50–60 cycle, single phase.

Description.—The model RBS radio receiver is designed for shipboard use and at shore stations. It is sturdy in design, rugged in construction and particularly suitable for operation under adverse conditions. The electrical design of the Model RBS is basically the same as the Model RBM equipments. There are mechanical changes and modifications in the RBS receiver as compared to the RBM equipments. The RBS is designed for bulkhead installation.

The RBS series radio receiver is composed of two major units, the receiver unit and the rectifier power amplifier unit.

The receiver unit is constructed on an aluminum alloy chassis, which is shock-mount supported. The



Radio receiving equipment Model RBS.

receiver may be slid from its case for inspection maintenance or adjustment.

The rectifier power-amplifier unit is constructed on a steel sheet chassis. Flush with the chassis base is a cross strip about three and one-half inches wide, attached to the frame. Recessed in this strip are three jacks to which outside connections are made to the bottom of the unit when it is installed for use.

The Navy type CCT-20235 rectifier power-amplifier unit contains the following controls and devices located on the front and/or bottom of the unit:

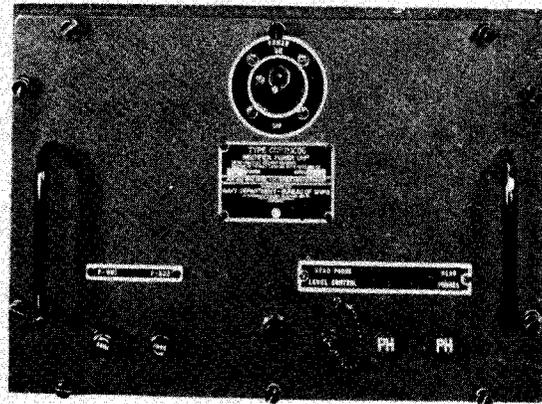
- (1) Master switch for line power.
- (2) Power input receptacle.
- (3) Power output receptacle for receiver unit.
- (4) Speaker output receptacle with screw cover cap.
- (5) Head phone jacks located behind hinged covers.
- (6) Output level control for head telephones.

(7) Pilot light.

(8) Fuses in each primary lead of the power transformer.

The Navy type CCT-46217 receiver unit has the following controls and devices located on the front operating panel:

- (1) Selectivity (BROAD-SHARP) switch.
- (2) RF and IF amplifier gain control.
- (3) Noise limiter (on-off) switch.
- (4) Head-telephone jack.
- (5) Output level control.
- (6) Reception (AVC-MOD-CW-OL) switch.
- (7) Antenna compensator.
- (8) Frequency band change switch.
- (9) Tuning control.
- (10) Beat note (CW oscillation frequency) control.
- (11) Ground connection terminal.
- (12) Dial light control.
- (13) Antenna connection terminal.



Rectifier power unit of Model RBS radio receiving equipment.

- (14) Calibration chart holder.
- (15) Tuning control lock.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|--|-----------------|-------|
| Receiver: | | |
| RF amplifier..... | 1 | 12SG7 |
| Mixer..... | 1 | 12SG7 |
| RF converter..... | 1 | 12SJ7 |
| First IF amplifier..... | 1 | 12SG7 |
| Second IF amplifier..... | 1 | 12SG7 |
| Beat frequency oscillator..... | 1 | 12SJ7 |
| Second detector..... | 1 | 12H6 |
| AVC tube..... | 1 | 12H6 |
| First audio frequency..... | 1 | 12SK7 |
| Second audio frequency..... | 1 | 12SJ7 |
| Audio output..... | 1 | 12A6 |
| Rectifier power amplifier unit: | | |
| Rectifier (full wave)..... | 1 | 5U4G |
| Push pull amplifier..... | 2 | 6V6GT |
| Total..... | 14 | |

Type of receiver.—Superheterodyne.

Type of reception.—CW, MCW and voice.

Input.—Antenna compensator control makes the sets adaptable to a wide range of open wire antennas.

Output impedance.—600 ohms.

Output power.—150 mw at head-telephone jack of receiver and 8 watts at the head-telephone jack or speaker receptacle on the rectifier power-amplifier unit.

Sensitivity.—The CW and MCW sensitivity of the receiver is better than 8 microvolts on bands 1, 2, and 3 and on band 4 it is better than 15 microvolts.

Antenna.—Any antenna with a capacity range of 80 to 500 micro-micro farads is suitable for operation.

Band coverage:

| Band No. | Frequency range (mc.) |
|----------|-----------------------|
| 1..... | 2.0 to 3.6 |
| 2..... | 3.6 to 6.5 |
| 3..... | 6.5 to 11.4 |
| 4..... | 11.4 to 20.0 |

Weights, dimensions, and Navy type numbers of equipment included in contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|--------------------------------|---------------|------------------------------------|-----------------------------------|----------------------------------|---------------------|
| Receiver..... | CCT-46217 | <i>Inches</i> 17 $\frac{1}{16}$ | <i>Inches</i> 12 $\frac{1}{2}$ | <i>Inches</i> 9 $\frac{3}{8}$ | <i>Pounds</i> 35 |
| Rectifier power amplifier..... | CCT-20235 | 10 $\frac{1}{2}$ | 14 $\frac{1}{8}$ | 9 $\frac{3}{8}$ | 65 |

Shipping weights and dimensions

| Unit | Size | Gross weight | Volume |
|---|------------------------|----------------------|----------------------------|
| Entire equipment including spare parts and accessories shipped in one case..... | <i>Inches</i> | <i>Pounds</i> 214 | <i>Cubic Feet</i> |



RBY PANORAMIC RADIO RECEIVING EQUIPMENT

Use.—Ship-shore.

Receiver frequency range.—0.55 to 43.0 mc. with 6 bands on the receiver. Panoramic sweep width adjustable from 0 to 200 kc. above 3 mc. (A reduced sweep is available below 3 mc.)

Power required for operation.—110/115/120 /1/ 25/50/60, 58 watts, 64 va. for the adapter, 200 watts for the receiver and adapter. A universal 110–220 volt model is available by special order. A provision is made for using a battery supply. A minimum of 270 volts at 150 ma. and 6 volts at 18 amperes is required.

Description.—The model RBY panoramic adapter consists of two units: A commercial Model SX28 modified receiver and a panoramic adapter. Simultaneously with normal operation of the receiver, the result is a visual image of several radio signalling frequencies distributed over the screen of a cathode ray tube. Both units are assembled in one metal cabinet.

The signals for the panoramic portion are taken from the output of the mixer stage of the receiver where there are a large number of frequencies. The number of frequencies at this point is large and spread over a relatively large band but with the peak at the center of the IF band.

The first stage of the adapter consists of a band pass which attenuates the frequencies at this center and accentuates the frequencies on either side. Thus a band of frequencies of practically uniform amplitude is passed on to the mixer and covering a wider range than just that shown on the cathode ray screen.

A saw-tooth generator supplies a voltage to the horizontal deflecting plate of the cathode ray tube and to the grid of a reactor tube working in conjunction with the frequency modulated oscillator. The oscillator output and the RF band pass output meet in the converter. After passing through one stage of IF, the signal is passed through a second detector and video amplifier and thence to the vertical plate of the oscilloscope. The signals within the band width appear as deflections and are then spread over the screen but appear to be stationary. Each signal appears periodically 30 times per second but for only a small fraction of the time, and makes a pattern that is characteristic of the type of wave involved. A constant carrier has a deflection of fixed amplitude. Voice or music modulation causes the amplitude to vary irregularly. A constant tone modulation of low frequency will produce a series of convolutions varying in amplitude, their number being determined by the modulation frequency. As the

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modulation frequency increases, the convolutions move toward the two sides of the deflection, as the side bands tend to become visible. The higher the frequency of modulation the farther away these side bands will move from the center deflection representing the carrier. A frequency modulated carrier appears as a carrier deflection wobbling sideways. To the experienced operator the nature of the signal can be identified without tuning the receiver to listen to it.

Both the receiver and the adapter have power units built in. The power for the adapter comes from a suitable socket on the receiver and the receiver has a line to the power outlet.

The panoramic adapter is, in effect, a complete super-heterodyne receiver which is periodically tuned over a fixed band of the frequency spectrum, centered at the intermediate frequency of the companion receiver. Connection to the receiver is made through a high impedance shielded line. The first stage or band pass is an amplifying stage. The signal is then frequency modulated in the mixer which is coupled to the one stage of IF and through the second detector to the direct coupled video amplifier before it reaches the vertical plate of the cathode ray tube. The center frequency of the IF band is the center on the screen and represents the frequency to which the companion receiver is tuned.

The screen scale is the scale adjacent to the base line, which is calibrated 100 kilocycles above and below center frequency for a maximum sweep-width setting.

On the adapter, the power switch is in the center below which is a pilot light and to the left is located a fuse. To the upper right is the face of the cathode ray tube with a frequency scale below the base line reading in kilocycles above and below the center frequency. A screen covers the opening which reduces glare from any external light as the pattern is viewed and improves the contrast between the green pattern and the white background.

Below and to the left of the screen is the "Sweep" knob controlling the sweep-width. This has the effect of increasing the "resolution" of the pattern which term would correspond to the "selectivity" of the conventional receiver. Next and to the right is the "Hor. Position" control which permits the lateral positioning of the patterns with reference to the zero of the scale. Following is the "Gain" which regulates the amount of deflection of the signal.

To the left and behind a panel held in place with screws are seven semi-adjustable controls suitably labeled. Those marked in white are "Vert. Pos." (vertical position) "Intensity" and "Focus." Those marked in red are for adjustment by an operator fully acquainted with the servicing of the equipment.

In addition to the observation of "traffic density" and the nature of interference, the equipment may be useful in direction finding, receiver check-up, alignment, transmitter adjustments, and measurements of field strength.

The receiver unit is built along conventional lines with two stages of RF, mixer, HFO, first IF amplifier and noise limiter, second IF amplifier, second detector and S meter tube, AVC amplifier, noise amplifier, noise rectifier, BFO, first audio amplifier, and push-pull output. B supply is self contained.

A "send-receive" switch removes plate voltage from the tubes, thus reducing the receiver to a stand-by condition. There is a 110-volt receptacle in parallel on the rear of the chassis so that a remote relay or switch may be in command while the send-receive switch is in the "send" position.

A phono-jack is provided for phonograph records or transcription play-back purposes. A high impedance crystal or magnetic pick-up arm should be used, equipped with a standard headphone plug. When such plug is used the reception of radio signals is disconnected as the plug is inserted.



Model S-35 panoramic radio receiver similar to the Model RBY panoramic radio-receiving equipment

For conventional a-c operation the shorting plug must remain in the d-c socket. A plug similar to the shorting plug design should be used to connect to a B battery or vibrapack equipment. 270 volts at 150 ma. is required for satisfactory operation in this manner.

An "S" meter (signal strength) is located on the left side of the panel and is provided with a "zero-set." It operates in the plate circuit of the second detector.

In the upper center is the main tuning dial. Directly below is the band-change switch ganged for suitable connections on the six bands. Behind the dial and ganged with the band-change switch is a screen shielding all other scales but illuminating the one scale in use. Parallax error is reduced to a minimum.

International and shortwave broadcast bands are specially indicated on the dials. Portions of the scale

of the amateur band where A₃ may be heard is underscored.

A band-spread dial is calibrated for the 10-, 20-, 40-, and 80-meter bands and is controlled by the right hand wheel with its dial above. To the left is the main tuning dial equipped with a vernier and set-lock which releases the hand wheel from the tuning mechanism. To the left and top is the tone control under which is the BFO knob which sets the pitch heard in the phones. Next below is the BASS IN and OUT switch and in the lower corner is the AF GAIN knob. To the right is the headphone jack, near the main tuning dial. Between the main tuning dial and the band-change switch is the RF GAIN and beyond to the right is the ANT. TRIM (antenna trimming) knob. Next to the lower right corner is the AVC and BFO "on" and "off" switch and in the corner, the "Selectivity" control. Next above is the "Send-Receive" switch, and above is the "Crystal Phasing" knob. In the upper corner is an ANL (automatic noise limiter) control which can be turned "off" or the threshold of operation can be raised or lowered as desired.

The selectivity knob controls six circuits providing a progressively narrower gate determining the width of the path to the second detector. The CHL-46195 is an adaptation of the manufacturer's model SX28, providing for connection into the IF Input and conducting the signal through a decoupling resistor to the panoramic adapter.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|---|-----------------|--------------------|
| PANORAMIC ADAPTER | | |
| First IF amplifier | 1 | 6AC7 |
| Mixer-sweep oscillator | 1 | 6SA7 |
| Reactor | 1 | 6AC7 |
| Second IF amplifier | 1 | 6SJ7 |
| Detector and Video amplifier | 1 | 6SQ7 |
| Sawtooth generator and horizontal amplifier | 1 | 6SL7G ¹ |
| Regulator | 1 | VR105/30 |
| Rectifier | 1 | 6X5GT |
| Rectifier | 1 | 2X2 |
| 3-inch cathode ray tube | 1 | 3AP1 |
| Total in the adapter only | 10 | |

Pilot lamp is a 6-8 volt, 0.15 ampere bayonet base.

Type of receiver.—Superheterodyne.

Type of reception.—CRT visual indication.

Input.—May be taken from any receiver with 455 kc. accessible, through a decoupling resistor.

Selectivity.—Resolution 5.5 kc. at maximum sweep width.

Sensitivity.—Is that of the receiver as the input of the adapter is the output of the mixer of the companion receiver.

Antenna.—Input to the adapter is connected to the first detector of the companion receiver through a high impedance and the receiver performance is not affected.

Tube complement

| Function | Number of tubes | Type * |
|--|-----------------|--------|
| RECEIVER | | |
| First RF amplifier | 1 | 6AB7 |
| Second RF amplifier | 1 | 6SK7 |
| Mixer | 1 | 6SA7 |
| HF oscillator | 1 | 6SA7 |
| First IF amplifier noise limiter | 1 | 6L7 |
| Second IF amplifier | 1 | 6SK7 |
| Second detector and S meter tube | 1 | 6B8 |
| AVC amplifier | 1 | 6B8 |
| Noise amplifier | 1 | 6AB7 |
| Noise rectifier | 1 | 6H6 |
| Beat oscillator | 1 | 6J5 |
| First audio amplifier | 1 | 6SC7 |
| Push pull output amplifier | 2 | 6V6GT |
| Rectifier | 1 | 5Z3 |
| Total | 15 | |

Type of receiver.—Superheterodyne.

IF frequency.—455 kc.

Type of reception.—A₁, A₂, A₃.

Input.—400 ohms, grounded or balanced.

Output.—5,000 or 500 ohms.

Output power.—8 watts undistorted power.

Sensitivity.—Bands 1-5, 2 microvolts and under, sixth band 4 microvolts (for 0.05 watts output).

Antenna.—Inverted L Marconi type 75 feet long and as high as possible. A doublet antenna may be used and a ground connected if it improves reception.

Band coverage:¹

| Band: | Frequency range |
|---------|------------------|
| 1 | 5.50 to 1600 kc. |
| 2 | 1.6 to 3.0 mc. |
| 3 | 3.0 to 5.8 mc. |
| 4 | 5.8 to 11.0 mc. |
| 5 | 11.0 to 21.0 mc. |
| 6 | 21.0 to 43.0 mc. |

Weights, dimensions, and Navy type numbers

| Unit | Navy type numbers | Height | Width | Depth | Weight |
|-------------------------|-------------------|--------|--------|--------|----------|
| Receiver | CHL-46195 | Inches | Inches | Inches | Pounds |
| Panoramic adaptor | CPN-55095 | ..... | ..... | ..... | 75 |
| Cabinet | CGP-10141 | 19½ | 21 | 15 | 115 Est. |
| Total | | | | | 200 |

Shipping weights and dimensions.—Data to be supplied when available.

¹ The range of the adapter depends upon the frequency range of the receiver, since the signal is taken from the IF.

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RBZ RADIO RECEIVING EQUIPMENT

Use.—Shore—personal equipment.

Frequency range.—2.0 to 5.8 mc.

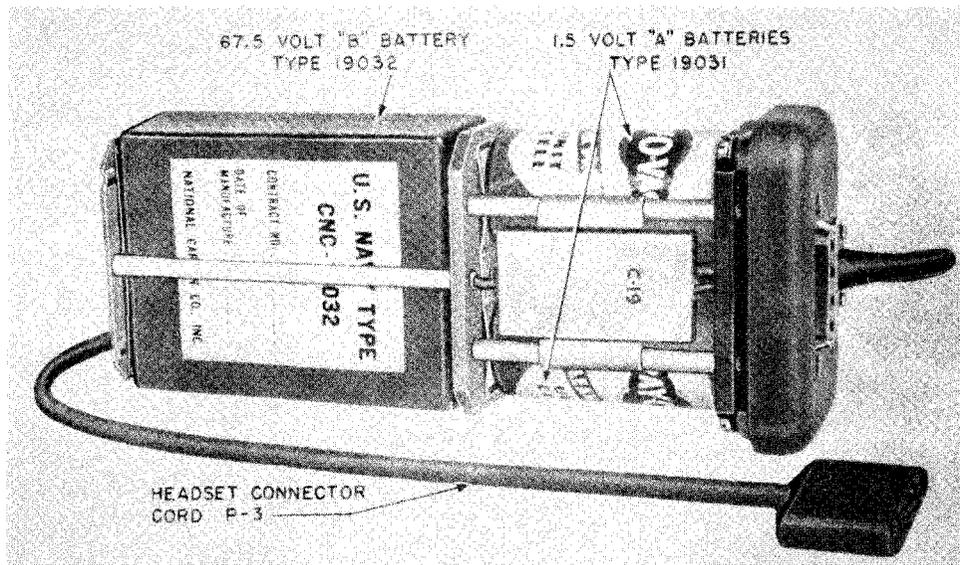
Power required for operation.—2—1.5 volt A Batteries; 1—67.5 B battery. Estimated life—8 hours for the A and 40 hours for the B batteries.

Description.—The model RBZ radio receiving equipment is designed to serve as a portable radio receiver intended to be carried primarily on the chest in a special canvas holder secured in place by shoulder straps. The antenna lead-in consists of a flexible cable, rubber covered, with a clamp on one end for fastening to the standard metal helmet which acts as the antenna, and a pin-terminal on the other for connecting with the radio set. Headphones, which are mounted in a suitable canvas skull cap, are provided for use under the helmet. The equipment is light and compact and derives all operating power from self-contained dry batteries which are carried in one of the two identical and interchangeable watertight plastic cases.

The circuit used is that of a five-tube permeability tuned superheterodyne receiver. There is one stage of RF, one mixer and oscillator tube, one IF stage, detector with AVC and AF amplifier, and an AF power amplifier. The “on and off” switch is on the same shaft with the gain control. The tuning knob must be pressed to engage the clutch operating the ganged powdered iron slugs of the three tuned coils, viz. antenna, RF, and oscillator.



RBZ radio-receiving equipment in use.

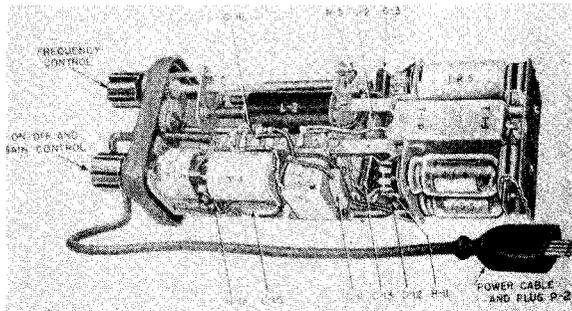


Interior view of the type CEX-19040 battery power unit of the Model RBZ radio-receiving equipment.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|---------------------------------------|-----------------|------|
| RF amplifier | 1 | 1T4 |
| Mixer-oscillator | 1 | 1R5 |
| IF amplifier | 1 | 1T4 |
| Diode detector, AVC, and AF amplifier | 1 | 185 |
| AF power amplifier | 1 | 1L4 |
| Total | 5 | |



Type CEX-46203 radio receiver for the Model RBZ radio-receiving equipment, bottom view, case removed.

Type of receiver.—Superheterodyne.

IF frequency.—455 Kc.

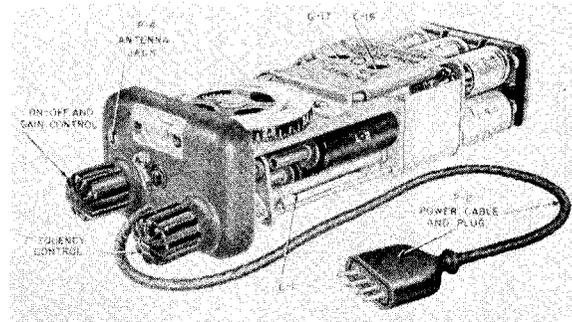
Type of reception.—A₃

Input.—Grounded to chassis.

Input impedance.—Low. For test purposes is through a 50 mmfd dummy antenna.

Output impedance.—600 ohms.

Output power.—Suitable for phone operation.



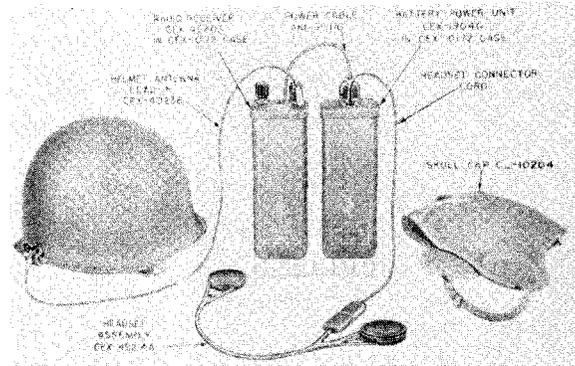
Type CEX-46203 radio receiver for the Model RBZ radio-receiving equipment, top front view, case removed.

Sensitivity.—1-4 microvolts for output of 1 milli-watt.

Antenna.—Standard steel helmet or 18' x 50' "hank of wire."

Weights, dimensions, and Navy type numbers of equipment units supplied with contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|--|------------------------|--------|------------------|------------------|---------|
| Receiver in case | CEX-46203 CEX-10172 | 8 | 27 $\frac{3}{8}$ | 17 $\frac{3}{8}$ | 1. 14 |
| Battery power: 2 A batteries | 19031 | 8 | 27 $\frac{3}{8}$ | 17 $\frac{3}{8}$ | 1 13 |
| 1 B battery | 19032 | | | | |
| All in case | CEX-10172 | | | | |
| Head-set assembly | CEX-49214A | | | | 0 8 |
| Receivers: 2-inch diameter, 5/16-inch thickness: 6-ounce. Cord length, 12 1/4 inches. Skhill cap, 2-ounce. | | | | | |
| Helmet antenna lead-in: Length, 27 inches. | CEX-49238 | | | | 0 1 1/2 |
| Carrying holder | CEX-10203 | | | | 1 0 |
| Total | | | | | 5 5 1/2 |



Major units of the Model RBZ radio-receiving equipment

Shipping weights and dimensions

| Unit | Size (inches) | Gross weight | Cubic feet |
|---|---------------|--------------|------------|
| 5 RBZ complete equipments (including a set of operating spare tubes and 2 gaskets for each equipment) packed for domestic shipment. | 25 x 15 x 10 | 37 | 2.17 |
| 1 set of bulk spares (replacement and spare parts) for 20 equipments packed for export shipment. | 20 x 16 x 15 | 32 | 2.18 |
| 50 sets of spare batteries (100 "A's" and 50 "B's") packed for export shipment. | 20 x 16 x 9 | 77 | 1.67 |
| 200 sets of spare tubes packed for export shipment. | 29 x 14 x 12 | 56 | 2.82 |

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RCF RADIO RECEIVING EQUIPMENT

Use.—Shore communications.

Frequency range.—550 kc. to 43 mc. in six bands.

Power required for operation.—Standard equipment operates from 110 to 125 volts of 50- to 60-cycle a. c. A universal 110- to 220-volt model is obtainable on order. This model can be operated at either of those 2 voltages with 25- to 60-cycle current.

Description.—The receiver comes equipped with a cabinet for table mounting. The standard 8¾ by 19-inch panel dimension with holes suitably spaced make it possible for the chassis to be mounted in a standard relay rack. When the receiver is so mounted, the table cabinet is replaced with a dust cover. The maximum over-all length of the receiver will then allow it to be mounted in a rack with upright channel clearance of 17½ inches.

On the rear apron of the receiver's chassis, appear two terminal strips for connecting either a 500 or 5,000 ohm speaker to the receiver.

The antenna chosen to be used with the receiver is connected to terminals marked A1-A2 and G. The antenna may be one of several types, a conventional inverted L Marconi type, 75 to 100 feet long, including lead-in, a doublet antenna, or a half-wave antenna. The approximate antenna input impedance of the receiver is 400 ohms.

The operation of the following controls is necessary for the receiver's performance:

1. The "Send-Receive" switch on the front panel makes the receiver inoperative when the switch is in the "Send" position.

2. The "Stand-By" switch socket is used for remote control of the receiver and will close and open the circuit so long as the "Send-Receive" switch is in the "Send" position.

3. A "Phono-Jack" is circuitally connected in the input of the high fidelity audio amplifier of the receiver to permit the attachment of a high impedance magnetic or crystal pick-up for phonograph record or transcription playback purposes. The output of the pick-up is terminated in a standard headphone plug and the plug is inserted in the "Phono-Jack" when record playing is desired. The receiver is inoperative to radio signals, when the plug is in the phono-jack.

4. The volume of the audio amplifier is varied by rotating the "AF Gain" control until the desired level is obtained.

5. The "DC Operation Socket" is used when it is necessary to furnish power to the receiver from a direct current source. For conventional a. c. operation, the shorting plug must remain in the "DC Operation Socket." This plug is removed for battery or vibrapack operation.

6. "S" meter control (zero set) is obtained by varying the knob appearing on the left hand chassis apron edge.

7. Band switch.

8. Bandsread dial.

9. Tone control.

10. RF gain control.

11. Antenna trimmer control.

12. Selectivity control.

13. Crystal phasing control.

14. Automatic noise limiter control.

15. AVC—BFO OFF-ON switch.

16. Bass in-out switch.

17. Head-phone jack.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|----------------------------------|-----------------|-------|
| First RF amplifier | 1 | 6AB7 |
| Second RF amplifier | 1 | 6SK7 |
| Mixer | 1 | 6SA7 |
| HF oscillator | 1 | 6SA7 |
| First IF amplifier noise limiter | 1 | 6L7 |
| Second IF amplifier | 1 | 6SK7 |
| Second detector and S meter tube | 1 | 6B8 |
| AVC amplifier | 1 | 6B8 |
| Noise amplifier | 1 | 6AB7 |
| Noise rectifier | 1 | 6H6 |
| Beat oscillator | 2 | 6F5 |
| First audio amplifier | 1 | 6SC7 |
| Push-pull output amplifier | 1 | 6V6GT |
| Rectifier | 1 | 5Z3 |
| Total | 15 | |

Type of receiver.—Superheterodyne.

Type of reception.—Pure, modulated, or telephone and telegraph modulated radio frequency waves.

Input impedance.—Approximately 400 ohms.

Output power.—8 watts undistorted.

Sensitivity (for 0.05 watt output).—Bands 1 to 5—2 microvolts and under; 6th band 4 microvolts.

Selectivity.—IF broad (high fidelity) $\left\{ \begin{array}{l} 2X \dots 1,000 X. \\ 12 kc. 36 kc. \\ 4.1 kc. 22 kc. \end{array} \right.$

Antenna.—The antenna may be one of several types, a conventional inverted L Marconi type, 75 to 100 feet long, including lead-in, a doublet antenna, or a half-wave antenna.

Band coverage:

| Band No. | Frequency range (mc.) |
|----------|-----------------------|
| 1 | 0.550 to 1,620 |
| 2 | 1.5 to 3.1 |
| 3 | 2.9 to 5.9 |
| 4 | 5.75 to 11.5 |
| 5 | 10.3 to 21.5 |
| 6 | 20.4 to 43 |

Weights, dimensions, and Navy Type numbers of equipment units included in contract

| Unit | Type No. | Height | Width | Depth | Weight |
|----------------------------|----------|-----------|------------|------------|--------|
| Receiver table cabinet | | Inches 10 | Inches 20½ | Inches 12¾ | |
| Relay rack dust cover | | 17¾ | 14¾ | 8¾ | |
| Receiver, chassis assembly | | 19 | 8¾ | 13½ | |

Shipping weight and dimensions

| | Size | Gross weight | Volume |
|---|--------|--------------|----------------|
| Entire equipment including spare parts shipped in one box | Inches | Pounds 213 | Cubic feet 9.1 |

RCH RADIO RECEIVING EQUIPMENT

Use.—Ship-shore, CW, MCW, and voice.

Frequency range.—80 to 560 kc. and 1.9 to 24 mc. in five bands.

Power required for operation.—100 to 125 volts, 58 to 62 cycles, single phase.

Description.—The Model RCH Radio Receiving Equipment is designed for ship board use and at shore stations. The entire equipment consists of one unit, a receiver with self-contained rectifier type power supply. It is especially designed to minimize radiation

mounts at the four bottom corners of the cabinet. Two separated shielded compartments each designed as a complete subassembly easily detachable, as such, from the chassis, contain the following:

1. The antenna compartment contains all the circuit elements between the antenna input and the signal grid of the r-f amplifier tube. The r-f tube, in turn, is mounted horizontally at the rear center of the RF and HF Oscillator compartment.

2. All the circuit elements from the r-f amplifier tube



Model RCH radio receiving equipment.

from the high frequency oscillator. This is accomplished by isolating the antenna input circuits from the first detector (or mixer) and the high frequency oscillator circuits, through the use of extensive shielding and filtering; and by the employment of a type of construction which reduces to practical limits undesirable circuit coupling by virtue of circulating currents in common shields.

The equipment is primarily designed for top of table or bench mounting. It is furnished in a metal cabinet supported from its mounting base with rubber shock

to the first IF amplifier input transformer and also all circuit elements associated with the high frequency oscillator are mounted in the RF and HF oscillator compartment located between the front panel and the compartment containing the antenna input circuit elements.

The front panel of the receiver has mounted on it the following knobs, dials and adjustments:

1. Phone-control switch:
 - a. Position "No. 1"—connects headphone jack to output of receiver.

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- b. "Mixed" position—connects phone jack to output of receiver and to terminal board in rear of receiver chassis which provides for connection to a second receiver.
 - c. Position "No. 3" provides for connecting the phone jack to output of second receiver only.
2. Reception switch:
- a. "Mod" position—for reception of modulated radio and telephone signals.
 - b. "CW"—for reception of telegraph signals.
 - c. "CWOL"—for telegraph reception with output limiter provided to limit variations in signal strength and give better signal to noise ratio.
- 3. Gain control knob.
 - 4. Antenna trimmer knob.
 - 5. Band change switch knob.
 - 6. C. W. oscillator knob.
 - 7. Main tuning dial.

The rear panel of the receiver has openings to give access to the following:

- 1. Speaker output terminals.
- 2. Set No. 2 input terminals.
- 3. A. C. line fuse.
- 4. D. C. power switch receptacle.
- 5. A. C. power receptacle.

The input circuit of the receiver is so arranged as to be suitable for use with either a balanced feed-line or a single wire antenna system. The dimensions of the single wire antenna are not critical, the recommended minimum over-all length of antenna and lead-in is 75 feet, the recommended maximum over-all length is 200 feet. The antenna should be spaced at least 6 feet away from any parallel stay, mast or stack. It should be well insulated and should be erected as high as possible. A one-half megohm static drain resistor should be permanently installed between the antenna and ground.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|--------------------------|-----------------|--------|
| RF amplifier | 1 | 6K7 |
| HF oscillator | 1 | 6J5 |
| First detector and mixer | 1 | 6SA7 |
| First IF amplifier | 1 | 68K7GT |
| Second IF amplifier | 1 | 68K7GT |
| CW oscillator | 1 | 68J7 |
| Second detector NL | 1 | 6H6GT |
| First AF amplifier AVC | 1 | 68Q7GT |
| Output limiter | 1 | 6H6GT |
| AF power amplifier | 1 | 6V6GT |
| Rectifier (full wave) | 1 | 5Y3GT |
| Total | 11 | |

- Type of receiver.**—Superheterodyne.
- Type of reception.**—Pure, modulated or telephone and telegraph modulated radio frequency waves.
- Input.**—Tuned circuit; inductive coupling.
- Output impedance.**—600 ohms.
- Power consumption.**—85 watts at 115 volts.
- Output power.**—2 watts into 600 ohms.
- Sensitivity.**—The CW and MCW sensitivity of the receiver is better than 20 microvolts on Band 1 and 2 and better than 40 microvolts on Bands 3, 4 and 5.
- Input impedance.**—On Band 1, 5,000 ohms, Band 2, 3,000 ohms, on Bands 3, 4 and 5, 700 ohms.
- Band coverage:**

| Band No: | Frequency range (mc) |
|----------|----------------------|
| 1 | 0.08 to 0.22 |
| 2 | 0.21 to 0.56 |
| 3 | 1.9 to 5.1 |
| 4 | 4.5 to 12.0 |
| 5 | 8.8 to 24.0 |



Model RCH radio receiving equipment—rear view.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type No. | Width | Depth | Height | Weight |
|---------------------------|----------|-------------------------|-----------|--|------------|
| Receiver | 46209 | Inches 13 $\frac{7}{8}$ | Inches 21 | Inches 20 $\frac{1}{2}$ $\frac{1}{16}$ | Pounds 106 |
| Spare tubes | | | | | 36 |
| Headphones, each (2 sets) | 49016 | | | | 1 |

Shipping weights and dimensions

| | Size | Gross weight | Volume |
|---|---------------------|--------------|-----------------|
| Entire equipment including spare parts and accessories shipped in one crate | Inches 31 x 26 x 19 | Pounds 200 | Cubic feet 8.87 |

RCK RADIO RECEIVING EQUIPMENT

Use.—Shore.

Frequency range.—115 to 156 mc.

Power required for operation.—110-, 115-, or 120-volt, single phase, 55 to 65 cycles.

Description.—The Model RCK receiving equipment is designed for use with the Model TDQ Transmitter.

This receiver is one of a series of V. H. F. equipments in which the I. F., audio, and power sections are of standard design with only the R. F. preselector section varying from model to model. This preselection unit contains one tuned r. f. stage, four third harmonic crystals, local oscillator, two third harmonic

quency and the other providing a linear scale. A dimmer control permits variations of brilliancy of both channel and dial lights.

The audio and I. F. sections occupy the right portion of the chassis assembly. This section is carefully engineered to permit a logical sequence of stages and the use of terminal strips to mount resistors and capacitors. As a result, wiring is direct, possibility of error in wiring is minimized, and all components are readily accessible for service. This section of the receiver contains 5 I. F. stages operating at 12 megacycles, a second detector and noise peak limiter, a silencer-amplifier, a silencer diode, and 3 audio stages,



Model RCK radio receiving equipment.

multiplier circuits, and the first detector. A single tuning control operates seven tuned circuits. This control has four adjustable mechanical detents which are present in accordance with the frequencies of the crystals being used. Once set, positioning the main tuning capacitor to any of the four channels is rapidly accomplished. The desired crystal is circuitally connected into the oscillator circuit by means of the channel switch. The four channel indicator lamps, located above the tuning dial function to simultaneously indicate proper tuning and provide easy determination of the channel on which the receiver is operating. The tuning control has two dial scales, one reading fre-

quency and the other providing a linear scale. A dimmer control permits variations of brilliancy of both channel and dial lights.

The controls are as follows:

A switch marked "Noise Limiter and Output Meter" has four positions as follows:

- (1) Both noise limiter and output meter "off."
- (2) Noise limiter "on", output meter "off."
- (3) Noise limiter "off", output meter "on", and,
- (4) Both "on."

A control marked "phones" varies the output at the monitor phone jack thus permitting the operator to control the volume of signal in his phones, irrespec-

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tive of the output power of the receiver. A control marked "silencer" varies the level at which this circuit operates. An "AF Band" switch permits selection of narrow and wide response. AF Gain, RF Gain, and Power "on-off" switch complete the controls. In addition to the foregoing controls, there are three front panel meters: plate volts, output meter (calibrated in decibels), and an input meter to measure the carrier level.

The power supply unit occupies the rear portion of the chassis assembly. There are four receptacles grouped at the rear corner of this chassis Antenna, a. c. input, audio output, and a receptacle to permit remote on and off control of the silencer. All receptacles are carefully filtered. Total power consumed by the equipment is approximately 110 watts. Runners permit ready access to or change of the entire unit.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|--|-----------------|----------|
| RF amplifier | 1 | 956 |
| Converter | 1 | 717A |
| Multipliers | 2 | 717A |
| Crystal oscillator-multiplier | 1 | 6N7 |
| IF amplifiers | 5 | 6AB7 |
| Second detector and noise peak limiter | 1 | 6H6 |
| Silencer-amplifier | 1 | 6AB7 |
| Audio output amplifier | 1 | 6V6GT |
| Rectifier | 1 | 5U4G |
| Voltage regulator | 1 | VR150/30 |
| Total | 15 | |

Type of receiver.—Superheterodyne.

Type of reception.—MCW and voice.

Input Impedance.—50 ohms.

Output Impedance.—600 ohms balanced to ground.

Output power.—Approximately 15 milliwatts.

Sensitivity.—Better than 8 microvolts throughout its range.

Antenna.—Fixed antenna with 50 ohm impedance length 46½ by 24½ inches. Transmission line from transmitter to antenna is 100 feet in length.

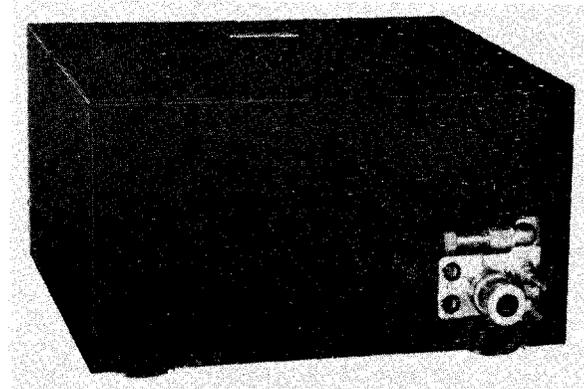
Recommended length of transmission line is as short as possible.

Band coverage.—4 bands ranging from 115 to 156 megacycles.

Weights, dimensions, and Navy type numbers

| Unit | Navy type No. | Height | Width | Depth | Weight |
|---|---------------|--------|--------|--------|--------|
| Receiver in dust cover with shock mountings | | Inches | Inches | Inches | Pounds |
| Equipment spare parts in metal box | | 12 | 18 | 9 | 62 |
| Tender spare parts in metal box | | 15 | 18 | 12 | 110 |
| Stock spare parts | | | | | 90 |

NOTE. The above weights are estimated and will be subject to revision upon completion of the first Production Receiver.



Model RCK radio receiving equipment—rear view.

Shipping weights and dimensions

| Unit | Size | Gross weight | Volume |
|---|------------------------|---------------|-------------------|
| Model RCH receiver and equipment spares box, packed in one container for ocean shipment | Inches 34 x 24 x 15 | Pounds 182 | Cubic ft. 5.69 |

RCO RADIO RECEIVING EQUIPMENT

Use.—Shore.

Frequency range.—100 to 156 mc.

Power required for operation.—75 watts, 105 to 115 volts, 50- to 60-cycles.

Description.—This receiver is an extremely compact, crystal-controlled, fixed-frequency superheterodyne for single-channel reception, mounted on a 5¼-inch relay rack panel. It is designed to stand the extra pressure of constant duty such as that required for aeronautical ground stations, or for point-to-point service. It is also well suited for either local or remote operation,

squelch switch is mounted above and to the right of the squelch control.

All cable connectors necessary for set-up and operation of the unit are brought out to the rear of the chassis. Power connections are terminated at a recessed plug mounted at the left-hand side of the rear of the chassis. The antenna connection is completed through a connector mounted at the upper right-hand side. The antenna circuit is designed to work from a 50-ohm coaxial line. The 600-ohm output terminates at a chassis connector mounted on the upper left-hand side at the rear of the chassis and at a jack on the front panel. As the VHF receiver is intended for



Model RCO radio receiving equipment.

monitoring, or other service requiring a reliable crystal-controlled fixed frequency receiver. In many cases, individual receivers are mounted in a relay rack, with each receiver used to monitor a given station or frequency. This makes possible a system of fixed-tuned units and provides immediate selection of a desired station or frequency.

Those tuning and alignment controls requiring only infrequent adjustments are mounted on the rear of the chassis. The controls mounted on the panel are the "Sensitivity" control, located on the left end of the center row of controls, the "volume" control, at the right of the sensitivity control, the "Squelch" control, at the right of the volume control. The power switch is mounted to the left of the sensitivity control. The

communication work, the audio channel has been made flat only from 100 to 3,000 cycles, with increasing attenuation of higher frequencies, thus providing good intelligibility with maximum reduction of unwanted signals and noise.

The Navy type CKV-66091 receiving antenna should be installed as high as possible and in the clear. Approximate length for the frequency in use may be interpolated. After the coaxial cable has been secured, antenna length for best response may be more accurately determined by running a long twisted pair from the receiver to an output meter temporarily located so as to be visible from the antenna, adjusting for maximum receiver output with a constant tone applied to a transmitter at some distance from the receiver.

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TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|---|-----------------|--------|
| Crystal oscillator | 1 | 6AC7 |
| Harmonic multiplier | 1 | 6AC7 |
| Mixer | 1 | 6AC7 |
| First IF amplifier | 1 | 6AC7 |
| Second IF amplifier | 1 | 6AC7 |
| Third IF amplifier | 1 | 6AC7 |
| Second detector and automatic noise limiter | 1 | 6H6 |
| First audio and cathode follower | 1 | 6SL7GT |
| AVC | 1 | 6SJ7 |
| Squelch | 1 | 6SJ7 |
| Audio output | 1 | 6V6GT |
| Rectifier | 1 | 5Y3GT |
| Total | 12 | |

Type of receiver.—Crystal-controlled, fixed-frequency superheterodyne.

Type of reception.—MCW and voice.

Input.—Signal applied through a dummy antenna having 50 ohms resistance.

Input impedance.—50 ohms for coaxial cables.

Output impedance.—600 ohm line.

Output power.—0.5-watt undistorted.

Sensitivity.—7.5 microvolts, 30 percent modulated for 6 milliwatts output.

IF frequency.—6,480 kc.

Band coverage.—100 to 156 mc.

Selectivity:

| 2x down (6 db.) | 10x down (20 db.) | 100x down (40 db.) | 1000x down (60 db.) |
|--------------------|----------------------|-----------------------|------------------------|
| 65 kc. | 105 kc. | 145 kc. | 200 kc. |

Image ratios:

100 to 1 (40 db.) at 156-128 mc.

300 to 1 (50 db.) at 128-100 mc.

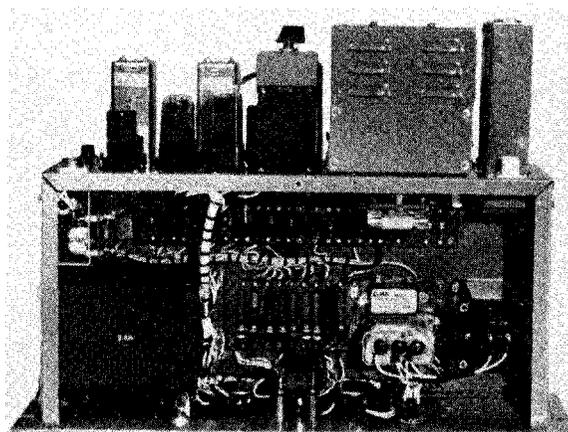
A. V. C. action.—Output constant within 3 db. with input from 100 μ V to 100,000 μ V.

Signal-to-noise ratio.—13 db. at 7 microvolts input 30 percent modulated.

Audio range.—6 db. from 100 cycles to 3,000 cycles.

Weights, Dimensions, and Navy Type Numbers of Equipment Included In Contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|----------|---------------|------------------------|---------------------|---------------------|---------------------|
| Receiver | CCI-46220 | <i>Inches</i> 5 1/4 | <i>Inches</i> 19 | <i>Inches</i> 14 | <i>Pounds</i> 28 |



Model RCO radio receiving equipment—cover removed.

Shipping weights and dimensions.

| | Size | Gross weight | Volume |
|--|-------------------------------|----------------------|-------------------------|
| Entire equipment excluding spare parts shipped in box 1 of 2 boxes | <i>Inches</i> 30 x 19 x 17 | <i>Pounds</i> 110 | <i>Cubic ft.</i> 5.6 |
| Station (equipment) spare parts, sets, less tubes and crystals shipped in box 2 of 2 boxes | 15 x 12 x 9 | 40 | .94 |

RDE RADIO RECEIVING EQUIPMENT

Use.—Shore.

Frequency Range.—2.0 to 8.0 mc.

Power required for operation.—110 to 115-volt, 60-cycle.

Description.—The Model RDE is a fixed-tuned, single frequency, crystal controlled, radio telephone receiver. It can be supplied for operation on any frequency within the range of 2 to 8 megacycles. It is especially designed for airport control operation, and for aeronautical ground stations. It is also well suited for monitoring or other services requiring a reliable, fixed-tuned receiver.

The receiver can be used for either local, or unattended remote operation. Provision is made for re-

sible for testing or servicing by removing the single top cover plate.

The various controls which are located on the front panel are plainly marked by means of a photo-etched plate covering the panel. Three tunable plug-in coils are used in the circuits prior to the mixer tube. These coils are easily removed and by changing these and the crystal, the receiver may be instantly set upon another frequency. These coils have a high "Q" which provides high image rejection. The receiver has a self-contained power supply, and operates directly from the 110- to 115-volt, 60-cycle circuit.

The following controls and accessories are mounted on the front panel:



Model RDE radio receiving equipment.

motely controlling the sensitivity of the receiver over a metallic telephone line by means of simplexing. Muting, or "disabling," may also be controlled remotely from the transmitter press-to-talk circuit.

All of the controls of the receiver are mounted on a 3½-inch standard, 19-inch rack front panel. The alignment controls, tubes, and connectors are located on the rear of the chassis. The chassis is mounted on the front panel and has a removable cover to provide for ease in servicing. This method of construction permits these receivers to be stacked one above another, thereby requiring only 3½ inches of panel space per receiver. As all tubes are removable from the rear of the receiver, there is no necessity for wasted blank space between these receivers when stacked in a rack cabinet. The majority of the resistors and small fixed condensers are mounted on terminal strips within the receiver and all are easily acces-

1. Squelch off-on switch.
2. A-F or volume control.
3. Off-on switch.
4. Phone jack.

The sensitivity control is mounted behind the front panel and can be adjusted with a screw-driver by removing the plug from the access hole in the front panel.

On the rear of the receiver is mounted the A-C receptacle, the antenna terminal strip, and a four-pin receptacle connector for terminating the audio output. The control circuit for connection to the external relay which is connected in the press-to-talk circuit of the transmitter; and the provision for remote sensitivity control, also terminates on this receptacle. The audio output may be connected to either a loudspeaker or to the remote telephone line.

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TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|-----------------------|-----------------|---------|
| RF stage..... | 1 | 6K7 |
| Oscillator mixer..... | 1 | 6A5 |
| IF stage..... | 1 | 6K7 |
| Second detector..... | 1 | 6SJ7 |
| Phase splitter..... | 1 | 6SN7-GT |
| Squelch..... | 1 | 6SN7-GT |
| Push-pull output..... | 1 | 6SN7-GT |
| Amplifier AVC..... | 1 | 6SJ7 |
| Rectifier..... | 1 | 5Y3-GT |
| Total..... | 9 | |

Sensitivity.—3 microvolts, 30 percent modulated for 50 milliwatts output. Signal applied through a dummy antenna having the following characteristics: 400-ohm pure resistance, to low impedance input winding.

Signal-to-noise ratio.—9 db. at 5 microvolts input 30 percent modulated.

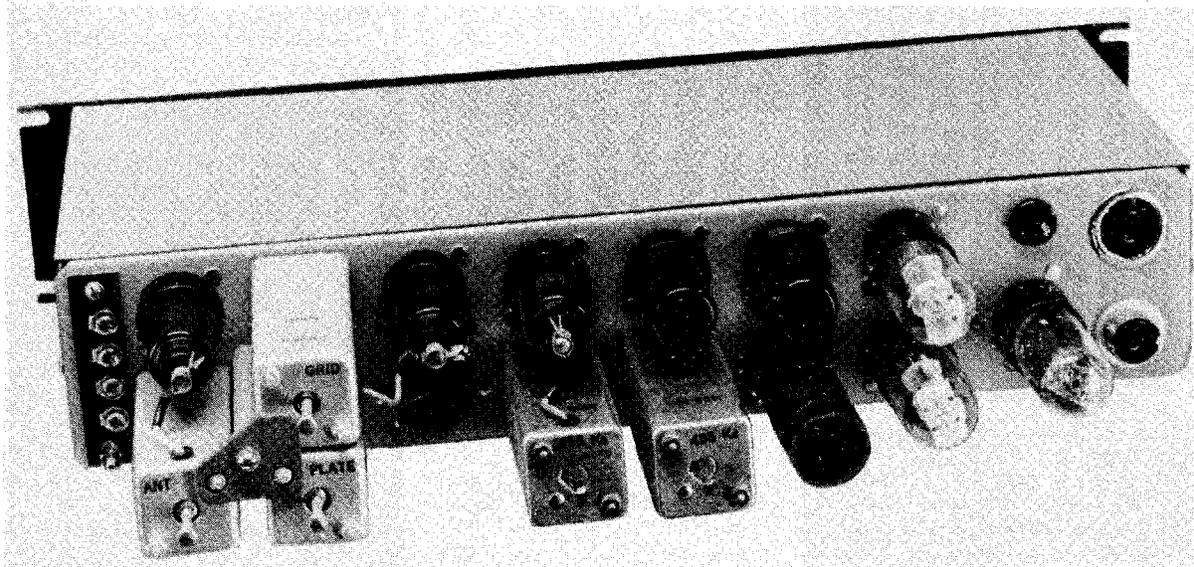
Antenna input impedances.—400 ohms balanced, 400 ohms or 100 ohms unbalanced, complex coupling for a short capacitive antenna.

Output impedance.—500–600 ohms. Balanced for operating into a telephone line.

Maximum undistorted power output.—0.5 watt.

Audio range.—6 db. from 80 cycles to 2,500 cycles.

NOTE: -Over-all, including RF and IF attenuation.



Model RDE radio receiving equipment--rear view.

Type of receiver.—Fixed-tuned single frequency, crystal controlled, radio telephone receiver.

Selectivity:

| Band width for 2x down (6 db.) | 10x down (20 db.) | 100x down (40 db.) | 1000x down (60 db.) |
|--------------------------------|-------------------|--------------------|---------------------|
| 9 ke..... | 16 ke | 29 ke | 50 ke..... |

Image ratios:

- a. 50,000 to 1 (94 db.) at 2.5 mc.
- b. 55,000 to 1 (95 db.) at 3.6 mc.
- c. 45,000 to 1 (93 db.) at 4.8 mc.
- d. 10,000 to 1 (80 db.) at 6.5 mc.

AVC action.—Output constant within 5 db. with input from 10 microvolts to 1 volt.

Power consumption.—60 watts.

Band coverage:

| Band: | Frequency range (mc) |
|--------|----------------------|
| a..... | 2.0 to 2.8 |
| b..... | 2.8 to 4.0 |
| c..... | 4.0 to 5.5 |
| d..... | 5.5 to 8.0 |

Weights, dimensions, and Navy type numbers of equipment included in contract

| Unit | Type No. | Width | Depth | Height | Weight |
|---------------|-----------|--------------|-------------------|-----------------|--------|
| Receiver..... | CCI-46219 | Inches 19 | Inches 13 1/16 | Inches 3 1/2 | |

Shipping weights and dimensions.—Data will be supplied when available.

NAVY TYPE 49131 LOUDSPEAKER—AMPLIFIER

Use.—Ship.

Power required for operation.—Unit operates from a power source of 115 volts ± 10 percent either d. c. or 60-cycle, single phase a. c. The power consumed is not more than 50 watts.

Description.—The loudspeaker-amplifier unit is designed for use with radiotelephone communication in connection with Naval radio receivers. Each unit contains a loudspeaker proper, a power amplifier, and the necessary rectifier and filter equipment for its operation from the power or lighting circuits of the vessel upon which it is installed.

The unit is designed to withstand continuous simple harmonic vibration, having an amplitude of 0.03135 inch at frequencies between 5 and 30 cycles per second, except at the critical frequency of the whole unit at which frequency it withstands this vibration for one minute.

Each unit consists of a push-pull power amplifier suitable for raising the level of a standard input of 6 milliwatts at 600 ohms to a level of at least 1.75 watts at 15 ohms for feeding the voice coil of a loud speaker, a rectifier to permit the operation of the unit on 115 volts a. c. or d. c. and a permanent field, cone-type dynamic loudspeaker, all housed within a spray-proof cast aluminum cabinet suitable for bulkhead mounting.

The cabinet is provided with a reinforced cast aluminum cover and mounting lugs or bosses at each corner to permit securing the unit to a bulkhead. The loudspeaker and the necessary controls for the operation of the unit are mounted on the front panel (cover) of the unit. The chassis mounts all the necessary amplifier and rectifier equipment and is secured to the mounting brackets carried by the cover through shock-proof mountings.

The loud speaker is of the dynamic cone type, employing a permanent magnet for the field. It is capable of handling up to 1.75 watts without appreciable variation in fidelity. The diaphragm of the speaker is protected from both mechanical and acoustical damage from the blast of gun fire by a blast plate and durable diaphragm construction. The voice coil impedance is 15 ohms.

The amplifier-power unit consists of the following basic components:

1. An input transformer.
2. A push-pull power amplifier.
3. An output transformer for feeding the loud speaker voice coil.
4. A rectifier with the necessary filter capacitors and reactors.
5. A switch for changing from a. c. to d. c. operation.
6. Necessary capacitors, resistors, etc.

An a. c./d. c. switch is provided on the amplifier chassis. In the d. c. position the rectifier tube plate-

cathode circuit is shorted and at the same time the heater is shorted and a suitable resistor connected in the series heater circuit combination to permit the maintenance of the proper operating current for the amplifier tube heaters and pilot lamp.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|-----------------|-----------------|---------|
| Power amplifier | 2 | 35L6 GT |
| Rectifier | 1 | 35Z5 GT |
| Total | 3 | |

Input impedance.—600 ohms ± 10 percent at 1,000 cycles for any input level up to 6 milliwatts and any adjustment of the volume control.

Gain.—The maximum amplifier gain is such that with an input of 6 milliwatts at 1,000 cycles the output to the loud speaker voice coil is at least 1.75 watts. The manual gain control operates in such a manner as not to appreciably affect the fidelity characteristics of the amplifier speaker, introduce distortion or change the input impedance of the units. It effects a variation of output (for constant input) of at least 40 decibels. The attenuation offered versus angular dial rotation is linear in decibels within plus or minus 12 decibels.

Distortion.—With a sinusoidal input and with an output of 1.75 watts to the loudspeaker voice coil, the total distortion is less than 10 percent.

Frequency.—The frequency characteristics of the amplifier is "flat" within 2 decibels between the limits of 300 and 5,000 cycles with reference to the 1,000-cycle response.

The over-all frequency characteristics of the units, measured as acoustical output with respect to a standard input of 6 milliwatts, is flat within 6 decibels over a frequency range of 750 to 1,300 cycles. The acoustical pressure averages at least 10 dynes/cm².

Hum and noise level.—The total hum and noise level of the unit as measured electrically at speaker voice coil with no signal impressed on the input is at least 50 decibels below the rated maximum output of 1.75 watts.

Weights, dimensions, and Navy type numbers

| Unit | Height | Width | Depth | Weight |
|-------------|---|--|---|--------|
| Loudspeaker | Inches 14 ⁹ / ₁₆ | Inches 14 ¹ / ₄ | Inches 8 ³ / ₄ | (1) |

¹ Not more than 50 pounds.

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NAVY TYPE 53153 INTERFERENCE FILTER

Use.—Ship, shore.

Description.—The Navy type 53153 interference filter consists of an open circuited quarter wave trap designed for insertion between the antenna trunk and the input of any receiving equipments containing a type 49120 concentric jack for antenna connection. When properly installed, the type 53153 filter is very effective in reducing or eliminating pulse type interference which is picked up by the receiving antenna system. The type 53153 filter is cylindrical in form, approximately 12 inches long and 2½ inches in diameter. One end of the cylinder is equipped with a type 49120 concentric jack and a length of cable terminated into a type 4912A concentric plug. The opposite end of the cylinder contains a bar type knob. The filter should be

mounted in such manner that the cable of the filter can be plugged into the antenna junction box and the patch cord from the receiver inserted into the concentric jack of the filter. In operation, the control knob is adjusted until the interfering pulse is reduced to a minimum as noted in the output signal of the receiver.

Dimensions and Navy type number

| Unit | Navy type No. | Length (Approximate) | Diameter |
|---------------------|---------------|----------------------|-------------|
| Interference filter | 53153 | Inches 12 | Inches 2 |

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NAVY TYPE CKB-50172 ANTENNA MULTICOUPLER UNIT

Use.—Shore.

Description.—The antenna multicoupler was designed primarily to allow the coupling of four superheterodyne receivers to one antenna and to eliminate any interference which might be present due to oscillator radiation between the receivers.

The unit weighs about 30 pounds and fits conveniently into a 19 inch rack. The rubber bumpers on the bottom of the dust cover permit the use of table top mounting.

A self contained power unit furnishes the necessary plate and heater power for the five 6AB7 tubes. Antenna connections can be made from a concentric cable to the front panel or from an open wire transmission line to the rear of the chassis. The four r. f. amplifier circuits are parallel, untuned circuits and offer 0 to 3 decibels gain to all signals within the 4 to 24 mc range. Attenuation of oscillator radiation between receivers is

approximately 60 decibels. A screw driver controlled rotary switch facilitates matching the input of the unit with antennas of 70, 400, and 600 ohms impedances. Four antenna output concentric jacks facilitate attachment of receivers through concentric jacks and cables. One hundred feet of CASSF-50-1 low loss solid dielectric, semiflexible, coaxial cable and all necessary jacks are supplied with the equipment.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type No. |
|-----------------|-----------------|----------|
| R. F. amplifier | 5 | 6AB7 |
| Rectifier | 1 | 5Y3 |

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Section IV
RADIO TRANSMITTING EQUIPMENTS

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TAB-5 RADIO TRANSMITTING EQUIPMENT

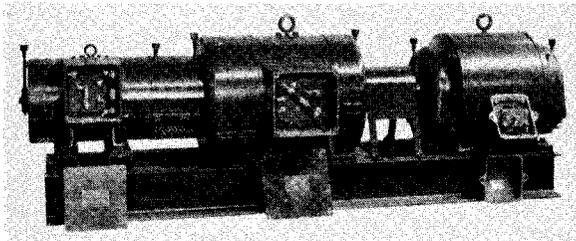
Use.—Shore.

Frequency range.—100–555 kc.

Power output and emission.—2 kw, A₁; 1 kw, A₂.

Description.—The Model TAB-5 is designed for installation at shore bases where low and medium frequency high power telegraph equipment is required.

The *transmitter* is designed to be installed with the back of the unit flush against a wall. The components are built on two frames of semishelf type of construction which are permanently fastened together to operate as a single mechanical unit. All the tuning and operating controls are located on the front panel. Access to all parts which are subject to replacement may be had by removing the side shields or through doors provided on the front panel. The r-f and a-f stages, with the exception of the power amplifier plate tank components and the antenna coupling and tuning circuits, are located in the left frame. All of the vacuum tubes are mounted on the top shelf and are accessible through a door on the front panel. The associated inductors and capacitors of the master oscillator Colpitts circuit as well as the master oscillator and audio oscillator plate current meter capacitors are located in a shock mounted compartment on the center shelf. The power amplifier plate tank components are on the first shelf of the right frame and the antenna coupling and tuning circuits occupy the entire upper portion of the right frame. Provision is made for the use of two antennas—one to be employed for transmission over the range of 100–300 kc. and the other to be employed for transmission over the range of 300–555 kc.



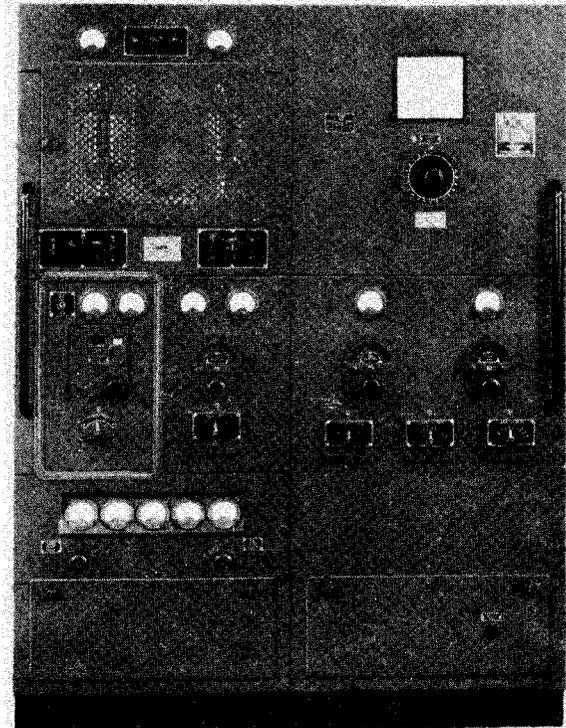
Model TAB-5 motor-generator.

The lead from the antenna selector switch to the transmitter antenna connecting link is brought through an opening in the top of the frame. The relays and terminal boards for all other external connections are located to the front and bottom of both frames and are accessible through doors on the front panel.

The *antenna selector switch* is provided to permit the transfer of the power output of the transmitter from one antenna to the other. This unit, designed for mounting on a wall or ceiling, consists of two fixed antenna contactors and a selector arm. The larger antenna is intended to be attached to one contactor

and the smaller antenna attached to the other contactor. An insulated switch rod is furnished for the operation of the selector arm.

The *motor generator set* is a three-unit six-bearing direct coupled assembly mounted on a common bedplate. The motor is of 10 horsepower capacity and is mounted on the right side of the bedplate as viewed from the terminal box side. The high voltage generator is located in the center and supplies 2.2 amperes at 2,300 volts d. c. for intermediate and power amplifier plate potential. The medium and low voltage generator is located on the right and supplies 0.3 ampere at 1,000 volts d. c. for master oscillator and audio os-



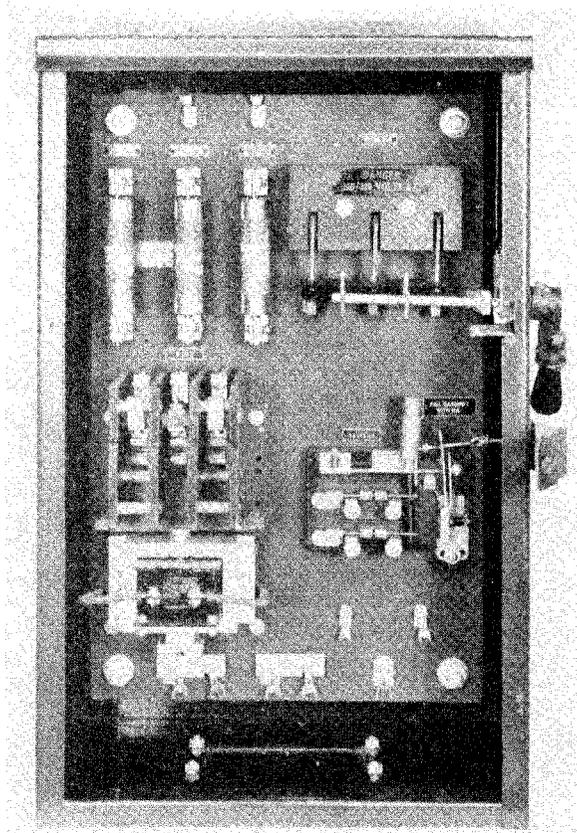
Model TAB-5 radio transmitter.

illator plate and intermediate amplifier screen grid potential and 0.5 ampere at 230 volts d. c. for bias and field excitation. Drip proof terminal boxes are located on the side of each unit and contain fuses for the protection of all circuits as well as terminals for all external connections. Drive motors for various input voltages are directly interchangeable on this equipment.

The *motor starters* are of the remote controlled magnetic contactor type, with all switches, contactors, fuses, and over-load protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side

of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

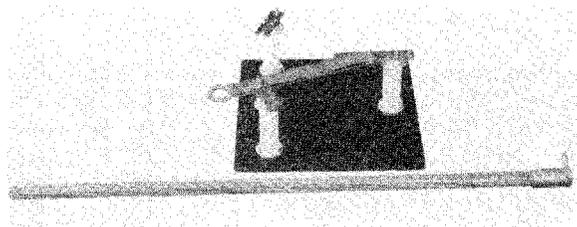
The power transfer panels and the land line control unit described below are used extensively by the Navy



Model TAB-5 magnetic controller

in conjunction with various models of the TBK, TBL, TBM and TBU equipments as well as with the model TAB-5 equipment.

The *power transfer panel* is a self-contained manually operated switch used for transferring the input of the



Model TAB-5 antenna selector switch.

transmitter from one motor generator set to the other motor generator set. The switch panel is hinged at the bottom so as to facilitate the connecting of external wiring to the rear of the panel. Provision is made so that the spare motor generator set may be started and run for testing or repair purposes without disturbing the motor generator set then connected to the transmitter. The power transfer panel type CAY-24084 is contained in an aluminum cabinet whereas type CAY-24084A is contained in a steel cabinet. The only other difference between these units is in the location of the spare motor generator switch which is mounted respectively on the side of type CAY-24084 and on the front of type CAY-24084A.

The *land line control unit* components are mounted on an aluminum panel which is housed in a welded steel box with a hinged access door. All of the operating controls are mounted on the front of this door and are connected to the electrical circuits of the unit by means of flexible cables. A suitable keyer unit (supplied by the Navy) may be connected to the land line control unit by means of a two wire line up to fifty miles in length. These two units used conjunctively with the equipment permit the starting, stopping and telegraphic keying of the transmitter from a remote point. The keyer unit employed should have a d. c. signal voltage (approximately 6 volts) sufficient to furnish from 20-40 milliamperes to the terminals of the land line control unit for relay keying and from 35-125 volts to the terminals of the land line control unit for vacuum tube keying. A feature of the land line control unit is a long or short time delay period during which the equipment is reduced to stand-by prior to automatic shut-down. The length of this time delay and stand-by condition may be adjusted for any time period from 0 to 50 minutes. The land line unit takes its operating power from the transmitter and all external connections are made to terminal strips along the bottom of the panel.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Function | Number of tubes | Type |
|--------------------------------|-----------------|-------------|
| Transmitter: | | |
| Master oscillator | 1 | 803 |
| Intermediate amplifier | 1 | 803 |
| Keyer tube | 1 | 807 |
| Audio oscillator | 1 | 803 |
| Power amplifiers | 2 | 851 |
| Land line control unit: | | |
| Keyer control tube | 1 | 807 |
| Rectifier | 1 | 5Z3 |
| Control start | 1 | OC3/V R 105 |
| Total | 9 | |

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Frequency control.—Master oscillator.

Power.—Supplies available: 220/3/60; 220/3/25; 440/3/25.

REQUIRED FOR STARTING

| Power source | Line current (amps.) (maximum per phase) | KW | KVA | Power factor (percent) |
|--------------|--|------|------|------------------------|
| 220/3/60 | 153 | 29 | 58 | 50 |
| 220/3/25 | 98 | 22.5 | 37.5 | 60 |
| 440/3/25 | 49 | 22.5 | 37.5 | 60 |

REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current (amps.) (maximum per phase) | KW | KVA | Power factor (percent) |
|--------------|--|------|------|------------------------|
| 220/3/60 | 21.9 | 7.25 | 8.21 | 88 |
| 220/3/25 | 21.0 | 6.98 | 7.85 | 89 |
| 440/3/25 | 10.5 | 6.98 | 7.85 | 89 |

Allowable variation in supply line voltage ± 10 percent; frequency ± 5 percent; combined voltage and frequency ± 10 percent (5 percent each).

Operating control.—Front of panel. Land line control unit up to 50 miles.

Type of keying.—Relay—100 words per minute A₁; 50 words per minute A₂; vacuum tube—500 words per minute A₁, A₂.

Antenna.—The equipment is designed for operation into two antennas, a large antenna being employed for transmission over the range of 100–300 kc. and a small antenna being employed over the range 300–555 kc. The following are examples of successful antenna arrangements:

- (1) 100–300 kc.—“T” type, approximate height 350 feet, length 600 feet, lead-in 300 feet.
- (2) 300–555 kc.—“T” type, approximate height 350 feet, length 250 feet, lead-in 300 feet.

Other antenna arrangements having an equivalent total length of wire also may be used successfully.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type No. | Height | Width | Depth | Weight |
|------------------------------------|------------|---------------------------------|---------------------------------|---------------------------------|---------------|
| Transmitter: | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| 220/3/60 | CAY-52164 | 76 | 57 ¹ / ₂ | 37 | 1,050 |
| 220/440/3/25 | CAY-52165 | 76 | 57 ¹ / ₂ | 37 | 1,100 |
| Motor generators: ³ | | | | | |
| 220/3/60 | CC-21503 | 25 ⁵ / ₁₆ | 71 | 22 | 1,225 |
| 220/440/3/25 | CC-21507 | 25 ⁵ / ₁₆ | 72 ¹ / ₂ | 22 | 1,650 |
| Magnetic controllers: ¹ | | | | | |
| 220/3/60 | CAY-21500 | 26 ³ / ₄ | 17 ¹ / ₄ | 11 ⁷ / ₁₆ | 100 |
| 220/3/25 | CAY-21501 | 26 ³ / ₄ | 17 ¹ / ₄ | 11 ⁷ / ₁₆ | 100 |
| 440/3/25 | CAY-21502 | 24 ¹ / ₄ | 17 | 11 ⁷ / ₁₆ | 100 |
| Land line control unit: | | | | | |
| 220/3/60 | CAY-23216 | 20 ³ / ₄ | 21 ³ / ₁₆ | 11 ¹ / ₁₆ | 85 |
| 220/440/3/25 | CAY-23217 | 20 ³ / ₄ | 21 ³ / ₁₆ | 11 ¹ / ₁₆ | 85 |
| Power transfer panel: | | | | | |
| 220/3/60 ² | CAY-24084 | 39 ¹ / ₁₆ | 20 ¹ / ₄ | 11 | 77 |
| 220/3/25 | CAY-24084 | 39 ¹ / ₁₆ | 20 ¹ / ₄ | 11 | 77 |
| 440/3/25 | CAY-24084A | 39 ¹ / ₁₆ | 20 ¹ / ₄ | 11 | 108 |
| Antenna selector switch | CAY-24082 | 20 ⁷ / ₈ | 17 ¹ / ₄ | 7 ⁵ / ₈ | 35 |
| Spare parts box | | 15 | 24 | 15 | 146 |

¹ Two duplicate units are furnished with each equipment.

² Type CAY-24084A (steel case) furnished on supplement contract in lieu of type CAY-24084 (aluminum case).

Accessories not supplied by the contractor.—Standard Navy keying equipment.

Shipping weights and dimensions.—Information is for 220/3/60 equipment.

| Unit | Size | Gross weight | Cubic feet |
|--|---------------|---------------|------------|
| | <i>Inches</i> | <i>Pounds</i> | |
| Transmitter and 2 instruction books | 68 x 42 x 82 | 1,558 | 135.53 |
| Motor generator set | 77 x 26 x 34 | 1,440 | 39.39 |
| Motor generator set | 77 x 26 x 34 | 1,440 | 39.39 |
| Magnetic controller | 33 x 23 x 17 | 150 | 7.46 |
| Magnetic controller | 33 x 23 x 17 | 150 | 7.46 |
| Land line control unit | 29 x 27 x 17 | 120 | 7.70 |
| Power transfer panel and handle for antenna switch | 48 x 27 x 17 | 182 | 12.75 |
| Antenna selector switch | 26 x 25 x 17 | 77 | 6.40 |
| Vacuum tubes: | | | |
| 1—851 tube | 17 x 17 x 27 | 12 | 4.51 |
| 1—851 tube | 17 x 17 x 27 | 12 | 4.51 |
| Remaining tubes | 25 x 23 x 16 | 50 | 5.32 |
| Spare parts | 27 x 18 x 17 | 188 | 3.04 |

TAB-6 AND TAB-7 RADIO TRANSMITTING EQUIPMENTS

Use.—Shore.

Frequency range.—100–555 kc.

Power output and emission.—2 kw, A₁; 1 kw, A₂.

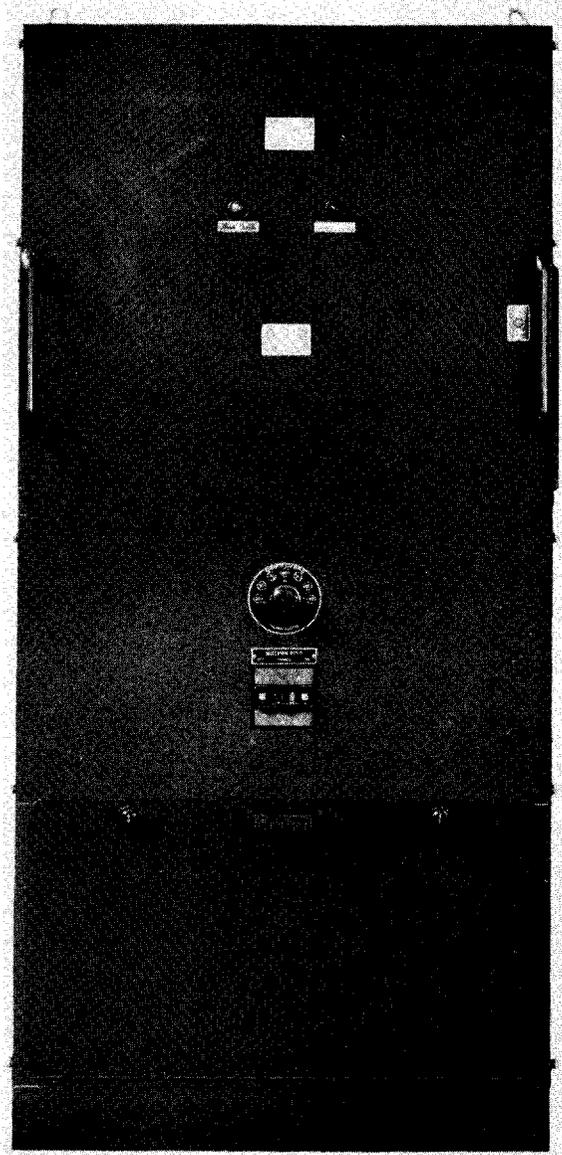
Description.—The models TAB-6 and TAB-7 are designed for installation at shore bases where low or medium frequency, high power operation is required. Provision is made in these equipments for connecting a spare power supply. Though designed to be powered by rectox copper oxide rectifiers, these models may be powered by motor generators with associated magnetic controllers in the same manner as the TAB-5, or, if so desired, one rectifier and one motor generator set with an appropriate magnetic controller may be employed. Choice of rectifier or motor generator operation is provided by means of a switch on the transmitter. However, under the respective contracts only rectifiers are supplied with these equipments and the two models differ in that two rectifier units are furnished with the TAB-6 and only one rectifier unit is furnished with the TAB-7; consequently, the power transfer panel is also omitted with the later model.

The *transmitter* is designed to be installed with the back of the unit flush against a wall. The components are built on two frames of semishelf type of construction which are permanently fastened together to operate as a single mechanical unit. All the tuning and operating controls are located on the front panel. Access to all parts which are subject to replacement may be had by removing the side shields or through doors provided on the front panel. The r-f and a-f stages with the exception of the power amplifier plate tank components and the antenna coupling and tuning circuits are located in the left frame. All of the vacuum tubes are mounted on the top shelf and are accessible through a door on the front panel. The associated inductors and capacitors of the master oscillator Colpitts circuit as well as the master oscillator and audio oscillator plate current meter capacitors are located in a shock mounted compartment on the center shelf. The power amplifier plate tank components are on the first shelf of the right frame and the antenna coupling and tuning circuits occupy the entire upper portion of the right frame. Provision is made for the use of two antennas—one to be employed for transmission over the range of 100–300 kc. and the other to be employed for transmission over the range of 300–555 kc. The lead from the antenna selector switch to the transmitter antenna connecting link is brought through an opening in the top of the frame. The relay and terminal boards for all other external connections are located to the front and bottom of both frames and are accessible through doors on the front panel.

The *antenna selector switch* is provided to permit the transfer of the power output of the transmitter from one antenna to the other. This unit, designed for mounting on a wall or ceiling, consists of two fixed antenna contactors and a selector arm. The larger antenna is intended to be attached to one contactor

and the smaller antenna attached to the other contactor. An insulated switch rod is furnished for the operation of the selector arm.

Three separate *rectox copper oxide rectifier* systems are employed as follows to furnish the required power



Model TAB-6 rectifier power unit.

to the transmitter: (1) a single phase bridge type bias rectifier to furnish 0.5 ampere at 230 volts d. c.; (2) a single phase bridge type M. O. plate rectifier to furnish 0.3 ampere at 1,000 volts d. c.; and (3) a 3-phase full-wave high voltage rectifier to furnish 2.2 amperes at 2,300 volts d. c.

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The *rectifier* with self-contained filter and control circuits is assembled in a steel frame which is mounted on a channel base. A main line switch, voltage tap switch, and indicator lights showing supply line power and high voltage "on" are mounted on the front panel. Approximately the lower third of the front panel is hinged so that it may be opened to provide access to the main control panel fuses, resistors, and contactors. Bolted in the lower section of the unit, directly behind the control panel, are the three single-phase high voltage transformers. Above the control panel on the left side of the frame is mounted the single phase master oscillator plate and bias transformer. In the center at the same level is the rectifier input switch. Directly over this switch is the tap switch which is a completely enclosed unit that may be removed from the rectifier and mounted externally, if so desired, to provide remote control of the output voltage of the rectifier. The copper oxide rectox units together with a cooling fan are mounted above the tap switch. The "rectox" stacks are mounted vertically in three frame assemblies which slide into slots provided in the main unit. All a. c. leads connect to the bottom of the stacks; all d. c. leads are brought out the top of the stacks. Above the blower motor and "rectox" stacks are located the two indicator lights which are mounted on the front panel. Suspended from the roof of the unit are all the filter circuit components.

The power transfer panel type 24084 or 24084-A and the land line control unit described below are used extensively by the Navy in conjunction with various models of the TBK, TBL, TBM and TBU equipments as well as with the TAB-5, TAB-6 and TAB-7 equipments.

The *power transfer panel* is a self-contained manually operated switch used for transferring the input of the transmitter from one power unit to the other power unit. The switch panel is hinged at the bottom so as to facilitate the connecting of external wiring to the rear of the panel. Provision is made so that the spare power supply may be started and run for testing or repair purposes without disturbing the power supply, then connected to the transmitter. The switch for this purpose is located on the side of the steel cabinet. This unit is identical to that used with the TBM-6 and certain TAB-5 equipments.

The *land line control unit* components are mounted on an aluminum panel which is housed in a welded steel box with a hinged access door. All of the operating controls are mounted on the front of this door and are connected to the electrical circuits of the unit by means of flexible cables. A suitable keyer unit (supplied by the Navy) may be connected to the land line control unit by means of a two wire line up to fifty miles in length. These two units, used conjunctively with the equipment, permit the starting, stopping and tele-

graphic keying of the transmitter from a remote point. The keyer unit employed should have a d. c. signal voltage (approximately 6 volts) sufficient to furnish from 20-40 milliamperes to the terminals of the land line control unit for relay keying and from 35-125 volts to the terminals of the land line control unit for vacuum tube keying. A feature of the land line control unit is a long or short time delay period during which the equipment is reduced to stand-by prior to automatic shut-down. The length of this time delay and stand-by condition may be adjusted for any time period from 0 to 50 minutes. The land line unit takes its operating power from the transmitter and all external connections are made to terminal strips along the bottom of the panel.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Function | Number of tubes | Type |
|-------------------------|-----------------|-----------|
| Master oscillator | 1 | 803 |
| Intermediate amplifier | 1 | 803 |
| Keyer tube | 1 | 807 |
| Audio oscillator | 1 | 803 |
| Power amplifiers | 2 | 851 |
| Land line control unit: | | |
| Keyer control tube | 1 | 807 |
| Rectifier | 1 | 5Z3 |
| Control start | 1 | OC3/VR105 |
| Total | 9 | |

Frequency control.—Master oscillator.

Power.—Supply required: 220/3/50/60.

Required for starting: 10 kw.

Required for locked key operation: 7.5 kw.

Allowable variation in supply line voltage ± 10 percent; frequency ± 5 percent; combined voltage and frequency ± 10 percent (5 percent each).

Operating control.—Front of panel. Land line control unit up to 50 miles.

Type of keying.—Relay—100 words per minute A₁, 50 words per minute A₂; vacuum tube—500 words per minute A₁, A₂.

Antenna.—The equipment is designed for operation into two antennas, a large antenna being employed for transmission over the range of 100-300 kc. and a small antenna being employed for transmission over the range of 300-555 kc. The following are examples of successful antenna arrangements:

- (1) 100-300 kc.—"T" type, approximate height 350 feet, length, 600 feet, lead-in 300 feet.
- (2) 300-555 kc.—"T" type approximate height 350 feet, length 250 feet, lead-in 300 feet.

Other antenna arrangements having an equivalent total length of wire also may be used successfully.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type No. | Height | Width | Depth | Weight |
|--|-------------|---|-----------------------------------|---------------------|------------------------|
| Transmitter..... | CAY-52273 | <i>Inches</i> 77 $\frac{3}{8}$ $\frac{3}{2}$ | <i>Inches</i> 57 $\frac{1}{2}$ | <i>Inches</i> 37 | <i>Pounds</i> 1,065 |
| Two rectifiers (each) ¹ | CAY-20167 | 71 $\frac{5}{8}$ | 34 | 24 $\frac{7}{8}$ | 1,000 |
| Land line control unit..... | CAY-23216 | 20 $\frac{3}{4}$ | 21 $\frac{3}{16}$ | 11 $\frac{1}{16}$ | 85 |
| Power transfer panel ² | CAY-24084-A | 39 $\frac{1}{4}$ $\frac{1}{16}$ | 20 $\frac{3}{4}$ | 11 | 108 |
| Antenna selector switch..... | CAY-24145 | 20 $\frac{7}{8}$ | 17 $\frac{1}{2}$ | 9 $\frac{7}{8}$ | 18 |
| Spare parts..... | | | | | |

¹ Only one rectifier is supplied with Model TAB-7.
² The power transfer panel is not supplied with Model TAB-7.

Accessories not supplied by the contractor.—Standard Navy keying equipment.

Shipping weights and dimensions of the TAB-6

| Unit | Size | Gross weight | Cubicfeet |
|--|-------------------------------|------------------------|-----------|
| Transmitter and instruction books..... | <i>Inches</i> 65 x 42 x 83 | <i>Pounds</i> 1,649 | 131.12 |
| Rectifier..... | 45 x 30 x 79 | 1,459 | 61.71 |
| Rectifier..... | 45 x 30 x 79 | 1,459 | 61.71 |
| Land line control unit..... | 30 x 26 x 17 | 140 | 7.67 |
| Power transfer panel and handle for antenna selector switch..... | 48 x 27 x 17 | 210 | 12.75 |
| Antenna selector switch..... | | 105 | 10.26 |
| Spare parts..... | 28 x 18 x 33 | 348 | 9.74 |
| Complete set of vacuum tubes: | | | |
| 1-851 tube..... | 17 x 17 x 27 | 12 | 4.51 |
| 1-851 tube..... | 17 x 17 x 27 | 12 | 4.51 |
| Remaining tubes..... | 26 x 20 x 9 | 30 | 2.70 |
| Complete set of spare tubes: | | | |
| 1-851 tube..... | 17 x 17 x 27 | 12 | 4.51 |
| 1-851 tube..... | 17 x 17 x 27 | 12 | 4.51 |
| Remaining tubes..... | 26 x 20 x 9 | 30 | 2.70 |
| Total..... | | 5,478 | 318.40 |

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TAJ-8 RADIO TRANSMITTING EQUIPMENT

Use.—Shipboard.

Frequency range.—175-600 kc.

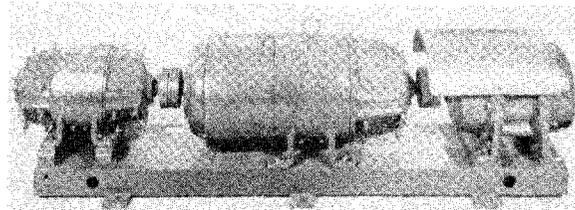
Power output and emission.—500 watts, A₁; 250 watts, A₂.

Description.—The Model TAJ-8 radio transmitting equipment is designed primarily for installation and use on destroyers and light cruisers for LF and MF, CW and MCW operation.

The transmitter is built into a single complete unit. The frame is constructed of aluminum alloy angle, spot welded to form a nonremovable shelf-type of construction. All the tuning and operating controls and two access doors are located on the front panel. The vacuum tubes are mounted on the second, third and fourth shelves, and are accessible through a door which is located on the right of the transmitter. The components for the various stages are located to the left, adjacent to the vacuum tube compartments. A door located at the bottom of the transmitter provides access to the first shelf which contains the control and filter circuits, as well as the terminal boards for all external connections. The second shelf contains the Navy type 803 master oscillator tube, which is located to the front of the transmitter. Directly above the master oscillator tube on the third shelf is located the Navy type 803 intermediate power amplifier tube with the Navy type 803 audio oscillator tube mounted slightly to the left and in the rear. The fourth shelf contains the Navy type 861 power amplifier tube, and the fifth shelf contains the antenna variometer, load switch and loading inductance.

The motor generator is a three unit, six bearing direct-coupled assembly mounted on a common bed-plate. Motors providing for various line voltages are interchangeable on the left end of the common bed-plate as

viewed from the terminal box side. Motors furnished for a-c operation are rated at 4-horsepower capacity, and motors furnished for d-c operation are rated at 3.5-horsepower capacity. The high voltage generator is located in the center and supplies 1,500 volts D. C. at 0.25 ampere for IPA and modulator plate potential and 3,000 volts D. C. at 0.4 ampere for power amplifier



Model TAJ-8 motor-generator.

plate potential. The low voltage or bias generator supplies 250 volts at 1.1 amperes for screen voltage for the modulator and IPA tubes and for field excitation, and 600 volts D. C. for power amplifier screen potential and master oscillator screen and plate potential. Drip-proof terminal boxes are located on the side of each unit and contain fuses for the protection of all circuits as well as terminals for all external connections. (D-c equipment provides a-c supply for filaments from slip-rings located on the driving motor.)

The motor starter is of the remote-controlled magnetic contactor type with all switches, contactors, fuses and overload protective devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

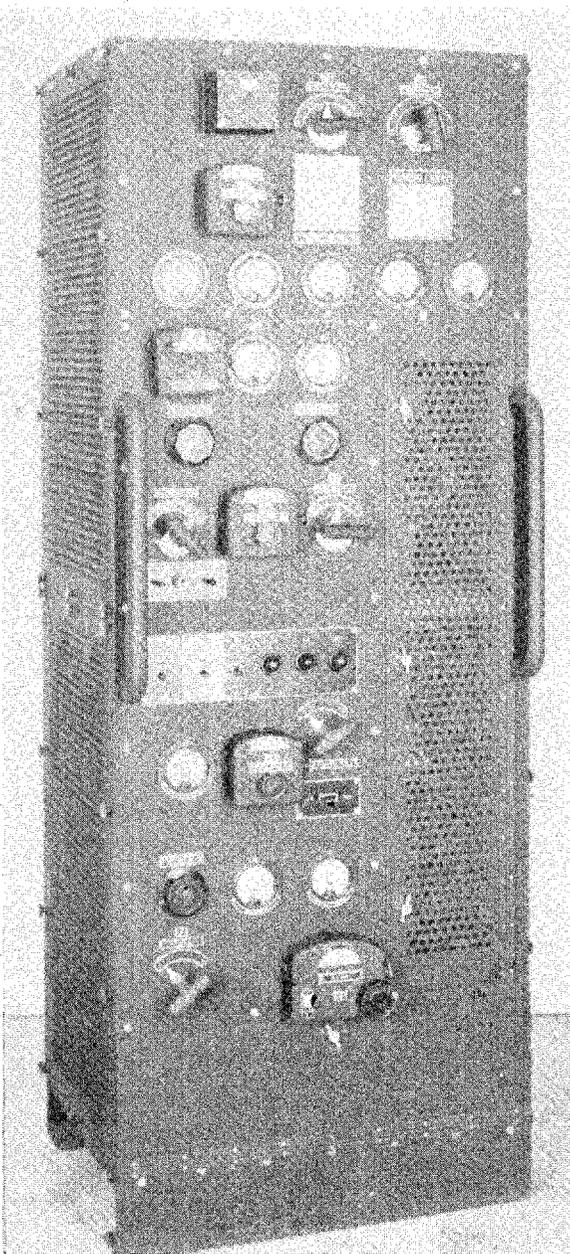
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TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | Number of tubes | Type |
|------------------------------|-----------------|------|
| Master oscillator | 1 | 803 |
| Intermediate power amplifier | 1 | 803 |
| Audio oscillator | 1 | 803 |
| Power amplifier | 1 | 861 |
| Total | 4 | |



Transmitter for Model TAJ-8 equipment.

Frequency control.—Master oscillator.

Power.—Supplies available—115/230 volts D. C.; 220/440 /3/60 A. C.

REQUIRED FOR STARTING

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|-----------------|--|-----|------|------------------------|
| 115 volts D. C. | 80 | 9.2 | | |
| 230 volts D. C. | 40 | 9.2 | | |
| 220/3/60 | 92 | 20 | 35 | 65 |
| 440/3/60 | 45 | 20 | 34.2 | 65 |

REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|-----------------|--|------|------|------------------------|
| 115 volts D. C. | 27.0 | 3.11 | | |
| 230 volts D. C. | 13.6 | 3.13 | | |
| 220/3/60 | 8.88 | 2.72 | 3.37 | 80.6 |
| 440/3/60 | 4.55 | 2.77 | 3.46 | 79.8 |

Allowable variation in the supply line voltage, $\pm 10\%$ for D. C. and $\pm 5\%$ for A. C.; frequency, $\pm 5\%$ for A. C.; combined voltage and frequency, $\pm 10\%$ (5% each).

Operating control.—Front of panel and Navy standard 4- or 6-wire remote control unit.

Type of keying.—Relay—100 words per minute.

Antenna.—Any antenna having values within 25% of 770 mmfd. capacity and 12 ohms resistance at 175 kc. to 930 mmfd. capacity and 3.8 ohms resistance at 600 kc.

Weights and dimensions of equipment units included in contract

| Unit | Height | Width | Depth | Weight |
|--------------------------------------|---------------------------|--------------------------|-------------------------|------------|
| Transmitter (a-c or d-c) | 72 $\frac{1}{4}$ Inches | 27 Inches | 24 Inches | 610 Pounds |
| Motor-generator (a-c) | 19 $\frac{13}{16}$ Inches | 70 $\frac{7}{16}$ Inches | 16 $\frac{5}{8}$ Inches | 775 Pounds |
| Motor-generator (d-c) | 19 $\frac{5}{16}$ Inches | 75 Inches | 16 $\frac{5}{8}$ Inches | 775 Pounds |
| Magnetic controller (a-c equipments) | 28 Inches | 15 $\frac{1}{2}$ Inches | 20 $\frac{1}{2}$ Inches | 111 Pounds |
| Magnetic controller (d-c equipments) | 24 Inches | 16 $\frac{1}{2}$ Inches | 26 Inches | 105 Pounds |

Navy type numbers of units of TAJ-8 equipments

| Supply | Transmitter | Motor-generator set | Magnetic controller |
|-----------------|-------------|---------------------|---------------------|
| 115 volts D. C. | CRR-52142 | CG-21466 | CG-21457 |
| 230 volts D. C. | CRR-52142 | CG-21467 | CG-21458 |
| 220 volts A. C. | CRR-52143 | CG-21468 | CG-21459 |
| 440 volts A. C. | CRR-52143 | CG-21468 | CG-21460 |

Accessories not supplied by contractor.—Remote control unit—standard 4- or 6-wire.

Shipping weights and dimensions

[Information is for 440 volt a-c equipments]

| Units, as shipped in 8 boxes | Gross weight | Cubic feet |
|--|----------------|----------------|
| Transmitter | 850 Pounds | |
| Motor-generator set | 930 Pounds | |
| Magnetic controller | 144 Pounds | |
| 1-861 vacuum tube | 11.5 Pounds | |
| 3-803 vacuum tubes | 43 Pounds | |
| Transmitter spare parts | 90 Pounds | |
| Motor-generator and magnetic controller spare parts: | | |
| Box No. 1 | 108 Pounds | |
| Box No. 2 | 181 Pounds | |
| Total | 2,357.5 Pounds | 104 Cubic feet |

TAJ-11 RADIO TRANSMITTING EQUIPMENT

Use.—Ship.

Frequency range.—175–600 kc

Power output and emission.—500 watts; A₁, A₂.

Description.—The Navy Model TAJ-11 radio equipment designed for low and medium frequency telegraph and modulated telegraph operation is primarily intended for installation on destroyers and light cruisers.

The transmitter is built into a single complete unit. The frame is constructed of aluminum alloy angles and gussets riveted together to form a semishelf type of construction. All the tuning and operating controls and three access doors are located on the front panel. The vacuum tubes are mounted on a common tube cradle and are accessible through a door located on the right of the transmitter. The Navy type 860 intermediate power amplifier tube is located to the front of the transmitter, the Navy type 860 master oscillator tube is located in the center, and the Navy type 860 audio oscillator tube in the rear. The Navy type 861 power amplifier tube is mounted to the front and above the intermediate power amplifier tube. The master oscillator, intermediate power amplifier, and power amplifier compartments are located, respectively, on three shelves, one above the other, to the left of the tube cradle. Access to these compartments is obtained by removal of the shields between the tube compartment and the master oscillator and intermediate power amplifier compartments. Two doors located at the bottom of the transmitter provide access to the control and filter circuits as well as the terminal boards for all external connections. The top shelf contains the power amplifier tank coil and the antenna variometer, load switch, and loading inductance.

The motor generator set is a three unit, six bearing, direct coupled assembly mounted on a common bed plate. The motors, both A. C. and D. C., are of 4 h. p. capacity, and are interchangeable on the left hand end of the bed plate as viewed from the terminal box side. The high voltage or plate generator is located in the center and supplies 1,500 volts D. C. for the intermediate power amplifier and audio oscillator plate potential, and 3,000 volts D. C., for the power amplifier plate potential. The bias generator supplies 1,200 volts D. C. for the master oscillator plate and screen grid and 115 volts D. C. for d-c control circuits and fixed bias. Drip proof terminal boxes are located on the side of each unit and contain fuses for the protection of all circuits as well as terminals for all external connections. D-c equipment provides a-c supply for filaments from slip rings located on the driving motor.

The motor starter is of the remote controlled magnetic contactor type with all switches, contactors, fuses, and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

TECHNICAL FEATURES

Design—Navy.

Tube Complement

| | Number of tubes | Type |
|-----------------------------------|-----------------|------|
| Master oscillator..... | 1 | 860 |
| Intermediate power amplifier..... | 1 | 860 |
| Power amplifier..... | 1 | 861 |
| Audio oscillator..... | 1 | 860 |
| Total..... | 4 | |

Frequency control.—Master oscillator.

Power.—Supplies available: 115/230 volts D. C., 220/440/3/60.

Required for starting: 8.0 kw. for 115 volts D. C.; 8.1 kw. for 230 volts D. C.; 19.7 kw. for 220/440/3/60 A. C.

Required for locked key operation: 2.0 kw. for 115 volts D. C. or 220/440/3/60 A. C.; 2.82 kw. for 230 volts D. C.

Allowable variation in supply line voltage.—±10% A. C. and D. C. equipments.

Allowable variation in supply line frequency.—±5%

Allowable variation in supply voltage and frequency.—±10% (5% each).

Operating control.—Front of panel and Navy standard 4- or 6-wire remote control unit.

Type of keying.—Mechanical relay—100 words per minute.

Antenna.—Any antenna having values within 25% of 770 mmfd. capacity and 12 ohms resistance at 175 kc. to 930 mmfd. capacity and 3.8 ohms resistance at 600 kc.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type Number | Height | Width | Depth | Weight |
|---------------------------------------|-------------|--|---------------------------------|---------------------------------|--------|
| Transmitter: | | | | | |
| 220/3/60..... | CG-52241 | 73 ³ / ₄ | 27 | 24 ³ / ₈ | 562 |
| 440/3/60..... | CG-52241 | 73 ³ / ₄ | 27 | 24 ³ / ₈ | 562 |
| 115 volts D. C..... | CG-52240 | 73 ³ / ₄ | 27 | 24 ³ / ₈ | 550 |
| 230 volts D. C..... | CG-52240 | 73 ³ / ₄ | 27 | 24 ³ / ₈ | 550 |
| Motor generator: | | | | | |
| 220/3/60..... | CG-21758 | 19 ¹ / ₄ ¹ / ₆ | 71 ¹ / ₈ | 18 ¹ / ₁₆ | 850 |
| 440/3/60..... | CG-21758 | 19 ¹ / ₄ ¹ / ₆ | 71 ¹ / ₈ | 18 ¹ / ₁₆ | 850 |
| 115 volts D. C..... | CG-21756 | 19 ¹ / ₄ ¹ / ₆ | 76 ¹ / ₂ | 18 ¹ / ₁₆ | 950 |
| 230 volts D. C..... | CG-21757 | 19 ¹ / ₄ ¹ / ₆ | 76 ¹ / ₂ | 18 ¹ / ₁₆ | 960 |
| Magnetic controller: | | | | | |
| 220/3/60..... | CG-21754 | 21 ¹ / ₈ | 19 ¹ / ₁₆ | 9 | 70 |
| 440/3/60..... | CG-21755 | 21 ¹ / ₈ | 19 ¹ / ₁₆ | 9 | 70 |
| 115 volts D. C..... | CAO-21752 | 25 | 14 ³ / ₈ | 13 ¹ / ₄ | 70 |
| 230 volts D. C..... | CAO-21753 | 22 ³ / ₄ | 14 ³ / ₈ | 13 ¹ / ₄ | 70 |
| Transmitter spares ¹ | | 12 | 15 | 30 | 60 |

¹ (Information is for 440-volt A. C. equipment.)

REMARKS.—A quantity of d-c equipments are supplied with conversion parts so that they may be operated from both 115 and 230 volts D. C. The conversion units consist of the necessary 115 or 230 volts d-c motors, magnetic controller and spare parts.

Accessories not supplied by contractor.—Remote-control unit (Navy standard 4 to 6 wire).

Shipping weights and dimensions.—Data will be supplied when available.

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TAQ-9 RADIO TRANSMITTING EQUIPMENT

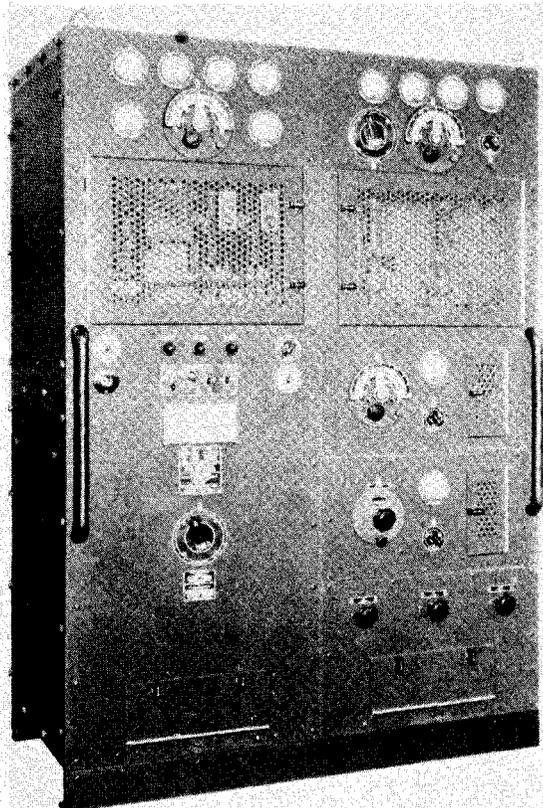
Use.—Ship—High power.

Frequency range.—175–600 kc.

Power output and emission.—2000 watts A₁; 1000 watts A₂.

Description.—The model TAQ-9 is designed for use as the main medium frequency transmitting equipment on battleships and light cruisers. Any single unit of this equipment, when uncrated for installation, and without further disassembly, is capable of passage through a door 25 inches wide by 54 inches high and through a hatch 30 inches wide and 36 inches long.

The transmitter components are built into two separate frames which are constructed of aluminum alloy angles and gussets riveted together. When installed the two frames are bolted together to form a



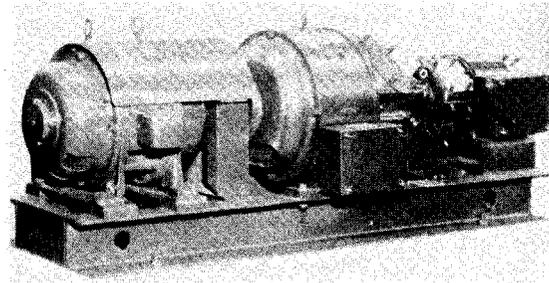
Type CG-52183 transmitter of the Model TAQ-9 radio transmitting equipment.

single unit with removable back and side shields. The mounting pedestals at the base of each frame are designed to permit the transmitter to be bolted to the deck. All the tuning and operating controls and access doors are located on the front panels of the transmitter. These doors permit access to the tube compartments, terminal boards, and the relay compartment. The master oscillator and intermediate power amplifier stages are constructed as separate sub-assemblies and may be removed for servicing purposes. Across the bottom shelf of the transmitter and to the front are located the terminal boards for all external

connections. Directly above the terminal boards in the right-hand section are located the bias, plate, and filament voltage control rheostats. Progressing upward are the master oscillator, intermediate power amplifier, and power amplifier stages. The left section contains the antenna coupling and tuning system and the transmitter control circuits.

The motor generator is a three-unit, six-bearing, direct-coupled assembly mounted on a common bed-plate. The motor is of 10-hp. capacity and is mounted on the left end of the bedplate as viewed from the terminal box side. The high voltage generator is located in the center and supplies 2,250 volts D. C. at 2.3 amperes for the intermediate-power-amplifier, audio-oscillator, and power-amplifier plate circuits. The low voltage generator is located on the right and supplies 750 volts D. C. at 0.125 amperes for the master-oscillator plate and screen grid circuits and 115 volts D. C. at 2.0 amperes for d-c control circuits and fixed biases. Drip proof terminal boxes are located on the side of each unit and contain fuses for the protection of all circuits as well as terminals for all external connections. (D-c equipments provide a-c filament power from slip rings located on the driving motor.) Drive motors for various line input voltages are directly interchangeable on the motor generator unit.

The motor starters are of the remote controlled magnetic contactor type, with all switches, contactors, fuses, and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.



Type CG-21360A motor-generator of the Model TAQ-9 radio transmitting equipment.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location and function | Number of tubes | Type |
|-----------------------------------|-----------------|------|
| Transmitter: | | |
| Master oscillator..... | 1 | 803 |
| Intermediate power amplifier..... | 1 | 803 |
| Power amplifiers..... | 2 | 851 |
| Audio oscillator..... | 1 | 803 |
| Total..... | 5 | |

Frequency control.—Master oscillator.

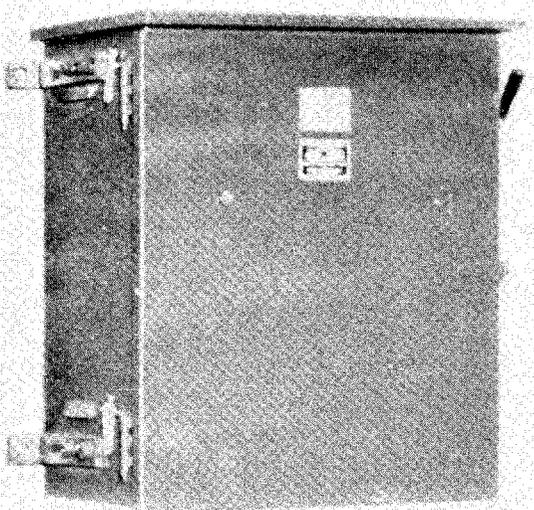
Power.—Supplies available: 115, 230 volts D. C.; 220/440/3/60.

REQUIRED FOR STARTING

| Power source | Line current (amperes) maximum per phase | KW | KVA | Power factor (percent) |
|-----------------|--|------|-----|------------------------|
| 115 volts D. C. | 180 | 20.3 | | |
| 230 volts D. C. | 90 | 23.6 | | |
| 220/3/60 | 180 | 45.0 | 69 | 65 |
| 440/3/60 | 100 | 45.0 | 76 | 59 |

REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current (amperes) maximum per phase | KW | KVA | Power factor (percent) |
|-----------------|--|-----|-----|------------------------|
| 115 volts D. C. | 67.0 | 8.4 | | |
| 230 volts D. C. | 32.0 | 8.1 | | |
| 220/3/60 | 24.0 | 7.2 | 8.9 | 81 |
| 440/3/60 | 12.0 | 7.5 | 8.9 | 85 |



Types CG-21368 or CG-21369 magnetic controller for Model TAQ-9 radio transmitting equipment.

Allowable variation in supply line voltages: ± 10 percent for D. C. and ± 5 percent for A. C.; frequency ± 5 percent for A. C.; combined voltage and frequency ± 10 percent (5 percent each).

Operating control.—Front of panel and 4- or 6-wire Navy standard remote-control unit.

Type of keying.—Relay, 100 words per minute.

Antenna.—A flexible coupling and tuning system provides operation into widely varying capacitive shipboard antennas.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| | Type Nos. | Height | Width | Depth | Weight |
|------------------------------|-----------|------------------|------------------|------------------|--------|
| 115-volt D. C. units: | | | | | |
| Transmitter | CG-52182 | 72 | 49 $\frac{3}{8}$ | 34 $\frac{1}{8}$ | 985 |
| Motor generator | CG-21358A | 27 | 78 $\frac{3}{8}$ | 22 $\frac{3}{8}$ | 1,325 |
| Magnetic controller | CAO-21366 | 22 $\frac{1}{2}$ | 16 $\frac{1}{2}$ | 14 $\frac{1}{2}$ | 109 |
| Set of vacuum tubes | | | | | 7 |
| Spare parts | | | | | 464 |
| 230 volt D. C. units: | | | | | |
| Transmitter | CG-52182 | 72 | 49 $\frac{3}{8}$ | 34 $\frac{1}{8}$ | 970 |
| Motor generator | CG-21359A | 27 | 78 $\frac{3}{8}$ | 22 $\frac{3}{8}$ | 1,325 |
| Magnetic controller | CAO-21367 | 22 $\frac{1}{2}$ | 13 $\frac{1}{2}$ | 14 $\frac{1}{2}$ | 94 |
| Set of vacuum tubes | | | | | 7 |
| Spare parts | | | | | 464 |
| 220/3/60 units: | | | | | |
| Transmitter | CG-52183 | 72 | 49 $\frac{3}{8}$ | 34 $\frac{1}{8}$ | 1,050 |
| Motor generator | CG-21360A | 27 | 71 $\frac{3}{8}$ | 22 $\frac{3}{8}$ | 1,185 |
| Magnetic controller | CG-21368 | 26 $\frac{1}{2}$ | 27 | 12 $\frac{3}{8}$ | 140 |
| Set of vacuum tubes | | | | | 7 |
| Spare parts | | | | | 7 |
| 440/3/60: | | | | | |
| Transmitter | CG-52183 | 72 | 49 $\frac{3}{8}$ | 34 $\frac{1}{8}$ | 1,050 |
| Motor generator | CG-21360A | 27 | 71 $\frac{3}{8}$ | 22 $\frac{3}{8}$ | 1,185 |
| Magnetic controller | CG-21369 | 26 $\frac{1}{2}$ | 27 | 12 $\frac{3}{8}$ | 140 |
| Set of vacuum tubes | | | | | 7 |
| Spare parts | | | | | 309 |

Accessories.—Conversion kits for operation of 115-volt D. C. equipment on 230 volts D. C. are available.

Accessories not supplied by contractor.—Telegraph key. Remote control unit—Navy standard 4- or 6-wire.

Shipping weights and dimensions

[Information is relative to 220/440/3/60 equipments]

| | Size (inches) | Gross weight (pounds) | Cubic feet |
|---|---------------|-----------------------|------------|
| Equipment as shipped in 18 cases: | | | |
| Transmitter (right section) | 81 x 53 x 49 | 1,060 | 121.0 |
| Transmitter (left section) | 81 x 53 x 49 | 836 | 121.0 |
| Motor generator | 21 x 32 x 26 | 1,370 | 38.9 |
| Magnetic controller | 37 x 32 x 20 | 222 | 13.7 |
| Vacuum tubes, 3—806 in 3 boxes (each) | 16 x 11 x 11 | 2 | 1.1 |
| Vacuum tubes, 2—851 in 2 boxes (each) | 27 x 16 x 16 | 10 | 4.0 |
| Spare vacuum tubes, 3—806 in 3 boxes (each) | 16 x 11 x 11 | 2 | 1.1 |
| Spare vacuum tubes, 2—851 in 2 boxes (each) | 27 x 16 x 16 | 10 | 4.0 |
| Spare parts box | 40 x 28 x 23 | 258 | 15.0 |
| Spare parts box | 53 x 23 x 15 | 356 | 10.6 |
| Spare parts box | 46 x 23 x 21 | 360 | 12.8 |
| Spare parts box | 40 x 20 x 15 | 164 | 6.9 |

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CONFIDENTIAL

TBA-6 RADIO TRANSMITTING EQUIPMENT

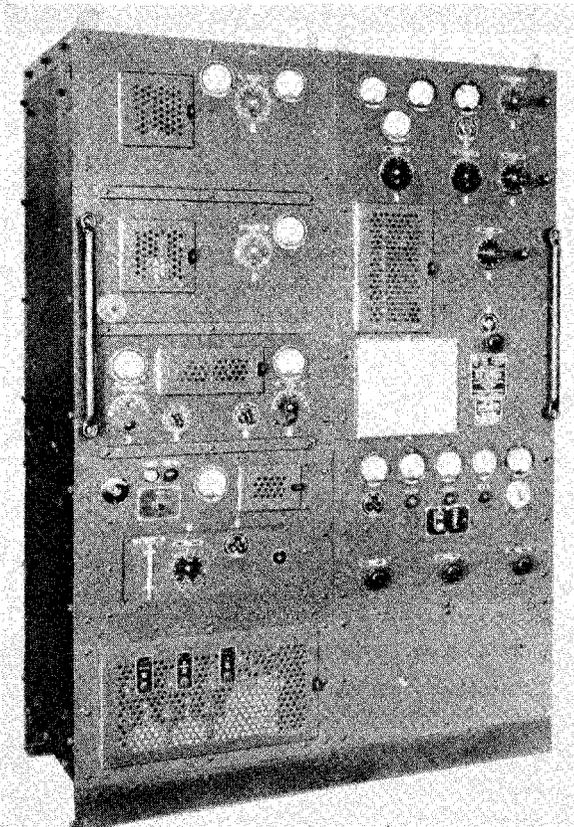
Use.—Ship.

Frequency range.—4000–26,000 kc.

Power output and emission.—1000 watts, A₁.

Description.—The Model TBA-6 equipment is designed primarily for service as the main high-frequency transmitter on the larger types of surface vessels, such as battleships, aircraft carriers, and cruisers.

The *transmitter* consists of two pedestal-mounted sections bolted together to form a single unit. The frames are made up of aluminum alloy angles and gussets riveted together to form a shelf type of construction. The entire radio frequency portion of the transmitter, up to the power amplifier stage is housed in the left hand section on four shelves which are

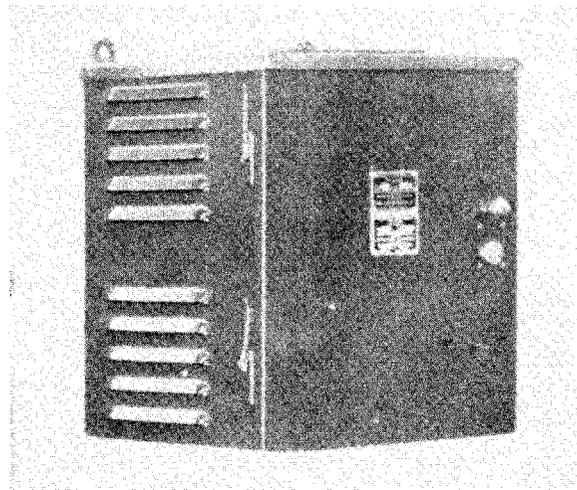


Transmitter for Model TBA-6 equipment.

located one above the other and are removable through the front of the unit. The first shelf is mounted directly over the relay access door which is located at the bottom of the section, and contains the Navy type 837 electron coupled master oscillator. The second shelf contains the Navy type 837 first intermediate power amplifier and the Navy type 837 second intermediate power amplifier units. The third and fourth shelves contain, respectively, the Navy type 803 third intermediate power amplifier unit and the Navy type 803 fourth intermediate power amplifier unit. The bottom of the

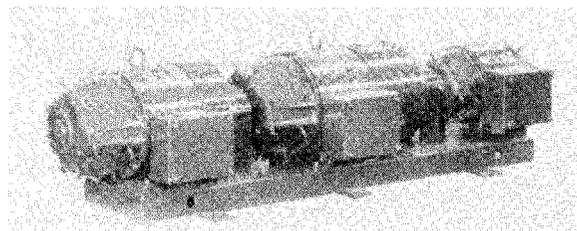
right hand section contains the terminal boards for all external connections. Directly opposite from the master oscillator in the right hand section is mounted the control panel. The Navy type 833A push-pull power amplifier and the antenna coupling and tuning components are located in a compartment at the top of the right hand section.

The *motor-generator* is a three unit, six bearing, direct coupled assembly mounted on a common bed-plate. Both the a-c and the d-c motors are of 5.5-horsepower capacity, and are interchangeable on the left end of the bed-plate as viewed from the terminal box side. The high voltage generator is located in the center and supplies 2,500 volts d-c at 0.98 ampere for the power amplifier plate potential and 1,250 volts d-c at 0.44



Magnetic controller for Model TBA-6 equipment.

ampere for the plate potential of the third and fourth intermediate power amplifiers. The low voltage generator on the right supplies 500 volts D. C. at 0.55 ampere for the plate potential of the first and second intermediate amplifiers and the master oscillator, and 115 volts D. C. at 1.96 amperes for bias and field excitation. Drip-proof terminal boxes are located on the sides of each unit and contain fuses for the protection of all circuits as well as terminals for all external connections. (D-c equipments provide a-c supply for filaments from slip rings located on the driving motor.)



Motor-generator for Model TBA-6 equipment.

The motor starter is of the remote controlled magnetic contactor type with all switches, contactors, fuses, and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | Number of tubes | Type |
|------------------------------------|-----------------|------|
| Master oscillator..... | 1 | 837 |
| First intermediate amplifier..... | 1 | 837 |
| Second intermediate amplifier..... | 2 | 837 |
| Third intermediate amplifier..... | 1 | 803 |
| Fourth intermediate amplifier..... | 2 | 803 |
| Power amplifier..... | 2 | 833A |
| Total..... | 9 | |

Frequency control.—Master oscillator.

Power.—Supplies available: 440/3/60; 115 volts D. C. and 230 volts D. C.

REQUIRED FOR STARTING

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|---------------------|--|----|------|------------------------|
| 115 volts D. C..... | 104 | 12 | | |
| 230 volts D. C..... | 52 | 12 | | |
| 440/3/60..... | 65 | 30 | 49.5 | 60.5 |

REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|---------------------|--|-----|-----|------------------------|
| 115 volts D. C..... | 46.0 | 5.3 | | |
| 230 volts D. C..... | 23.0 | 5.3 | | |
| 440/3/60..... | 8.0 | 5.0 | 6.0 | 83 |

Allowable variation in the supply line voltage, ± 10% A. C. and D. C.; frequency, ± 5%; combined voltage and frequency, ± 10%, (5% each.)

Operating control.—Front of panel and Navy standard 4- or 6-wire remote control unit.

Type of keying.—Relay—100 words per minute.

Antenna.—Single wire antenna as follows: Length outside of trunk—40 to 200 feet; Length of trunk—0 to 100 feet; Static capacitance of trunk—5 to 15 mmfd.; surge impedance—70 to 200 ohms.

Weights and dimensions of equipment units included in contract

| Unit | Height | Width | Depth | Weight |
|--|-----------|-----------|------------|------------|
| Transmitter 440/3/60, 230 or 115 volts D. C..... | Inches 72 | Inches 49 | Inches 31½ | Pounds 975 |
| Magnetic controller: 220/440/3/60..... | 22½ | 20¼ | 8¾ | 65 |
| 230 or 115 volts D. C..... | 22 | 17¾ | 15¼ | 110 |
| Motor-generator set: 440/220/60..... | 19½ | 70¼ | 16 | 815 |
| 230 or 115 volts D. C..... | 19½ | 75 | 18½ | 875 |
| Spare parts ¹ | | | | |

¹ Data to be supplied.

Navy type numbers of units of the TBA-6 equipments

| Supply | Transmitter | Magnetic controller | Motor-generator set |
|---------------------|-------------|---------------------|---------------------|
| 440/3/60..... | CG-52197 | CG-21374 | CG-21375A |
| 230 volts D. C..... | CG-52196 | CAO-21592 | CG-21596 |
| 115 volts D. C..... | CG-52195 | CAO-21591 | CG-21595 |

Shipping weights and dimensions

[Figures are given for 115- or 230-volt D. C.]

| Unit | Size | Gross weight | Cubic feet |
|---|----------------|--------------|------------|
| Transmitter: | Inches | Pounds | |
| Case 1..... | 80 x 56 x 54.. | 880 | 140 |
| Case 2..... | 80 x 56 x 54.. | 872 | 140 |
| Magnetic controller..... | 21 x 31 x 51.. | 277 | 19.20 |
| Motor generator set..... | 22 x 24 x 75.. | 930 | 22.90 |
| Vacuum tubes (4-837)..... | 10 x 12 x 15.. | 5 | 1.04 |
| Vacuum tube spares (4-837)..... | 10 x 12 x 15.. | 5 | 1.04 |
| Vacuum tubes (3-803) 3 cases..... | 11 x 11 x 15.. | 2 | 1.05 |
| Vacuum tube spares (3-803) 3 cases..... | 11 x 11 x 15.. | 2 | 1.05 |
| Vacuum tubes (2-833) 2 cases..... | 13 x 13 x 18.. | 7 | 1.76 |
| Vacuum tube spares (2-833) 2 cases..... | 13 x 13 x 18.. | 7 | 1.76 |
| Spare parts, 1 case..... | 15 x 20 x 40.. | 160 | 6.94 |
| Do..... | 15 x 20 x 40.. | 160 | 6.94 |
| Do..... | 15 x 23 x 53.. | 340 | 10.60 |
| Do..... | 19 x 19 x 30.. | 125 | 6.70 |
| Do..... | 17 x 20 x 47.. | 150 | 9.25 |



TBA-8 AND TBA-11 RADIO TRANSMITTING EQUIPMENTS

Use.—Shore.

Description.—The identical Models TBA-8 and TBA-11 transmitting equipments are designed for high frequency telegraph communication. Each equipment furnished under these model designations includes units similar to those provided for the Model TBA-10 and in addition, a transmission line coupling unit for use when the transmitter is required to work into a balanced 600-650 ohm transmission line. When the transmission line coupling unit is employed, a single ended antenna may also be connected to the transmitter and the output of the equipment transferred as desired from one antenna to the other. The transmission line coupling unit is designed to be mounted on top of the transmitter and is complementary to the transmitter in construction. All the electrical

parts are mounted on the bottom shield, and the controls and indicating instruments are brought out on the front panel.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|--|---------------|--------|--------|--------|--------|
| Transmitter: | | Inches | Inches | Inches | Pounds |
| TBA-8..... | CG-52280 | 72 | 49 | 31½ | 975 |
| TBA-11..... | CG-52280-A | 72 | 49 | 31½ | 975 |
| Transmission line coupling unit..... | CG-50118 | 10¾ | 49 | 31½ | 116 |
| Land line control unit..... | CG-23269 | 42¾ | 24 | 15¾ | 160 |
| Power transfer switch..... | CG-24092 | 12¾ | 16 | 9¼ | 14 |
| Duplicate magnetic controllers (each)..... | CG-21897 | 23¾ | 21¾ | 9½ | 70 |
| Duplicate motor generator sets (each)..... | CG-21899 | 19¾ | 71¾ | 18¾ | 815 |
| Spare parts..... | | | | | |

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TBA-9 RADIO TRANSMITTING EQUIPMENT

Use.—Shipboard—Coast Guard.

Description.—The Model TBA-9 is designed for high frequency telegraph communication. Similar to the Model TBA-6 in construction and design, this equipment differs primarily from the earlier model in that in addition to master oscillator control, crystal control is provided on 10 frequencies throughout the operating range. The crystal unit employed utilizes a type 837 oscillator tube, is located just above the control panel in the right section of the transmitter, and is removable for servicing purposes. A switch mounted on the front panel of the crystal unit permits selection of master oscillator or crystal control.

Two magnetic controllers and two motor generator sets are furnished with each TBA-9 equipment.

Power.—Supply available: 440/3/60.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|--|---------------|--------|--------|--------|--------|
| | | Inches | Inches | Inches | Pounds |
| Transmitter..... | CG-52281 | 72 | 49 | 31½ | 975 |
| Duplicate magnetic controllers (each)..... | CG-21898 | 23¾ | 29¾ | 9¼ | 70 |
| Duplicate motor generator sets (each)..... | CG-21899 | 19¼ | 71¼ | 18½ | 815 |
| Spare parts. | | | | | |

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TBA-10 RADIO TRANSMITTING EQUIPMENT

Use.—Shore.

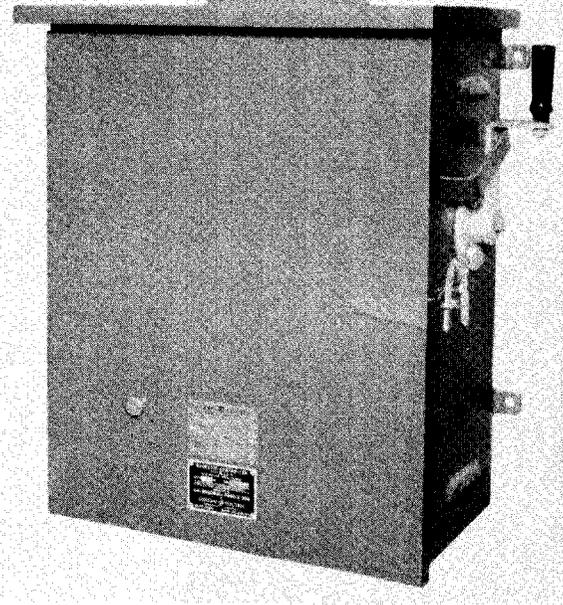
Frequency range.—4000-26,000 kc.

Power output and emission.—1,000 watts, A₁.

Description.—The Model TBA-10 is a shore modification of the 440/3/60 model TBA-6 which was designed for shipboard use. This equipment is suitable for installation at shore stations or bases where high frequency medium power telegraph operation is required.

The transmitter consists of two pedestal mounted sections bolted together to form a single unit. The frames are made up of aluminum alloy angles and gussets riveted together to form a shelf type of construction. The entire radio frequency portion of the transmitter up to the power amplifier stage is housed in the left hand section on four shelves which are located one above the other and are removable through the front of the unit. The first shelf is mounted directly over the relay access door which is located at the bottom of the section and contains the Navy type 837 electron coupled master oscillator. The second shelf contains the Navy type 837 first intermediate power amplifier and the Navy type 837 second intermediate power amplifier unit. The third and fourth shelves contain respectively the Navy type 803 third intermediate power amplifier unit and the Navy type 803 fourth intermediate power amplifier unit. The bottom of the right-hand section contains the terminal boards for all external connections. Directly opposite from the master oscillator in the right-hand section is mounted the control panel. The Navy type 833A push-pull power amplifier and the antenna coupling and tuning components are located in a compartment at the top of the right-hand section.

The land-line control unit makes it possible to start, stop and telegraphically key the equipment over a 4-wire line up to 50 miles in length. Provision is made in this unit for keying the transmitter on A₁ emission by means of relay keying at speeds up to 100 words per minute or keying the transmitter by means of vacuum tube keying at speeds up to 500 words per minute. A d-c voltage of 40 to 100 volts is necessary



Model TBA-10 magnetic controller.

in order to operate vacuum tube keying of the transmitter through this unit. A feature of the land-line control unit is a time delay period during which the equipment is reduced to stand-by condition prior to automatic shutdown. This unit takes its operating power from the transmitter and all external connections are made to terminal strips along the bottom of the panel.

The *motor-generator set* is a three-unit, six-bearing, direct coupled assembly mounted on a common bed-plate. The motor is of 5.5 HP capacity and is located on the left end of the bed-plate as viewed from the terminal box side. The high voltage generator is located in the center and supplies 2,500 volts D. C. at 0.98 ampere for power amplifier plate potential and 1,250 volts D. C. at 0.44 ampere for the plate potential of the third and fourth intermediate power amplifiers. The low-voltage generator located on the right supplies 500 volts D. C. at 0.55 ampere for the plate potential of the first and second intermediate amplifiers and master oscillator, and 115 volts D. C. at 1.96 amperes for bias and field excitation. Drip-proof terminal boxes are located on the sides of each unit and contain fuses for the protection of all circuits as well as terminals for all external connections. (D-c equipments provide a-c supply for filaments from slip rings located on the driving motor.)

The *motor-starter* is of the remote controlled magnetic contactor type with all switches, contactors, fuses and overload protective devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

The *power transfer switch assembly*, designed for wall or bulkhead mounting, is enclosed in an aluminum case and is a self-contained manually operated switch used for transferring the terminals of the transmitter from one motor-generator set to another. Knockouts are provided at the bottom of the case to facilitate the connecting of external wiring to the rear of the panel.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | Number of tubes | Type |
|------------------------------------|-----------------|------|
| Transmitter: | | |
| Master oscillator..... | 1 | 837 |
| First intermediate amplifier..... | 1 | 837 |
| Second intermediate amplifier..... | 2 | 837 |
| Third intermediate amplifier..... | 1 | 803 |
| Fourth intermediate amplifier..... | 2 | 803 |
| Power amplifier..... | 2 | 833A |
| Land-line control unit: | | |
| Rectifier..... | 1 | 5Z3 |
| Relay tube..... | 1 | 807 |
| Keying tube..... | 1 | 807 |
| Total..... | 12 | |

Frequency control.—Master oscillator.

Power.—*Supply.*—220/3/60

REQUIRED FOR STARTING¹

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|---------------|--|----|------|------------------------|
| 220/3/60..... | 130 | 30 | 49.5 | 60.5 |

REQUIRED FOR LOCKED KEY OPERATION¹

| | | | | |
|---------------|----|------|------|----|
| 220/3/60..... | 17 | 5.35 | 6.23 | 86 |
|---------------|----|------|------|----|

¹ These figures are from manufacturers' test data of the TBA-4. an equipment similar to the TBA-10.

Allowable variation in supply line voltage, $\pm 10\%$; frequency, $\pm 5\%$; combined voltage and frequency, $\pm 10\%$ (5% each).

Operating control.—Front of panel, land-line remote control up to 50 miles.

Type of keying.—Relay—100 words per minute. Vacuum tube—500 words per minute.

Antenna.—Single wire with reactance of 0 to $\pm 2,000$ ohms and resistance of 26 to 3,500 ohms or balanced 600–650-ohm transmission line between 100 and 1,000 feet in length terminated with suitable antenna or array.

A transmission line coupling unit must be used if it is desired to work the equipment into a balanced antenna. (See "Accessory not supplied under the contract.")

Shipping weights and dimensions¹

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type Nos. | Height | Width | Depth | Weight |
|--|----------------|--------------------|-------------------|------------------|---------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Transmitter..... | CG-52282 | 72 | 49 | 31 $\frac{1}{2}$ | 975 |
| Land-line control unit..... | CG-23269 | 42 $\frac{1}{2}$ | 24 | 15 $\frac{3}{4}$ | 160 |
| Power transfer switch..... | CG-24092 | 12 $\frac{1}{4}$ | 16 | 9 $\frac{1}{4}$ | 14 |
| Duplicate magnetic controllers (each)..... | CG-21373 | 22 $\frac{1}{2}$ | 19 | 10 $\frac{1}{4}$ | 65 |
| Duplicate motor-generator sets (each)..... | CG-21375-A | 19 $2\frac{3}{32}$ | 70 $\frac{1}{16}$ | 16 | 815 |
| Spare parts ¹ | | | | | |

¹ Data to be supplied when available.

Accessory not supplied under the contract.—A transmission line coupling unit type CG-50118 not furnished with the TBA-10 equipments, but available separately may be employed with those equipments which are required to match a balanced 600–650-ohm transmission line. This unit is designed to be mounted on top of the transmitter, and is complementary to the transmitter, in construction. The transmission line coupling unit was originally designed for use with the Model TBA-8 equipments. When used with the Model TBA-10 equipments, slight modification of the equipments are necessary. A kit containing modification parts is provided.

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TBK-11 RADIO TRANSMITTING EQUIPMENT

Use.—Shore.

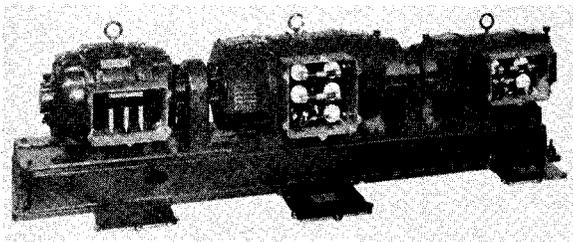
Frequency range.—2000-18,100 kc.

Power output and emission.—500 watts A_1 (also 75 watts 2000-9050 kc. with final amplifier disconnected).

Description.—The Model TBK-11 is intended for shore installations requiring equipment of high frequency medium power. The TBK and TBM series equipments are similar in construction and general appearance. The outstanding difference between these equipments is that the TBM incorporates a modulator unit to provide A_2 and A_3 emission. With the exception of the omission of the modulator unit and the incorporation of a magnetic controller of a later design, the TBK-11 a-c equipments are identical to the TBM-6 equipments.

The transmitter is built into a single complete unit. The frame is constructed of aluminum alloy angle, spot-welded to form a nonremovable, semishelf type of construction. All the tuning and operating controls and doors for access to the tube compartments and relays are located on the front panel. The first shelf contains the control and filter circuits and the terminal boards which are located to the front and bottom for all external connections. Directly above the first shelf on the left hand side is located the Navy type 860 electron coupled master oscillator and doubler stage which is mounted within the transmitter as a separate unit and is removable for servicing purposes. This unit is $35\frac{1}{2}$ inches high, 22 inches deep, and $12\frac{1}{2}$ inches wide. The second and third shelves on the right hand side contain the first intermediate and second intermediate Navy type 860 amplifier tubes. Directly above the second intermediate amplifier is located the Navy type 861 single-ended power amplifier tube. The entire top shelf contains a very flexible antenna coupling system which enables the equipment to be tuned to antennas of widely varying characteristics.

The land-line control unit makes it possible to start and stop and telegraphically key the equipment over a two-wire line up to 50 miles in length. Provision is made in this unit for keying the transmitter on A_1 emission by means of vacuum tube keying at any speed

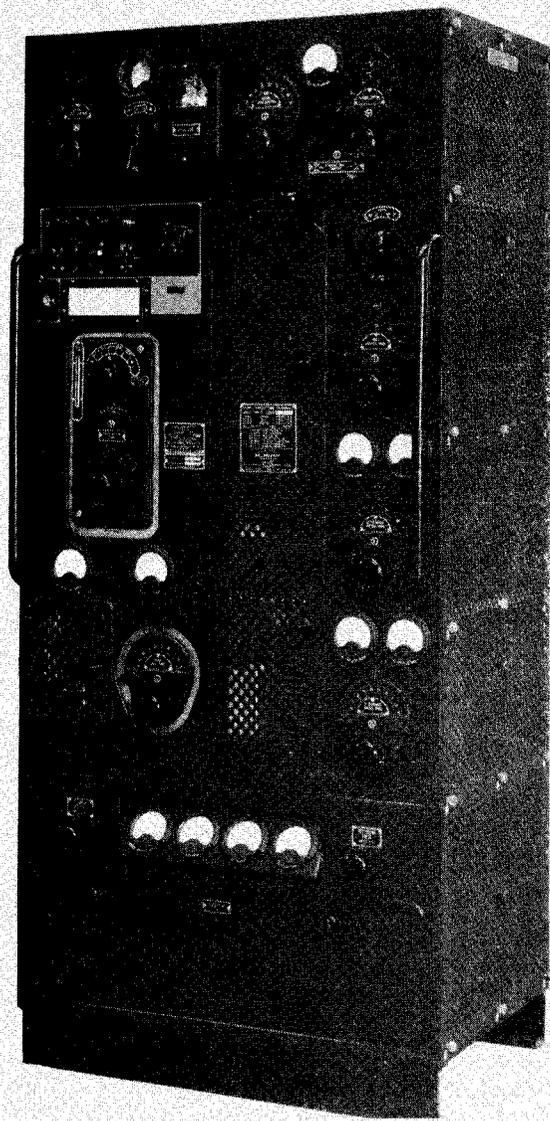


Model TBK-11 motor-generator.

up to 500 words per minute or relay keying at any speed up to 100 words per minute. Relay keying on type A_2 emission is possible up to 50 words per minute. A d-c voltage is necessary in order to key this equipment. A Navy type 807 tube located in the master oscillator unit of the transmitter is used for vacuum tube keying. Another feature of the land-line control unit is a long or short time delay period during which the equipment is reduced to stand-by condition prior to automatic shut

down. This unit takes its operating power from the transmitter, and all external connections are made to terminal strips along the bottom of the panel.

The motor generator set is a 3-unit, 6-bearing direct coupled assembly mounted on a common bed-plate. The motor is of 5 horsepower capacity and is mounted on the left end of the bed-plate as viewed from the terminal box side. The high voltage generator, is located in the center and supplies 3,000 volts D. C. at 0.35 ampere for power amplifier plate potential and



Model TBK-11 radio transmitter.

2,000 volts D. C. at 0.75 ampere for the plate potential of the intermediate amplifiers. The low voltage generator located on the right supplies 1,000 volts D. C. at 0.075 ampere for the master oscillator plate potential and 275 volts D. C. at 1.3 amperes for bias and field excitation. Dripproof terminal boxes are located on the side of each unit and contain fuses for the protection of all circuits as well as terminals for all external

connections. Drive motors for various line input voltages are directly interchangeable on this equipment.

The *motor-starters* are of the remote-controlled magnetic contactor type, with allswitches, contactors, fuses, and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

The *power transfer-panel* is a self-contained manually operated switch used for transferring the input of the transmitter from one motor-generator set to the other motor-generator set. The switch panel is hinged at the bottom so as to facilitate the connecting of external wiring to the rear of the panel.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | Number of tubes | Type |
|--|-----------------|-----------|
| Transmitter: | | |
| Master oscillator..... | 1 | 860 |
| First intermediate power amplifier..... | 1 | 860 |
| Second intermediate power amplifier..... | 1 | 860 |
| Power amplifier..... | 1 | 861 |
| Keyer tube..... | 1 | 807 |
| Land line control unit: | | |
| Keyer control tube..... | 1 | 807 |
| Rectifier..... | 1 | 5Z3 |
| Control start..... | 1 | OC3/VR105 |
| Total..... | 8 | |

Weights, dimensions, and Navy type numbers of equipment units included in contract

[Figures given are for 440/3/25 a-c equipment. See other type numbers below]

| Unit | Navy type No. | Height | Width | Depth | Weight |
|---|-----------------|---------------|---------------|---------------|---------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Transmitter..... | CAY-52169..... | 72 | 32 | 24 | 797 |
| Duplicate motor-generator sets, each..... | CAY-21521..... | 21¾ | 78½ | 20½ | 1,162 |
| Duplicate motor starters, each..... | CAY-21512..... | 24¼ | 17 | 11½ | 80 |
| Land-line control unit..... | CAY-23217..... | 20¾ | 21¾ | 11½ | 54 |
| Transfer panel..... | CAY-24084A..... | 39¾ | 20¼ | 11 | 77 |
| Spare parts box..... | | 15¾ | 25¾ | 16¾ | 143 |

Type numbers of units of the TBK-11 equipments

| Power Source | Transmitter | Motor-generator sets | Motor starters | Land-line control unit | Transfer panel |
|---------------------|----------------|----------------------|----------------|------------------------|-----------------|
| 220/3/25 A. C..... | CAY-52169..... | CAY-21521..... | CAY-21609..... | CAY-23217..... | CAY-24084..... |
| 220/3/60 A. C..... | CAY-52170..... | CAY-21522..... | CAY-21610..... | CAY-23216..... | CAY-24084A..... |
| 220/1/60 A. C..... | CAY-52170..... | CAY-21671..... | CAY-21644..... | CAY-23216..... | CAY-24084A..... |
| 115 volts D. C..... | CAY-52166..... | CAY-21519..... | CAY-21611..... | CAY-23216..... | CAY-24083..... |

Accessories not supplied by contractor.—Navy standard 4- or 6-wire remote-control unit.

Shipping weights and dimensions

[Figures given are for 440/3/25 a-c equipment]

| Unit | Size | Gross weight | Cubic feet | Unit | Size | Gross weight | Cubic feet |
|------------------------------------|-------------------|---------------|------------|-----------------------------------|-------------------|---------------|---------------|
| | <i>Inches</i> | <i>Pounds</i> | | | <i>Inches</i> | <i>Pounds</i> | |
| Transmitter..... | 42 x 30 x 78..... | 1,092 | 56.87 | Vacuum tubes (balance)..... | 41 x 15 x 30..... | 40 | 4.62 |
| Motor-generator sets (2) each..... | 80 x 26 x 24..... | 1,402 | 29.42 | Equipment spare parts..... | 28 x 18 x 17..... | 188 | 4.96 |
| Motor starters (2) each..... | 22 x 27 x 17..... | 122 | 5.84 | Vacuum tube spares (one 861)..... | 23 x 23 x 24..... | 21 | 7.34 |
| Land-line control unit..... | 30 x 26 x 17..... | 120 | 7.67 | Vacuum tube spares (balance)..... | 41 x 15 x 30..... | 40 | 4.62 |
| Transfer panel..... | 48 x 27 x 17..... | 182 | 12.75 | | | | |
| Vacuum tube (one 861)..... | 23 x 23 x 24..... | 21 | 7.34 | Total..... | | 4,752 | 176.69 |

Frequency control.—Master oscillator.
Power.—

REQUIRED FOR STARTING

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|---------------------|--|------|------|------------------------|
| 115 volts D. C..... | 67 | 7.7 | | |
| 220/1/60..... | 102 | 13.5 | 22.5 | 60 |
| 220/3/25..... | 145 | 29.2 | 55.0 | 53 |
| 220/3/60..... | 115 | 22.0 | 44.0 | 50 |
| 440/3/25..... | 75 | 29.2 | 55.0 | 53 |

REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|---------------------|--|------|------|------------------------|
| 115 volts D. C..... | 34.2 | 3.93 | | |
| 220/1/60..... | 25.0 | 4.50 | 5.50 | 82 |
| 220/3/25..... | 13.2 | 4.15 | 4.60 | 90 |
| 220/3/60..... | 12.5 | 3.78 | 4.35 | 87 |
| 440/3/25..... | 6.6 | 4.15 | 4.60 | 90 |

Allowable variation in supply line voltage, $\pm 10\%$; frequency, $\pm 5\%$; combined voltage and frequency, $\pm 10\%$ (5% each).

Operating control.—(1) Front of panel for test purposes, (2) remote control using Navy standard 4- or 6-wire, (3) land-line remote control up to 50 miles.

Type of keying.—Relay—100 words per minute.
Vacuum tube—500 words per minute.

Antenna.—Recommended average length—80 feet.

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TBK-13, TBK-18, AND TBK-20 RADIO TRANSMITTING EQUIPMENTS

Use.—Ship.

Frequency range.—2000-18,100 kc.

Power output and emission.—500 watts A_1 (also 75 watts from 2000-9050 kc., with the final amplifier disconnected).

Description.—The Models TBK-13, TBK-18 and TBK-20 are designed for ship installations requiring equipment of high frequency and medium power. The TBK and TBM series of equipments are similar in construction and general appearances, differing essentially in that the TBM equipments are furnished with modulator units to permit modulated telegraph and voice operation whereas the TBK equipments are intended for telegraph operation only and do not include modulator units. The TBK-13 and TBK-18 model designations each cover equipments designed for operation on 440/3/60, 115 volts d. c. and 230 volts d. c. Equipments of the TBK-13 and TBK-18 for like voltages are identical. The TBK-20 equipments are designed for operation on 230 volts d. c. only and differ from the 230 volt d. c. equipment of the earlier models in that they incorporate a high impact type of magnetic controller.

The transmitter is built into a single complete unit. The frame is constructed of aluminum alloy angle, spot welded to form a nonremovable semishelf type of construction. All the tuning and operating controls and doors for access to the tube compartments and relays are located on the front panel. The bottom compartment contains the control and filter circuits and the terminal boards which are located to the front and bottom for all external connections. Directly above, this compartment on the left hand side is located the Navy type 860 electron-coupled master oscillator and doubler stage which is mounted within the transmitter as a separate unit and is removable for servicing purposes. This unit is 35½-inches high, 22 inches deep, and 12½-inches wide. The second and third shelves on the right hand side contain the first intermediate and second intermediate Navy type 860 amplifier stages respectively. Directly above the second intermediate amplifier is located the Navy type 861 single ended power amplifier stage. The entire top shelf contains a very flexible antenna coupling system which enables the equipment to be tuned to antennas of widely varying characteristics.

The motor generator set is a three unit, six bearing direct coupled assembly mounted on a common bedplate. The motor is of 5 horsepower capacity and is mounted on the left end of the bedplate as viewed from the terminal box side. The high voltage generator is located in the center and supplies 3,000 volts d. c. at 0.35 ampere for power amplifier plate potential and 2,000 volts d. c. at 0.75 ampere for the plate potential of the intermediate amplifiers. The low voltage generator located on the right supplies 1,000 volts d. c. at 0.075 ampere for the master oscillator plate potential and 275 volts d. c. at 1.3 amperes for bias and field excitation (d. c. units provide a. c. supply for filaments from slip rings located on the driving

motor). Drive motors for various line input voltages are directly interchangeable on this equipment.

The motor starters are of the remote controlled magnetic contactor type, with all switches, contactors, fuses and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Function | Number of tubes | Type |
|--|-----------------|------|
| Master oscillator..... | 1 | 806 |
| First intermediate power amplifier..... | 1 | 860 |
| Second intermediate power amplifier..... | 1 | 860 |
| Power amplifier..... | 1 | 861 |
| Total..... | 4 | |

Frequency control.—Master oscillator.

Power.—Supplies available: TBK-13, TBK-18, 440/3/60, 115 volts d. c., 230 volts d. c. TBK-20, 230 volts d. c.

REQUIRED FOR STARTING

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|---------------------|--|------|------|------------------------|
| 440/3/60..... | 43.0 | 16.1 | 32.2 | 50 |
| 115 volts d. c..... | 86.0 | 10.0 | | |
| 230 volts d. c..... | 43.0 | 10.0 | | |

REQUIRED FOR LOCKED KEY OPERATION

| 440/3/60..... | 5.75 | 3.6 | 4.2 | 87 |
|---------------------|------|------|-----|----|
| 115 volts d. c..... | 33.3 | 3.83 | | |
| 230 volts d. c..... | 16.7 | 3.83 | | |

Allowable variation in supply line voltage $\pm 10\%$; frequency $\pm 5\%$; combined voltage and frequency $\pm 10\%$ (5% each).

Operating control.—Front of panel and Navy standard 4 or 6 wire remote control units.

Type of keying.—Relay, 100 words per minute.

Antenna:

| | |
|-------------------------------------|-----------------|
| Maximum length..... | 80 feet. |
| Trunk length..... | 0 to 35 feet. |
| Diameter of trunk (if used)..... | 8 to 12 inches. |
| Distance to entering insulator..... | 2 to 20 feet. |

TBK-13
 TBK-15
 TBK-18
 TBK-20
 TBL-4

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Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type No. | Height | Width | Depth | Weight |
|-----------------------------------|-----------|------------------|---------------------------------|------------------|---------------|
| 440/3/60 equipment: | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Transmitter..... | CAY-52171 | 72 | 32 | 24 | 789 |
| Motor generator..... | CAY-21677 | 20 $\frac{3}{8}$ | 74 $\frac{1}{2}$ $\frac{1}{32}$ | 20 $\frac{1}{2}$ | 1,100 |
| Magnetic controller..... | CAY-21669 | 24 $\frac{1}{4}$ | 17 | 11 $\frac{3}{8}$ | 50 |
| 115 volts d. c. equipment: | | | | | |
| Transmitter..... | CAY-52217 | 72 | 32 | 24 | 825 |
| Motor generator..... | CAY-21675 | 20 $\frac{1}{4}$ | 78 $\frac{1}{2}$ $\frac{1}{16}$ | 20 $\frac{1}{4}$ | 1,150 |
| Magnetic controller..... | CAY-21666 | 26 $\frac{1}{4}$ | 16 $\frac{3}{8}$ | 15 $\frac{3}{8}$ | 70 |
| 230 volts d. c. equipment: | | | | | |
| Transmitter..... | CAY-52218 | 72 | 32 | 24 | 825 |
| Motor generator..... | CAY-21676 | 20 $\frac{1}{4}$ | 78 $\frac{1}{2}$ $\frac{1}{16}$ | 20 $\frac{1}{4}$ | 1,150 |
| Magnetic controller..... | CAY-21667 | 26 $\frac{1}{4}$ | 16 $\frac{3}{8}$ | 15 $\frac{3}{8}$ | 70 |
| Spare parts all voltages: | | | | | |
| Transmitter in box..... | | 15 $\frac{3}{4}$ | 25 $\frac{3}{8}$ | 16 $\frac{3}{4}$ | 120 |
| Power equipment in box..... | | 6 $\frac{3}{4}$ | 30 $\frac{1}{2}$ | 26 | 121 |
| HV generator armature in box..... | | 8 $\frac{1}{2}$ | 30 | 10 | 55 |
| LV generator armature in box..... | | 6 $\frac{3}{4}$ | 24 $\frac{1}{2}$ | 8 $\frac{1}{2}$ | 110 |
| Spare parts d. c. equipment only: | | | | | |
| Motor armature in box..... | | 10 $\frac{1}{4}$ | 32 | 12 $\frac{3}{4}$ | 105 |

¹ The TBK-20 employs a high impact magnetic controller—Type CAY-211232—dimensions and weight not available.

Accessories not supplied by contractor.—Navy standard 4- or 6-wire remote control units.

Shipping weights and dimensions.—Several different methods of packing the equipments have been employed. The figures below show one manner in which the TBK-13, 115 volt d. c. equipment is packed.

| Unit | Size | Gross weight | Cubic feet |
|---|---------------|---------------|------------|
| | <i>Inches</i> | <i>Pounds</i> | |
| Transmitter..... | 42 x 30 x 79 | 972 | 57.60 |
| Motor generator..... | 85 x 28 x 27 | 1,436 | 37.18 |
| Magnetic controller..... | 32 x 25 x 21 | 163 | 9.72 |
| Spare parts: | | | |
| Transmitter and power equipment spares..... | 29 x 19 x 30 | 296 | 9.56 |
| HV armature, LV armature and motor armature spares..... | 36 x 15 x 30 | 388 | 9.37 |
| Vacuum tubes: | | | |
| 3-860 tubes..... | 23 x 23 x 24 | 21 | 7.76 |
| 1-861 tube..... | 37 x 15 x 12 | 37 | 3.85 |
| Spare vacuum tubes: | | | |
| 3-860..... | 23 x 23 x 24 | 21 | 7.76 |
| 1-861..... | 37 x 15 x 12 | 37 | 3.85 |

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TBK-15 RADIO TRANSMITTING EQUIPMENT

Use.—Shore.

Frequency range.—2,000–18,100 kc.

Power output and emission.—500 watts A₁ (also 75 watts, 2,000–9,050kc. with final amplifier disconnected.)

The units of the TBK-15 equipment are identical to those of TBM-8. However, the TBK-15 is intended for CW operation only and therefore is supplied without a modulator unit.

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TBL-4 RADIO TRANSMITTING EQUIPMENT

Use.—Surface craft and submarines.

Frequency range.—175–600 kc.; 2,000–18,100 kc.

Power output and emission.¹—200 watts A₁, 100 watts A₂, and 50 watts A₃;¹ A₁, A₂, A₃ on MF; A₁, A₃ on HF.

¹ A₃ emission is obtained by the use of the Navy type CRV-50064 speech input equipment, available under separate contract. Carrier control is obtained by the use of a press-to-talk switch and low voltage relay in the speech input equipment, the latter relay controlling the normal keying relay of the transmitter. When the Model TBL-4 transmitter is used with a d-c power supply, a separate 110/1/60 a-c power source must be made available for the operation of the speech input equipment. With a-c operation, the speech input equipment derives its power from the transmitter.

Description.—The Navy Model TBL-4 radio transmitting equipment is designed for installation on submarines, destroyers, cruisers, and other types of vessels requiring a transmitter of medium power. All units of this equipment are capable of passage through a hatch 25 inches long by 20 inches wide without further disassembly when uncrated for installation.

The transmitter consists of three assemblies mounted on a spot welded aluminum alloy structure. The left assembly contains the MF stages and the right assembly contains the HF stages. The bottom removable assembly contains both the electron coupled master oscillator circuits, temperature controlled and suitably

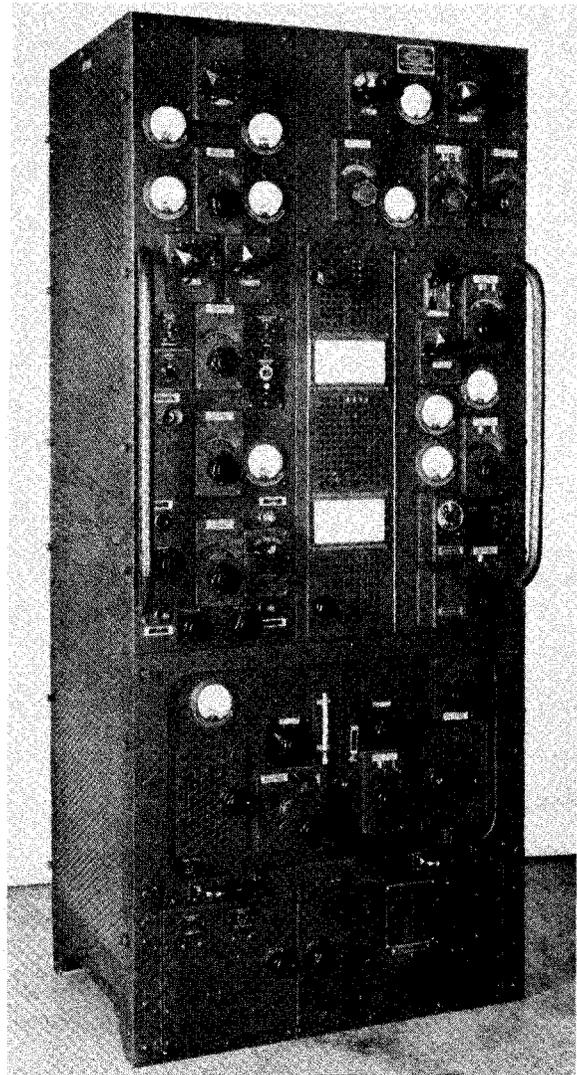
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shock mounted. The three units may be separated if necessary to facilitate installation. The two radio frequency circuits use common vacuum tubes for all stages with the exception of the master oscillator stage. Only one of the radio-frequency bands may be used at a time, selection of which is accompanied by an "MF-HF change switch" located on the front panel. The marker plates for all controls which apply to the MF circuits have a blue background, and those which apply to the HF circuits have a green background. In the right assembly over the HF oscillator circuit and in a central position in relation to the main frame are located from bottom to top respectively—the first HF intermediate amplifier, the second HF intermediate amplifier, with the MF audio oscillator circuit mounted behind it, and the HF power amplifier. The HF antenna coupling and tuning components occupy the entire top compartment. The MF intermediate amplifier is located above the MF oscillator in the left assembly. The MF power amplifier is mounted directly above the intermediate amplifier and the MF antenna coupling and tuning components occupy the entire top compartment.

The *filter* is a self-contained unit having suitable capacitors and reactors for filtering of the motor generator d-c output voltages. A-c filter units include a stepdown transformer for filament voltage supply.

The *motor generator set* is a three-unit six-bearing, direct coupled assembly mounted on a common bedplate. Motors provided for various line voltages are interchangeable on the left end of the bedplate, as viewed from the terminal box side. Motors furnished for a-c operation are rated at 3.5 hp. and motors supplied for d-c operation are rated at 4.5 hp. The high voltage or main plate generator located on the right of the bedplate supplies 2,000 volts D. C. at 0.6 ampere for intermediate and power amplifier plate potential and 500 volts D. C. at 0.35 ampere for screen-grid potential. The low voltage generator is located in the center of the bedplate and supplies 1,600 volts D. C. at 1.0 ampere for the master oscillator plates and screen grids and keying bias to the cathodes of the intermediate and power amplifiers. The low voltage generator also supplies 250 volts D. C. at 3.55 amperes for bias, and field excitation. Drip proof terminal boxes are located on the side of each unit and contain fuses for the protection of all circuits as well as terminals for all external connections. D-c type motor generator sets are equipped with a speed regulator which functions to produce automatically an essentially constant motor speed when the supply line voltage is varied over wide limits. (D-c equipments provide a-c supply for filaments from slip rings located in the bias generator.)

The *motor starter* is of the remote control magnetic contactor type with all switches, contactors, fuses and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of the equipment panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuit.



Transmitter for the Model TBL-4 radio transmitting equipment.

TECHNICAL FEATURES

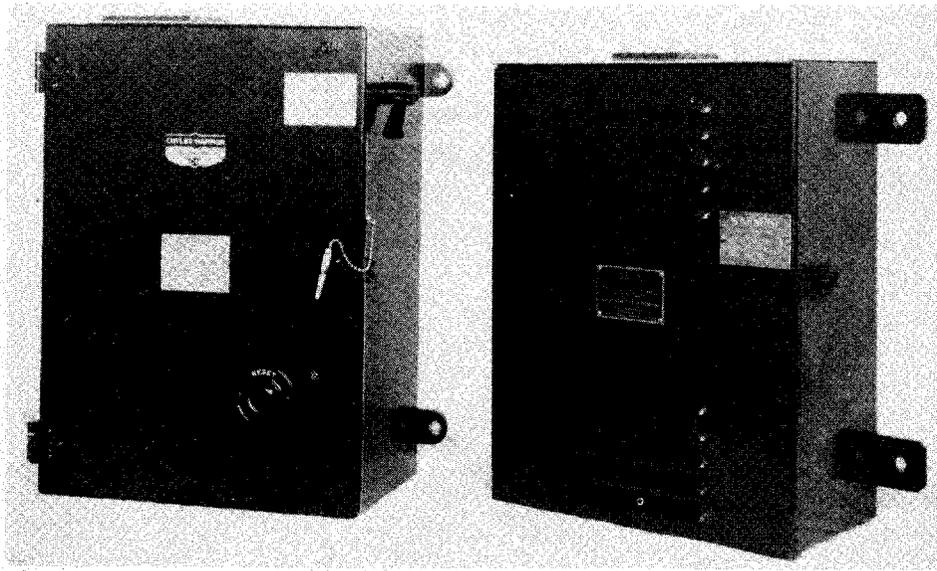
Design.—Navy.

Tube complement

| MF | HF | Tube |
|------------------------------|------------------------|-------|
| Oscillator | Oscillator | 1 860 |
| Intermediate amplifier | First amplifier | 1 860 |
| Audio oscillator | Second amplifier | 1 860 |
| Power amplifier | Power amplifier | 2 803 |
| Total | | 6 |

Frequency control.—Master oscillator.

Power—supplies available.—115/230 and 250 volts D. C.; 220/440/3/60 A. C.



Control unit (left) and filter unit of the Model TBL-4 radio transmitting equipment.

POWER REQUIRED FOR STARTING

| | Line current (amperes) maximum per phase | Kilowatt | Kilovolt-amperes | Percent power factor |
|---|--|----------|------------------|----------------------|
| Power source: | | | | |
| 115 volts D. C. | 58 | 6.7 | | |
| 230 volts D. C. | 27 | 6.2 | | |
| 250 volts D. C. | 27 | 6.2 | | |
| 220/3/60. | 58 | 19 | 22 | 87 |
| 440/3/60. | 34 | 22 | 25 | 87 |
| Power required for locked key operation: | | | | |
| 115 volts D. C. | 27.8 | 3.2 | | |
| 230 volts D. C. | 13.9 | 3.2 | | |
| 250 volts D. C. | 12.8 | 3.2 | | |
| 220/3/60. | 11.0 | 3.1 | 4.0 | 78 |
| 440/3/60. | 6.0 | 3.2 | 4.1 | 78 |

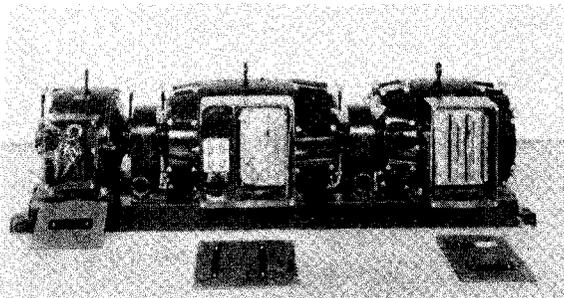
Allowable variation in supply line voltage.— +45 to -23 percent, on either 115/230 volts D. C.; ±30 percent, 250 volts D. C.; ±10 percent, 220/440/3/60 volts A. C.

Allowable variation in supply line frequency.— ±5 percent.

Operating control.—Front panel position and Navy standard 4- or 6-wire remote control unit.

Type of keying.—Relay—100 words per minute.

Antenna.—The transmitter output circuit is arranged for both current- and voltage-fed antenna systems of



Motor generator of the Model TBL-4 radio receiving equipment.

widely differing constants having, in general, equivalent capacities of 393 to 1750 mmfd., and equivalent resistances of 1.12 to 15 ohms.

Weights, dimensions, and Navy type numbers of equipment units included in contracts

| Unit | Type No. | Height | Width | Depth | Weight |
|---|-----------|----------|---------|---------|--------|
| Transmitter: | | | | | |
| 220/3/60 | CRV-52181 | 72 | 32 1/4 | 24 7/16 | 841 |
| 440/3/60 | CRV-52181 | 72 | 32 3/4 | 24 7/16 | 841 |
| 115 volts D. C. | CRV-52178 | 72 | 32 3/4 | 24 7/16 | 850 |
| 230 volts D. C. | CRV-52179 | 72 | 32 3/4 | 24 7/16 | 850 |
| 250 volts D. C. | CRV-52180 | 72 | 32 3/4 | 24 7/16 | 850 |
| Filter unit: | | | | | |
| 220/3/60 | CRV-53074 | 18 3/16 | 17 | 7 3/4 | 80 |
| 440/3/60 | CRV-53074 | 18 3/16 | 17 | 7 3/4 | 80 |
| 115 volts D. C. | CRV-53073 | 18 3/16 | 17 | 7 3/4 | 67 |
| 230 volts D. C. | CRV-53073 | 18 3/16 | 17 | 7 3/4 | 67 |
| 250 volts D. C. | CRV-53073 | 18 3/16 | 17 | 7 3/4 | 67 |
| Motor generator (terminal board on top): | | | | | |
| 220/3/60 | CBP-21340 | 20 3/8 | 60 9/16 | 13 | 847 |
| 440/3/60 | CBP-21340 | 20 3/8 | 60 9/16 | 13 | 847 |
| 115 volts D. C. | CBP-21546 | 20 3/8 | 64 | 13 | 970 |
| 230 volts D. C. | CBP-21547 | 20 3/8 | 64 | 13 | 970 |
| 250 volts D. C. | CBP-21547 | 20 3/8 | 64 | 13 | 970 |
| Motor generator (terminal board on side): | | | | | |
| 220/3/60 | CBP-21340 | 15 1/2 | 60 9/16 | 18 | 847 |
| 440/3/60 | CBP-21340 | 15 1/2 | 60 9/16 | 18 | 847 |
| 115 volts D. C. | CBP-21546 | 15 1/2 | 64 | 18 | 970 |
| 230 volts D. C. | CBP-21547 | 15 1/2 | 64 | 18 | 970 |
| 250 volts D. C. | CBP-21547 | 15 1/2 | 64 | 18 | 970 |
| Magnetic controller: | | | | | |
| 220/3/60 | CAE-21543 | 19 2 1/2 | 16 | 9 | 45 |
| 440/3/60 | CAE-21341 | 19 2 1/2 | 17 | 9 | 45 |
| 115 volts D. C. | CAE-21541 | 20 7/8 | 17 | 13 7/8 | 93 |
| 230 volts D. C. | CAE-21542 | 20 7/8 | 17 | 13 7/8 | 93 |
| 250 volts D. C. | CAE-21542 | 20 7/8 | 17 | 13 7/8 | 93 |
| Transmitter and magnetic controller spares: For any supply | | | | | |
| | | 18 | 38 | 18 | 188 |
| Miscellaneous spare parts for MG: For any supply | | | | | |
| Armature for type CBP-21338 generator: For any supply | | 10 | 28 | 10 | 93 |
| Armature for type CBP-21339 generator: For any supply | | 8 | 21 | 8 | 71 |
| Armature for type CBP-21544 motor: For 115 volts D. C. | | 10 | 22 1/2 | 10 | 90 |
| Armature for type CBP-21545 motor: For 230 volts D. C. | | 10 | 22 1/2 | 10 | 90 |
| For 250 volts D. C. | | 10 | 22 1/2 | 10 | 90 |

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TBL-5 AND TBL-6 RADIO TRANSMITTING EQUIPMENTS

Use.—Ship.

Frequency range.—175–600 kc. and 2000–18,100 kc.

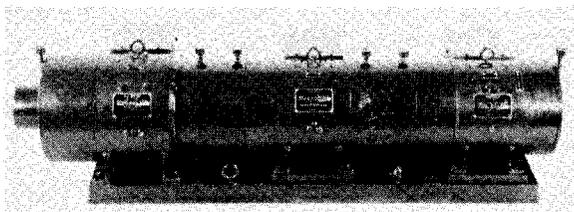
Power output and emission.—200 watts A₁, 100 watts A₂ (MF band only) and 50 watts A₃.¹

Description.—The Models TBL-5 and TBL-6 radio transmitting equipments are designed for installation on submarines, destroyers, cruisers, and other types of vessels requiring a transmitter of low, medium, and high frequency operation with telegraph, modulated telegraph and voice. These models are essentially the same, the TBL-6 differing from the earlier model only in that the motor generator sets are of cast steel instead of cast iron, and the magnetic controllers are designed to withstand a more severe shock. All units of this equipment are capable of passage through a hatch 25'' by 20'' without further disassembly, when uncrated for installation.

The transmitter, which consists of two frames bolted together and mounted on a single base, comprises two separate radio frequency circuits to allow coverage of the MF and HF bands. The two radio frequency circuits use common vacuum tubes for all stages, with the exception of the master oscillator stage. The relay panel and the terminal board for all external connections with the exception of the antenna leads are located at the bottom of the left frame. The MF Colpitts oscillator circuit and the HF electron coupled oscillator circuit, temperature controlled and suitably shock-mounted, form one unit which is mounted in the lower right frame. The HF first intermediate amplifier and the MF audio oscillator are located in the lower portion of the left frame. The HF second intermediate amplifier is located immediately above this. The MF intermediate amplifier and the MF power amplifier tank circuit occupy the space in the right frame directly above the oscillator assembly. The HF power amplifier is located in the upper part of the left hand frame. The HF antenna coupling and tuning system occupies the top portion of the left frame and the MF antenna coupling and tuning system occupies the top portion of the right hand frame.

The filter is a self-contained unit having suitable capacitors and reactors for filtering the motor-generator d-c output voltages. A-c filter units include two step-down transformers for filament and M. O. compartment heater voltages.

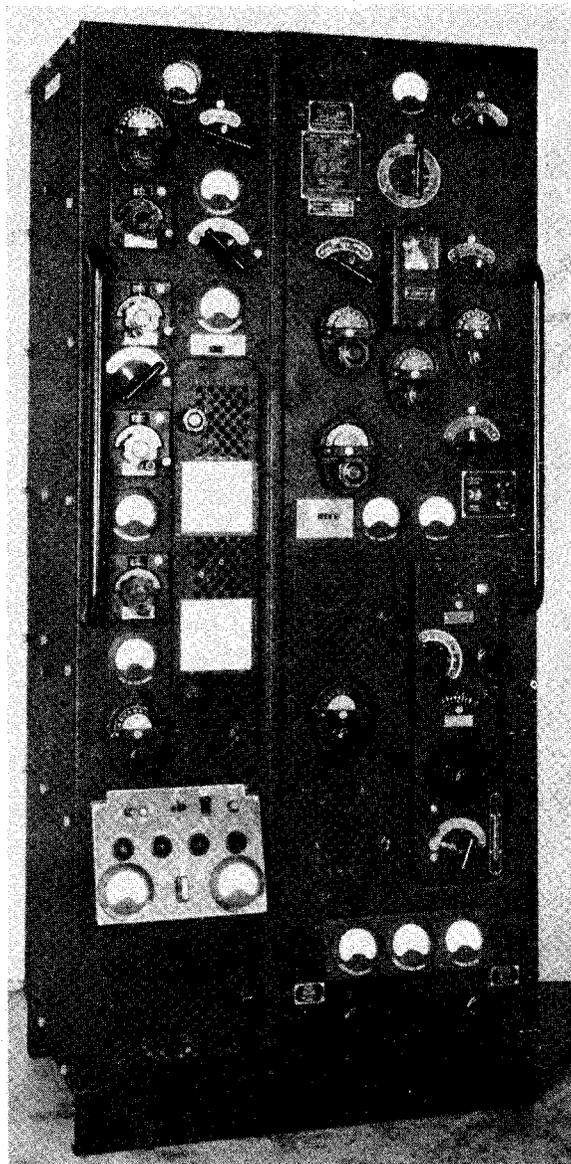
The motor-generator set is made up of three direct coupled units mounted on a common bed-plate. The



Motor-generator for Model TBL-5 equipment.

¹ The Navy Type CRV-50064 speech input equipment, available under separate contract, is necessary to obtain A₂ emission from the Model TBL-5/6 transmitters. Carrier control is obtained by a "push-to-talk" switch in this unit when it is used.

motor is of 3½-horsepower capacity. All a-c-d-c motors are interchangeable on a common bed-plate. The high voltage generator supplies 2,000 volts D. C. at 0.7 ampere for intermediate and power amplifier plate and screen grid potential. The low voltage generator supplies 1,000 volts D. C. at 0.2 ampere for the master oscillator plate and screen grid potential, and 250



Transmitter for Model TBL-5 equipment.

volts D. C. at 1.02 amperes for bias and field excitation. Power for operation of type CRV-50064 speech input equipment, when used in conjunction with the transmitting equipment, is obtained from a separate 110-volt, 60-cycle single-phase supply. Drip-proof terminal boxes are arranged for mounting on either the side or top of each unit and contain fuses for the protection of all circuits as well as terminals for all

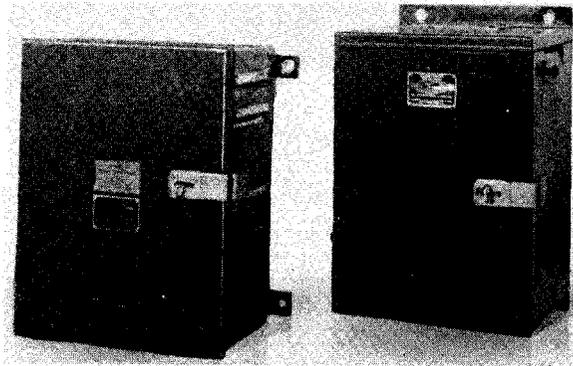
external connections. (D-c equipments provide a-c filament power from slip rings located on the exciter unit of the low voltage generator.)

The motor starter is of the remote control magnetic contactor type with all switches, contactors, fuses, and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of the equipment panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

TECHNICAL FEATURES

Design.—Navy.

Frequency control.—Master oscillator.



Model TBL-5 motor starter and filter unit.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type numbers | | Height | Width | Depth | Weight |
|----------------------------------|--------------------|-------------|--------------------------------|--------------------------------|--------------------------------|---------------|
| | TBL-5 ¹ | TBL-6 | | | | |
| Transmitter: | | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| 115 volts D. C. | CAY-52131 | CAY-52131-A | 72 | 31 ³ / ₄ | 23 ⁵ / ₈ | 820 |
| 230 volts D. C. | CAY-52132 | CAY-52132-A | | | | |
| 220 volts A. C. | | CAY-52133-A | | | | |
| 440 volts A. C. | CAY-52133 | CAY-52133-A | | | | |
| Filter unit: | | | | | | |
| 115 volts D. C. | CAY-53036-A | | 18 ³ / ₄ | 16 ³ / ₄ | 9 | 56 |
| 230 volts D. C. | CAY-53036-A | | | | | |
| 220 volts A. C. | | CAY-53037-A | | | | |
| 440 volts A. C. | CAY-53037-A | | | | | |
| Motor generator: | | | | | | |
| 115 volts D. C. | CC-21426 | CC-21426-A | | | | |
| 230 volts D. C. | CC-21427 | CC-21427-A | | | | |
| 220 volts A. C. | | CC-21428-A | | | | |
| 440 volts A. C. | CC-21428 | CC-21428-A | | | | |
| Terminal board on the side | | | 17 ⁵ / ₈ | 31 | 16 ³ / ₄ | 745 |
| Terminal board on top | | | 20 | 61 | 13 ³ / ₄ | 745 |
| Magnetic controller: | | | | | | |
| 115 volts D. C. | CAY-21234-A | CAY-21713 | 20 ³ / ₄ | 13 | 11 ⁵ / ₈ | 50 |
| 230 volts D. C. | CAY-21235-A | CAY-21714 | | | | |
| 220 volts A. C. | | CAY-21715 | | | | |
| 440 volts A. C. | CAY-21425 | CAY-21716 | | | | |
| Equipment spare parts: | | | 15 ¹ / ₂ | 25 ¹ / ₂ | 16 ³ / ₄ | 140 |
| Motor-generator spare parts | | | 6 ³ / ₄ | 25 ¹ / ₂ | 16 ³ / ₄ | 85 |
| Bias generator armature (spare) | | | 6 ³ / ₄ | 25 ¹ / ₂ | 7 ¹ / ₂ | 50 |
| Plate generator armature (spare) | | | 6 ³ / ₄ | 25 ¹ / ₂ | 7 ¹ / ₂ | 50 |
| Motor armature (spare) | | | 9 ¹ / ₂ | 25 ¹ / ₂ | 10 ¹ / ₂ | 80 |

Shipping weights and dimensions ¹

| Unit | Size | Gross Weight | Cubic feet | Unit | Size | Gross weight | Cubic feet |
|------------------------------------|-------------------------------|------------------------|------------|---|-----------------------------|---------------------|------------|
| Transmitter | <i>Inches</i> 42 x 30 x 78 | <i>Pounds</i> 1,087 | 56.87 | Box 3. Bias generator armature (spare) | <i>Inches</i> 28 x 9 x 8 | <i>Pounds</i> 66 | 1.16 |
| Filter unit | 27 x 20 x 17 | 115 | 5.31 | Box 4. Plate generator armature (spare) | 38 x 9 x 8 | 68 | 1.58 |
| Motor-generator set | 66 x 21 x 21 | 822 | 16.84 | Box 5. Motor armature (spare) | 39 x 12 x 11 | 102 | 2.21 |
| Magnetic controller | 27 x 21 x 17 | 117 | 5.58 | Vacuum tubes (regular set as shipped) | 25 x 23 x 31 | 65 | 9.49 |
| Box 1. Equipment spare parts | 29 x 18 x 17 | 174 | 4.34 | | | | |
| Box 2. Motor-generator spare parts | 28 x 18 x 8 | 105 | 2.33 | | | | |

¹ Weights and dimensions given apply to the model TBL-6 230 volt d-c equipments. Figures for TBL-5 a-c and d-c and TBL-6 a-c equipments are approximately the same.

Antenna.—Submarine flat top, loop, inverted L and surface craft antennas having lengths from 50 to 100 feet and a maximum trunk length of 20 feet.

Tube complement

| Location | Number of tubes | Type |
|--|-----------------|------|
| Master oscillator 1HF, 1MF | 2 | 860 |
| Audio HF and MF | 1 | 860 |
| First intermediate amplifier HF and MF | 1 | 860 |
| Power amplifier HF and MF | 2 | 803 |
| Total | 6 | |

Power— REQUIRED FOR STARTING

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|-----------------|--|------|------|------------------------|
| 115 volts D. C. | 53 | 6.1 | | |
| 230 volts D. C. | 27 | 6.1 | | |
| 220/3/60 | 62 | 13.8 | 23.3 | 59 |
| 440/3/60 | 37 | 14.6 | 28.0 | 54 |

REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|-----------------|--|------|------|------------------------|
| 115 volts D. C. | 27 | 3.1 | | |
| 230 volts D. C. | 14.5 | 3.34 | | |
| 220/3/60 | 10.2 | 3.32 | 3.94 | 84 |
| 440/3/60 | 4.7 | 3.1 | 3.57 | 87 |

Allowable variation in supply line voltage + 45%, - 23% D. C.; ±10% A. C.; frequency, ± 5%; combined voltage and frequency ± 10%, (5% each).

Operating control.—Front panel and Navy standard 4- or 6-wire remote-control unit.

Type of keying.—Relay—100 words per minute.

CONFIDENTIAL

TBL-10 RADIO TRANSMITTING EQUIPMENT

Use.—Shore.

Frequency range.—175–600 kc, 2000–18,100 kc.

Power output and emission.—200 watts, A₁ on MF and HF; 100 watts A₂, MF only; 50 watts A₃ on MF and HF.¹

Description.—The model TBL-10 transmitting equipment is designed for installation at shore bases.

The transmitter consists of two aluminum alloy angle spot welded frames bolted together and mounted on a single base and comprises two separate radio frequency circuits to allow coverage of the MF and HF bands. The two radio frequency circuits use common vacuum tubes for all stages, with the exception of the master oscillator stage. The relay panel and the terminal board for all external connections with the exception of the antenna leads are located at the bottom of the left frame. The MF Colpitts oscillator circuit and the HF electron coupled oscillator circuit, temperature controlled and suitably shock mounted, form one unit which is mounted in the lower right-hand frame. The HF first intermediate amplifier and the MF audio oscillator are located in the lower portion of the left frame. The HF second intermediate amplifier is located immediately above this. The MF intermediate amplifier and the MF power amplifier tank circuit occupy the space in the right frame directly above the oscillator assembly. The HF power amplifier is located in the upper part of the left-hand frame. The HF antenna coupling and tuning system occupies the top portion of the left frame and the MF antenna coupling and tuning system occupies the top portion of the right-hand frame.

The rectifier power units, constructed of welded steel angle frames, are of the dry disc copper-oxide type. Two of these units, identical in design, are furnished with each equipment. The lower portion of each rectifier contains the control circuits and power transformers as well as the terminal board located at the lower right front. Directly above are located the rectifier input and voltage control switches. At the upper left is located the blower motor and at the upper right the rectox rectifiers. Auxiliary transformers and filter circuits are mounted on the underside of the top of the unit. Each rectifier power unit has a d-c output of 2,000 volts at 0.7 ampere, 1,000 volts at 0.2 ampere and 250 volts at 0.5 ampere.

The power transfer panel consists of a welded steel box containing 14 knife switches ganged to transfer the transmitter to either rectifier power unit. A switch is provided on the side of the unit for testing the blower motor in the spare rectifier power unit. The power transfer panel may be used with emergency motor generators.

The land-line control unit is housed in a welded box with the controls mounted on the hinged door. The terminal board is located at the bottom and the other components are mounted for easy accessibility. This unit provides a means of starting, stopping and keying

¹ The Navy type CRV-50064 Speech-input equipment, available separately, is necessary to obtain A₃ emission from the model TBL-10 transmitters. Carrier control is obtained by a "push-to-talk" switch in this unit when it is used.

the equipment over a telephone line up to 50 miles in length. The land-line control unit was designed for use with the TBM series of equipments and incorporates stand-by and vacuum-tube keying features which cannot be utilized with the TBL-10 equipment.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | | Number of tubes | Type |
|-----------------------------------|------------------------------------|-----------------|-----------|
| MF | HF | | |
| Transmitter: | | | |
| Master oscillator..... | Master oscillator..... | 1 | 860 |
| Audio oscillator..... | First intermediate amplifier..... | 1 | 860 |
| First intermediate amplifier..... | Second intermediate amplifier..... | 1 | 860 |
| Power amplifier..... | Power amplifier..... | 2 | 803 |
| Land line control unit: | | | |
| Keyer control tube..... | | 1 | 807 |
| Rectifier..... | | 1 | 5Z3 |
| Control start..... | | 1 | OC3/VR105 |
| Total..... | | 9 | |

Frequency control.—Master oscillator.

Power.—Supplies available: Copper oxide rectifier which is provided with link connections for operation from either a 220 /3/ 50/60 or 440 /3/ 50/60 power source.

Required for starting: 4.1 kw.

Required for locked key operation: 3.45 kw.

Allowable variation in supply line voltage $\pm 10\%$; frequency $\pm 5\%$; combined voltage and frequency $\pm 10\%$ (5% each).

Operating control.—Front of panel. Navy standard 4- or 6-wire remote control unit up to 1,000 feet. Land-line control unit up to 50 miles.

Type of keying.—Relay—100 words per minute.

Antenna.—Maximum length 180 feet.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type Nos. | Height | Width | Depth | Weight |
|--------------------------------|----------------|-------------------|-------------------|-------------------|--------|
| | | Inches | Inches | Inches | Pounds |
| Transmitter..... | CA Y-52249... | 72 | 31 $\frac{3}{4}$ | 23 $\frac{3}{16}$ | 829 |
| Rectifier..... | CA Y-20195... | 72 | 27 $\frac{1}{8}$ | 23 $\frac{1}{16}$ | 900 |
| Do..... | CA Y-20195... | 72 | 27 $\frac{1}{8}$ | 23 $\frac{1}{16}$ | 900 |
| Land-line control unit..... | CA Y-23216... | 20 $\frac{3}{4}$ | 21 $\frac{1}{16}$ | 11 $\frac{1}{8}$ | 85 |
| Power transfer unit..... | CA Y-24084A... | 39 $\frac{1}{16}$ | 20 $\frac{1}{4}$ | 11 | 108 |
| Spare parts ¹ | | | | | |

¹ Data to be supplied.

Shipping weights and dimensions

| Unit | Size (inches) | Gross weight (pounds) | Cubic feet |
|-----------------------------|-------------------|-----------------------|------------|
| Transmitter..... | 42 x 30 x 78..... | 1,096 | 56.87 |
| Rectifier..... | 32 x 29 x 78..... | 1,025 | 41.31 |
| Do..... | 32 x 29 x 78..... | 1,025 | 41.31 |
| Land-line control unit..... | 30 x 26 x 17..... | 140 | 7.61 |
| Power transfer unit..... | 48 x 27 x 17..... | 210 | 12.74 |
| Spare parts..... | 30 x 18 x 30..... | 360 | 9.38 |

TBL-11
TBM-5
TBM-7
TBM-9
TBM-11

CONFIDENTIAL

TBL-11 RADIO TRANSMITTING EQUIPMENT

Use.—Shore.

Frequency range.—175–600 kc., 2,000–18,100 kc.

Power output and emission.—200 watts, A₁ on MF and HF; 100 watts, A₂ MF only; 50 watts A₃ on MF and HF.¹

¹The Navy type CRV-50064 speech input equipment, available separately, is necessary to obtain A₃ emission from the model TBL-11 transmitters. Carrier control is obtained by a "push-to-talk" switch in this unit when it is used.

Description.—The Navy Model TBL-11 transmitting equipment is designed for installation at shore bases.

The units of the Model TBL-11 differ only numerically from those of the Model TBL-10. The spare rectifier and associate power transfer panel supplied with the earlier model are not furnished with the TBL-11.

★ ★ ★

TBM-5, TBM-7, TBM-9, AND TBM-11 RADIO TRANSMITTING EQUIPMENTS

Use.—Ship.

Frequency range.—2,000–18,100 kc.

Power output and emission.—500 watts A₁; 350 watts A₂, A₃ (also 75 watts A₁ from 2,000–9,050 kc., with the final amplifier disconnected).

Description.—The models TBM-5, TBM-7, TBM-9 and TBL-11 are designed for installation afloat where medium to high frequency operation providing telegraph, modulated telegraph, and telephone communication is required. The TBM series of equipments are used so extensively by the Navy that they have come to be considered standard equipment for their power output and frequency range.

The transmitter is built into a single complete unit. The frame is constructed of aluminum alloy angle, spot welded to form a nonremovable semi-shelf type of construction. All the tuning and operating controls and doors for access to the tube compartments and relays are located on the front panel. The bottom compartment contains the control and filter circuits and the terminal boards which are located to the front and bottom for all external connections. Directly above this compartment on the left-hand side is located the Navy type 860 electron-coupled master oscillator and doubler stage which is mounted within the transmitter as a separate unit and is removable for servicing purposes. This unit is 35½ inches high, 22 inches deep, and 12½ inches wide. The second and third shelves on the right-hand side contain the first intermediate and second intermediate Navy type 860 amplifier stages, respectively. Directly above the second intermediate amplifier is located the Navy type 861 single ended power amplifier stage. The entire top shelf contains a very flexible antenna coupling system which enables the equipment to be tuned to antennas of widely varying characteristics.

The modulator is a single self-contained unit, complementary to the transmitter unit and similar to it in

general construction and appearance. This unit is designed to take power from a local handset, a 600 ohm line or a radiophone unit and deliver 400 watts of audio output which is sufficient for 100 per cent modulation of the transmitter over the frequency range of from 100 to 5000 cycles, with an overall characteristic of ±2 db, and an audio frequency distortion of less than 10 per cent. The modulator is essentially a three stage push-pull amplifier with the additional features of a modulation limiting tube, voice relay tube, compressor limiting tube, microphone power supply, and all necessary controls for selection of emission and the method of control. All external connections are made to terminal boards located in the front and bottom compartment.

The TBM-7, TBM-9, and TBM-11 motor generator sets are of cast steel construction. The A. C. sets furnished with these models differ only in this manner from the TBM-5 motor generator sets which are of iron construction.

The motor generator set is a three unit, six bearing direct coupled assembly mounted on a common bedplate. The motor is of five HP capacity and is mounted on the left end of the bedplate as viewed from the terminal box side. The high voltage generator is located in the center and supplies 3,000 volts D. C. at 0.35 ampere for power amplifier plate potential and 2,000 volts D. C. at 0.75 ampere for the plate potential of the intermediate amplifiers. The low voltage generator located on the right supplies 1,000 volts D. C. at 0.75 ampere for the master oscillator plate potential and 275 volts D. C. at 1.3 amperes for bias and field excitation. Power for operation of the modulator unit is also obtained from the motor-generator set. (D. C. units provide A. C. supply for filaments from slip rings located on the driving motor). Drive motors for various line input voltages are directly interchangeable on this equipment.

CONFIDENTIAL

The TBM-7 and TBM-9 A. C. motor starters differ from the TBM-5 motor starters in that they are equipped with improved type overload relays and contactors. These improvements are also incorporated in the TBM-7 and TBM-9 D. C. units.

The motor starters are of the remote controlled magnetic contactor type, with all switches, contactors, fuses, and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | Number of tubes | Type |
|--|-----------------|------|
| Transmitter: | | |
| Master oscillator..... | 1 | 860 |
| First intermediate power amplifier..... | 1 | 860 |
| Second intermediate power amplifier..... | 1 | 860 |
| Power amplifier..... | 1 | 861 |
| Modulator: | | |
| Intermediate amplifier..... | 2 | 867 |
| Voice relay..... | 1 | 807 |
| Input amplifier..... | 2 | 6D6 |
| Modulators..... | 2 | 803 |
| Modulation limiter..... | 1 | 1616 |
| Compressor limiter..... | 1 | 25Z5 |
| Total..... | 13 | |

Frequency control.—Master oscillator.

Power.—Supplies available: TBM-5/7/9/11-440/3/60; TBM-7/9/11-115 volts D. C., 230 volts D. C.

REQUIRED FOR STARTING

| | Power source | Line current (amps) maximum per phase | KW | KVA | Power factor (percent) |
|--------------|---------------------|---------------------------------------|------|------|------------------------|
| TBM-5..... | 440/3/60..... | 58.0 | 22.0 | 44.0 | 50 |
| TBM-7/9..... | 440/3/60..... | 58.0 | 22.0 | 44.0 | 50 |
| TBM-7/9..... | 115 volts D. C..... | 86.0 | 9.88 | | |
| TBM-7/9..... | 230 volts D. C..... | 43.0 | 9.88 | | |

REQUIRED FOR LOCKED KEY OPERATION

| | Power source | Line current (amps) maximum per phase | KW | KVA | Power factor (percent) |
|--------------|---------------------|---------------------------------------|------|-----|------------------------|
| TBM-5..... | 440/3/60..... | 7.42 | 4.9 | 5.6 | 87 |
| TBM-7/9..... | 440/3/60..... | 5.75 | 3.65 | 4.2 | 87 |
| TBM-7/9..... | 115 volts D. C..... | 33.3 | 3.83 | | |
| TBM-7/9..... | 230 volts D. C..... | 16.7 | 3.83 | | |

Allowable variation in supply line voltage $\pm 10\%$; frequency $\pm 5\%$; combined voltage and frequency $\pm 10\%$ (5% each).

Operating control.—(1) Front panel, A₁, A₂, A₃; (2) remote control—Navy standard 4 or 6 wire control units, A₁, A₂, (3) Navy standard radiophone units, A₁, A₂, A₃.

Carrier control.—Push-to-talk button or voice control relay operation.

Type of keying.—Relay—100 words per minute A₁, 50 words per minute A₂.

Antenna:

- Maximum length..... 80 feet.
- Trunk length..... 0 to 35 feet.
- Diameter of trunk (if used)..... 8 to 12 inches.
- Distance to entering insulator..... 2 to 20 feet.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Equipment and unit | Navy type No. | Height | Width | Depth | Weight |
|--|---------------|------------------|----------------------------------|------------------|--------|
| | | Inches | Inches | Inches | Pounds |
| TBM-5: | | | | | |
| Transmitter..... | CAY-52171 | 72 | 32 | 24 | 789 |
| Modulator..... | CAY-50065 | 72 | 18 | 24 | 380 |
| Motor generator..... | CAY-21522 | 20 $\frac{3}{4}$ | 78 $\frac{3}{8}$ | 20 $\frac{1}{2}$ | 1,030 |
| Magnetic controller..... | CAY-21412 | 21 $\frac{1}{4}$ | 15 | 11 $\frac{3}{8}$ | 50 |
| TBM-7/9/11, 440/3/60: | | | | | |
| Transmitter..... | CAY-52171 | 72 | 32 | 24 | 789 |
| Modulator..... | CAY-50065A | 72 | 18 | 24 | 380 |
| Motor generator..... | CAY-21677 | 20 $\frac{3}{4}$ | 74 $\frac{1}{2}$ ^{1/2} | 20 $\frac{1}{2}$ | 1,100 |
| Magnetic controller..... | CAY-21669 | 24 $\frac{1}{4}$ | 17 | 11 $\frac{3}{8}$ | 50 |
| TBM-7/9/11, 115 volts D. C.: | | | | | |
| Transmitter..... | CAY-52217 | 72 | 32 | 24 | 825 |
| Modulator..... | CAY-50065A | 72 | 18 | 24 | 380 |
| Motor generator..... | CAY-21675 | 20 $\frac{1}{4}$ | 78 $\frac{1}{2}$ ^{1/16} | 20 $\frac{1}{4}$ | 1,150 |
| Magnetic controller..... | CAY-21666 | 26 $\frac{1}{4}$ | 16 $\frac{3}{8}$ | 15 $\frac{3}{8}$ | 70 |
| TBM-7/9/11, 230 volts D. C.: | | | | | |
| Transmitter..... | CAY-52218 | 72 | 32 | 24 | 825 |
| Modulator..... | CAY-50065A | 72 | 18 | 24 | 380 |
| Motor generator..... | CAY-21676 | 20 $\frac{1}{4}$ | 78 $\frac{1}{2}$ ^{1/16} | 20 $\frac{1}{4}$ | 1,150 |
| Magnetic controller..... | CAY-21667 | 26 $\frac{1}{4}$ | 16 $\frac{3}{8}$ | 15 $\frac{3}{8}$ | 70 |
| TBM-5/7/9/11 spare parts: | | | | | |
| Transmitter box..... | | 15 $\frac{3}{4}$ | 25 $\frac{3}{8}$ | 16 $\frac{3}{4}$ | 120 |
| Power equipment box..... | | 6 $\frac{3}{4}$ | 30 $\frac{1}{2}$ | 26 | 121 |
| HV generator armature box..... | | 8 $\frac{1}{2}$ | 30 | 10 | 55 |
| LV generator armature box..... | | 6 $\frac{3}{4}$ | 24 $\frac{1}{2}$ | 8 $\frac{1}{2}$ | 110 |
| Modulator box..... | | 12 $\frac{3}{4}$ | 19 $\frac{3}{8}$ | 13 $\frac{3}{4}$ | 50 |
| TBM-7/9/11 spare parts: | | | | | |
| Motor armature (D. C. equipment only)..... | | 10 $\frac{1}{4}$ | 12 $\frac{3}{4}$ | 32 | 105 |

¹ The TBM-11 employs high impact magnetic controllers for the various voltages of equipments—type numbers are as follows: 440/3/60, CAY-211233; 115-volt D. C., CAY-211231; 230-volt D. C., CAY-211232—dimensions and weights not available.

Accessories not supplied by contractor.—Navy standard 4- or 6-wire control, telegraph or radiophone remote control units.

Shipping weights and dimensions.—Several different methods of packing the TBM-5/7/9 equipments have been employed. The figures below show one manner in which the TBM-7 230-volt D. C. equipment is packed.

| Unit | Size | Gross weight | Cubic feet |
|----------------------------|---------------|---------------|------------|
| | <i>Inches</i> | <i>Pounds</i> | |
| Transmitter..... | 42 x 30 x 78 | 1,015 | 56.97 |
| Modulator..... | 29 x 24 x 78 | 600 | 31.42 |
| Motor generator..... | 80 x 26 x 24 | 1,335 | 29.42 |
| Magnetic controller..... | 27 x 22 x 17 | 112 | 5.84 |
| Spare parts: | | | |
| Transmitter..... | 28 x 18 x 17 | 148 | 4.95 |
| Power equipment..... | 40 x 24 x 14 | 235 | 7.77 |
| HV generator armature..... | 34 x 12 x 11 | 135 | 2.59 |
| LV generator armature..... | 28 x 12 x 8 | 75 | 1.55 |
| Motor armature..... | 22 x 15 x 14 | 70 | 2.07 |
| Modulator..... | 34 x 15 x 14 | 152 | 4.13 |
| Vacuum tubes: | | | |
| 1-861..... | 23 x 23 x 24 | 21 | 7.34 |
| Balance..... | 37 x 26 x 12 | 65 | 6.67 |
| Spare vacuum tubes: | | | |
| 1-816..... | 23 x 23 x 24 | 21 | 7.34 |
| Balance..... | 37 x 26 x 12 | 65 | 6.67 |

TBM-6 RADIO TRANSMITTING EQUIPMENT

Use.—Shore, ship.

Frequency range.—2000–18,100 kc.

Power output and emission.—500 watts A_1 ; 350 watts A_2 , A_3 , (also 75 watts A_1 at 2000–9050 kc., with the final amplifier disconnected).

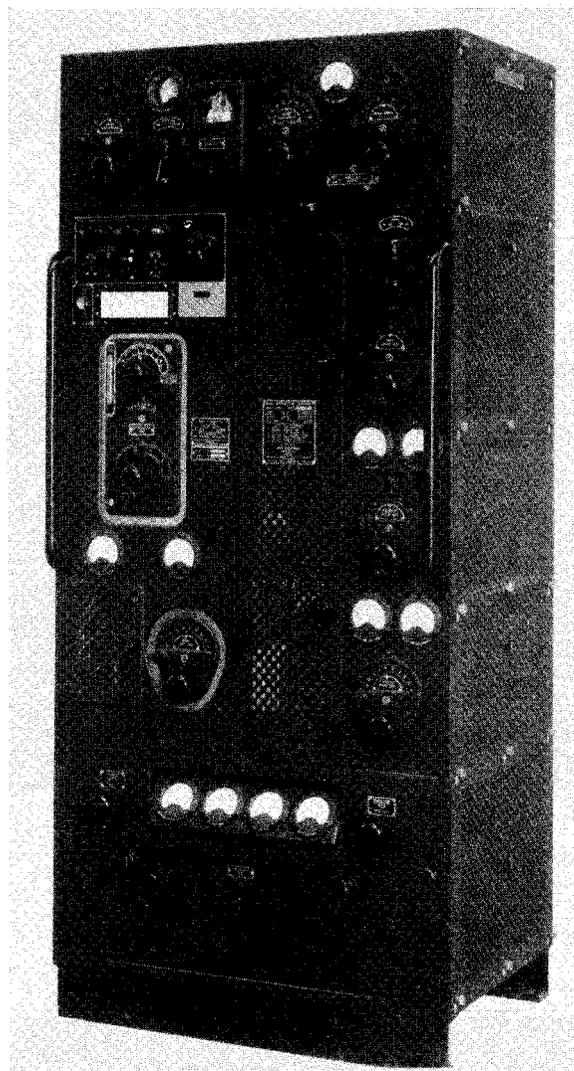
Description.—The Model TBM-6 radio transmitting equipment is designed primarily for installation at shore stations and bases where medium to high frequency operation providing telegraph, modulated telegraph and telephone communication is required. This equipment is also suitable for shipboard use. The TBM series of equipments are used so extensively by the Navy that they have come to be considered standard equipment for their power output and frequency range.

The *transmitter* is built into a single complete unit. The frame is constructed of aluminum alloy angle, spot welded to form a nonremovable semishelf type of construction. All the tuning and operating controls and doors for access to the tube compartments and relays are located on the front panel. The first shelf contains the control and filter circuits and the terminal boards which are located to the front and bottom for all external connections. Directly above the first shelf on the left hand side is located the Navy type 860 electron-coupled master oscillator and doubler stage which is mounted within the transmitter as a separate unit and is removable for servicing purposes. This unit is 35½ inches high, 22 inches deep, and 12½ inches wide. The second and third shelves on the right hand side contain the first intermediate and second intermediate Navy type 860 amplifier tubes. Directly above the second intermediate amplifier is located the Navy type 861 single ended power amplifier tube. The entire top shelf contains a very flexible antenna coupling system which enables the equipment to be tuned to antennas of widely varying characteristics.

The *modulator* is a single self-contained unit, complementary to the transmitter unit and similar to it in general construction and appearance. This unit is designed to take power from a local hand-set, a 600-ohm line or a radiophone unit and deliver 400 watts of audio output which is sufficient for 100 percent modulation of the transmitter over the frequency range of from 100 to 5000 cycles, with an overall characteristic of ± 2 db, and an audio frequency distortion of less than 10 percent. The modulator is essentially a three-stage push-pull amplifier with the additional features of a modulation limiting tube, voice relay tube, compressor limiting tube, microphone power supply, and all necessary controls for selection of emission and the method of control. All external connections are made to terminal boards located in the front and bottom compartment.

The *motor-generator set* is a three unit, six bearing direct coupled assembly mounted on a common bed-plate. The motor is of five HP capacity and is mounted on the left end of the bed-plate as viewed

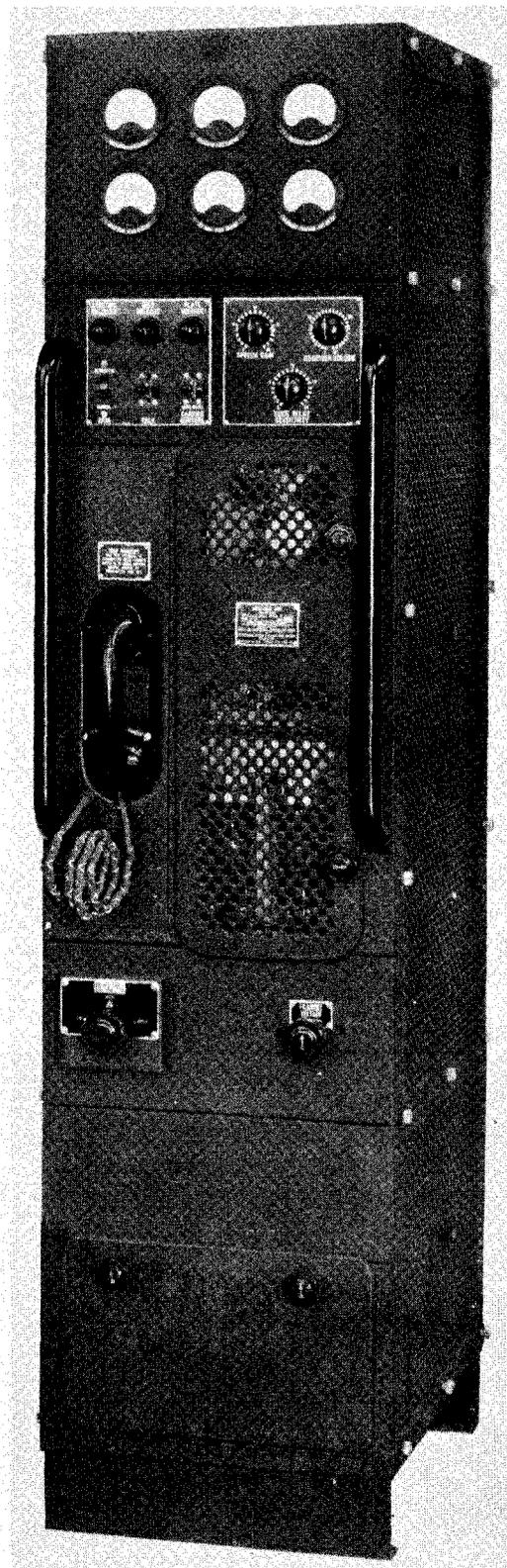
from the terminal box side. The high voltage generator is located in the center and supplies 3,000 volts D. C. at 0.35 ampere for power amplifier plate potential, and 2,000 volts D. C. at 0.75 ampere for the plate potential of the intermediate amplifiers. The low voltage generator located on the right supplies



Transmitter for Model TBM-6 equipment.

1,000 volts D. C. at 0.075 ampere for the master oscillator plate potential and 275 volts D. C. at 1.3 amperes for bias and field excitation. Power for operation of the modulator unit is also obtained from the motor-generator set. Drip-proof terminal boxes are located on the side of each unit and contain fuses for the protection of all circuits as well as terminals

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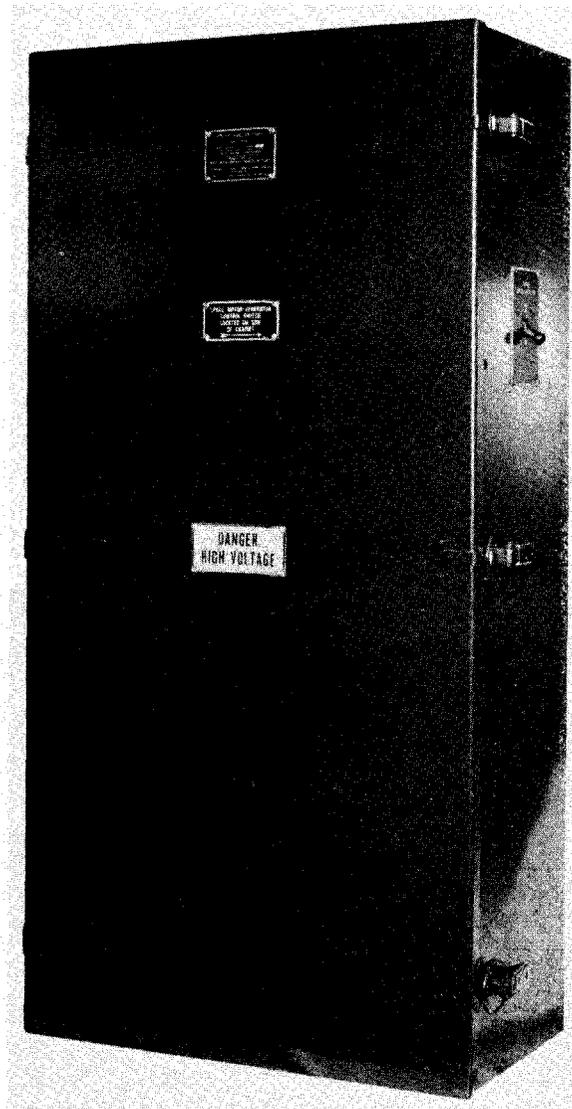


Modulator for Model TBM-6 equipment.

for all external connections. Drive motors for various line input voltages are directly interchangeable on this equipment.

The *motor starters* are of the remote controlled magnetic contactor type, with all switches, contactors, fuses, and over-load protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

The *power transfer panel* is a self-contained manually operated switch used for transferring the input of the transmitter from one motor-generator set to the other motor-generator set. The switch panel is contained in an aluminum cabinet which is hinged at



Model TBM-6 power transfer panel.

the bottom to facilitate the connecting of external wiring to the rear of the panel.

The *land-line control* unit makes it possible to start and stop, and telegraphically key the equipment over a two-wire line up to 50 miles in length. Provision is made in this unit for keying the transmitter on A₁ emission by means of vacuum tube keying at any speed up to 500 words per minute or relay keying at any speed up to 100 words per minute. Relay keying on type A₂ emission is possible up to 50 words per minute. A d-c voltage is necessary in order to key this equipment. A Navy type 807 tube located in the master oscillator unit of the transmitter is used for vacuum tube keying. Another feature of the land-line control unit is a long or short time delay period during which the equipment is reduced to stand-by condition prior to automatic shut-down. This unit takes its operating power from the transmitter, and all external connections are made to terminal strips along the bottom of the panel.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | Number of tubes | Type |
|--|-----------------|-----------|
| Transmitter: | | |
| Master oscillator..... | 1 | 807 |
| First intermediate power amplifier..... | 1 | 860 |
| Second intermediate power amplifier..... | 1 | 860 |
| Power amplifier..... | 1 | 861 |
| Keyer..... | 1 | 807 |
| Modulator: | | |
| Intermediate amplifier and relay..... | 3 | 807 |
| Input amplifier..... | 2 | 6D6 |
| Modulators..... | 2 | 803 |
| Modulation limiter..... | 1 | 1615 |
| Compressor limiter..... | 1 | 25Z5 |
| Land Line Control Unit: | | |
| Keyer control..... | 1 | 807 |
| Rectifier..... | 1 | 5Z3 |
| Control start..... | 1 | OC3/VR105 |
| Total..... | 17 | |

Frequency control.—Master oscillator.

Antenna.—Recommended average length 80 feet.

When used on shipboard the following data should apply: maximum length outside trunk—80 feet; trunk length—8 to 35 feet; diameter of trunk (if used)—8 to 12 inches; distance to entering insulator—2 to 20 feet.

Weights dimensions and Navy type numbers of equipment units included in contract

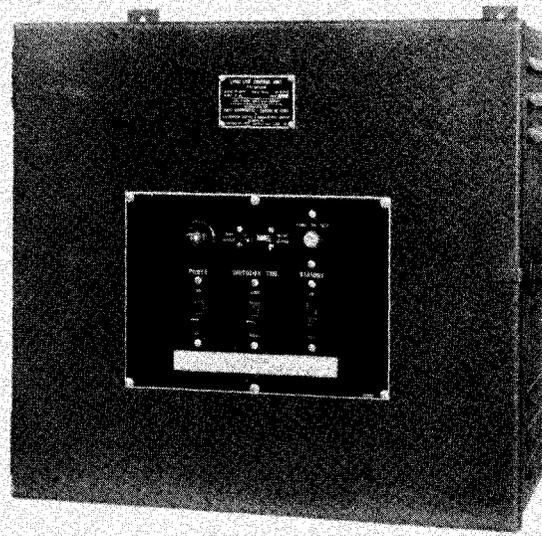
| Unit | 60-cycle Navy numbers | 25-cycle Navy numbers | Height | Width | Depth | Weight |
|--|-----------------------|-----------------------|---------------------------------|---------------------------------|---------------------------------|---------------|
| Transmitter: | | | | | | |
| 60-cycle equipment..... | CAY-52170 | | Inches 72 | Inches 32 | Inches 24 | Pounds 797 |
| 25-cycle equipment..... | | CAY-52169 | 72 | 32 | 24 | 825 |
| Duplicate motor-generator sets: | | | | | | |
| 60-cycle equipment..... | CAY-21522 | | 20 ³ / ₈ | 74 ² / ₁₆ | 20 ¹ / ₂ | 1,030 |
| 25-cycle equipment..... | | CAY-21521 | 21 ³ / ₄ | 78 ¹ / ₂ | 20 ¹ / ₂ | 1,162 |
| Duplicate motor starters: | | | | | | |
| 60-cycle equipment..... | CAY-21411 | CAY-21511 | 24 ¹ / ₄ | 17 | 11 ⁵ / ₈ | 80 |
| 25-cycle equipment..... | CAY-50065 | CAY-50066 | 72 | 18 | 24 | 380 |
| Modulator: | | | | | | |
| Land-line remote control unit..... | CAY-23216 | CAY-23217 | 20 ³ / ₈ | 21 ³ / ₁₆ | 11 ¹ / ₁₆ | 54 |
| Generator transfer-panel..... | CAY-24084 | CAY-24084 | 39 ³ / ₁₆ | 20 ¹ / ₄ | 11 | 77 |
| Equipment spare parts box..... | | | 15 ³ / ₄ | 25 ³ / ₈ | 16 ³ / ₄ | 143 |
| Modulator spare parts box..... | | | 12 ³ / ₄ | 19 ³ / ₄ | 13 ³ / ₄ | 43 |

Power.—Supplies available: 220/3/60 and 220/3/25.

| REQUIRED FOR STARTING | | | | |
|-----------------------------------|---------------------------------------|------|------|------------------------|
| Power source | Line current (amps) maximum per phase | KW | KVA | Power factor (percent) |
| 220/3/60..... | 115 | 22 | 44 | 50 |
| 220/3/25..... | 145 | 29.2 | 55 | 53 |
| REQUIRED FOR LOCKED KEY OPERATION | | | | |
| 220/3/60..... | 16.6 | 5.1 | 5.85 | 87 |
| 220/3/25..... | 16.9 | 5.47 | 6.1 | 90 |

Allowable variation in supply line voltage, ±10%; frequency, ±5%; combined voltage and frequency, ±10% (5% each).

Operating control.—(1) Front panel A₁, A₂, A₃; (2) Remote control. Navy standard 4- or 6-wire A₁, A₂; (3) Land-line remote control up to 50 miles A₁, A₂; (4)



Land-line control unit for Model TBM-6 equipment.

Land-line and telephone remote control up to 10 miles A₁, A₂, A₃.

Carrier control.—“Push-to-talk” button or voice control relay operation.

Type of Keying.—Relay—100 words per minute A₁, 50 words per minute A₂; Vacuum tube—500 words per minute A₁.

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Accessories not supplied by contractor.—4- or 6-wire remote-control units; land-line telephone remote-control unit.

Shipping weights and dimensions

[As shipped in 14 boxes]

| Unit | Size | Gross weight | Cubic feet | Unit | Size | Gross weight | Cubic feet |
|---|----------------|---------------|------------|------------------------------|----------------|---------------|------------|
| | <i>Inches</i> | <i>Pounds</i> | | | <i>Inches</i> | <i>Pounds</i> | |
| Transmitter: | | | | Generator transfer-panel | 48 x 27 x 17.. | 182 | 12.75 |
| 60 cycles | 42 x 30 x 78.. | 1,064 | 56.87 | Vacuum tube, one 861 | 23 x 23 x 24.. | 21 | 7.34 |
| 25 cycles | 42 x 30 x 78.. | 1,092 | 56.87 | Vacuum tubes (balance) | 37 x 26 x 12.. | 65 | 6.67 |
| Motor-generator set (2 furnished at either cycle specified): | | | | Equipment spare parts | 28 x 18 x 17.. | 188 | 4.96 |
| 60 cycles (each) | 80 x 26 x 24.. | 1,270 | 29.42 | Modulator spare parts | 28 x 15 x 15.. | 70 | 2.87 |
| 25 cycles (each) | 80 x 26 x 24.. | 1,402 | 29.42 | Vacuum tube spare, one 861 | 23 x 23 x 24.. | 21 | 7.34 |
| Motor starters (each) (2 furnished at either cycle specified) | 22 x 27 x 17.. | 122 | 5.84 | Vacuum tube spares (balance) | 37 x 26 x 12.. | 65 | 6.67 |
| Modulator | 29 x 24 x 78.. | 600 | 31.42 | Total: | | | |
| Land-line control unit | 30 x 26 x 17.. | 120 | 7.67 | 60-cycle equipment | | 5,180 | 215.08 |
| | | | | 25-cycle equipment | | 5,472 | 215.08 |

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TBM-8 RADIO TRANSMITTING EQUIPMENT

Use.—Shore, ship.

Frequency range.—2000-18,100 kc.

Power output and emission.—500 watts A₁; 350 watts A₂, A₃; also 75 watts A₁ on 2000-9050 kc. (with the final amplifier disconnected).

Description.—The TBM-8 transmitting equipment

is a subsequent model of the TBM-6 for 220/3/60 operation. These later equipments differ from the Model TBM-6 equipment only in that a slightly improved motor-starter is supplied.

Navy type number.—Motor-starter: 220/3/60—CA Y-21668.

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TBS SERIES RADIO TRANSMITTING-RECEIVING EQUIPMENTS

Use.—Ship.

Frequency range.—Transmitter and receiver—60,000-80,000 kc. (one preset channel).

Power output and emission.—50 watts, A₂, A₃.

Description.—The Models TBS-3 through TBS-7 transmitting and receiving equipments are designed for very high frequency, low power operation. All equipments for respective voltages of the various models are essentially the same. Only two design exceptions have been made in the series. These exceptions and the models affected are as follows: The receiver incorporated in TBS-5 and TBS-6 is constructed to employ either a type 6J5GT or 6J5G tube as a second doubler. The receiver of all other models must use a 6J5G tube in this stage. The motor generators furnished for TBS-6 and TBS-7 equipments

are of a later and improved design from those furnished with the earlier models. This equipment is intended for installation on surface craft or submarines to provide telegraph and telephone intercommunication between task forces, convoy vessels, and others separated by line of sight distances.

The transmitter is constructed on a horizontal type aluminum alloy chassis which is contained in a case of similar material designed for mounting on the top of a stand in which the associate receiver is contained. The transmitter may, however, be mounted in any convenient location. The meters, dials, and switches which are required for the operation of this unit are all mounted on the front panel. The chassis is divided lengthwise into two sections. The audio frequency tubes and transformers are mounted on the rear section. The

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front section is divided into three parts which are, from right to left, the crystal controlled oscillator, the first and second doublers, and the modulated power amplifier. The transmitter circuits are accessible for adjustment and change of vacuum tubes through a

mitter is secured. All the tuning and operating controls are grouped on an engraved plate located on the front panel and are protected when not in use by a large hinged cover. At each end of the engraved plate are located small access doors to the crystal and fuse



Transmitter and receiver for Model TBS equipment.

hinged lid in the case. The terminal board for all external connections is located to the rear of the chassis.

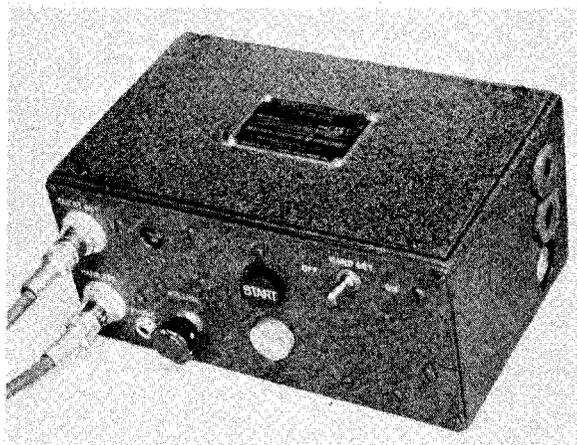
The receiver is constructed on an aluminum alloy chassis which is contained within a rectangular metal case designed to fit inside the stand on which the trans-

compartment. An input tuning meter, output tuning meter, and calibration chart are located on the front panel above the control plate. All vacuum tubes are mounted on the top of the chassis and are accessible for replacement upon partial withdrawal of the chassis

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and panel from the cabinet. In the case of the RF amplifier tube, however, the cover of the small shielded compartment just behind the front panel must be removed to gain access to the tube. The receiver circuit is of the conventional superheterodyne design employing an RF input stage, local oscillator and two doubler stages, first detector, three intermediate frequency stages, second detector and noise suppressor, automatic volume control, a two stage audio frequency output and a self-contained power supply. The low temperature-coefficient quartz crystal controlled tuned plate oscillator is followed by the two frequency-doubler stages to furnish heterodyning voltage to the first detector at a frequency which is 5.3 megacycles lower than the signal frequency. Terminals for connection of the receiver output and the power input supply are provided on a small terminal board located in the rear of the chassis.



Control unit for Model TBS equipment.

The *motor-generator set* is a single unit, two bearing direct-coupled assembly. Both a-c and d-c motors are of 1-horsepower capacity and are interchangeable on the left end of the bed-plate, as viewed from the terminal box side. The generator supplies 875 volts at 0.350 ampere for plate potential of the first doubler, second doubler, power amplifier, and modulator tubes and 300 volts at 0.200 ampere for plate potential of the RF oscillator, speech amplifiers, AF drivers, the AF oscillator and the modulator limiter. Drip proof terminal boxes are provided on each motor generator set, and contain fuses for the protection of all circuits, as well as terminals for all external connections. The TBS-6 and TBS-7 motor generator sets employ a single terminal box located on the top of the unit. Two separate terminal boxes are employed with the motor generator sets of other models and are located on the side of the unit. D-c equipments provide a-c supply for filaments from a separate 220-volt winding located in the d-c motor.

A 440/220-volt *step-down line transformer* designed for bulkhead mounting is supplied with 440/3/60 equipment

to provide power for the transmitter filaments and the starting control circuit.

The *motor starter* is of the remote controlled magnetic contactor type with all switches, contactors, fuses, and overload protection devices mounted in a panel and housed in a metal box with a removable cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

The two *remote-control units*, which are contained in small metal cases, are identical, and may be installed in any two convenient locations against a wall or bulkhead. The units are provided with the necessary transmitter and receiver controls, to permit full operation of the equipment up to a distance of 200 feet. On the front panel of each unit are located a hand-set jack, chest-set jack, telegraph key jack, transmitter "on-light," volume control, start button, stop button, and OFF-Handset-ON switch. Provision is made on the right hand side of the units for connection to the transmitter, receiver, and loudspeaker.

The *loudspeaker* is of the permanent magnet dynamic type with a 5-inch diaphragm. This unit, which is designed for bulkhead mounting, is contained in a two-section cylindrical metal case and incorporates the required output transformer and an auxiliary volume control. The loudspeaker has an input impedance of 500 ohms and a maximum power capability of 20 watts.

The two *handsets* are identical, each consists of a 35-ohm, single-button carbon microphone and a 600-ohm earphone. Both components are assembled in a molded phenolic shell containing a press-to-talk switch located in the handle. The handsets are equipped with a four-conductor cable, 4 feet long, terminated by a plug for connection to either remote-control unit.

The *chest set* consists of a 35-ohm carbon microphone equipped with a press-to-talk button type switch. A jack is mounted on the breastplate for plug connection of a standard 600-ohm Navy headset (not furnished) and the set is provided with a four-conductor cable, 20 feet long, which is terminated by a polarized connection for attachment to the remote-control unit. A woven strap of adjustable length is furnished to hold the chest-set in position against the chest of the operator.

A quarter-wave vertical *antenna* is utilized in this equipment for both transmission and reception. Two types of antennas are provided, one designed for mounting on top of the forward mast of destroyers and the other for mounting on the after side of the king post in submarines. Both types are electrically equivalent and differ only in constructional detail. Each is designed to radiate a maximum of vertically polarized energy throughout the operating range of 60,000 to 80,000 kc. Seven metal rods are furnished, of which four are arranged as a ground plane. One of the three remaining rods is used as the quarter-wave vertical antenna. These three rods are interchangeable for this purpose, depending upon the frequency used.

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Antenna.—The quarter wave vertical rod 28¼ to 44 inches in length is fed by nitrogen filled coaxial transmission line supplied in 80-foot lengths for submarine service and 120-foot for surface craft.

TECHNICAL FEATURES

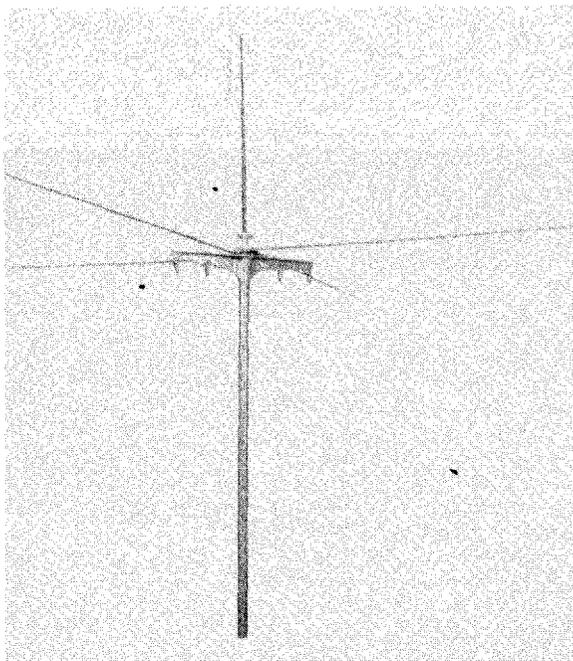
Design.—Navy.

Tube complement

| Location | Number of tubes | Type |
|---|-----------------|-------|
| Transmitter: | | |
| R. F. oscillator..... | 1 | 807 |
| First doubler..... | 1 | 807 |
| Second doubler..... | 1 | 808 |
| Power amplifier..... | 1 | 808 |
| Audio frequency oscillator..... | 1 | 6A6 |
| Speech amplifier..... | 2 | 6D6 |
| Audio frequency driver..... | 2 | 2A3 |
| Modulator..... | 2 | 808 |
| Modulator limiter..... | 1 | 84 |
| Receiver: | | |
| R. F. amplifier..... | 1 | 956 |
| Oscillator and first doubler..... | 1 | 6E8-G |
| Second doubler..... | 1 | 6J5-G |
| First detector..... | 1 | 6C6 |
| I. F. amplifier..... | 3 | 6D6 |
| A. V. C..... | 1 | 6F7 |
| Second detector and noise suppressor..... | 1 | 75 |
| First A. F. amplifier..... | 1 | 6C6 |
| Output amplifier..... | 1 | 6Y6-G |
| Rectifier..... | 1 | 5Z3 |
| Total..... | 24 | |

Frequency control.—1 preselected crystal channel.

Operating control.—Remote control (only) up to 200 feet.



Antenna for Model TBS equipment

Carrier control.—Push-to-talk switches located on handsets and chest set.

Type of keying.—Relay—40 words per minute.

Receiver.—Frequency range: 60,000–80,000 kc. using one preselected crystal controlled channel.

Reception—A₂, A₃.

Intermediate-frequency—5.3 mc.

Sensitivity—6 mw. output for 5 microvolts input.

Image ratio—1,000 to 1 minimum.

Input—70 ohms.

Output—2 watts into 600-ohm load.

Power supply—115/1/60. A line transformer—(type 301058) is provided as an accessory with the TBS-4 and TBS-7 equipments in order that the receiver may be operated from a 230/1/50/60 power source.

Allowable variation in supply line voltage ±5%, frequency ±5%.

Weights, dimensions, and Navy type numbers of equipment units included in contract

The manufacturer's prefix designations have been omitted from the type numbers, as the equipment is built by more than one company.

| Unit | Navy type Nos. | Height | Width | Depth | Weight |
|---|---|------------------|------------------|------------------|--------|
| | | Inches | Inches | Inches | Pounds |
| Transmitter..... | 52093 | | | | |
| Receiver..... | 46068 ¹ 46068-A | | | | |
| Motor-generator sets: | | | | | |
| 220-volt A. C..... | 21301 211128 ² | 10¼ ⁶ | 19½ | 10¼ ⁶ | |
| 440-volt A. C..... | 21302 211129 ² | | | | |
| 120-volt D. C..... | 21300 211127 ² | 10¼ ⁶ | 23¼ ⁶ | 10¼ ⁶ | |
| 230-volt D. C..... | 21745 211130 ² | 10¼ ⁶ | 23¼ ⁶ | 10¼ ⁶ | |
| Line Transformer 440 volts A. C. only..... | 30445 | 8¾ | 4½ | 4 | 16.8 |
| Line Transformer..... | 301058 ³ | 5¼ ⁶ | 8¾ ⁶ | 7½ | |
| Remote-control units (2)..... | 23135 | 5¼ ⁶ | 10¼ | 7¼ | 9 |
| Chest set..... | 51018 | | | | 1.25 |
| Handsets (2)..... | 51019 | | | | 1.5 |
| Loudspeaker..... | 4915 ⁴ 49101 ⁵ | 5 | 4 10 | | 21 |
| Antenna-destroyer equipment..... | 66015 | | | | 46 |
| Antenna-submarine equipment..... | 66016 | | | | 57 |
| Support stand for transmitter and receiver..... | | 9¾ | 27¾ | 17½ | |
| Hooks (two) for support of handset..... | | | | | |
| Transmission line kit (destroyer)..... | | | | | 29 |
| Transmission line kit (submarine)..... | | | | | 23 |
| Junction box for terminating transmission line..... | | | | | |
| Spare parts box, a-c equipment..... | | 6¾ | 13¾ | 13¾ | 36 |
| Spare parts box, d-c equipment..... | | 6¾ | 13¾ | 13¾ | 44 |
| Spare parts box, motor generator set a-c equipment..... | | 9½ | 19 | 10 | 46 |
| Spare parts box, motor generator set d-c equipment..... | | 9½ | 25 | 13 | 75 |

¹ Used with TBS-5 and TBS-6 equipments.

² Used with TBS-6 and TBS-7 equipments.

³ Used with TBS-4 receivers.

⁴ Diameter.

⁵ Used with TBS.

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Power.—Supplies available: 115-volt D. C., 230-volt D. C., 220/440 /3/ 60 A. C.

REQUIRED FOR STARTING

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|----------------------|--|-----|-------|------------------------|
| 120 volts D. C. | 30.0 | 3.6 | ----- | ----- |
| 230 volts D. C. | 15.0 | 3.4 | ----- | ----- |
| 220/3/60 | 21.2 | 7.0 | 8.0 | 87 |
| 440/3/60 | 10.7 | 7.0 | 8.0 | 87 |

REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|----------------------|--|------|-------|------------------------|
| 120 volts D. C. | 7.4 | 0.88 | ----- | ----- |
| 230 volts D. C. | 4.8 | 1.10 | ----- | ----- |
| 220/3/60 | 2.8 | .87 | 1.1 | 79 |
| 440/3/60 | 1.4 | .87 | 1.1 | 79 |

Allowable variation in supply line voltage $\pm 5\%$, frequency, $\pm 3\%$.

Accessories not supplied by contractor.—Telegraph key; telephone headset—600-ohm.

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet |
|---|--------------------------|---------------|------------|
| | <i>Inches</i> | <i>Pounds</i> | |
| Transmitter and receiver | 33 x 30 x 27.5 | 300 | 15.7 |
| Motor-generator | 29 x 13 x 11.5 | 163 | 2.5 |
| Antenna assembly (destroyer) | 66.5 x 25.5 x 7 | 95 | 6.9 |
| Transmission line kit | 44.5 x 45.5 x 7 | 105 | 8.2 |
| Accessories, speaker, controller, crystals, etc. | 32 x 22.5 x 19.5 | 165 | 8.1 |
| Set of equipment tubes and spare tubes | 23.5 x 14.5 x 15.5 | 39 | 3.1 |
| Equipment spare parts and motor-generator spare parts | 23.5 x 16 x 12 | 67 | 2.7 |
| Motor-generator spare parts | 28 x 14 x 11.5 | 97 | 2.6 |

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TBW AND TBW-1 RADIO TRANSMITTING EQUIPMENTS

Use.—Shore—Advanced bases.

Frequency range.—350–1000 kc. and 3000–18100 kc.

Power output and emission.—100 watts, A₁, A₂; 25 watts, A₃.

Description.—The identical Models TBW and TBW-1 portable radio transmitting equipments may be installed and operated aboard ship, but are primarily designed for use in establishing a complete advance base radio transmitting station. The transmitter units receive plate power from a rectifier supply which receives its power from a 120/1/800 generator. Two generators are supplied with each equipment, one driven by a gasoline engine and the other by a line-powered a-c motor.

The equipment is capable of being readily set up for operation ashore as a complete radio transmitting station by a trained crew of six men within a period of 1 hour; dismantling and packing time the same. The units can be stowed and transported readily in a small size lifeboat, or by airplane with hatch dimensions of

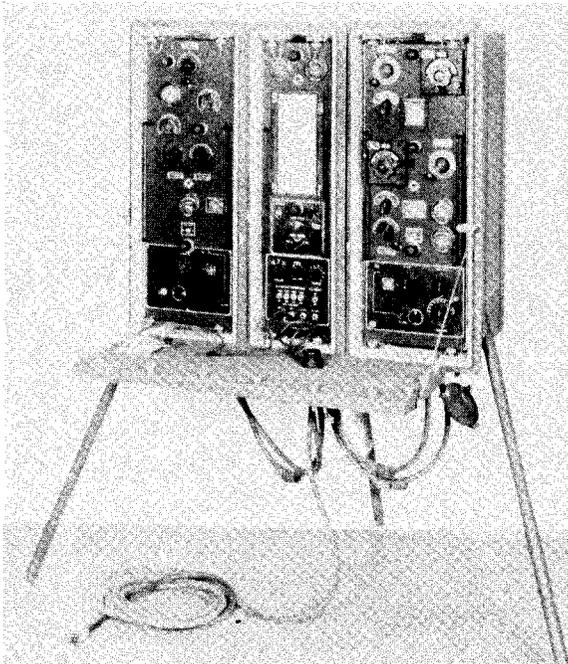
not less than 18 by 24 inches. This equipment, when used in conjunction with suitable receiving equipment, provides communication between similar installations, or other units of the Naval Communication system without the necessity for preliminary calling. Various components of the RBM series portable receiving equipment, when used in conjunction with Model TBW or TBW-1 transmitting equipment then comprise the Navy Model MM portable transmitting and receiving equipment.

The electrical parts of the *MF transmitter*, *HF transmitter*, and *rectifier units* are enclosed and supported by aluminum alloy spot welded frames, and shock mounted in separate water tight transportation cases fabricated of aluminum alloy sheet and angle. For normal operation the three units are left in the transportation cases with only the covers and caps over the various power receptacles being removed. The MF transmitter and the HF transmitter which are located, respectively, to the left and right of the rectifier are assembled together,

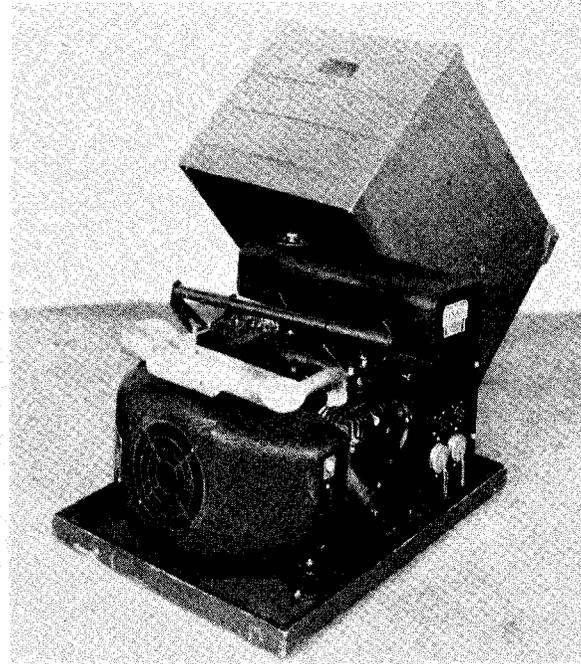
and held in place by means of two steel rods which are passed through projections on the bottom of the cases. The assembly is elevated above the ground at a convenient operating level by installation of three tubular metal legs. Attachment brackets, and two lengths of chain are furnished to mount the cover of the HF transmitter unit on flanges located on the bottom of the cases, to provide an operating table. The MF transmitter and HF transmitter units are interconnected to the rectifier unit by means of plugs and cables, which are inserted in sockets accessible through the bottom of the transportation cases. Separate antenna connections are made to each transmitter through openings provided in the rear of the respective transportation cases. The equipment is operated from the front panel position of the rectifier unit. This unit includes a

contains the power transformer and necessary filter circuits, and directly above this, on the second floor are located the two 1616 tubes, delivering approximately 2,000 volts D. C. for power amplifier plate potential, and one 5Z3 rectifier tube, delivering approximately 500 volts D. C. for the master oscillator intermediate amplifier and modulating circuits. On the third floor is located the class A 843 modulator and its associate input and output modulating transformers.

The *gasoline engine generator set* is mounted on a 1/4-inch plate of aluminum, which is designed to serve as a base and as the bottom of the water-tight aluminum carrying case. The gasoline engine is of the horizontal 2-cylinder, L head, 4-cycle, air-cooled type, equipped with a governor to maintain a speed of approximately 2,666 revolutions per minute. The engine and genera-



Two transmitters and rectifier for the TBW-1 equipment with case covers off and assembled for operation.



Gas-driven generator with cover of floatable case removed; for use with Model TBW-1 equipment.

switch which serves to transfer power from one transmitter to the other.

The *HF transmitter* frame contains the Navy type 837 electron coupled master oscillator and doubler stage located in the bottom of the unit. The first floor contains the Navy type 837 intermediate amplifier stage. On the second floor is located the Navy type 803 power amplifier stage and the antenna tuning inductance, capacitor and voltage current feed switch.

The *MF transmitter* frame contains the Navy type 801 Colpitts master oscillator stage and the Navy type 807 intermediate amplifier stage located in the bottom of the unit. On the first floor is located the Navy type 803 power amplifier stage and antenna loading coil.

The *rectifier* is provided with a space on the bottom of the unit for the projection through the case of the interconnecting plugs and cables to the transmitters and generator. A sub-floor located over the cable sockets

tor are directly coupled by a splined taper. The generator is of the 4-pole inductor alternator air-cooled type, with an output of 800 watts at 120/1/800 and 280 watts at 14 volts D. C. The 14-volt D. C. output supplies 50 watts filament power for the transmitter and 230 watts for battery charging when this equipment is used in connection with RBM receivers requiring storage batteries for operation. The engine is started by means of a rope wound around a grooved pulley on the generator end of the unit. The machine is stopped by an ignition stop-button located on the air blower housing. The fuel tank has a capacity of 2 gallons of gasoline requiring an inspection every 2 hours after filling, while the engine is operating.

The *motor generator* is a 2-unit 4-bearing, V-belt-driven assembly of drip-proof construction mounted on a common bed-plate. The magnetic starter is mounted on the side of the motor and, by means of a push-button

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station and indicator light, control can be provided at a distance of up to 50 feet. A filter to reduce the ripple in the d-c output voltage is mounted on the bed-plate adjacent to the generator. Both 60- and 25-cycle motors, which are mechanically interchangeable with each other, are of 3-horsepower capacity and will operate at approximately 1,750 and 1,450 revolutions per minute, respectively. The generator will deliver 800 watts at 120/1/800, and 280 watts at 14 volts D. C. when the approximate speed of 2,666 revolutions per minute is maintained by a correct proportioning of the V-belt-driven pulleys.

The antenna assembly consists of two 45-foot tubular aluminum masts, made up of 10 sections each. All the necessary spreaders, insulators, guy ropes, guy stakes, mast bases, wire halyards for setting up a 150-foot 2-wire intermediate frequency antenna and counterpoise, and approximately a 140-foot single-wire high-frequency antenna, are included.

TECHNICAL FEATURES

Design—Navy

Tube complement

| Location | Number of tubes | Type |
|-----------------------------|-----------------|------|
| MF transmitter: | | |
| Master oscillator..... | 1 | 801 |
| Intermediate amplifier..... | 1 | 807 |
| Power amplifier..... | 1 | 803 |
| HF transmitter: | | |
| Master oscillator..... | 1 | 837 |
| Intermediate amplifier..... | 1 | 837 |
| Power amplifier..... | 1 | 803 |
| Rectifier: | | |
| High voltage..... | 2 | 1616 |
| Low voltage..... | 1 | 5Z3 |
| Modulator..... | 1 | 843 |
| Total:..... | 10 | |

Frequency control.—Master oscillator.

Power.—Supplies available: 115/230 /1/ 60, 115/230 /1/ 25 motor-generator sets and gasoline driven motor-generator.

Required for starting: 10 kw.

Required for locked key: 1.85 kw.

Allowable variation in supply line voltage, $\pm 5\%$; frequency $\pm 5\%$; combined voltage and frequency, $\pm 10\%$ (5% each).

Operating control.—Front of panel.

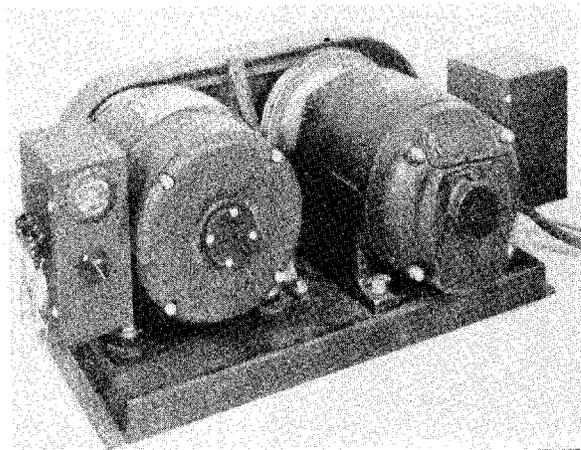
Type of keying.—Relay—100 words per minute.

Antenna.—An intermediate frequency antenna and a high frequency antenna, with supporting masts and guys, are supplied with the equipment.

Weights, dimensions, and Navy type numbers included in contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|---|----------------|------------------|-------------------|------------------|---------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| MF transmitter..... | CA Y-52119.... | 33 $\frac{3}{4}$ | 13 $\frac{7}{16}$ | 17 $\frac{3}{4}$ | 56.5 |
| HF transmitter..... | CA Y-52120.... | 33 $\frac{3}{4}$ | 13 $\frac{7}{16}$ | 17 $\frac{3}{4}$ | 86.5 |
| Rectifier..... | CA Y-20084.... | 33 $\frac{3}{4}$ | 10 $\frac{7}{16}$ | 17 $\frac{3}{4}$ | 69.5 |
| Gasoline engine generator..... | CDO-73004.... | 17 $\frac{3}{8}$ | 26 $\frac{1}{4}$ | 21 $\frac{1}{4}$ | 168 |
| Motor-generator and magnetic controller: | | | | | |
| 25-cycle..... | CDO-21652.... | 14 $\frac{1}{4}$ | 32 $\frac{1}{2}$ | 20 $\frac{7}{8}$ | 287 |
| 60-cycle..... | CDO-21648.... | 14 $\frac{1}{4}$ | 32 $\frac{1}{2}$ | 20 $\frac{7}{8}$ | 287 |
| Microphone..... | 51004-A..... | | | | |
| Telegraph key..... | CJB-26001-B.. | | | | |
| Mobile spare parts set..... | | 12 $\frac{3}{4}$ | 25 $\frac{5}{8}$ | 13 $\frac{3}{8}$ | 50.5 |
| Canvas case for transmitter rectifier unit..... | | | | | |
| Antenna mast assemblies (in 2 canvas bags)..... | | 60 | 12 | | 92 |
| Accessories in canvas case..... | | 28 | 18 | | |

¹ Diameter.



Motor-generator for use with Model TBW-1 equipment.

Shipping weight and dimensions

| Unit | Size | Gross weight | Cubic feet |
|---|----------------|---------------|------------|
| | <i>Inches</i> | <i>Pounds</i> | |
| MF transmitter, HF transmitter and rectifier..... | 59 x 43 x 27.. | 495 | 39.64 |
| Gasoline-engine generator..... | 31 x 23 x 19.. | 230 | 7.84 |
| Motor-generator and magnetic controller..... | 41 x 27 x 20.. | 395 | 12.81 |
| Antenna..... | 65 x 25 x 12.. | 184 | 11.29 |
| Vacuum tube set..... | 22 x 17 x 12.. | 26 | 2.90 |
| Accessory set, tool kit, canvas cover..... | 27 x 19 x 19.. | 113 | 5.60 |
| Gas can, oil can..... | 26 x 13 x 13.. | 28 | 2.55 |
| Mobile spare parts set..... | 29 x 15 x 15.. | 74 | 3.78 |

TBX
 TBX-1
 TBX-2
 TBX-3
 TBX-4
 TBX-4A
 TBX-5
 TBX-6

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TBX SERIES RADIO TRANSMITTING-RECEIVING EQUIPMENT

Use.—Ship-shore portable transmitting-receiving.

Frequency range-transmitter.—TBX-1, -2, -3, -4—2000-4525 kc; TBX-4A, -5, -6—2000-5800 kc.

Frequency range-receiver.—2000-8000 kc.

Power output and emission.—9 watts, A₁; 3 watts A₃.

Description.—The TBX series portable radio transmitting-receiving equipments are designed for medium to high frequency telegraph and telephone operation. These equipments are intended for ship and shore communication purposes between similar equipments and other units of the Navy Communication System at ranges of approximately 30 miles for A₁ transmission and 15 miles for A₃ transmission. The major units are supplied with canvas pack carrying cases, and the entire equipment is fitted into a vulcanized fiber-plywood shipping chest with wooden inner partitions. All the units of this equipment are watertight and submergence-proof. The models TBX through TBX-6 are essentially the same. The only design differences in the series are relative to the transmitter-receiver unit and are as follows: Type 43005-A unit, employed with TBX-4, is similar to type 43005 unit employed with the TBX-1/2/3 except for minor mechanical and electrical improvements. The transmitter frequency range of these units is 2000-4525 kcs. Type 43005-D unit, furnished with the TBX-4a/5 is the same as type 43005-A except the transmitter frequency range is greater, covering 2000-5800 kcs. Type 43005-C unit, employed with TBX-6, is mechanically and electrically equivalent to type 43005-D, but is manufactured by a different company. The receiver frequency range of all the above units is 2000-8000 kcs.

The transmitter-receiver unit is of the chassis type of construction. The case is of stainless steel or protected steel. The transmitter portion is capable of self-excited transmission within the specified frequency range. In addition, crystal-controlled transmission is available on any two frequencies in the range of the unit for which crystals are provided. The receiver is of the super-heterodyne type and is capable of receiving A₁, A₂, and A₃ signals on frequencies from 2000-8000 kc.

The hand-driven d-c generator, constructed of protected steel and protected lynite, is of the double-commutator type, and delivers 500 volts D.C. at 0.065 ampere and 12.6 volts D.C. at 0.86 ampere for the transmitting portion of the transmitter-receiver unit. This generator may be mounted on any suitable vertical object approximately 1½ to 12 inches in diameter at about shoulder height. Installation is obtained by means of a clamping attachment provided with the equipment.

The accessory box, constructed in a manner similar to the transmitter-receiver unit contains the following batteries for the receiver supply: namely, 2 A batteries in series, 3 B batteries in series, and 2 C batteries in series, producing 3, 135, and 15 volts, respectively. The screen supply of 90 volts is provided from the connection between the second and third B batteries. At least 80 hours of service, based on intermittent use of four hours

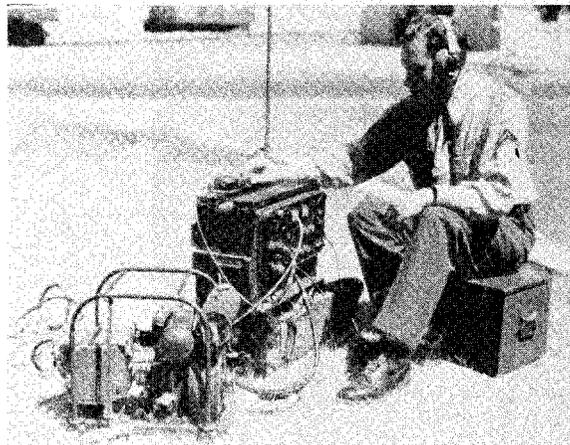
per day should be obtained from a fresh set of batteries.

The antenna assembly consists of two antennas, namely, a small whip antenna designed for installation when space and time are limited, and a single wire L type large antenna designed to be erected when space and time permit. The mast sections of the antenna assembly are constructed of protected chrome-steel, in detachable sections. A canvas case is provided for transportation and protection.

Two telephone headsets are provided, each consisting of two receivers fitted with rubber molded ear-cushions, a combination head and chin strap, and a rubber covered Y cord. Either of these units is designed to be plugged into a receptacle in the receiver portion of the transmitter-receiver unit.

The hand microphone with the press-to-talk switch rated at 30 ohms, is furnished with a 5-foot rubber-covered cord, terminated by a 3-circuit plug. This unit is designed to be plugged into a panel receptacle.

The telegraph key, enclosed in a rubber cover, and fitted with cord and plug, is designed to be mounted on top of the transmitter-receiver unit.



Photograph showing Model TBX equipment set up for operation.

TECHNICAL FEATURES

Design — Navy.

Tube complement

| Location | Number of tubes | Type |
|---|-----------------|------|
| TRANSMITTER | | |
| Master oscillator and power amplifier | 1 | 837 |
| RECEIVER | | |
| Frequency converter | 1 | 1C6 |
| Intermediate frequency amplifier | 1 | 34 |
| CW oscillator | 1 | 34 |
| Detector | 1 | 34 |
| Audio amplifier | 1 | 34 |
| Total | 6 | |

Frequency control.—Master oscillator and two crystal channels.

Power.—Supply (standard)—Hand-driven generator for transmitter. Receiver operated from battery pack.

Supply (optional)—Operation of this equipment is

TBX
TBX-1
TBX-2
TBX-3
TBX-4
TBX-4A
TBX-5
TBX-6

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possible with the following power supplies which are not supplied with the basic equipment:

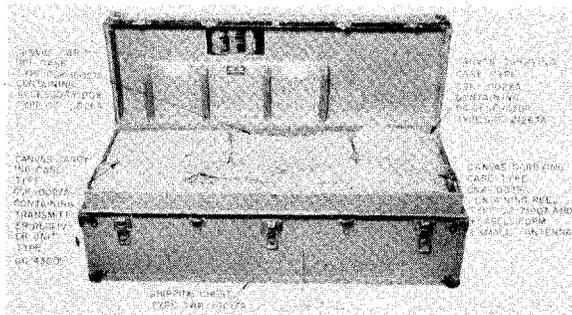
TRANSMITTER

- EF Series—Gas engine driven generator.
- EG Series—Motor-generator set, 115/1/60.
- EH Series—Motor-generator set, 115 volts D. C.
- EJ Series—Dynamotor equipment, 12 volts D. C.

RECEIVER

- EL Series—Rectifier equipment, 115/1/60.
- EM Series—Dynamotor equipment, 6 volts D. C.
- EN Series—Dynamotor equipment, 12 volts D. C.
- EO Series—Dynamotor equipment, 24 volts D. C.
- EP Series—Dynamotor equipment, 32 volts D. C.
- EQ Series—Dynamotor equipment, 110 volts D. C.

Operating control.—Front panel only.
Carrier control.—Push-to-talk button on microphone.



Photograph showing Model TBX equipment packed in shipping chest.

Type of keying.—Direct to key.

Receiver.—Type of reception—A₁, A₂, A₃. Output—600-ohm headphone jack.

Antenna.—7-section 24-foot vertical demountable whip, or single wire L type 30 feet long, supplied with equipment.

Weights dimensions and Navy type numbers of equipment units included in contract

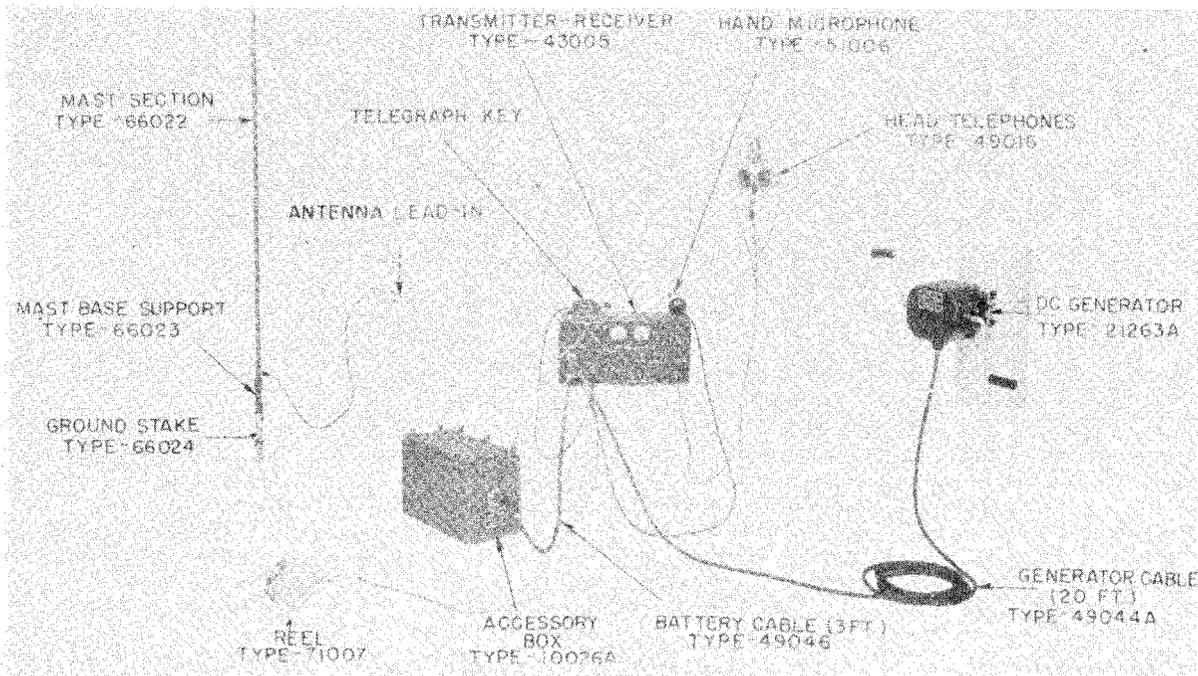
The manufacturer's prefix designations have been omitted from the type numbers as the equipment is manufactured by more than one company.

| Units | Navy type Nos. | Height | Width | Depth | Weight |
|---------------------------------|----------------|--------|----------------------------------|---------------------------------|--------|
| | | Inches | Inches | Inches | Pounds |
| Transmitter-receiver | 43005 | 8½ | 15½ ⁵ / ₁₆ | 10 | 29.0 |
| TBX-1/2/3 | 43005-A | | | | |
| TBX-4 | 43005-D | | | | |
| TBX-4a/5 | 43005-C | | | | |
| TBX-6 | 43005-C | | | | |
| Hand-driven D. C. generator | 21263A | 14½ | 19½ | 6½ ⁵ / ₁₆ | 22.3 |
| Accessory box | 10026A | 10 | 16½ | 8½ | 31.0 |
| Antenna assembly | | | | | 7.5 |
| Vacuum tubes: 1 set | | | | | .8 |
| Canvas case: | | | | | |
| Transmitter-receiver | 10027A | | | | 3.1 |
| Generator | 10028A | | | | 4.9 |
| Antenna assembly | 10029A | | | | 3.7 |
| Accessory box | 10027A | | | | 3.1 |
| Station spares: 1 set | | | | | 5.8 |
| Hand microphone | 51006 | | | | 1.0 |
| Head telephone set (2 supplied) | 49016 | | | | .8 |
| Telegraph key (rubber mounted) | | | | | .9 |
| Shipping chest | 10017A | 17¾ | 49¾ | 18¾ | (1) |

¹ 82 empty; 195 packed.

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet |
|--|----------------|--------------|------------|
| | Inches | Pounds | |
| Basic equipment and station spare parts in shipping chest, as crated.. | 22 x 24 x 58.. | 355 | 17.7 |



Model TBX transmitting equipment, showing random connections for field operation.

TBY, TBY-1, AND TBY-2 RADIO TRANSMITTING-RECEIVING EQUIPMENTS

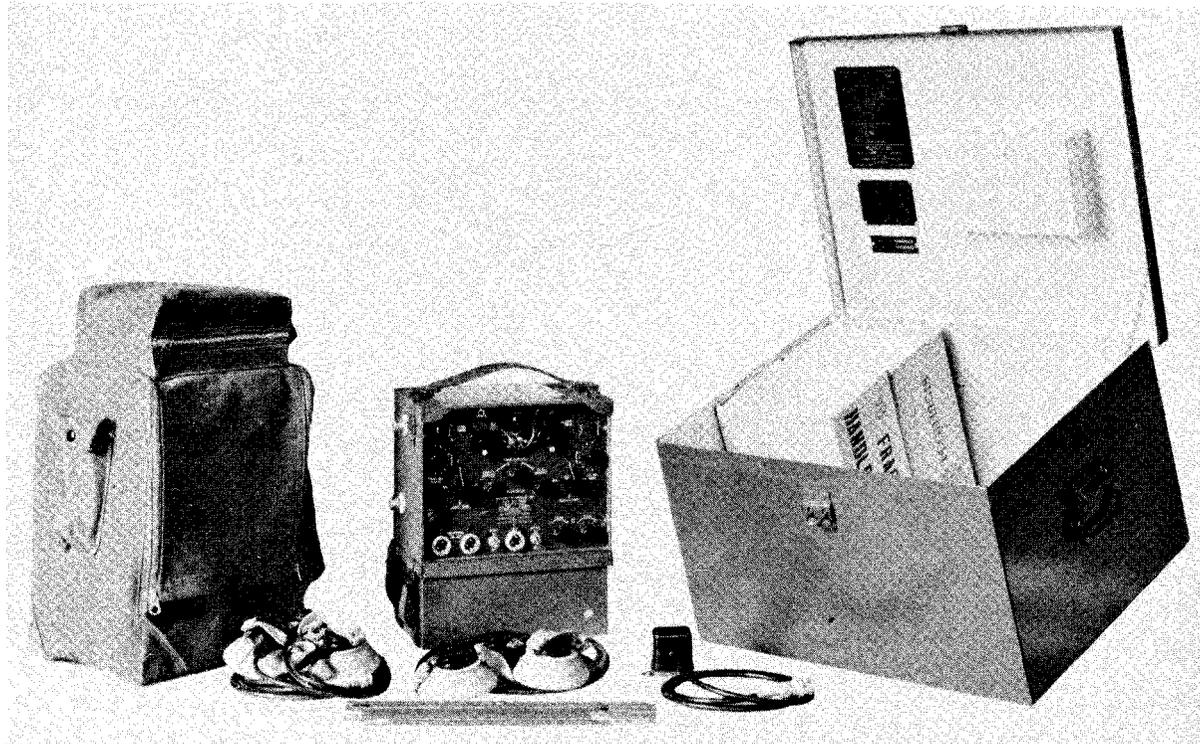
Use.—Portable pack equipment—Marines.

Frequency range.—Transmission and reception: 28,000–80,000 kc. in 4 bands with 131 calibrated channels separated by 400 kc.

Power output and emission.—Transmitters—0.5 watt, A₂, A₃.

Description.—The Models TBY, TBY-1, and TBY-2 portable radio transmitting and receiving equipments are high to very high frequency self-powered, moisture-resistant, pack-type equipments, designed to provide two-way modulated telegraph or telephone communication, within line of sight distances. All three models are identical and are intended pri-

throughout the transmitter-receiver frequency range. The dry battery pack power supply is designed to be strapped to the bottom of the transmitter-receiver unit, and furnishes the voltages required for continuous operation of the equipment over a period of 30 hours. Two fittings, mounted on the left side of the transmitter-receiver unit, provide connection and support of the antenna, which is of the sectionalized, demountable type. Provision is made for the simultaneous use of the two microphone-headphone assemblies, so that the operation of the equipment may be monitored by a second operator, if desired. In this case, control of the equipment may be transferred from one operator to



Model TBY-2 transmitter-receiver showing pack cover and shipping case.

marily for use by Marine foot troops. The equipment is so constructed that it may be set up in minimum time and easily operated by one man either in the field or while being transported as an approximate 30-pound knapsack load on the back of the operator.

The components are built of light weight durable material to provide portability and satisfactory operation during transportation over difficult terrain. Large exposed surface areas of the various units are finished in dull olive green. The transmitter-receiver unit contains a transmitter RF section, receiver RF section, an audio amplifier section, common to both the transmitter and receiver, and a 5000 kc. crystal oscillator to provide calibrated check points every 12½ channels

the other at will. The two microphone-headphone assemblies are identical and are each equipped with a press-to-talk switch, which transfers the transmitter-receiver unit circuits from the "receive" position to the "transmit" position when pressed. The key cord and plug assembly incorporates a "send-receive" switch which performs the same function as the "press-to-talk" switch on the microphones, so that both telegraph and telephone two-way operation is available while the equipment is being transported as a pack load. Provision is made to carry one spare tube of each type inside the transmitter-receiver unit cover. The equipment is carried in a canvas case provided with shoulder straps. The shipping chest is designed for

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stowage of the equipment and the mobile spare parts.

The *transmitter-receiver* unit is housed in a spot welded, sheet aluminum cabinet with a hinged cover. To the bottom of the case is spot welded a bent up angle frame to provide a positioning flange for retaining the battery power supply unit. The cover is equipped with a strap handle to facilitate lifting of the unit. On the top center of the cover is fastened the unit calibration chart. To the right of this chart a space and suitable catches are provided to permit mounting of the telegraph key on the transmitter-receiver unit, if so desired. Snap-catches hold the cover in place and allow quick access to the interior of the case for inspection of the RF circuits and the replacement of vacuum tubes. For servicing purposes the chassis may be entirely removed from the case. All the tuning controls, the key jack, and the two headphone-microphone jacks are located on a recessed front panel. Special fittings are located on the left hand side of the unit for electrical connection and support of the antenna.

The circuits of the transmitter-receiver unit consist of the four following distinct parts: Transmitter RF section, receiver RF section, audio amplifier section and crystal calibrator section. The audio amplifier and crystal calibrator sections are common to both the transmitter and receiver. The transmitter RF section employs two Navy type 958-A tubes in a "Hartley" push-pull oscillator circuit. The receiver RF section employs a Navy type 959 tube in an amplifier circuit followed by a Navy type 958-A tube in a super-regenerative detector circuit. The audio amplifier section employs a Navy type 30 tube (used as a tone generator during MCW transmission and as an amplifier for the receiver detector tube during reception) and a Navy type 1E7G tube, which is used as a modulator for voice transmission, and as an amplifier for MCW transmission. The crystal calibrator section employs a Navy type 30 tube in a 5000 kc. crystal oscillator circuit to provide check points every 12½ channels throughout the frequency range.

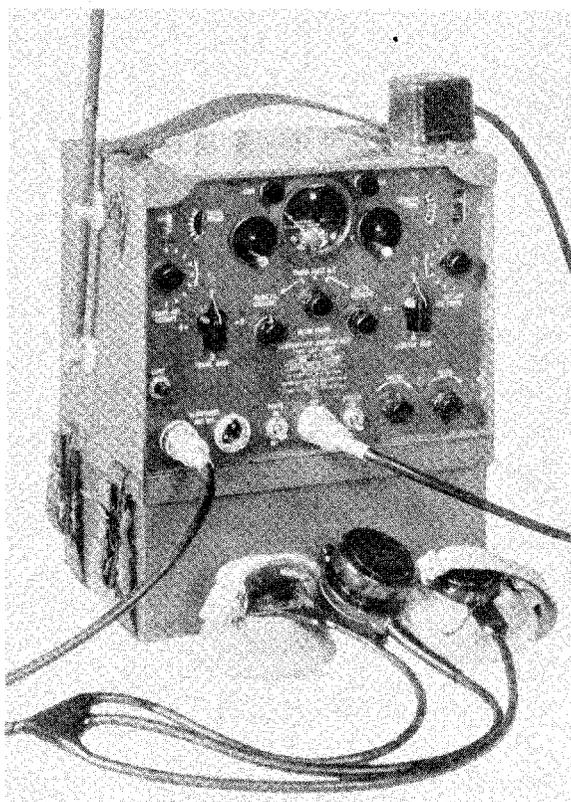
The *dry battery pack* is designed to fit into position on the transmitter-receiver unit by means of a connection socket located on the top of the battery, which fits into a corresponding connection plug located on the bottom of the transmitter-receiver unit. The battery is enclosed in a light weight, metal container, to protect it from becoming defective when set in water or other foreign matter up to a depth of approximately two inches. Made up of four individual sections, this unit supplies the equipment with the following required voltages and current: Bias lead, 7.5 volts at 20 ma, for transmitter load; filament lead, 1.5 volts at 200 ma, for transmitter load; filament lead, 3 volts at 375 ma, for transmitter load; 300 ma for receiver load. Plate lead, 156 volts at 30 ma for transmitter load, and 16 ma for receiver load. These sections are so proportioned as to rating that each will supply the load required for a duration of 30 hours continuous operation, composed of alternate fifteen minutes of transmission and fifteen minutes of reception.

The *microphone-headphone* assemblies each consist of an aircraft type antinoise microphone and a special light weight headphone assembly. The microphone

is equipped with a press-to-talk switch which transfers the transmitter-receiver unit circuits from the "receive" position to the "transmit" position when pressed. The headphones may be held in place on the operator's head by means of a chin strap so that the hands are left free to manipulate the microphone.

The *key, cord, and plug assembly* consists of a specially designed key, housed in a small aluminum box. In addition to the actual key, this unit contains a "send-receive" switch which transfers the transmitter-receiver unit circuits to the "receive" or "transmit" position when pressed. A rubber cap is provided to cover the key when operation in rain is necessary.

The *antenna* which is of the collapsible, demountable type is made up of ten sections of chrome molybdenum



Model TBY transmitter-receiver equipment set up for operation.

stainless steel tubing, chromium plated. The number of sections to be used varies with different operating frequencies and the length and diameter of the sections vary depending on the position each occupies in the complete assembly. The sections are from 3/32 to 3/8 inch in diameter, and from 12 to 13½ inches in length. The total length of the antenna, when fully assembled, is nine feet. This antenna has sufficient resilience to bend through an arc of at least 5° per section without becoming damaged, or taking a permanent set.

The *canvas carrying case*, is designed to hold all of the above units in three zipper and snap fastened compartments. The case is equipped with wide adjustable shoulder straps designed to pass over the shoulders and under the arms where they are fastened by snap

catches to two rings located at the lower corners of the case. Two secondary straps are supplied to keep the shoulder straps in place. These straps fall straight from the chest, are adjusted to the proper length and secured to a regulation pistol-belt by means of catches.

The *shipping chest* holds the complete equipment, including mobile spare parts. This chest is constructed of sheet steel and is provided with a hinged cover which may be locked in place by means of a standard Navy lock attached to the chest. The interior of the chest is divided into compartments, which maintain the equipment in its proper position.

TECHNICAL FEATURES

Design—Navy.

Tube complement

| Location | Number of tubes | Type |
|---|-----------------|------|
| Push-pull oscillator..... | 2 | 958A |
| Audio amplifier..... | 1 | 30 |
| Receiver RF amplifier..... | 1 | 959 |
| Receiver detector..... | 1 | 958A |
| Audio output amplifier and modulator..... | 1 | 1E7G |
| Crystal calibrating oscillator..... | 1 | 30 |
| Total..... | 7 | |

Frequency control.—Master oscillator. Crystal controlled calibrating oscillator.

Power.—*Supply (regular):* Dry battery pack with life of 30 hours.

Supplies (optional): (1) Navy type CLG-19029 storage battery, CLG-20144 vibrator power pack, CLG-20445 battery charger.

(2) Navy type CLG-20206 110-volt a-c, d-c, vibrator power pack.

Operating control.—Front of panel and "send-receive" switch located at end of a 4-foot cable.

Type of keying.—Relay—40 words per minute.

Type of reception.—A₂, A₃.

Receiver output.—600-ohm headphones.

Antenna.—*Regular*—attached 9-foot collapsible demountable type.

Optional—Shipboard whip antenna Navy type 66089 designed to operate on 72.5 mc.

Accessories not supplied by contractor.—Power supplies: (1) Storage battery CLG-19029, vibrator CLG-20144; (2) Battery charger CLG 20445; (3) Vibrator power pack CLG-20206; (4) Antenna—Shipboard type 66089.

Weights dimensions and Navy type numbers of equipment units included in contract

| Unit | Navy type Nos. | Height | Width | Depth | Weight |
|---|----------------|---------------------------------|--------------------------------|---------------------------------|------------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Shipping chest (empty)..... | CAY-10038. | 10 ³ / ₈ | 20 | 16 ⁷ / ₁₆ | 20.6 |
| Transmitter-receiver including battery..... | CAY-43007. | 12 ³ / ₄ | 10 ² / ₃ | 7 ¹ / ₄ | 23 |
| Battery pack..... | CGD-19018. | 4 ¹ / ₄ | 9 ³ / ₈ | 6 ⁹ / ₁₆ | 13 |
| Canvas carrying case..... | CSS-10039. | 15 ⁷ / ₈ | 12 ³ / ₈ | 7 ⁷ / ₈ | 3.5 |
| Key cord and plug assembly..... | CAY-26013. | 11 ³ / ₁₆ | 1 ³ / ₄ | 2 ⁵ / ₁₆ | 1.0 |
| Microphone-headphone assembly (2 furnished)..... | CTE-51022. | | | | 1.25 |
| Antenna..... | CWA-66025. | (¹) | | | (²) |
| Equipment mobile spare parts in shipping chest..... | | 10 ⁷ / ₈ | 20 | 16 ⁷ / ₁₆ | 82 |

¹ 9 feet extended.
² 10 ounces.

Equipment mobile spare parts

| | |
|-----------------------------------|---|
| Antenna..... | 1 |
| Antenna supports (set)..... | 1 |
| Dry battery packs..... | 2 |
| Indicator light bulbs..... | 2 |
| Vacuum tubes (set)..... | 1 |
| Instruction books..... | 2 |
| Test data books..... | 1 |
| Keys for shipping chest lock..... | 2 |

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet |
|--|---------------|---------------|------------|
| | <i>Inches</i> | <i>Pounds</i> | |
| Equipment and equipment mobile spare parts in chest as shipped in box..... | 28 x 22 x 20. | 140 | 7.13 |
| Stock spare parts box..... | 28 x 18 x 17. | 140 | 4.96 |



TCA-1 RADIO TRANSMITTING EQUIPMENT

Use.—Air station control towers—General shore.

Frequency range.—3000-9050 kc. (4 quick-shift frequencies, any 2 between 3000-5100 kc., and any 2 between 5100-9050 kc.).

Power output and emission.—15 watts, A₃.

Description.—The Model TCA-1 radio telephone equipment is designed primarily for installation in air station control towers, for communication to aircraft, but may be used for shore installations wherever high-frequency, low-power equipment with up to four quickly available frequencies is required. Model TCA series of equipments are in current use but have been superseded by the TCS.

The *transmitter*, which is of the console type of construction, suitable for table mounting, consists of a



Model TCA-1 desk set.

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radio frequency unit inserted into the center front of a modulator and power unit and housed in a heavy gauge electrically welded sheet steel cabinet which fits over the two units and may easily be removed for servicing purposes. Mounted on the left section of the front panel from top to bottom, respectively are the modulation meter, grid current meter and filament switch with indicator light. The center portion of the front panel contains the frequency selection switch and four individual sets of tuning controls one for the operation of each of the four frequency channels. The four sets of tuning controls provide a means of switching from one frequency to another within 30 seconds without the necessity of retuning the transmitter. On the right section of the front panel are mounted respectively from top to bottom the antenna post, plate current meter, plate current meter selection dial, plate switch and indicating light. Connections for control circuits of an associated receiver are provided in the right side of the transmitter.

The *radio-frequency portion of the transmitter* contains a Navy type 6L6G beam pentode electron coupled crystal oscillator, impedance coupled to a buffer Navy type 807 tube which may be operated as either a straight amplifier or as a doubler amplifier. The power amplifier uses a Navy type 807 tube as a class C plate modulated stage. The output circuit is a pi network designed to operate into an unbalanced antenna or transmission line.

The *audio portion of the transmitter* unit consists of a Navy type 6J5G audio amplifier and two Navy type 807 push-pull class A modulator tubes. Carrier control is obtained by the use of a push-to-talk switch on the microphone.

The *power portion of the transmitter* employs a full

wave Navy type 5U4G rectifier tube with an output of approximately 400 volts at 250 ma. This rectifier in conjunction with various resistors supplies potential for all the transmitter stages.

The *desk set* is provided with a 12 terminal plug for connection to the 12 terminal flush receptacle on the right side of the transmitter.

TECHNICAL FEATURES

Design—Navy.

Tube complement

| Location | Number of tubes | Type |
|-----------------------|-----------------|------|
| Power amplifier..... | 1 | 807 |
| Buffer amplifier..... | 1 | 807 |
| Power rectifiers..... | 2 | 5U4G |
| Audio amplifiers..... | 1 | 6J5G |
| Modulators..... | 2 | 807 |
| R.F oscillator..... | 1 | 6L6G |

Frequency control.—Crystal.

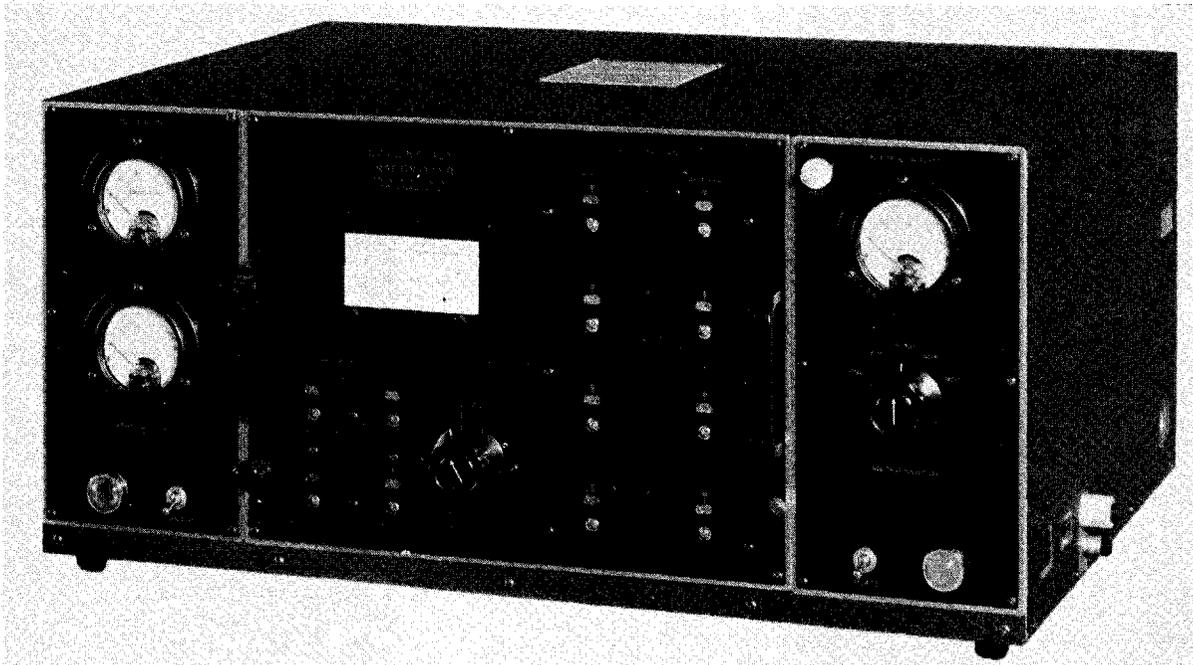
Power.—Supplies Available: 110/115 1-phase 50/60 cycles. 110/115 1-phase 50/60/25 cycles.

POWER REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current amps., maximum per phase | Kilowatts | Kilovolt-ampere | Power factor (percent) |
|---------------|---------------------------------------|-----------|-----------------|------------------------|
| 115/1/60..... | 2.0 | 0.200 | 0.235 | 85 |
| 115/1/25..... | 2.2 | .200 | .250 | 80 |

Operating control.—Desk telephone set equipped with press-to-talk button.

Antenna.—The equipment is designed to work into an unbalanced antenna, or transmission line having



Transmitter for Model TCA-1 equipment.

from 70 to 600 ohms resistance and up to 1,000 ohms reactive impedance. Recommended antenna: Single wire end fed with a conductor of at least $\frac{3}{8}$ inch outside diameter. The length of the antenna, including lead-in, should be at least $\frac{1}{4}$ wave length long on the lowest operating frequency. A suitable material is phosphor bronze cable.

Shipping weights and dimensions (shipped in two (2) boxes).

| Unit | Size | Gross weight | Cubic feet |
|----------------------------------|---------------------------------|----------------------|------------|
| Transmitter and accessories..... | <i>Inches</i> 22 x 32 x 48.. | <i>Pounds</i> 310 | 19.60 |
| Spare parts..... | 12 x 19 x 29.. | 115 | 3.83 |

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Weights and dimensions of equipment units included in contract

[Type numbers are those of the Collins Manufacturing Co.]

| Unit | Type No. | Height | Width | Depth | Weight |
|--------------------------------|-----------|---------------|---------------|---------------|---------------|
| Transmitter-rectifier: | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| 50/60 cycle operation..... | 32T-1.. | } 12 | 27 | 19 | 170 |
| 25/50/60 cycle operation..... | 32T-2.. | | | | |
| Desk set..... | 223F-5.. | ----- | ----- | ----- | ----- |
| Power line connector cord..... | 65J-1.. | ----- | ----- | ----- | ----- |
| Receiver connector..... | 365N808.. | ----- | ----- | ----- | ----- |

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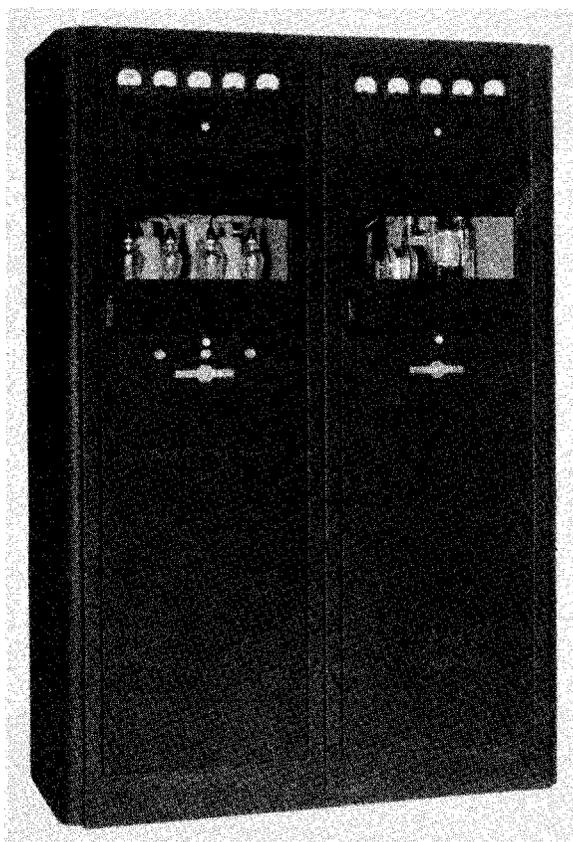
TCC-1 RADIO TRANSMITTING EQUIPMENT

Use—Shore.

Frequency range.—2000–18,100 kc. (rapid choice of any 1 of 10 preselected channels).

Power output and emission.—1,000 watts, A₁; 600 watts, A₂, A₃.

Description.—The Model TCC-1 radio transmitting equipment is designed for shore use where medium and high frequency telegraph, modulated telegraph and telephone operation on a number of instantly selectable frequencies is required. By means of a Collins auto-tune motor and telephone dial system, frequency change, choice of emission and starting and shutting



Transmitter for Model TCC-1 equipment.

down the equipment is accomplished either at the transmitter or a remote point.

The *transmitter and power-modulator assemblies* are constructed of autobody steel and are bolted together side-by-side. The front panel of each assembly is in the form of a door by means of which access to the interior is gained for maintenance and repair. The operating controls are reached for tuning and adjustment through two small doors located in each main door. Windows in the center of the doors provide a means of viewing the power amplifier and high voltage rectifier tubes. The meters are mounted in a row along

the top of each assembly. The assemblies are composed of a number of chassis-type removable units mounted one above the other and supported by brackets attached to the sides of the cabinets. A ventilation blower is located in a small compartment at the bottom of each assembly for filtering and circulating air to cool the equipment.

The *remote control unit* is designed for mounting in a standard 19-inch relay rack. All external connections to the 4-wire remote control system are made on the rear of the unit. A key on the panel provides local-remote intercommunication during testing periods and a meter is provided to indicate the operating frequency.

The *desk set*, used in conjunction with the remote control unit, contains the telephone dial for controlling the transmitter frequency and emission, the PHONE-CW switch, telephone handset, and keying jack.

TECHNICAL FEATURES

Design.—Commercial.

Tube complement

| Location | Number of tubes | Type |
|---|-----------------|-----------|
| RF oscillator and multiplier | 1 | 837 |
| Frequency doubler | 1 | 807 |
| Intermediate amplifier | 1 | 813 |
| Power amplifier | 2 | 833A |
| First audio amplifier and second preamplifier | 2 | 6F8G |
| First preamplifier | 1 | 6J7G |
| Second audio amplifier | 1 | 6J5G |
| Volume limiter control | 1 | 6C8G |
| Limiter amplifier | 1 | 6R7G |
| Audio driver | 2 | 807 |
| Modulator | 2 | 833A |
| Preamplifier (remote) | 1 | 6F6G |
| V. O. amplifier and V. O. control | 2 | 6Q7G |
| Keyer tube | 1 | 6S7 |
| MCW oscillator | 1 | 6L7G |
| Low-voltage rectifier | 2 | 866A |
| High-voltage rectifier | 4 | 866A |
| Bias rectifier | 2 | 866A |
| Relay power supply rectifier | 4 | 83 |
| Power rectifier (remote) | 1 | 5U4G |
| Preamplifier power rectifier | 1 | 5U4G |
| Keyer power rectifier | 1 | 84 |
| Voltage regulator | 2 | VR-105-30 |
| Total | 37 | |

Frequency control.—Crystal.

Power.—Supplies available. 220/3/60, 220/3/25.

REQUIRED FOR LOCKED-KEY OPERATION

| Power supply | Emission | Modulation (percent) | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|-----------------------|---------------------------------|----------------------|--|------|------|------------------------|
| 220/3/60 | A ₁ | | 13.8 | 4.80 | 5.22 | 92 |
| 220/3/60 | A ₂ , A ₃ | 100 | 17.5 | 6.20 | 6.67 | 93 |
| 220/3/25 ¹ | | | | | | |

¹ Data will be supplied when available.Allowable variation in supply line voltage $\pm 5\%$.

Operating control.—Front of panel; special remote control unit.

Carrier control.—Push-to-talk switch or voice control relay operation.

Type of keying.—Vacuum tube.

Antenna.—Horizontal, vertical, or combination with total length at least one-quarter wave length for lowest



Desk-set for Model TCC-1 equipment, showing Autotune dial.

operating frequency. Transmitter output is adjustable to work into 70- to 600-ohm circuits.

Remarks.—The TCC series of equipments are in current use, but have been superseded by the model TDH.

Weights, dimensions, and commercial type numbers² of equipment units included in contract

| Unit | Commercial type Nos. | Height | Width | Depth | Weight |
|--|----------------------|-----------------|-----------|-----------|------------|
| RF transmitter unit, 60 or 25 cycles, respectively | 1014-1 or 2 | Inches 78 | Inches 24 | Inches 24 | Pounds 600 |
| Power and modulator unit | 1021-1 | 78 | 24 | 24 | 1,600 |
| Transmitter and power units together | 231C | 78 | 52 | 24 | 1,640 |
| Remote control unit | 177G-1 | 10½ | 19 | 10 | 53 |
| Desk set | 223G-1 | 5½ | 5½ | 7½ | 5.75 |
| RH dust cover | 38M-1 | 78 | 24 | 2 | 20 |
| LH dust cover | 38M-2 | 78 | 24 | 2 | 20 |
| Station hand set and cord | 69K-1 | | | | |
| Interconnecting cable | 65V-1 | ¹ 15 | | | |
| Tool kit | 106C-1 | 4¼ | 10½ | 7½ | |
| Telegraph key | 274N-7 | | | | |
| Telegraph key, cord and plug | 65P-1 | ¹ 72 | | | |
| Metering cable extension | 65J-3 | ¹ 96 | | | |

¹ Length.

² Collins Manufacturing Co.

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet |
|--|--------------|--------------|------------|
| Complete equipment shipped in 24 boxes | Inches | Pounds 4,068 | 213.4 |
| Spare parts as shipped in 2 boxes | | 378 | 19.6 |
| Dimensions of largest box | 35 x 37 x 84 | 372 | 63 |



TCE-1 RADIO TRANSMITTING EQUIPMENT

Use.—Ship.

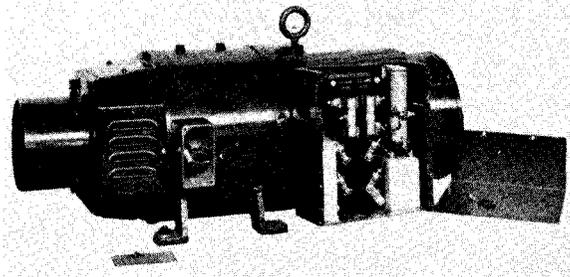
Frequency range.—350–9050 kc. covered by 6 plug-in tuning units with the following ranges: A 350–800 kc.; B 800–1500 kc.; C 1500–3000 kc.; D 3000–4525 kc.; E 4525–6500 kc.; F 6200–9050 kc.

Power output and emission.—85W, A₁, A₂; 30W, A₃ from 350–800 kc. 100W, A₁, A₂; 35W, A₃ from 800–1500 kc. 125W, A₁, A₂; 40W, A₃ from 1500–9050 kc.

Description.—The Model TCE-1 radio transmitting equipment is a modified design of the GP aircraft equipment, and is constructed for medium to high frequency low power operation on telegraph, modulated telegraph and telephone. The TCE series are extensively used on both small and large vessels and though in current use are gradually being superseded by the TDE.

The transmitter-rectifier is of the chassis type of construction. The case is of fabricated aluminum with an aluminum cover shield which may be removed for servicing purposes. All the controls are mounted on the front panel. The plug-in tuning units determine the frequency at which the equipment will operate, and are mechanically interchangeable in the center front of the transmitter. One of the six units provided is normally

left mounted in the transmitter-rectifier unit and the other five are housed in metal containers furnished for this purpose. Each plug-in tuning unit contains the necessary components and frequency controls to provide operation of the transmitter over the portion of the 350–



Model TCE-1 motor-generator.

9050 kc. frequency range for which it was designed. The transmitter-rectifier circuit components are so arranged as to minimize bulky wiring and all vacuum tubes are made accessible by removal of the tuning unit.

The motor-starter is of the remote controlled drip-

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proof, protected magnetic contactor type with all the switches, contactors, fuses and overload protection devices mounted on an insulated panel and housed in a metal box with a hinged cover. All external connections are made to the front side of the equipment panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

The *motor-generator* set is a two-unit¹ two-bearing assembly. The armature for the motor and generator are constructed on separate hollow shafts which are coupled together by means of a taper fit and through

supplies 800 watts at 120 volts single phase 800 cycles and 4 amperes at 14 volts D. C. for transmitter-rectifier operation. Drip-proof terminal boxes are located on the side of each unit and contain fuses for the protection of all circuits as well as terminals for all external connections.

The *control-transfer unit* consists of a "remote-local" switch and the necessary jacks to make operation of the transmitter possible on A₁, A₂, or A₃ emission from the local point when the remote-control unit is used in conjunction with the equipment.



Transmitter for Model TCE-1, -2, equipment with plug-in tuning unit in place.

bolt to form a single unit. Feet are provided on the motor for mounting the set in a horizontal position. The motor is 1.5 horsepower. D-c motors are provided with automatic speed regulators to maintain constant speed with normal variations in load, temperature and supply line voltage. The generator which is flange mounted to the right of the motor as viewed from the terminal box side is of the inductor alternator type and

¹ Motor Generators for all equipments are of the two bearing type with the exception of Navy type CC-21524 motor-generators, which are of the three bearing type, and were supplied with some of the first 120-volt D. C. contract equipments.

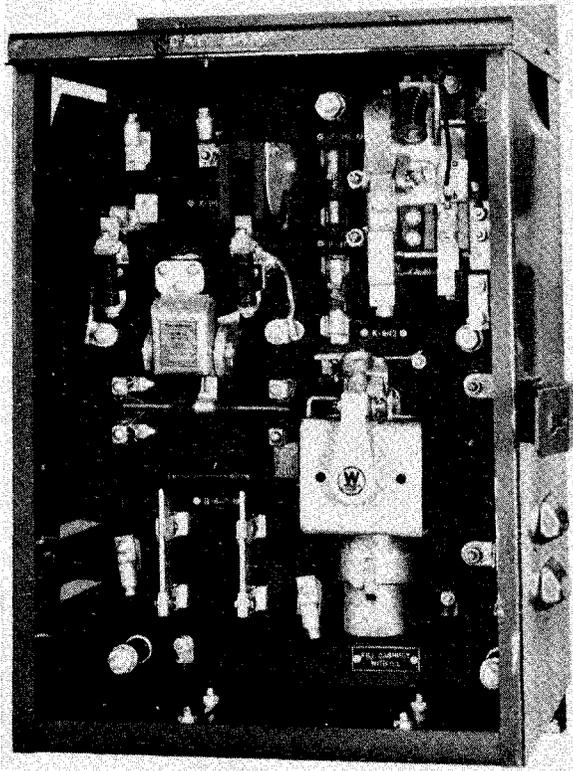
The *remote control unit* components are contained in a splash-proof, fabricated steel box; on the front panel are located a start-stop switch, indicator light, key, microphone and phone jacks. The remote-control unit may be directly connected to the transmitter if operation of the equipment from the remote point only is desired, or connected to the transmitter through the control-transfer unit if operation of the equipment is desired from either the remote or local point.

TECHNICAL FEATURES

Design—Navy

Tube complement

| Location | Number of tubes | Type |
|----------------------------------|-----------------|------|
| Power amplifier..... | 1 | 803 |
| Master oscillator..... | 1 | 801 |
| Audio amplifier..... | 1 | 843 |
| MO plate and bias rectifier..... | 1 | 5Z3 |
| Main plate rectifiers..... | 2 | 1616 |
| Total..... | 6 | |



Model TCE-1 magnetic controller.

Shipping weights and dimensions

[Figures given are for 230-volt D. C. equipment]

| Unit | Size | Gross weight | Cubic feet |
|---|---------------------------------|----------------------|------------|
| Transmitter-rectifier unit with plug-in tuning unit range A in place..... | <i>Inches</i> 35 x 27 x 24.. | <i>Pounds</i> 164 | 13.12 |
| Tuning units (5) in carrying cases..... | 39 x 30 x 19.. | 185 | 12.86 |
| Motor-generator set..... | 29 x 17 x 16.. | 200 | 4.56 |
| Magnetic controller..... | 26 x 19 x 17.. | 112 | 4.86 |
| Remote control unit..... | 13 x 12 x 13.. | 19 | 1.17 |
| Vacuum tubes (1 set)..... | 22 x 17 x 13.. | 26 | 2.81 |
| Basic spare parts box..... | 34 x 19 x 15.. | 174 | 5.60 |

Frequency control.—Master oscillator.

Power.—Supplies available: 32-, 120-, or 230-volt, D. C.; 115/1/60.

REQUIRED FOR STARTING

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|---------------------|--|------|------|------------------------|
| 32 volts D. C..... | 83.5 | 2.67 | | |
| 120 volts D. C..... | 26.0 | 3.12 | | |
| 230 volts D. C..... | 15.7 | 3.61 | | |
| 115/1/60..... | 50.0 | 2.87 | 5.75 | 50 |
| 230/1/60..... | 25.0 | 2.87 | 5.75 | 50 |

REQUIRED FOR LOCKED-KEY OPERATION

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|---------------------|--|------|------|------------------------|
| 32 volts D. C..... | 40.0 | 1.28 | | |
| 120 volts D. C..... | 10.9 | 1.31 | | |
| 230 volts D. C..... | 5.5 | 1.26 | | |
| 115/1/60..... | 14.9 | 1.4 | 1.72 | 81 |
| 230/1/60..... | 7.45 | 1.4 | 1.72 | 81 |

Allowable variation in supply line voltage $\pm 10\%$ D. C.; $\pm 5\%$ A. C.

Operating control.—Front panel position and special 4-wire remote-control unit.

Type of keying.—Relay—30 words per minute.

Antenna.—From 22 to 350 feet, depending upon frequency used.

Weights dimensions and Navy type numbers of equipment units included in contract

| Unit | Navy type Nos. | Height | Width | Depth | Weight |
|---|----------------|------------------|-------------------|------------------|--------|
| Transmitter-rectifier unit..... | CAY-5215L | 16 | 25 $\frac{3}{8}$ | 17 $\frac{1}{8}$ | 58 |
| Plug-in tuning unit (6) each..... | (1) | 8 $\frac{1}{2}$ | 10 $\frac{3}{16}$ | 9 $\frac{1}{2}$ | 13-15 |
| Plug-in tuning unit containers (5) each..... | CAY-47124 | 10 $\frac{7}{8}$ | 12 | 9 $\frac{1}{16}$ | 5 |
| Remote control unit..... | CAY-23245 | 6 | 5 $\frac{1}{16}$ | 5 $\frac{3}{8}$ | 4.25 |
| Magnetic controllers for 32, 120, or 230 volts D. C. operation..... | (2) | 20 $\frac{1}{2}$ | 13 $\frac{1}{2}$ | 12 $\frac{1}{4}$ | 60 |
| Magnetic controller for 115/1/60 operation..... | CAY-21420 | 17 | 11 | 8 $\frac{1}{2}$ | 30 |
| Motor-generator for 32 volts D. C..... | CC-21635 | 12 $\frac{1}{2}$ | 29 | 14 | 180 |
| Motor-generator for 120 volts D. C..... | CC-21636 | 12 $\frac{1}{2}$ | 26 $\frac{3}{8}$ | 12 $\frac{1}{2}$ | 160 |
| Motor-generator for 230 volts D. C..... | CC-21637 | 12 $\frac{3}{8}$ | 26 $\frac{1}{2}$ | 14 | 160 |
| Motor-generator for 115/230/1/60..... | CC-21638 | 12 $\frac{3}{8}$ | 22 $\frac{3}{4}$ | 14 | 160 |
| Set of vacuum tubes..... | | | | | 1.5 |
| Basic spare parts (in box) 32, 120, 230 volts D. C. equipment..... | | 15 | 34 | 19 | 122 |
| Basic spare parts 115/1/60 equipment..... | | 14 | 28 | 18 | 96 |

¹ Unit A, CAY-47150; unit B, CAY-47151; unit C, CAY-47155; unit D, CAY-47152; unit E, CAY-47153; unit F, CAY-47154.

² 32-volt, CAY-21418; 120-volt, CAY-21419; 230-volt, CAY-21558.

Accessories not supplied by contractor.

Control transfer unit, CAY-23346, height 9 inches, width 7 inches, depth 3 $\frac{3}{16}$ inches.

Aircraft microphone.

Headphones.

Telegraph key.

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TCE-2 RADIO TRANSMITTING EQUIPMENT

Use.—Ship—Low power.

Frequency range.—350–9050 kc. covered by 6 plug-in tuning units with the following ranges: A 350–800 kc.; B 809–1500 kc.; C 1500–3000 kc.; D 3000–4525 kc.; E 4525–6500 kc.; F 6200–9050 kc.

Power output and emission.—85W, A₁, A₂; 30W, A₃ from 350–800 kc. 100W, A₁, A₂; 35W, A₃ from 800–1500 kc. 125W, A₁, A₂; 40W, A₃ from 1500–9050 kc.

Description.—The transmitter-rectifier unit of Model TCE-2 equipment differs from that of Model TCE-1 in that the chassis construction is of zinc sprayed steel in lieu of fabricated aluminum and incorporates the necessary components to eliminate the necessity of the control-transfer unit provided with TCE-1 equipments.

One of two types of remote-control unit is supplied with this equipment. Type CAY-23305 has brackets arranged for bulkhead mounting.

Power.—Supplies available: 115 and 230 volts D. C.; 115/1/60, 208/3/60, 440/3/60.

POWER REQUIRED FOR STARTING

| Power source | Line current, maximum amperes per phase | Kilowatts | Kilovolt-amperes | Power factor (percent) |
|-----------------|---|-----------|------------------|------------------------|
| 115 volts D. C. | 60 | 6.9 | | |
| 230 volts D. C. | 30 | 6.9 | | |
| 440/3/60 | 11 | 5.4 | 8.38 | 64.0 |
| 115/1/60 | 42 | 1.8 | 4.9 | 23.7 |
| 208/3/60 | 23 | 5.4 | 8.38 | 64.0 |

POWER REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current, maximum amperes per phase | Kilowatts | Kilovolt-amperes | Power factor (percent) |
|-----------------|---|-----------|------------------|------------------------|
| 115 volts D. C. | 10 | 1.15 | | |
| 230 volts D. C. | 6.0 | 1.38 | | |
| 440/3/60 | 1.65 | 1.10 | 1.23 | 89.0 |
| 115/1/60 | 14.00 | 1.40 | 1.68 | 83.2 |
| 208/3/60 | 3.45 | 1.10 | 1.23 | 89.0 |

Accessories not supplied by contractor.—Aircraft microphone, headphones, telegraph key.

Shipping weights and dimensions

[Figures given are for 440/3/60]

| Unit (shipped in 6 boxes) | Size | Gross weight | Cubic feet |
|---|------------------------|---------------|------------|
| Transmitter-rectifier, remote control unit and plug-in tuning unit, range A | Inches 35 x 27 x 24 | Pounds 250 | 13.14 |
| Plug-in tuning units and containers (5) | 39 x 30 x 19 | 234 | 12.86 |
| Motor-generator set | 29 x 17 x 16 | 200 | 4.56 |
| Magnetic controller | 26 x 19 x 16 | 100 | 4.57 |
| Vacuum tubes | 22 x 15 x 13 | 20 | 2.42 |
| Basic spare parts box | 28 x 18 x 14 | 122 | 4.08 |

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type Nos. | Height | Width | Depth | Weight |
|--------------------------------------|--------------|--------------|---------------|---------------|--------------|
| Transmitter-rectifier | CAY-52151-AS | Inches 16 | Inches 25½ | Inches 17½ | Pounds 78 |
| Plug-in tuning units (6) each: | | | | | |
| Range A | CAY-47150-AS | 8½ | 10¼ | 9½ | 22 |
| Range B | CAY-47151-AS | 8½ | 10¼ | 9½ | 21.5 |
| Range C | CAY-47152-AS | 8½ | 10¼ | 9½ | 21.0 |
| Range D | CAY-47153-AS | 8½ | 10¼ | 9½ | 21.0 |
| Range E | CAY-47154-AS | 8½ | 10¼ | 9½ | 20.5 |
| Range F | CAY-47154-AS | 8½ | 10¼ | 9½ | 21.5 |
| Containers for tuning units (5) each | CAY-47226 | 10¾ | 12 | 9¼ | 6.25 |
| Remote-control unit | CAY-23245 | 6¼ | 6 | 5¾ | 4.25 |
| Do. | CAY-23305 | 3¼ | 5¾ | 5¾ | 3 |
| Magnetic controllers: | | | | | |
| 115 volts, D. C. | CAY-21873 | 20½ | 13½ | 12¼ | 60 |
| 230 volts, D. C. | CAY-21558 | 20½ | 13½ | 12¼ | 60 |
| 115/1/60 | CAY-21420 | 17 | 11 | 8½ | 30 |
| 208/3/60 | CAY-21846 | 14½ | 15½ | 9½ | 45 |
| 440/3/60 | CAY-21847 | 17½ | 15½ | 9½ | 50 |
| Motor-generator sets: | | | | | |
| 115 volts D. C. | CC-21636 | 12½ | 26½ | 14 | 175 |
| 230 volts D. C. | CC-21637 | 12½ | 26½ | 14 | 175 |
| 115/230/1/60 | CC-21638 | 12¾ | 22¾ | 14 | 160 |
| 208/416/3/60 | CC-21927 | 12½ | 22¼ | 12¾ | 150 |
| 220/440/3/60 | CC-21607 | 12½ | 22¼ | 12¾ | 150 |
| Vacuum tubes (1 set) | | | | | 1.5 |
| Basic spare parts in box: | | | | | |
| 115-230 volts D. C. equipments | | 15 | 34 | 19 | 122 |
| 115/1/60 equipments | | 14 | 28 | 18 | 96 |
| 208/3/60 | | | | | 90 |
| 440/3/60 | | | | | 90 |

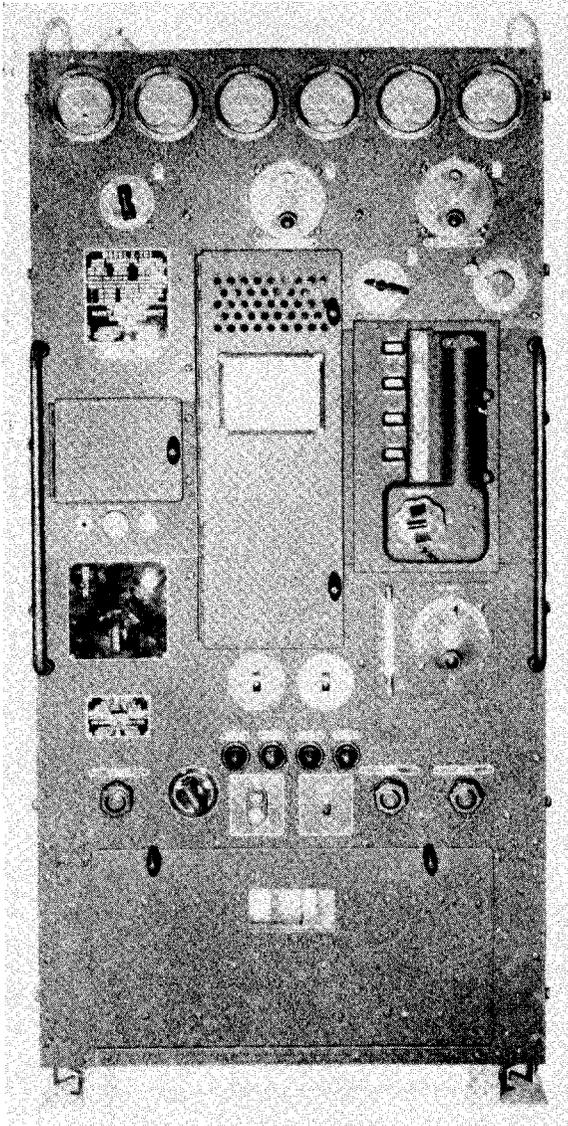
TCJ RADIO TRANSMITTING EQUIPMENT

Use.—Ship—shore.

Frequency range.—300–600 kc. (in four bands).

Power output and emission.—400 watts, A1; 200 watts, A2.

Description.—The model TCJ radio transmitting equipment is designed for medium frequency, telegraph and modulated telegraph operation on ship and shore



Transmitter for the Model TCJ radio transmitting equipment.

and is particularly desirable for installation where medium power equipment of small size is required. Similar to the TCK series in physical appearance and design, the TCJ incorporates the same feature of single dial control, calibrated directly in frequency, for "minimum-time" adjustment of all major tuning operations.

The transmitter is of the subassembly type of con-

struction with all components enclosed in a frame of welded chrome-moly steel tubing. All shields, sub-bases, partitions castings, and the front panel are of aluminum or aluminum alloy. Tuning of the entire transmitter with the exception of the antenna circuit is accomplished by a single tuning control with a separate directly calibrated dial for each of the four frequency bands. The dials may be calibrated within an accuracy of 0.02 percent by means of a built-in crystal frequency indicator unit consisting of a crystal oscillator and multivibrator which provides check points every 25 and 33.3 kc. throughout the operating range. A combination modulator and audio oscillator provides grid modulation of the power amplifier stage for A2 output.

The motor generator is a single unit two-bearing assembly with all armatures mounted on a common shaft to provide light-weight compact construction. The assembly consists of a 2-hp. motor and a combination high- and low-voltage generator. The combination generator delivers 0.35 ampere at 500 volts for the master oscillator plate and screen circuits, intermediate power amplifier plate and screen circuits, power amplifier screen circuits, audio circuits, and the crystal frequency indicator and 1.50 amperes at 115 volts for control circuits and fixed biases. This generator also delivers 0.4 ampere at 1,800 volts for the power amplifier plate circuit. Drip proof terminal boxes are located on the top of the unit and contain fuses for the protection of all circuits, as well as terminals for all external connection. Slip rings on the motor deliver 2.15 amperes A. C. at 163/1/60 for filament supply.

The motor starter is of the remote controlled magnetic contactor type with all switches, contactors, fuses, and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Function | Number of tubes | Type |
|--|-----------------|------|
| Master oscillator..... | 1 | 837 |
| Intermediate power amplifier..... | 1 | 807 |
| Power amplifier..... | 2 | 813 |
| Modulator and audio oscillator..... | 1 | 837 |
| Crystal frequency ind. oscillator..... | 1 | 6K8 |
| Multivibrator..... | 1 | 6SC7 |
| Detector and amplifier..... | 1 | 6SJ7 |
| Audio amplifier..... | 1 | 6F8G |
| Total..... | 9 | |

Frequency control.—Master oscillator.

Power.—Supplies available—115 volts D. C.; 230 volts D. C.

Allowable variation in supply line voltage.—±10%.

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POWER REQUIRED FOR STARTING

| Power source | Amperes maximum per phase | KW |
|----------------------|---------------------------|-----|
| 230 volts D. C.----- | 30 | 6.9 |
| 115 volts D. C.----- | 60 | 6.9 |

POWER REQUIRED FOR LOCKED KEY OPERATION

| | | |
|----------------------|----|-----|
| 230 volts D. C.----- | 10 | 2.3 |
| 115 volts D. C.----- | 20 | 2.3 |

Operating control.—Front of panel and Navy standard 4- or 6-wire remote control unit.

Type of keying.—Relay—100 words per minute.

Antenna.—500-1400 mmfd. capacity and 1.5-15 ohms resistance. In general will work satisfactorily into all antennas encountered in shipboard installations.

Type numbers, weights, and dimensions of equipment included in contract—230 volt D. C. equipment

| Unit | Type No. | Height | Width | Depth | Weight |
|--------------------------|----------|---|--|--|-------------------|
| Transmitter----- | CG-52257 | <i>Inches</i> 52 ⁹ / ₁₆ | <i>Inches</i> 24 ¹ / ₂ | <i>Inches</i> 20 ¹ / ₂ | <i>Pounds</i> 249 |
| Motor generator----- | CG-21798 | 14 | 38 | 12 ¹ / ₄ | 335 |
| Magnetic controller----- | CG-21628 | 28 ¹ / ₂ | 17 | 13 ¹ / ₂ | 131 |

Navy type numbers—115 volt D. C. equipment

| | | | | | |
|--------------------------|----------|-------|-------|-------|-------|
| Transmitter----- | CG-52242 | ----- | ----- | ----- | ----- |
| Motor generator----- | CG-21764 | ----- | ----- | ----- | ----- |
| Magnetic controller----- | CG-21627 | ----- | ----- | ----- | ----- |

Shipping weights and dimensions.—Data will be supplied when available.



TCJ-1 RADIO TRANSMITTING EQUIPMENT

Use.—Shore, ship.

Frequency range.—300-600 kcs (in four bands).

Power output and emission.—400 watts, A₁; 200 watts, A₂.

Description.—The model TCJ-1 transmitting equipment is designed for medium frequency telegraph and modulated telegraph operation on shore or ship and is particularly desirable for installation where medium power equipment of small size is required. Single dial control calibrated directly in frequency is the principal feature of this equipment, providing "minimum time" adjustment in all major tuning operations. The equipment is intended essentially for installation on shore and differs from the basic TCJ ship model in that a land line control unit, spare power supply and power transfer switch are provided. The equipment is also designed for a different input voltage and the transmitter incorporates slight control and keying circuit modifications in order that land line control may be employed. However, if so desired, the equipment may be used on ship—the transmitter being equipped with a link terminal board through which connections may be made for utilizing either a Navy standard 4- or 6-wire remote control system as well as the land line unit.

The transmitter unit is of the sub-assembly type of construction with all components enclosed in a frame of welded chrome-moly steel tubing. All shields, sub-bases, partitions, castings, and the front panel are of aluminum or aluminum alloy. Tuning controls for the master oscillator and intermediate and power amplifier circuits are ganged on a common shaft providing uni-control. The antenna circuits are separately controlled

and tuned in a conventional manner. A suitable dial associated with the ganged control and calibrated directly in frequency is employed for each of the six bands. The dials may be calibrated within an accuracy of 0.02 percent by means of a built-in frequency indicator unit consisting of a crystal oscillator and multivibrator which provides check points every 25 and 33.3 kcs. throughout the operating range. A combination modulator and audio oscillator provides grid modulation of the power amplifier stage for A₂ output.

The land line control unit is identical to that used with the model TBA-10 equipments. This unit is constructed of aluminum angles and gussets and is equipped with a pedestal designed so that the cabinet may be bolted to the floor. The components are mounted on a vertical panel inside the frame. The top, rear and side shields are removable. In addition a hinged door on the front panel permits access to the vacuum tubes and relays, and a removable panel section at the bottom of the unit provides access to the main terminal board, to which all incoming wires are connected. Through the use of this unit, it is possible to start, stop and telegraphically key the equipment over a 4-wire line up to 50 miles in length. Provision is made in the unit for keying the transmitter on A₁ emission by means of relay keying at speeds up to 100 words per minute, or keying the transmitter by means of vacuum tube keying at speeds up to 500 words per minute. A d. c. voltage of 40 to 100 volts is necessary in order to operate vacuum tube keying of the transmitter through this unit. A feature of the land line control unit is a time delay period during which the equipment is reduced to stand-

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by condition prior to automatic shutdown. The land line control unit takes its operating power from the transmitter.

The *motor generator set* is a single unit, two bearing assembly with all armatures mounted on a common shaft to provide light-weight compact construction. The assembly consists of a 2 h. p. motor and a combination high and low voltage generator. The combination generator delivers 0.35 ampere at 500 volts for the master oscillator plate and screen circuits, intermediate power amplifier plate and screen circuits, power amplifier screen circuits, audio circuits, and the crystal frequency indicator and 1.50 amperes at 115 volts for control circuits and fixed biases. This generator also delivers 0.4 ampere at 1,800 volts for the power amplifier plate circuit. Drip proof terminal boxes are located on the top of the unit and contain fuses for the protection of all circuits as well as terminals for all external connections.

The *motor starter* is of the remote controlled magnetic contactor type with all switches, contactors, fuses, and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

TECHNICAL FEATURES

Design.—Navy.

Frequency control.—Master oscillator.

Power.—*Supply available:* 220/3/60.

Requirements: Starting current (approximate per line) 47 amperes; total current, key locked (approximate per line) 7.4 amperes; total line input power, key locked, full power operation at 300 kcs., 2.4 kw.

Allowable variation in supply line voltage $\pm 10\%$; frequency $\pm 5\%$; combined voltage and frequency $\pm 10\%$ (5% each).

Tube complement

| Location and function | Number of tubes | Type |
|---|-----------------|------|
| Transmitter: | | |
| Master oscillator..... | 1 | 837 |
| Intermediate power amplifier..... | 1 | 807 |
| Power amplifier..... | 2 | 813 |
| Modulator and audio oscillator..... | 1 | 837 |
| Crystal frequency indicator oscillator..... | 1 | 6K8 |
| Multivibrator..... | 1 | 6SC7 |
| Detector and amplifier..... | 1 | 6SJ7 |
| Audio amplifier..... | 1 | 6F8G |
| Land line control unit: | | |
| Control rectifier..... | 1 | 5Z3 |
| Relaying tube..... | 1 | 807 |
| Keying tube..... | 1 | 807 |
| Total..... | 12 | |

Operating control.—Front of panel; Navy standard 4- or 6-wire remote control unit; land line control unit.

Type of keying.—Relay—100 words per minute; vacuum tube (when land line control unit is employed) 500 words per minute.

Antenna.—500–1400 mmfd. capacity and 1.5–15 ohms resistance.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type No. | Height | Width | Depth | Weight |
|--|----------|-----------------------------------|---------------------|-----------------------------------|----------------------|
| Transmitter..... | CG-52243 | <i>Inches</i> 52 $\frac{3}{8}$ | <i>Inches</i> 25 | <i>Inches</i> 18 $\frac{1}{4}$ | <i>Pounds</i> 285 |
| Motor generator sets (2), each..... | CG-21765 | 14 $\frac{1}{8}$ | 34 $\frac{1}{4}$ | 11 $\frac{1}{4}$ | 267 |
| Magnetic controllers (2), each..... | CG-21629 | 19 $\frac{3}{16}$ | 20 $\frac{7}{8}$ | 8 $\frac{13}{16}$ | 40 |
| Power transfer switch..... | CG-24092 | 12 $\frac{1}{4}$ | 16 | 9 $\frac{1}{4}$ | 14 |
| Land line control unit..... | CG-23269 | 42 $\frac{1}{8}$ | 24 | 15 $\frac{3}{4}$ | 160 |

Shipping weights and dimensions.—Data will be supplied when available.

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TCK TO TCK-3, INCLUSIVE, AND TCK-5 RADIO TRANSMITTING EQUIPMENTS

Use.—Ship, shore.

Frequency range.—2,000–18,100 kc. (in 6 bands).

Power output and emission.—400 watts A_1 , 100 watts A_3 .

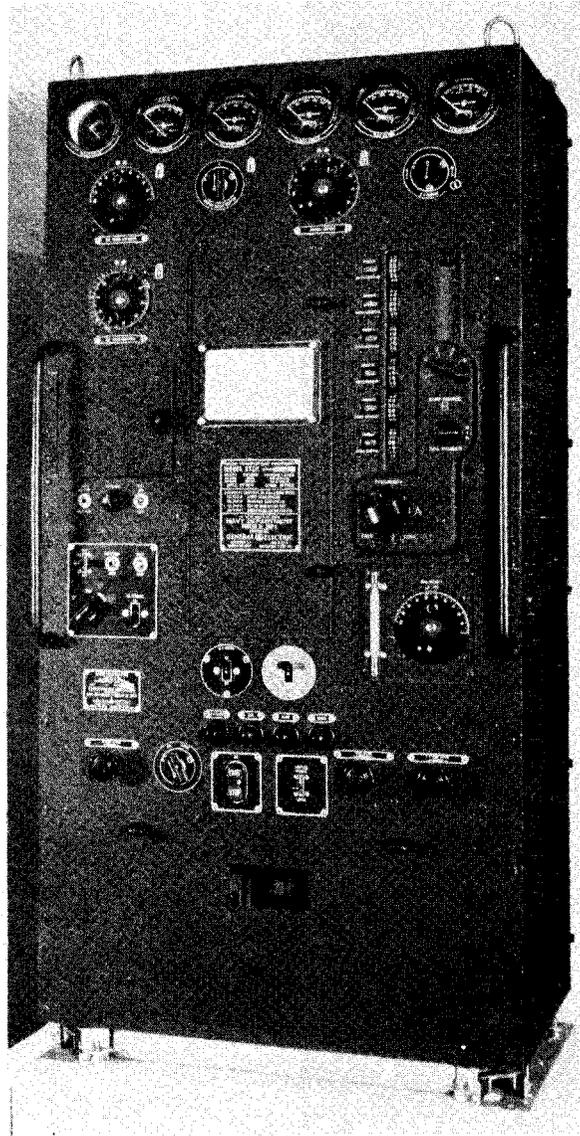
Description.—The models TCK to TCK-3 (inclusive) and the TCK-5 radio transmitting equipments are designed for medium and high frequency telegraph and telephone operation on ship and shore. Single dial control calibrated directly in frequency is the outstanding new feature of this equipment providing "minimum time" adjustment in all major tuning operations. Small in size, with a relatively high power output, the TCK models are particularly desirable for installation where space is limited to the exclusion of the average medium power equipment.

The transmitter is of the subassembly type of construction with all components enclosed in a frame of welded chrome-moly steel tubing. This type of frame, strong yet light in weight, is distinctly new in ship and shore transmitter construction. All shields, sub-bases, partitions, castings, and the front panel are of aluminum or aluminum alloy. Tuning controls for the master oscillator and intermediate and power amplifier circuits are ganged on a common shaft providing unicontrol. The antenna circuits are separately controlled and tuned in a conventional manner. A suitable dial, associated with the ganged control and calibrated directly in frequency is employed for each of the six bands. The dials may be calibrated within an accuracy of 0.02 percent by means of a built-in frequency indicator unit consisting of a crystal oscillator and multi-vibrator which provides check points every 100 kc. throughout the operating range. Choice of the desired band is obtained by means of a band switch. A_3 emission is provided by suppressor grid modulation of the power amplifier.

The motor generator is a single unit two-bearing assembly with all armatures mounted on a common shaft. This represents a departure from the usual type of interchangeable unit, bed plate mounting, and though less accessible, it results in a light weight compact set. The assembly consists of a 2-horsepower motor and a combination high and low voltage generator with a low voltage overhung generator attached to one end. The combination generator delivers 500 volts at 0.35 ampere for the master oscillator plate and screen circuits, intermediate amplifier plate and screen circuits, power amplifier screen circuits, audio circuits and the crystal frequency indicator and 115 volts at 1.50 amperes for control circuits and fixed biases. This generator also delivers 1,800 volts at 0.4 ampere for the power amplifier plate circuit. The low voltage generator delivers 12 volts at 2 amperes for field excitation of the combination low and high voltage generator and to supply the microphone current. The motor and overhung generator may be removed for servicing purposes. Drip-proof terminal boxes are located in the top of the unit and contain fuses for the protection of all circuits as well as terminals

for all external connections. (D. c. equipments provide a-c supply for filaments from slip rings located on the motor.)

The motor starter is of the remote controlled magnetic contactor type with all switches, contactors, fuses, and overload protection devices mounted on a panel



Transmitter for Model TCK equipment.

and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

The microphone filter unit is provided to filter the commutator ripple in the motor generator d-c voltage supply to the microphone.

TCK
TCK-1
TCK-2
TCK-3
TCK-5

TCK
TCK-1
TCK-2
TCK-3
TCK-5

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TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | Number of tubes | Type |
|---|-----------------|------|
| Master oscillator..... | 1 | 837 |
| Intermediate power amplifier..... | 1 | 837 |
| Power amplifier..... | 2 | 813 |
| Modulator..... | 1 | 807 |
| First speech amplifier..... | 1 | 6SK7 |
| Second speech amplifier..... | 1 | 6SQ7 |
| Crystal frequency indicator oscillator..... | 1 | 6K8 |
| Multivibrator..... | 1 | 6SC7 |
| Detector amplifier..... | 1 | 6SJ7 |
| Audio amplifier..... | 1 | 6F8G |
| Total..... | 11 | |

Frequency control.—Master oscillator.

Power.—Supplies available:

TCK—115, 230 volts D.C.; 220/440/3/60.

TCK-1—220/3/60; 115/1/60.

TCK-2—440/3/60

TCK-3—115, 230 volts D.C.

TCK-5—115 volts D.C.

REQUIRED FOR STARTING

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|--------------------|--|-----|------|------------------------|
| 115-volt D. C..... | 60 | 6.9 | | |
| 230-volt D. C..... | 30 | 6.9 | | |
| 220/3/60..... | 40 | 9.2 | 15.3 | 60 |
| 440/3/60..... | 20 | 9.2 | 15.3 | 60 |

REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|--------------------|--|-----|------|------------------------|
| 115-volt D. C..... | 20 | 2.3 | | |
| 230-volt D. C..... | 10 | 2.3 | | |
| 220/3/60..... | 7.4 | 2.4 | 2.68 | 89 |
| 440/3/60..... | 3.7 | 2.4 | 2.70 | 89 |

Allowable variation in supply line voltage: ±5% a-c equipment; ±10% d-c equipment.

Operating control.—Front of panel and Navy standard 4- or 6-wire remote control unit.

Carrier control.—Press-to-talk switch on microphone.

Type of keying.—Relay—100 words per minute.

Antenna.—All shipboard types; the design also allows operation into antenna trunks with lengths up to 20 feet.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type No. | Height | Width | Depth | Weight |
|--------------------------------|------------------|---------------------------------|----------------------------------|--------------------------------|---------------|
| 115-volt D. C.: | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Transmitter..... | CG-52214..... | 52 ⁵ / ₁₆ | 25 | 18 ³ / ₄ | 275 |
| Motor-generator..... | CG-21631..... | 14 ¹ / ₈ | 41 ¹⁵ / ₁₆ | 11 ³ / ₄ | 370 |
| Magnetic controller..... | CG-21627..... | 29 ⁹ / ₁₆ | 19 ⁷ / ₁₆ | 13 ¹ / ₂ | 130 |
| 230-volt D. C.: | | | | | |
| Transmitter..... | CG-52215..... | 52 ⁵ / ₁₆ | 25 | 18 ³ / ₄ | 280 |
| Motor-generator..... | CG-21632..... | 14 ¹ / ₈ | 41 ¹⁵ / ₁₆ | 11 ³ / ₄ | 370 |
| Magnetic controller..... | CG-21628..... | 29 ⁹ / ₁₆ | 19 ⁷ / ₁₆ | 13 ¹ / ₂ | 130 |
| 220/3/60: | | | | | |
| Transmitter..... | CG-52216..... | 52 ⁵ / ₁₆ | 25 | 18 ³ / ₄ | 285 |
| Motor-generator..... | CG-21633..... | 14 ¹ / ₈ | 38 ³ / ₄ | 11 ³ / ₄ | 320 |
| Magnetic controller..... | CG-21629..... | 19 ¹ / ₂ | 20 ⁷ / ₁₆ | 8 ¹ / ₂ | 40 |
| 440/3/60: | | | | | |
| Transmitter..... | CG-52216..... | 52 ⁵ / ₁₆ | 25 | 18 ³ / ₄ | 285 |
| Motor-generator..... | CG-21633..... | 14 ¹ / ₈ | 38 ³ / ₄ | 11 ³ / ₄ | 320 |
| Magnetic controller..... | CG-21630..... | 19 ¹ / ₂ | 20 ⁷ / ₁₆ | 8 ¹ / ₂ | 40 |
| 115/1/60: | | | | | |
| Transmitter..... | CG-52216..... | 52 ⁵ / ₁₆ | 25 | 18 ³ / ₄ | 285 |
| Motor-generator..... | CG-21982..... | 19 ¹ / ₂ | 20 ⁷ / ₁₆ | 7 ¹ / ₂ | 287 |
| Magnetic controller..... | CG-21972..... | 14 ¹ / ₈ | 39 ³ / ₄ | 11 ³ / ₄ | 70 |
| All voltages: | | | | | |
| Microphone circuit filter..... | CG-53087..... | 9 ⁹ / ₃₂ | 7 ⁷ / ₁₆ | 5 ³ / ₁₆ | 9 |
| Hand microphone..... | 51047A..... | | | | 1 |
| Chest microphone..... | CAU-51012-C..... | | | | 2 |
| Spare parts..... | | | | | |

Shipping weights and dimensions.—Information will be included when available.

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TCK-4 AND TCK-6 RADIO TRANSMITTING EQUIPMENTS

Use.—TCK-4—Shore—primarily advanced base; TCK-6—Ship-Coast Guard.

Frequency range.—2000-18100 kc. (in 6 bands).

Power output and emission.—400 watts A1, 100 watts A3.

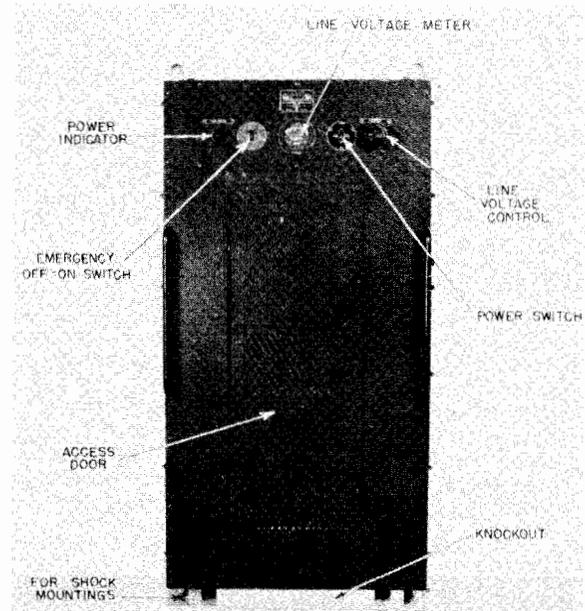
Description.—The TCK series of equipments was found to be superior in many ways to other Navy transmitting equipment for advanced base use. The model TCK-4 was designed primarily for this application when a need for larger numbers of these equipments for advance base installation developed. The model TCK-4 is similar to previous models, differing essentially in that it incorporates a rectifier power supply in lieu of a motor generator. Though the TCK-4 is intended for shore use, it is in every respect suitable for shipboard installation. The Coast Guard TCK-6

is in every way identical to the TCK-4. Any single unit of these equipments when uncrated for installation, and without further disassembly is capable of passage through a door 20 inches wide by 38 inches high with 10-inch radius at the corners, and through a hatch 25 inches by 20 inches.

- The principal design differences of the TCK-4 and TCK-6 transmitters in respect to previous a-c models are as follows:
1. Design of top of the transmitter to provide for mounting a transmission line coupling unit.
 2. Omission of field rheostats and resistors.
 3. The terminal box provides connections between the transmitter and rectifier.
 4. Transformers operate on 50 or 60 cycles.



Model TCK-4 radio transmitter.



Model TCK-4 rectifier power unit.

The *rectifier unit* is physically complementary to the transmitter in design. The front panel is divided into two separate sections. The top section is permanently attached to the frame and provides mounting for all panel controls and indicators. The lower section of the panel containing the tube and terminal board access door is removable to facilitate servicing. The principal components of the rectifier unit are mounted on three separate chassis which may be removed through the front of the frame when the lower section of the panel is removed. Four rectifier circuits are employed in this unit. A full-wave high-vacuum tube rectifier supplies 500 volts D. C. at 0.26 ampere for the master oscillator plate and screen circuits, intermediate amplifier plate and screen circuits, power amplifier screen circuits, audio circuits and the crystal frequency indicator. A full-wave high-vacuum tube bridge type

The *transmitter unit* is of the subassembly type of construction with all components enclosed in a frame of welded chrome-moly steel tubing. All shields, sub-bases, partitions, castings, and the front panel are of aluminum or aluminum alloy. Tuning controls for the master oscillator and intermediate and power amplifier circuits are ganged on a common shaft providing unicontrol. The antenna circuits are separately controlled and tuned in a conventional manner. A suitable dial associated with the ganged control and calibrated directly in frequency is employed for each of the

TCK-4
TCK-6
TCM
TCM-1
TCM-2
TCN
TCN-1
TCU
TCU-1
TCU-2

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rectifier supplies 1,800 volts D. C. at 0.36 ampere for the power amplifier plate circuit. Two dry disc, bridge-type rectifier circuits are used to furnish 12 volts D. C. at 0.86 ampere and 115 volts D. C. at 0.5 ampere, respectively, for microphone and keying relay current.

The *transmission line coupling unit* is of similar construction to the transmitter unit on which it is designed to be mounted. This unit is provided to permit satisfactory operation of the equipment into a two-wire balanced transmission line.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location and function | Number of tubes | Type |
|---|-----------------|------|
| Transmitter: | | |
| Master oscillator..... | 1 | 837 |
| Intermediate power amplifier..... | 1 | 837 |
| Power amplifier..... | 2 | 813 |
| Modulator..... | 1 | 807 |
| First speech amplifier..... | 1 | 6SK7 |
| Second speech amplifier..... | 1 | 6SQ7 |
| Crystal frequency indicator oscillator..... | 1 | 6K8 |
| Multivibrator..... | 1 | 6SC7 |
| Detector amplifier..... | 1 | 6SJ7 |
| Audio amplifier..... | 1 | 6F8G |
| Rectifier: | | |
| Full wave rectifier..... | 2 | 836 |
| Full wave bridge rectifier..... | 4 | 836 |
| Total..... | 17 | |

Frequency control.—Master oscillator.

Power.—*Supply available:* 115/230/1/50/60. *Required for locked key operation:* Approximately 1.8 KW and 1.95 KVA with a power factor of 92 percent. Allowable variation in supply line voltage: $\pm 15\%$.

Operating control.—Front of panel and Navy standard 4- or 6-wire remote control unit.

Carrier control.—Press-to-talk switch on microphone.

Type of keying.—Relay—100 words per minute.

★ ★ ★

TCM SERIES, TCN SERIES, AND TCU SERIES RADIO TRANSMITTING EQUIPMENTS

Use.—Ship and shore.

Frequency range.—TCM—2000 to 18,100 kc.; TCN—300 to 2000 and 2000 to 18,100 kc.; TCU—300 to 2000 kc.

Power output and emission.—TCM—125 watts, A₁; 30 watts, A₂, A₃. TCN—125 watts, A₁; 30 watts, A₂, A₃. TCU—125 watts, A₁; 30 watts, A₂.

Description.—Models TCM, TCN, and TCU series transmitting equipments are designed for ship and shore installations. They are of compact construction intended for use in limited space.

Transmitter and rectifier units of all models are housed in aluminum alloy cases which are identical except for depth. The chassis of all units are of similar construction and consist of duralumin angle frame to which the front panel is permanently secured. Shelf type construction is used for mounting the circuit components. Four rigid handles extending beyond

Antenna.—In general, the equipment will work satisfactorily into all single wire antennas encountered in typical land and shipboard installations. The design also allows operation into antenna trunks with lengths up to 20 feet. When the equipment is used with the transmission line coupling unit, operation is possible into a balanced transmission line, with a sending end reactance value not exceeding 2,000 ohms (either positive or negative) and with a sending end radio frequency resistance value not exceeding 3,500 ohms.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type No. | Height | Width | Depth | Weight |
|--|----------|---|---|--------------|---------------|
| Transmitter..... | CG-52299 | Inches 52 ³ / ₁₆ | Inches 24 ¹ / ₁₆ | Inches 18 | Pounds 240 |
| Transmitter with transmission line coupling unit mounted on top..... | | 61 ² / ₃₂ | 24 ¹ / ₁₆ | 16 | 305 |
| Transmission line coupling unit..... | CG-50139 | 9 ¹ / ₃₂ | 24 ¹ / ₁₆ | 16 | 65 |
| Rectifier..... | CG-20219 | 51 ² / ₃₂ | 24 ¹ / ₁₆ | 16 | 170 |
| Microphone..... | 51044A | | | | 75 |
| Spare parts box..... | | | | | |

Accessories not supplied by contractor.—Remote control unit, Navy standard 4- or 6-wire. Headphones for operation with crystal frequency calibrator. Telegraph key.

Shipping weights and dimensions

| Crate | Unit | Size | Gross weight | Volume |
|-------|---|--|--------------|------------|
| | | Inches | Pounds | Cubic feet |
| 1 | Transmitter, transmission line, coupling unit, microphone, and instruction books..... | 34 ³ / ₄ x 38 ¹ / ₂ x 72 ³ / ₄ | 450 | 55.2 |
| 2 | Rectifier unit..... | 34 ¹ / ₂ x 36 ³ / ₈ x 54 ³ / ₄ | 370 | 39.5 |
| 3 | Spare parts..... | 11 ¹ / ₈ x 15 ¹ / ₂ x 40 ³ / ₄ | 115 | 4.05 |

the panel controls afford a means of removing each chassis from its case.

The *HF transmitter unit* is composed of a master oscillator, two intermediate amplifier stages and a power amplifier stage. The final two stages are suppressor modulated for A₂ and A₃ emission.

The *LF transmitter unit* consists of a master oscillator, intermediate amplifier and power amplifier stage. The last stage is suppressor modulated for A₂ emission. Tone for A₂ modulation is obtained in both transmitter units by causing the modulator stage to oscillate at a frequency of approximately 1,000 cps.

Special cables are supplied to interconnect the various units.

The *rectifier unit* consists of three sections, main plate, auxiliary and keying circuit. All are of the single phase full wave type with the first two sections using rectifier tubes and the third a copper-oxide type

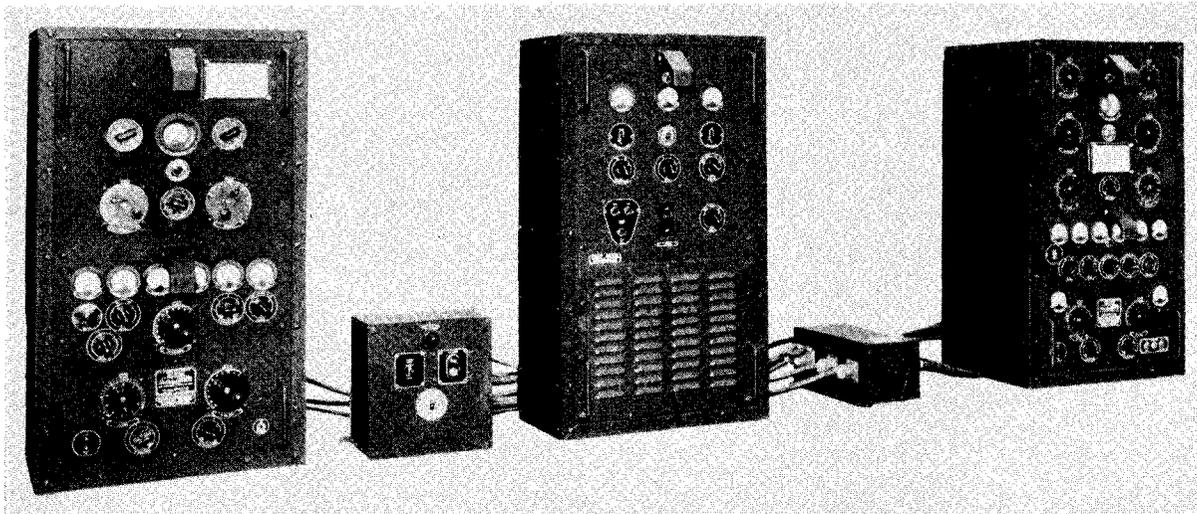
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rectifier. Each section has its own filter system so that the peak voltage ripple content in the output does not exceed 1 percent. The main plate rectifier supplies 1,350 volts, the auxiliary rectifier 550 volts and the keying circuit rectifier 58 volts. The main plate rectifier supplies the power amplifier stage and also microphone current by means of a resistor network. The auxiliary rectifier provides power for the master-oscillator and intermediate power amplifier stages. The keying circuit rectifier operates all control relays and supplies bias for the amplifier stages.

Shipping weights and dimensions

[As estimated]

| Unit | Size | Gross weight |
|----------------------|----------------|--------------|
| | Inches | Pounds |
| HF transmitter..... | 46 x 35 x 32.. | 410 |
| MF transmitter..... | 46 x 35 x 32.. | 382 |
| Rectifier..... | 46 x 35 x 32.. | 465 |
| Control unit..... | 24 x 19 x 19.. | 55 |
| Transfer switch..... | 24 x 19 x 19.. | 50 |



Model TCN transmitting equipment showing component units: low frequency transmitter, control unit, rectifier, power transfer switch, high frequency transmitter.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | Number of tubes | | | Type |
|--|-----------------|-----|-----|------|
| | TCM | TCU | TCN | |
| Master oscillator..... | 1 | 1 | 2 | *837 |
| First intermediate power amplifier..... | 1 | 1 | 2 | 837 |
| Second intermediate power amplifier..... | 1 | 1 | 1 | 837 |
| Power amplifier..... | 2 | 2 | 4 | 803 |
| Audio oscillator and modulator..... | 1 | 1 | 2 | 837 |
| Rectifier separate unit..... | 4 | 4 | 4 | 836 |
| Total..... | 10 | 9 | 15 | |

Frequency control.—Master oscillator.

Power.—Supply available: 115/1/50-62.

Required for locked-key operation: 1,200 watts.

Allowable variation in supply line voltage: -15%, +10%; frequency, 50-62 cycles.

Operating control.—Front of panel and 4- or 6-wire Navy standard telegraph or telephone remote control unit.

Type of keying.—Relay—40 words per minute.

Antenna.—Any antenna with values approximating a capacity of 380 mmfd., inductance of 38 microhenries and resistance of 5 to 50 ohms.

Remarks.—TCN combines the TCM and TCU but operates with only one rectifier unit and a transfer switch.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type Nos. | Height | Width | Depth | Weight |
|----------------------------|----------------|--------|--------|--------|--------|
| | | Inches | Inches | Inches | Pounds |
| TCM, -1, -2 | | | | | |
| HF transmitter..... | CG-52206.. | 36¾ | 20½ | 18¾ | 169 |
| Rectifier..... | CG-20122.. | 36¾ | 20½ | 14¾ | 229 |
| Control unit..... | CG-23241.. | 11½ | 12¾ | 9 | 17 |
| Chest microphone..... | (1) | | | | |
| Hand microphone..... | (2) | | | | |
| Spare parts box..... | | | | | 95 |
| TCN, -1 | | | | | |
| MF transmitter..... | CG-52205.. | 36¾ | 20½ | 18¾ | 146 |
| HF transmitter..... | CG-52206.. | 36¾ | 20½ | 18¾ | 169 |
| Rectifier..... | CG-20122.. | 36¾ | 20½ | 14 | 229 |
| Power transfer switch..... | CG-24094.. | 6¼ | 10 | 18¾ | 15 |
| Control unit..... | CG-23241.. | 11½ | 12¾ | 9 | 17 |
| Chest microphone..... | (3) | | | | |
| Hand microphone..... | (4) | | | | |
| Spare parts box..... | | | | | |
| TCU, -1, -2 | | | | | |
| MF transmitter..... | CG-52205.. | 36¾ | 20½ | 18¾ | 146 |
| Rectifier..... | CG-20122.. | 36¾ | 20½ | 14¾ | 229 |
| Control unit..... | CG-23241.. | 11½ | 12¾ | 9 | 17 |
| Spare parts box..... | | | | | 93 |

¹ Chest microphone: TCM, CAU-51012A; TCM-1, CAU-51046 (not furnished with TCM-2).

² Hand microphone: TCM and TCM-1, CAU-51006A; TCM-2, CMX-51004C.

³ Chest microphone: TCN, CAU-51012A; TCN-1, CAU-51046.

⁴ Hand microphone: TCN, CAU-51006A; TCN-1, CG-51006A.

Accessories not supplied by contractor.—Telegraph key.

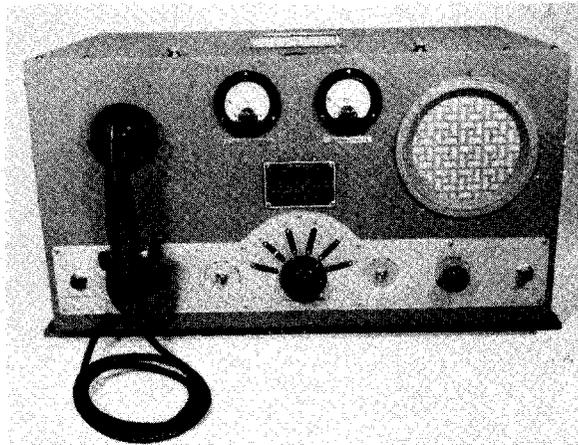
TCO, TCO-1, AND TCO-2 RADIO TRANSMITTING-RECEIVING EQUIPMENTS

Use.—Ship.

Frequency range.—Transmitter, 2000–3500 kc. (6 pretuned channels). Receiver, 2000–3500 kc. (6 pretuned channels).

Power output and emission.—25 watts A3.

Description.—The model TCO-2 radiotelephone equipment is designed for ship-to-ship and ship-to-shore communication. This equipment, also used by the U. S. Coast Guard Service, is identified by that branch of the service as the model TRC-121. Provison has been made, so that at a future date, a selective ringer may be used with the equipment to enable a local coastal harbor station to ring a bell aboard the ship on which the equipment is installed. Model TCO-2 differs from Model TCO and Model TCO-1 only in that the receiver has been improved by the addition of an RF amplifier stage to eliminate receiver radiation.



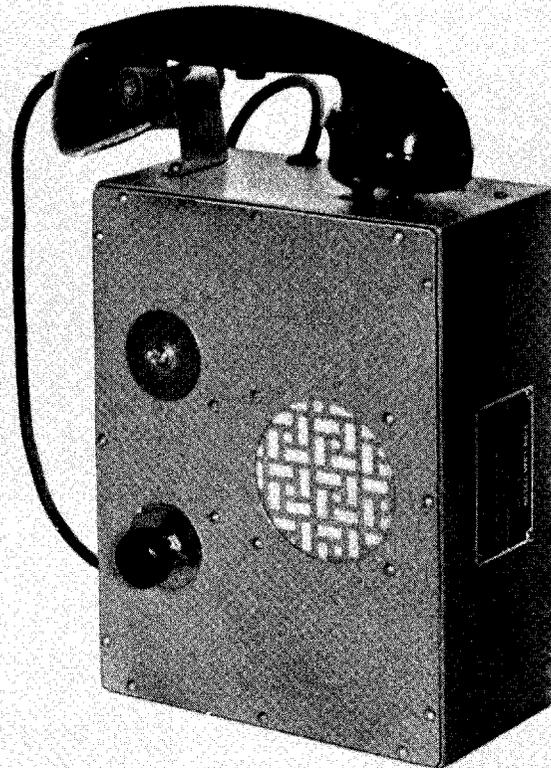
Transmitter-receiver for the TCO-2 radio equipment.

The *transmitter-receiver* unit components are constructed on a cadmium plated steel chassis with an aluminum front panel. The chassis is contained in a steel cabinet with a hinged cover top to provide access to the interior for servicing purposes. Rubber shock mounts at the base of the cabinet are connected to metal straps, the latter being employed to fasten down the unit to a table. A built-in loud speaker, telephone handset, switch hook, and all the necessary controls and meters are located on the front panel. A 10-conductor shielded cable is furnished for connection between the transmitter-receiver and power unit.

Power units for all d-c operated equipments are of similar construction. A steel cabinet with a hinged front cover contains the terminal board, fuse panel, starting relays, and RF filter assembly. An inverter to supply 115 volts, 0.5 ampere, 60-cycle a-c for the receiver circuits and a dynamotor to supply 630 volts,

0.23 ampere d-c for the transmitter circuits are mounted on the top of the cabinet. The inverter operates continuously when the receiver is turned on. Thy dynamotor operates only when the telephone handset is removed from its switch hook. The size of the conductor required for connection of the power unit to the incoming power line must be selected in accordance with the d-c power supply involved to minimize voltage drop.

A *rectifier power* supply is furnished for installations where the main power supply is 115/1/60. This unit



Remote control unit for the Model TCO-2 transmitting equipment.

employs two mercury vapor rectifier tubes and a filter network to furnish 630 volts, 0.23 ampere d-c for the transmitter. The receiver, including a built-in rectifier, is designed for operation directly from 115/1/60 and may be connected directly to that source of voltage in the rectifier power unit.

The *remote control* unit includes a handset, a loud speaker, a volume control, and a handset-loud speaker switch. A 10-conductor cable is furnished for connection of this unit to the transmitter-receiver unit. For remote operation it is necessary first to select the desired frequency and turn on the equipment through

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the transmitter-receiver unit. For future applications, provision is made in the remote-control unit to install a bell in connection with a selective ringer installation.

TECHNICAL FEATURES

Design.—Commercial.

Tube complement

| Function | Number of tubes | Type |
|--------------------------------|-----------------|------|
| Transmitter: | | |
| Crystal-controlled oscillator | 1 | 1624 |
| Power amplifier | 1 | 1624 |
| Modulators | 2 | 1624 |
| Receiver: | | |
| RF amplifier | 1 | 6SK7 |
| Converter | 1 | 6K8 |
| First IF amplifier | 1 | 6SK7 |
| Second IF amplifier | 1 | 6SK7 |
| Detector—First audio amplifier | 1 | 6SQ7 |
| Second audio amplifier | 1 | 6K6G |
| AVC amplifier | 1 | 6SK7 |
| Noise limiter—AVC rectifier | 1 | 6H6 |
| Power rectifier | 1 | 5W4 |
| Total | 13 | |
| Rectifier power unit | 2 | 866 |

¹ TCO-2 equipment only.

Frequency control.—Crystal.

Power.—Supplies available: 12, 32, 115, 230 volts D. C.; 115/1/60. Power requirements:

| Power source | Receiver "on" (standby) | 2-way communication | |
|-----------------|-------------------------|---------------------|--------------|
| | | Receiving | Transmitting |
| | Amperes | Amperes | Amperes |
| 12 volts D. C. | 10.0 | 20.0 | 32.0 |
| 32 volts D. C. | 3.5 | 7.0 | 12.0 |
| 115 volts D. C. | 1.0 | 2.0 | 3.0 |
| 230 volts D. C. | 0.5 | 1.0 | 1.5 |
| 115 volts A. C. | 0.6 | 1.8 | 3.0 |

2-way communication (receiving) requires handset off support and transmitter ready for use.
2-way communication (transmitting) requires handset off support and pushbutton closed to talk.

Operating control.—Front of panel and remote-control unit.

Carrier control.—"Push-to-talk button" on local or remote telephone set.

Type of receiver circuit.—Superheterodyne.

Receiver intermediate frequency.—455 kc.

Type of reception.—A3.

Receiver sensitivity.—Not more than 10 microvolts for audio output of 50 milliwatts to loud speaker with a signal to noise ratio of at least 4 to 1 in power.

Receiver output.—50 milliwatts.

Antenna.—Single wire T or L and vertical rod types with a capacity of 100–300 mmfds. The T or L types should have a total length, including lead-in, of approximately 25–35 feet. The vertical rod type should be at least 23 feet high.

Type numbers, weights, and dimensions of equipment units included in contract

| Unit | Type No. | Height | Width | Depth | Weight |
|--|------------------------|---------------------------------|--------------------------------|---------------------------------|--------|
| | | Inches | Inches | Inches | Pounds |
| Transmitter-receiver TCO-2 ¹ | CRM-43026 ¹ | 13 ³ / ₁₆ | 24 | 18 ³ / ₁₆ | 80 |
| Power supply unit: | | | | | |
| 115 volts D. C. | CRM-21554 | 12 ⁷ / ₈ | 22 | 5 | 44 |
| 12 volts D. C. | CRM-21563 | 12 ⁷ / ₈ | 22 | 5 | 44 |
| 32 volts D. C. | CRM-21564 | 12 ⁷ / ₈ | 22 | 5 | 44 |
| 230 volts D. C. | CRM-21565 | 12 ⁷ / ₈ | 22 | 5 | 44 |
| 115/1/60 | CRM-20120 | 9 ¹ / ₄ | 19 | 10 ¹ / ₄ | 54 |
| Remote control unit | CRM-23229 | 10 ³ / ₈ | 13 ³ / ₈ | 5 ³ / ₈ | 11 |
| 10-conductor shielded R/C cable, 50-foot length. | | | | | |

¹ Transmitter-receiver TCO, -1 CRM-43003.

Accessories.—Power conversion kits, for conversion of existing equipment to 12, 32, 115 or 230 volts D. C. are available if required.

Accessories not supplied by contractor.—Conductor for connection between d-c power unit and incoming power line.

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet |
|------------------------------------|--------------|--------------|------------|
| | Inches | Pounds | |
| Case 1—Transmitter-receiver | 50 x 29 x 21 | 230 | 17.1 |
| Case 2—Accessories and spare parts | 23 x 24 x 24 | 100 | 7.1 |

TCP-1 AND TCP-2 RADIO TRANSMITTING-RECEIVING EQUIPMENTS

Use.—Ship.

Frequency range.—2000–3000 kc. (A maximum of 1 transmitter and 1 receiver frequency may be used in each of the following 10 bands: 2000–2250 kc., 2000–2275 kc., 2000–2310 kc., 2070–2385 kc., 2210–2560 kc., 2350–2700 kc., 2480–2870 kc., 2570–2960 kc., 2625–3000 kc., 2710–3000 kc.)

Power output and emission.—75 watts, A3.

Description.—The identical models TCP-1, -2 radio telephone equipments are designed for ship-to-ship and ship-to-shore communication. Provision has been made so that at a future date a selective ringer may be used with the equipment to enable a local coastal harbor station to ring a bell aboard the ship on which the equipment is installed.

The equipment transmitter, receiver, and respective motor generator and rotary converter power supplies are contained in a nonmagnetic metal cabinet. The transmitter components are mounted in the upper section, the receiver components in a removable chassis in the center section and the power units in the lower section. The top, rear, and side shields of the cabinet may be removed for servicing purposes. Access to the main terminal board, fuses, and the automatic starter for the transmitter motor generator is obtained by removal of the lower front panel section.

The following transmitter controls are located on the upper section of the front panel:

Two meters, one to read the antenna current and one to read the various tube currents as determined by a "current" switch below this meter.

An antenna current tuning control.

A 10-position "Trans" switch for selection of the desired transmitter frequency.

A "press-to-talk—automatic" switch for press-to-talk or voice relay operation.

A "speaker-handset" switch for control of the incoming signal to the handset or loudspeaker.

An "off-on" toggle switch for turning the receiver off or on, and in the "on" position also permits the transmitter to be used when the handset is removed from its support. A green pilot light "transmitter on" is illuminated when the handset is removed from its support.

The following receiver controls as well as a built-in loudspeaker are mounted on the center section of the front panel:

A red pilot light, "receiver on."

A 10-position "Recr." switch for selection of the desired frequency.

A toggle type "volume-switch" for control of the receiver volume at either the local or remote position.

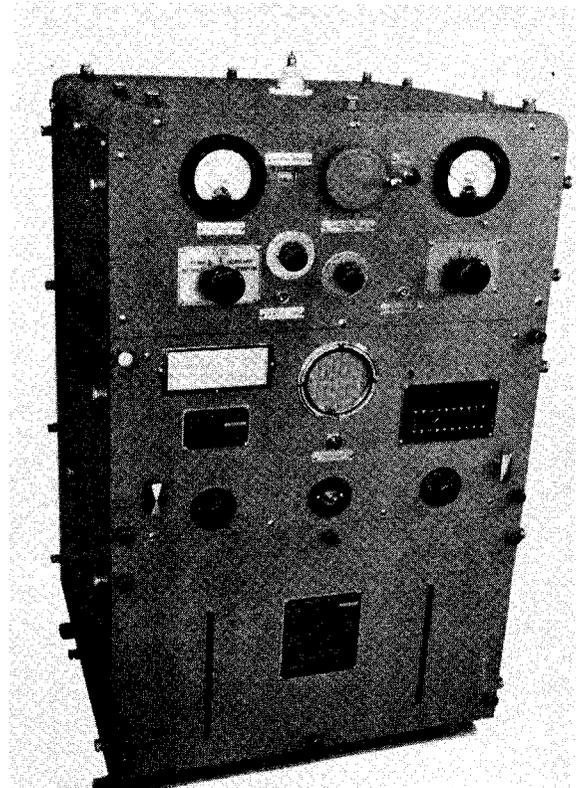
A local-receiver "volume" control.

Frequency marker plates are mounted on the front panel with provision for 10 plates, to indicate the positions to which the transmitter and receiver switches should be placed for the various operating frequencies.

The dynamotor transmitter power supply is a ball-bearing, enclosed machine 17½ inches long, 8¼ inches

high and 10½ inches deep, weighing 82 pounds. Dynamotors for 32-volt D. C. equipments have an output of 0.5 ampere at 550 volts D. C. and 4.55 amperes at 22 volts 60 cycles. Dynamotors for 115-volt D. C. equipments have an output of 0.5 ampere at 550 volts D. C. and 1.28 amperes at 78 volts 60 cycles. The alternating-current output is employed to energize all tube filaments in the transmitter. Power to the dynamotor is furnished through a magnetic controller situated just inside the access door of the main cabinet.

The receiver power supply consists of a built-in RF filter unit with a ball-bearing, enclosed rotary con-



Transmitter-receiver of the Model TCP-1, -2 radio transmitting-receiving equipment.

verter mounted on top. Over-all dimensions are 10 inches long, 9 inches high, and 6 inches deep; weight, 25 pounds. This unit has an output of 0.605 ampere at 110 volts, 60 cycles.

The line filter unit, mounted in a metal container, is designed for connection between the power source and the transmitter-receiver unit. This unit, which contains RF filters, a toggle type line switch and a fuse, is intended for installation near the main cabinet and connects to that unit by means of a rubber-covered cable which is a part of the transmitter-receiver unit.

The hand telephone assembly consists of a "press-to-talk" type handset and a switch hook unit for supporting

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the handset. This assembly is designed for installation near the transmitter-receiver unit to provide local control. A rubber clamping device is provided on the assembly so that the handset remains securely in place when not in use.

The *remote control unit*, designed for installation in any convenient location, includes a handset, loud-speaker, volume control, and "volume switch." For remote operation it is necessary to select the desired frequency and turn on and tune the equipment through the transmitter-receiver unit. Choice of local or remote operation is controlled by the volume switch on the transmitter-receiver unit. For future applications, provision is made in the remote control unit to install a bell in connection with a selective ringer installation.



Type CRM-53085 line filter unit of the Model TCP-1 radio transmitting-receiving equipment.

TECHNICAL FEATURES

Design.—Commercial.

Tube complement

| Location and function | Number of tubes | Type |
|---------------------------------------|-----------------|------|
| Transmitter: | | |
| Crystal control oscillator | 1 | 807 |
| Power amplifiers | 4 | 807 |
| Modulators | 2 | 809 |
| Driver audio amplifier | 1 | 6A6 |
| Microphone audio amplifier | 1 | 6A6 |
| Vodas audio rectifier | 1 | 6A6 |
| Receiver: | | |
| RF amplifier | 1 | 6L7 |
| Mixer | 1 | 6L7 |
| Intermediate amplifiers | 2 | 6L7 |
| Crystal controlled RF oscillator | 1 | 6C5 |
| Second detector—first audio amplifier | 1 | 6R7 |
| Second audio amplifier | 1 | 6V6 |
| Power rectifier | 1 | 5W4 |
| Total | 18 | |

Frequency control.—Crystal.

Power.—Supplies available, 32, 115 volts D. C.
Allowable variation in supply line voltage: $\pm 10\%$.

Power requirements

| Power source | Receiver "on" (standby) | Two-Way Communication | |
|-----------------|-------------------------|-----------------------|--------------|
| | | Receiving | Transmitting |
| 32 volts D. C. | Amperes 5.2 | Amperes 18 | Amperes 26 |
| 115 volts D. C. | 1.4 | 6 | 8 |

Two-way communication (receiving) is handset off support and transmitter ready for use. Two-way communication (transmitting) is handset off support and push button closed to talk.

Operating control.—Hand telephone set and remote control unit.

Carrier control.—"Press-to-Talk" button or voice control relay operation.

Type of receiver circuit.—Superheterodyne.

Receiver intermediate frequency.—455 kc.

Type of reception.—A3.

Receiver sensitivity.—2-5 microvolts for audio output of 50 milliwatts at loudspeaker.

Receiver output.—50 milliwatts.

Antenna.—In general a minimum capacity not less than 150 mmfd. and a maximum capacity not exceeding 300 mmfd. On the average vessel a single wire antenna having a length, including lead-in, between 30 and 50 feet should be satisfactory

Weights, dimensions, and Navy type numbers of equipment units included in contract

| | Type Nos. | Height | Width | Depth | Weight |
|---|-----------|-------------------|------------------|-----------------|--------|
| 32 volts D. C. equipment units: | | | | | |
| Transmitter receiver | CRM-43009 | 37 | 20 $\frac{1}{2}$ | 22 | 310 |
| Line filter unit | CRM-53085 | 10 $\frac{1}{16}$ | 9 $\frac{3}{8}$ | 3 $\frac{5}{8}$ | 9 |
| 115 volts D. C. equipment units: | | | | | |
| Transmitter receiver | CRM-43010 | 37 | 20 $\frac{1}{2}$ | 22 | 310 |
| Line filter unit | CRM-53086 | 10 $\frac{1}{16}$ | 9 $\frac{3}{8}$ | 3 $\frac{5}{8}$ | 9 |
| 32, 115 volts D. C. equipment units: | | | | | |
| Remote control unit | CRM-23230 | 10 $\frac{3}{8}$ | 13 $\frac{3}{8}$ | 5 $\frac{3}{8}$ | 11 |
| Hand telephone assembly | CRM-51026 | 9 | 3 $\frac{1}{2}$ | 6 $\frac{1}{4}$ | 4 |
| Remote control cable (two 30- or 50-foot lengths) | | | | | |
| Spare parts | | | | | |

Accessories.—Conversion kits for operation of 115-volt D. C. equipment on 230 volts D. C. are available.

Shipping weights and dimensions

| Case | Unit | Size (inches) | Gross weight (pounds) | Cubic feet |
|------|-----------------------------|---------------|-----------------------|------------|
| 1 | Transmitter-receiver | 49 x 28 x 30 | 388 | 23.8 |
| 2 | Accessories and spare parts | 47 x 24 x 25 | 190 | 16.2 |

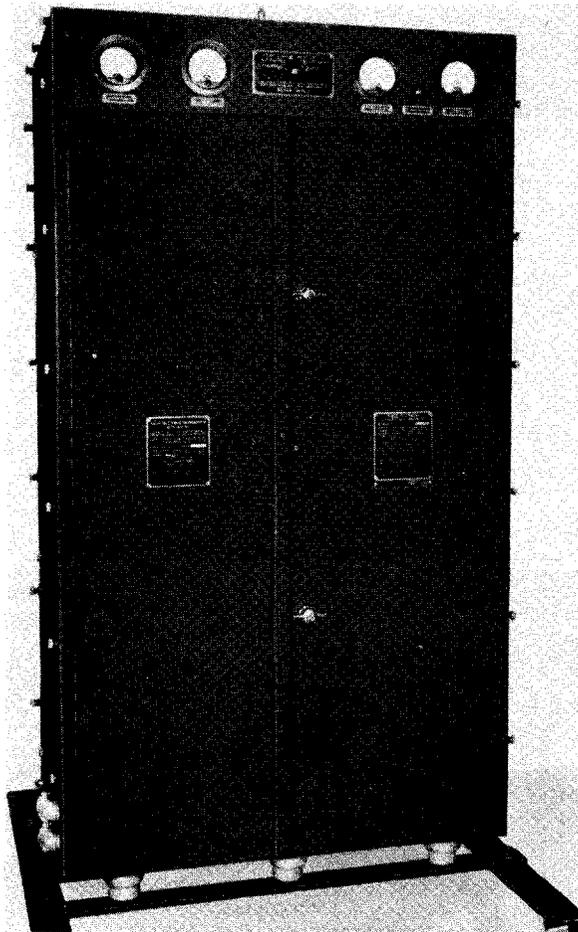
TCR RADIO TRANSMITTING EQUIPMENT

Use.—Shore.

Frequency range.—2000–3000 kc (six pre-tuned frequency channels).

Power output and emission.—125 watts A_2 , A_3 .

Description.—The model TCR equipment is designed primarily for installation at shore stations to effect communication with ships or other shore stations. The equipment is designed for complete remote control operation. Turning on and shutting down of the transmitter, selection of frequency and choice of emission are



Model TCR radio transmitter.

all controlled by the use of two identical control units intended generally for installation at respective distances of ten and forty feet from the transmitter. Though in current use, the model TCR has been superseded by the model TDF which provides continuous wave telegraph operation as well as modulated telegraph and telephone operation and a greater frequency range to include choice of operation on higher channels.

The transmitter and rectifier power components are mounted on nonremovable shelves which are enclosed

in a welded steel cabinet with detachable rear and side panels. The cabinet is equipped with doors in the front so that the components are readily accessible for servicing purposes. A small door is provided in the upper left panel of the cabinet for access to the power amplifier tube—all other tubes are accessible through the front door. Six separate crystal oscillator and antenna circuits are employed and independently tuned at the front of the unit so that the operating frequency may be changed at will from a remote point without necessitating a further adjustment of the transmitter controls. A telegraph push button and microphone receptacle are provided so that the transmitter may be operated locally for test purposes after the equipment is turned on through one of the remote control units.

Two remote control units of identical design, for table or desk mounting, are furnished. The components are



Model TCR control panel for power conversion unit.

housed in small cabinets of welded steel construction. Each control unit contains a six position "Frequency" switch, six frequency indicator lamps, a standby "Off-On" switch, a carrier "Off-On" switch and lamp and an emission "MCW-Phone" switch and lamp. In order to avoid interference, provision is made to prevent the use of more than one remote control unit at a time. When a remote control unit is in service the appropriate frequency indicator light and the carrier light on the control unit not in use will be illuminated. The standby light on the unused control unit will be illuminated if the "Frequency" switch on that unit happens to be in the same position as the "Frequency" switch on the control unit in use. Fifty feet of 28- or 18-conductor cable is furnished for connection of the control units to the transmitter. In each case 16 conductors are used, the remaining conductors being reserved as spares. A

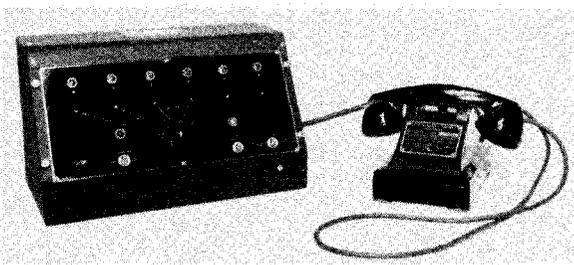
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fourteen foot length of 2 conductor cable is furnished for connection of each control unit directly to the power supply line.

Two identical *hand telephone assemblies* are furnished, one for use with each remote control unit. Each assembly consists of a desk stand and handset equipped with a "Press-to-Talk" button. These units connect to the rear of the remote control unit by means of four foot lengths of 4 conductor cable.

Two type CQ *telegraph keys* are provided. Each key is connected to terminals in the rear of the remote control unit by means of a seven foot length of 2 conductor cable.

The *fused line switch* is a safety switch and is designed to be installed on a wall near the transmitter where it may be conveniently operated when it is desired to remove all a-c power from the transmitter.



Model TCR remote control unit and hand telephone assembly.

TECHNICAL FEATURES

Design.—Commercial.

Tube complement

| Location | Function | Number of tubes | Type |
|------------------------------|-------------------------|-----------------|----------|
| Transmitter..... | Crystal oscillator..... | 6 | 1624 |
| Do..... | Power amplifier..... | 1 | 813 |
| Do..... | Modulators..... | 2 | 811 |
| Do..... | Audio amplifiers..... | 2 | 6L6G |
| Do..... | Bias rectifiers..... | 4 | 83 |
| Do..... | LV rectifiers..... | 2 | 83 |
| Do..... | HV rectifiers..... | 2 | 866A/866 |
| Do..... | Audio oscillator..... | 1 | 6L6G |
| Remote control unit (1)..... | Rectifier..... | 1 | 6X5GT |
| Remote control unit (2)..... | do..... | 1 | 6X5GT |
| Total..... | | 22 | |

Frequency control.—Crystal.

Power.—*Supply available:* 105/125/210/250/1/50/60; conversion kits are available for operation of the equipment on the following line voltages: 220/3/25; 44 volts d. c.; 110/120 volts d. c.; 210/230 volts d. c.

Power required for a. c. operation:

Transmitter

| Stand-by | Carrier "on" modulation | Key locked | Phone 100 percent modulation |
|--------------|-------------------------|----------------|------------------------------|
| Watts 600 | Watts 800 | Watts 1,000 | Watts 1,000 |

Remote control unit: 15 watts.

Operating control.—Complete remote control. Front of panel for test purposes only.

Carrier control.—"Press-to-Talk" button on handset.

Type of keying.—Relay—40 words per minute.

Antenna.—A quarter wave antenna and suitable ground system. In general a single wire antenna of the vertical, horizontal, or sloping type with an overall length, including lead-in, of approximately 50 to 65 feet.

Weights, dimensions and Navy type numbers of equipment units included in contract

| Unit | Type No. | Height | Width | Depth | Weight |
|--|-----------|---------------|--------------|--------------|---------------|
| Transmitter..... | CRM-52207 | Inches 61¼ | Inches 34 | Inches 20 | Pounds 690 |
| Remote control unit (2 furnished)..... | CRM-23242 | 8¼ | 14 | 9¼ | 16 |
| Hand telephone assembly (2 furnished)..... | CRM-51027 | 5½ | 9 | 7½ | 5 |
| Fused line switch..... | | 7½ | 6½ | 4 | 4¼ |
| Telegraph key (2 furnished)..... | | 1¾ | 2¾ | 5½ | ¼ |
| Interconnecting cables..... | | | | | |
| Spare parts..... | | | | | 390 |

Shipping weights and dimensions

| Case | Unit | Size | Gross weight | Cubic feet |
|------|------------------|----------------|--------------|------------|
| | | Inches | Pounds | |
| 1 | Transmitter..... | 73 x 41 x 29.. | 900 | 25.0 |
| 2 | Accessories..... | 52 x 29 x 21.. | 185 | 18.0 |
| 3 | Spare parts..... | 52 x 29 x 21.. | 175 | 18.0 |
| 4 | Spare parts..... | 51 x 27 x 21.. | 400 | 13.0 |

TCS
TCS-1
TCS-2
TCS-3
TCS-4
TCS-5
TCS-6
TCS-7
TCS-8
TCS-9
TCS-10
TCS-11
TCS-12
TCS-13
TCS-14

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TCS TO TCS-14 RADIO TRANSMITTING-RECEIVING EQUIPMENTS

Use.—Semiportable—ship, shore.

Frequency range transmitter and receiver.—1500 to 12,000 kc. in three bands.

Power output and emission.—25 watts, A₁; 15 watts, A₃.

Description.—The Navy Models TCS to TCS-14 semiportable transmitting-receiving equipments are designed for medium and high frequency telegraph and telephone operation. These equipments are used extensively on patrol and landing craft, reconnaissance vehicles, and for similar purposes.

All units are mounted in corrosion-proof cabinets of sheet steel utilizing the subassembly type of construction. The transmitter and receiver may be assembled either side by side or stacked vertically with the horizontal type of mounting preferred. The assembly may be located on a shelf or bulkhead.

The *transmitter* is composed of an oscillator, buffer-doubler and power-amplifier stage with modulator. The frequency range is covered by means of three bands. Crystal-control is provided on any four desired frequencies within the range, and eight harmonics of these frequencies. For master oscillator use, a separate oscillator tube and associated circuits continuously variable, and capable of controlling output at any frequency within the range are used. The single-button carbon microphone works directly into the modulator-stage without the use of a speech-amplifier. The loading coil permits the use of short length antennas down to 20 feet, although better efficiency is obtained with the use of a longer wire up to 75 feet in length.

The *receiver* utilizes a superheterodyne circuit, with 1 radio-frequency stage and 2 I. F. stages, with AVC used for A₃ reception. A range of 1500-12,000 kc. is covered in 3 bands, utilizing either a continuously variable oscillator or crystal-control. Crystals may be employed on 4 frequencies in band 1, and on various higher frequencies determined by the harmonic frequencies of the crystals.

The *remote-control unit*, which may be mounted vertically or horizontally at a distance up to 20 feet from the power supply unit, contains a loudspeaker, audio volume-control, receiver output-switch providing for headphone or loudspeaker operation and ON-OFF switches for both receiver and transmitter. Headphone, microphone, and key jacks are also located in this unit. No frequency control of transmitter or receiver, or choice of emission is provided from this point. The remote-control unit is not interchangeable with any other Navy type.

Power supply units are of three types, dynamotor, motor-generator, and rectifier. Starting relays for these units are contained within the power supply units, and are controlled from either the remote-control unit or panel switches in the transmitter and receiver.

Dynamotor operation is obtained exclusively from 12 volts D. C. Units of interchangeable operation are

available. Type 21770 is connected to the grounded terminal of the power source as indicated by the instructions on the unit. The types 21881 and 211035 are used with either power source lead connected to the grounded terminal. The high-voltage section of each unit has an input of 9.9 amperes at 12 volts, and an output of 0.180 ampere, at 400 volts. This supplies the

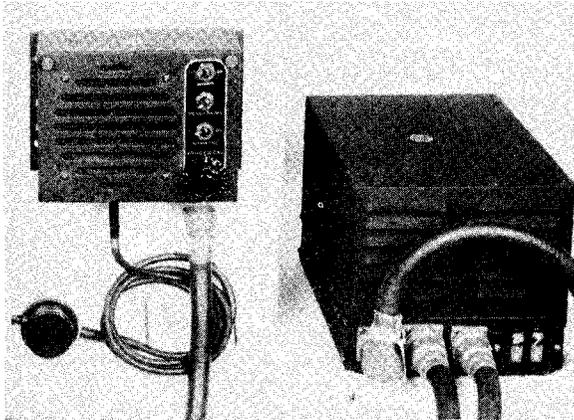


Model TCS transmitting-receiving equipment set up for operation. The antenna loading coil is mounted on top of the transmitter.

transmitter power amplifier and modulator stages. The low voltage section has an input of 3.8 amperes at 12 volts and an output of 0.100 ampere at 220 volts, and operates the transmitter oscillator and buffer-doubler stages as well as the receiver. When the dynamotor units are used, the filaments are operated directly from the power source.

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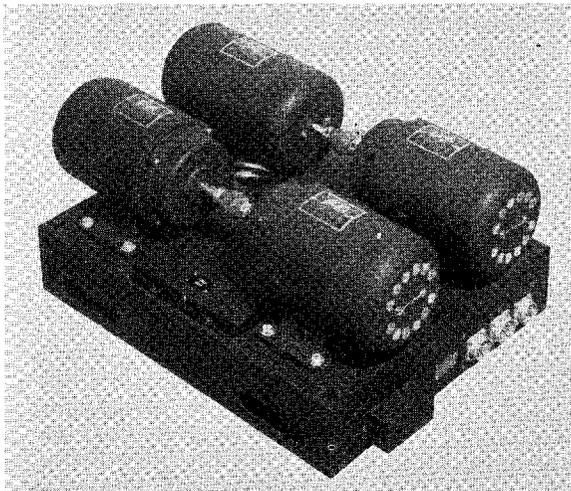
The *motor generator units* consist of two double units mounted on a common bed-plate. The motors are interchangeable for various line voltages, and mount on the front as viewed from the power cable side. A-c motors for 115/1/60 operation are ¼ horsepower. The HV generator is located to the back and left of the unit and supplies 415 volts D. C. at 0.180 ampere for the transmitter power amplifier and modulator. The LV generator is located at the back and right of the



Accessories for Model TCS transmitting equipment. Remote-control box (left) microphone and 12-volt dynamotor power supply

unit and supplies 240 volts D. C. at 0.100 ampere for the receiver and oscillator and buffer-doubler stages of the transmitter. It also supplies filament voltage through the use of a separate winding rated at 3.5 amperes and 12.6 volts. Fuses are located under a plate on the top center of the unit.

The *rectifier power unit* combines two rectifier filter supplies in a single case. The high voltage section supplies 400 or 450 volts D. C. as required, and the low-voltage section furnishes 225 volts D. C. Filament



Motor-generator for Model TCS-5 transmitting-receiving equipment.

supply for both the transmitter and receiver is obtained from a separate transformer which also provides, in connection with a dry-disc rectifier, 12 volts D. C. for the operation of the relays.

The *antenna* normally used with this equipment is of the 20-foot vertical "whip" type. A change over relay operated by the key or microphone "push-to-talk" button allows break-in operation by connecting the antenna to either transmitter or receiver as required. Separate antennas may be used if desired.

TECHNICAL FEATURES

Weights, dimensions, and Navy type numbers of the TCS series of equipments.—All prefix letter designations to the type numbers of the various units have been omitted here as the equipments and major units included in the TCS series are manufactured by several different companies. The transmitter, receiver, remote control unit, loading coil and accessories supplied with any one model of the series are directly interchangeable with those supplied for any other model of the series and may be used in combination with any of the various types of power supply units indicated in the table below. The supply line from which the combined equipment may be operated is determined by the required input voltage to the power supply unit. Power equipments designed for like voltages are essentially the same—difference in type number of these units or addition of suffix letters indicates a difference in manufacturer and/or a very slight change in design.

| Unit | Type No. | Height | Width | Depth | Weight |
|-------------------------------------|------------------------------------|--|--|--|--------------|
| Transmitters | 52245, -A | 11 ¹ / ₁₆ Inches | 13 ³ / ₄ Inches | 11 ¹³ / ₁₆ Inches | 41 13 |
| Receivers | 46159, -A | 11 ¹ / ₁₆ Inches | 13 ³ / ₄ Inches | 11 ¹³ / ₁₆ Inches | 36 13 |
| Remote control unit | 23270, -A | 5 ³ / ₁₆ Inches | 7 ³ / ₈ Inches | 3 ⁷ / ₁₆ Inches | 6 |
| Antenna loading coil | 47205 | 6 | 9 ¹ / ₂ | 6 ³ / ₄ | 3 11 |
| Dynamotors: | | | | | |
| 12 volts d. c. | { 21770 21881, -A, -B 211035 | { 6 ⁵ / ₈ 7 ¹ / ₄ | { 13 ¹ / ₂ 12 ³ / ₄ | { 7 ¹⁵ / ₁₆ 7 ⁵ / ₈ | { 28 8 27 |
| Motor generator sets: | | | | | |
| 24 volts d. c. | { 21774 21826 | 11 ¹ / ₂ | 23 | 17 ¹ / ₂ | 115 |
| 32 volts d. c. | { 21775 | | | | |
| 115 volts d. c. | { 21776 211100 | | | | |
| 230 volts d. c. | { 21827 | | | | |
| 115 volts a. c. | { 21777 21909 | | | | |
| Rectifiers: | | | | | |
| 115 volts a. c. | 20218 | 10 ⁵ / ₁₆ | 16 ¹ / ₄ | 16 ¹ / ₄ | 91 |
| 230 volts a. c. | 20242 | | | | |
| Interconnecting cables: | | | Length | | |
| Power supply to remote control unit | | | Feet | 20 | |
| Power supply to transmitter | | | | 10 | |
| Power supply to receiver | | | | { 10 or 2 11 | |
| Telegraph key cord and plug | | | | | |
| Carbon microphones (2) | | | | | |
| Spare parts. | | | | | |

¹ Has internal provision for reversing connection to power source to accommodate changes in polarity.
² Later equipments furnished with 11' lengths

TCS
TCS-1
TCS-2
TCS-3
TCS-4
TCS-5
TCS-6
TCS-7
TCS-8
TCS-9
TCS-10
TCS-11
TCS-12
TCS-13
TCS-14

TCS
TCS-1
TCS-2
TCS-3
TCS-4
TCS-5
TCS-6
TCS-7
TCS-8
TCS-9
TCS-10
TCS-11
TCS-12
TCS-13
TCS-14

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Design.—Navy.

Tube complement

| Location | Number of tubes | Type |
|--|-----------------|-------|
| Transmitter: | | |
| Crystal oscillator..... | 1 | 12A6 |
| Master oscillator..... | 1 | 12A6 |
| Buffer-doubler..... | 1 | 12A6 |
| Power amplifier..... | 2 | 1625 |
| Modulator..... | 2 | 1625 |
| Receiver: | | |
| R. F. amplifier..... | 1 | 12SK7 |
| Converter..... | 1 | 12SA7 |
| Oscillator..... | 1 | 12A6 |
| First and second I. F. amplifier..... | 1 | 12SK7 |
| Detector..... | 2 | 12SQ7 |
| Audio amplifier..... | 1 | 12A6 |
| Total..... | 14 | |
| Rectifier power supply (when used): | | |
| H. V. power rectifier..... | 2 | 5R4GY |
| L. V. power rectifier..... | 2 | 6X5GT |

Accessories not supplied by contractor.—Antenna, headphones.

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet |
|---|-------------------------------|----------------------|--------------|
| 12 volt D. C. dynamotor equipment: Case 1. Transmitter, receiver, tubes. | <i>Inches</i> 20 x 22 x 34 | <i>Pounds</i> 140 | 8.65 |
| Case 2. Power supply, remote control unit, antenna loading coil, cables, bases, key, microphones, mounting kit..... | 20 x 24 x 30 9 x 15 x 17 | 135 50 | 8.34 1.32 |
| Case 3. Spare parts..... | | | |

Frequency control.—Master oscillator.

Crystal on 4 fundamental frequencies in band 1; 4 harmonics in bands 2 and 3, respectively.

Power.—*Supplies available:* Dynamotors: 12 volts D. C. Motor generator sets: 24, 32, 115, 230 volts d. c., 115/1/60 a. c. Rectifiers: 115/1/60, 230/1/60.

Power requirements

| CONDITIONS | Dyna- mo- tors 12 volts d. c. | Motor generator sets | | | | | Rectifiers | |
|--------------------------------------|--|----------------------|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | | 24 volts d. c. | 32 volts d. c. | 115 volts d. c. | 230 volts d. c. | 115 volts a. c. | 115 volts a. c. | 230 volts a. c. |
| CW—Key open, receiver on..... | 108 | 359 | 350 | 288 | 275 | 275 | 150 | 150 |
| CW—Key closed, receiver on..... | 185 | 414 | 448 | 391 | 385 | 360 | 234 | 234 |
| Voice—Key open, receiver on..... | 110 | 352 | 358 | 288 | 275 | 275 | 150 | 150 |
| Voice—90% Mod., receiver on..... | 205 | 445 | 474 | 397 | 385 | 390 | 243 | 243 |
| Transmitter off, receiver on..... | 58 | 175 | 184 | 144 | 140 | 135 | 89 | 89 |

Allowable variation in supply line voltage $\pm 10\%$.

Operating control.—Front of panel or remote control up to 20 feet using special interconnecting cables.

Type of keying.—Relay—30 words per minute.

Receiver.—*Type of reception:* A₁, A₂, A₃.

Sensitivity: 6 mw output with 15 microvolts input.

Output: 600-ohm headphone jack or speaker in remote control unit.

Antenna.—Single wire 20 to 75 feet over-all or 20-foot whip-type. Used for both transmitting and receiving.

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TCY AND TCY-1 RADIO-TRANSMITTING EQUIPMENTS

Use.—Lifeboats—Portable emergency.

Operating frequency.—500 kc.

Power output and emission.—5 watts, A₂ with 700 to 1,000-cycle modulation.

Description.—The Navy Models TCY and TCY-1 portable lifeboat radio transmitting equipments are designed for emergency use, primarily by inexperienced personnel. These equipments are identical and consist of a transmitter, storage battery, vibrator power pack, and antenna, housed in a laminated wood, enamel coated, water tight bouyant carrying case. Complete instructions for the operation of this equipment are contained on a plastic plate attached to the front panel. This unit is intended to be kept in a convenient place aboard ship, where it is available for immediate removal to a lifeboat, life raft, or other point of operation.

The equipment may be operated automatically, or by a key mounted on the front panel. When operated automatically the equipment transmits either an SOS or SSS signal, followed by 12-second dashes to permit direction finding by rescue vessels. The available power allows operating periods of 3 minutes at half-hour intervals for 20 hours or approximately 1½ hours of continuous operation.

The storage battery, which is mounted in a recessed space in the lower front panel, is of splashproof construction and will not leak if inadvertently turned on its side. It furnishes power for a vibro pack which provides an output of 400 volts at 0.100 ampere for both plate and screen potentials of the oscillator and amplifier tubes. If not used to any extent, the battery will retain its charge from 4 to 6 months.

The antenna which is stored within a compartment at the lower right-hand side of the case consists of a roll of rubber covered flexible wire with several link type insulators permanently fastened. The length and height of the antenna may be as great as conditions will permit. A roll of copper ribbon with an attached weight is used as the ground-lead with the weighted end dropped overboard. A neon bulb located behind a window in the panel indicates when antenna resonance has been obtained. Spare tubes are stored in the same space as the antenna equipment.

TECHNICAL FEATURES

Design.—Commercial.

Tube complement

| Location | Number of tubes | Type |
|------------------------|-----------------|------|
| Master oscillator..... | 1 | 6C5 |
| Power amplifier..... | 1 | 6L6 |
| Total..... | 2 | |

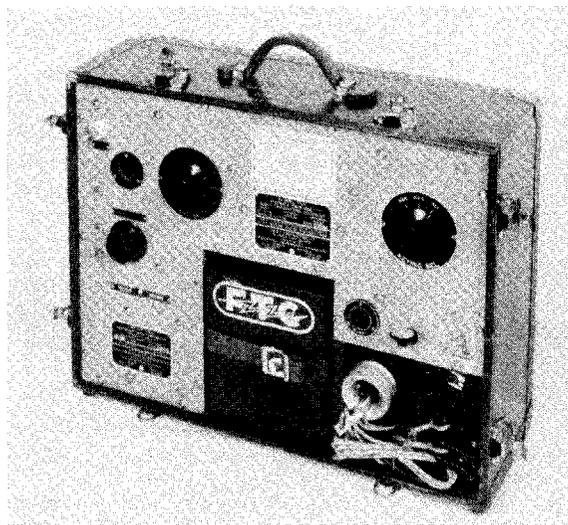
Frequency control.—Master oscillator.

Power.—Supply—Self-contained 6-volt, 20-ampere-hour storage battery. Required for locked-key operation—90 watts from 6-volt source.

Operating control.—Front of panel.

Types of keying.—Automatic SOS and SSS signal, with 12-second dashes interspersed to allow direction finding by rescue vessels. Hand keying.

Antenna.—Attached wire and guys suitable for erecting antenna aboard lifeboat or in other small space.



Model TCY emergency portable transmitting equipment.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|--|---------------|-----------|-----------|-----------|-----------|
| Transmitter in case, including power supply, storage battery, spare tubes, and antenna material..... | CFT-52236 | Inches 14 | Inches 20 | Inches 8½ | Pounds 58 |

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet |
|---|---------------------|--------------|------------|
| Equipment in case, including spare parts..... | Inches 49 x 26 x 25 | Pounds 145 | 18.35 |

TCZ RADIO TRANSMITTING EQUIPMENT

Use.—Ship and shore.

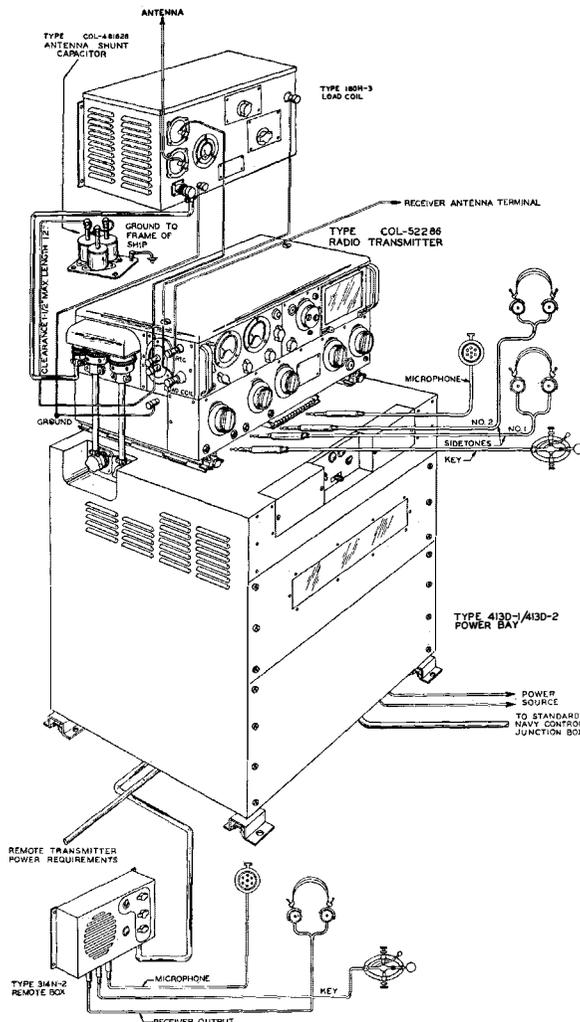
Frequency range.—300 to 600 kcs., and 2000 to 18100 kcs. (Automatic selection of one preset frequency in the low range and ten preset frequencies in the high range, manual selection of all frequencies in either range.)

Power output and emission.—100 watts A₁, A₂, A₃.

Description.—The Model TCZ is a shipboard adaptation of the ATC aircraft equipment and differs from the ATC primarily in the following respects: a power supply suitable for shipboard use has been incorporated, provision has been made for control of the equipment from more than one remote position, and external tuning circuits to permit operation into a whip antenna are furnished. The transmitter portion of the TCZ incorporates a low frequency oscillator capable of being tuned over the frequency range of from 200 to 1500 kcs., but the power amplifier tuning is entirely dependent upon an external tuning and load coil. The external combined tuning and load coil is designed to cover the frequency range of 300 to 600 kcs., and is the frequency limiting circuit in the low frequency range.

The TCZ features rapid automatic selection of 11 predetermined frequencies. The Collins autotune system employed for this purpose is an electrically controlled means of mechanically positioning the transmitter tuning elements. The positioning elements are driven by a single motor which is controlled by a series of interlocking relays. The control system will operate to change the frequency of transmission in less than 25 seconds. The autotune frequencies are set up without the aid of tools and after the several frequencies are adjusted any one frequency may be changed without disturbing the other frequency settings. Any combination of ten frequencies may be selected within the limits of the high frequency band and any one frequency may be selected within the limits of the low frequency band. Provision is also made for manual tuning of the transmitter throughout the entire frequency range and aside from the single channel in the low frequency range, the autotune preset frequencies are not deranged by manual tuning and are instantaneously available upon reverting to automatic operation. The tuning and operating controls are located on the front panel of the transmitter. Choice of autotune or manual tuning is provided by means of a switch. A switch for "on-off" control, voice, CW or MCW operation is also provided. Two meters are furnished, one to indicate the antenna current and the other to indicate the input voltage and PA plate and PA grid current as determined by the position of the meter selector switch. The transmitter incorporates a built-in crystal frequency calibrator. The error of frequencies previously calibrated through the use of this unit will not exceed 0.02 percent in the high frequency range or 500 cps. in the low frequency range. A calibration chart is provided for approximate settings of the MO dials. Either a dynamic or carbon microphone may be used to modulate the transmitter, the selection of the proper input circuit being made by a

switch. Sidetone output is provided for all types of emission. Provision is also made in the transmitter for break-in operation so that an associate receiver may be used. A pilot light is employed to indicate when the set is in operating condition after changing channels with the autotune. An appropriate switch provides choice of local operation or remote operation through the use of the remote control unit furnished with the



A complete Model TCZ installation with all the accessories necessary for transmission on any frequency within the range of the equipment with operating control from either the local or remote position.

equipment. This remote control unit permits selection of the autotune channels, selection of the emission and the turning on and shutting down of the equipment. In addition, the TCZ power supply incorporates the necessary circuits and terminals through which the equipment may be operated in conjunction with standard 4 or 6 wire radiophone units. When standard

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radiophone units are used, the remote control unit furnished with the equipment may still be employed with selection of either the standard type or the unit supplied controlled from the transmitter and power unit.

The *transmitter*, constructed essentially of stamped sheet aluminum, is equipped with detachable sliding mounting tracks which may be secured to the top of the power cabinet. Subassembly type of construction has been used extensively in this unit to facilitate servicing of the various components. Three of these subassemblies, namely, the medium frequency oscillator unit, the MCW-CFI unit, and the audio amplifier unit, are provided with multiterminal connector plugs so that they may be conveniently removed from the main chassis without the use of a soldering iron. The vacuum tubes are all available through the top of the transmitter cabinet after removal of the cabinet cover. When the transmitter cover has been removed the CFI unit is also accessible and the shield of this unit may in turn be removed for access to the calibration crystal. All components not included in units that are removable from the main assembly have been mounted in positions so as to be as accessible as possible in the limited space available. All the tuning and operating controls are on the front panel and the various external connections are made to connectors and terminals on the left side of the cabinet.

The *remote control unit* permits complete control of the TCZ equipment from a distant position and provides connection for the output of a receiver. A switch for selection of the autotune channels, a switch for turning the equipment on or off and selecting the emission, and a receiver volume control and speaker-phone switch are provided on the front panel. Key, headphone and microphone jacks are located on the side of the unit. The remote control unit is similar to that employed with the ATC equipment differing only in that a loudspeaker is incorporated so that either speaker or headphone reception may be selected.

The *antenna loading coil* is intended to be installed within easy reach of the transmitter. Universal mounting brackets may be fastened to either the bottom or rear of the cabinet. The tuning controls and terminals for external connections are all located on the front panel. The loading coil is only employed when the equipment is operated in the low frequency range of 300-600 kc. and must be manually tuned for each change of frequency. A relay located in this unit connects the tank circuit of the load coil to the antenna when the equipment is operated in the low frequency range. The relay remains inoperative when the equipment is operated in the high frequency range and the output of the transmitter is connected directly to the antenna.

An *antenna shunt capacitor* is provided and may be required if operation in the range 2000-3000 kc. is desired and the antenna does not have sufficient capacity to permit the tuning of the output circuit within this frequency range.

The components of the a. c. and d. c. *power units* are contained in similar steel cabinets which are designed

to be bolted to a table or desk. The a. c. power unit utilizes a dry disc rectifier system with an output of 0.3 ampere at 115 volts d. c., a vacuum tube rectifier system with an output of 0.3 ampere at 400 volts d. c. and 0.275 ampere at 1,150 volts d. c., and a motor generator with an output of 1.2 amperes at 14 volts d. c., and 10.0 amperes at 28 volts d. c. The d. c. power unit utilizes two dynamotors. The low voltage dynamotor has an output of 1.2 amperes at 14 volts d. c., and 10.0 amperes at 28 volts d. c. The high voltage dynamotor has an output of 0.35 ampere at 400 volts d. c. and 0.35 ampere at 1,150 volts d. c. This unit also takes 0.3 ampere at 115 volts d. c. from the line. Both the motor generator for the a. c. power unit and the dynamotors for the d. c. power unit are mounted on removable chassis. The power connections are made to plugs at the rear of these chassis which engage socket terminals when the chassis are inserted into their respective cabinets. External cable connections are made through the bottom of each power cabinet, near the front edge, to a terminal board that is made accessible through the removal of the bottom front panel. Both units are supplied with a terminal strip to permit the connecting of a standard Navy 4 or 6 wire radiophone unit. The switch for control of local or remote operation along with the various power controls, local "on-off" switch and emergency "on-off" switch, are located on the front panel.

TECHNICAL FEATURES**Design.—Navy.****Tube complement**

| Location and function | Number of tubes | Type |
|--------------------------------|-----------------|----------|
| TRANSMITTER | | |
| High-frequency oscillator..... | 1 | 837 |
| First multiplier..... | 1 | 1625 |
| Second multiplier..... | 1 | 1625 |
| Power amplifier..... | 1 | 813 |
| Modulators..... | 2 | 811 |
| First audio amplifier..... | 1 | 12SJ7 |
| Audio driver..... | 1 | 6V6GT |
| Sidetone amplifier..... | 1 | 6V6GT |
| Calibration oscillator..... | 1 | 12SJ7 |
| MCW oscillator..... | 1 | 12SJ7 |
| Low frequency oscillator..... | 1 | 1625 |
| Low voltage rectifiers..... | 2 | 866/866A |
| High-voltage rectifiers..... | 2 | 866/866A |

Frequency control.—Master oscillator.

Power.—*Supplies available:* 115/1/60; 115 volts d. c.

Required for starting: Approximately 4.5 kw.

Required for locked key operation:

0.65 kw, a. c. equipment;

1.15 kw, d. c. equipment.

Allowable variation in supply line voltage ± 10 percent; frequency ± 5 percent; combined voltage and frequency ± 10 percent (5 percent each).

Operating control.—Front of panel and remote control through the use of a special remote control unit (supplied as a unit of the equipment) or standard Navy 4- or 6-wire radiophone units.

Carrier control.—Push-to-talk switch on microphone.

Type of keying.—Relay, 30 words per minute.

Antenna.—Shipboard whip type antennas 20 to 35 feet in length.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|--|---------------|---------------------------------|---------------------------------|---------------------------------|---------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Transmitter..... | COL-52286 | 10 ³ / ₄ | 23 ³ / ₁₆ | 13 ¹ / ₄ | 66 |
| Power unit A. C..... | COL-211101 | 29 ¹ / ₈ | 23 ³ / ₈ | 20 ¹ / ₈ | ----- |
| Power unit D. C..... | COL-211102 | 29 ¹ / ₈ | 23 ³ / ₈ | 20 ¹ / ₈ | ----- |
| Transmitter mounted on power unit..... | | 39 ⁷ / ₈ | 23 ³ / ₈ | 20 ¹ / ₈ | ----- |
| Remote control unit..... | COL-23410 | 4 ³ / ₈ | 9 ³ / ₃₂ | 6 ¹ / ₁₆ | 2.5 |
| Antenna loading coil..... | COL-47370 | 10 ⁷ / ₃₂ | 18 ⁵ / ₈ | 12 ² / ₃₂ | ----- |
| Antenna shunt capacitor..... | COL-481628 | 4 ³ / ₈ | 5 | 3 ⁷ / ₈ | 1.5 |
| Interconnecting cables (all)..... | | | | | |
| Spare parts..... | | | | | |

Accessories not supplied by contractor.—1. Microphone—carbon of 40 ohms internal resistance or dynamic of 200 ohms internal resistance for red coded circuit.

(a) Cord—3 conductor, shielded.

(b) Cord plug—3 circuit, tip ¼-inch diameter and 1³/₁₆ inches long.

2. Telegraph key—any type.

(a) Key cord—2 conductor.

(b) Cord plug—2 circuit, tip ¼-inch diameter and 1³/₁₆ inches long.

3. Headphones—500 ohms impedance.

(a) Cord plug—2 circuit, tip ¼-inch diameter and 1³/₃₂ inches long.

4. Navy standard 4- or 6-wire radiophone unit.

Shipping weights and dimensions.—Data will be furnished when available.



TDD, TDD-1, AND TDD-2 RADIO TRANSMITTING EQUIPMENTS

Use.—Shore.

Frequency range.—200 to 550 kc (Crystal Controlled).

Power output and emission.—15 watts, A₃.

Description.—The Models TDD, TDD-1, and TDD-2 are low frequency, low power equipments designed primarily for airport traffic control. Each equipment consists of a transmitter with associated modulator and power components mounted in a standard rack cabinet of such proportion that it may be installed in a control tower without obscuring vision in any direction. The r. f., modulator and power supply components are mounted in a single chassis which is located in the upper portion of the cabinet. Guides on either sides of the cabinet permit sliding the chassis in or out through the front of the frame. On installation, the chassis is secured in the cabinet with angle iron and screws through the front panel. Three plug-in oscillator coils are provided covering all frequencies within the range of 200 to 550 kilocycles per second and may be selected for use according to the frequency range in which it is desired to have the transmitter operate. The three coils are interchangeable in a ceramic socket adjacent to the oscillator tube. The antenna load coil supported by ceramic standoffs is located directly under the transmitter chassis, and occupies all of the lower portion of the cabinet. This coil has a variometer adjustment for fine tuning and a number of taps on the stator

for course adjustments, thus permitting a wide choice of antenna types to suit the individual installation. All necessary fuses, receptacles, meters, controls, and switches are brought out on the front panel of the cabinet. A telephone handset with supporting hook is provided on the left side of the cabinet. In the event that it is desired to connect speech input to the equipment from a remote point the local handset must first be disconnected. Remote telephone line connections are made to the microphone terminals on the rear of the transmitter chassis. These terminals also handle the interlock switch and provide means for operating a receiver muting relay which may be used to prevent feed-back and interference when a receiver is used in conjunction with the equipment. The back panel of the cabinet is in the form of a door through which access to these terminals and the incoming 115/1/60 power connector may be made. The power connector is located to the left of the terminal strips on the transmitter chassis.

The TDD and TDD-1 are identical. The TDD-2 differs from these models only in that round type meters are employed instead of the square type furnished with the TDD and TDD-1.

TECHNICAL FEATURES

Design.—Commercial.

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Tube complement

| Function | Number of tubes | Type |
|------------------------|-----------------|-----------|
| Oscillator..... | 1 | 6V6 |
| Power amplifier..... | 2 | 807 |
| Speech amplifier..... | 1 | 6V6 |
| Modulators..... | 2 | 6L6G |
| Voltage regulator..... | 1 | VR-150-30 |
| Bias rectifier..... | 1 | 6X5GT |
| HV rectifier..... | 1 | 83 or 5Z3 |
| Total..... | 9 | |

Frequency control.—Crystal.

Power.—Supply Available: 115/1/60.

Required for standby: 80 watts.

Required for transmission: 330 watts.

Allowable variation in supply line voltage: ±10 percent.

Operating control.—Front panel; also provision for connecting remote telephone or microphone by means of a single telephone line having an impedance of from 50–500 ohms.

Carrier control.—Press-to-talk button on handset.

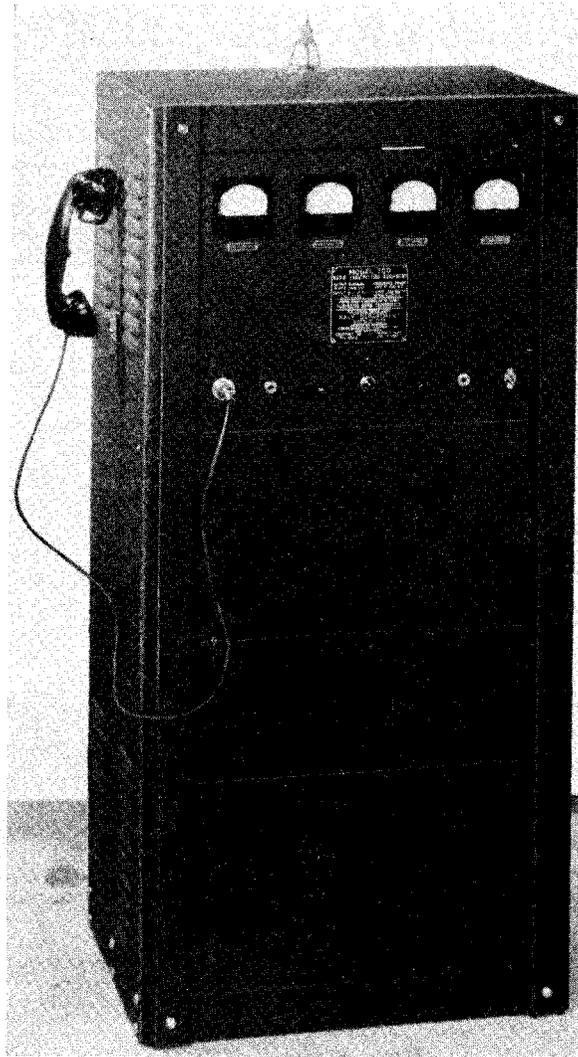
Antenna.—The equipment is designed to work into a single wire antenna from 100 to 500 feet in length.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|-----------------|---------------|--------|--------|--------|--------|
| | | Inches | Inches | Inches | Pounds |
| TRANSMITTER | | | | | |
| TDD, TDD-1..... | CCI-52258 | 52 | 25½ | 18 | 190 |
| TDD-2..... | CCI-52258A | | | | |

Shipping weights and dimensions

| Unit | Crate size (inches) | Gross Weight (pounds) | Cubic Feet |
|---|---------------------|-----------------------|------------|
| Transmitter r. f., modulator, and power chassis | 17½ x 21 x 21¾ | | 4.45 |
| Cabinet (load coil installed), spare parts box, tubes, coils and hardware | 23½ x 28 x 54 | | 20.03 |
| Total..... | | 475 | 24.48 |



Model TDD radio transmitter.

TDE TO TDE-3 RADIO TRANSMITTING EQUIPMENTS

Use.—Shipboard—shore.

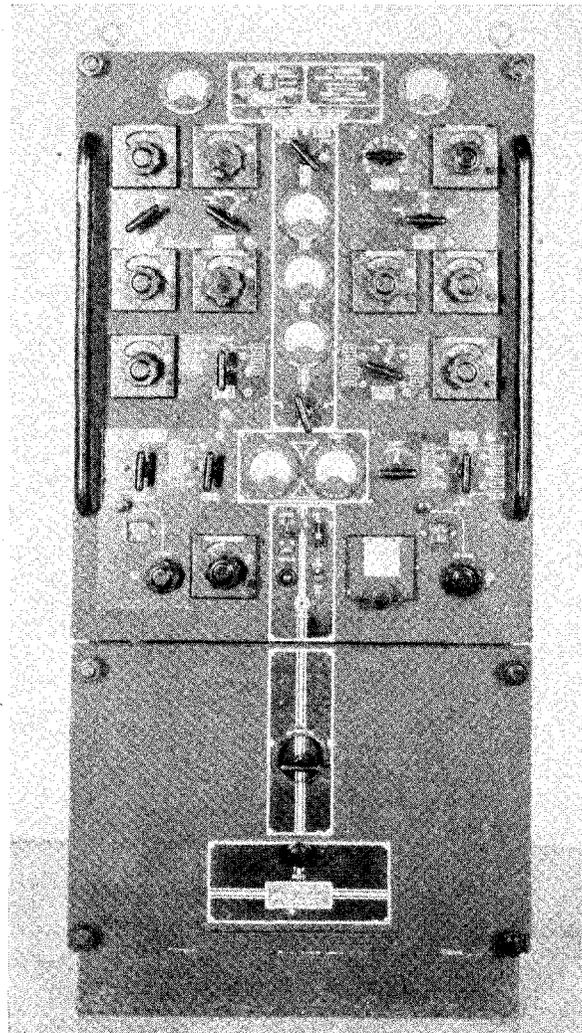
Frequency range.—300–18100 kc.

Power output and emission.—125 watts A₁, 35 watts A₂, 30 watts A₃.

Description.—The TDE, TDE-1, TDE-2, and TDE-3 radio transmitting equipments are designed for medium and high frequency telegraph and telephone operation primarily on destroyers, light cruisers, and auxiliary vessels. Small size, compact construction, and provision for flexible mounting make this equipment particularly desirable for installation where space is limited. The equipments of all models include a remote control unit and in addition, provision has been made for the connection of Navy standard remote telegraph or telephone units of the 4- or 6-wire control type in order that operation of the equipment from more than one remote position may be made available if desired. Several slight design improvements have been incorporated in the later models; however, these models differ primarily from the basic TDE only in that the remote control unit is modified to include either a momentary or maintaining type of start-stop switch. Provision for inclusion of the momentary type switch omits the need for an external switch of this type which must be used with the TDE remote control unit when this unit is used in conjunction with Navy standard 6-wire remote control units.

The *transmitter* is a single self-contained unit of shelf type construction incorporating a high-frequency transmitter and an intermediate-frequency transmitter as a single unit. The transmitter consists of two parts; namely, frame and case. The frame which forms the front panel and top, is made from a single sheet of $\frac{3}{2}$ inch zinc sprayed steel to which the floors and center shield are welded. The case forms the three sides of the unit and is made from a single sheet of zinc-sprayed steel welded to a steel floor. The frame is hinged to the bottom of the case and may be swung out at approximately 45° for easy accessibility for inspection and replacement of the tubes. For servicing purposes, catches located on the interior of either side of the case may be released, and the frame lowered to 90° where it is supported at the end by a tubular metal leg. If desired, the frame may be entirely removed from the case by removal of the steel hinge pins. The transmitter unit, space permitting, is normally mounted on top of the power supply unit. For installation in small quarters, the transmitter and power supply may be separated and the power supply placed in any near-by available location. All the operating controls and indicating instruments necessary for the operation of the equipment are located on the front panel of the transmitter with the exception of the main field control for adjustment of the motor generator output voltage which is brought out on the front panel of the power unit. When the transmitter and power supply unit are separated this control may be removed from the power unit and placed in a position near the transmitter in order that the equipment may be completely operated from a single location.

The *transmitter MF and HF circuits* are located respectively on the right and left hand sides of the frame. The bottom shelf contains the master oscillator assemblies for both the MF and HF transmitter circuits. The first and second shelves contain the HF intermediate amplifier, power amplifier, the antenna tuning inductance and capacitor and the antenna voltage feed switch. On the right of the second shelf is mounted



Transmitter for Model TDE equipment.

the amplifier, and on the top part of this shelf is located the power amplifier and antenna coils for the MF portion of the transmitter.

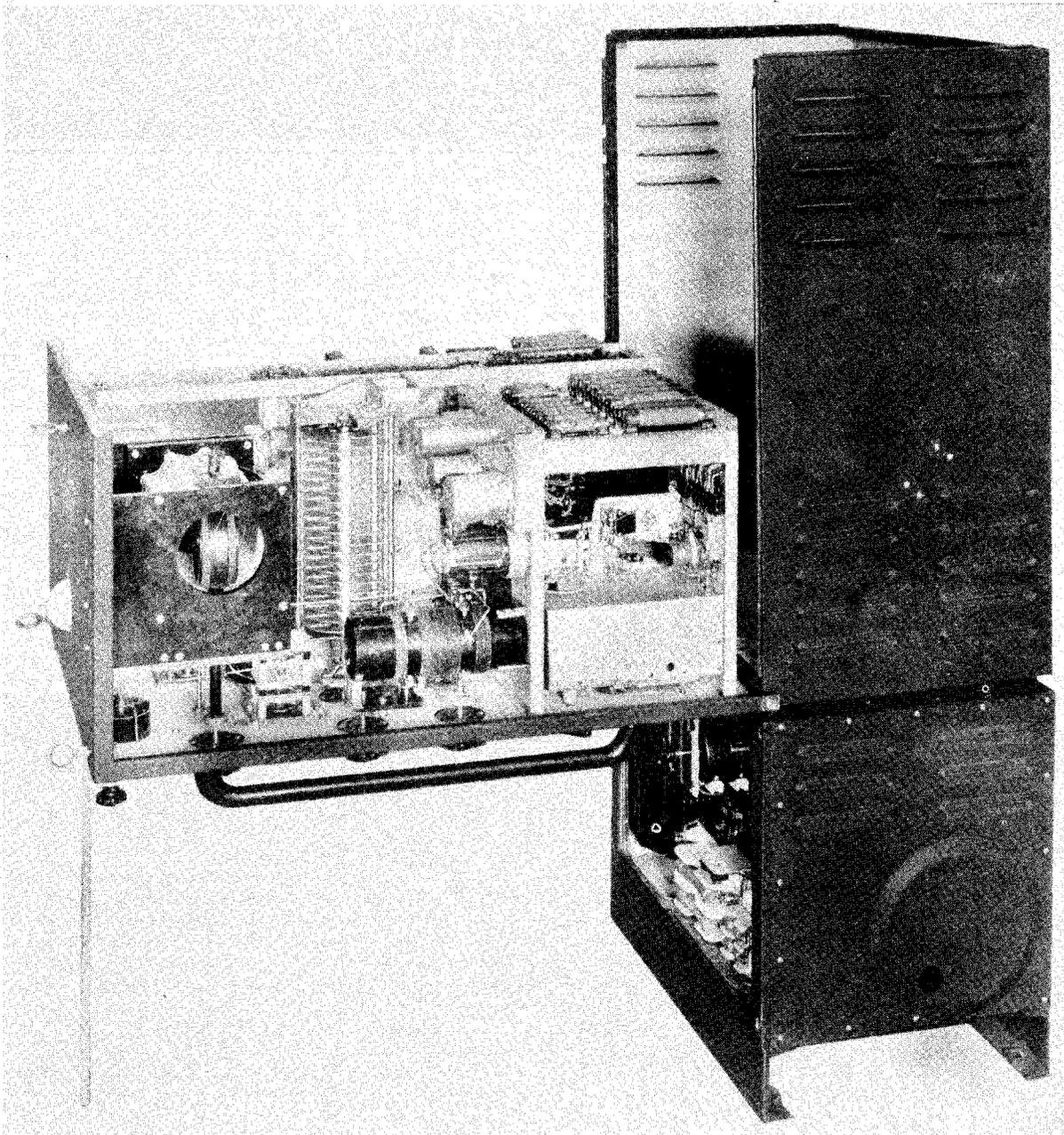
The *power unit* includes a motor-generator set, a starting contactor, rectox and filter circuits for the radiophone and microphone power supply and a bias rectifier consisting of a transformer and a full-wave rectifier tube which supplies power for the bias and keying circuits. The motor-generator set is made up of

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two direct coupled units mounted on a common bed-plate. The motor is of 1 horsepower capacity. All a-c and d-c motors are interchangeable on the same motor generator unit. The generator is of the single core double commutator type with outputs rated at 2,000 volts at 0.75 ampere, and 550 volts at 0.26 ampere. D-c equipments provide a-c bias and filament power from slip rings located on the armature of the motor. The rectifier output is 90 volts D. C. at 0.260 ampere. The above parts with appropriate fuses and terminals are enclosed in a frame which normally provides a base for the transmitter.

The *remote-control unit* consists of a start-stop switch, indicator light, key jack, microphone jack and phone jack mounted in a small metal box. The microphone jack is connected with the audio circuit and also with an auxiliary relay in the transmitter which operates the keying circuit. This is provided so that a standard push-button type aircraft microphone may be used from the remote position. The phone jack provides a means of connecting a receiver to the remote unit so that complete two-way operation may be obtained.

Separate *antenna* connections are provided for the



TDE transmitter, showing access for servicing.

MF and HF portions of the transmitter. When only one antenna is available, it may be used with both frequency ranges. The output circuits are adjustable for both current and voltage feed over the entire frequency range of the transmitter, and operation is possible with any length antenna commonly found on the vessels on which this equipment is used.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | Number of tubes | | | Type | | |
|--------------------------------|-----------------|-----------|----|------|-----|-----------|
| | HF | HF and MF | MF | HF | MF | HF and MF |
| Master oscillator | 1 | | 1 | 837 | 801 | |
| Amplifier-frequency multiplier | 1 | | 1 | 807 | 807 | |
| Power amplifier | 1 | | 1 | 803 | 803 | |
| Audio amplifier | | 1 | | | | 801 |
| Bias rectifier | | 1 | | | | 5U4G |
| Total | 8 | | | | | |

Frequency control.—Master oscillator.

Power.—Supplies available: 115-volt D. C., 230-volt D. C., 220/440 /3/ 60, 110/220/1/60.

REQUIRED FOR STARTING

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|----------------|--|-----|-----|------------------------|
| 115-volt D. C. | 74 | 8.5 | | |
| 230-volt D. C. | 37 | 8.5 | | |
| 220/3/60 | 22 | 4.6 | 8.5 | 54 |
| 440/3/60 | 11 | 4.6 | 8.5 | 54 |
| 110/1/60 | 74 | 4.6 | 8.5 | 54 |
| 220/1/60 | 37 | 4.6 | 8.5 | 54 |

REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|----------------|--|-----|------|------------------------|
| 115-volt D. C. | 10.4 | 1.2 | | |
| 230-volt D. C. | 5.2 | 1.2 | | |
| 220/3/60 | 3.7 | 1.2 | 1.41 | 58 |
| 440/3/60 | 1.85 | 1.2 | 1.41 | 85 |
| 110/1/60 | 12.2 | 1.2 | 1.31 | 85 |
| 220/1/60 | 6.1 | 1.2 | 1.31 | 85 |

Allowable variation in supply line voltage: $\pm 10\%$ D. C., $\pm 5\%$ A. C.; frequency: $\pm 5\%$; combined voltage and frequency: $\pm 10\%$ (5% each).

Operating control.

Local.—Front panel position.

Navy type numbers of models TDE, TDE-1, TDE-2, TDE-3 equipments

| Unit | TDE | TDE-1 | TDE-2 | TDE-3 |
|---------------------|-----------|-------------|-------------|--------------|
| Transmitter | CAY-52267 | CAY-52267-A | CAY-52267-A | CFN-52267-A. |
| Remote control unit | CAY-23305 | CAY-23381 | CAY-23381 | CFN-23381. |
| Power supply unit: | | | | |
| 115-volts D. C. | CAY-21848 | CAY-21848 | CAY-21848 | CFN-21848. |
| 230-volts D. C. | CAY-21849 | CAY-21849 | CAY-21849 | |
| 220/440/3/60 | CAY-21850 | CAY-21850 | CAY-21850 | CFN-21850. |
| 110/220/1/60 | | CAY-211030 | CAY-211030 | |

Remote control.—With unit supplied on A1, A2, and A3 emission, and with Navy standard 4- or 6-wire telegraph units on A1 and A2 emission or Navy standard 4- or 6-wire radiophone units on A1, A2, and A3 emission. When 6-wire control units are employed in conjunction with the basic TDE type CAY-23305 remote control unit, a momentary push button switch must be used with the latter unit.

Type of keying.—Relay—100 words per minute.

Antenna.—50 to 200 feet over-all.

Weights and dimensions of equipment units included in contract

| Unit | Height | Width | Depth | Weight |
|---------------------------------------|------------------|------------------|------------------|---------------|
| | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Transmitter and power unit | 62 $\frac{3}{4}$ | 28 | 20 | 672 |
| Transmitter (as single unit) | 39 $\frac{3}{4}$ | 28 | 20 | 314 |
| Power unit (as single unit) | 24 | 28 | 20 | 316 |
| Remote control unit | 3 $\frac{3}{16}$ | 5 $\frac{1}{16}$ | 5 $\frac{1}{16}$ | 3.5 |
| Equipment spare parts box | | | | |
| Spare generator armature box | | | | |
| Spare motor armature box ¹ | | | | |

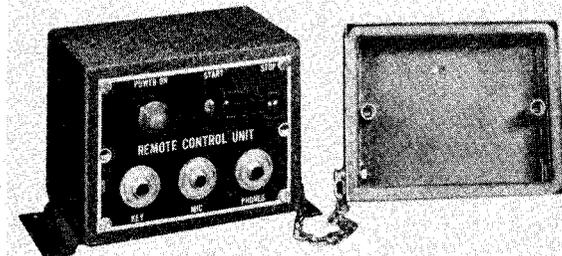
¹ Furnished with D. C. equipment only.

Accessories not supplied by contractor.—Telegraph key. Navy standard 4- or 6-wire remote telegraph or radiophone units Microphone type 51004C.

Shipping weights and dimensions

[440/3/60 equipment]

| Unit | Size | Gross weight | Cubic feet |
|--|---------------|---------------|------------|
| | <i>Inches</i> | <i>Pounds</i> | |
| Transmitter, power unit, remote control unit, vacuum tubes | 37 x 27 x 70 | 966 | 40.52 |
| Equipment spares and spare generator armature | 35 x 18 x 17 | 185 | 6.19 |



Model TDE remote control unit.

CONFIDENTIAL

TDF RADIO TRANSMITTING EQUIPMENT

Use.—Shore.

Frequency range.—2000–9400 kc., six pretuned frequency channels which may be set up as indicated below:

- 6 frequencies from 2000–3050 kc.
- or
- { 3 frequencies from 2000–3050 kc.
- and
- { 3 frequencies from 2750–9400 kc., with—
 - 1 frequency: 2750–5000 kc.
 - 1 frequency: 3750–5500 kc. or 7000–9400 kc.
 - 1 frequency: 5000–9400 kc.

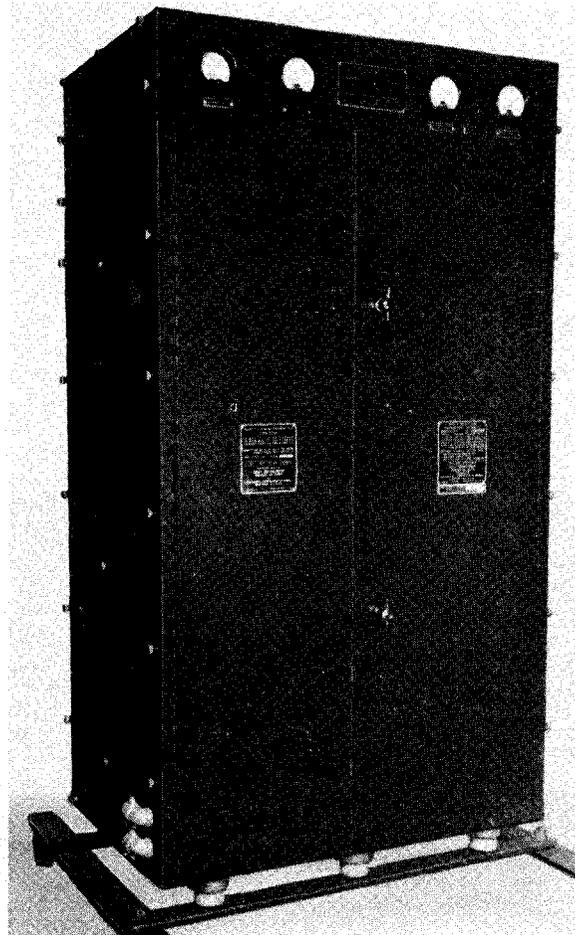
Power output and emission.—125 watts, A₁, A₂ or A₃.

Description.—The model TDF equipment is designed primarily for installation at shore stations to effect communication with ships or other shore stations. The equipment is designed for complete remote control operation. Turning on and shutting down of the transmitter, selection of frequency and choice of emission are all controlled by the use of two identical control units intended generally for installation at respective distances of ten and forty feet from the transmitter. The model TDF, similar to the model TCR in design and physical construction, differs primarily in that it provides continuous wave telegraph operation, and a greater frequency range to include choice of operation on higher channels.

The transmitter and rectifier power components are mounted on nonremovable shelves which are enclosed in a welded steel cabinet with detachable rear and side panels. The cabinet is equipped with doors on the front so that the components are readily accessible for servicing purposes. A small door is provided in the upper left panel for access to the power amplifier tube; all other tubes are accessible through the front door. Six separate crystal oscillator and antenna circuits are employed and independently tuned at the front of the unit so that the operating frequency may be changed at will from a remote point without necessitating a further adjustment of the transmitter controls. A telegraph push button and microphone receptacle are provided so that the transmitter may be operated locally for test purposes after the equipment is turned on through either of the remote control units.

Two remote control units of identical design, for table or desk mounting, are furnished. The components are housed in small cabinets of welded steel construction. Each control unit contains a six position "Frequency" switch, six frequency indicator lamps, a standby "Off-On" switch, a carrier "Off-On" switch and lamp, and an emission "MCW-CW-Phone" switch and lamp. In order to avoid interference, provision is made to prevent the use of more than one remote control unit at a time. When a remote control unit is in service, the appropriate frequency indicator light and the carrier light on the control unit not in use will be illuminated. The stand-

by light on the unused control unit will be illuminated if the "Frequency" switch on that unit happens to be in the same position as the "Frequency" switch on the control unit in use. Fifty feet of 28 or 18 conductor cable is furnished for connection of the control units to the transmitter. In each case 16 conductors are used, the remaining conductors being reserved as spares. Two 14-foot lengths of 2 conductor cable are furnished for connection of each control unit directly to the power supply line.

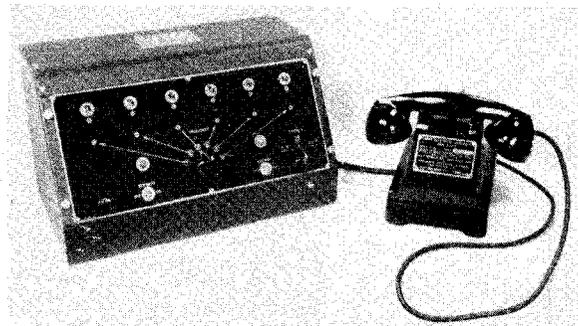


Model TDF radio transmitter.

Two identical hand telephone assemblies are furnished, one for use with each remote control unit. Each assembly consists of a desk stand and handset equipped with a "Press-to-talk" button. These units connect to the rear of the remote control unit by means of four-foot lengths of conductor cable.

Two type CQ telegraph keys are provided. Each key is connected to terminals in the rear of the remote control unit by means of a 7-foot length of two conductor cable.

The *fused line switch* is a safety switch and is designed to be installed on a wall near the transmitter where it may be conveniently operated when it is desired to remove all a-c power from the transmitter.



Model TDF remote control unit and hand telephone assembly.

TECHNICAL FEATURES

Design.—Commercial.

Tube complement

| Location | Function | Number of tubes | Type |
|-------------------------|--------------------|-----------------|----------|
| Transmitter | Crystal oscillator | 6 | 1624 |
| Do | Power amplifier | 1 | 813 |
| Do | Modulators | 2 | 811 |
| Do | Audio amplifiers | 2 | 6L6G |
| Do | Bias rectifiers | 4 | 83 |
| Do | LV rectifiers | 2 | 83 |
| Do | Audio oscillator | 1 | 6L6G |
| Do | HV rectifiers | 2 | 866A/866 |
| Remote control unit (1) | Rectifier | 1 | 6X5GT |
| Remote control unit (2) | do | 1 | 6X5GT |
| Total | | 22 | |

Frequency control.—Crystal.

Power.—Supply available: 105/125/210/250/1/50/60.

Conversion kits are available for operation of the equipment on the following line voltages: 220/3/25; 440 volts d. c.; 110/120 volts d. c.; 210/230 volts d. c.

Power required from line for a-c operation:

Remote control unit.—15 watts.

Transmitter:

| Stand-by (watts) | Carrier "on" no modulation (watts) | Key locked CW operation (watts) | Key locked MCW operation (watts) | Phone 100 percent modulation (watts) |
|------------------|------------------------------------|---------------------------------|----------------------------------|--------------------------------------|
| 600 | 800 | 800 | 1,000 | 1,000 |

Operating control.—Complete remote control. Front of panel for test purposes only.

Carrier control.—"Press-to-talk" button on handset.

Type of keying.—Relay—40 words per minute.

Antenna.—A quarter wave antenna and suitable ground system. In general a single wire antenna of the vertical, horizontal, or sloping type with an overall length, including lead-in, of approximately 50 to 65 feet.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type No. | Height | Width | Depth | Weight |
|---------------------------------------|-----------|------------|-----------|-----------|------------|
| Transmitter | CRM-52261 | 61¼ Inches | 34 Inches | 20 Inches | 690 Pounds |
| Remote control unit (2 furnished) | CRM-23288 | 8¼ | 14 | 9¼ | 16 |
| Hand telephone assembly (2 furnished) | CRM-51027 | 5½ | 9 | 7½ | 5 |
| Fused line switch | | 7½ | 6½ | 4 | 4¼ |
| Telegraph key (2 furnished) | | 1¾ | 2¾ | 5½ | ½ |
| Interconnecting cables | | | | | |
| Spare parts | | | | | 390 |

Shipping weights and dimensions.

| Case | Unit | Size | Gross weight | Cubic feet |
|------|-------------|---------------------|--------------|------------|
| 1 | Transmitter | 73 x 41 x 29 Inches | 900 Pounds | 25.0 |
| 2 | Accessories | 52 x 29 x 21 | 185 | 18.0 |
| 3 | Spare parts | 52 x 29 x 21 | 175 | 18.0 |
| 4 | do | 51 x 27 x 21 | 400 | 13.0 |

CONFIDENTIAL

TDH AND TDH-2 RADIO TRANSMITTING EQUIPMENTS

Use.—Shore.

Frequency range.—2,000–18,100 kc. (continuously variable and automatic choice of any one of 11 pre-selected channels).

Power output and emission.—3,000 watts A₁, A₂, A₃ from 2,000–12,000 kc. and 2,500 watts A₁, A₂, A₃ from 12,000–18,100 kc.; also up to 5,000 watts on A₁ emission when operated at the high power level.

Description.—The identical TDH and TDH-2 equipments feature rapid automatic selection of eleven pre-determined channels. Selection of these channels, choice of emission and starting and shutting down the equipment are all accomplished through the use of a telephone dial located on the remote control unit. The above functions, with the exception of automatic starting, may also be controlled by means of a similar dial on the front panel of the equipment proper. In addition to automatic frequency selection, the transmitter may be tuned manually throughout the entire frequency range. The equipment incorporates a built-in frequency calibrator to provide check points at each 50 kc. interval throughout the master oscillator range of 1,000–1,510 kc. The crystal calibrator frequency is accurate to within 0.01 percent.

The *Collins autotune system*, employed for frequency change, is an electrically controlled means of mechanically positioning the transmitter tuning elements. The positioning elements are driven by a single motor which is controlled by a series of interlocking relays. The control system will operate to change the frequency of transmission within a period of fifteen seconds. The autotune frequencies are set up without the aid of tools and after the several frequencies are adjusted, any one frequency may be changed without disturbing the other frequency settings. The equipment is normally set up for telephone operation and choice of CW or MCW emission is obtained by dialing following the dial operation for selection of the desired frequency. The equipment may also be adjusted for automatic emission selection, in which case the type of emission, with the exception of channel 11, may be pre-determined for each autotune frequency. By operating the dial to the manual position the transmitter may be tuned manually throughout the entire frequency range without up-setting the autotune channels.

The *transmitter, rectifier, and modulator* components are contained in three welded sheet steel cabinets. The transmitter and modulator are located respectively to the right and left of the rectifier as viewed from the front. The cabinets are of the unit type of construction; most of the components, except the larger transformers, are mounted on removable chassis or panels. The transmitter cabinet contains all the r.f. units, the crystal calibrator, and the autotune control system. The rectifier cabinet contains the bias, low voltage and high voltage powersupplies and all the transmitter power controls. The modulator cabinet contains the speech

amplifier, audio driver and modulator circuit components. Each cabinet is equipped with full length front and rear doors. Glass windows in the front doors of the r.f. and audio cabinets permit the viewing of all indicating instruments. Most of the controls are accessible for operation through openings in the cabinet front doors. The tuning controls are located on the transmitter; the power controls on the rectifier; and the telephone dial, local-remote switch, test key switch and key and microphone jacks on the modulator. In addition, a telephone handset with a push-to-talk button is mounted in a recess on the front of the latter unit. The antenna and ground terminals are located on the top of the transmitter; all other external connections are made to terminal boards at the base of each cabinet. When assembled together the three units require a clearance of 28½ inches to the front and rear to permit the free circulation of air, the making of antenna and ground connections and to allow the doors to open. The cabinets are ventilated by a blower located in the base of the modulator unit.

Two *Remote Control units* of identical design, intended for mounting in .19-inch relay racks are furnished. These units may be connected in parallel, and either one employed for complete control of the equipment up to any distance where the total line loop resistance does not exceed 1,000 ohms. The remote control units are similar to those used with the TDO equipment; however, provision has been made for the use of a carbon type microphone in lieu of the dynamic type used with the TDO control units, and consequently a push-to-talk circuit relay is employed, and the terminal arrangements differ.

The *remote control unit* provides selection of the eleven autotune frequencies, choice of emission, control of emission, and turning on and shutting down of the transmitter. All of these functions, except the control of the carrier, are performed by dialing. A microphone amplifier circuit with an associate rectifier power supply and a receiver disabling circuit are incorporated in the unit. The control system requires two cable pairs and a ground return circuit. The telephone dial and following items are located on the front panel: a channel indicator meter (to indicate the frequency on which the transmitter is operating), a volume level meter, a gain control, a power ON-OFF switch, an indicating pilot lamp, key and microphone jacks, a frequency indication chart, and a power input fuse.

The *microphone* is of the carbon type. The unit is equipped with a nonlocking press-to-talk button and includes a 4-foot 2-conductor shielded cord and plug.

The telegraph key assembly includes CSE type M-100 key and a 2½-foot cord and plug.

TECHNICAL FEATURES

Design.—Commercial.

Tube complement

| Location and function | Number of tubes | Type |
|--|-----------------|-----------|
| Transmitter: | | |
| Master oscillator..... | 1 | 6A8/6A8GT |
| R. F. amplifier..... | 1 | 6AG7 |
| R. F. multiplier..... | 1 | 807 |
| R. F. amplifier-tripler..... | 1 | 807 |
| Intermediate amplifiers..... | 2 | 813 |
| Voltage regulator..... | 1 | VR150-30 |
| Keyer..... | 1 | 6SJ7 |
| CFI converter..... | 1 | 6SL7GT |
| CFI oscillator..... | 1 | 6A8/6A8GT |
| CFI audio amplifier..... | 1 | 6SN7GT |
| Power amplifiers..... | 2 | 750TL |
| Parasitic suppressor..... | 1 | 811 |
| Rectifier power unit: | | |
| High-voltage rectifiers..... | 6 | 872A |
| Low-voltage rectifiers..... | 2 | 866/866A |
| Bias rectifiers..... | 2 | 866/866A |
| Modulator: | | |
| Audio amplifier..... | 1 | 6SL7GT |
| Limiter..... | 1 | 6C8G |
| Audio squelch..... | 1 | 6C8G |
| Audio amplifier..... | 1 | 6SJ7 |
| M.C.W. oscillator..... | 1 | 6SN7GT |
| Limiter rectifier..... | 1 | 6X5GT |
| Audio amplifiers..... | 2 | 801 |
| Audio drivers..... | 2 | 845 |
| Modulators..... | 2 | 450TL |
| Remote Control units (2 furnished): | | |
| First audio amplifier..... | 1 | 6SJ7 |
| Second audio amplifier..... | 1 | 6SN7GT |
| Rectifier..... | 1 | 6X5GT |

Frequency control.—Master oscillator.

Power.—*Supplies required:* 220/3/50/60 for transmitter and 115/1/50/60 for remote control unit.

Requirements.—Remote control unit, 20 watts approximately 85 percent power factor.

Transmitter:

| Filaments on (watts) | Standby (watts) | Carrier on—no modulation (watts) | Carrier—100 percent modulation (watts) |
|---|---|--|--|
| A ₁ , 1105 A ₂ , 1385 A ₃ , 1385 | A ₁ , 1840 A ₂ , 3160 A ₃ , 3160 | A ₁ , 6480 A ₂ , 7240 | A ₃ , 9920 |

The power factor under all the above conditions is approximately 85 percent; the equipment proper

draws a maximum of 30 amperes when operating with full 3 kw. output.

Allowable variation in supply line voltage.—± 10 percent.

Operating control.—Front of panel and complete remote control (two identical remote control units furnished).

Carrier control.—Press-to-talk switch on microphones or handset.

Type of keying.—Vacuum tube, several hundred words per minute on A₁ emission; 60 words per minute on A₂ emission.

Antenna.—The equipment is designed to work into an unbalanced antenna or transmission line having an impedance of from 70–600 ohms with a phase angle up to 45°.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|--|---------------|---------------|---------------|---------------|-------------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Transmitter..... | COL-52291 | 84 | 28½ | 31 | } 3,000 (approx.) |
| Modulator..... | COL-50129 | 84 | 28½ | 31 | |
| Rectifier..... | COL-20196 | 84 | 25 | 31 | |
| Remote control units (2 furnished)..... | COL-23351 | 10 | 19 | 12 | 60 |
| Microphones (3 furnished)..... | COL-51004C | | | | |
| Telegraph key cord and plug (2 furnished)..... | | | | | |
| Antenna ammeter..... | | | | | |
| Meter extension cord..... | | | | | |
| Test cables..... | | | | | |
| Kit assembly hardware..... | | | | | 2 |
| Spare parts (2 boxes)..... | | 13 | 31 | 15 | 187 |

Accessories not supplied by contractor.—Head phones—may be 500-ohms impedance up, including high impedance phones such as the crystal type.

Shipping weights and dimensions.—The complete equipment including spare parts is shipped in 22 cases—total gross weight 6,108 pounds (approximate); total cubic feet 468 (approximate).

CONFIDENTIAL

TDO RADIO TRANSMITTING EQUIPMENT

Use.—Shore.

Frequency range.—2,000–18,100 kc. (continuously variable and instantaneous choice of any 1 of 11 pre-selected channels).

Power output and emission.—400 watts A_1 , 250 watts A_2 , A_3 .

Description.—The TDO equipments feature rapid automatic selection of eleven pre-determined channels. Selection of these channels, choice of emission and starting and shutting down the equipment are all accomplished through the use of a telephone dial located on the remote control unit. The above functions, with the exception of automatic starting, may also be controlled by means of a similar dial on the front panel of the equipment proper. In addition to automatic frequency selection, the transmitter may be tuned manually throughout the entire frequency range. The equipment incorporates a built-in frequency calibrator to provide check points at each 50 kc. interval throughout the master oscillator range, 1,000–1,510 kc. The crystal calibrator frequency is accurate to within 0.01 percent.

The Collins autotune system, employed for frequency change, is an electrically controlled means of mechanically positioning the transmitter tuning elements. The positioning elements are driven by a single motor which is controlled by a series of interlocking relays. The control system will operate to change the frequency of transmission within a period of ten seconds. The autotune frequencies are set up without the aid of tools, and after the several frequencies are adjusted, any one frequency may be changed without disturbing the other frequency settings. The equipment is normally set up for telephone operation, and choice of CW or MCW emission is obtained by dialing following the dial operation for selection of the desired frequency. The equipment may also be adjusted for automatic emission selection, in which case the type of emission, with the exception of channel 11, may be pre-determined for each autotune frequency. By operating the dial to the manual position, the transmitter may be tuned manually throughout the entire frequency range without upsetting the autotune channels.

The transmitter, including a self-contained rectifier power supply and modulator, is housed in a heavy gauge reinforced sheet steel cabinet. All the components, except the larger transformers, are mounted on removable chassis or panels. The cabinet is equipped with a full length front door to provide access to the various units. The rear panel is held in place by sliding pins and may be removed for servicing purposes. A glass covered window in the front door permits the viewing of the various indicating instruments. Openings are provided so that the control panel and autotune control knobs are accessible when the front door is closed. The panel controls consist of a channel and emission selector dial, a tune operate switch, a local-remote switch, filament and plate power switches, filament and plate indicator lights, a test key switch, and telegraph key and microphone receptacles. Either of two antennas may be employed. The two antenna terminals and the ground post are located on the top

of the transmitter. All connections to the power supply unit are made to a terminal strip on the rear of the panel. A ventilation blower is located in the bottom compartment of the cabinet.

Two remote control units of identical design, intended for mounting in 19-inch relay racks are furnished. These units may be connected in parallel and either one employed for complete control of the equipment up to any distance where the total line loop resistance does not exceed 1,000 ohms. The remote control units are similar to those used with the TDH equipment; however, provision has been made for the use of a dynamic type microphone in lieu of the carbon type used with the TDH control units, and consequently a push-to-talk circuit relay is not employed and the terminal arrangements differ.

The remote control unit provides selection of the 11 autotune frequencies, choice of emission, control of emission and turning on and shutting down of the transmitter. All of these functions except the control of the carrier are performed by dialing. A microphone amplifier circuit with an associate rectifier power supply and a receiver disabling circuit are incorporated in the unit. The control system requires two cable pairs and a ground return circuit. The telephone dial and following items are located on the front panel: a channel indicator meter (to indicate the frequency on which the transmitter is operating), a volume level meter, a gain control, a power on-off switch, an indicating pilot lamp, key and microphone jacks, a frequency indication chart and a power input fuse.

The microphone is of the permanent magnet type with a push-to-talk switch. This unit includes a 6-foot 4-conductor unshielded cord and plug connector. The output impedance is 600 ohms.

The telegraph key cord and plug assembly includes a CSE type M-100 key, a 2½-foot cord and plug.

TECHNICAL FEATURES

Design.—Commercial.

Tube complement

| Location and function | Number of tubes | Type |
|--|-----------------|-----------|
| Transmitter: | | |
| R. F. oscillator..... | 1 | 6A8/6A8GT |
| R. F. buffer-amplifier..... | 1 | 6AG7 |
| R. F. multiplier..... | 1 | 807 |
| Intermediate amplifier..... | 1 | 807 |
| Power amplifier..... | 2 | 813 |
| Keyer..... | 1 | 6SJ7 |
| Voltage regulator..... | 1 | VR150-30 |
| Converter..... | 1 | 6A8/6A8GT |
| Frequency multiplier..... | 1 | 6SJ7 |
| CFI output amplifier..... | 1 | 6SN7GT |
| MCW oscillator-amplifier..... | 1 | 6SN7GT |
| Audio preamplifier..... | 1 | 6SL7GT |
| Volume limiter..... | 1 | 6C8G |
| Audio squelch..... | 1 | 6C8G |
| Audio amplifier..... | 1 | 6SJ7 |
| Limiter control..... | 1 | 6X5GT |
| Audio driver..... | 2 | 2A3 |
| Modulator..... | 2 | 805 |
| H. V. rectifier..... | 2 | 1249C |
| Bias rectifier..... | 1 | 5U4G |
| L. V. rectifier..... | 2 | 866/866A |
| Remote control units (2 furnished): | | |
| Audio preamplifier..... | 1 | 6SJ7 |
| Audio preamplifier..... | 1 | 6SN7GT |
| Power rectifier..... | 1 | 6X5GT |

¹ Type 866/866A may be substituted in an emergency.

CONFIDENTIAL

Frequency control.—Master oscillator.

Power.—*Supply available:* 115/230 /1/50 /60—auto-transformer incorporated in transmitter permits operation on either 115 or 230 volts. The remote control unit, is designed to operate from 115 /1/ 50/60 only.

Requirements: Remote control unit, 25 watts, approximately 85 percent power factor.

Transmitter:

| Filaments on (watts) | Standby (watts) | Carrier on—no modulation (watts) | Carrier on—100 percent modulation (watts) |
|--|--|--|---|
| A ₁ , 462 A ₂ , 521 A ₃ , 521 | A ₁ , 700 A ₂ , 832 A ₃ , 832 | A ₁ , 700 A ₂ , 832 A ₃ , 832 | A ₂ , 1570 A ₃ , 1570 ----- |

The power factor under all the above conditions is approximately 85 percent; operation on 115 volts requires a line current of 20 amperes and operation on 230 volts requires a line current of 10 amperes.

Allowable variation in supply line voltage ±10 percent.

Operating control.—Front of panel and complete remote control (two identical remote control units furnished).

Carrier control.—Press-to-talk switch on microphones.

Type of Keying.—Vacuum tube, several hundred words per minute A₁; 60 words per minute A₂.

Antenna.—The equipment is designed to work into an unbalanced antenna or transmission line having an impedance of from 70–600 ohms with a phase angle of not more than 45°.

Weights, dimensions and Navy type numbers of equipment units included in contract

| Unit | Navy type Nos. | Height | Width | Depth | Weight |
|---|----------------|---|---------------------|---|-----------------------|
| Transmitter..... | COL-52318 | <i>Inches</i> 80 ³ / ₈ | <i>Inches</i> 28 | <i>Inches</i> 30 ³ / ₄ | <i>Pounds</i> 1140 |
| Remote control units (2 furnished)..... | COL-23377 | 10 ¹ / ₂ | 19 | 11 | 30 |
| Microphones (2 furnished)..... | CAU-51057 | ----- | ----- | ----- | ----- |
| Power cord..... | ----- | ----- | ----- | ----- | ----- |
| Telegraph key..... | COL-26019 | ----- | ----- | ----- | ----- |
| Metering cord..... | ----- | ----- | ----- | ----- | ----- |
| Test cables (2)..... | ----- | ----- | ----- | ----- | ----- |
| Spare parts..... | ----- | 12 ³ / ₄ | 16 | 19 | 100 |

Accessories not supplied by contractor.—Head phones (may be 500 ohms impedance up, including high impedance phones such as the crystal type.)

Shipping weights and dimensions

| Case | Content | Size | Gross Weight | Cubic feet |
|------|--------------------------------------|---------------|---------------|------------|
| | | <i>Inches</i> | <i>Pounds</i> | |
| 1 | Cabinet..... | 39 x 41 x 84 | 660 | 77.5 |
| 2 | Power unit..... | 24 x 28 x 40 | 450 | 15.5 |
| 3 | Control unit and amplifier unit..... | 20 x 24 x 36 | 140 | 10.0 |
| 4 | Remote control units..... | 20 x 31 x 30 | 140 | 10.7 |
| 5 | Exciter unit..... | 20 x 31 x 35 | 164 | 12.6 |
| 6 | Output network unit..... | 20 x 31 x 35 | 142 | 12.6 |
| 7 | Transformer..... | 13 x 15 x 15 | 140 | 1.69 |
| 8 | Transformer..... | 11 x 12 x 13 | 76 | 0.99 |
| 9 | Transformer..... | 11 x 12 x 13 | 82 | 0.99 |
| 10 | Vacuum tubes (2 sets)..... | 20 x 24 x 30 | 76 | 8.3 |
| 11 | Accessories..... | 20 x 24 x 36 | 165 | 10.0 |
| 12 | Spare parts..... | 13 x 17 x 23 | 127 | 2.94 |

CONFIDENTIAL

TDQ RADIO TRANSMITTING EQUIPMENT

Use.—Ship-shore.

Frequency range.—115–156 mcs. crystal controlled.

Power output and emission.—45 watts A_2 , A_3 .

Description.—The TDQ is a very high frequency, low power transmitting equipment designed for installation on ship or shore primarily to effect communication with aircraft. The equipment may be operated from several different power sources. The transmitter includes a self-contained rectifier and is suitable for connecting directly to a 115/230-volt, single phase, 50–60 cycle power line. Through the use of a line transformer furnished with the equipment operation is also possible from a 440-volt, single phase, 50–60-cycle power source. Motor generator sets with associate magnetic controllers are also available, so that the equipment may be operated from a d. c. line of either 115 or 230 volts.

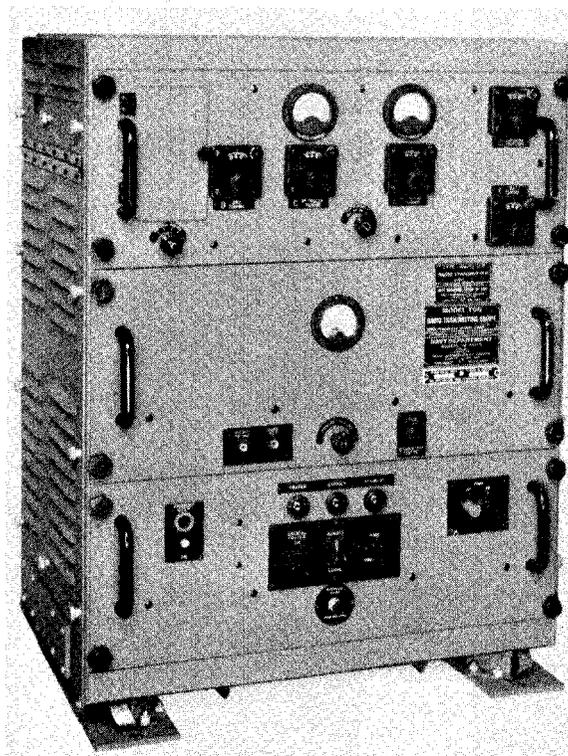
Crystals for any four frequencies within the range of the equipment may be employed and selected as desired by a switch on the transmitter; however, any change of frequency necessitates the retuning of the transmitter. For installations where rapid variation of transmission from one frequency to another or simultaneous transmission on different frequencies is required, two or more equipments may be employed. Provision is made by the Navy at the time of installation for mounting two transmitter-rectifier units, one above another, through the use of a suitable rack. When mounted in this manner the overall height of the two transmitters does not exceed 72 inches. The TDQ is intended for use with the RCK, an associated receiver. An antenna transfer relay, included in the transmitter unit, permits operation of both the TDQ and RCK equipments on a common antenna.

The transmitter may be bolted to a deck or floor or mounted on a table, is of the unit type of construction, and is quite similar in proportion and physical design to the transmitter associated with the YG homing beacon equipment. The power, modulator, and r-f components are contained on three separate aluminum chassis which are designed to slide on runners into a spot welded aluminum alloy frame, where they are positioned by means of two heavy centering pins located at the rear of each compartment. These three units, namely power, modulator, and r-f, form respectively the lower, center, and upper sections of the transmitter. Interconnection between the units is made by plugs and jacks. Each chassis is provided with a plug board at the rear which fits into a corresponding jack board mounted on the frame. Access to the various components is provided through the removal of the side or rear shields of the frame or by partial or complete withdrawal of the various chassis from the frame. The transmission lines from the antenna and receiver are brought into the transmitter through an opening near the top of the left side shield and are coupled to the transmitter through standard coaxial connectors. All other external leads may be brought into the cabinet from either side or the

rear and connected to terminal boards located on the floor of the frame.

The power chassis contains the high voltage power supply and the 12-volt power supply for the microphone circuit and control circuits. On the panel of this chassis are located the emergency power switch, start-stop switch, local-remote switch, tune-operate switch, crystal heater switch, over-load reset button and carrier, stand-by and heater indicator lamps.

The modulator chassis contains the audio system and low voltage rectifier. On the panel of this unit are



Model TDQ radio transmitter.

located the modulation meter, test key, head phone, volume control, and microphone and headset jacks.

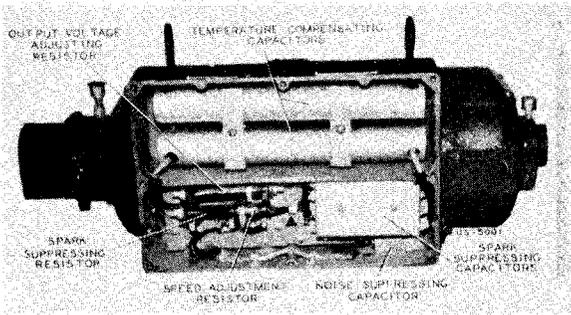
The r-f chassis contains the crystal oven and r-f stages. The antenna transfer switch and the blower for cooling the second tripler and power amplifier tubes are also included on this chassis. Mounted on the panel of this unit are the r-f tuning controls, the crystal access door, crystal selector switch, meter selector switch and two meters, one to measure the plate current of each r-f tube as determined by the position of the meter selector switch and the other to measure the grid current of the power amplifier tube.

A line transformer is supplied with each equipment and may be used when operation is desired from 440/1/50–60 power source. This unit is suitable for wall or bulkhead

mounting. The primary of the transformer is rated at 220/440/1/60 and the secondary is provided with taps for 105, 115, and 122 volts.

Motor generator sets are supplied if required for operation of the equipment from either a 115 or 230 volts d. c. power source. Each set is of the two unit, four bearing type. The motor is rated at 1.5 horsepower and is located on the left end of the bed plate as viewed from the terminal box side. The generator delivers 115/1/60 at approximately 6.1 amperes to the transmitter-rectifier unit. The terminal box contains a regulator for the adjustment of the generator output voltage as well as fuses for the protection of the circuits and the terminals for external connections.

The *motor starter* is of the remote controlled magnetic contactor type, with all switches, contactors, fuses and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.



Model TDQ motor-generator.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Function | Number of tubes | Type |
|---|-----------------|--------|
| Crystal oscillator..... | 1 | 807 |
| First tripler..... | 1 | 829 |
| Second tripler..... | 1 | 829 |
| Power amplifier..... | 1 | 829 |
| Audio amplifier..... | 2 | 6SK7 |
| Audio amplifier..... | 2 | 6J5 |
| Modulator..... | 2 | 807 |
| Limiter rectifier..... | 1 | 6X5GT |
| Audio oscillator and carrier control..... | 1 | 6SN7GT |
| Low voltage rectifier..... | 1 | 5R4GY |
| High voltage rectifier..... | 3 | 5R4GY |
| Total..... | 16 | |

Frequency control.—Crystal.

Operating control.—Front panel; 1 to 4 remote positions at distances up to 1,000 feet through use of standard Navy 4- or 6-wire remote control units and standard Navy radiophone units.

Carrier control.—Press to talk button in microphone.

Type of keying.—Relay, 40 words per minute.

Antenna.—Half wave dipole—includes a concentric two-step matching section to couple into a 50-ohm transmission line.

Power.—*Supplies available:* 115/230/440/1/50–60; 115, 230 volts d. c.

POWER REQUIRED FOR STARTING

| Power Source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|----------------------|--|------|------|------------------------|
| 115 volts a. c. | 2.60 | 0.27 | 0.30 | 90 |
| 230 volts a. c. | 1.23 | .24 | .28 | 85 |
| 440 volts a. c. | .75 | .30 | .33 | 90 |
| 115 volts d. c. | 50.00 | 5.8 | | |
| 230 volts d. c. | 25.00 | 5.6 | | |

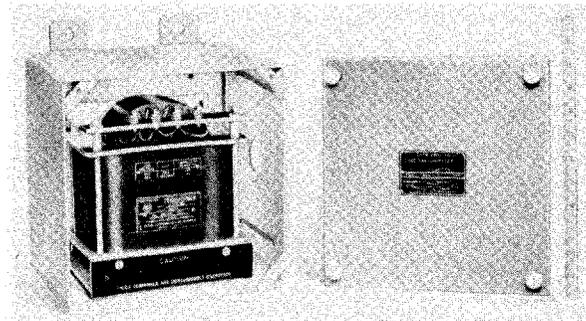
POWER REQUIRED FOR STAND-BY

| Power Source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|----------------------|--|------|------|------------------------|
| 115 volts a. c. | 2.60 | 0.27 | 0.30 | 90 |
| 230 volts a. c. | 1.23 | .24 | .28 | 85 |
| 440 volts a. c. | .75 | .30 | .33 | 90 |
| 115 volts d. c. | 8.70 | 1.00 | | |
| 230 volts d. c. | 4.40 | 1.00 | | |

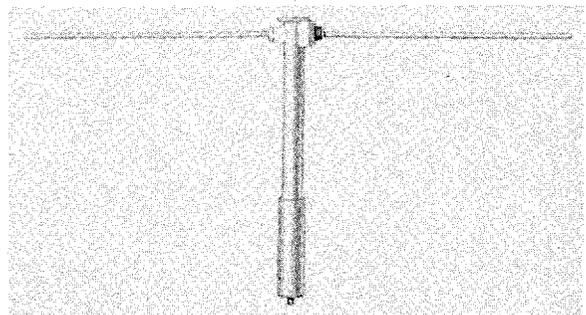
POWER REQUIRED FOR LOCKED KEY OPERATION (85% MOD.)

| Power Source | Line current (amps.) maximum per phase | KW | KVA | Power factor (percent) |
|----------------------|--|------|------|------------------------|
| 115 volts a. c. | 6.80 | 0.70 | 0.78 | 90 |
| 230 volts a. c. | 3.50 | .68 | .80 | 85 |
| 440 volts a. c. | 1.80 | .71 | .80 | 90 |
| 115 volts d. c. | 13.00 | 1.50 | | |
| 230 volts d. c. | 6.50 | 1.50 | | |

Allowable variation in line voltage: ± 10 %.



Model TDQ bulkhead transformer.



Model TDQ antenna.

CONFIDENTIAL

Weights, dimensions, and Navy type numbers of equipment units included in contract.—The units indicated below are supplied with each equipment furnished under the contract and permit operation from the following power sources: 115/230/220/440/1/50-60.

| Unit | Type No. | Height | Width | Depth | Weight |
|---|-----------|--|---|--|----------------------|
| Transmitter-rectifier... | CRV-52328 | <i>Inches</i> 32 ⁷ / ₃₂ | <i>Inches</i> 25 ³ / ₄ | <i>Inches</i> 18 ² / ₃₂ | <i>Pounds</i> 285 |
| Line transformer..... | CRV-30984 | 13 ³ / ₄ | 10 ⁷ / ₈ | 8 ⁷ / ₈ | 50 |
| Antenna assembly..... | CRV-66095 | 24 ⁷ / ₃₂ | 46 ¹ / ₂ | 4 ³ / ₄ | 23 |
| Antenna cable and fittings, 100 feet in length..... | | | | | |
| Microphone..... | 51004C | | | | |
| Spare parts..... | | | | | |
| Spare vacuum tubes..... | | | | | |

The following units are auxiliary units and are furnished as required to permit operation of the equip-

ment from either a 115-volt d. c. or a 230-volt d. c. power source.

| Unit | Type No. | Height | Width | Depth | Weight |
|------------------------|-----------|---------------------------------|---------------------------------|---------------------------------|---------------|
| 115-volt d. c. units: | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Motor generator..... | CG-211092 | 11 ⁵ / ₈ | 27 ³ / ₈ | 13 ³ / ₈ | 160 |
| Magnetic controller... | CG-211090 | 20 ² / ₃₂ | 17 ² / ₃₂ | 12 ⁰ / ₃₂ | 60 |
| Spare parts..... | | | | | |
| 230-volt d. c. units: | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Motor generator..... | CG-211093 | 11 ⁵ / ₈ | 27 ³ / ₈ | 13 ³ / ₈ | 160 |
| Magnetic controller... | CG-211091 | 20 ² / ₃₂ | 17 ¹ / ₃₂ | 12 ⁰ / ₃₂ | 60 |
| Spare parts..... | | | | | |

Accessories not supplied by contractor.—600-ohm headphones, Navy standard 4- or 6-wire remote control units and Navy standard radiophone units.

Shipping weights and dimensions.—Data will be supplied when available.



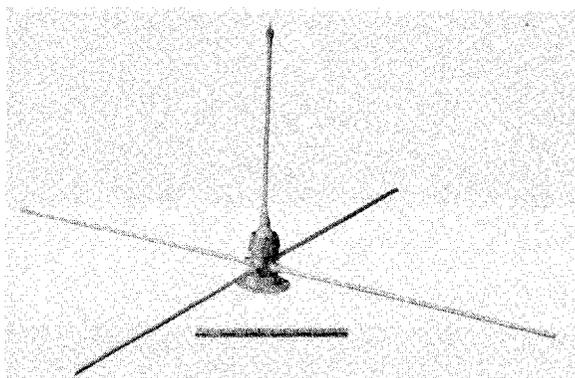
TDT RADIO TRANSMITTING EQUIPMENT

Use.—Airfields.

Frequency range. 115-156 mcs. (one preset crystal frequency).

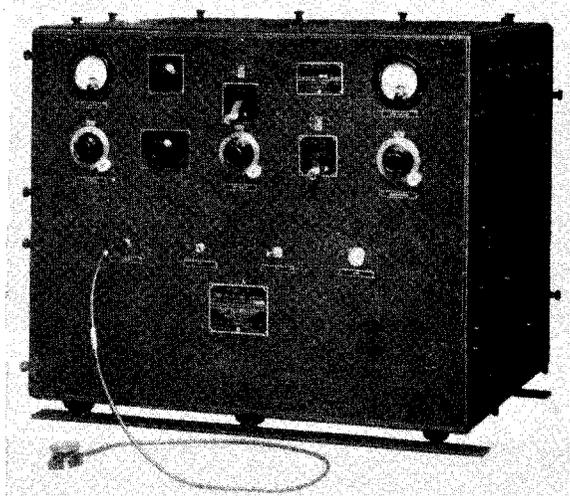
Power output and emission.—35 watts, A₂, A₃.

Description.—The TDT is a very high frequency, low power transmitting equipment designed for installation on shore primarily to effect communication with aircraft.



Model TDT antenna.

mounting. The upper portion of the frame houses the r-f chassis, next to the front panel, and the modulator chassis directly behind it. The power chassis



Model TDT radio transmitter.

The transmitter and associate rectifier power components are contained on three chassis which are housed in a spot welded angle steel frame covered with sheet steel panels. The equipment is designed for table

occupies the entire lower portion of the frame. Access to the interior of the cabinet may be made through the removal of the side, rear and top panels. In addition, all three chassis may be completely withdrawn from the

cabinet after disconnecting the cable plugs and shaft couplings and removing the bolts which are provided at the four corners of the chassis to secure them to the frame. The power chassis may be slid out from the right side of the unit—the r-f and modulator chassis may be removed from either side. The dimensions of the three chassis are as follows: r-f chassis, 29½ inches long, 25¼ inches wide, and 2½ inches deep; modulator chassis, 29½ inches long, 6 inches wide, and 2½ inches deep; power chassis, 20¼ inches long, 18½ inches wide and 1½ inches deep. A motor driven blower is incorporated in the transmitter for cooling the tripler and final amplifier tubes. This assembly is supported from the frame work and is located in the upper left hand corner of the unit as viewed from the front panel. The blower's associate air duct is also suspended from the framework. The antenna output cable is attached to the top panel by means of a connector and may be removed by unscrewing the connector when the top panel is raised. The power line receptacle and remote microphone and key connector are located in the left side of the back panel as viewed from the rear of the unit. All the operating controls and the key and microphone jacks are located on the front panel. Two meters are also provided on the front panel, one to indicate the crystal oscillator doubler, first frequency doubler, second frequency doubler, tripler and modulator plate currents as determined by the position of the meter selector switch; and the other to indicate the plate current of the final amplifier.

TECHNICAL FEATURES

Design.—Commercial.

Frequency control.—Crystal.

Power.—Supply available: 115/1/50–60. Consumption: 750 watts. Allowable variation in supply line voltage ± 10 percent

Operating control.—Front panel; also provision for connecting remote microphone and telegraph key.

Carrier control.—Push-to-talk button on microphone.

Type of keying.—Relay, 40 words per minute.

Tube complement

| Function | Number of tubes | Type |
|---------------------------------|-----------------|-----------|
| Crystal oscillator doubler..... | 1 | 807 |
| First doubler..... | 1 | 807 |
| Second doubler..... | 1 | 807 |
| Tripler..... | 1 | 829 |
| Final amplifier..... | 1 | 829 |
| Tone generator..... | 1 | 6J5GT/G |
| Buffer amplifier..... | 1 | 6J5GT/G |
| Voltage amplifier..... | 1 | 6J5GT/G |
| Modulator drivers..... | 2 | 6J5GT/G |
| Modulators..... | 2 | 807 |
| Voltage regulators..... | 2 | VR-150-30 |
| Rectifiers..... | 4 | 5U4-G |
| Total..... | 18 | |

Antenna.—Quarter-wave vertical antenna with ground planes which consist of 4 rods 90° apart. The quarter-wave vertical section is adjustable for various frequency ranges.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type No. | Height | Width | Depth | Weight |
|------------------|---------------|----------------------|----------------------|----------------------|----------------------|
| Transmitter..... | CRV-52322 | <i>Inches</i> 26¾ | <i>Inches</i> 32¼ | <i>Inches</i> 23¾ | <i>Pounds</i> 430 |
| Antenna..... | CRV-66091 | 28¾ | 49½ | | 16.5 |
| Microphone..... | -51004C | | | | |
| Spare parts..... | | 10½ | 25½ | 19½ | 37.5 |

* The weight includes 100 feet of cable.

Accessories not supplied by contractor.—Telegraph key.

Shipping weights and dimensions

| Crate | Unit | Size | Gross weight | Cubic feet |
|-------|---|---------------------------------|----------------------|------------|
| 1 | Transmitter and accessories..... | <i>Inches</i> 40½ x 34¼ x 30 | <i>Pounds</i> 470 | 24.2 |
| 2 | Spare parts..... | 30½ x 15 x 23 | 125 | 7.2 |
| 3 | Antenna and antenna transmission cable..... | 30½ x 13½ x 9¼ | 35 | 1.6 |

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TDU RADIO TRANSMITTING EQUIPMENT

Use—Permanent land stations.

Frequency range.—Adjustable from 2 to 22 mcs.

Power output.—15 kw. from 2 to 12 mcs locked key, and 12.5 kw. from 12 to 22 mcs locked key, when a continuous duty type plate transformer is employed; 12 kw. from 2 to 12 mcs, and 9.5 kw. from 12 to 22 mcs, when an intermittent duty type plate transformer is employed.

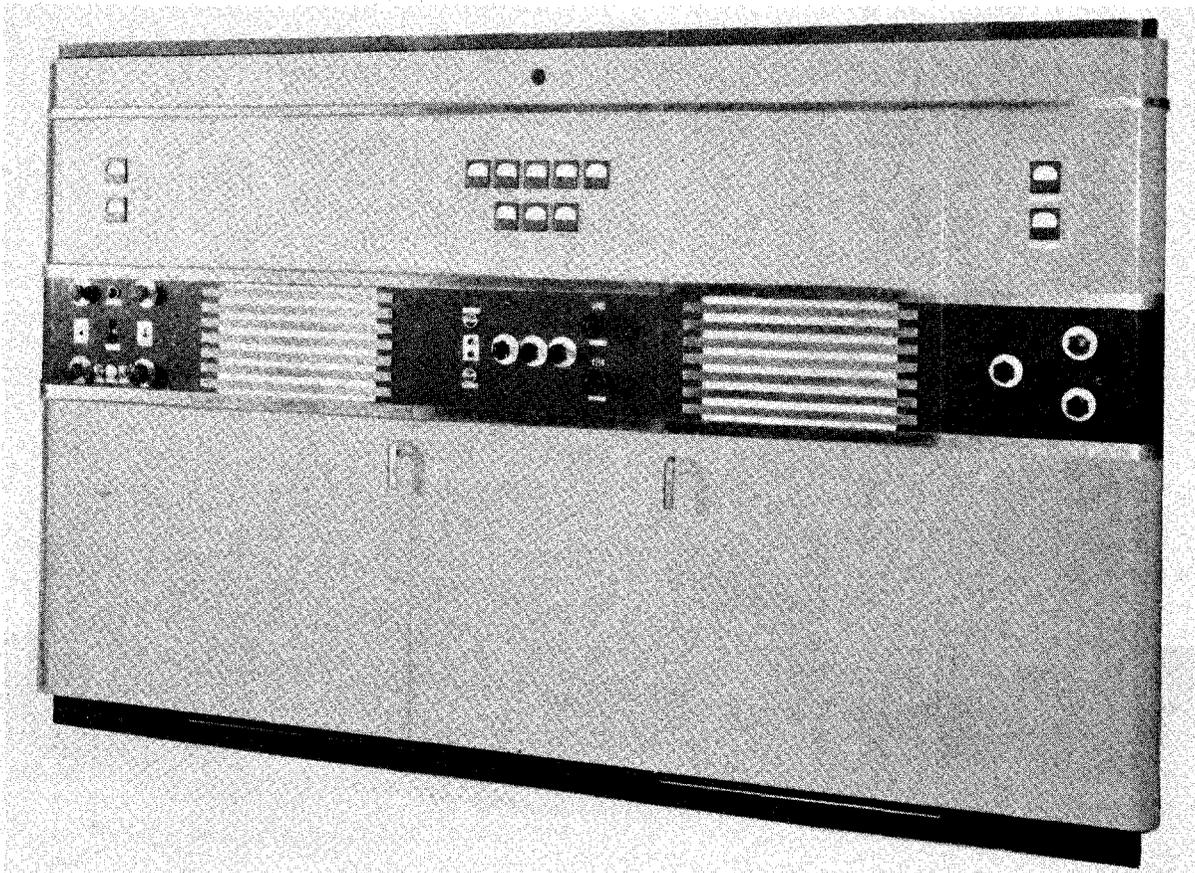
Emission.—A₁.

Description.—The TDU high frequency, high power

with the exception of the power amplifier plate-tank circuit and the antenna coupling system.

3. The *r. f. output unit* comprises the plate-tank circuit of the power amplifier and the harmonic suppressing antenna circuit.

4. The *master oscillator unit* includes the r. f. oscillator, an a. f. oscillator (which may be employed to provide frequency modulation of the carrier at a constant tone frequency), a regulated rectifier power supply, and an autotransformer. This unit is designed to



Model TDU radio transmitter.

transmitting equipment consists essentially of seven major units. Five of these units comprise the transmitter proper. The remaining two units, namely, the rectifier-keyer unit and the high voltage plate transformer, may be situated at any convenient location in the enclosure back of the transmitter. The units mounted or contained within the transmitter frame are described below.

1. The *power control panel* incorporates most of the relays and control circuit components, and a stop-start circuit to supply filament power to the amplifier tubes

2. The *r. f. amplifier unit* includes the r. f. stages

operate from a power source of 115/230 volts, 50/60 cycles.

5. The *oscillator coupling unit* comprises a set of coils tuned by a capacitor and band switch to cover the frequency range of 2 to 22 mcs. This unit is employed to couple the output of the master oscillator to the buffer stage of the transmitter. A solid copper sheathed coaxial cable having a characteristic impedance of 70 to 75 ohms is furnished for this purpose.

The transmitter consists of a front panel, base, and frame to enclose or support the various unit components. Most of the controls and meters required for operation of the equipment are mounted on the front panel.

Access to the master oscillator and r. f. panels is provided by two large doors, each of which is equipped with a safety-interlock switch. The power control panel, r. f. amplifier and r. f. output units are of the vertical chassis type of construction, and are assembled in a row immediately behind the front panel to which they are bolted. The master oscillator unit is located within the transmitter frame between the power control panel and the r. f. amplifier unit and just behind the left access door of the front panel. All the controls used for the operation of the master oscillator are mounted on the front panel of this unit. The arrangement of the various units, from right to left, as viewed from the back of the transmitter, is in the order indicated above. The oscillator coupling unit is intended to be mounted in the transmitter adjacent to the tube that is to be excited.

The *rectifier-keyer* is of the shelf type of construction. This unit requires an input of 230/3/60 and 5250/3/60. The latter supply is obtained from the output of the secondary of the high voltage plate transformer unit. The rectifier supplies 7,000 volts d. c. for the plates of the power amplifier tubes, 1,800 and 600 volts d. c. for the plates of the low power stages, and 500 volts d. c. for bias to the grids of the second and third amplifier stages and the keyer tubes. The bias rectifier components are included with the keyer components on a separate chassis located on the bottom shelf of the unit. The keying assembly permits keying of the buffer stage of the r. f. unit at speeds up to 250 words per minute.

TECHNICAL FEATURES

Design.—Commercial.

Tube complement

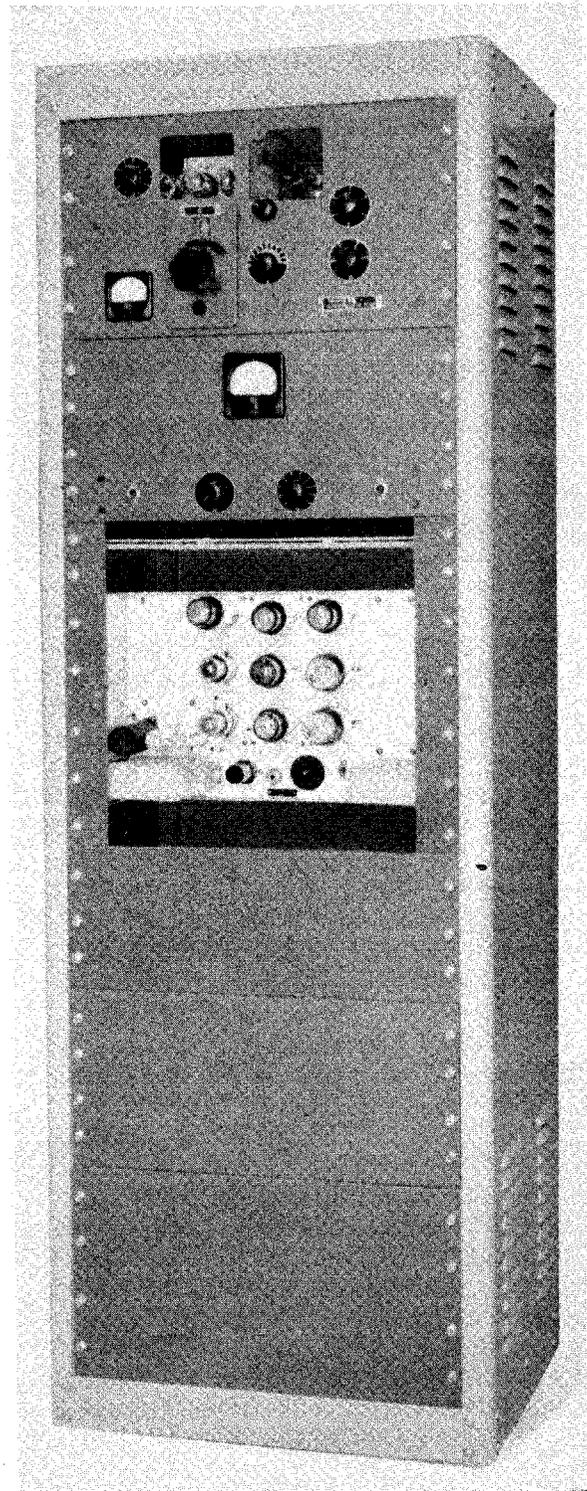
| Location | Function | Number of tubes | Type |
|---------------------------|----------------------------------|-----------------|-----------|
| Transmitter—r. f. stages. | First amplifier (doubler)..... | 1 | 807 |
| | Second amplifier..... | 4 | 813 |
| | Power amplifier..... | 2 | 889-R |
| Rectifier and keyer unit. | Plate rectifier..... | 6 | 872-A |
| | Auxiliary rectifier..... | 3 | 872-A |
| | Bias rectifier..... | 2 | 872-A |
| | Keyer..... | 2 | 807 |
| Master oscillator unit. | Electron coupled oscillator..... | 2 | 3Q5-GT |
| | Buffer-amplifier..... | 1 | 807 |
| | A. f. oscillator..... | 1 | 6AB7 |
| | Amplifier..... | 1 | 6F6 |
| | Full wave rectifier..... | 2 | 5U4-G |
| | Voltage regulator..... | 2 | VR-150-30 |
| | Voltage regulator..... | 1 | 1852 |
| | Voltage regulator..... | 5 | 6Y6-G |
| Total..... | | 35 | |

Frequency control.—Master oscillator (amplitude modulation or frequency modulation) from 2 to 22 mcs.

Modulation frequency.—600 cycles.

Frequency deviation.—When frequency modulated, the master oscillator will deliver a signal which will produce a maximum deviation of ± 500 cycles (1,000 cycles swing) in the output (carrier) frequency of the associated radio transmitter.

Power.—*Supplies required:* Transmitter 230/3/50/60; master oscillator 115/230/1/50/60. The equipment is



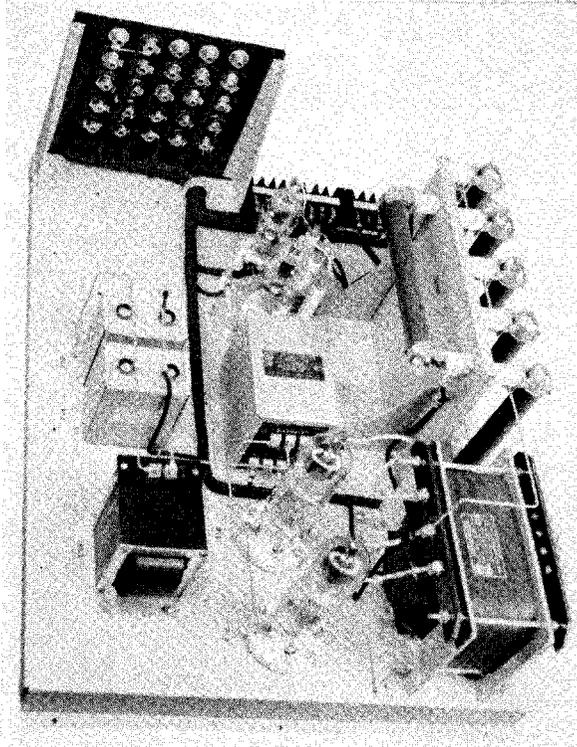
Model TDU master-oscillator rack.

originally set up for 60-cycle operation. Conversion kits are supplied for operation on 50 cycles. *Requirements:* Key down, 30 kw.; filaments only, 4.5 kw.; master oscillator, 200 watts.

CONFIDENTIAL

Operating control.—Local.

Type of keying.—(1) Vacuum tube, 250 words per minute (input terminals provided for connection of telegraph key, open closed contact relay or polar keying ± 100 volts), (2) transmitter may be modified if so desired for frequency shift keying with the mobile AN/FGC-1A unit. This modification requires the



Model TDU keyer unit.

installation of a receptacle on the front left side of the transmitter and rearrangement of the master oscillator bay to incorporate two extra stages of r. f. amplifiers and connecting coaxial cables.

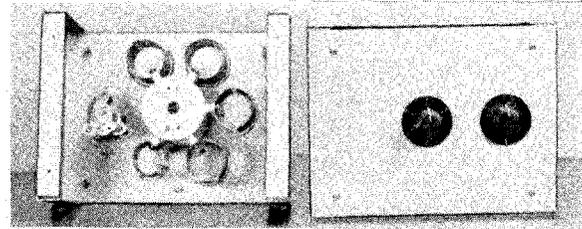
Antenna.—600 ohms balanced transmission line.

Space required for installation.—Recommended minimum: 17'-4" x 13'.

Weights, dimensions, and Navy type numbers of major units included in contract

| Unit | Navy type Nos. | Height | Length | Depth | Weight |
|-------------------------------|------------------------|---------------------------------|--------------------------------|--------------------------------|-----------------------|
| Transmitter..... | | <i>Inches</i> 90 | <i>Inches</i> 132 | <i>Inches</i> 49 | <i>Pounds</i> 3000 |
| Rectifier unit..... | CEJ-20239 | 63 | 50 | 38 | 1675 |
| Plate transformer..... | ¹ CAT-30116 | 42 ³ / ₈ | 30 ³ / ₄ | 21 ¹ / ₂ | 1250 |
| Master oscillator bay..... | CAGX-35037 | 66 ⁹ / ₁₆ | 22 | 17 ³ / ₈ | 275 |
| Oscillator coupling unit..... | CAGX-47343 | 7 ³ / ₄ | 9 ⁵ / ₈ | 6 ¹ / ₁₆ | 7.25 |
| Spare parts..... | | | | | |

¹ Intermittent duty plate transformer—Type number is not available for the continuous duty plate transformer—Weight and dimensions should be approximately the same.



Model TDU coupling unit.

Navy type numbers of the subunits

| Major unit | Subunits | Navy type No. |
|--------------------------|----------------------------|---------------|
| Transmitter..... | Control panel..... | CEJ-23380 |
| | R. f. amplifier..... | CEJ-52319 |
| | Amplifier output unit..... | CEJ-52320 |
| Rectifier and keyer..... | Keyer unit..... | CEJ-67013 |
| | Master oscillator..... | CAGX-35035 |
| Master oscillator..... | A. f. oscillator..... | CAGX-35036 |
| | Rectifier power..... | CAGX-20240 |
| | Autotransformer..... | CRV-301117 |
| | | |

Accessories not supplied by contractor.—Keying equipment.

Shipping weights and dimensions.—The complete equipment, including spare parts, is shipped in 27 cases. Total gross weight: 10,781 pounds (approximate). Total cubic feet: 643.1 (approximate).

50064 SPEECH INPUT EQUIPMENT

Use.—Voice modulating TBL series.

Description.—The Navy type 50064 speech input equipment is designed for use in conjunction with Navy models of the TBL series transmitting equipments and associate models RAA, RAK, RAB, RAG, RAH, RAL receiving equipments.

The *speech amplifier* is designed to be mounted on a table. All the controls and the chassis are built onto the front panel, which is hinged to the bottom of the cabinet and may be swung out for servicing purposes.

Two *hand set telephone units* are supplied: One set supplied is fastened to the top of the speech amplifier unit, but may be detached if desired and mounted on the table used to support the latter unit. The second telephone assembly may be mounted on any horizontal or vertical surface at a remote location.

The *chest microphone assembly* is of the single-button carbon type and is equipped with a plug-terminated cord designed to be inserted into a jack located in the speech amplifier unit.

The *receiver input attenuator units*, enclosed in aluminum boxes, are designed to permit an operator to adjust the input to his receiver from a nearby transmitter so that the audio levels resulting from the nearby transmitter signal will be the same as those from a more distant transmitter operating at the same frequency. One of these units must be installed on the panel or case of each receiver employed in conjunction with a model TBL series transmitter used in radio telephone operation.

TECHNICAL FEATURES

Design.—Navy.

Audio power.—3 watts in 500-ohm load.

Power.—Supply 110/1/60. *Required:* 125 watts. Allowable variation in supply line voltage $\pm 10\%$, frequency $\pm 5\%$.

Input impedance.—600/200 ohms.

Output impedance.—500 ohms.

Overall frequency response.—300 to 3,000 cycles with ± 2 db of 1,000 cps. value.

Modulation capability.—Up to 85 percent.

Type of control.—Front of panel. Controls TBL transmitter by means of standard Navy 4- or 6-wire control circuit.

Tube complement

| Location | Number of tubes | Type |
|------------------------|-----------------|------|
| First stage..... | 2 | 6D6 |
| Second stage..... | 2 | 2A3 |
| Limiter rectifier..... | 1 | 84 |
| Power rectifier..... | 1 | 5Z3 |
| Total..... | 6 | |

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Type Nos. | Height | Width | Depth | Weight |
|-------------------------------------|-----------|---------------------|---------------------|---|---------------------|
| Speech amplifier..... | CRV-50055 | <i>Inches</i> 16 | <i>Inches</i> 16 | <i>Inches</i> 15 $\frac{1}{2}$ $\frac{3}{8}$ | <i>Pounds</i> 77 |
| Handset assemblies (2)..... | CRV-51008 | 5 | 11 $\frac{1}{4}$ | 3 $\frac{3}{8}$ | 4 $\frac{3}{4}$ |
| Chest microphone assembly..... | CRV-51011 | | | | 2 |
| Receiver input attenuators (2)..... | CRV-29017 | 5 $\frac{3}{4}$ | 4 $\frac{1}{4}$ | 4 $\frac{3}{4}$ | 3 $\frac{3}{4}$ |
| Spare parts and tubes..... | | | | | 14 |



Speech input unit Type 50064 for providing external voice modulation.

Accessories not supplied by contractor: 4- or 6-wire remote control unit.

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet |
|--|---------------------------------|----------------------|------------|
| Speech amplifier, handsets and chest microphone..... | <i>Inches</i> 22.5 x 20 x 25 | <i>Pounds</i> 134 | 6.55 |
| Receiver input attenuators..... | 18.5 x 10.5 x 11 | 21 | 1.32 |
| Spare parts and tubes..... | 23 x 15 x 11 | 34 | 2.21 |
| Total..... | | 189 | 10.08 |

CONFIDENTIAL

Section V

RADIO HOMING BEACON EQUIPMENTS

CONFIDENTIAL

YE-1, YE-2, AND YE-3 RADIO HOMING BEACON EQUIPMENTS

Use.—Aircraft carriers and air bases.

Frequency range.—200 to 250 mc. (usually operated at 246 mc.).

Power output and emission.—50 watts, A₂.

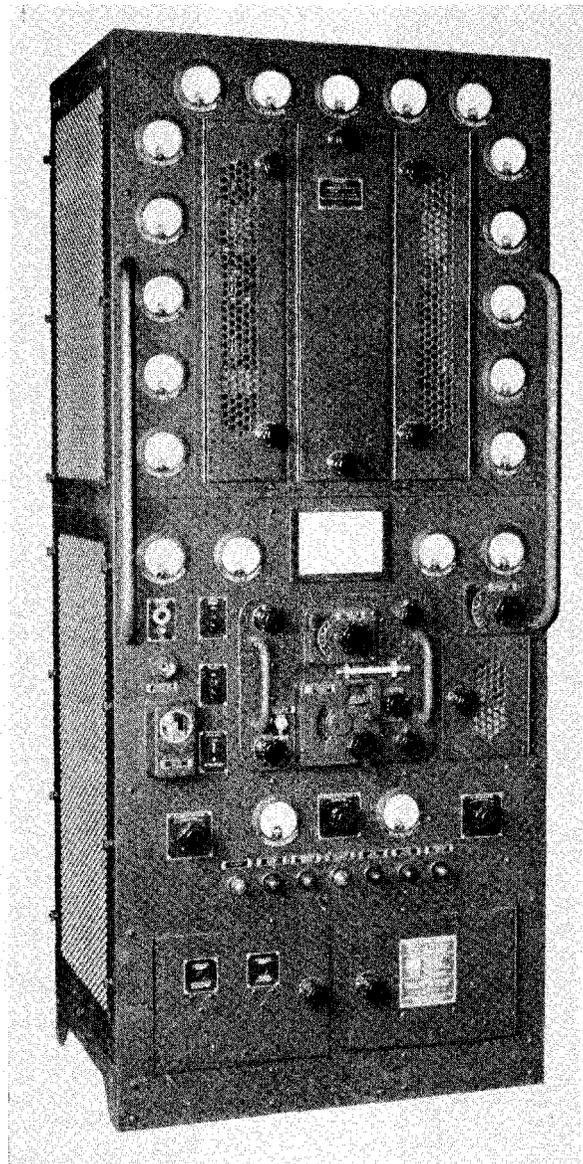
Description.—The Navy Models YE-1, YE-2, and YE-3 radio homing beacon equipments are designed primarily for installation on aircraft carriers but may be used on other vessels, or at air bases. The equipment is designed to transmit bearing and identification signals from a constant speed directional rotative antenna for guidance of aircraft to the point from which the signals are radiated. The bearing signals which may be arranged according to any prescribed code conform to twelve different Morse Code letters. Each signal consists of one of these letters transmitted in duplicate through a 30° segment of the true bearing circle. The bearing signals are transmitted for 9 revolutions of the antenna which turns at a speed of 2 revolutions per minute. The station identification signal consists of a combined choice of any 2 of 9 Morse letters which are transmitted through the bearing circle during every tenth revolution of the antenna. The speed and direction of the antenna, and the selection of the proper signals, regardless of the ship's movements, are controlled in reference to true north through various synchronous motors and generators located in the antenna control and drive units. Either manual setting of the course or automatic setting of the course by electrical connection to the ship's gyro-compass repeater may be employed.

The *transmitter* is composed of four mechanical assemblies including the frame which is constructed of spot welded duralumin. The carrier-frequency crystal-oscillator and amplifier stages with the demodulator stages are located in the upper part of the transmitter in an assembly that may be isolated completely from the chassis for servicing purposes. The removable Dow modulation oscillator mounted on a cast aluminum chassis is located in the center of the transmitter. Assembled together, directly to the right of the modulation-oscillator, are located the modulation-amplifier and modulation-rectifier stages. The lower section of the transmitter contains the control circuits and terminal boards which are located to the front and left side for all external connections. The power developed in this transmitter is delivered to the antenna assembly by means of a 3/8-inch nitrogen gas filled co-axial transmission line.

The *radio frequency monitor unit* is an accessory of the Model YE-2 and YE-3 equipments, and is furnished to provide monitoring of the radiated signal at a remote point. This unit consists essentially of an extended rod antenna, a concentric line, a crystal rectifier, and an indicating meter, housed in a small, metal, watertight case, which is designed for mounting on a horizontal surface or against a bulkhead.

The *motor-generator* set is a 2-unit, 4-bearing, direct-coupled assembly with both units mounted on a common bed platé. The drive motor is of 3-horse-

power capacity and is located on the right hand end of the bed plate as viewed from the terminal box side. All a-c and d-c motors are interchangeable. The double commutator generator located to the left of the motor supplies 750 volts at 1.3 amperes for plate potential and 250 volts at 0.5 ampere for grid bias and field



Transmitter for Model YE homing beacon equipment

excitation. Drip-proof terminal boxes are located at the side of each unit and contain fuses for the protection of all circuits as well as terminals for all external connections. (D-c equipments provide a-c supply for filaments from slip rings located on the driving motor.)

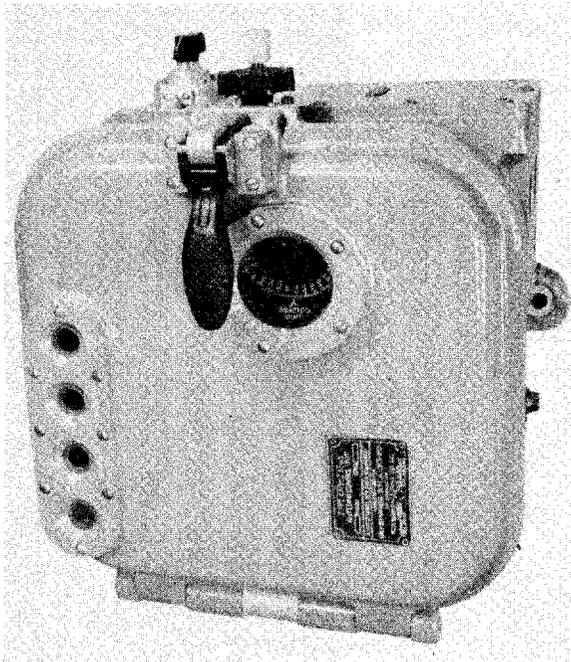
The *motor starter* is of the remote controlled magnetic

contactor type with all switches, contactors, fuses, and overload protection devices mounted on a panel and housed in a metal box with a hinged cover. All external connections are made to the front side of this panel. Power for operation of the motor starting contactor is obtained from the transmitter control circuits.

The *matching transformer* is a line-coupling device with an impedance ratio of 140 to 70 ohms at 246 megacycles. This transformer is used to couple the output of the transmitter to the antenna.

The *antenna control unit*, of weather-proof construction, with a quick opening cover for access to the mechanism is designed for bulkhead mounting. This unit serves to control the rotative directional antenna in speed and direction, to energize the keying circuit of the radio transmitter automatically, and as a control panel for interconnecting the various units of the equipment. The control unit contains a constant speed motor and the necessary gears for driving the rotor of a synchronous generator which operates to control the rotation of the antenna in respect to true North. The constant speed motor in conjunction with the necessary gear train also drives the bearing and identification signal discs contained in this unit. Automatic azimuth setting of the antenna is provided through electrical connection of the control unit to the ship gyro compass repeater. Facilities for manual control or adjustment are also provided.

The *antenna drive unit* incorporates a motor and synchro-receiver which in conjunction with suitable contacts and a friction brake serve to drive a gear train that rotates the antenna in a clockwise direction. A separate 115/1/60 supply source is necessary for the operation of this unit.



Antenna control unit for Model YE equipment.



Antenna for YE beacon mounted on a tower.

The *antenna assembly* consists of a rotative directional di-pole and the necessary reflectors to produce a desired beam through various sections of a 360° true bearing circle.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | Number of tubes | Type |
|-----------------------------------|-----------------|------|
| Crystal oscillator (carrier)..... | 1 | 807 |
| First amplifier stage..... | 1 | 807 |
| Second amplifier stage..... | 1 | 829 |
| Third amplifier stage..... | 1 | 829 |
| Fourth amplifier stage..... | 2 | 826 |
| Power amplifier stage..... | 2 | 826 |
| Dow modulation oscillator..... | 1 | 807 |
| Modulation amplifier..... | 3 | 807 |
| First demodulator stage..... | 2 | 955 |
| Second demodulator stage..... | 1 | 6A6 |
| Modulator rectifier..... | 1 | 807 |
| Total..... | 16 | |

Frequency control.—Crystal control on one channel. Modulation frequency range: 540–830 kc. Modulation frequency control: master oscillator.

Power.—*Supplies available:* YE-1—115, 230 volts d. c., 220/440/3/60; YE-2—230 volts d. c., 220/440/3/60; YE-3—230 volts d. c., 440/3/60.

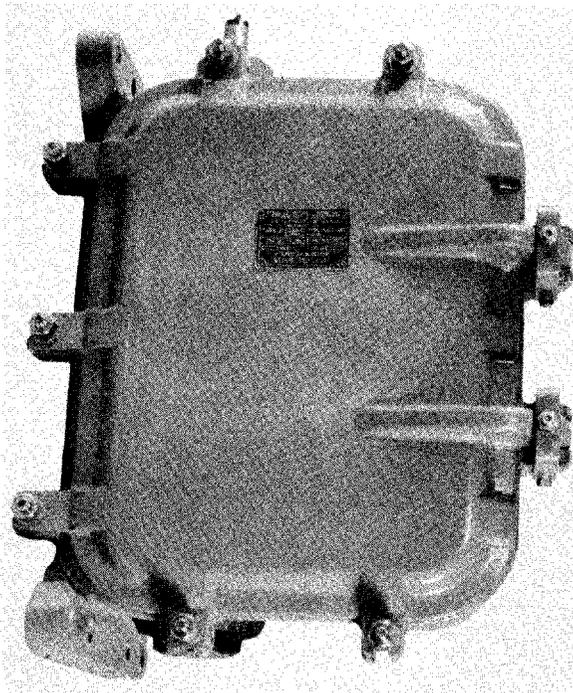
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POWER REQUIRED FOR STARTING

| Power source | Line current amperes maximum per phase | Kilowatts | Kilovolt-amperes | Power factor (percent) |
|---------------------|--|-----------|------------------|------------------------|
| 440/3/60..... | 26.4 | 12.8 | 14.5 | 88 |
| 220/3/60..... | 52.0 | 12.8 | 14.5 | 88 |
| 230 volts D. C..... | 23.0 | 5.29 | | |

POWER REQUIRED FOR LOCKED KEY OPERATION

| Power source | Line current amperes maximum per phase | Kilowatts | Kilovolt-amperes | Power factor (percent) |
|---------------------|--|-----------|------------------|------------------------|
| 440/3/60..... | 4.71 | 2.3 | 2.8 | 80 |
| 220/3/60..... | 9.5 | 2.3 | 2.8 | 80 |
| 230 volts D. C..... | 9.85 | 2.27 | | |



Model YE-1 antenna assembly.

Allowable variation in supply line voltage $\pm 10\%$, frequency $\pm 5\%$; combined voltage and frequency $\pm 10\%$ (5% each).

Operating control.—Front of panel—manual keying for test purposes. Antenna control unit—automatic keying.

Type of keying.—Relay—20 words per minute.

Antenna.—Rotating directional antenna system sup-

plied as unit of equipment. Requires high, clear space for installation.

Weights, dimensions, and Navy type numbers of equipment units included in contract

The Model YE-2 does not include equipment for 115 volts d. c. The Model YE-3 does not include equipment for 115 volts d. c. or 220/3/60.

| Unit | Navy Type Number | Height | Width | Depth | Weight |
|--|-------------------------|--------------------|--------------------|--------------------|--------|
| Transmitter: | | | | | |
| 115-volts d. c..... | CRV-52262 | 72 $\frac{3}{8}$ | 31 $\frac{5}{8}$ | 23 $\frac{7}{16}$ | 775 |
| 230-volts d. c..... | CRV-52234 | | | | |
| 220/440/3/60..... | CRV-52235 | 72 $\frac{3}{8}$ | 31 $\frac{5}{8}$ | 23 $\frac{7}{16}$ | 850 |
| Motor-generator set: | | | | | |
| 115-volts d. c..... | CC-21810 | 17 $\frac{1}{8}$ | 46 $\frac{5}{8}$ | 16 | 586 |
| 230-volts d. c..... | CC-21725 | | | | |
| 220/440/3/60..... | CC-21726 | 17 $\frac{1}{8}$ | 43 $\frac{3}{8}$ | 16 | 520 |
| Magnetic controller: | | | | | |
| 115-volts d. c..... | CAE-21812 | 20 $\frac{3}{8}$ | 15 | 13 | 61 |
| 230-volts d. c..... | CAE-21741 | | | | |
| 230-volts d. c..... | CAE-211199 ¹ | 23 | 15 $\frac{1}{2}$ | 10 $\frac{1}{2}$ | 85 |
| 220/3/60..... | CAE-21740 | 19 $\frac{21}{32}$ | 16 | 9 | 46 |
| 440/3/60..... | CAE-21771 | 19 $\frac{21}{32}$ | 16 | 9 | |
| 440/3/60..... | CAE-211200 ¹ | 14 | 10 $\frac{3}{8}$ | 8 $\frac{15}{16}$ | 40 |
| Radio frequency Monitor: | | | | | |
| 2 | CRV-60047 | | | | |
| Antenna retracted | | 18 $\frac{5}{32}$ | 51 $\frac{15}{16}$ | 4 $\frac{9}{8}$ | 18 |
| Antenna extended | | 10 $\frac{9}{32}$ | 5 $\frac{15}{16}$ | 4 $\frac{9}{8}$ | 18 |
| Antenna control unit (cover closed) | CRV-23263 | 16 $\frac{7}{8}$ | 16 $\frac{15}{16}$ | 11 $\frac{1}{4}$ | 75 |
| Antenna control unit (cover open) | | 3 $\frac{14}{32}$ | | | |
| Signal disc container | | 10 | 7 $\frac{1}{2}$ | 2 | 12 |
| Matching transformer | CRV-47194 | 29 $\frac{9}{16}$ | 6 $\frac{1}{2}$ | 4 | 8 |
| Antenna drive unit (cover closed) | | 22 $\frac{13}{32}$ | 17 $\frac{23}{64}$ | 13 $\frac{15}{16}$ | 120 |
| Antenna drive unit (cover open) | | 3 $\frac{16}{64}$ | | | |
| Reflector radiator (15- or 30-foot tube) | | 35 $\frac{1}{4}$ | 102 | | 225 |
| Transmitter spares | | 18 | 24 $\frac{1}{4}$ | 21 | 133 |
| Motor-generator and controller spares | | 18 | | | 40 |
| Spare armature for motor | | 24 | | | 40 |
| Spare armature for generator | | | 30 | | 70 |

¹ Employed with YE-3 equipments.

² Employed with YE-2 and YE-3 equipments.

³ Radius door swing required.

Accessories not supplied by contractor.—Nitrogen gas for transmission line.

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet |
|---------------------------------|-----------------------|---------------|------------|
| Transmitter | | | |
| | <i>Inches</i> | <i>Pounds</i> | |
| 80 x 37 x 28..... | | 1,032 | 48.0 |
| Modulation oscillator unit..... | 32.5 x 21 x 19..... | 122 | 7.5 |
| Motor-generator set..... | 50 x 18.5 x 20.5..... | 545 | 11.0 |
| Magnetic controller..... | 28 x 19 x 14..... | 82 | 4.4 |
| Antenna control unit..... | 21 x 15 x 19.5..... | 115 | 3.6 |
| Antenna accessories..... | 105 x 53 x 41.5..... | 510 | 132.0 |
| Antenna drive shaft..... | 369 x 10.5 x 11..... | 549 | 24.6 |
| Antenna drive unit..... | 29 x 16.5 x 20..... | 167 | 5.4 |

YG AND YG-1 RADIO HOMING BEACON EQUIPMENTS

Use.—Airbases, aircraft carriers.

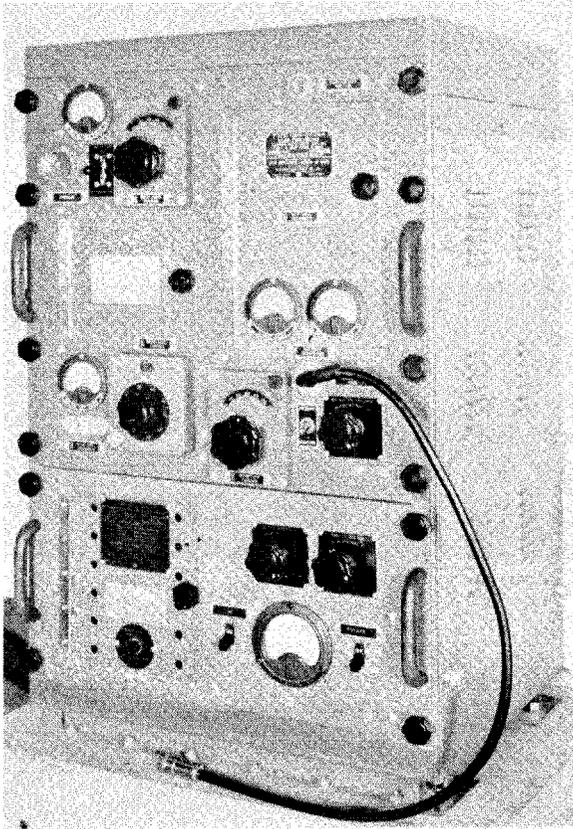
Frequency range.—241–251 mc. (usually operated at 246 mc.).

Power and emission.—25 watts, A₂.

Description.—The identical Navy Models YG and YG-1 radio homing beacon equipments are designed primarily for use at air bases, but may be installed on aircraft carriers and other vessels. These equipments are designed to transmit bearing and identification signals from a constant speed directional rotative antenna for guidance of aircraft to the point from which the signals are radiated. The bearing signals which may be

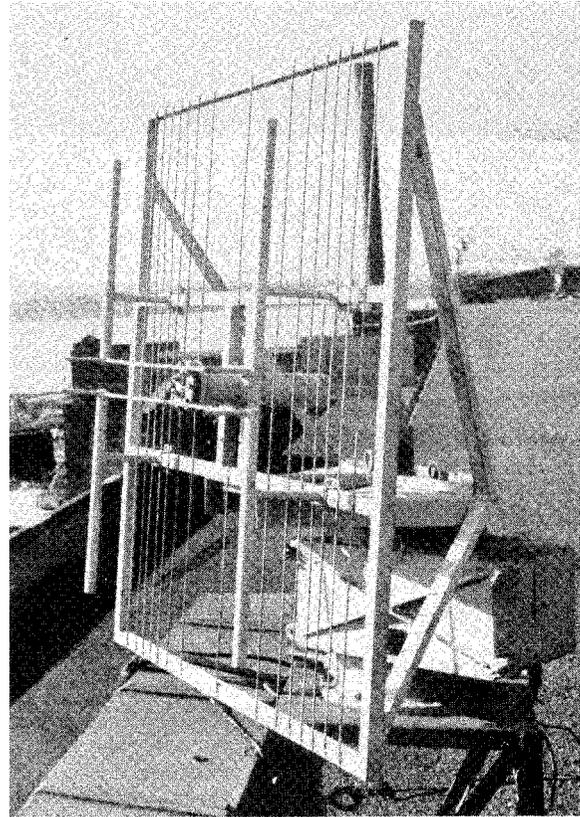
trolled in reference to true north through various synchronous motors and cams located in the antenna control unit and the antenna assembly. Manual setting of the course is obtained by means of a crank handle and “Ships Course” dial, both of which are located in the antenna control unit. If required for ship installations, automatic setting of the course may be obtained through the use of an auxiliary unit not supplied with the basic equipment but described herein and available under separate contract.

The *transmitter*, which may be bolted to a deck of mounted on a table for convenient operation, consists or



Transmitter for Model YG homing beacon equipment.

arranged according to any prescribed code, conform to twelve different Morse Code letters. Each signal consists of one of these letters transmitted in duplicate through a 30° segment of the true bearing circle. The bearing signals are transmitted for 9 revolutions of the antenna which turns at a speed of 2 revolutions per minute. The station identification signal consists of a combined choice of any two of nine Morse Code letters which are transmitted through the bearing circle during every tenth revolution of the antenna. The speed and direction of the antenna, and the selection of the proper signals, regardless of the ship's movements, are con-



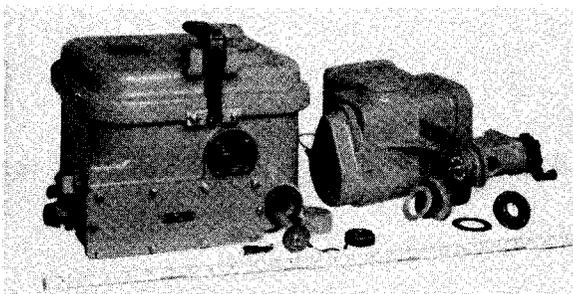
Antenna array unit for use with Model YG homing beacon equipment.

an RF unit and a power unit, which are contained in two separate aluminum chassis, designed to slide on runners into a spot welded, aluminum alloy frame, where they are positioned by means of two heavy centering pins located at the rear of each deck. The RF unit forms the upper section of the transmitter and the power unit forms the lower section of the transmitter. Interconnections between these two sections are made by plugs and jacks. Each unit contains a plug board at the rear, which fits into a corresponding jack board mounted on the frame. A terminal board for all external connections to the transmitter is located on the

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frame between the two jack boards. The bottom left hand portion of the RF unit contains the Navy type 807 electron coupled modulator oscillator and the Navy type 807 modulator amplifier stages. A removable subchassis containing the Navy type 6SA7 monitor converter stage is located to the bottom right of the unit. In a compartment above the subchassis is located the carrier oscillator stage which employs two 8025 tubes connected in push-pull. The power developed in the transmitter is delivered to the antenna assembly by means of a 3/8-inch nitrogen gas filled 70-ohm, flexible, co-axial transmission line. The Power unit contains two Navy type 836 rectifier tubes used in conjunction with various transformers and filter components to provide the necessary d-c voltages for the transmitter and monitor stages.

The *frequency meter*, designed for checking the carrier frequency of the transmitter is mounted during periods of use on top of the transmitter. This meter consists mainly of a microammeter, a crystal detector and a resonant line. The resonant line may be brought to the desired resonant frequency by means of a micrometer head "dial" which lengthens or shortens the



Model YG antenna control unit with true bearing attachment at right.

effective portion of the inner conductor. Energy from the carrier oscillator in the transmitter is conducted to the frequency meter through a flexible 70-ohm coaxial line. The frequency meter with the necessary accessories is stowed in a wooden carrying case when not in use.

The *radio frequency monitor unit* is furnished for monitoring the radiated signal at a remote point. This unit consists essentially of an extended rod antenna, a concentric line, a crystal rectifier, and an indicating meter housed in a small metal, watertight case which is designed for mounting on a horizontal surface or against a bulkhead.

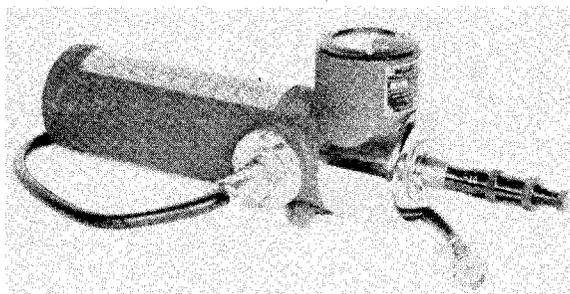
The *antenna control unit*, of weatherproof construction with a quick opening cover for access to the mechanism is designed for bulkhead mounting, though horizontal mounting is permissible if desired. This unit serves to control the rotative antenna in speed and direction, manually by means of a hand crank and "Ships Course" dial, to energize the keying circuit of the radiotransmitter automatically, and as a control panel for connecting the various units of the equipment. The control unit contains a constant speed synchronous motor geared down to rotate the synchro (motor control)

cam at the rate of 2 revolutions per minute. This cam in turn actuates a switch which is electrically interconnected to a separate cam-actuated switch in the antenna assembly. Automatic and continuous correspondence is maintained between these two units and thus between the position of the antenna and the constant speed motor in the control unit.

The *antenna assembly* consists of a directional antenna array, composed of twin dipoles centered in an assembly of reflector rods; and an aluminum alloy pedestal-housing, which serves as a mounting base, and also contains the rotating and mechanical coupling mechanism for the antenna array.

The *signal-disc container* holds a set of station identification inserts, and four completely assembled bearing signal cams.

A *maintenance of true bearing attachment*, not supplied as a unit of the model YG and YG-1 equipments but available under separate contract, is designed for use with ship installations of these equipments to permit automatic azimuth setting of the antenna through electrical connection to the ship gyro compass repeater. When the True Bearing attachment is



Frequency meter for use with Model YG equipment.

employed, facilities for manual control or adjustment of the antenna in relation to the ship's course are also available. All component parts of this attachment are housed in an aluminum casting which is designed to mount on the YG or YG-1 antenna control unit. Power for the operation of this attachment is taken from the ship's gyro compass transmitter busses. The attachment contains a small single phase reversible motor which turns a drive shaft coupled to the ship course dial in the control unit. The direction and degree of shaft rotation are controlled by the action of a synchro-motor and a follow-up contactor upon the single phase motor. The synchro motor in turn corresponds to changes in the gyro compass. This control system, therefore, acts upon the bearing signal keying disc to automatically compensate for change of course. To mount the attachment, the crank and jack assemblies are removed from the control unit and the attachment is placed in position over the crank and jack apertures. The crank and jack assemblies are then mounted to the attachment and all are secured to the control unit. Only one switch is used in the True Bearing attachment and is actuated by pushing the course crank handle in or pulling it out. In the re-

tracted position of the crank, the switch is open and the unit ready for manual course correction; in the extended position of the crank the switch is closed and the drive motor is energized, permitting automatic course correction. A green signal light is provided to serve as an indicator when the equipment is placed in the gyro (automatic) position.

TECHNICAL FEATURES

Design.—Navy.

Tube complement

| Location | Number of tubes | Type |
|-----------------------------|-----------------|------|
| Modulation oscillator..... | 1 | 807 |
| Modulator amplifier..... | 1 | 807 |
| Carrier oscillator..... | 2 | 8025 |
| Monitor convertor..... | 1 | 6SA7 |
| Power supply rectifier..... | 2 | 836 |
| Total..... | 7 | |

Frequency control.—Master oscillator. Modulation frequency range: 540-830 kc. Modulator frequency control; master oscillator.

Power.—Supply—115 /1/ /50/60.

| Required: | Watts |
|-----------------------------|-------|
| Key up—heaters off..... | 320 |
| Key locked—heaters off..... | 390 |
| Key up—heaters on..... | 750 |
| Key locked—heaters on..... | 820 |

Allowable variation in supply line voltage $\pm 10\%$, frequency $\pm 5\%$, combined voltage and frequency $\pm 10\%$ (5% each).

Operating control.—Front panel. Manual keying for test purposes. Antenna control unit; automatic keying.

Type of keying.—Relay—20 words per minute.

Antenna.—Rotating directional antenna system supplied as unit of equipment. Requires high, clear space for installation.

Weights, dimensions, and Navy type numbers of equipment units included in contract

| Unit | Navy type Nos. | Height | Width | Depth | Weight |
|--|----------------|-----------------------------------|---------------------|-------------------------------------|----------------------|
| Transmitter..... | 1 CRV-52244 | <i>Inches</i> 31 $\frac{3}{8}$ | <i>Inches</i> 21 | <i>Inches</i> 19 $\frac{25}{32}$ | <i>Pounds</i> 187 |
| Antenna control unit..... | 1 CRV-23271 | 13 $\frac{3}{4}$ | 16 $\frac{1}{2}$ | 10 $\frac{3}{16}$ | 75 |
| Antenna assembly..... | 1 CRV-66037 | 43 $\frac{15}{16}$ | 46 $\frac{3}{8}$ | 47 $\frac{3}{8}$ | 152 |
| Frequency meter..... | 1 CRV-60028 | 6 $\frac{1}{16}$ | 18 $\frac{1}{4}$ | 8 $\frac{3}{8}$ | 14.5 |
| Radio frequency monitor: | | | | | |
| Antenna retracted..... | 1 CRV-60047 | 18 $\frac{3}{8}$ | 5 $\frac{15}{16}$ | 4 $\frac{3}{8}$ | 18 |
| Antenna extended..... | | 10 $\frac{9}{32}$ | 5 $\frac{15}{16}$ | 4 $\frac{3}{8}$ | 18 |
| Transmission line kit and accessories..... | | (?) | (?) | (?) | ----- |
| Signal disc container..... | | | | | ----- |
| Spare-parts box: | | | | | |
| Transmitter..... | | 9 | 18 | 12 | 36 |
| Monitor unit..... | | | | | ----- |
| Antenna control unit and antenna assembly..... | | 9 | 18 | 12 | ----- |

¹ YG-1 equipment units type number prefix letters are CWS.
² 140 feet long in 20-foot sections— $\frac{7}{8}$ -inch diameter.

Maintenance of True Bearing Attachment, Navy type CRV-23408, associate unit for YG/YG-1 Homing Beacon equipment—dimensions and weight.

| Height | Width | Depth | Weight |
|------------------------------------|------------------------------------|----------------------------------|------------------------|
| <i>Inches</i> 15 $\frac{3}{16}$ | <i>Inches</i> 10 $\frac{1}{16}$ | <i>Inches</i> 7 $\frac{3}{8}$ | <i>Pounds</i> 23-25 |

Accessories not supplied by contractor.—Nitrogen gas for transmission line. Maintenance of True Bearing Attachment.

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet |
|--|--|---------------|------------|
| | <i>Inches</i> | <i>Pounds</i> | |
| Transmitter..... | 41 x 28 $\frac{1}{2}$ x 31 $\frac{1}{2}$ | 334 | 21.40 |
| Antenna control unit..... | 21 x 19 x 14 $\frac{1}{2}$ | 99 | 3.32 |
| Antenna assembly..... | 46 $\frac{1}{2}$ x 53 x 34 | 315 | 48.50 |
| Frequency meter..... | 25 x 23 $\frac{1}{2}$ x 12 | 33 | 4.20 |
| Radio frequency monitor..... | 18 $\frac{1}{2}$ x 11 x 19 | 32 | 2.24 |
| Transmission line kit..... | 254 x 11 x 6 $\frac{1}{2}$ | 295 | 10.50 |
| Equipment tubes..... | 16 $\frac{1}{2}$ x 13 $\frac{1}{2}$ x 12 $\frac{1}{2}$ | 16 | 1.60 |
| Spare-parts box: | | | |
| Equipment..... | 23 x 15 $\frac{1}{2}$ x 12 | 58 | 2.48 |
| Monitor unit ¹ | | | |
| Antenna control unit and antenna assembly..... | 23 x 15 $\frac{1}{2}$ x 12 | ----- | 2.48 |

¹ Data to be supplied.

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Section VI
SIGNAL CORPS EQUIPMENTS

RADIO RECEIVERS BC-312-N, BC-312-NX, AND BC-342-N

Use—Part of radio set SCR-299.

Frequency range.—1.5 to 18 megacycles in six bands.

Power required for operation

| Receiver | Volts | Amperes | Watts |
|----------------|------------------|----------------|------------|
| BC-312-N..... | 12-14 d-c..... | 4.3-4.8..... | 51.6-67.2. |
| BC-312-NX..... | 24-28 d-c..... | 2.2-2.4..... | 52.8-67.2. |
| BC-342-N..... | 110-120 a-c..... | 0.64-0.71..... | 70.0-85.0. |

Description.—Radio Receivers BC-312-N, BC-312-NX, and BC-342-N are of the multi-band, integral-

ation, a combined second detector and first stage of a-f amplification, and a separate stage of a-f amplification. Also each receiver has a separate high-frequency oscillator and a separate c-w beat-frequency oscillator. The i-f amplifier in Radio Receiver BC-342-N only is designed to permit the use of a crystal filter circuit.

Receiver BC-312-N is designed to operate on 12 volts d-c and uses Dynamotor DM-21-B for its plate power source; Receiver BC-312-NX operates on 24 volts d-c and uses Dynamotor DM-21-CX; Receiver BC-342-N uses 110-220 volts a-c and Rectifier RA-20. These are the main differences between these receivers



Radio receiver BC-312.

coil, superheterodyne type. Metal tubes are employed in all stages except the first i-f amplifier, the second i-f amplifier, and the second detector-first a-f amplifier. These latter stages are equipped with "GT" (glass, tubular) type tubes. These radio receivers are designed to receive an amplitude modulated signal. Provision is made for the reception of continuous wave (c-w), tone modulated (m-c-w), or voice modulated signals. The circuit also provides reception using either automatic or manual control of volume. Each receiver has two stages of r-f amplification, a first detector (mixer) stage, two stages of i-f amplifi-

Tube complement.—Radio receiver BC-312-N:

- 6K7, First r-f amplifier.
- 6K7, Second r-f amplifier.
- 6L7, First detector (mixer).
- 6K7GT, First i-f amplifier.
- 6K7GT, Second i-f amplifier.
- 6R7GT, Second detector, a-v-c, and first a-f amplifier.
- 6C5, R-F oscillator.
- 6C5, C-W oscillator.
- 6F6, A-F amplifier.

Radio receiver BC-312-NX: Same as radio receiver

BC-312-N
BC-312-NX
BC-342-N
BC-329

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BC-312-N except that the a-f amplifier tube is a 12A6 instead of a 6F6.

Radio receiver BC-342-N: Same as radio receiver BC-312-N, except that an additional rectifier tube—5W4—is used.

Type of receiver.—Superheterodyne.

Type of reception.—A₁, A₂, and A₃.

Frequency bands:

Band A, 1.5 to 3.0 megacycles.

Band B, 3.0 to 5.0 megacycles.

Band C, 5.0 to 8.0 megacycles.

Band D, 8.0 to 11.0 megacycles.

Band E, 11.0 to 14.0 megacycles.

Band F, 14.0 to 18.0 megacycles.

The i-f amplifier of these three radio sets is set at 470 kc. On bands A, B, and C, the high-frequency oscillator tunes 470 kc. higher in frequency than the

incoming signal. On bands D, E, and F, the high-frequency oscillator tunes 470 kc. lower in frequency than the incoming signal.

Weights, dimensions, and Army type numbers of the principal equipment units

| Unit | Type No. | Dimensions | Weight |
|---------------------------|----------------|---|------------------|
| | | <i>Inches</i> | <i>Pounds</i> |
| Radio receiver BC-312-N: | | | |
| Radio Receiver..... | BC-312-N..... | 18 x 10 $\frac{3}{4}$ x 9 $\frac{1}{4}$ | 58 |
| Dynamotor..... | DM-21-B..... | 6 x 5 $\frac{1}{2}$ x 3 $\frac{1}{4}$ | 7 |
| Mounting..... | FT-162..... | 18 x 6 $\frac{7}{8}$ x 1 $\frac{1}{4}$ | 3 $\frac{3}{4}$ |
| Radio receiver BC-312-NX: | | | |
| Radio Receiver..... | BC-312-NX..... | 18 x 10 $\frac{3}{4}$ x 9 $\frac{1}{4}$ | 58 |
| Dynamotor..... | DM-21-CX..... | 6 x 5 $\frac{1}{2}$ x 3 $\frac{1}{4}$ | 7 |
| Mounting..... | FT-162..... | 18 x 6 $\frac{7}{8}$ x 1 $\frac{1}{4}$ | 3 $\frac{3}{4}$ |
| Radio receiver BC-342-N: | | | |
| Radio Receiver..... | BC-342-N..... | 18 x 10 $\frac{3}{4}$ x 9 $\frac{1}{4}$ | 61.5 |
| Rectifier..... | RA-20..... | 6 $\frac{1}{2}$ x 6 $\frac{1}{8}$ x 3 $\frac{1}{4}$ | 10 $\frac{1}{2}$ |
| Mounting..... | FT-162..... | 18 x 6 $\frac{7}{8}$ x 1 $\frac{1}{4}$ | 3 $\frac{3}{4}$ |



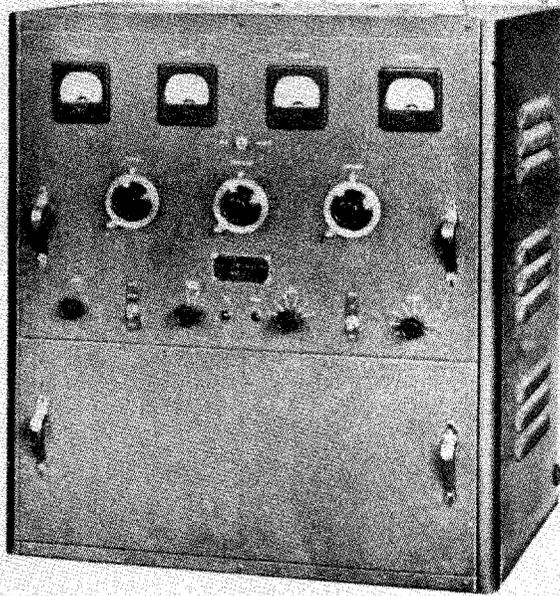
RADIO TRANSMITTER BC-329

Use—Transmit.

Frequency range.—200 to 410 kilocycles.

Power output.—25 watts.

Emission.—A₁, A₂, and A₃.



Radio transmitter BC-329.

Description.—Radio transmitter BC-329 is a complete radio transmitter. It was developed to provide low power radio transmission for airport traffic control on any frequency between 200 and 410 kilocycles. It is contained in one cabinet and derives its power from the usual 115-volt 60-cycle power or lighting circuits. It is designed to be operated in conjunction with Remote Control Unit RM-6-C and contains all necessary power conversion units so that no batteries are required.

Tube complement:

- 59, Oscillator.
- VT100, Buffer amplifier.
- 830B, Class C amplifier.
- 809, Class B zero bias modulator.
- 809, Class B zero bias modulator.
- 6V6G, Class A driver.
- 6V6G, Class A driver.
- VT46A, Rectifier.
- VT46A, Rectifier.
- VT46A, Rectifier.
- VT46A, Rectifier.

Frequency control.—Crystal.

Power supplies available.—115/1/60 a-c.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|--------------------------|-------------|--|---------------|
| | | <i>Inches</i> | <i>Pounds</i> |
| Radio transmitter..... | BC-329..... | 25 $\frac{1}{2}$ x 28 $\frac{3}{8}$ x 21 | 215 |
| Remote control unit..... | RM-6-C..... | 19 x 5 $\frac{7}{8}$ x 10 $\frac{3}{4}$ | 22 |

CONFIDENTIAL

RADIO TRANSMITTER BC-339

Use—Transmit.**Frequency range**.—4.0 to 26.5 megacycles.**Power output**.—Over 1 kilowatt.**Emission**.—A₁.**Description**.—Radio Transmitter BC-339 is a single, self-contained unit designed to work into a balanced

600-ohm line, or Power Amplifier BC-340, if higher output is desired. All r-f circuits, power supply rectifiers, and control equipment are contained within the main unit. All operating controls and indicating instruments are located on the front panels, and a section of the front panel, with a chassis attached, may be slid forward to give access to the crystal holders and low power r-f exciter stages.

Provision is made for remotely starting, stopping, and keying the transmitter through a two-wire telephone cable and ground at distances as great as 6 miles and at speeds as high as 300 words per minute. It is also possible to connect remote indicating lamps to indicate when plate power is "ready" or "on".

Tube complement:

- 833, Power amplifier.
- 833, Power amplifier.
- 813, Fourth intermediate amplifier.
- 837, Keying tube.
- 5Z3, Oscillator plate supply rectifier.
- 866A, Low voltage plate supply rectifier.
- 866A, Low voltage plate supply rectifier.
- 837, Third intermediate amplifier.
- 837, Second intermediate amplifier.
- 837, First intermediate amplifier.
- 6F6, Oscillator.
- 872A, Power amplifier plate supply rectifier.
- 872A, Power amplifier plate supply rectifier.
- 872A, Power amplifier plate supply rectifier.
- 5Z3, Bias supply rectifier.

Frequency control.—Crystal or master-oscillator.**Power supplies available**.—220/3/60.**Operating power required:**

Key open:

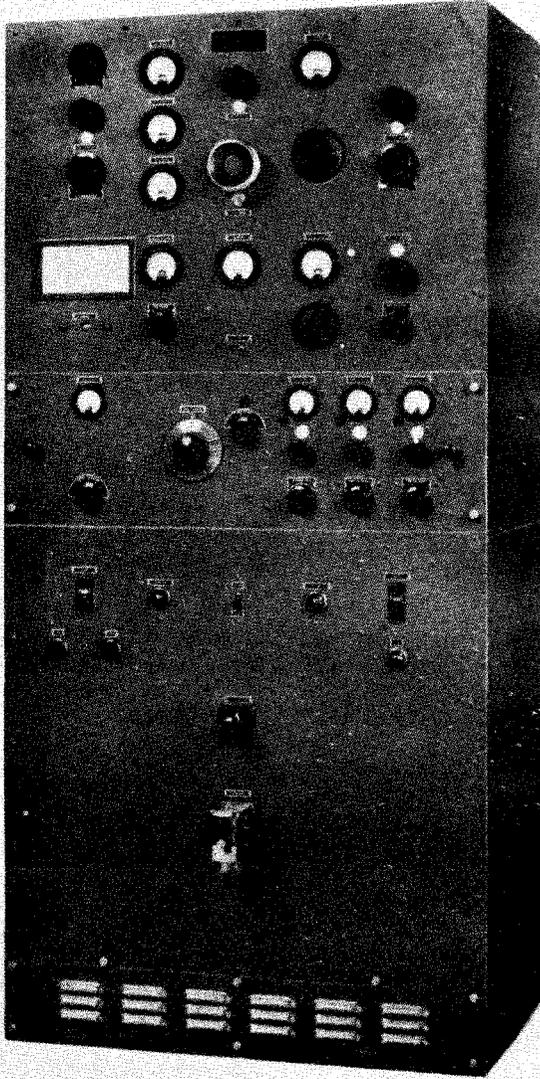
- Phase A, 1 ampere;
- Phase B, 7 amperes;
- Phase C, 7 amperes; 1,610 watts.

Key closed:

- Phase A, 7 amperes;
- Phase B, 11 amperes;
- Phase C, 13 amperes; 4,300 watts.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|----------------------|-------------|------------------------------|-----------------------|
| Transmitter..... | BC-399..... | <i>Inches</i> 81½x33½x37½ | <i>Pounds</i> 1275 |
| Spare parts box..... | ..... | 14½x24½x15½ | 60 |



Radio transmitter BC-339.

RADIO TRANSMITTER BC-610

Use.—Part of Radio Set SCR-299.

Frequency range.—2.0 to 8.0 megacycles.

Power output.—Over 300 watts of A_3 ; 400 watts of A_1 .

Emission.— A_1 and A_3 .

Description.—Radio transmitter BC-610 and associated equipment is designed for use as a high power

effected over a distance of one hundred miles or more while the vehicle is either stationary or in motion.

Tube complement:

Radio transmitter BC-610:

2A3, Audio driver.

2A3, Audio driver.

100TH, Modulator.

100TH, Modulator.

5Z3, Rectifier.

5Z3, Rectifier.

866A, High-voltage rectifier.

866A, High-voltage rectifier.

6V6, Oscillator.

6L6, Doubler-buffer.

807, Intermediate amplifier.

807, Intermediate amplifier.

250TH, Class C power amplifier.

VT139.

VT139.

VT139.

Speech amplifier BC-614:

6SQ7, Microphone input amplifier.

6J5, Voltage amplifier.

6SN7GT, Voltage amplifier and phase inverter.

6SN7GT, Push-pull output tube.

6SR7, Amplifier-rectifier for voice limiter circuits.

6SN7GT, Audio oscillator.

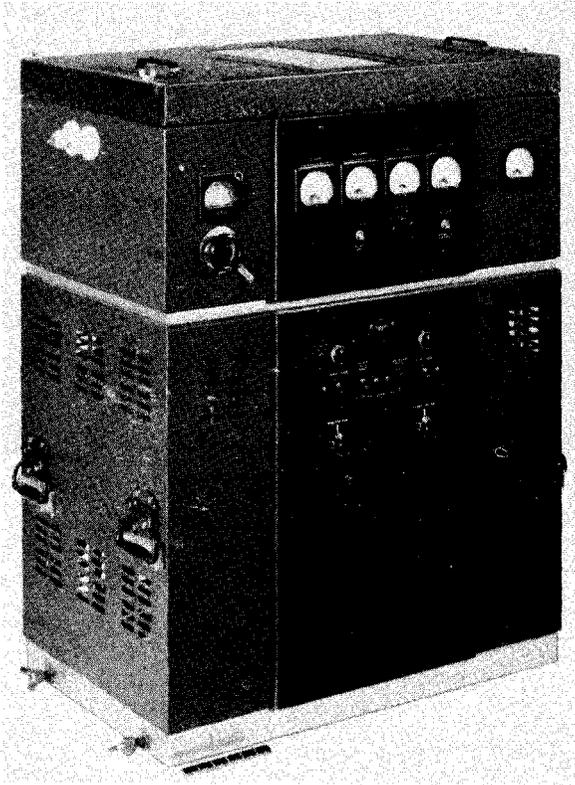
80, Rectifier.

Frequency control.—Crystal or master-oscillator.

Power supplies available.—105-125/1/50-60 a-c and 12 volts d-c.

Operating power required.—2,000 watts—approximately.

Antenna.—15- to 21-foot whip.



Radio transmitter BC-610.

vehicular radio telephone and radio telegraph transmitter. The principal component units are provided with shock-proof mountings which permit their installation in a suitable vehicle. When installed, and provided with a whip antenna and an adequate source of power (as power unit PE-95), transmission may be

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|--|-----------------|------------------------------------|------------------------|
| Transmitter, antenna tuning unit, and shock-mount..... | BC-610, BC-729. | <i>Inches</i> 50 x 33 x 31..... | <i>Pounds</i> 452.5 |
| Speech amplifier and shock-mount..... | BC-614..... | 9 5/8 x 17 3/4 x 12. | 35.0 |

CONFIDENTIAL

FREQUENCY METER BC-638-A

Use.—With fighter-control equipments.

Frequency range.—100.0 to 156.0 megacycles.

Emission.—A₁ and A₂.

Description.—Frequency Meter BC-638-A is a crystal controlled signal generator with a frequency range of 100 to 156 megacycles (3 to 1.92 meters). It is tone modulated approximately 30 percent at 1,000 cycles. The frequency meter is used to pre-test, test,

Frequency control.—Crystal. 5555.5 to 8666.6 kc. (one eighteenth of the final output frequencies).

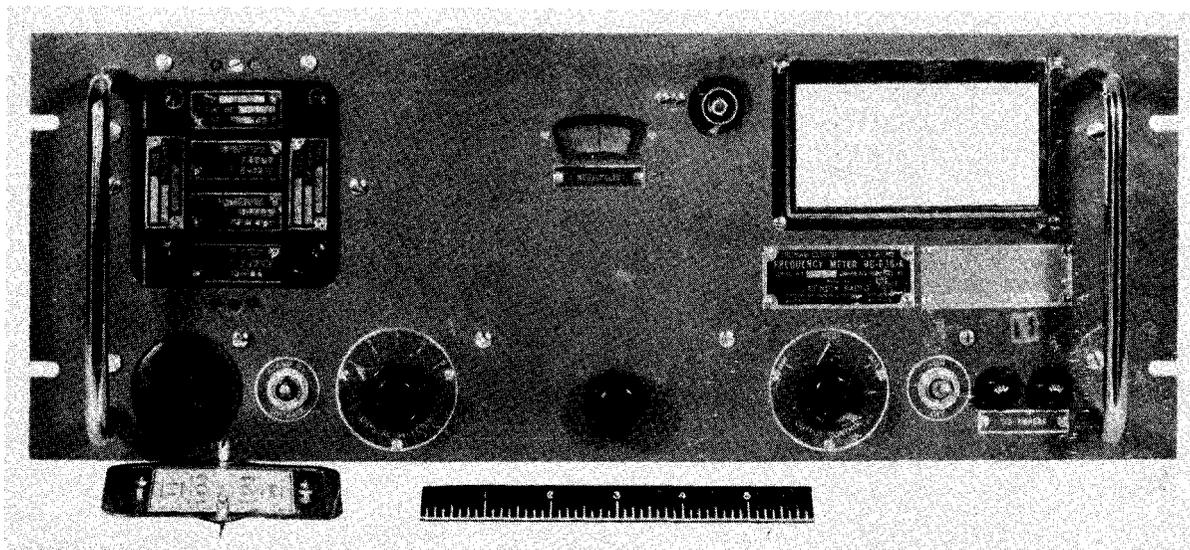
Power supplies available:

110-120 volts, single phase, 50-60 cycles.

200-250 volts, single phase, 50-60 cycles.

6 volts d-c (with Dynamotor Unit PE-100-A).

Operating power required.—30 watts from a-c line; 7.5 amperes at 6.0 volts from battery.



Frequency meter BC-638.

and align radio receivers whose frequency range is within the frequency limits of the frequency meter.

Tube complement:

6SK7, Oscillator.

9002, R-F rectifier.

9003, Frequency multiplier.

9003, Frequency multiplier.

5V4G, Power supply rectifier.

6L5G, 1,000-cycle oscillator and modulator.

6E5, Electron-ray-tube resonance indicator.

Antenna.—12.5-inch vertical rod.

Weights, dimensions, and Army type numbers of principal equipment units:

| Unit | Type No. | Dimensions | Weight |
|-----------------|----------|--------------------------------|---------------------|
| Frequency meter | BC-638-A | <i>Inches</i> 7 x 19 x 11.5 | <i>Pounds</i> 35 |
| Dynamotor unit | PE-100-A | | |

★ ★ ★

RADIO RECEIVER BC-639

Use: Receive.

Frequency range.—100.0 to 156.0 megacycles (1.92 to 3.0 meters).

Power required for operation:

180-240 volts d-c at approximately .060 ampere.

6.3 volts a-c or d-c at 3.5 amperes.

Description.—Receiver BC-639 is designed for reception of radio signals on the ultra-high frequency

band from 100 to 156 megacycles. Complete coverage of the band is accomplished without switching, using a slow-motion drive dial. The receiver is used at ground stations for reception of both radiophone communication and direction finding signals from aircraft.

The receiver consists of an r-f amplifier stage, an oscillator followed by a doubler which in turn feeds a mixer stage, three i-f amplifier stages, a second detector

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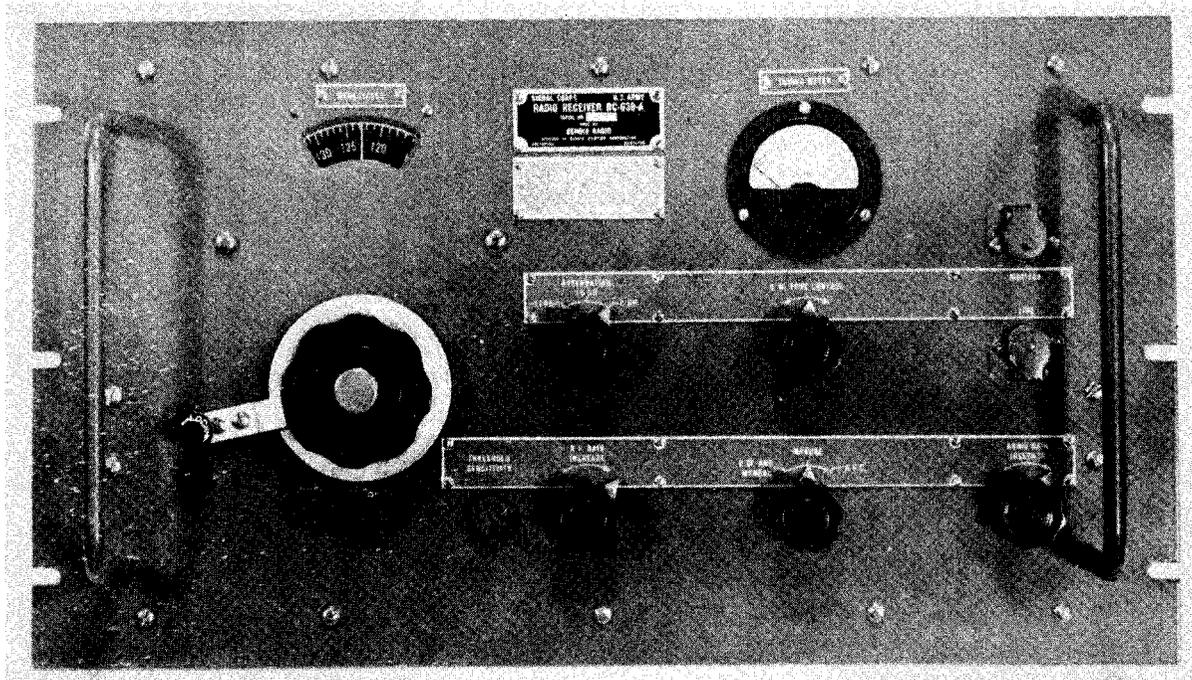
stage combined with the first a-f amplifier stage in a single tube, and an a-f output amplifier stage. A beat frequency oscillator feeds into the second detector and can be switched into the circuit when necessary. The beat frequency oscillator is provided to enable D-F bearings to be taken on an unmodulated carrier. The power supply is not built into the receiver, but a cable which plugs into the rear of the chassis connects the receiver to a separate power supply.

The output of the receiver is fed directly into a telephone line system. The receiver output impedance has been chosen to satisfy this requirement. The output transformer has a balanced output and an

dust proof cover which is held securely in place by fifteen round head screws. Since the heat (power) dissipated by the receiver is relatively small, ventilating louvres have been satisfactorily left out, and the receiver is completely dust proof.

Tube complement:

- 9003, R-F amplifier.
- 9003, Mixer.
- 9002, Heterodyne frequency oscillator.
- 9003, Heterodyne frequency doubler.
- 6SG7, First i-f amplifier.
- 6SG7, Second i-f amplifier.
- 6SG7, Third i-f amplifier.



Radio receiver BC-639.

electrostatic shield between the windings to insure that the receiver output circuit is suitable for the direct connection to the telephone line circuit. Two telephone jacks are provided on the front panel. One titled MONITOR is used for monitoring the receiver at any time. The other, titled LINE is wired so that when a plug is inserted into it, the output of the receiver is disconnected from the telephone line system by opening both sides of the output circuit. The receiver is designed to work into a 600-ohm load, but satisfactory operation will be obtained when operating into any load between 200 and 20,000 ohms.

The entire receiver unit is mounted on a shelf-type chassis with a front panel to provide easy accessibility to all necessary controls. The chassis is inclosed by a

- 6SQ7, Detector, avc, and first a-f amplifier.
- 6K6GT/G, Second a-f amplifier.

Type of receiver.—Superheterodyne.

Type of reception.—A₁, A₂, and A₃.

Output impedance.—600 ohms.

Power output.—1 watt—less than 15 percent distortion.

Band coverage.—One band only.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|---------------------|---------------|---|--------|
| | | Inches | |
| Radio receiver..... | BC-639..... | 19 x 10 ¹ / ₂ x 13 ³ / ₁₆ | 38 |
| Rectifier..... | RA-42-A..... | 19 x 6 ³ / ₁₆ x 8 ² / ₁₆ | 26 |
| Dynamotor unit..... | PE-100-A..... | 19 x 10 ¹ / ₂ x 8 ¹ / ₁₆ | 24 |

CONFIDENTIAL

RADIO TRANSMITTER BC-640

Use.—Part of Radio Set SCR-574.

Frequency range.—100 to 156 megacycles.

Power output.—Not less than 51.5 watts from 100 to 125 megacycles inclusive; 50 watts at 140 megacycles; and 46 watts at 156 megacycles.

Emission.—A₂ and A₃.

Description.—Radio Transmitter BC-640 is designed to provide a modulated signal, on any predetermined frequency in the range from 100 to 156 megacycles (3 to 1.92 meters), of sufficient power to permit communication with stations on the ground 11.5 miles distant, and aircraft 135 miles distant when the aircraft is at an altitude of 10,000 feet. The distance ranges described above are considered conservative for reasonably level country. Under certain conditions of terrain or altitude the range will be substantially greater. In very hilly or mountainous country, the range will probably be reduced, and reflection effects might be expected which would give rise to zones of low signal strength.

For practical purposes, it may be considered that the signals from the BC-640 Radio Transmitter will follow optical paths and the reliable range of the transmitter will be limited to the line-of-sight from the transmitter radiator to the receiving antenna.

Tube complement:

- 2—HK24G, Class C amplifier.
- 1—6J5, Rectifier (monitor signal).
- 1—1613, Oscillator.
- 1—807, Tripler.
- 1—HK24G, Tripler.
- 1—HK24G, Doubler.
- 1—HK24G, Intermediate power amplifier.
- 2—6J5, Push-pull voltage amplifier.
- 2—1613, Push-pull driver.
- 2—811, Class B modulator.
- 1—6J5, 1,000-cycle audio oscillator.
- 8—5Z3, Rectifiers.

Frequency control.—Crystal (5555.5 to 8666.6 kilocycles).

Power supplies available:

- 110-125/1/50/60 a-c.
- 220-250/1/50/60 a-c.

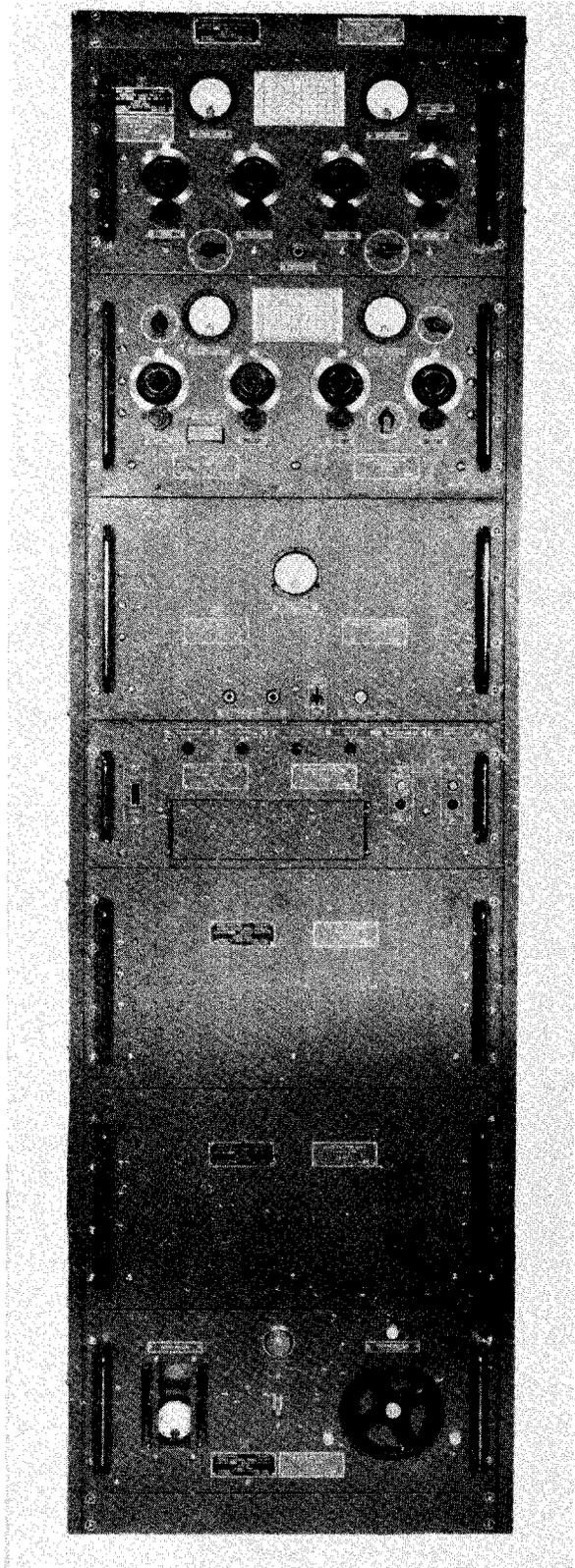
Operating power required:

- Unmodulated: .891 kva; 815 watts.
- Modulated: .918 kva; 860 watts.

Antenna.—Antenna Equipment RC-81 mounted on either 90-foot Mast AN-56 or 50-foot Mast AN-57.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|------------------|-------------|--|------------------------|
| Transmitter..... | BC-640..... | <i>Inches</i> 72 ¹ / ₃₂ x 21 ¹ / ₈ x 20 | <i>Pounds</i> 601.5 |



Radio transmitter BC-640.

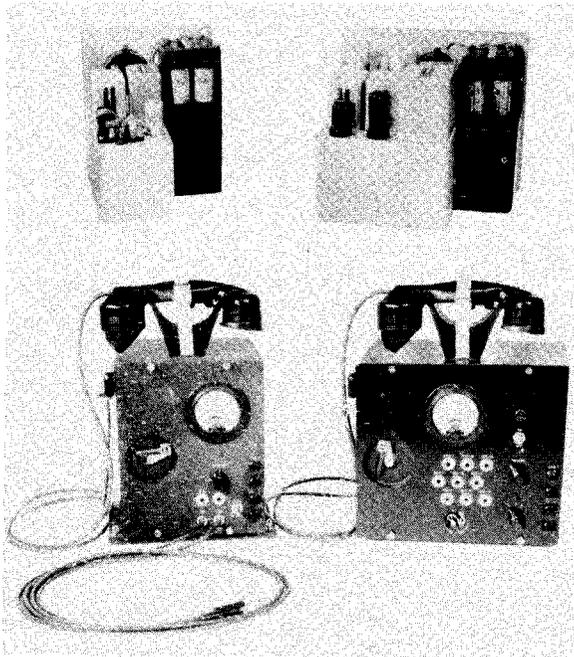
RADIO SET SCR-188-A

Use: Transmit and receive.

Frequency range.—Transmitter: 1.5 to 12.5 megacycles. Receiver: 1.5 to 18.0 megacycles.

Power output.—75 watts.

Emission.—A₁, A₂, and A₃.



Radio set SCR-188-A. Remote control equipment RC-47-A.

Description.—Radio set SCR-188-A is a large but transportable unit of equipment intended primarily for semifix use inside buildings where commercial a-c power and suitable operating tables are available. Under emergency conditions, the entire equipment can

be operated by means of a separate gasoline engine driven generator. Battery power cannot be used under any circumstances. The transmitting units are provided with rugged operating chests and can be erected out-of-doors, but the receiving units must be installed under adequate shelter.

Tube complement.—1-5W4; 3-6C5; 1-6F6; 4-6K7; 1-6L7; 1-6R7; 1-6X5GT; 1-10; 4-211SPL; and 2-866A.

Frequency control.—Master-oscillator.

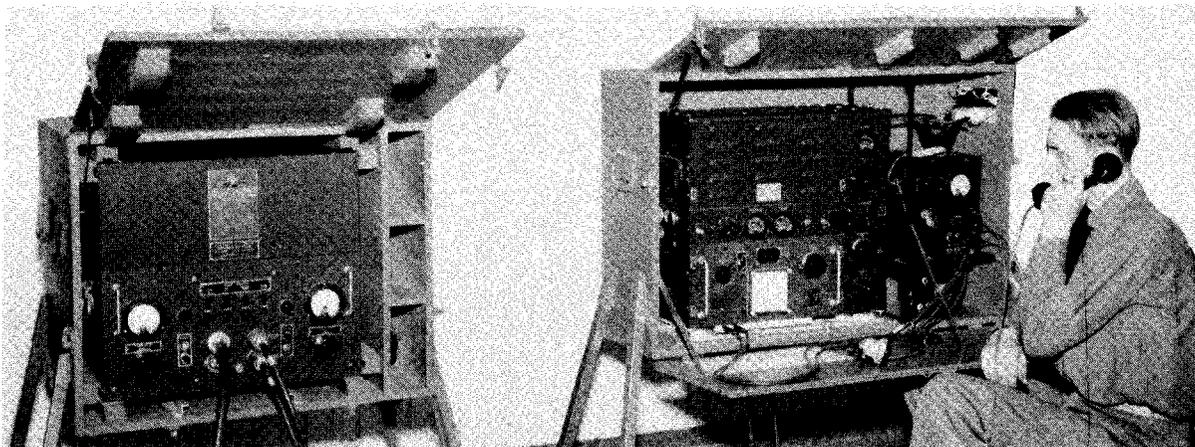
Supplies available.—100/120/1/60.

Antennas.—Transmitting: The antenna system provided with this set is of the inverted L type. It consists of one antenna assembly and one counterpoise assembly supported between two masts 85 feet apart. The antenna and the counterpoise are made by joining several lengths of wire, using insulators between the various lengths. This permits combining the various lengths of wire (by means of jumpers across the insulators) to form the antenna and counterpoise required to cover the frequency range of 1.5 to 12.5 megacycles.

Receiving: No prepared antenna is provided in this radio set for attachment to the receiver antenna post. It is intended that about 50 feet of insulated wire W-29, furnished with the set, be attached to the antenna binding posts and the far end hung over a tree or other convenient support.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|------------------|-------------|------------|--------|
| | | Inches | Pounds |
| Transmitter..... | BC-191..... | ..... | ..... |
| Receiver..... | BC-342..... | | |
| Power unit..... | PE-75..... | | |
| Rectifier..... | RA-34..... | | |
| Total..... | | | 1,385 |



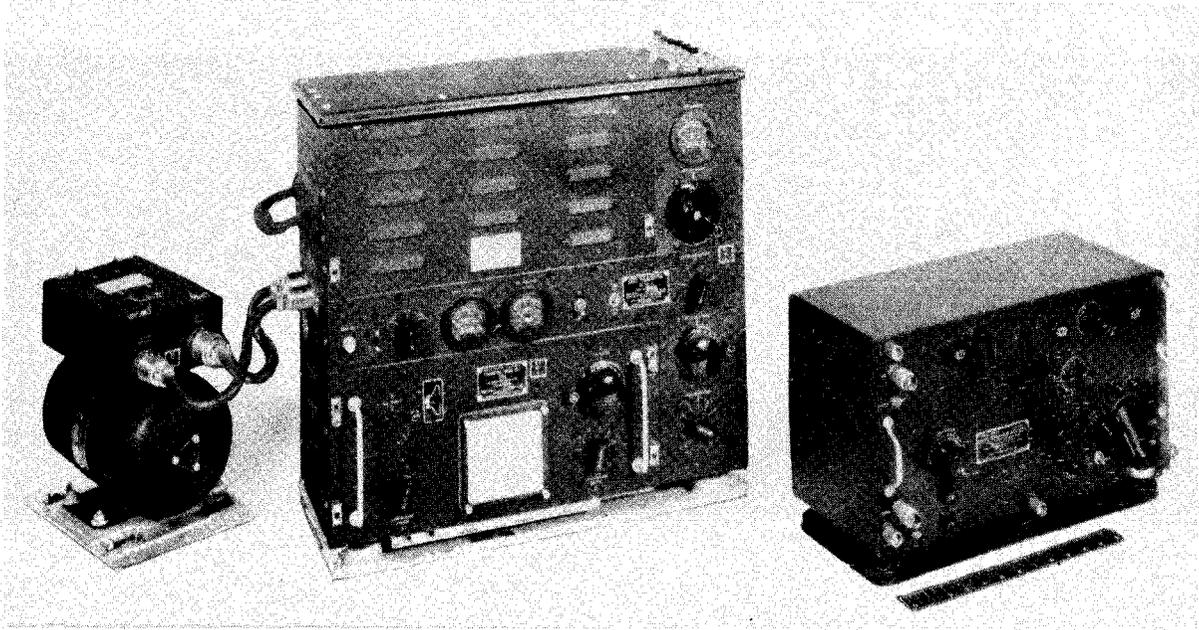
Radio set SCR-188-A.

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RADIO SET SCR-193

Use.—In reconnaissance cars.
Frequency range.—Transmitter: 1.5 to 4.5 megacycles. Receiver: 1.5 to 18.0 megacycles.
Power.—75 watts.
Emission.—A₁, A₂, and A₃.
Description.—Radio set SCR-193 is designed for installation in vehicles for the purpose of providing

2-VT38—1 in use, 1 spare.
 8-VT49—4 in use, 4 spare.
Frequency control.—Master oscillator.
Power supplies available.—12-volt vehicular storage battery.
Antenna.—15-foot fishpole on flexible mast base MP-14 or MP-37.



Radio set SCR-193.

intervehicular communication whether the vehicles are stationary or moving. Modifications may appear from time to time to adapt this radio set to new types of vehicles. These sets may be installed in many different types of vehicles, if a proper battery is available, and if proper shielding against ignition noise is provided.

Tube complement:

- 8-VT4B—4 in use, 4 spare.
- 2-VT25—1 in use, 1 spare.
- 6-VT36—3 in use, 3 spare.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Volume | Weight |
|-------------------|-------------|---|-------------------|---------------|
| | | <i>Inches</i> | <i>Cubic feet</i> | <i>Pounds</i> |
| Transmitter..... | BC-191..... | 20 ³ / ₁₆ x 23 ³ / ₈ x 9 ⁷ / ₁₆..... | ..... | 55.75 |
| Receiver..... | BC-312..... | 9 ¹ / ₄ x 18 x 7..... | ..... | 40.00 |
| Dynamotor..... | BD-77..... | 11 x 11 x 7 ¹ / ₂..... | ..... | 37.3 |
| Total weight..... | ..... | ..... | ..... | 200.0 |
| Total volume..... | ..... | ..... | 7 | ..... |

RADIO SET SCR-274-N

Use.—Transmit and receive.

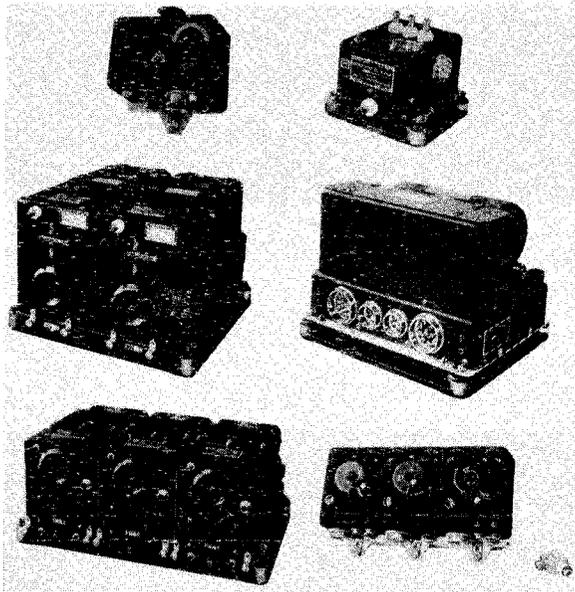
Frequency range.—Transmitters: 4.0 to 5.3 megacycles; 5.3 to 7.0 megacycles; and 7.0 to 9.1 megacycles. Receivers: 0.19 to 0.55 megacycle; 3.0 to 6.0 megacycles; and 6.0 to 9.1 megacycles.

Power output.—A₁, 40 watts; A₃, 20 watts.

Emission.—A₁, A₂, and A₃.

Description.—Radio set SCR-274-N is a multi-channel aircraft radio receiving and transmitting equipment.

The receiving equipment consists of radio receivers BC-453-A (190-550 k. c.), BC-454-A (3.0-6.0 mc.), and BC-455-A (6.0-9.1 mc.); three dynamotors DM-32-A; and either radio control box BC-450-A (for three receivers) or radio control boxes BC-473-A (for one receiver) and BC-496-A (for two receivers). This



Radio set SCR-274—principal components.

receiving equipment has been designed for either local or remote control, but only remote control accessories are provided as part of this radio set. Manual control of sensitivity is employed, aided by a built-in auxiliary control circuit which prevents strong radio signals from blocking reception. No provision is made for complete automatic gain control. All tuning dials are calibrated directly in kilocycles or megacycles. All of the receivers are of the superheterodyne type and except for elements forming the r-f and i-f tuned circuits, they are essentially alike, electrically and physically.

The transmitting equipment consists of radio transmitters BC-457-A (4.0-5.3 mc.), BC-458-A (5.3-7.0 mc.), and BC-459-A (7.0-9.1 mc.) (any two of which may be installed); dynamotor DM-33-A and modulator unit BC-456-A which supply the high vol-

tage d-c and the modulating power to either transmitter; radio control box BC-451-A for remote control of the transmitting equipment; and antenna relay unit BC-442-A for switching a single antenna between the receivers and the transmitters.

The master-oscillator and the r-f power amplifier tuning capacitors are ganged for simplification of controls. Continuously variable magnetic coupling between the power amplifier tank circuit and the antenna circuit is controlled by the antenna coupling knob on the front panel. The antenna circuit is tuned by a continuously adjustable series inductor. A piezo-crystal resonator is built into each transmitter for use in connection with an electron resonance indicator to check the accuracy of the calibration at one frequency. The transmitter dials are calibrated in megacycles.

Tube complement:

Each receiver:

- 12SK7, R-F amplifier.
- 12K8, Mixer.
- 12SK7, First i-f amplifier.
- 12SK7, Second i-f amplifier.
- 12SR7, Second detector—c-w oscillator.
- 12A6, A-F amplifier.

Each transmitter:

- 1625, R-F power amplifier.
- 1625, R-F power amplifier.
- 1626, Master-oscillator.
- 1629, Resonance indicator.

Modulator unit BC-456-A:

- 12J5GT, Tone oscillator.
- 1625, Modulator.
- VR-150-30, Voltage regulator.

Frequency control.—Master-oscillator.

Power supplies available.—20-30 volts d-c.

Operating power required.—Receivers (each): 1.6 amperes at 28 volts. Transmitters (each): Transmitting, 9 amperes at 28 volts; stand-by, 2.5 amperes at 28 volts.

Antenna.—A single antenna may be used for all receivers and transmitters provided only that it is suitable for each. It may be desirable to use a long fore and aft inverted L or T antenna for all receivers and transmitters except Radio Receiver BC-453-A. If the latter is to be used for reception of airways range signals, a suitable antenna such as a vertical mast or a nearly vertical wire should be specified for this receiver only.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|--|----------|---------------|---------------|
| | | <i>Inches</i> | <i>Pounds</i> |
| Total weight of receiving equipment | | | 35.3 |
| Total weight of transmitting equipment | | | 41.2 |

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RADIO SETS SCR-299, SCR-399 AND SCR-499

Use.—Portable and mobile.

Frequency range.—Transmitter: 2.0 to 8.0 megacycles. Receiver: 1.5 to 18.0 megacycles.

Power output.—400 watts A₁; 300 watts A₃.

Emission.—A₁ and A₃.

Description.—Radio sets SCR-299, SCR-399, and SCR-499 are high power radio stations providing voice or c-w communication over a range of more than 100 miles under all conditions of atmosphere and terrain, either from a stationary position, or while moving at high speeds over rough roads.

Radio set SCR-299 consists of a completely equipped radio station installed in a 1½-ton truck K-51-D, combined with a power plant carried in a 1-ton cargo trailer K-52-D.

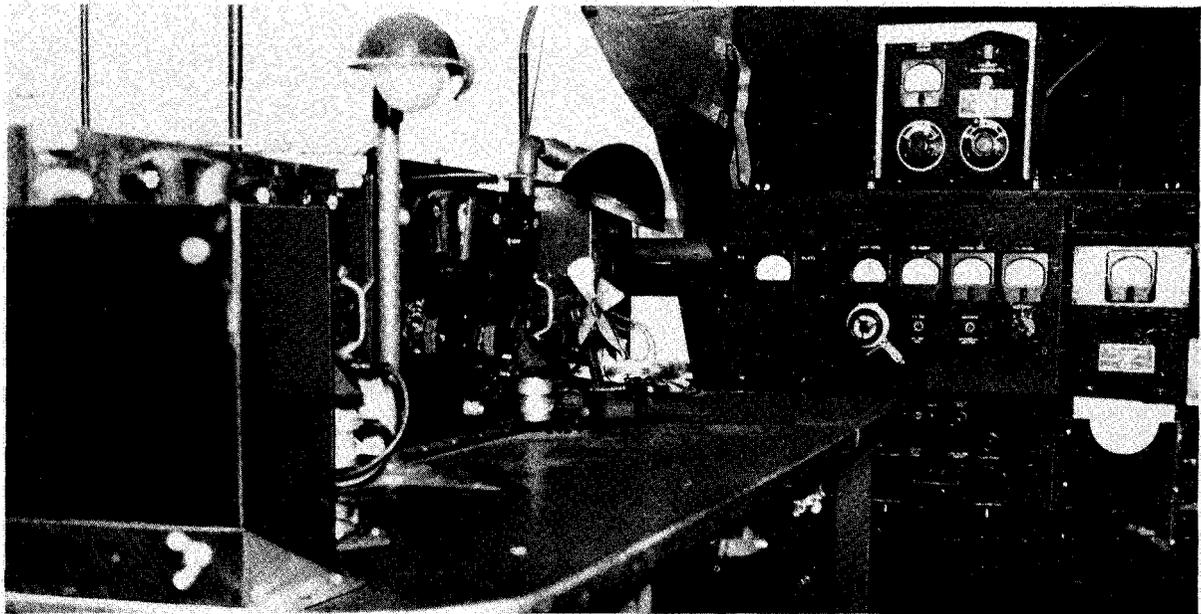
Radio set SCR-399 comprises the same components

are provided in the forward part of the radio truck. Behind them is the radio, where two operators may sit at the operating positions provided at the operating table. From there it is possible, by remote control, to start or stop the power unit PE-95 located in the trailer. All receiving and transmitting controls as well as tuning units, coils, and crystals (when required for changing frequency) are within reach of the operating positions.

Tube complement:

Radio transmitter BC-610:

- 2A3, Audio driver.
- 2A3, Audio driver.
- 100TH, Modulator.
- 100TH, Modulator.
- 5Z3, Rectifier.



Radio set SCR-299—Installation of components.

as radio set SCR-299 and consists of a completely equipped radio station normally installed in shelter HO-17-A, combined with a power plant normally carried in a 1-ton cargo trailer K-52-E. The shelter is usually installed on a 2½-ton 6 x 6 truck or similar motor vehicle.

Radio set SCR-499 includes all of the principal components of radio set SCR-399, except that none of the radio equipment is installed in the shelter and the power unit is not installed in a trailer. Canvas covers are provided for protection for the major radio components and the various units may be transported by air or other means to a desired destination where they may be quickly set up as a field radio station either in a tent, shelter or vehicle.

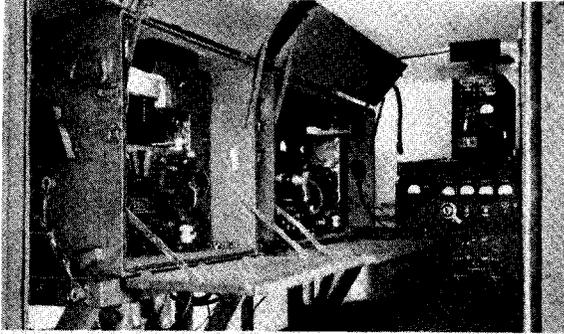
Radio sets SCR-299 and SCR-399 will accommodate a crew of four. Two seats, one of them for the driver,

- 5Z3, Rectifier.
- 866A, High-voltage rectifier.
- 866A, High-voltage rectifier.
- 6V6, Oscillator.
- 6L6, Doubler-buffer.
- 807, Intermediate amplifier.
- 807, Intermediate amplifier.
- 250TH, Class C power amplifier.
- VR-150-30.
- VR-150-30.
- VR-150-30.
- Speech amplifier BC-614:
- 6SQ7, Microphone-input amplifier.
- 6J5, Voltage amplifier.
- 6SN7GT, Voltage amplifier and phase inverter.
- 6SN7GT, Push-pull output tube.

SCR-299
 SCR-399
 SCR-499
 SCR-300

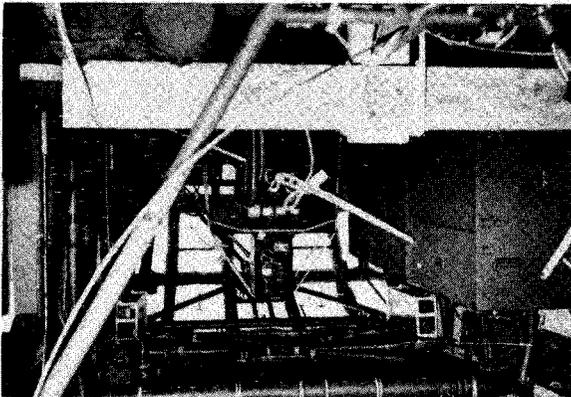
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6SR7, Amplifier-rectifier for voice limiter circuits.
 6SN7GT, Audio oscillator.
 80, Rectifier.



Radio set SCR-399 installed in Shelter HO-17.

Radio receiver BC-342:
 6K7, First r-f amplifier.
 6K7, Second r-f amplifier.
 6L7, First detector-mixer.



Radio set SCR-499 prepared for flight.

6K7GT, First i-f amplifier.
 6K7GT, Second i-f amplifier.
 6R7GT, Second detector, avc, and first a-f amplifier.
 6C5, R-F oscillator.
 6C5, C-W Oscillator.
 6F6, A-F amplifier.
 5W4, Rectifier.

Radio receiver BC-312: Same as radio receiver BC-342, except that no rectifier tube is included.

Frequency control.—Master-oscillator and crystal control (three pre-set frequencies).

Power Supplies Available.—105-125/1/60 a-c and a 12-Volt Battery.

Antenna.—Whip or long wire.

Weights, dimensions, and Army type numbers of principal equipment units:

| Unit | Type number | Dimensions | | Weight |
|------------------------------------|-------------|------------|--------|--------|
| | | Inches | Pounds | |
| Radio set SCR-299: | | | | |
| Transmitter..... | BC-610..... | ..... | ..... | ..... |
| Receiver..... | BC-342..... | ..... | ..... | ..... |
| Receiver..... | BC-312..... | ..... | ..... | ..... |
| Speech amplifier..... | BC-614..... | ..... | ..... | ..... |
| Antenna tuning unit..... | BC-729..... | ..... | ..... | ..... |
| Power unit..... | PE-95..... | ..... | ..... | ..... |
| Truck..... | K-51..... | ..... | ..... | ..... |
| Trailer..... | K-52..... | ..... | ..... | ..... |
| Total (radio components only)..... | ..... | ..... | ..... | 1,000 |
| Radio set SCR-399: | | | | |
| Transmitter..... | BC-610..... | ..... | ..... | ..... |
| Receiver..... | BC-342..... | ..... | ..... | ..... |
| Receiver..... | BC-312..... | ..... | ..... | ..... |
| Speech amplifier..... | BC-614..... | ..... | ..... | ..... |
| Antenna tuning unit..... | BC-939..... | ..... | ..... | ..... |
| Power unit..... | PE-95..... | ..... | ..... | ..... |
| Trailer..... | K-52..... | ..... | ..... | ..... |
| Shelter..... | HO-17..... | ..... | ..... | ..... |
| Junction box..... | JB-70..... | ..... | ..... | ..... |
| Radio set SCR-499: | | | | |
| Transmitter..... | BC-610..... | ..... | ..... | ..... |
| Receiver..... | BC-342..... | ..... | ..... | ..... |
| Receiver..... | BC-312..... | ..... | ..... | ..... |
| Speech amplifier..... | BC-614..... | ..... | ..... | ..... |
| Antenna tuning unit..... | BC-939..... | ..... | ..... | ..... |
| Power unit..... | PE-95..... | ..... | ..... | ..... |
| Junction box..... | JB-70..... | ..... | ..... | ..... |

★ ★ ★

RADIO SET SCR-300

Use.—Portable transmitter and receiver.
Frequency range.—40.0 to 48.0 megacycles.
Power output.—1 watt.
Emission.—A₃ (FM).

Description.—Radio set SCR-300 is a low power, portable, frequency modulated radio receiver and transmitter powered by dry batteries. The set is designed for two-way voice communication over short

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ranges and is designed primarily for use by combat troops on foot.

The normal operating range, using the long antenna AN-131-A, is 3 miles or more, depending upon operating conditions. The range with the short antenna AN-130-A will be slightly less.

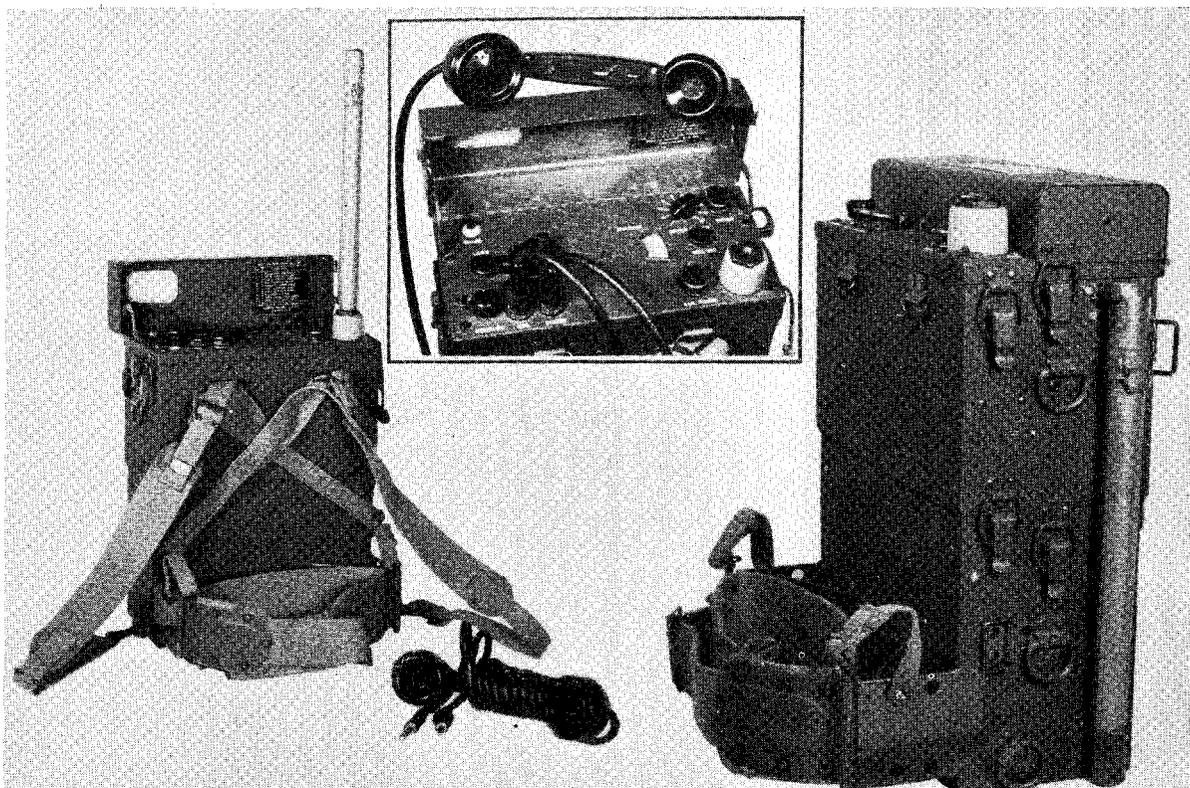
Tube complement:

- 3A4, R-F power amplifier.
- 3A4, Transmitter mixer.
- 1T4, Transmitter-receiver doubler.
- 1T4, Transmitter-receiver master-oscillator.
- 1L4, Receiver AFC control; transmitter reactance modulator.
- 1T4, Receiver r-f amplifier.

ing of three sections—4.5 volts, 90 volts, and 60 volts—furnishes power for filament and plate circuits of the receiver and transmitter.

Antennas.—Antenna AN-130-A consists of two sections and is 33 inches in length when assembled. The two sections are held captive by means of a kinkless, stainless steel cable, eliminating the possibility of losing a section and permitting rapid assembly of the antenna.

Antenna AN-131-A is a lightweight tapered flexible antenna consisting of eight sections and is 10 feet 8 inches in length when assembled. The eight sections are held captive by means of a kinkless, stainless steel cable which runs the entire length of the antenna and



Radio set SCR-300—three views.

- 1L4, First mixer.
- 1T4, First i-f amplifier.
- 1T4, Second i-f amplifier.
- 1R5, Second mixer and crystal oscillator.
- 1T4, Third i-f amplifier.
- 1L4, First limiter.
- 1L4, Second limiter.
- 1A3, Discriminator.
- 1S5, Discriminator and a-f power amplifier.
- 1S5, Noise amplifier—rectifier.
- 1L4, D-C amplifier.
- 1S5, Squelch oscillator—rectifier.

Frequency control.—Master-oscillator.

Power supplies available.—Battery BA-70, consist-

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is under spring tension. This cable eliminates the possibility of losing a section and permits rapid assembly of the antenna.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|--------------------------|----------|--|--------|
| Receiver and transmitter | BC-1,000 | 15 x 10 x 6 | 17 |
| Battery | BA-70 | 7 ³ / ₂ x 10 ¹ / ₂ x 4 ¹ / ₂ | 15 |
| Antenna | AN-130 | | |
| Do. | AN-131 | | |
| Total weight | | | 38.23 |

RADIO SETS SCR-508, SCR-528, AND SCR-538

Use.—Amphibian tractors.

Frequency range.—20.0 to 27.9 megacycles.

Power output:

SCR-508—25 watts.

SCR-528—25 watts.

SCR-538—No transmitter.

Emission:

SCR-508—A₃.

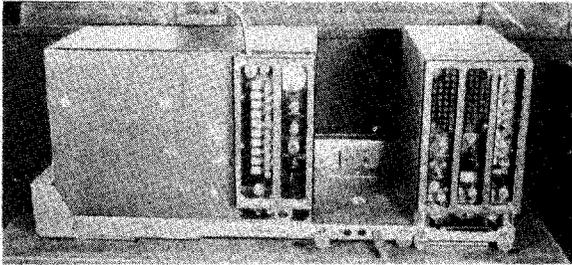
SCR-528—A₃.

SCR-538—No transmitter.

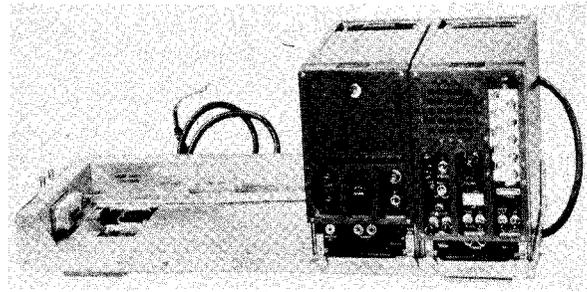
set SCR-528 uses one transmitter and one receiver; and radio set SCR-538 uses one receiver and no transmitter.

These equipments are intended to operate within a temperature range of minus 40° to plus 130° F. Care must be exercised to avoid prolonged operation in inclosed spaces when the operating temperature may become excessively high.

The range of the equipment, while in motion, is 7 miles.



Radio set SCR-528.



Radio set SCR-538.

Description.—Radio sets SCR-508, SCR-528, and SCR-538 provide frequency modulated radio-telephone communication facilities. Interphone communication facilities are provided for personnel in noisy applications. The radio sets may be installed and operated in combat vehicles of the Armored Force, such as tanks, scout cars, command cars, and any other vehicle which may be specified. The radio sets may be operated by personnel unskilled in radio technique.

Radio sets SCR-508, SCR-528, and SCR-538 all use the same equipment components, but differ in the quantity of each component employed. Radio set SCR-508 uses one transmitter and two receivers; radio

Tube complement:

Radio receiver BC-603-D:

6AC7, R-F amplifier.

6AC7, Modulator.

6J5, R-F oscillator.

12SG7, I-F amplifier.

12SG7, I-F amplifier.

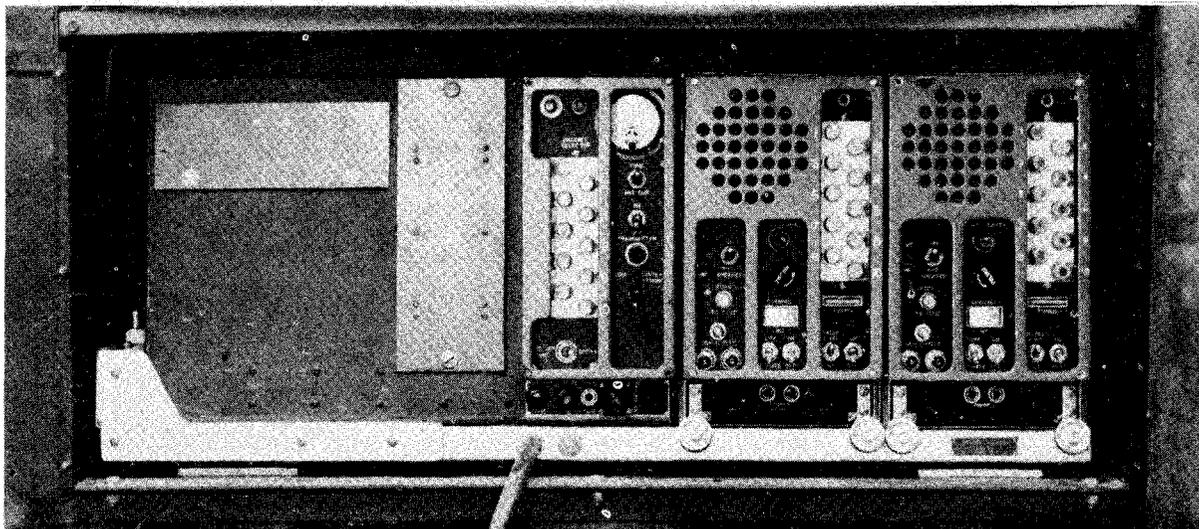
6AC7, Limiter.

6H6, Detector.

6V6GT, Second a-f amplifier.

6SL7GT, AVC and squelch.

6SL7GT, First a-f amplifier and i-f oscillator.



Radio set SCR-508.

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Radio transmitter BC-604-D:
 1619, First r-f amplifier.
 1619, Rectifier.
 1619, Tripler.
 1624, Power amplifier.
 1619, First a-f amplifier.
 1619, Second a-f amplifier.
 1619, Oscillator.
 1619, Doubler.

Interphone amplifier BC-605-D:
 1619, First a-f amplifier.
 1619, Second a-f amplifier.

Frequency control.—Master-oscillator or crystal (10 pushbutton pre-set frequencies).

Power supplies available.—12- or 24-volt vehicular battery.

Antenna.—A suitable antenna system is essential for satisfactory operation of the equipment. The transmitter is most easily tuned to an antenna which is quarter-wave resonant near the center of the frequency

band. The antenna most universally used is a 9-foot fishpole.

Weights, dimensions, and Army type numbers of principal equipment units

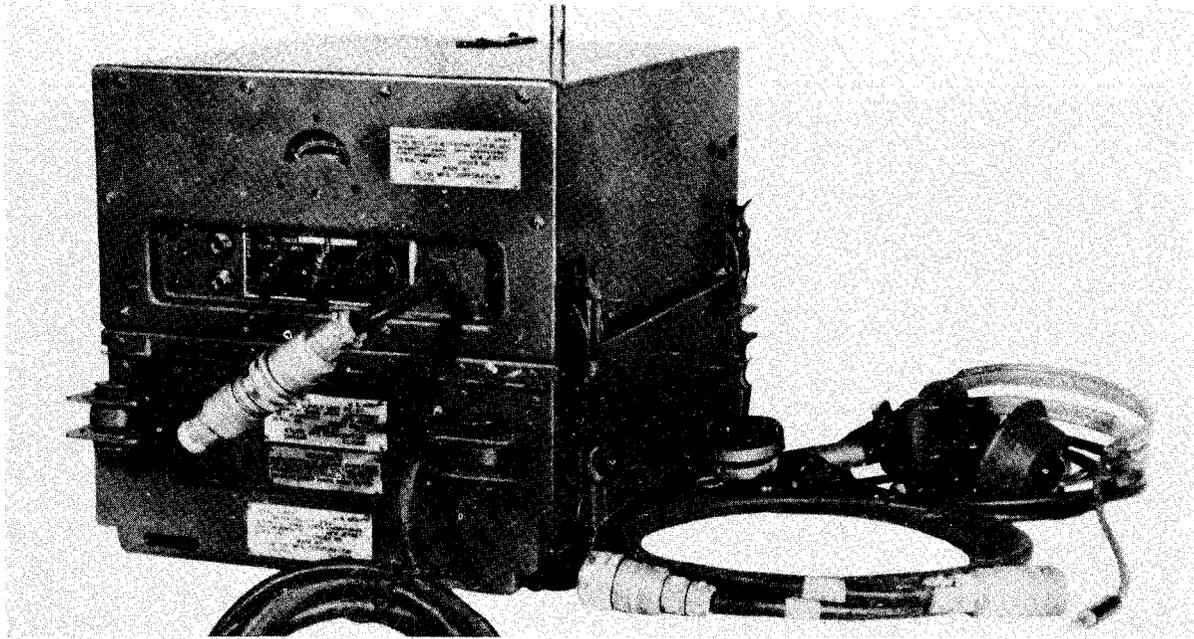
| Unit | Type No. | Dimensions | Weight |
|------------------------|----------|---------------|---------------|
| | | <i>Inches</i> | <i>Pounds</i> |
| Radio set SCR-508: | | | |
| 2—Receiver | BC-603 | ----- | 70 |
| 1—Transmitter | BC-604 | ----- | 67 |
| 1—Mounting base | FT-237 | ----- | 44 |
| Total weight | | ----- | 181 |
| Radio set SCR-528: | | | |
| 1—Receiver | BC-603 | ----- | 35 |
| 1—Transmitter | BC-604 | ----- | 67 |
| 1—Mounting base | FT-237 | ----- | 44 |
| Total weight | | ----- | 146 |
| Radio set SCR-538: | | | |
| 1—Receiver | BC-603 | ----- | 35 |
| 1—Interphone amplifier | BC-605 | ----- | 29 |
| 1—Mounting base | FT-237 | ----- | 44 |
| Total weight | | ----- | 108 |



RADIO SET SCR-510

Use.—Portable transmitter and receiver.
Frequency range.—20.0 to 27.9 megacycles.

Power output.—1.8 watts.
Emission.—A₃ (FM).



Radio set SCR-510.

Description.—Radio set SCR-510 is a portable, low power, frequency modulated radio set capable of a dependable communication range of approximately five miles. Radio set SCR-510 is intended for (1) operation from stationary positions such as on the ground or on a stationary support; and (2) vehicular use. In case (1), the set obtains its power from dry batteries; in case (2); it obtains its power from either a 6- or 12-volt storage battery.

Either of two pre-set frequencies may be chosen by throwing the channel switch. The change from receiving to transmitting is made by pressing a button on the handset or microphone.

Tube complement:

Radio receiver and transmitter BC-620:

1291, Transmitter r-f power amplifier.

1291, Transmitter buffer.

1299, Transmitter oscillator.

1299, Transmitter react. modulator.

1LN5, Receiver r-f amplifier.

1LC5, Receiver mixer.

1299, Receiver crystal oscillator.

1LN5, Receiver first i-f amplifier.

1LN5, Receiver second i-f amplifier.

1LN5, Receiver limiter.

1294, Receiver diode rectifier.

1LH4, Receiver diode rectifier and d-c amplifier.

1299, Receiver a-f power amplifier.

Plate supply unit PE-97:

VR-90/30, Voltage regulator.

CK-1005, Rectifier.

Frequency control.—Crystal.

Power supplies available.—Dry batteries or 6- or 12-volt storage battery.

Operating power required:

Portable operation:

Receiving:

Receiver "A" battery—0.7 ampere at 1.5 volts.

Receiver "B" battery—0.025 ampere at 90.0 volts.

Transmitting:

Receiver "A" battery—0.7 ampere at 1.5 volts.

Receiver "B" battery—0.045 ampere at 90.0 volts.

Transmitter "A" battery—0.3 ampere at 7.5 volts.

Transmitter "B" battery—0.045 ampere at 150.0 volts.

Vehicular operation:

6-volt storage battery:

Receiving—2.8 amperes—17.4 watts.

Transmitting—3.5 amperes—21.7 watts.

12-volt storage battery:

Receiving—2.1 amperes—21.0 watts.

Transmitting—2.9 amperes—36.0 watts.

Antenna.—8-foot telescopic masts for portable operation; vehicular whip for vehicular operation.

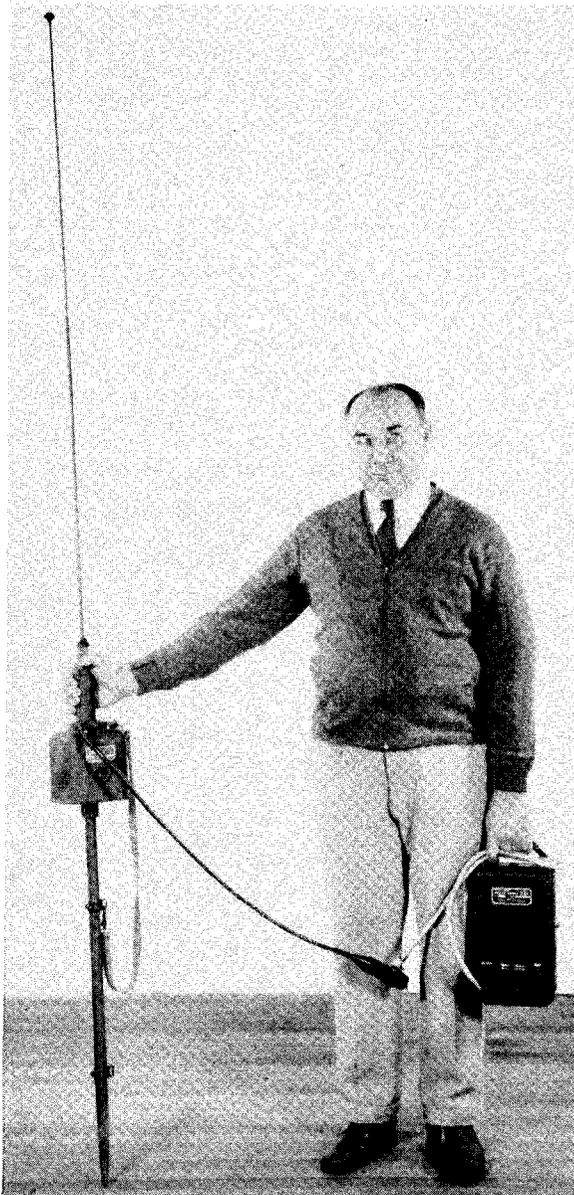
Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Volume | Weight |
|--------------------------------|----------|--|-------------------|---------------|
| Radio receiver and transmitter | BC-620 | <i>Inches</i> 6 $\frac{3}{4}$ x 13 $\frac{3}{16}$ x 15 $\frac{5}{16}$ | <i>Cubic feet</i> | <i>Pounds</i> |
| Plate supply unit | PE-97 | 4 $\frac{3}{16}$ x 13 $\frac{3}{16}$ x 15 $\frac{5}{16}$ | | |
| Total weight | | | | 65 |
| Total volume | | | 1.3 | |

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RADIO SET SCR-511

Use.—Portable transmitter and receiver.
Frequency range.—3.0 to 6.0 megacycles.
Power output.—0.75 watt.



Radio set SCR-511.

Emission.—A₃.

Description.—Radio set SCR-511 is a battery operated portable radio receiver and transmitter intended

for voice communication and designed for reconnaissance, sentry, or mobile service. Under favorable conditions, communication at a distance of five miles is possible. Radio set SCR-511 consists of two units. Chest unit T-39-A is supported on the chest by shoulder straps. This unit contains the battery, spare tuning unit, and the speaker-microphone. Radio transmitter and receiver BC-745-A contains the radio circuit components. The two units are interconnected by a seven-conductor rubber-covered cord CD-571-A. Conversion from receiver to transmitter is accomplished by means of a thumb-operated "press-to-talk" switch.

Tuning units BC-746-A are pre-tuned plug-in devices and contain appropriate transmitter and receiver crystals and plug-in coils. These units permit quick change-over between any two frequency channels in the 3- to 6-megacycle band. Two of these units are issued with radio set SCR-511 for the channels authorized at the time of issue.

Tube complement:

- 1T4, Receiver r-f amplifier.
- 1T4, Receiver mixer.
- 1T4, Receiver i-f amplifier.
- 1S5, Receiver detector, avc, and a-f amplifier; transmitter microphone amplifier.
- 3S4, Receiver power amplifier; transmitter modulator.
- 3S4, Receiver power amplifier; transmitter modulator.
- 3S4, Receiver oscillator; transmitter oscillator.
- 3S4, Transmitter r-f amplifier.
- 3S4, Transmitter r-f amplifier.

Power supplies available.—Radio set SCR-511 operates from battery BA-49—a plug-in type which contains one 1.5-volt "A" battery and two 67.5-volt "B" batteries.

Operating power.—Receiving: 0.355 ampere at 1.5 volts, 0.01 ampere at 67.5 volts, and 0.01 ampere at 67.5 volts. Transmitting: 0.49 ampere at 1.5 volts and 0.05 ampere at 135.0 volts.

Antenna.—Telescope mast. This antenna actuates the set's on-off switch when extended.

Frequency control.—Crystal.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|--------------------------------|----------|---------------|----------------------|
| Radio receiver and transmitter | BC-745-A | <i>Inches</i> | <i>Pounds</i> 9.3 |
| Tuning unit | BC-746 | | .5 |
| Chest unit | T-39-A | | 3.7 |
| Battery | BA-49 | | 2.5 |
| Total | | | 20.0 |

RADIO SETS SCR-522 AND SCR-542

Use.—Ground-air liaison.

Frequency range.—100 to 156 megacycles.

Power output.—6 watts.

Emission.—A₃ and special tone signal when used with contactor equipment RC-96.

Description.—Radio sets SCR-522 and SCR-542 are intended for use in aircraft and will provide two-way radio-telephone communication between aircraft in flight and between aircraft and ground stations. Operation may take place on any one of four crystal-controlled channels lying within the frequency range of 100 to 156 megacycles. Remote control only is provided. Radio set SCR-522 operates from a 28-volt source and uses dynamotor PE-94-A; radio set SCR-542 operates from a 14-volt source and uses dynamotor PE-98-A. Radio sets SCR-522 and SCR-

12A6, First harmonic amplifier.

12A6, Modulator.

12A6, Modulator.

6G6G, Oscillator.

6SS7, Speech amplifier.

6SS7, R-F indicator diode.

Frequency control.—Crystal (four pre-set channels in the receiver and four in the transmitter).

Power supplies available:

SCR-522: 28 volts dc.

SCR-542: 14 volts dc.

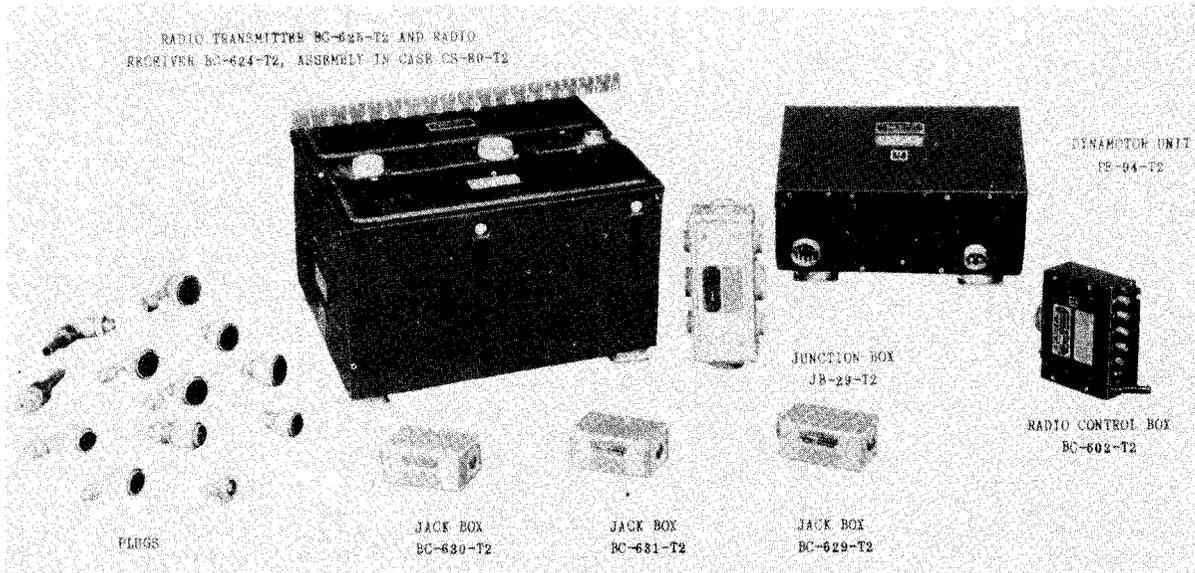
Operating power:

SCR-522: Transmit—11.5 amperes at 28 volts;

Receive—11.1 amperes at 28 volts.

SCR-542: Transmit—23.0 amperes at 14 volts;

Receive—22.2 amperes at 14 volts.



Radio set SCR-522—principal components.

542 differ only in the primary power supply voltage and the dynamotor unit used.

Tube complement:

Receiver:

- 12J5GT, Second audio amplifier.
- 12C8, Detector, avc, and first audio amplifier.
- 9002, Harmonic generator.
- 9003, R-F amplifier.
- 9003, Mixer.
- 9003, Harmonic amplifier.
- 12AH7GT, Oscillator and audio squelch.
- 12SG7, First i-f amplifier.
- 12SG7, Second i-f amplifier.
- 12SG7, Third i-f amplifier.

Transmitter:

- 832, Second harmonic amplifier.
- 832, Power amplifier.

Antenna.—A quarter-wave vertical mast.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Volume | Weight | | |
|---|----------------------------|---|------------|--------------|--|-----|
| Case CS-80 containing: Radio Transmitter Radio Receiver Rack | BC-625 BC-624 FT-244 | Inches 16 ⁵ / ₃₂ x 12 ⁹ / ₁₆ x 10 ¹ / ₁₆ | Cubic feet | Pounds 49 | | |
| Dynamotor | PE-94-A | | | | 12 ²⁵ / ₃₂ x 8 ²⁷ / ₃₂ x 6 ¹⁵ / ₆₄ | 37 |
| Dynamotor | PE-98-A | | | | 12 ²⁵ / ₃₂ x 8 ²⁷ / ₃₂ x 6 ¹⁵ / ₆₄ | 37 |
| Radio Control box | BC-602 | | | | 5 ⁷ / ₈ x 5 ⁹ / ₁₆ x 2 ¹ / ₂ | 2.4 |
| Total weight | | | | 91 | | |
| Total volume | | | 1.8 | | | |

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RADIO SET SCR-536

Use.—Handy-Talky.

Frequency range.—3.5 to 6.0 megacycles.

Power output.—.027 watt.

Emission.—A₃.

Description.—Radio set SCR-536 is designed for short-range two-way voice conversation. Descriptively, it is a press-to-talk portable radiotelephone, receiving and transmitting on the same frequency. No skill is required to operate it.

The set is self-contained; all equipment necessary for reception and transmission is contained in one aluminum case. The set may be held in either hand when operating, although it is designed and balanced for left-hand operation. The microphone and earphone are attached to the case in such manner that the set resembles a hand telephone. An adjustable carrying strap is attached to the case.

The set is designed to operate over distances from 100 feet to 1½ miles. The dependability of operation at the greater distance will depend on the terrain and the freedom from signal absorbing objects such as steel buildings, trees, hills, and telephone and power lines between the two sets. This is particularly true for sets operating at the higher frequencies in the band. The maximum range may be considerably greater when operating over water or in air.

Tube complement:

VT-171, Receiver converter and oscillator; transmitter oscillator.

VT-172, Receiver second detector, avc, and a-f amplifier; transmitter microphone amplifier.

VT-173, Receiver i-f amplifier.

VT-174, Receiver r-f amplifier; transmitter r-f power amplifier.

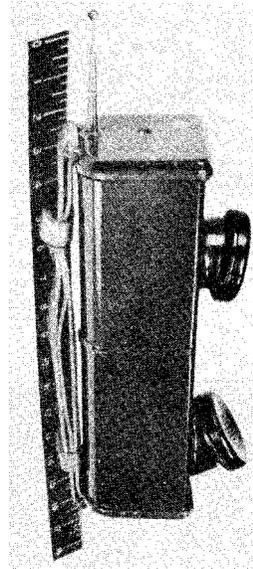
VT-174, Receiver output amplifier; transmitter modulator.

Frequency control.—Crystal.

Power supplies available.—Radio set SCR-536 operates from a 1.5-volt "A" battery, BA-37, and a 103.5-volt "B" battery, BA-38.

Operating power.—Receiving: 0.25 ampere at 1.5 volts and 0.011 ampere at 103.5 volts. Transmitting: 0.30 ampere at 1.5 volts and 0.035 ampere at 103.5 volts.

Antenna.—44-inch whip antenna. Telescopes into set box. Receiver is turned on when antenna is extended.



Radio set SCR-536.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Volume | Weight |
|----------------------|-------------|---------------|---------------------|---------------|
| | | <i>Inches</i> | <i>Cubic inches</i> | <i>Pounds</i> |
| Transceiver..... | BC-611..... | 15¾ x 5⅝ x 3¾ | 480.0 | 5.5 |
| Total weight..... | | | | 6.0 |
| Total volume..... | | | 480.0 | |
| Shipping weight..... | | | | 8.0 |

RADIO SETS SCR-608 AND SCR-628

Use.—Mobile.

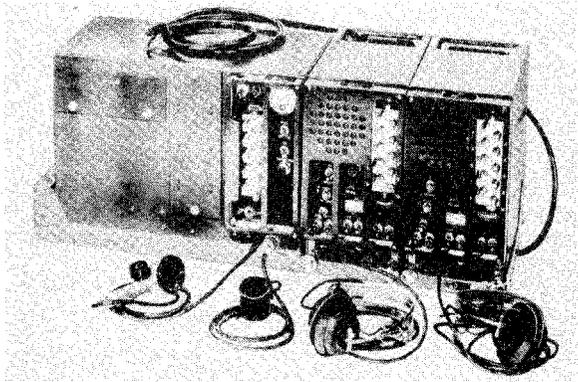
Frequency range.—27.0 to 38.9 megacycles.

Power output.—35 watts.

Emission.—A₃ (FM).

Description.—Radio sets SCR-608 and SCR-628 provide frequency modulated radiotelephone communication facilities for antiaircraft and antitank warning and control nets, base stations at battalion command posts for fire control and fire-direction nets and for intra-battalion communication.

The radio sets may be installed and operated in combat vehicles, such as command cars, or any other vehicle which may be specified. The radio sets may



Radio set SCR-608

Radio transmitter BC-684:

1619, First r-f amplifier.

1619, Rectifier.

1619, Doubler.

1624, Power amplifier.

1619, First a-f amplifier.

1619, Second a-f amplifier.

1619, Oscillator.

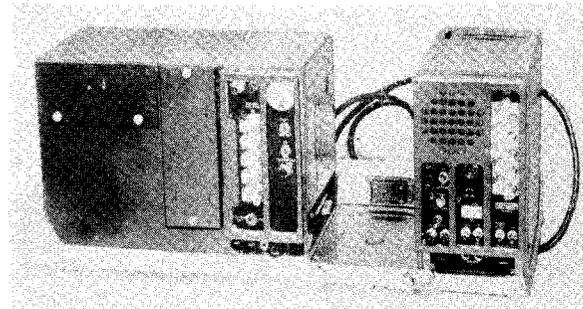
1619, Tripler.

Frequency control.—Crystal (10 pre-set push-button frequencies).

Power supplies available.—12 or 24 volts d-c.

Operating power required.—12-volt source: Receiver 4 amperes; transmitter 20 amperes. 24-volt source: Receiver 2 amperes; transmitter 12 amperes.

Antenna.—Fishpole type.



Radio set SCR-628.

be operated by personnel unskilled in radio technique.

Tube complement:

Radio receiver BC-683:

6AC7, R-F amplifier.

6AC7, Modulator.

6J5, R-F oscillator.

12SG7, I-F amplifier.

12SG7, I-F amplifier.

6AC7, Limiter.

6H6, Detector.

6V6GT, Second a-f amplifier.

6SL7GT, AVC and squelch.

6SL7GT, First a-f amplifier and i-f oscillator.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|-----------------------|----------|---------------|---------------|
| Radio set SCR-608: | | <i>Inches</i> | <i>Pounds</i> |
| 1—Transmitter | BC-684 | | 67 |
| 2—Receiver | BC-683 | | 70 |
| 1—Mounting | FT-237 | | 44 |
| 1—Remote control unit | RM-29 | | 15 |
| Total weight | | | 306 |
| Radio set SCR-628: | | | |
| 1—Transmitter | BC-684 | | 67 |
| 1—Receiver | BC-683 | | 35 |
| 1—Mounting | FT-237 | | 44 |
| 1—Remote control unit | RM-29 | | 15 |
| Total weight | | | 271 |

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RADIO SETS SCR-609 AND SCR-610

Use.—Mobile—tanks.

Frequency range.—27.0 to 38.9 megacycles.

Power output.—2 watts.

Emission.—A₃ (FM).

Description.—Radio sets SCR-609 and SCR-610 are portable, low power, frequency modulated radio transmitting and receiving sets which differ only in that radio set SCR-610 includes additional components required for vehicular use. They will communicate with each other within a 5-mile range over average terrain, and within a 7-mile range when communicating with radio set SCR-608.

Radio set SCR-609 is intended for operation from stationary positions such as on the ground, or on a stationary support, and obtains its power from dry batteries. Radio set SCR-610, in addition to being used like radio set SCR-609, is also intended for vehicular use and may obtain its power from either a 6- or 12-volt storage battery.

Both radio sets are pre-set for crystal controlled operation on any two of 120 different channels, spaced

Transmitting "B" battery: 0.050 ampere at 150.0 volts.

SCR-610:

On dry batteries: Same as SCR-609.

On 6-volt storage battery:

Receiving: 2.25 amperes, 17 watts.

Transmitting: 3.25 amperes, 20 watts.

On 12-volt storage battery:

Receiving: 2.25 amperes, 28 watts.

Transmitting: 2.6 amperes, 32 watts.

Antenna:

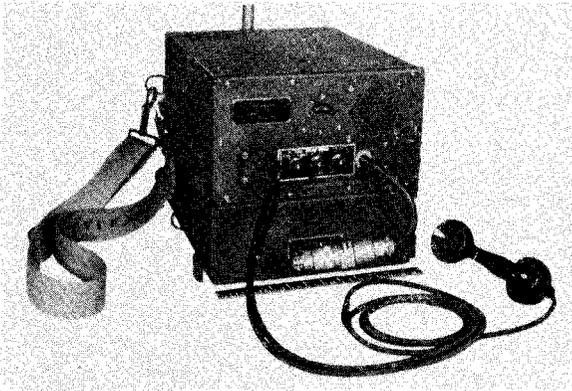
SCR-609: Fishpole type antenna AN-29-C.

SCR-610: Same as SCR-609 or vehicular whip type.

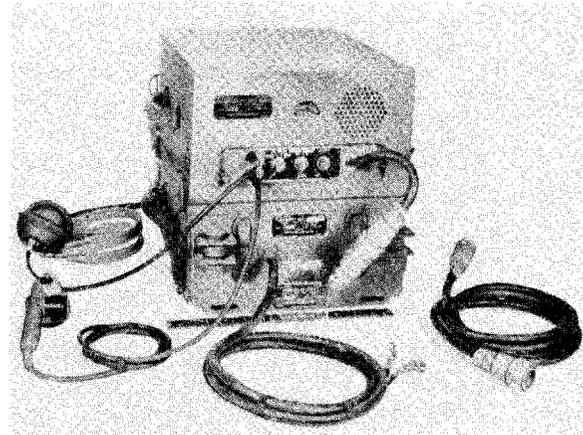
Power supplies available:

SCR-609: Dry batteries BA-39, BA-40, and BA-41.

SCR-610: Same as SCR-609; also 6-volt or 12-volt storage battery.



Radio set SCR-609.



Radio set SCR-610.

100 kilocycles apart, within the frequency range of the set. Either of these two pre-set frequencies may be instantly chosen by turning the two-position panel switch marked "chan." To change from receiving to transmitting it is merely necessary to press a button on the handset or microphone.

Operating power:

SCR-609:

Receiving:

Receiving "A" battery: 0.94 ampere at 1.5 volts.

Receiving "B" battery: 0.028 ampere at 90.0 volts.

Transmitting:

Receiving "A" battery: 0.94 ampere at 1.5 volts.

Receiving "B" battery: 0.048 ampere at 90.0 volts.

Transmitting "A" battery: 0.3 ampere at 7.5 volts.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Volume | Weight |
|------------------------|----------|----------------|-------------------|---------------|
| | | <i>Inches</i> | <i>Cubic feet</i> | <i>Pounds</i> |
| SCR-609: | | | | |
| Receiver - transmitter | BC-659 | 6¾ x 13¾ x 14½ | | 26 |
| Case (for batteries) | CS-79 | 4½ x 13¾ x 15½ | | 10 |
| Remote control unit | RM-29 | 5¼ x 9¾ x 6¼ | | 12 |
| Total weight | | | | 170 |
| Total volume | | | 1.3 | |
| SCR-610: | | | | |
| Receiver - transmitter | BC-659 | 5¼ x 9¾ x 6¼ | | 12 |
| Platesupplyunit | PE-177 | 4¾ x 13¾ x 15½ | | 28.5 |
| Mounting | FT-250 | 4½ x 11¾ x 20 | | 11.5 |
| Remote control unit | RM-29 | 4½ x 11¾ x 20 | | 11.5 |
| Case (for batteries) | CS-79 | 4½ x 11¾ x 20 | | 11.5 |
| Total weight | | | | 177.0 |
| Total volume | | | 1.3 | |

Tube complement:

Radio receiver and transmitter BC-659:
1291, Transmitter r-f power amplifier.
1291, Transmitter buffer.
1299, Transmitter oscillator.
1299, Transmitter reactance modulator.
1LN5, Receiver first r-f amplifier.
1LN5, Receiver second r-f amplifier.
1LC6, Receiver mixer.
1299, Receiver crystal oscillator.
1LN5, Receiver first i-f amplifier.

1LN5, Receiver second i-f amplifier.
1LN5, Receiver limiter.
1294, Receiver diode rectifier.
1LH4, Receiver diode rectifier and d-c amplifier.
1299, Receiver a-f power amplifier.
Plate supply unit PE-117 (Radio Set SCR-610 only):
VR-90-30 (glass), Voltage regulator.
CK-1005 (metal), Rectifier.
Frequency control.—Crystal.



RADIO SET SCR-624

Use.—Fighter control.

Frequency range.—100.0 to 156.0 megacycles.

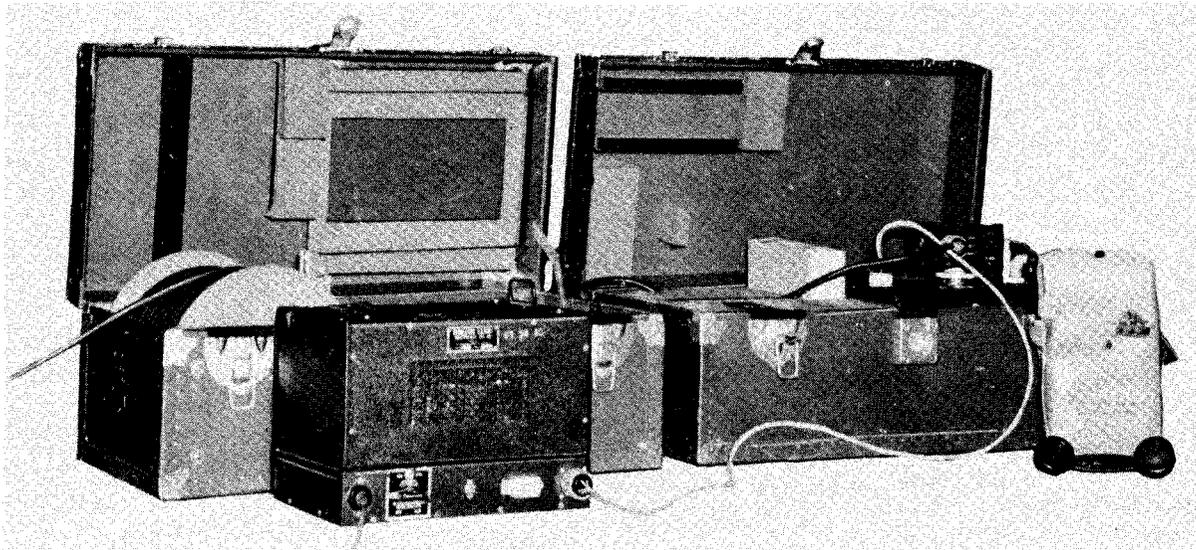
Power output.—6 watts.

Emission.—A₃.

Description.—Radio set SCR-624 is a complete very high frequency radio ground station especially designed for transportation by air. Radio set SCR-624 may be operated on any one of four crystal controlled

Tube complement:

Radio transmitter BC-625:
832, Second harmonic amplifier.
832, Power amplifier.
12A6, First harmonic amplifier.
12A6, Modulator.
12A6, Modulator.
6G6G, Oscillator.



Radio set SCR-624.

channels within the 100-156 megacycle frequency range. Control facilities are provided so that the transmitter and receiver may be operated at the station, at a remote distance of 500 feet from the station, or at a remote distance of 2 miles. Channel selection can be made only at the station or at the 500-foot remote point of control, while only send-receive communication is possible at the 2-mile remote point. Land line telephone communication is possible between any two points of control by use of telephone EE-8-A.

6SS7, Speech amplifier.
6SS7, R-F indicator diode.
Radio Receiver BC-624:
12J5GT, Second a-f amplifier.
12C8, Detector, avc, and first a-f amplifier.
9002, Harmonic generator.
9003, R-F amplifier.
9003, Mixer.
9003, Harmonic amplifier.
12AH7GT, Oscillator and a-f squelch.

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- 12SG7, First i-f amplifier.
- 12SG7, Second i-f amplifier.
- 12SG7, Third i-f amplifier.

Rectifier RA-62:

- 5U4G, Plate supply rectifier.
- 5U4G, Plate supply rectifier.
- 6X5GT, Bias supply rectifier.

Power supplies available:

- 100-130 volts, single phase, 40-60 cycles a-c.
- 230-260 volts, single phase, 40-60 cycles a-c.

Operating power required.—320-325 watts.

Frequency control.—Crystal (4 pre-set channels).

Antenna.—Antenna AN-94 and the coaxial h-f cable are packed separately in order to afford suitable protection against damage to the antenna. Antenna AN-94 is a J-type antenna with a long (radiator) section and a short (matching) section mounted in

a base for connection to the antenna mast. The long and short sections of the antenna are telescopic for adjusting the length to accommodate the transmitting frequency. Antenna AN-94 is supported on a 50-foot high tubular plywood mast.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|----------------------|---------------|--|---------------|
| | | <i>Inches</i> | <i>Pounds</i> |
| Chest..... | CH-173-A..... | 34 x 16 ³ / ₄ x 13 ³ / ₄ | 134 |
| Chest..... | CH-172-A..... | 34 x 16 ³ / ₄ x 13 ³ / ₄ | 205 |
| Chest..... | CH-170-A..... | 47 ¹ / ₄ x 14 ³ / ₈ x 6 ³ / ₈ | 41 |
| Strap crate..... | ..... | 11 x 16 ¹ / ₂ x 12 | 152 |
| Stays box..... | ..... | 23 ³ / ₄ x 16 ³ / ₄ x 12 ¹ / ₄ | 121 |
| Spare parts box..... | ..... | 27 x 13 ¹ / ₂ x 11 | 45 |
| Power unit..... | PE-75..... | 36 x 19 ¹ / ₂ x 20 ¹ / ₂ | 322 |
| Total..... | ..... | ..... | 1,020 |



RADIO SET SCR-694

Use.—Portable—Marine Corps.

Frequency range.—3.8 to 6.5 megacycles.

Power output:

Vehicle operation: A₁, 25 watts; A₃, 7 watts.

Field operation: A₁, 20 watts; A₃, 5 watts.

Emission.—A₁ and A₃.

Description.—Radio set SCR-694 is a compact and efficient two-way radio-telephone and radio-telegraph unit for communication between moving or stationary vehicles. The set may also be removed from the vehicle and can be set up as a field station

Tube complement:

Transmitter:

- 2—3A4.
- 1—HY65.
- 1—TS70.
- 1—VR-105-30.

Receiver:

- 3—1T4.
- 1—1R5.
- 1—1S5.
- 1—3Q4.

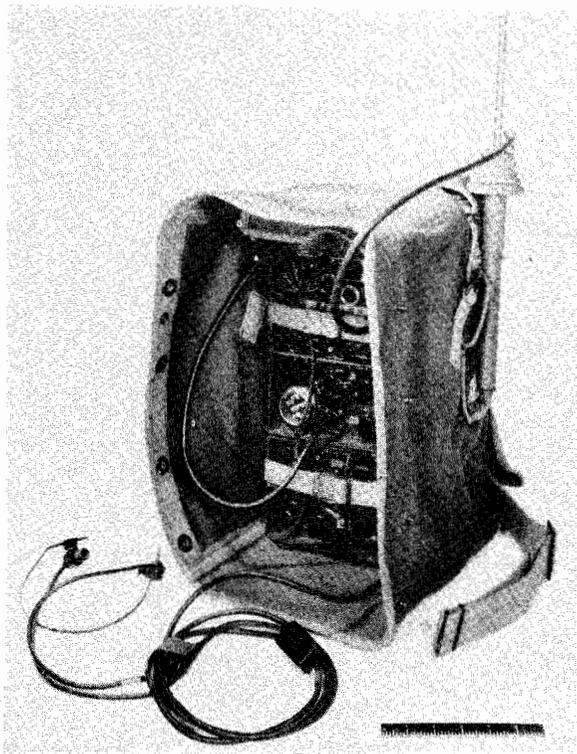
Frequency control—Master-oscillator and crystal (two pre-set frequencies).

Power source.—6- or 12-volt vehicle battery with vibrator unit PE-237; hand generator GN-57; or battery BA-48 (for receiver only).

Antenna.—15-foot whip AN-123, 124.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|---------------------------|--------------|---------------|---------------|
| | | <i>Inches</i> | <i>Pounds</i> |
| Transmitter-receiver..... | BC-1306..... | ..... | 27 |
| Vibrator unit..... | PE-237..... | ..... | ..... |
| Generator..... | GN-57..... | ..... | ..... |



Radio set SCR-694.

RADIO SET WE-233

Use.—Ground-air liaison.

Frequency range.—140 to 144 megacycles.

Power output.—5–10 watts.

Emission.—A₃.

Description.—The WE-233 radio telephone equipment is a VHF communication unit designed for aircraft use in the 140 to 144 mc. band. It is intended for two-way radio-telephone communication between airplanes and from airplanes to ground stations. It also provides an interphone system for the pilots.

The equipment consists of a VHF transmitter and a VHF receiver mounted on a single chassis. Both the transmitter and receiver may be pre-tuned for operation on any four crystal controlled frequencies in the 140 to 144 mc. band. One of the four frequencies is intended for plane-to-plane communication. The remaining frequencies are intended for plane-to-ground communication. A transmitter crystal and a receiver crystal are mounted in a single crystal holder and are so selected that the transmitter and receiver both operate on the same carrier frequency. Crystal switching relays incorporated in the equipment permit rapid selection of any of the four pre-tuned carrier frequencies.

The radio receiver has two independent r-f input circuits which permit simultaneous monitoring on two carrier frequencies. One input circuit may be used to monitor continuously on the plane-to-plane carrier frequency. The other input circuit may be used simultaneously to monitor any one of the plane-to-ground frequencies. Provision is made to temporarily disable either circuit if two signals are received at the same time.

The WE-233 radio telephone equipment may be used interchangeably in airplanes equipped with either 12- or 24-volt d-c power supplies, provided the power receptacle on the apparatus mounting in the plane is properly wired and the proper dynamotor is inserted in the equipment. A single dynamotor provides high voltage supply for both the transmitter and the receiver and is transferred by means of a relay controlled by the press-to-talk switch on the microphone. The same relay also transfers the antenna to the receiver or to the transmitter.

Tube complement:

Transmitter:

6V6GT, Oscillator and tripler.

6V6GT, First doubler (harmonic generator).

1614, Second doubler (harmonic generator).

1614, Third doubler (harmonic generator).

6L6, A-F amplifier—push-pull.

6L6, A-F amplifier—push-pull.

832, Final amplifier.

Receiver:

6N7, Oscillator and first harmonic generator—plane-to-ground unit.

6N7, Second and third harmonic generators—plane-to-ground unit.

6N7, Oscillator and first harmonic generator—plane-to-plane unit.

6N7, Second and third harmonic generator—plane-to-plane unit.

6AC7, First detector—plane-to-ground unit.

6AC7, First detector—plane-to-plane unit.

12SJ7, First i-f amplifier—both units.

12SJ7, Second i-f amplifier—both units.

12SJ7, Third i-f amplifier—both units.

12SQ7, Noise gate and codan—both units.

12SQ7, Second detector, avc, and first a-f amplifier—both units.

12A6, Second a-f amplifier—both units.

12A6, Second a-f amplifier—both units.

Frequency control.—Crystal.

Power supplies available.—12 or 24 volts d-c.

Operating power required:

Standby condition receiver on: 13.5 volts at 14.5 amps; 27 volts at 7.5 amps.

Transmit condition carrier only: 13.5 volts at 21 amps; 27 volts at 10.5 amps.

Transmit condition fully modulated: 13.5 volts at 21.5 amps; 27 volts at 10.5 amps.

Antenna.—A quarter-wave shunt-fed antenna is recommended. The location of the antenna is determined by sliding it along the top of the fuselage and taking field strength readings at the rear of the airplane. The point or points where maximum radiation to the rear occurs are comparatively sharp and a matter of six inches means the difference between full output and a null. The antenna should be fed by a 50- to 70-ohm low loss coaxial transmission line.

Weights, dimensions, and Army type numbers of principal equipment units

| Unit | Type No. | Dimensions | Weight |
|----------------|-------------|---------------------------------|---------------------|
| Radio set..... | WE-233..... | <i>Inches</i> 19½ x 10¼ x 7¼ | <i>Pounds</i> 33 |

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Section VII
HARBOR DETECTION EQUIPMENTS

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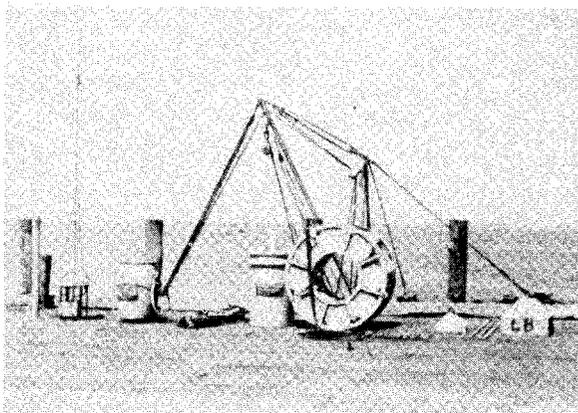
JM-4 SONO RADIO BUOY TRANSMITTING EQUIPMENT

Use.—Underwater sound detection—Moored off-shore.

Frequency.—70–90 mc.

Description.—The model JM-4 Sono Radio Buoy is a complete battery operated transmitter intended to be anchored off-shore in a position to pick up and transmit to a shore station the underwater sounds created in the area. It will pick up underwater sounds and transmit them to a shore station not more than 15 miles distant. The transmitter carrier is frequency modulated.

The equipment consists of transmitter, battery supply, and underwater hydrophone. The battery is a dry cell type providing 300-volt plate and 7.5-volt filament supply. It is contained in a steel drum or barrel which is made water-tight by clamping down a fitted cover on the top of the barrel. This battery barrel is floated in a battery raft which is moored by



Model JM-4 sono radio buoy equipment—components arranged on dock prior to installation.

wire rope or chain and anchored in the desired location. The battery container is equipped with a gas release valve to permit the release of explosive hydrogen gas which accumulates in the barrel as a result of decomposition of the battery.

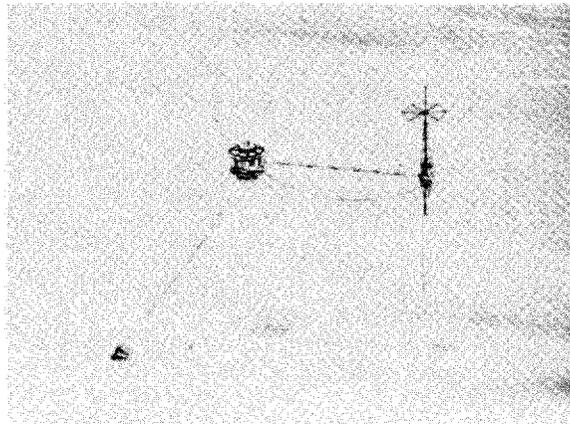
The transmitter buoy is tied to the battery raft by wire rope tie cables and is electrically connected by the battery power cable, which supplies plate and filament voltage to the transmitter. The antenna assembly consists of a tripod antenna tower terminating in a one-fourth wave ground plane antenna all mounted on a water-tight cover, clamped to the top of the transmitter buoy. A hydrophone plugs into a water-tight receptacle on the buoy cover and is suspended in the water to a depth of approximately 60 feet. A weighted tail pipe mounted under the transmitter buoy causes the buoy to float in an upright position.

The Sono Buoy Transmitter is mounted in a cradle

on the underside of the buoy cover. It transmits a frequency modulated signal in the 70–90 mc. range. The circuit employs two stages of audio frequency, resistance-capacity coupled. The second audio stage is similarly coupled to the control circuit of the reactance modulator which modulates the oscillator.

The oscillator consists of a 6AJ6 tube. The plate circuit of the oscillator is coupled to the antenna transmission line. The transmission line passes up the center of the tripod tower and is coupled to the ground plane antenna at the top of the tower.

Frequency is controlled by plate and grid tuning condensers in the oscillator circuit. The control shafts of these condensers extend up through the buoy barrel cover and are fitted with calibrated dials and control knobs. The audio gain control is a potentiometer in the grid circuit of the second audio stage. Its shaft extends out through the buoy cover and is



Model JM-4 sono radio buoy equipment installed.

equipped with a control knob. Packing glands provide water-tight fittings for these shafts. Water-tight plastic windows mounted in the top of the buoy cover make the dials visible for tuning the transmitter.

TECHNICAL FEATURES

Tube complement

| Function | Quantity | Type |
|--------------------------|----------|------|
| First audio..... | 1 | 6SJ7 |
| Second audio..... | 1 | 6SJ7 |
| Reactance modulator..... | 1 | 955 |
| R. F. oscillator..... | 1 | 6AJ6 |

Power output.—6 to 8 watts.

Emission.—F. M.

Power requirements.—Battery:

7.5-volt "A" supply.

300-volt "B" supply.

Weights, dimensions, and Navy type numbers

| Unit | Quantity | Navy type No. | Dimensions | Weight before packing | Case space | Case weight | | |
|----------------------------------|------------|------------------|----------------------------------|-----------------------|--|---------------|-----|-----|
| Antenna assembly with spike..... | 1..... | CIA 66042..... | 23" x 23" x 11 7/8"..... | 71 | Cubic feet 69 These items contained in case No. 1. | Pounds 600 | | |
| Radio transmitter..... | 1..... | CIA 52250-A..... | 8" x 8" x 11"..... | 12 | | | | |
| Hydrophone assembly..... | 1 box..... | CBD 51031..... | 10" x 10" x 18"..... | 55 | | | | |
| Tie cable floats..... | 10..... | | 8" x 16" x 17"..... | 33 | | | | |
| Battery container latch..... | 2..... | | 4" x 6" x 11"..... | 8 | | | | |
| Rubber hose..... | 2..... | | 1 1/16" x 1 1/8" x 5'..... | | | | | |
| Clips, swivels, thimbles..... | 1 box..... | | 9" x 12" x 36"..... | 98 | | | | |
| Artificial ground planes..... | 2..... | | 2 1/2" x 65" x 65"..... | 7 | | | | |
| Transm. buoy tail pipe..... | 1..... | CIA 10091..... | 16" x 5" x 11"..... | 160 | | | 6.2 | 41 |
| Transm. buoy barrel..... | 1..... | CPZ 10090..... | 32" dia x 37"..... | 148 | | | 22 | 275 |
| Battery container..... | 2..... | CPZ 10093..... | 28" dia x 40"..... | 124 | 20 | 193 | | |
| Battery raft..... | 1..... | CMB 10092..... | 58" dia x 30"..... | 475 | 72 | 169 | | |
| Danforth anchor..... | 1..... | | 2" x 47" x 56"..... | 200 | 3 | 660 | | |
| 1/2-inch wire rope..... | 1..... | | 24" dia x 19"..... | 360 | 5 | 200 | | |
| Battery container cover..... | 2..... | | 28" dia x 23"..... | 113 | 14 | 360 | | |
| Dry cell battery..... | 4..... | CGD 19026..... | 17 1/2" x 17 1/2" x 36 1/2"..... | 440 | 8 | 133 | | |
| | | | | | | 495 | | |



JR CABLE-CONNECTED HYDROPHONE EQUIPMENT

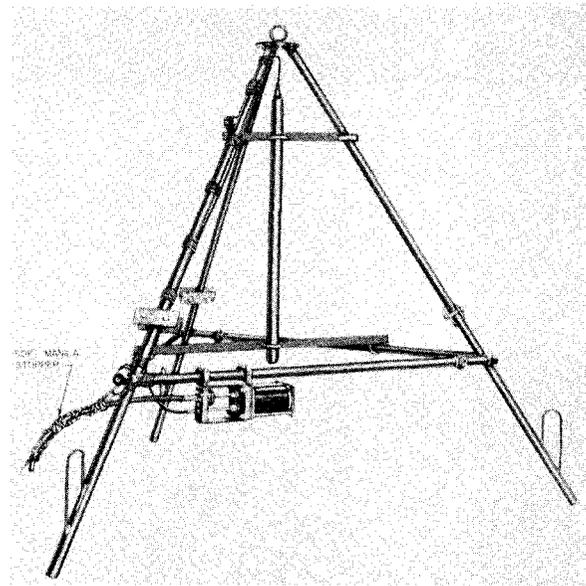
Use.—Shore.

Description.—The JR equipment provides a means of transmitting subaqueous ship noises picked up by tripod mounted type CBD-51038 hydrophones to shore over cable conductors where they are amplified by a high gain audio amplifier, so that the original sounds can be made audible by a set of headphones.

Two types of submarine cable are furnished when more than six hydrophones are used in one line. One is type 107PT, 16 conductor armored cable, which is used between the shore terminal location and the next to the last off-shore hydrophone. This cable is made up of 12 No. 16 B & S gauge stranded conductors (4 copper and 3 steel strands) and 4 No. 14 B & S stranded copper conductors. The other is Type 109P, 4 conductor armored cable, consisting of 4 No. 14 B & S gauge stranded copper conductors, and is used as laterals between the individual hydrophones and the main cable, type 107PT. Type 108P, armored cable was furnished in the past for use as laterals and is the same as type 109P cable except for the armor wire. Type 108P cable has No. 14 BWG armor wire and type 109P cable has No. 12 BWG armor wire.

On installations of six hydrophones or less, type 109P cable is used between the shore terminal location and the hydrophones, with one cable providing circuits for two hydrophones. At certain locations, conditions may make it more economical to use 107PT cable with 109P cable as laterals for installations of five or six hydrophones in one line.

The hydrophones are mounted on tripods and connections to the submarine cable are made in a junction box mounted on the tripod. On installations using 107PT cable each junction box contains a double pole d. c. relay for connecting and disconnecting the



Model JR cable-connected hydrophone equipment—sea unit tripod assembly.

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hydrophones from the line. In addition to the relay each box contains an attenuation pad connected in the program pair on the hydrophone side of the relay contacts to bring the signals from all hydrophones to approximately the same level at the input of the amplifier. The values of the pads vary with the distance from the shore terminal location. The two off-shore junction boxes each contain a terminating network connected across the program pair on the shore side of the relay contacts. Attenuation pads are not installed in these boxes.

Installations having two hydrophones connected to shore by one type 109P cable have the relays, for opening and closing the circuits to the hydrophones, located in a cable terminal cabinet at the shore station.

The 12 No. 16 gauge conductors of the 107PT cable are in the outer lay and are used for controlling the relays located in the tripod junction boxes, frequently referred to as sea relays. The 4 No. 14 gauge conductors in the core of the cable are laid spirally and are shielded from the control conductors with a tinned copper tape. These conductors are used for transmitting the signals, transduced by the hydrophones, to the shore station. One pair connects to the odd numbered hydrophones and the other pair to the even-numbered hydrophones. The hydrophones are numbered from the shore end to the off-shore end.

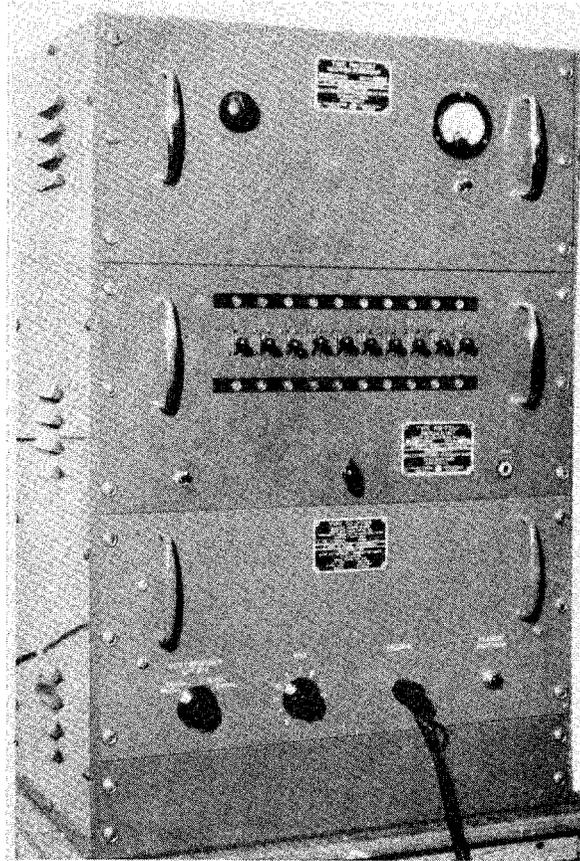
The shore terminal equipment consists of type RW-62075 or type RW-62076 terminal cabinet, type RW-10161 mounting rack, type RW-20187 rectifier power unit, type RW-23340 or type RW-23393 automatic-switching unit, type CDI-50123 audio amplifier and type CDI-20186 rectifier power unit. Types RW-23340 and RW-23393 auto-manual switching units are interchangeable, the difference between the two being, type RW-23340 has a 2 r. p. m. timing motor and type RW-23393 has a 1 r. p. m. motor with the necessary changes in cams operating the timing contacts.

Type RW-62075 terminal cabinet is used for terminating type 107PT, 16 conductor submarine cable and type RW-62076 cabinet is used for terminating as many as three type 109P, 4 conductor cables. The terminal cabinets provide an easily accessible place to test the cable conductors or open the sea circuits for testing the shore terminal equipment.

Type RW-10161 mounting rack is designed for table mounting and accommodates the type RW-20187 rectifier power unit, type RW-23340 or RW-23393 auto-manual switching unit and type CDI-50123 audio amplifier. Type CDI-20186 rectifier power unit is housed in a separate cabinet to reduce the coupling between this unit and the high gain Type CDI-50123 amplifier.

Type RW-20187 rectifier power unit is of chassis and panel construction. All transformers, reactors, capacitors, and rectifier tubes are mounted on top of the chassis, with wiring and small parts underneath. The chassis is fastened to the panel by means of two brackets, and a milliammeter and voltage control knob are accessible from the front of the unit. Current in the sea relay circuit is indicated on the milliammeter and the voltage control knob regulates this current. The

fuses are accessible from the bottom of the chassis. The unit is fastened to type RW-10161 mounting rack by means of six screws through the panel. An eight-conductor cable connects the rectifier unit to the switching unit. This cable which enters at the rear of the rectifier chassis serves the purpose of supplying the rectifier with 115 volts a. c. power, and of making the three output voltages of this unit available for use in the switching unit. The three separate output circuits of the rectifier are: one supplying 115 volts of filtered d. c. for operation of the switching unit relays, one supplying two-stage filtered d. c. current for oper-



Model JR cable-connected hydrophone equipment—shore gear (amplifier power unit not shown).

ation of the sea relays and one supplying 6 volts a. c. for operating the indicator lamps on the panel of the switching unit.

Twenty hydrophones have been established as a maximum for one line of hydrophones. Type RW-23340 or type RW-23393 auto-manual switching units were designed to permit the automatic scanning of a line of 20 hydrophones or less, each one in succession, and the time interval each hydrophone is connected to the "program pair" may be selected from several values, which are 2, 3, 5, 7½, and 10 seconds. Automatic operation may be cut out at any time by manually operating one of the keys provided for that purpose.

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Type RW-23340 or type RW-23393 switching units are of chassis and panel construction, and are designed to mount in the type RW-10161 mounting rack. The front panel has a power switch, a headphone jack, 10 3-position key switches, 20 indicator lamps, and a 5-position timing switch. Receptacles for the interconnection of the unit to the type RW-20187 power rectifier unit, the terminal cabinet, and the audio amplifier are mounted at the rear of the chassis, and a receptacle for the 115 volt a. c. power cord is also provided on this unit. A 25-position, 3-bank- automatic rotary selector switch, and a contact strip are mounted on the top of the chassis, while four relays, a timing mechanism, and various small parts are mounted below the chassis. The selector switch magnet and rotary arms are accessible from beneath the chassis as is the 4-ampere power fuse.

The type CDI-20186 rectifier power unit is an adjustable voltage-regulated source of direct current especially designed to supply the power required for operation of the type CDI-50123 audio amplifier from a 115-volt a. c. source. It is of chassis and panel construction. All transformers, capacitors, and vacuum tubes are mounted on top of the chassis, with wiring and small parts underneath. The chassis is fastened to the panel by means of two brackets and the power switch, indicator light and fuse receptacle are accessible from the front. The unit is held in its cabinet by means of screws through the panel into the cabinet. The vacuum tubes and the voltage adjustment are accessible through a door in the top of the cabinet.

The type CDI-50123 audio amplifier is a high gain, low level amplifier, with variable frequency response and several output impedances. It is of chassis and panel construction. All transformers, chokes, and vacuum tubes are mounted on top of the chassis, with wiring, resistors, capacitors, etc., underneath. The chassis is fastened to the panel by means of two brackets, and the gain control, filter network switch, headphone jack, and indicator lamp are accessible from the front. The filter switch controls an adjustable high-pass filter network which is inserted between the second and third stages of the amplifier. The switch has four positions, namely, "None," "600," "1200," and "2400" that indicate the four different values at which the cut-off may be made to occur. The front panel is provided with handles to facilitate the removal of the unit from its mounting. The front panel also has six slotted holes, to permit the equipment to be mounted in the type RW-10161 mounting rack or a cabinet. Input, power supply, and output receptacles are mounted at the rear of the chassis, and are labeled accordingly.

TECHNICAL FEATURES

Type RW-20187 Rectifier Power Unit

Input voltage, 90-115 volts/1/60.

Input power, 76 watts at 115 volts a. c.

Output voltage (section (a)), 105-115 volts d. c.

Output voltage (section (b)), adjustable. For a load of 1,250-ohms, voltage can be varied from 33 to 80 volts.

Output voltage (section (c)), 5.8 volts a. c.

Output current (section (a)), 73 ma. continuous—218 ma., intermittent.

Output current (section (b)), adjustable. For a load of 1,250-ohms, the current can be varied from 22 to 60 ma.

Output current (section (c)), 1 amp., continuous.

Output voltages and currents based on an input of 115 volts a. c.

Type CDI-20186 Rectifier Power Unit

Input voltage, 105-130 volts/1/60.

Input power, 1.1 amperes-130 watts at 115 volts a. c.

Output voltage, adjustable from 170 volts to 230 volts d. c. (Designed for use at 200 volts d. c.)

Output current, 180 ma. continuous—350 ma., intermittent.

Voltage regulation, less than 1 percent variation in output voltage with input voltage variations from 105-130 volts a. c. or load variations from 50 percent to 200 percent of normal.

Ripple content, less than 1 percent at rated input and load.

Power required for operation: 115/1/60—210 watts.

Tube complement

| Equipment | Number of tubes | Type |
|--|-----------------|----------|
| Type RW-20187 rectifier power unit..... | 2 | 83 |
| Type CDI-20186 rectifier power unit..... | 1 | 5U4G |
| | 2 | 6B4G |
| | 1 | 6X5G |
| | 1 | 6SJ7 |
| | 1 | VR150-30 |
| Type CDI-50123 audio amplifier..... | 4 | 12SJ7 |
| | 1 | 12A6 |

Shipping weights and dimensions

| Unit | Size | Gross weight | Cubic feet | |
|--------|---|----------------------|----------------------|-----|
| Case 1 | Terminal cabinet, mounting rack, auto-manual sw. unit, rectifier power unit, spare parts and accessories. | <i>Inches</i> (1) | <i>Pounds</i> 329 | 14 |
| Case 2 | Audio amplifier..... | 13 x 18 x 27.5 | ----- | 3.7 |
| Case 3 | Rectifier power unit CDI-20186..... | 13 x 18 x 27.5 | ----- | 3.7 |
| Case 4 | Spare parts for amplifier and rectifier CDI-20186..... | 11.5 x 15 x 24 | ----- | 2.5 |
| | Gross weight and volume, cases 2, 3, and 4..... | ----- | 280 | 9.9 |

¹ Not available.

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OBB CABLE DETECTING EQUIPMENT

Use.—General service.

Frequency.—230 cycles.

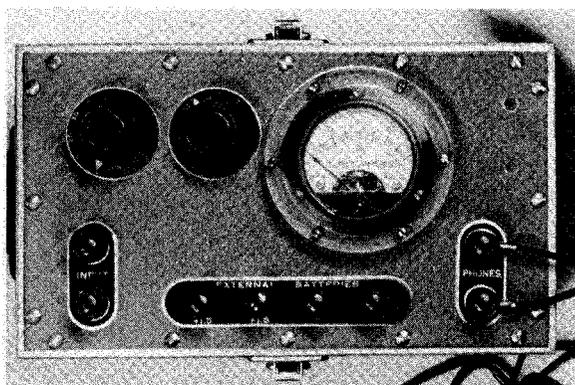
Description.—The equipment was designed for locating submarine cables from a boat or ship and consists of two units, an audio oscillator, type CZH-35034 and an audio amplifier, type CZH-50152. The oscillator is a source of alternating current and is stationed at one end of the cable to impress a signal upon it, which establishes electric and magnetic fields around the cable. The amplifier is a sensitive indicator of alternating current, and with a detector attached, it is conveyed over the region of the cable. The intensity of the signal received is indicated by means of an output meter and a pair of headphones. The proximity of the radiating cable is recognized by the increasing signal intensity as it is approached. Directly over the cable, the signal is a maximum, which reveals its location.

All the necessary equipment is furnished except a 6-volt storage battery for supplying power to the oscillator, and the detector, a device connected to the

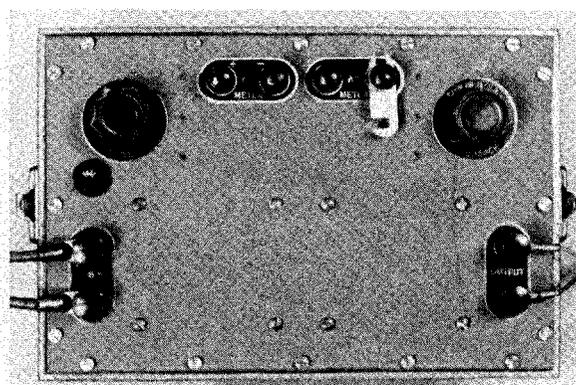
position rotary power switch is placed in the ON position. The output frequency of the oscillator then is 230 cycles per second, automatically keyed two times per second to aid in identifying the signal in the presence of interference. When a steady signal is preferable, this can be obtained by switching to the TEST position.

The secondaries of the two vibrator output transformers are tapped and connected to the rotary three position impedance range switch so that all or part of the windings may be used to match, approximately, loads of different magnitudes.

The amplifier is contained in a small metal box with a leather handle at the top and snap fasteners on the lid. It is equipped with a canvas strap so that it may be suspended from the shoulder of the operator. Under the lid, space is provided for stowing the headphones. Two binding posts are provided on the panel for connecting the phones, two for connecting the detector input leads, and four binding posts for con-



Model OBB cable detecting equipment—audio amplifier.



Model OBB cable detecting equipment—audio oscillator.

input of the amplifier which picks up the signal from the radiating cable.

The oscillator is contained in a small metal box with a leather handle at the top and snap fasteners on the lid. Under the lid, space is provided for stowing the input and output leads, which are attached to four binding posts on the panel. There are four additional binding posts for connecting external meters in case measurements are desired. Two control knobs are provided. One controls the power switch; the other the impedance range switch. A fuse holder also is mounted on the panel so that the fuse may be replaced without opening the case. All circuit components are attached to the panel or chassis. The entire assembly may be removed from the case after extracting the rim screws. The case is completely waterproofed by means of a gasket under the panel, packing glands on the control shafts, and washers on the fuse holder. The vibrator is a plug-in type and may be readily replaced.

Most cable-locating operations will be conducted with a keyed signal, which is emitted when the three

connecting external batteries, if required. There are two control knobs. One controls the battery switch and the other the amplification. The remaining item on the panel is the output meter, which is protected by a plastic cover. The case is completely waterproofed by means of gaskets under the panel and the meter cover, and packing glands on the control shafts. All circuit components are attached to the panel and chassis, which may be removed from the case by extracting the rim screws. The sub-panel, upon which the tubes are mounted, is provided with a rubber cushion support to minimize microphonic disturbances. The batteries are mounted on a separate bakelite panel and are readily removable.

Two 1.5-volt and one 67.5-volt dry cells that fit in the amplifier are provided with the equipment. When fresh, the operating life of the 1.5-volt batteries is about 8 hours to a voltage of 1.1. The operating life of a fresh 67.5-volt battery is about 70 hours to a voltage of 50.

The battery switch has three positions. In the ON

position, the internal batteries are connected, and in the EXT position, the external batteries are connected. External batteries are required only when replacement batteries of the proper physical dimensions cannot be obtained.

The detector may take the form either of a pair of electrodes or of a coil, depending upon the purpose for which it is to be used.

An electrode detector consists of a pair of elements for making connection between the water and the input terminals of the amplifier. It is prepared from two lengths of insulated wire (10 to 100 feet), which are then suspended from the exploring boat or ship. Approximately 2 feet of insulation is removed from one end of each wire to serve as an electrode.

A coil detector may consist of insulated wire arranged in a loop of any convenient diameter. One turn may be sufficient although additional turns may be used to obtain greater signal strength.

Many other uses of the equipment will probably occur to those who are working with submarine cables.

It may be used to locate the old cable positions so that new cable can be laid in the clear.

In harbors where heavy fog is often encountered, a pilot cable can be laid for the convenience of any traffic that might require it.

TECHNICAL FEATURES

Oscillator characteristics

- Supply voltage, 6 volts d. c.
- Supply power, 45 watts, maximum (7.5 amps.).
- Output voltages:
 - 150 volts, maximum, at 1,500-ohm resistive load.

- 60 volts, maximum at 220-ohm resistive load.
- 16 volts, maximum, at 15-ohm resistive load.
- Output currents:
 - 1.10 amps., maximum at 15-ohm resistive load.
 - 0.27 amp., maximum, at 220-ohm resistive load.
 - 0.10 amp., maximum, at 1,500-ohm resistive load.
- Output power, 20-volt amperes, maximum.
- Output frequency, 230 ± 14 cycles per second, keyed $2 \pm \frac{1}{2}$ times per second (or for testing purposes, unkeyed).

Amplifier characteristics

Supply:

- 1.5 volts d. c. at 100 ma. for first two filaments.
- 1.5 volts d. c. at 100 ma. for second two filaments.
- 67.5 volts d. c. at 2 ma. for plates and screens.

Input impedance (external), 10-ohm, adopted as minimum probable value.

Output impedance (external), 125 ohms, actual impedance of type 49016 phones at 230 cycles.

Maximum power gain, 80 decibels or more at 230 cycles with 10-ohm input and 125-ohm output loads.

Frequency response, peaked near 230 cycles per sec.

Tubes, 4 Type 1S5.

Weights, dimensions, and Navy type numbers

| Unit | Type No. | Height | Width | Depth | Weight |
|--------------------------------------|-----------|-----------------|------------------|------------------|---------------|
| | | <i>Inches</i> | <i>Inches</i> | <i>Inches</i> | <i>Pounds</i> |
| Oscillator | CZH-35034 | 7 $\frac{5}{8}$ | 11 | 7 | 21 |
| Amplifier | CZH-50152 | 7 $\frac{5}{8}$ | 10 $\frac{1}{2}$ | 6 $\frac{3}{4}$ | 12 |
| Spare parts | | 6 $\frac{1}{2}$ | 13 $\frac{1}{4}$ | 10 $\frac{3}{8}$ | 26 |
| Equipment packed for ocean shipment. | | 15 | 18 $\frac{1}{4}$ | 16 $\frac{1}{4}$ | 95 |

CONFIDENTIAL

MODELS OS, OS-1, OS-2, OS-3, AND OS-5 RECORDING FLUXMETER EQUIPMENTS

Use.—To detect and record the presence of a submarine or surface vessel entering a harbor area.

Description.—The Model OS recording fluxmeter equipment is employed to detect the presence of a surface or submerged vessel entering a harbor area.

This equipment is used in conjunction with a grid or loop of submarine cable placed on the floor of the ocean. The grid or loop usually consists of twin parallelograms, side by side having a common middle leg. The average width of the parallelograms is 600 yards, and the length may be up to 3 miles, depending on local conditions. The maximum depth for effective operation is limited to approximately 300 feet. In most cases more than one loop is required to protect a harbor area. A three conductor tail cable connects the two outer legs and the common middle leg of each loop with the fluxmeter equipment on shore.

As a vessel moves across the surface of the earth, the lines of force of the earth's magnetic field at that particular location are concentrated in the metal parts of the vessel. When a vessel passes over a magnetic detection loop, these lines of force sweeping across the conductors induce a voltage therein. This induced voltage deflects the galvanometer of the fluxmeter, which in turn, through a photo-electric system, causes the recorder pen to move across a chart producing a signature.

The fluxmeter equipment consists of the following three units:

- (a) Resistance balance box.
- (b) Fluxmeter.
- (c) Recorder.

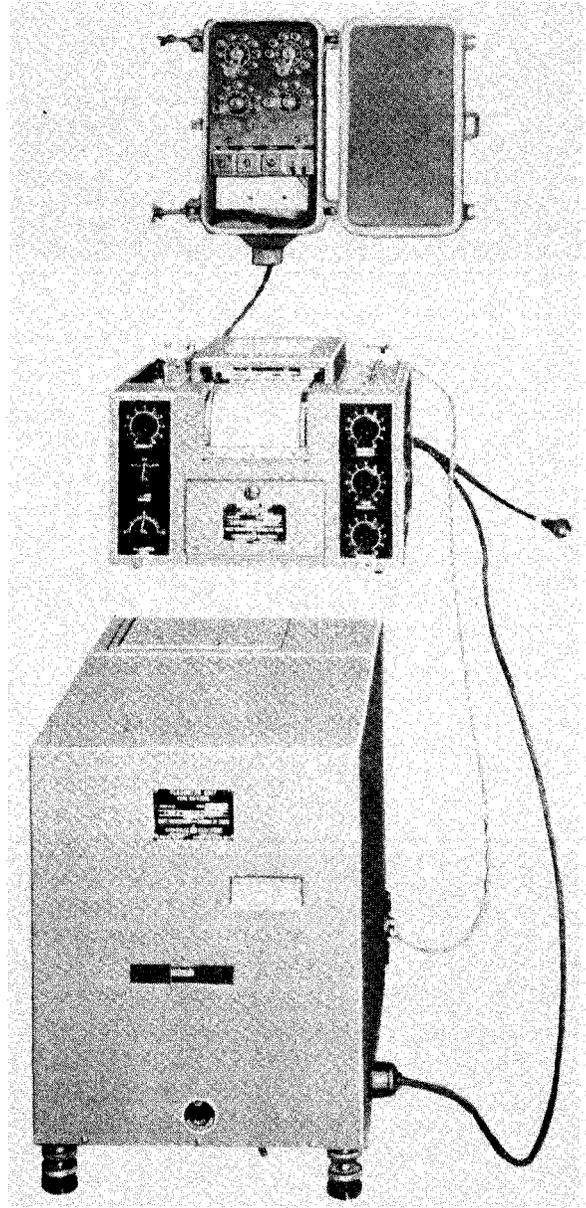
Resistance balance box.—The resistance balance box contains three sets of tapped resistance coils in series, approximating 70 ohms, as balance resistors and one separate set of tapped resistor coils of approximately 200 ohms for the fluxmeter shunt. The taps from each set of coils are terminated on a dial to facilitate adjustment. In addition, the balance box contains a loop fuse holder and a loop fuse.

The balance resistors are inserted in series with either of the outer legs of the loop in order to electrically balance the area of one "parallelogram" against the other. The fluxmeter shunt limits the voltage input from the loop.

Fluxmeter.—The fluxmeter unit contains the galvanometer with compensation coil, follow-up coil and scale, optical system, photo-electric system, compensation control, line voltage adjustment, amplifier and power supply.

A light beam from a primary source, focused on the galvanometer mirror, is reflected to a mirror on a second moving element known as a follow-up coil. From the mirror on the follow-up coil, the light beam is reflected to the dividing edge mirrors. These mirrors reflect the light beam equally on two phototubes. These phototubes comprise the variable elements of a bridge circuit. In case there is an extreme deflection of the

galvanometer, the light beam is prevented from moving off the phototubes by means of several auxiliary mirrors that reflect the light beam back to the tubes. The galvanometer coil, follow-up coil and recorder



Model OS recording fluxmeter equipment.

coil are electrically locked in synchronism. The follow-up coil carries a scale that indicates the amount of deflection. A secondary light source, focused on the galvanometer mirror, is reflected on a scale in the front of the fluxmeter. This provides a means for checking

OS
OS-1
OS-2
OS-3
OS-5

CONFIDENTIAL

the level of the fluxmeter and may be used in an emergency as a visual indication of a signature in case the recorder becomes inoperative. In order to compensate for the tendency of the galvanometer coil to rapidly return to zero, due to the torque exerted by the suspension, a voltage is fed in the proper direction through the compensation coil wound on the same frame with the galvanometer coil. Although it is possible to entirely neutralize the torque exerted by the suspension, a slight degree of under compensation is desirable to allow the coil to slowly drift back to zero. In the balanced state, this allows the recorder pen to move down the center of the chart.

The recorder unit.—The recorder unit contains a moving coil carrying a siphon pen, slow and high speed chart motors, fast chart and centering relays, step-up transformer, ink well, dry cell battery for injected voltage, various resistors, condensers and most of the control switches and potentiometers for the entire system.

Since the galvanometer coil, follow-up coil and recorder coil are electrically locked in synchronism, deflection of the galvanometer coil causes a deflection of the recorder coil. The attached pen then records the deflection on the chart paper.

As a measure of economy when no signatures are being recorded, the Chart Paper moves at a speed of one inch per hour. However, when a signature is being recorded, the paper moves at the rate of one inch per minute. This is accomplished on the initial deflection by the pen striking a set of contacts, tripping the high speed relay and energizing the high speed motor. When the signature is terminated, slow speed operation is restored by a manual reset.

In order to limit the deflection of the pen a recentering contact is placed at each of the outer edges of the chart paper. When the pen strikes these contacts, it trips the recentering relay, energizes the timing motor and the pen is returned to center position on the chart paper.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|---------------------------|-----------------|---|
| Beam power amplifier..... | 1 | 7C5 |
| Detector amplifier..... | 1 | 7C7 |
| Full wave rectifier..... | 2 | 7Y4 |
| Phototube, gas..... | 2 | { Mfr. No. PJ-23 Navy type No. 1P-23 |

Power required.—115/1/60—100 watts.

Weights, dimensions, and Navy type numbers

| Unit | Type No. | Width | Depth | Height | Weight |
|-------------------------------|-----------|------------------|------------------|---------------------------------|--------|
| | | Inches | Inches | Inches | |
| <i>Model OS</i> | | | | | |
| Fluxmeter shunt..... | CG-631076 | 16 $\frac{3}{8}$ | 6 $\frac{1}{2}$ | 11 $\frac{1}{2}$ $\frac{1}{16}$ | --- |
| Resistance balance box.. | CG-631066 | 8 | 6 $\frac{1}{2}$ | 13 $\frac{3}{8}$ | --- |
| Fluxmeter..... | CG-74025 | 11 $\frac{3}{4}$ | 17 $\frac{1}{8}$ | 16 | 85 |
| Recorder..... | CG-22349 | 13 $\frac{1}{4}$ | 13 $\frac{1}{8}$ | 9 $\frac{1}{16}$ | 39 |
| <i>Model OS-1</i> | | | | | |
| Resistance balance box.. | CG-631077 | 8 | 6 $\frac{1}{2}$ | 13 $\frac{3}{8}$ | 25 |
| Fluxmeter..... | CG-74025 | 11 $\frac{3}{4}$ | 17 $\frac{1}{8}$ | 16 | 85 |
| Recorder unit..... | CG-22357 | 13 $\frac{1}{4}$ | 13 $\frac{1}{8}$ | 9 $\frac{1}{16}$ | 39 |
| <i>Model OS-2, OS-3, OS-5</i> | | | | | |
| Resistance balance box.. | CG-631077 | 8 | 6 $\frac{1}{2}$ | 13 $\frac{3}{8}$ | 25 |
| Fluxmeter..... | CG-74026 | 11 $\frac{3}{4}$ | 17 $\frac{1}{8}$ | 16 | 85 |
| Recorder..... | CG-22357 | 13 $\frac{1}{4}$ | 13 $\frac{1}{8}$ | 9 $\frac{1}{16}$ | 39 |

CONFIDENTIAL

HARBOR ECHO RANGING AND LISTENING DEVICES (HERALDS)

General description.—Herald equipments are designed for installation at the entrance to harbors and bays to provide a means of searching a sector of the waters for submerged submarines. This is accomplished by means of supersonic (above audibility) sound waves projected into the water, which, when impinging upon any submerged object cause a portion of their energy to be reflected in the manner of an ordinary echo. These sound waves are projected, and in turn received, by means of a projector located in a structure known as a sea unit, which has been designed to be located on the sea bottom at a depth not exceeding 300 feet and at a distance up to 5 nautical miles from the associated shore station. The signal-producing, signal-receiving, and indicating equipment and the remote training control are located at the shore station and are connected to the sea unit by means of submarine cables.

Basically, the transmitting channel consists of an oscillator producing a signal of the desired frequency, an amplifier and a driver to raise the power of the signal to the proper level, the submarine cable to transmit the energy to the sea unit and the projector which emits the underwater supersonic beam.

The receiving channel consists of the same projector in the sea unit acting as a sensitive microphone to "pick up" the reflected echo, the same submarine cable which transmits the received signal to the shore station, and the receiver which amplifies the signal to the

required level to actuate a loudspeaker and an indicator which is calibrated in yards and provides a visual means of determining the distance to the object producing the echo.

Since the underwater supersonic beam pattern has unidirectional properties, a means for rotating the beam from shore is provided. A bearing indicating device ashore shows the direction in which the projector in the sea unit is trained.

In addition to locating submerged objects the system may be used as a listening device for noises created by propellers.

The system is automatically keyed. Transmission consists of a series of sound wave impulses whose duration and interval are timed by a mechanical device. However, provision is made for manual keying by means of a hand key.

Two types of submarine cable, the signal cable and the control cable, are provided for each Herald installation. The Type 114 or 114P cable is an armored submarine cable containing a No. 8 AWG coaxial cable. This cable transmits the supersonic energy from the shore station to the sea unit and the received signal from the sea unit to the shore station. The 115 or 115P cable is an armored submarine cable containing 10 No. 14 AWG conductors. These conductors link the projector training control, projector bearing indicator and tilt alarm elements at the shore station with the corresponding equipment in the sea unit.

★ ★ ★

QBC-1 HERALD

Use.—To detect, locate and track submarines entering a harbor area.

Frequency range.—10 to 50 kc.

Description.—(See general description under "Harbor Echo Ranging and Listening Devices.")

The sea unit consists essentially of a supersonic projector to convert electrical energy into acoustical energy, an acoustic mirror to direct the underwater sound beam, a motor reduction gear to train the mirror with its shaft and attached potentiometer arms, a mechanism chamber or "bell," partially open at the bottom, to house the mechanism, a nitrogen gas system to maintain the gas in the mechanism chamber at the pressure of the surrounding water, and a level indicator to signal the shore station when the structure is tilted more than 11 degrees from the vertical. The entire inner assembly is hung on heavy gimbals. The supporting outer structure is streamlined in order to produce minimum disturbance when submerged in a tideway.

When the projector is energized over the submarine cable (the signal cable) from shore, the sound beam impinges on the acoustic mirror which is tilted at 45 degrees on its vertical shaft. The mirror reflects the

sound beam horizontally, at right angles to the shaft.

The returning echo impinges on the sound mirror, is reflected to the projector which converts the acoustical energy into electrical energy, "the signal." The signal is transmitted to shore (over the same signal cable which transmitted the pulse), amplified and utilized as indicated below under "shore gear."

The speed and direction of mirror rotation is controlled by means of a d. c. motor and associated reduction gear in the sea unit. This motor is controlled from the shore station over the submarine cable known as the control cable.

The sea unit potentiometers, one in use, one spare, the rotating arms of which are coupled to the mirror shaft, are linked to shore by means of the control cable to indicate the bearing in which the mirror is trained.

The sea unit tilt device grounds a lead in the control cable (and sounds an alarm at the shore station) when the sea unit is tilted in excess of 11 degrees.

The shore gear consists of the driver, which supplies 350 watts, 10 to 50 kc., to the signal cable; the receiver indicator, which receives, amplifies, and detects the incoming signal and provides audio amplification to operate the speaker, headphones, and the range indi-

ator; the training control unit which controls the speed and direction of the sea unit mirror rotation and indicates the bearing in which this mirror is trained; the power rectifier which provides the power for the training control circuits; the switching relay which connects the signal cable to the driver while pulsing the projector and to the receiver while receiving the echo signal; and the signal and control cable junction boxes which join the submarine cables to the shore equipment.

In addition to manual control of the direction and speed of rotation of the sound mirror, automatic sweep is provided which sweeps any given sector of the water area, from right to left and return, automatically and continuously.

This was the first model Herald developed when the H. D. program was initiated in 1941. Only a limited number of this model has been procured. Because of the large size and weight of the sea unit and the complexity of the shore gear, the QBC-1 heralds have not been distributed beyond the jurisdiction of the naval districts.

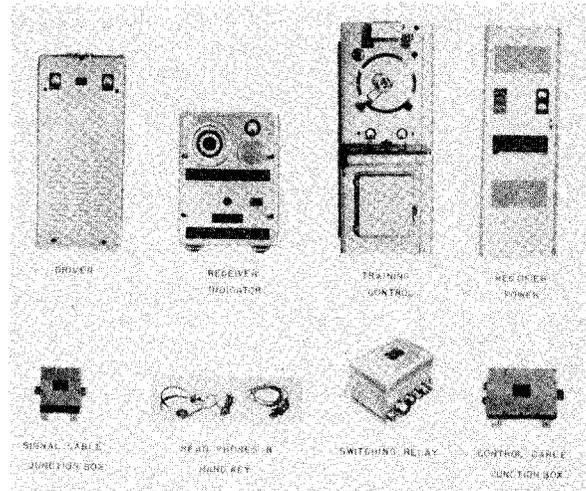
TECHNICAL FEATURES

Tube complement

| Location and circuit function | Number of tubes | Type |
|--|-----------------|-----------|
| Receiver-indicator: | | |
| R-F amplifier..... | 3 | 6SK7 |
| Mixer..... | 2 | 6SA7 |
| Oscillator..... | 2 | 6J5 |
| Audio amplifier..... | 1 | 6SQ7 |
| Do..... | 1 | 6SJ7 |
| Do..... | 3 | 6AG7 |
| Rectifier..... | 1 | 5U4G |
| Voltage regulator..... | 1 | VR-150-30 |
| Control rectifier power supply: | | |
| Rectifier..... | 2 | 5U4G |
| Regulator..... | 2 | 6B4G |
| Driver: | | |
| Power amplifier..... | 2 | 805 |
| Oscillator and modulator..... | 2 | 6J5 |
| Rectifier..... | 2 | 5U4G |
| Voltage regulator..... | 2 | VR-150-30 |
| Mixer..... | 1 | 6SA7 |
| R-F amplifier..... | 1 | 6AG7 |
| Do..... | 2 | 807 |
| Rectifier..... | 4 | 866 |
| Training control unit: | | |
| Thyratron..... | 2 | FG-27A |
| Rectifier..... | 1 | 8J |
| Amplifier..... | 1 | 24A |
| Do..... | 1 | 35 |
| Thyratron..... | 4 | KU-627 |
| Rectifier..... | 1 | 5Z3 |
| Total..... | 44 | |

| | |
|---|--|
| Total power requirements (115-volt, 60-cycle, a. c.) (kw.)..... | 2.7. |
| Projector (rochelle salt or magnetostriction)..... | R. S. 24" diameter. |
| Rotatable sound mirror or rotatable projector..... | Sound mirror—fixed projector. |
| Rated driver output power, watts..... | 350. |
| Driver frequency range..... | 10-50 kc. |
| Training..... | Speed of mirror-rotation variable-d.c. motor— manual control and automatic sweep. |

Type of bearing indicator... Thyratron.
Receiver..... Super het. 10-50 kc. (175
kc. IF).
Chemical range recorder... No.
Protection of receiver dur-
ing pulsing period..... Keying relay.

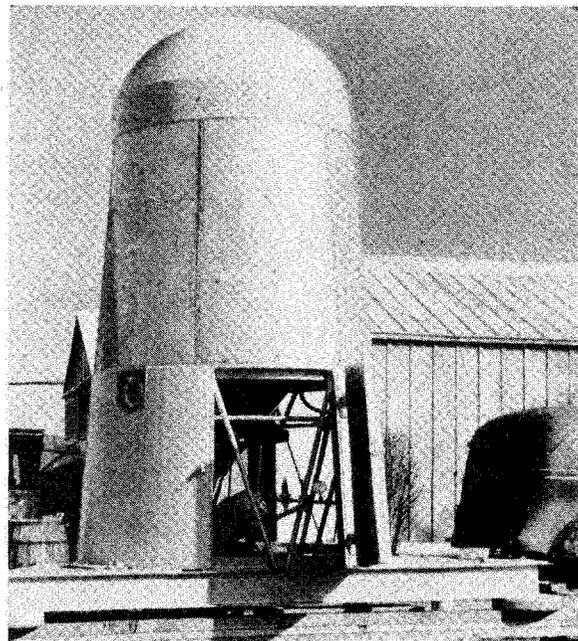


Model QBC-1 herald—shore gear.

Weights, dimensions, and Navy type numbers

| Unit | Type No. | Height | Width | Depth | Weight |
|------------------------------|-----------|--------|--------|--------|--------|
| | | Inches | Inches | Inches | |
| Sea unit..... | CWT-10180 | 178 | 192 | 192 | 8,300 |
| Receiver indicator..... | CPK-55110 | 31 | 22 | 15 | 190 |
| Training control unit..... | CWT-23353 | 70½ | 30½ | 34½ | 690 |
| Control rectifier power..... | CAT-20199 | 70 | 21 | 23½ | 555 |
| Driver..... | CPK-52292 | (1) | (1) | (1) | (1) |
| Switching relay..... | CPK-29207 | 7 | 11 | 9 | 17 |

¹ Included in control rectifier stack.



Model QBC-1 herald—sea unit.

CONFIDENTIAL

QBD HERALD

Use.—To detect, locate and track submarines entering a harbor area.

Frequency range.—10 to 50 kc.

Description.—(See general description under "Harbor Echo Ranging and Listening Devices.")

The Model QBD herald is similar in many ways to Model QBC-1. The principal differences are as follows:

The sea unit is much lighter; a tripod footing structure is used instead of the heavy, bulky exterior housing. No bearing indicating potentiometers are used in the sea unit. The training motor is of the "stepper" type having a permanent magnet rotor. No nitrogen gas system is needed because the mechanism housing of the QBD sea unit is oil-filled and has a rubber diaphragm which regulates the pressure so that the sea water pressure against the outside of this diaphragm is equal to the oil pressure on the inside of the diaphragm, i. e., in the interior of the mechanism housing. The sea unit has a mirror tilt mechanism which permits the raising and lowering of the mirror angle between the horizontal and 10° above the horizontal.

The QBD shore gear is more compact than the QBC-1 shore gear. Training control and power rectifiers are housed in one cabinet. In addition to training controls needed for rotating the sound beam at sea in a horizontal plane, the shore gear contains the elements necessary to raise or lower the sound beam in a vertical plane from the horizontal to 10° above the horizontal. The bearing in which the projector is trained is shown on a bearing indicator, the pointer of which is geared to the training control mechanism of the shore gear. In the event that the projector at sea should fall out of synchronism with the bearing indicator ashore a means for synchronizing these two elements is provided.

TECHNICAL FEATURES

Tube complement

| Location and circuit function | Number of tubes | Type |
|--|-----------------|-----------|
| Receiver-indicator: | | |
| R-F amplifier..... | 3 | 6SK7 |
| Mixer..... | 2 | 6SA7 |
| Oscillator..... | 2 | 6J5 |
| Audio amplifier..... | 1 | 6SQ7 |
| Do..... | 1 | 6SJ7 |
| Do..... | 3 | 6AG7 |
| Rectifier..... | 1 | 5U4G |
| Voltage regulator..... | 1 | VR-150-30 |
| Control rectifier power supply: | | |
| Rectifier..... | 2 | 5U4G |
| Regulator..... | 2 | 6B4G |
| Power output for motors..... | 4 | 6B4G |
| Regulator..... | 1 | 6SJ7 |
| Do..... | 1 | 6SQ7 |
| Voltage regulator..... | 1 | 991 |
| Driver: | | |
| Power amplifier..... | 2 | 805 |
| Oscillator and modulator..... | 2 | 6J5 |
| Rectifier..... | 2 | 5U4G |
| Voltage regulator..... | 2 | VR-150-30 |
| Mixer..... | 1 | 6SA7 |
| R-F amplifier..... | 1 | 6AG7 |
| Do..... | 2 | 807 |
| Rectifier..... | 4 | 866 |
| Training control unit: Selector rectifier..... | 1 | 25Z5 |
| Total..... | 43 | |

Total power requirements... 1.75 kw. (115-v., 60-cycle).

Projector (Rochelle Salt or magnetostriction)..... R. S. 18" diameter.

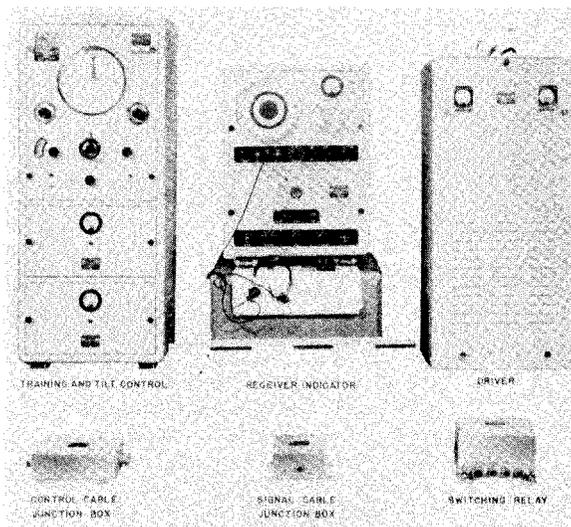
Rotatable projector or mirror..... Mirror.

Rated driver output power..... 350 watts.

Driver frequency range..... 10-50 kc.

Training..... Speed of mirror-rotation, variable stepper motor, manual control and automatic sweep.

Type of bearing indicator..... Mechanically geared.



Model QBD herald—shore gear.

Receiver..... Super Het. 10-50 kc. (175 kc. IF).

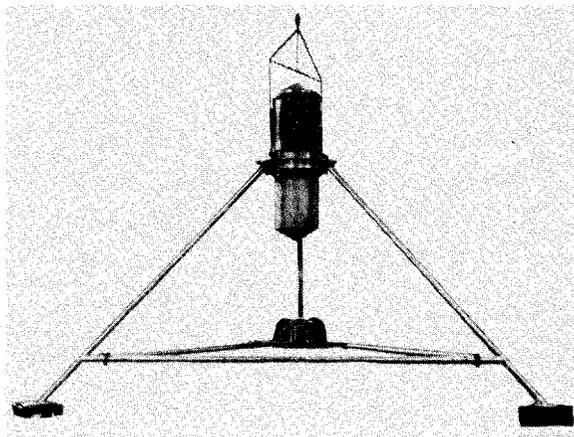
Chemical range recorder..... No.

Protection of receiver during pulsing period.....

..... Keying relay.

Weights, dimensions, and Navy type numbers

| Unit | Type No. | Height | Width | Depth | Weight |
|----------------------------------|-----------|--------|--------|--------|--------|
| | | Inches | Inches | Inches | |
| Sea unit..... | CWT-10181 | 188 | 198 | 198 | 3,500 |
| Receiver indicator..... | CPK-55110 | 31 | 22 | 16 | 190 |
| Training control unit..... | CWT-23354 | 55 | 22 | 17 | 120 |
| Control rectifier power (2)..... | CWT-20213 | 10½ | 18½ | 14 | 58 |
| Driver..... | CPK-52292 | 50 | 23 | 16 | 560 |
| Switching relay..... | CPK-29207 | 7 | 11 | 9 | 18 |



Model QBD herald—sea unit.

QCP HERALD

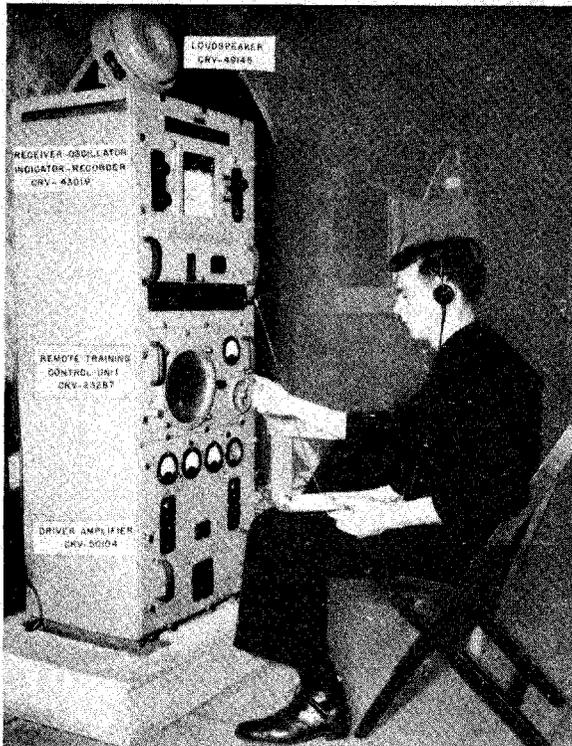
Use.—To detect, locate and track submarines entering a harbor area.

Frequency range.—17 to 27 kc.

Description.—(See general description under "Harbor Echo Ranging and Listening Devices.")

The operating principles of the QCP Herald are, in general, identical to those of the QBD Herald with the following exceptions:

The projector in the sea unit is of the magnetostriction type. No sound mirror is used in this model, instead, the projector is rotatable. The training motor in the sea unit is a 115-volt, 60-cycle, 0.36 ampere, 75



Model QCP herald—shore gear.

r. p. m., reversible unit. A potentiometer, the rotating arm of which is coupled to the rotatable projector shaft, provides means of bearing indication at the shore station.

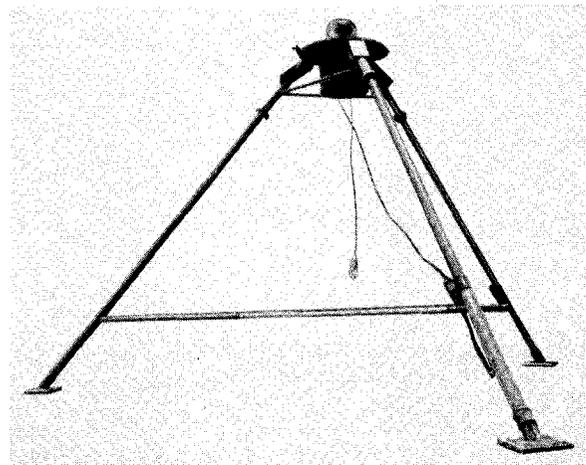
With the shore gear there is provided, in addition to the usual range indicator, a chemical range recorder, which makes a visual track of the target as far as the ranges are concerned. The bearing indicator is associated with the training control shaft. When the latter is turned the shore potentiometer, which with the sea potentiometer is connected in the manner of a Wheatstone bridge, unbalances the bridge circuit. The projector training motor will then rotate the projector

shaft until the sea unit potentiometer and its mate ashore have reestablished the bridge balance. No automatic sweep feature is provided with this gear.

TECHNICAL FEATURES

Tube complement

| Location and circuit function | Number of tubes | Type |
|--|-----------------|-----------|
| Receiver-indicator: | | |
| First R-F amplifier..... | 1 | 6AB7 |
| R-F limiter..... | 1 | 6H6 |
| Beat oscillator..... | 1 | 6J5 |
| Driver oscillator..... | 1 | 6J5 |
| Recorder amplifier..... | 1 | 6J5 |
| Sweep modulator..... | 1 | 6J5 |
| Audio output..... | 1 | 6K6GT |
| Recorder output..... | 1 | 6K6GT |
| Second R-F amplifier..... | 1 | 6SJ7 |
| Third R-F amplifier..... | 1 | 6SJ7 |
| R-F Driver..... | 1 | 6SJ7 |
| R-F Mixer and detector..... | 1 | 6SJ7 |
| Driver oscillator amplifier..... | 1 | 6SJ7 |
| Indicator output..... | 1 | 1635 |
| Driver oscillator output..... | 1 | 1635 |
| Rectifier..... | 1 | 5U4G |
| Voltage regulator..... | 1 | VR-150-30 |
| Driver amplifier: Power amplifiers and rectifiers..... | 8 | 811 |
| Remote training control unit: | | |
| Amplifier..... | 1 | 6N7 |
| Output amplifier..... | 2 | 6J5 |
| Rectifier..... | 1 | 6X5GT |
| Total..... | 29 | |



Model QCP herald—sea unit.

- Total power requirement (115-volt, 60-cycle, a. c.) (kw)..... 1.3.
- Projector (Rochelle Salt or magnetostriction)..... M.S. 9 inch diameter.
- Rotatable sound mirror or rotatable projector..... Rotatable projector.

CONFIDENTIAL

Rated driver output power, watts----- 400 watts.
 Driver frequency range---- 17-27 kc.
 Training----- Projector rotation speed constant—a. c. motor—balanced bridge—manual hand wheel control.
 Type of bearing indicator. Mechanically geared.
 Receiver----- Tuned R-F, 17-27 kc.
 Chemical range recorder-- Yes.
 Protection of receiver during pulsing period----- Limiter tube (no keying relay).

Weights, dimensions, and Navy type numbers

| Unit | Navy Type No. | Height | Width | Depth | Weight |
|--|---------------|--------|--------|--------|--------|
| | | Inches | Inches | Inches | Pounds |
| Sea unit----- | CRV-10099 | 144 | 288 | ----- | 1,500 |
| Shore station cabinet (with units in place) .. | CRV-50104 | 57½ | 21½ | 16 | 475 |
| Receiver-oscillator-indicator-recorder----- | CRV-43019 | 23¾ | 20½ | 15½ | 125 |
| Remote training control unit----- | CRV-23287 | 11¾ | 20½ | 15½ | 75 |
| Driver amplifier----- | CRV-50104 | 20½ | 20½ | 15½ | 135 |
| Relay junction box----- | CRV-62047 | 16¾ | 12 | 5 | 45 |
| Loudspeaker----- | CRV-49145 | 11¾ | 10 | 7½ | 23 |

¹ Diameter.



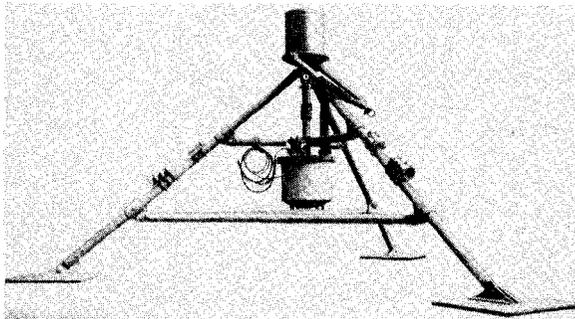
QCP-1 HERALD

Use.—To detect, locate and track submarines entering a harbor area.

Frequency.—16 to 30 kc.

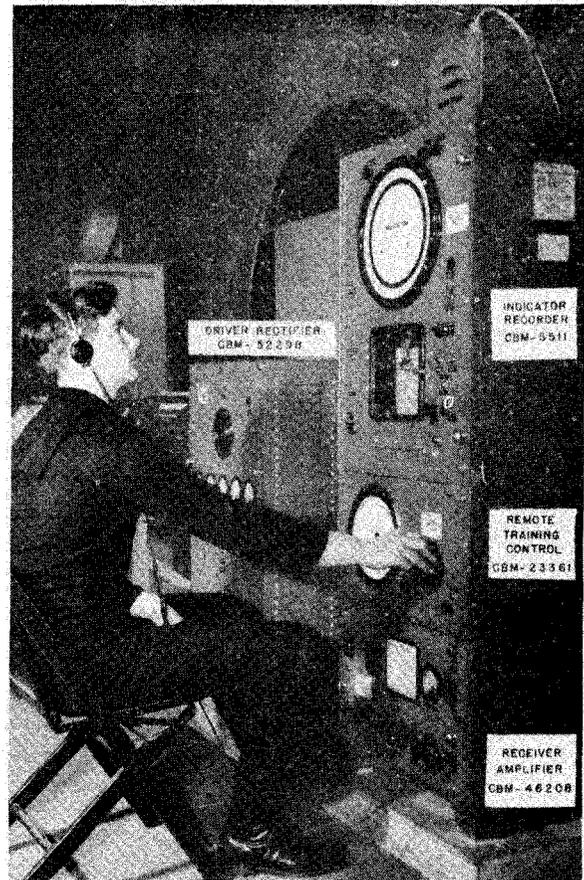
Description.—(See general description under “Harbor Echo Ranging and Listening Devices.”)

The sea unit of the Model QCP-1 Herald has a tripod footing structure which is somewhat sturdier than that of the tripod-type sea units of other model Heralds. The upper housing contains the rotatable mag-



Model QCP-1 herald—sea unit.

neto-striction projector, the lower housing contains the training mechanism. Both housings are oil-filled. An expansion tube serves to equalize the pressure of the surrounding sea water and of the oil within the housings. A rotatable shaft connects the lower training mechanism housing with the upper projector housing. A mercury level switch in the sea unit is provided to check the levelling of the tripod. If the tripod is displaced more than 10° from the vertical,



Model QCP-1 herald—shore gear.

an indicating lamp at the shore station will be illuminated.

The components of the shore gear are indicated in the accompanying illustration and under QCP-1 technical data given below. Like the shore gear of the QCP Herald the QCP-1 is equipped with a chemical range recorder. These two models of Heralds are the only equipments provided with the range recorders. The training control mechanism of the QCP-1 shore gear is of the a. c. type, bearing indication is effected by means of a selsyn system.

TECHNICAL FEATURES

Tube Complement

| Location and circuit function | Number of tubes | Type |
|---|-----------------|-------|
| Receiver-indicator: | | |
| First R-F amplifier..... | 1 | 6C6 |
| First I. F..... | 1 | 6D6 |
| Second I. F..... | 1 | 6D6 |
| Third I. F..... | 1 | 6D6 |
| First audio..... | 1 | 6C6 |
| Audio output..... | 1 | 41 |
| First red light..... | 1 | 76 |
| Red light output..... | 1 | 41 |
| Second oscillator..... | 1 | 76 |
| First oscillator..... | 1 | 76 |
| Input protector..... | 1 | 874 |
| Rectifier..... | 1 | 5Z3 |
| Chart amplifier..... | 1 | 6V6GT |
| Driver rectifier: | | |
| Oscillator, keying, amplifiers..... | 4 | 807 |
| Power amplifier..... | 4 | 838 |
| Rectifiers..... | 3 | 5Z3 |
| Remote training control unit: Rectifiers..... | 4 | 872A |
| Total..... | 28 | |

| | |
|--|--|
| Total power requirement (115-volt, 60-cycle, a. c.) (k. w.)..... | 2.5 |
| Projector (Rochelle Salt or magneto-striction)..... | M. S. 18-inch diameter. |
| Rotatable sound mirror or rotatable projector..... | Rotatable projector. |
| Rated driver output power, watts..... | 600 watts. |
| Driver frequency range..... | 16-30 kc. |
| Training..... | Projector rotation speed constant—a.c. mo.or— manual hand lever control. |
| Type of bearing indicator.. | Selsyn. |
| Receiver..... | Superheterodyne 13-37 kc. (60 kc IF). |
| Chemical range recorder... | Yes. |
| Protection of receiver during pulsing period..... | Keying relay. |

Weights, dimensions, and Navy type numbers

| Unit | Type No. | Height | Width | Depth | Weight |
|--|-----------|----------------------|------------------------|------------------------|------------------------|
| Sea unit..... | CBM-10200 | <i>Inches</i> 140 | <i>Inches</i> 1 288 | <i>Inches</i> ----- | <i>Pounds</i> 6,000 |
| Shore station cabinet (with units in place)..... | | 56 $\frac{3}{8}$ | 17 | 22 | 338 |
| Indicator recorder..... | CBM-55111 | 30 | 16 | 22 | 125 |
| Receiver amplifier..... | CBM-46208 | 14 $\frac{1}{4}$ | 16 $\frac{3}{8}$ | 22 | 143 |
| Driver rectifier..... | CBM-52298 | 42 $\frac{1}{16}$ | 15 | 22 | 425 |
| Remote training control unit..... | CBM-23361 | 12 $\frac{5}{8}$ | 17 | 22 | 70 |
| Loudspeaker..... | CBM-49225 | 8 $\frac{3}{4}$ | 5 $\frac{3}{8}$ | 11 $\frac{1}{4}$ | 12 |

¹ Diameter.

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QCW, QCX, QCY, AND QCZ HERALDS

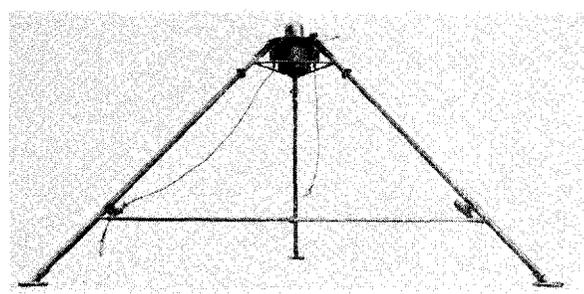
Use.—To detect, locate and track submarines entering a harbor area.

Frequency range:

- QCW, 21 kc.
- QCX, 23 kc.
- QCY, 25 kc.
- QCZ, 27 kc.

Description.—(See general description under "Harbor Echo Ranging and Listening Devices," and "Description of Model QCP Herald.")

The sea unit of these four models is identical to the Model QCP sea unit except that the projectors are tuned to the frequencies as indicated under "Frequency range" above.



Models QCW, QCX, QCY, and QCZ heralds—sea unit.

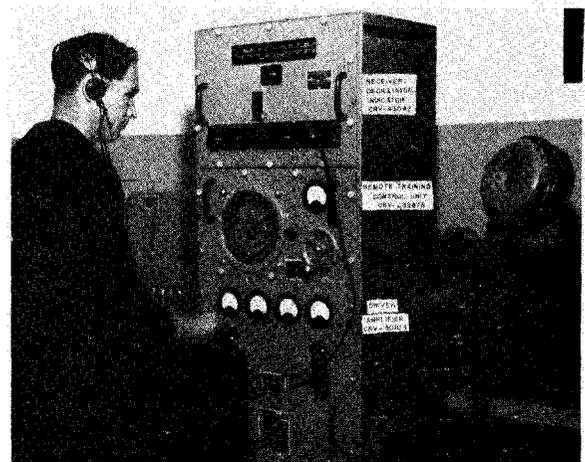
The shore equipments of these models are similar to the shore gear of the Model QCP Herald shore gear except that no chemical range recorder is provided.

TECHNICAL FEATURES

Tube complement

| Location and circuit function | Number of tubes | Type |
|---|-----------------|-----------|
| Receiver-indicator: | | |
| First R-F amplifier | 1 | 6AB7 |
| R-F limiter | 1 | 6H6 |
| Beat oscillator | 1 | 6J5 |
| Driver oscillator | 1 | 6J5 |
| Sweep modulator | 1 | 6J5 |
| Audio output | 1 | 6K6GT |
| Second R-F amplifier | 1 | 6SJ7 |
| Third R-F amplifier | 1 | 6SJ7 |
| R-F driver | 1 | 6SJ7 |
| R-F mixer and detector | 1 | 6SJ7 |
| Driver oscillator amplifier | 1 | 6SJ7 |
| Indicator output | 1 | 1635 |
| Driver oscillator output | 1 | 1635 |
| Rectifier | 1 | 5U4G |
| Voltage regulator | 1 | VR-150-30 |
| Driver amplifier: Power amplifiers and rectifiers | 8 | 811 |
| Remote training control unit: | | |
| Amplifier | 1 | 6N7 |
| Output amplifier | 2 | 6J5 |
| Rectifier | 1 | 6X5GT |
| Total | 27 | |

- Total power requirement (115-volts, 61-cycle, a.c.) (11w.)----- 1.3.
- Projector (Rochelle Salt or Magneto-striction) M. S. 9-inch diameter.
- Rotatable sound mirror or rotatable projector----- Rotatable projector.
- Rated driver output power, watts----- 400.
- Driver frequency range---- 17-27 kc.



Models QCW, QCX, QCY, and QCZ heralds—shore gear.

- Training----- Projector rotation speed constant a. c. motor—balanced bridge—manual hand wheel control.
- Type of bearing indicator-- Mechanically geared.
- Receiver----- Tuned RF 17-27 kc.
- Chemical range recorder--- No.
- Protection of receiver during pulsing period----- Limiter tube and TVG (no keying relay).

Weights, Dimensions, and Navy Type Numbers

| Unit | Navy type no. | Height | | Depth | Weight |
|---|---------------|---------|-----------|--------|--------|
| | | Inches | Inches | | |
| Sea unit | CRV-10099 | 144 | 1 288 | | 1,500 |
| Shore station cabinet (with units in place) | CRV-50104 | 49 1/16 | 21 1 3/16 | 16 | 430 |
| Receiver-oscillator-indicator | CRV-43042 | 14 3/4 | 20 1/2 | 15 1/2 | 100 |
| Remote training control unit | CRV-23287-A | 11 7/16 | 20 1/2 | 15 1/8 | 75 |
| Driver amplifier | CRV-50104 | 20 3/16 | 20 1/2 | 15 1/8 | 135 |
| Relay junction box | CRV-02047 | 16 3/4 | 12 | 5 | 45 |
| Loudspeaker | CRV-49145 | 11 9/16 | 10 | 7 1/2 | 23 |

¹ Diameter.

RBF-1 SONO RADIO BUOY RECEIVING EQUIPMENT

Use.—Underwater sound detection.—Shore.

Frequency.—70–90 mc.

Power Requirements.—105–120 volts, 50–60 cycles, 6.5–7.0 amps.

Description.—The Model RBF-1 equipment receives the frequency modulated signals radiated by Sono Radio Buoys anchored off-shore at a distance of not more than 12 to 15 miles from the receiving antenna. It consists of a high voltage rectifier unit, a low voltage rectifier unit, 10 radio receiver units, an audio amplifier, an automatic switching unit and an artificial ground plane type of antenna assembly. The equipment is rack mounted.

Each radio receiver unit is tuned to a different frequency corresponding to that of one of the Sono-Radio Buoys anchored off-shore. The automatic switching unit provides a means for scanning or monitoring each Sono Buoy Transmitter in a predetermined sequence. The switching unit connects the antenna and audio amplifier to the proper radio receiver. Each station is monitored for a predetermined length of time from 2 to 10 seconds by settings of the time interval switch on the front of the switching unit.

Manual selection of stations is accomplished by rotating the manual-automatic switch to manual and using the channel selector switch. These switches are mounted on the front of the automatic switching unit.

The radio receiver units are frequency modulation receivers. They employ 2 stages of tuned grid r-f. amplification, a detector mixer stage, a high frequency oscillator and 4 stages of I. F. One stage of I. F. acts as the first limiter, partially limiting any change in amplitude of signal. Another acts as the final limiter which then feeds into a frequency detector called the discriminator. The last stage is one of audio amplification and it terminates in a 60-ohm impedance and a 600-ohm impedance for transmission to the switching unit.

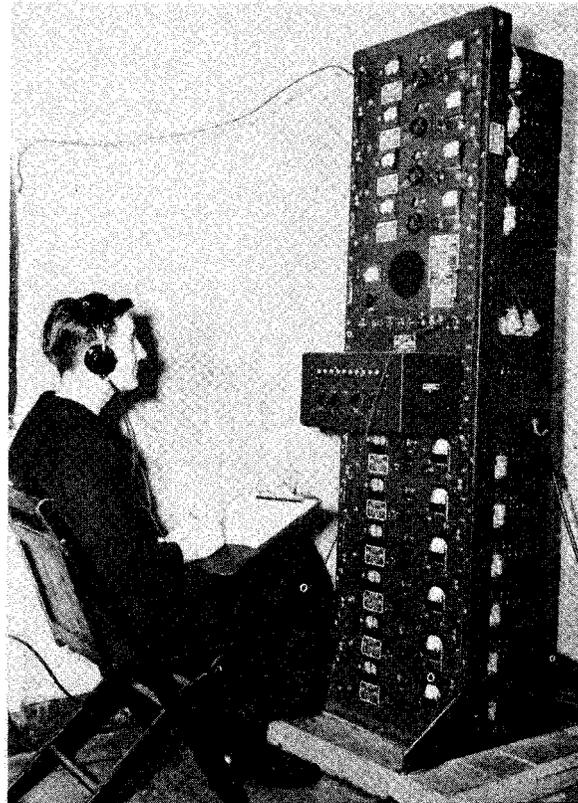
The audio amplifier and low voltage rectifier units mount on the same panel. This rectifier unit supplies voltage to the switching unit. The audio amplifier consists of two stages terminating in a 6-ohm output (for a permanent magnetic speaker on the audio amplifier panel) and a 60-ohm output (for low impedance head sets). A phone jack in a circuit that is capacity coupled to the plate circuit of the final audio stage provides for the use of high impedance phones.

A meter amplifier tube is coupled from the plate of the first audio amplifier tube to provide for determining the output level on an associated power level meter.

A fixed frequency oscillator circuit is incorporated in the unit. Its frequency of 17 kc. coupled to the input grid of the first audio stage will produce an audible signal when beating with supersonic signals that might be picked up by the Sono-Radio Buoy.

The high-voltage rectifier employs 2 identical rectifier units. Each unit has 2 tubes in parallel and has an output of 400 milliamperes at 270 volts.

The switching unit consists of an automatic magnetic stepping switch operating three banks of contacts actuated by a motor driven pulse timer. One bank



Model RBF-1 sono radio buoy receiving equipment.

operates the antenna relays and receiver indicator lights. The second bank switches the audio voltage, while the third operates the controlling circuit in the "automatic" position. The switching unit simultaneously connects the desired receiver to the antenna through the antenna switching unit and to the audio amplifier, lighting the corresponding indicator light on the front of the switching unit.

The antenna switching unit has 10 high frequency relays mounted radially in a shielded box. The coaxial antenna transmission line terminates on one side of each relay. The other side of each relay connects to the input of its corresponding receiver.

TECHNICAL FEATURES

Tube complement

| Function | Location | Number | Type |
|----------------------------|------------------------|--------|----------|
| R. F. amplifier | Receiver | 20 | 954 |
| Detector mixer | do | 10 | 954 |
| H. F. oscillator | do | 10 | 955 |
| 23 mc. I. F. amplifier | do | 10 | 6A C7 |
| 7 mc. fixed oscillator | do | 10 | 6SA7 |
| 16 mc. I. F. amplifier | do | 10 | 6SG7 |
| 1st limiter | do | 10 | 6SG7 |
| Final limiter | do | 10 | 6A C7 |
| Discriminator | do | 10 | 6H6 |
| A. F. amplifier | do | 10 | 6J5 |
| Voltage regulator | do | 10 | VR150-30 |
| High voltage rectifier | High-voltage rectifier | 4 | 5U4-G |
| Low voltage rectifier | Low-voltage rectifier | 1 | 5U4-G |
| A. F. amplifier | Audio amplifier | 1 | 6SJ7 |
| Do | do | 1 | 6V6GT |
| Fixed frequency oscillator | do | 1 | 6J5 |
| Meter amplifier | Audio amplifier | 1 | 6J5 |

CONFIDENTIAL

Type of receiver.—Superheterodyne.

Type of reception.—FM.

Input.—50–70-ohm concentric line connector.

Output impedance.—6 ohms, speaker; 60 ohms,

phones; high impedance capacity coupling for high impedance phones.

Output power.—Adjustable.

Antenna.—A quarter-wave artificial ground plane or one-half wave dipole.

Weights, dimensions and Navy type numbers

| Unit | Quantity | Navy Type No. | Dimensions | Weight |
|--------------------------------|----------|--------------------|---------------------------|---------------|
| | | | <i>Inches</i> | <i>Pounds</i> |
| Mounting rack..... | 1 | CIA 10123..... | 73 x 20½ x 27½..... | 120 |
| H. V. rectifier..... | 1 | CIA 20188..... | 10½½ x 19 x 14¾½..... | 121 |
| Switching unit..... | 1 | CIA 23318..... | 7¾ x 8¾ x 15½..... | 21 |
| Antenna switch unit..... | 1 | CIA 23363..... | 2½ x 11 x 13½..... | 13 |
| Radio receivers..... | 10 | CIA 46186..... | 5½½ x 19 x 14¾½..... | 142 |
| Audio amplifier..... | 1 | CIA 50117..... | 10½½ x 19 x 14¾½..... | 74 |
| L. V. rectifier..... | | | | |
| Ground plane antenna..... | 1 | CIA 66034..... | 3¾" OD x 10'..... | 31 |
| Antenna connecting cable..... | 1 | CIA 62094..... | 0.410" OD x 200'..... | 20 |
| Power supply cable..... | 1 | CIA 62096..... | ½" OD x 11' L..... | ¾ |
| Do..... | 1 | CIA 62095..... | 0.530" OD x 8' 44" L..... | 1½ |
| Antenna transmission line..... | ² 200 | RG-8/U or RG-11/U. | | |

¹ Each.
² Feet.



RBF-3 SONO-RADIO BUOY RECEIVING EQUIPMENT

Use.—Underwater sound detection—Shore.

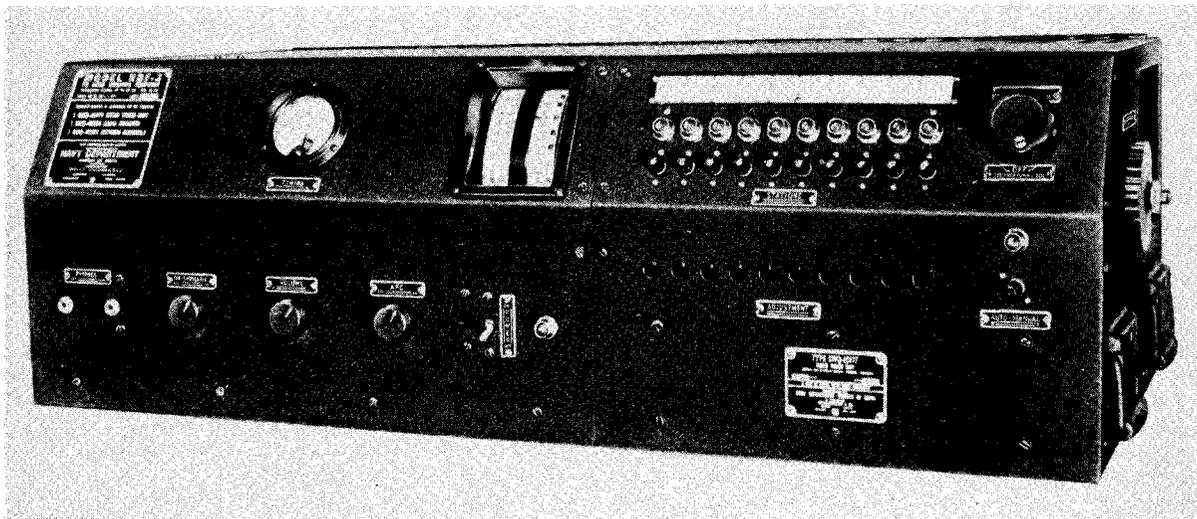
Frequency.—70–90 mc.

Power requirements.—95–125 volts, 50 or 60 cycles.

Description.—The Model RBF-3 equipment is designed to receive frequency modulated signals transmitted by the Sono Radio Buoys anchored off-shore. The equipment consists of a receiver and an automatic

tuner mounted side by side in a table mounted cabinet, the tuner being located to the right of the receiver.

The receiver employs a superheterodyne circuit which receives in one band signals in the 70–90 mc. range. Its tuning dial is of the fixed scale moving pointer type with the dial divided into two sections. The left section covers 70 to 78.6 mc. The right side



Model RBF-3 sono radio buoy receiving equipment.

CONFIDENTIAL

from 78.6 to 90 mc. On the front of the receiver panel are located the de-emphasis control, volume control, automatic frequency control switch, tuning meter, tuning dial, phone jacks, power on-off switch and pilot light.

The receiver uses one R-F stage, and a mixer stage with a separate oscillator. Three stages of I. F. amplification are followed by 2 limiter stages which are used to minimize noise or interference in the form of amplitude modulation. The discriminator is the next stage followed by 2 stages of audio amplification, resistance coupled to the power output stage. Separate tubes supply automatic volume control delay, automatic frequency control and interchannel noise suppression. A constant voltage transformer is supplied as part of the receiver equipment. It operates on 95 to 125 volts, 50 or 60 cycles and insures a constant supply voltage of 115 volts. It provides separate outlets for receiver and for tuner. The receiver is tuned by the automatic tuner unit.

The automatic tuner unit offers automatic tuning in groups of 6, 8, or 10 stations following a predetermined sequence. Tuning of any desired station is also accomplished by push button operation or by hand tuning with the tuning knob located on the right end of the cabinet. On the front of the tuner are located 10 station indicator lights, 10 push buttons, 10 holes giving access to tuning adjustment rods for each station. The Auto-Manual tuning switch and Automatic-Knob tuning switch are mounted on the same panel. By proper positioning of controls the tuner will cause the receiver to monitor the various stations in a preselected order. If it is desired to listen to any one station longer than automatic tuning permits, changing the Auto-Manual switch to Manual permits selection of stations by push buttons. A

lighted indicator lamp identifies the station tuned in.

To permit operation of the RBF-3 receiver during an emergency involving loss of power the receiver may be connected to a battery source of 8 volts "A" supply and 300 volts "B" supply. A battery cable and a jumper plug on the rear of the receiver chassis permit a quick change over to battery operation. During this emergency operation, however, the automatic tuner unit is inoperative. Tuning therefore must be accomplished by hand using the manual tuning knob.

TECHNICAL FEATURES

Tube complement

| Function | Number of tubes | Type |
|------------------------------------|-----------------|-----------|
| R. F. amplifier..... | 1 | 6AC7/1852 |
| Mixer..... | 1 | 6AC7/1852 |
| Oscillator..... | 1 | 6AC7/1852 |
| Automatic frequency control..... | 1 | 6AC7/1852 |
| 3 stages of I. F..... | 3 | 6SG7 |
| A. V. C. delay..... | 1 | 6H6 |
| First limiter..... | 1 | 6AC7/1852 |
| Second limiter..... | 1 | 6AC7/1852 |
| Interchannel noise suppressor..... | 1 | 6AC7/1852 |
| Discriminator..... | 1 | 6H6 |
| First audio..... | 1 | 6J5 |
| Second audio..... | 1 | 6SJ7 |
| Audio output..... | 1 | 6V6GT |
| Power rectifier..... | 1 | 5V4G |

Type of receiver.—Superheterodyne.

Type of reception.—FM.

Input.—50-75 ohm concentric line connector.

Output impedance.—50 ohms for low impedance phones; 5,000 ohms for high impedance phones.

Band coverage.—70-90 mc.

Antenna.—A quarter-wave artificial ground plane or one-half wave dipole.

Weights, dimensions and Navy type numbers

| Unit | Quantity | Navy type No. | Dimensions | Weight |
|-----------------------------------|----------|-------------------------------------|---|----------------------|
| Receiver—tuner..... | 1 | Receiver CWQ 46204; tuner CWQ 10177 | <i>Inches</i> 12 $\frac{7}{16}$ x 39 $\frac{1}{8}$ x 18 $\frac{3}{16}$ | <i>Pounds</i> 235 |
| Ground plane..... | 1 | | | 10 |
| Antenna assembly..... | 1 | CWQ 66084 | | 34 |
| Antenna transmission line..... | 200 ft. | RG-8/U or RG-11/U | | 17 |
| Constant voltage transformer..... | 1 | No Navy No.; Mfg. No. 30B722 | | 55 |

