



ARC-5 WW II Command Communications

An overview for the Collector

Command Radio

Development

SCR-274-N

ARC-5 vs SCR-274-N

VHF ARC-5

Aircraft Installation

Post War Amateur Radio Use

Some Accessories

Special Applications

References

Components Availability

Presentation Sources

Mr. ARC Radio Activity
6/2026



Command Radio

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WHAT IS A “COMMAND RADIO?” *

- The term Command Radio is the function the radio performed, namely plane to plane communication and plane to the airfield, while a Liaison (BC-348 & SCR-287) set was used between aircraft and the base (long distance).
- ARC-5 is the Navy command set while SCR-274-N is the Army version. “N” Stood for Navy
- Command Sets consisted of receivers, transmitters, modulators control boxes and an antenna relay unit
- There were also receivers that supported Radio Direction Finding as well a VHF (100-150 MHz) receiver and transmitter
- For this presentation I will focus mainly on the SCR-274-N HF sets but will provide some information on the other sets

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- In the Pacific, fighter aircraft used the command sets to communicate with Aircraft Carriers because they did not have the space or the access to controls of Liaison Sets Command Sets

Development

DEVELOPMENT

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- As a result of training exercises in the 1929's the navy had problems of switching channels for operational requirements due to the unavailability of crystals.
- This anti-crystal bias was a factor which moved the Navy to buy the Aircraft Radio Corporations Command set Concept
- The first command receiver called the "K Set" which was conceived by Dr. Frederick H. Drake, chief designer of the Aircraft Radio Corporation in Boonton NJ in 1934
- Being only a prototype, only a few were produced for evaluation by the Navy
- Later in 1937 Dr. Atherton Noyes was brought from General Radio to design the Transmitter



K Set First Command Receiver



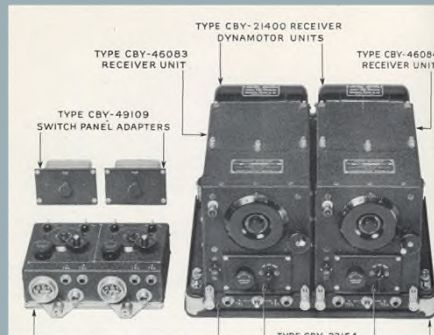
Last Command Set Receiver

DEVELOPMENT

- Advantages other than they did not use crystals, was their size
- 5.5x4.5x10.5 inches for a receiver
- 7x5x12 inches for a transmitter
- Superheterodyne receiver rather than TRF
- Stability was significantly above the then-industry standard
- The ability to reconfiguration the set through the use of plug-in rack mounting units was a great feature

THE RAT RECEIVER

- The RAT-1 is the first production version command receiver 13.5 – 20 MHz & RAV sets covering 20MHz -27 MHz
- Produced in 1939 in small quantiles for the Navy. Only 350 receivers were built to cover the, 13.5-20 and 20-27 MHz range
- While not strictly used in a command mode (no transmitter) and the unusually high frequency range hints at its' use in a surveillance role rather than normal Navy communications



Why did the Army adopt the Navy Design?

- 1940 the AIR Corps was directed to expand to 50,000 planes and the Army could not make the Westinghouse SCR-240/261 work, so they turned to the Navy's ATA/ARA sets.
- The Army then adopted the those sets as the SCR-274-N. but, in a reduced frequency coverage omitting 1.5-3 MHz band
- ARA/ATA units and equivalent SCR-274-N units are interchangeable between systems, aside from audio impedance differences
- In 1942-1943 an improved design, the ARC-5 was adopted by the Navy which were not interchangeable with the units of the earlier systems
- The Command Sets were the largest quantities of military radios ever produced, namely, 1,450,000 Receivers and Transmitters
- They were made by Aircraft Radio Corporation, Western Electric, Colonial Radio & Stromberg Carlson

SCR-274-N

SCR-274-N Receivers and Transmitters



Receivers



Transmitters

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- Receivers were usually three mounted in a rack while transmitters were two in a rack with additional units stored in the aircraft.
- Transmitters frequency were tuned prior to flight and could be re tuned while in flight if the need arose.
- The receivers covered .190-.55 MHz, .52-1.5 MHz 3-6MHz and 6-9 MHz
- Transmitters went from 3-4 MHz, 4-5.3MHz, 5.3-7 MHz, 7-9 MHz

SCR-274-N Control & Rack Units



**Dynamotor to Power the
Transmitters & Modulator
BC-456B**

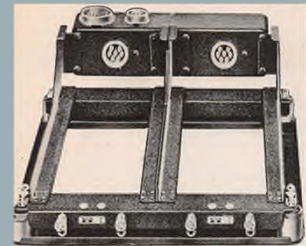
**Antenna Relay Unit
BC-442**

**Transmitter Control Box
BC-451A**

**Receiver Control Box
BC-450A**



**Receiver Rack
FT-220A**



**Transmitter Rack
FT-226A**

- These and the afore mentioned receivers and transmitters are the complete set of units that made up the SCR-274-N

Receiver Control Box



Receiver Control Box



**Speedometer Type Cable
for Remote Tuning**

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- The receiver control box had 3 dials for three receivers which were linked to the receiver it covered by a speedometer cable.
- There was a switch that switched the audio to one of two jacks or off. Another switch chose MCW, CW or AM mode

Transmitter Control Box. Antenna Relay Box & Jack Box *



Transmitter Control Box



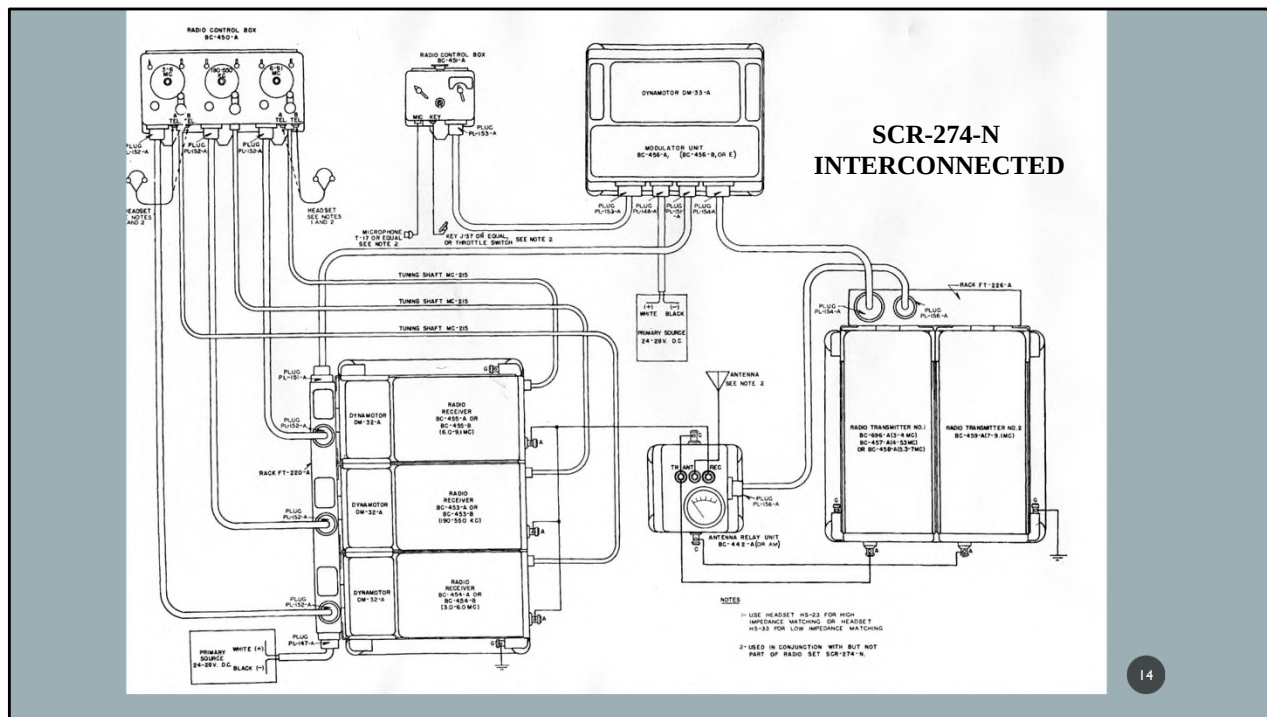
Antenna Relay Unit



BC-366 jack box, with volume control and several channels selectable by the crewman

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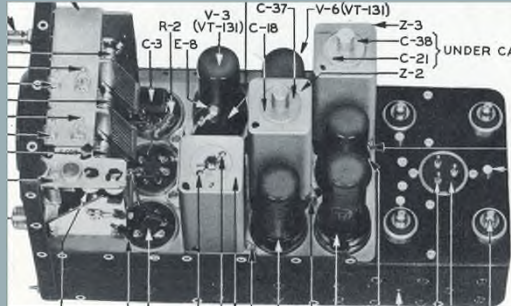
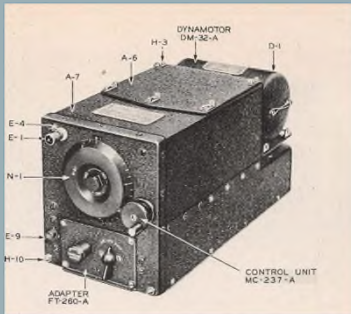
- The Transmitter Control Box has an on-off power switch which turns the dynamotor supplying HV power to the transmitter and modulator
- A switch provides modes MCW, CW or AM. There is a jack for a telegraph key as well as a microphone which can turn on the transmitter and modulator.
- There is also a telegraph key on the top of the box for CW or key down to fascinate transmitter tune up.
- Antenna Relay Box switches the antenna connection to the transmitter or receiver with the receiver grounded in the transmit mode. There is also an antenna current meter.



This diagram shows how it all came together

Inside the Command Receivers

- Direct tuning in frequency
- Six Tube Superheterodyne



Dynamotor

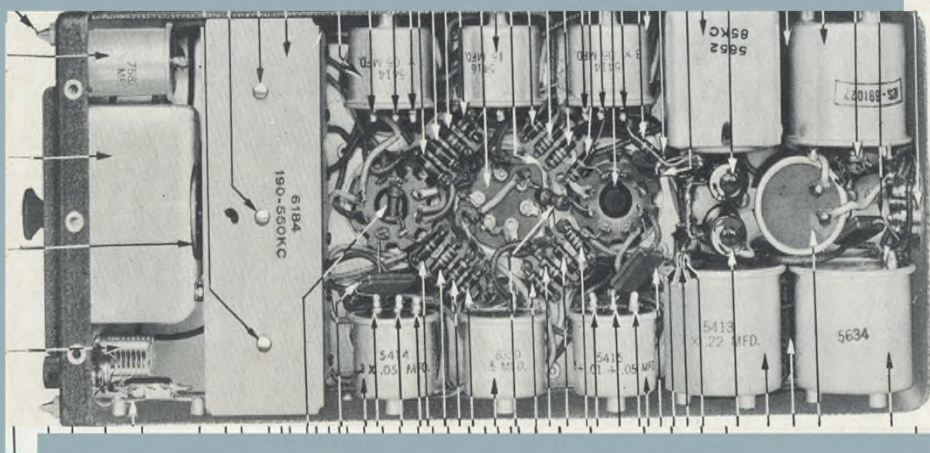
- Remotely Controlled via a Control Box with Gain and MCW/Off/CW switch and a flexible tuning shaft for frequency.

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- Plug in components, Coils and IF Transformer were plug in mounted.
- Parts were easily removed and accessible
- All meter; tubes

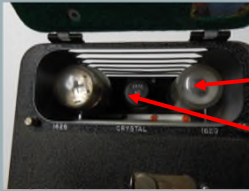
RECEIVER WITH BOTTOM COVER REMOVED

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- Resistors were mounted on boards for easy access
- Large capacitors were screw mounted cans on the side walls of the receiver
- Plug in coils
- Facilitate trouble shooting and repairs

Command Transmitters



1629 Magic Eye

Calibration Crystal



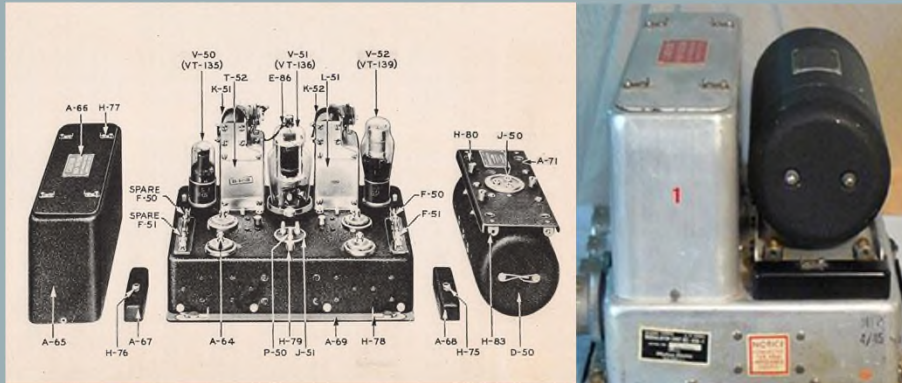
- **Direct Frequency Tuning .**
- **Transmitters were tuned prior to flight and then the tuning dial & other controls were locked**
- **A Magic eye tube (1629) and a fixed frequency crystal facilitated tuning.**
- **It used a triode 1637, master oscillator driving a parallel pair of two 1625s**
- **Rated output ranged from 16 to 20 watts on CW & 5 to 13 Watts on AM depending on the model and frequency range**

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- Set the "FREQ UENCY" dial
- Set the ANT. COUPLING to 3
- TONE-CW - VOICE" switch on Radio Control Box to "CW
- Set "TRANSMITTER SELECTION" switch on Radio Control Box BC-451-A to the number corresponding to the rack position of the transmitter which is being tuned.
- Make sure that neither the microphone button nor the key is closed. Turn "TRANS. POWER" switch to "ON", Dynamotor DM-33-A should 'start.
- Lock the "built-in" telegraph key on top of Radio Control Box
- Adjust "ANT. INDUCTANCE" for maximum antenna current reading on Antenna Relay Unit
- Tune-up the other transmitter in the rack
- Mark the frequency, to which each transmit ter has been tuned, in soft pencil in the appropriate blank space on the plate above the "TRANSMITTER SELECTION" switch
- Each transmitter is supplied with a special frequency checking circuit which is used for checking the frequency at one point on the dial
- Open the hinged cover (at the top back of' transmitter) to such an angle that the reflection of the entire magic eye tube may be seen.
- Tune the transmitter to the lowest frequency which will open the shadow in the tube
- The **1629 tube** is a vintage, 12.6-volt version of the classic 6E5 "Magic Eye" vacuum

tube. Primarily used as a tuning indicator in World War II military aircraft radios (like the ARC-5 and SCR-274N), it emits a bright green glow that narrows or widens based on signal strength. The indicated dial frequency should now correspond with that of the crystal

SCR-274N MODULATOR



- Tube complement was the same for the ARC-5 & SCR-274-N
- Used a 12J5 Medium-Mu Triode, 1625 Beam Power Tube and a VR-150 Voltage Regulator tube
- SCR-274-N used Screen Grid Modulation while the ARC-5 used Plate Modulation

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- Both were power: 24-28V DC Dynamotors
- A **medium-mu triode** is a type of **vacuum tube** with an amplification factor (μ) roughly between (15) and (50) . Featuring three electrodes—a cathode, an anode, and a control grid—it is primarily used for **voltage amplification** and in **driver circuits** for audio equipment and radios
- **Screen grid modulation** is a method used in vacuum-tube radio transmitters to superimpose an information signal (like audio or voice) onto a high-frequency carrier wave. It works by varying the voltage on the vacuum tube's screen grid in step with the modulating signal, which in turn controls the power output of the amplifier.
- **Plate modulation** (also known as anode modulation) is a highly efficient method of achieving **Amplitude Modulation (AM)** in radio transmitters. It works by injecting an audio-frequency signal in series with the high DC supply voltage applied to the plate (anode) of the final vacuum tube in the radio-frequency (RF) amplifier stage.
-] Plate modulation is considered superior to screen grid modulation because it provides higher transmitter efficiency (typically 70-80%), excellent linearity, and allows for clean, undistorted 100% modulation. Screen grid modulation, while simpler and cheaper to implement, is essentially a low-level technique that requires the stage to run at significantly lower power.

SCR-274-N vs ARC-5

GENERAL COMPARISON OF THE ARC-5 AND^{*} SCR-247-N RECEIVERS

TUBES	
RF Amp	12SK7
Mixer	12K8
1 st IF	12SK7
2 nd IF	12SK7 (SCR-247) 12SF7 (ARC-5)
Detector CW-OSC	12SR7
Audio	12A6

- ARC Receivers & Transmitters are all in Black Crackle Finish
- SCR-274-Ns can be in either finished in Black Crackle or Natural Aluminum
- The ARC-5 use the 12SF7 as the 2nd IF & AVC while in the SCR-274-N uses the 12SK7 as 2nd IF & AVC was taken from the 12SR7 stage

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- **Integrated Diode:** The 12SF7 includes a built-in diode, allowing a single vacuum tube to act as an IF amplifier *and* an automatic gain control (AGC/AVC) rectifier or AM detector.]
- **Identical Amplification:** Because the pentode section has precisely the same curves and pinout specifications as the 12SK7, the 12SF7 serves as a highly effective, logical upgrade in IF systems designed to handle AGC.

GENERAL COMPARISON OF THE ARC-5 * AND SCR-274-N TRANSMITTERS

- SCR-274-N units were painted & unpainted aluminum, while the ARC-5 units
- feature a black crackle finish
- Both used 1626 as an Oscillator , Two 1625 Power Amplifiers & a 1629 Magic Eye for tuning
- The early Navy Transmitters (ATA) as well as the SCR274-N transmitters used less effective Screen Grid Modulation while latter ARC-5 transmitters used Plate Modulation.
- Mechanically, the transmitter rear power connector is slightly different, so inserting the wrong transmitter in a rack can damage either the rack or the transmitter

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AN/ARC-5 transmitters use high-level final amplifier plate modulation, The two earlier systems use less effective screen modulation,

- Mechanically, the transmitter rear power connector is slightly different, so inserting the wrong transmitter in a rack can damage either the rack or the transmitter power connector. Electrically,

TABULATION OF NAVY vs ARMY HF COMMAND SETS

Description	Frequency [MHz]	Early Type ARA- ATA	Army SCR-274-N	Navy ARC-5
Receiver	0.19 - 0.55	CBY-46129	BC-453	R-23
Receiver	0.52 - 1.5	CBY-46145	BC-946	R-24
Receiver	1.5 - 3.0	CBY-46104	<i>No Equivalent</i>	R-25
Receiver	3.0 - 6.0	CBY-46105	BC-454	R-26
Receiver	6.0 - 9.0	CBY-46106	BC-455	R-27
Transmitter	2.1 - 3.0	CBY-52232	<i>No Equivalent</i>	T-18
Transmitter	3.0 - 4.0	CBY-52208	BC-696-A	T-19
Transmitter	4.0 - 5.3	CBY-52209	BC-457-A	T-20
Transmitter	5.3 - 7.0	CBY-52210	BC-458-A	T-21
Transmitter	7.0 - 9.0	CBY-52211	BC-459-A	T-22

VHF ARC-5

ARC-5 WESTERN ELECTRIC R-28 RECEIVER & T-23 TRANSMITTER

In March 1941 Western Electric took over production of the SCR-274N with the requirement that it be compatible with the existing command system



C-30 - Remote control of one VHF Transmitter & MF-HF Transmitters as well as the Channel Selection of the VHF Receiver

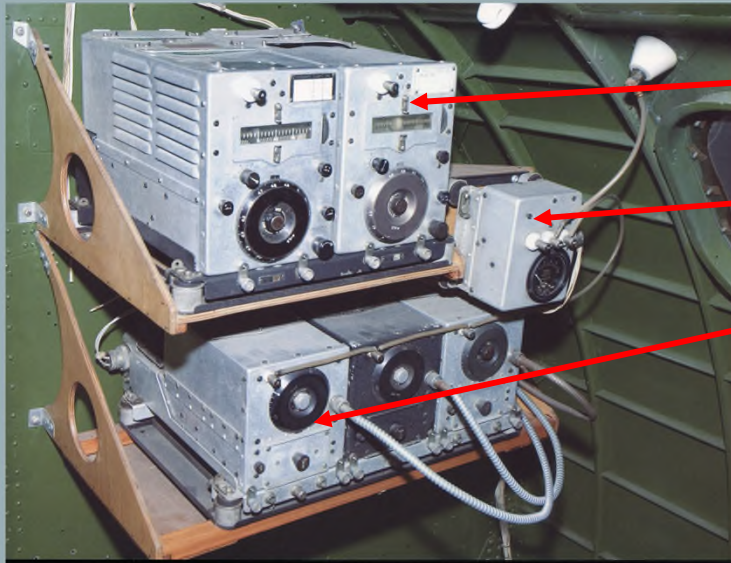
C-43 - VHF Receiver Control, but not VHF channel selection, Complete Receiver control of two MF-HF Receivers

- Rcvr & Xmitter controlled on 4 channels - Voice only
- Frequency Range: 100 – 156 MHz
- Receiver 10 used Tubes
Transmitter 4 Tubes:
- Total of 22,000 sets were produced for the Navy with the Army getting only 1000
- Power Output: 6-10 Watts on Voice only
- Channels on the VHF Receiver and Transmitter are controlled by motors

- An original Army contract transferred to the Navy
- Western Electric brought in Colonial Radio (later Sylvania) for SCR-274- N Production.
- C-30 Remote control of one VHF Transmitter
- 108 – 136.975 MHz

AIRCRAFT INSTLATION

SCR-274N IN THE B-17 RADIO ROOM *



SCR-274-N TRANSMITTERS

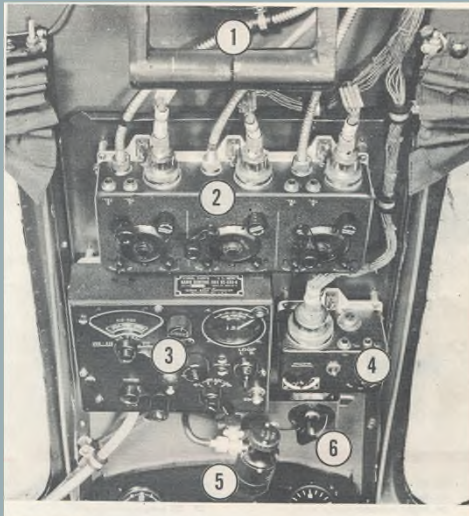
ANTANNA RELAY UNIT
BC-442A

SCR-274-N RECEIVERS

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- There was no local control of the equipment.
- The flexible shafts went to the pilots' station.
- The Modulator was located under the radio rack.
- Two additional Transmitters covering different frequencies could also be stored

COMMAND SET PILOTS CONTROLS in a B-17



PILOT'S COMPARTMENT CEILING

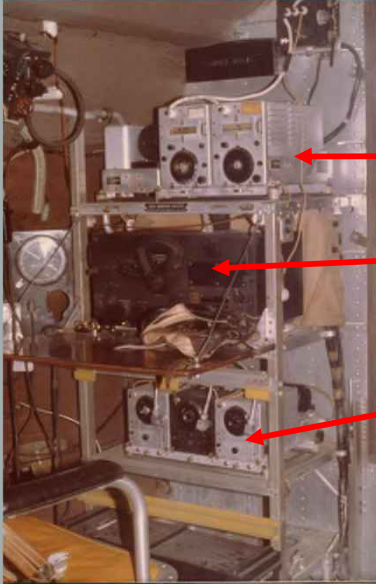
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RCVR TUNING BOX

4

TRANSMITTER CONTROL BOX

SCR-274N IN THE B-26 RADIO ROOM



SCR-274N TRANSMITTERS

BC-348 LIAISON RECEIVER

SCR-274N RECEIVERS

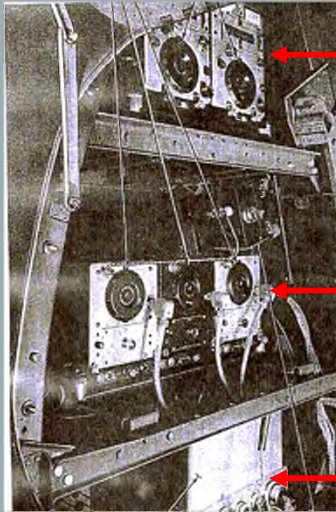
COMMAND SET PILOTS CONTROLS IN A B-26

BC-366 Jack Box

Control Boxes



Command Transmitters, Receivers and Dymomotor int a P-40



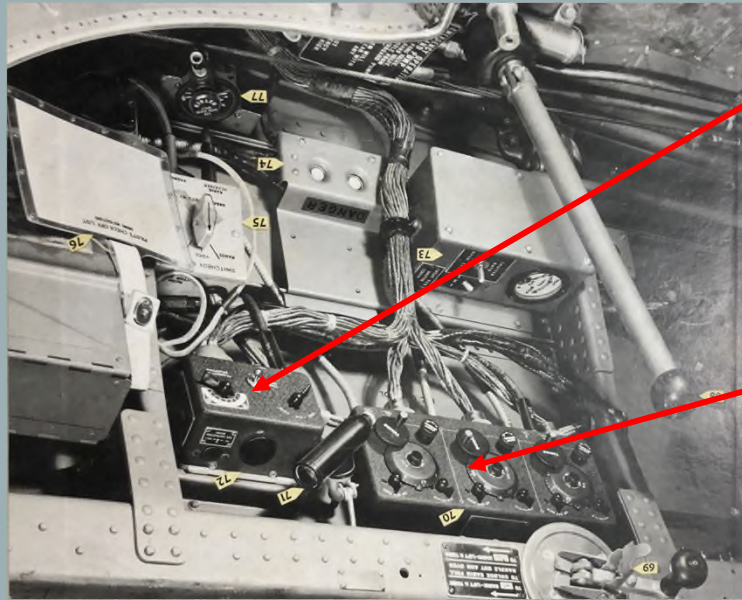
Transmitters

Receivers

Modulator

30

P-40 Cockpit Controls for SCR-274N



Transmitter Control Box

Receiver Control Box

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Command sets were being used for fleet communications over much longer distances than the design basis of short-range plane-to-plate work.

POST WAR AMATEUR RADIO USE

[illegible]

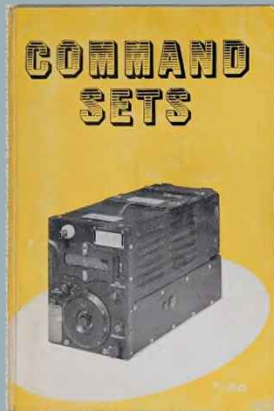
Transmitter &
Receivers
\$5.75 Each

April 1948 CQ

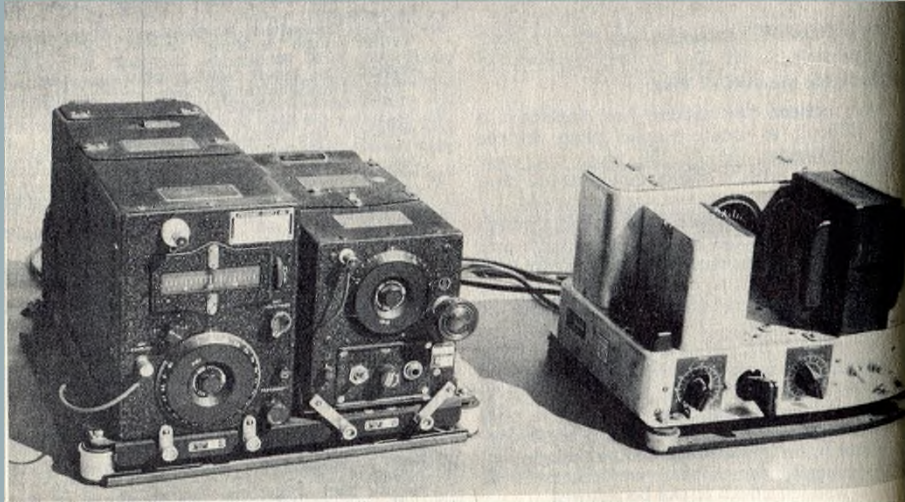
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POST WAR AMATEUR USE

- Book published in 1957 by CQ Magazine containing a collection of published articles from the magazine on converting command sets for Armature Radio use.

[illegible]

HAM STATION USING RECEIVER, TRANSMITTER & MODULATOR



- If you go to the book “Command Sets” it will describe the building of this station

“THE Q FIVER”



BC-453

- The BC-453 tuned from 190Khz - 550Khz
- IF frequency of the BC-453 is 85Khz
- Feeding the IF signal to the BC-453 will give you a dual conversion receiver with a sharp 85 KHz IF
- Quick and dirty way to get the Q Fiver advantage:
 1. *Connecting a shielded line from the phone jack of a communications receiver to the antenna post of the BC-453*
 2. *Turn down the communication receiver audio*
 3. *Sufficient signal would be picked up by the BC-453 to provide improved selectivity via the 85Khz IF of the BC-453*

SOME ACCESSORIES & SPECIAL APPLICATIONS

YE/ZB "Hayrake" Radio Navigation System *

- Installed in a Command Receive Rack
- Provided beams to facilitate returning Navy Aircraft to their Aircraft Carrier
- Used compatible dynamotors

Prior to the ARR-2 the R-24 (0.52-1.5 MHz) demodulated signals from the ARR-1



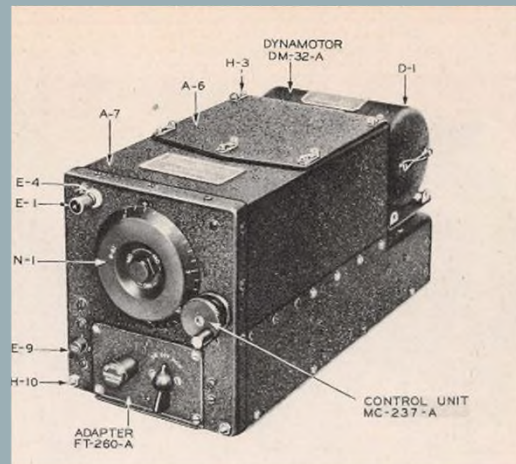
- Used the same dynamotor as the AN/ARC-5 sets, fitted in the same racks, and can be controlled by special AN/ARC-5 control boxes.
- Range at 10,000 feet was 50 to 75 miles.
- Order of the letters were switched each flight.

A DIFFERENCE BETWEEN THE ARC-5 AND THE SCR-247-N RECEIVERS



ARC-5 Receivers have a dial for the control box and a coupling for the tuning cable in the receiver access cover while the SCR-274-N does not.

LOCAL TUNING & OPERATION CONTROL



References, Components Availability & Presentation Sources

REFERENCES

- Army Radio Sales Co. Command Sets <https://armyradio.com/Command_Sets.html>
- Command Sets CQ Technical Series < <https://www.pestingers.net/pdfs/other-radios/military-manuals/command-sets.pdf> >
- Electric Radio March 1990, Walt Hutchens, Electric Radio in Uniform, History
- Handbook of Operating instructions for Model AN/ARC-5, NAVAER 08-5Q-95
- Instruction Book for Operation & Maintenance of Radio Set SCR-247-N
- Electric Radio March 1999 Walt Hutchens, Electric Radio in Uniform, ARR-1 & ARR-2
- Handbook of Maintenance Instructions for Radio Receiving Equipment AN/ARR-1
- Command Set Story by G.E. White CQ Nov 1964
- The First & the Last Q-5er, G.E. White 73 Magazine, June 1996
- Crystal Controlled Command Sets, G. E. White, CQ, Oct 1965
- Command Sets, G. E. White, CQ Oct 1965
- Wikipedia, < <https://en.wikipedia.org/wiki/AN/ARC-5>>
- Mike Hanz's AFF Radio web page < <https://aafradio.org>>
- Collectable Aircraft Radios-The "Command" Radios, Ed Lyon, Radio Age, Nov 2005

Sources for Command Sets

- **Hamfests** See the ARRL web page
- **eBay**
- **Army Radio Sales Co**
- **ARC-5 Digest** @< <http://mailman.qth.net/mailman/listinfo/arc5>>
- **John K. Seidts** @ <<http://www.forgottenfield.com/amg/instrument/radio>>

Sources Used The Presentation

This presentation is based on:

- **Military manuals & Internet sources**
- **The work of Gorden Elliot White, who wrote many articles for CQ and 73 Magazines**
- **Walt Hutchens articles in Electric Radio**
- **Wikipedia article on the ARC 5 Command Radio Sets**
- **Army Radio Sales Co. article on command Sets**
- **Mike Hanz's AAF Radio web site**
- **The authors experiences with Command Sets**