

DESCRIPTIVE SPECIFICATIONS

AND

OPERATING INSTRUCTIONS

UNITED STATES COAST GUARD

RADIO RECEIVER TYPE RC-123

(Mackay Radio Receiver 128-AZ)

FREQUENCY RANGE 15-650 KC.

Contract No. Tcg 35168

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FEDERAL TELEPHONE & RADIO CORP.

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Washington, D. C.

N O T I C E

UNITED STATES COAST GUARD
RADIO RECEIVER TYPE RC-123

MACKAY RADIO RECEIVER 128AZ

The United States Coast Guard Radio Receiver Type RC-123 is identical with Mackay Radio Receiver 128AZ. This in turn is identical with the standard Mackay Radio Receiver 128A with the two following exceptions.

(1) The output impedance of the Type 128AZ is 600 ohms, an output transformer being built in for that impedance.

(2) A heater transformer is mounted in the cabinet, for use in operating the tube heaters from an a-c line.

WARNING. If the Type 128AZ receiver is to be operated on a d-c line, the transformer leads must be disconnected from the cabinet terminals marked PRI, and the ends taped.

DESCRIPTIVE SPECIFICATIONS AND OPERATING INSTRUCTIONS
RADIO RECEIVERS 128A AND 128AY

1. GENERAL

Radio Receivers 128A and 128AY are marine radio-telegraph receivers which fulfill the requirements of shipboard use and are also suitable for use at fixed stations. They are of the tuned radio frequency type, having one stage of r-f amplification, regenerative detector, and two stages of a-f amplification. They cover the intermediate and low frequency bands, and are designed for reception of both CW and modulated signals. The complete frequency coverage is 15 to 650 kc, divided into four overlapping ranges.

Range A	15-41 Kc
Range B	37-105 Kc
Range C	95-260 Kc
Range D	240-650 Kc

The full vision tuning scale is calibrated in kilocycles for each of the four ranges.

The receivers are designed for operation from either a d-c or an a-c line as well as from batteries. Switches on the panel enable the operator to change immediately to batteries for emergency operation in case of failure of the line supply.

Radio Receiver 128AY is furnished with a transformer, mounted within the cabinet and wired to the terminal board, for supplying the vacuum tube heaters from a 115 volt a-c line. In all other respects it is identical with the type 128A receiver.

The following specifications apply to the antenna, output, and power circuits.

Antenna. Provision for a main and an emergency antenna with change-over switch on the receiver panel.

Output. Designed for a load impedance of 10,000 to 20,000 ohms. With a 90 volt "B" battery: output power is 100 milliwatts with low distortion; maximum 200 milliwatts.

Battery Operation. "A" battery 6.3 volts, drain 1.9 amperes. "B" battery 90 volts, normal drain approximately 8 milliamperes. The drain varies from 7 to 12 milliamperes according to the output power and the setting of the r-f gain control.

D-C Line Operation. Provision only for plate supply, with a drain of 0.17 ampere on a 115 volt line.

A-C Line Operation. Power consumption on a 115 volt line is 36 watts (approximately 0.4 ampere) total for plate and heater supply. (Heater transformer is furnished as standard equipment with the type 128AY receiver, but the type 128A heaters can also be operated on an a-c line if a suitable transformer is provided.)

Front panel controls are:

- Main tuning knob and scale
- Range selector switch
- Antenna switch
- Antenna trimmer
- R-F gain
- Regeneration
- A-F gain
- Power and battery switches
- Phone jack

2. MECHANICAL DESIGN

The receiver components are mounted on a substantial panel and chassis assembly. The panel dimensions are 17-1/16" wide by 9-9/16" high, and the receiver mounts in a cabinet 12-1/2" deep. The receiver panel-chassis assembly is secured in the cabinet by means of four 10-32 screws at the edges of the panel. Terminal boards are provided within the receiver cabinet for antenna, battery, line, and phone connections. These circuits are lead from the terminal boards to the chassis by means of three flexible cables and separable plugs, one part of the plug being on the cable and the other part mounted on the chassis. The receiver is readily removed from the cabinet by removing the four panel screws. The cables are sufficiently long so the receiver may be operated when removed from the cabinet for servicing.

All the radio frequency coils and the range selector switch are assembled on a bracket, which sub-assembly may be removed from the chassis as a unit.

In order to reduce microphonic response to a low level the detector and regenerator tube sockets are mounted on a small sub-panel which is suspended from the chassis by means of rubber mountings.

All resistors, mica capacitors, and tubular paper capacitors are mounted on three terminal boards except where special circuit conditions require separate mounting. This arrangement facilitates testing and servicing, and gives the interior of the receiver a much neater appearance.

3. ELECTRICAL DESIGN

The schematic circuit diagram is shown in drawing F-25529-3. The

tuned coils are marked L1 to L10, inclusive, and the range selector switch consists of two ganged switches S2 and S3. Antenna switch S1, when thrown to the MAIN position, connects the main antenna terminal in the cabinet to the primary coil of L1, L2, L3, or L4 according to the range (A, B, C, or D) in use. At the same time the E terminal is connected to the EXT terminal. The E terminal is intended for an emergency antenna. This may be the antenna for the high frequency receiver, in which case the EXT terminal would be run to the antenna post of that receiver. When the antenna switch is in the EMERG. position the primary coil is connected to the emergency antenna via terminal E on the cabinet terminal board, while the main antenna is grounded.

Assuming the selector switch is on range B, coil L2 is connected to C1A and C1B in parallel, the front two gangs of the tuning capacitor. Shunted across C1A is antenna trimmer C2, controlled from the front panel. L2 is also connected to the grid of the r-f amplifier tube V1. The plate of V1 drives coil L8 through its primary winding. Coil L8 is tuned by C1C and C1D in parallel, the rear two gangs of the tuning capacitor, forming the detector tuned circuit. The detector V3 utilizes grid leak R11 and capacitor C14. A separate regenerator tube V2 is used, whose plate is coupled back to L8 through a tickler winding. Two stages of resistance coupled a-f amplification, tubes V4 and V5, follow the detector. The output of V5 is coupled to the phone jack by means of choke L12 and capacitor C26.

The gain of the r-f amplifier is controlled by potentiometer R1, acting on the cathode potential of V1. Potentiometer R2 controls the degree of regeneration by adjustment of the plate voltage of V2. Audio frequency gain is controlled by potentiometer R3 in the grid circuit of V5. Resistor R15 in the detector plate output, together with capacitor C20 act as a filter to reduce the amount of r-f signal passing from the detector into the a-f amplifier. Resistor R23 and capacitor C34 further reduce the gain of the a-f amplifier for the lower radio frequencies of range A, which otherwise would appear in the phone circuit in appreciable strength. Resistor R10 and capacitors C10 and C11 constitute a scratch filter on the regeneration control. Resistor R5, shunted by capacitor C8, is a protective device required in case of accidental short circuit of the tuning capacitor under certain conditions of line operation.

On range A the receiver functions in a manner similar to that on range B. On ranges C and D two tuned circuits are used between the antenna and the grid of the r-f amplifier. For instance on range D the antenna signal current drives L4 which is tuned by C1A. This circuit is coupled to the circuit including L6 and C1B by means of the common capacitor C5. Resistor R4 gives a d-c path around C5 to the grid of V1. A trimmer C4 is used to track the r-f grid circuit L6, C1B with the detector grid circuit. The detector grid circuit comprises L10, tuned by C1D and trimmed for frequency tracking by C36. Capacitor gang C1C is not used on ranges C and D. The range selector switches are provided with segments which short circuit the primary and secondary coils of ranges not in use, in order to avoid dead spots due to self-resonance of the low frequency coils.

The built-in power supply for operation of the plates from an a-c or a d-c line consists of rectifier V6 followed by a filter. Both sides of the supply are filtered in order that the receiver may operate from a d-c line having either positive or negative grounded. When the plate supply switch is thrown to LINE operation the plate supply circuit of the receiver is floating with respect to the chassis except for bypass capacitors.

Terminals are provided in the cabinet for the connection of a heater transformer for operation of the tube heaters on alternating current, provided an a-c line is available. Such a transformer is furnished with the 128AY receiver.

1. INSTALLATION

4.1 General

The cabinet of the receiver may be secured in the desired location in the operating room by means of screws in four holes in the bottom of the cabinet.

Two holes are provided in the rear of the cabinet near the antenna terminal board, for antenna leads. The main antenna is to be connected to terminal M, the emergency antenna to terminal E, and an extension lead to the antenna post of the high frequency receiver is to be run from terminal EXT, in the event that the high frequency antenna is used as an emergency antenna for the 128A receiver.

Knockout holes are provided in the rear and bottom of the cabinet for power, battery, and phone cables. A 90 volt battery is to be connected to +B -B terminals, and a 6 volt storage battery to +A -A. For d-c line operation the line is to be connected to the LINE terminals, observing the polarity engraved on the terminal board. In the 128AY, disconnect the two transformer primary leads from the PRI terminals. Tape up the ends of the leads. For a-c line operation, the side of the line nearest ground potential must be connected to the LINE terminal marked -. If neither side is near ground potential appreciable a-c hum may result. In such case it will be necessary to provide a two winding transformer between the line and the receiver and to ground the side of the secondary connected to the "-Line" terminal.

The line voltage, either d-c or a-c should be within the range of 95 to 130 volts. For higher d-c line voltages an external series dropping resistor will be required. For higher or lower a-c line voltages, it is recommended to use an externally mounted step down or step up transformer, especially where both heater and plate supply are to be derived from the line. If one side of the line is grounded an autotransformer will be satisfactory. Otherwise it should have two separate windings. The same transformer may include the heater winding, thus saving the separate heater transformer (paragraph 4.2). In this case, however, a slight change in wiring between TBI, P4, E3, and ~~54~~ will be required, in order that the

POWER switch will control the primary side of the transformer (to turn off the heaters).

4.2 Heater Transformer

In case of a-c operation a suitable heater transformer such as that shown in the parts list should be installed, and connected as indicated on the schematic diagram. This transformer may be mounted either external to the receiver, or within the cabinet at the top of the left side, near the front. If the a-c supply has poor wave-form, it will be necessary to connect one of the 6.3 V AC terminals on TBI to the cabinet. Trial will indicate which terminal should be grounded for any particular line.

4.3 R-F Induction on the Power Line

In certain installations noise will appear in the receiver at one or more frequency regions, due to disturbances coming in over the a-c or d-c line. This condition can be corrected by inserting a noise filter in the line to the receiver, the filter being located external to the receiver. A suitable filter consists of an r-f choke of 1/2 to 1 millihenry in the ungrounded side of the line, and a 1 microfarad capacitor from the choke to ground. In case there is noise on both sides of the line, such a filter will be required in each side. The capacitor should be connected to the side of the choke which goes to the receiver, not to the line side. The capacitor should be rated at 200 volts d-c working, or more. It is important to run the ground wire from the capacitor as short as possible, and entirely independent of the ground wire from the receiver. If the noise appears only on the B, C, and D ranges, and not on range A, a capacitor of 0.1 microfarad will usually be found to be sufficient. The choke should have a current carrying capacity of at least 0.2 ampere for d-c line installation, and for a-c where such line is used only for plate supply. A suitable choke is National type R-300. Where an a-c installation is used for both heater and plate supply the current carrying capacity should be at least 0.4 ampere. Two type R-300 chokes in parallel may be used.

4.4 Extension Phone Jack

When it is desired to locate an additional phone jack in a particular position in the radio room, an extension shielded cable can be run from the terminals marked TEL. to the remote jack. Connect the shield to the G terminal.

5. OPERATION

To operate the receiver from batteries, the two switches on the lower left corner of the panel are to be turned DOWN to the BATTERY position. To operate from the line turn the POWER switch ON and the PLATE switch to LINE. When an a-c line is used and a transformer installed, the HEATER switch may also be turned to LINE. TO TURN THE RECEIVER OFF, turn the power switch OFF, and TURN BOTH THE LOWER SWITCHES UP TO THE LINE POSITION.

To receive signals, turn the ANTENNA switch to MAIN, set the R-F GAIN control at least half way up, and the A-F GAIN control at or near maximum. Set the range switch ABCD to the proper range and the tuning dial to the desired frequency. Turn up the REGENERATION control just above the oscillation point, where a slight click is heard in headphones plugged into the PHONE jack. The signal may now be trimmed up by means of the main tuning dial and the ANTENNA TRIMMER. The gain controls can be adjusted for the desired intensity. When receiving modulated signals the REGENERATION control may be turned just below the point of oscillation.

6. MAINTENANCE

6.1 Dial Lights, Fuses and Tubes

To renew these items, remove the two 10-32 screws at each ~~and~~ the panel and withdraw the panel-chassis assembly from the cabinet. ~~The~~ two dial lights are type 47. The fuses are located on a bracket at the back of the cabinet. The amperage of each fuse is stamped beside its post. All fuses are type 3AG.

The chassis is stamped beside each socket with the tube type required in that socket. Either the metal types or their equivalent glass types can be used. In an emergency it is possible to use a 6J5 or its glass equivalent as a substitute for the 6K6-G output tube, with a slight reduction in the gain of the receiver. No change is required in the internal connections of the receiver.

6.2 Circuit Check

The accompanying Parts List, Schematic Diagram F-25529-3, and Wiring Diagram F-28144-14, make possible a complete circuit check of the receiver. An insert on the schematic diagram shows views of the under side of the socket for each type of vacuum tube, with the prongs or pins numbered 1 to 8 in the conventional manner, and with identification of the electrode connected to each pin. The table on the fly leaf of the diagram indicates the proper voltage for each socket prong as measured from the chassis. For checking these voltages, remove the chassis from the cabinet and stand it on either end, leaving the battery cable plugged into the chassis.

6.3 Resistors

All insulated carbon resistors used in this receiver have resistance values based on the RMA Standard Preferred Number Values. If under some circumstances, however, a particular resistor cannot be obtained in a preferred number value, the nearest "round number" may be substituted. For instance, a 65,000 ohm or 70,000 ohm may be substituted for 68,000 ohm $\pm 10\%$, a 50,000 ohm for 47,000 ohm, etc.

6.4 Frequency Calibration

The accuracy of the frequency calibration of the tuning dial depends upon the inductance of the detector tuning coils, the capacitance curve of the tuning capacitor, and the minimum capacitance of the circuit. No attempt should be made in the field to adjust the coil inductance or the capacitance curve as these adjustments require laboratory equipment. There is little likelihood that the factors determining the calibration accuracy will change of their own accord. In the event that an appreciable frequency error develops, the minimum capacitance of the detector circuits may be adjusted in the field. Trimmers are provided on the two rear gangs of the tuning capacitor and on the coil bracket, for this purpose. Withdrawing the chassis from the shield for trimming will not change the calibration appreciably.

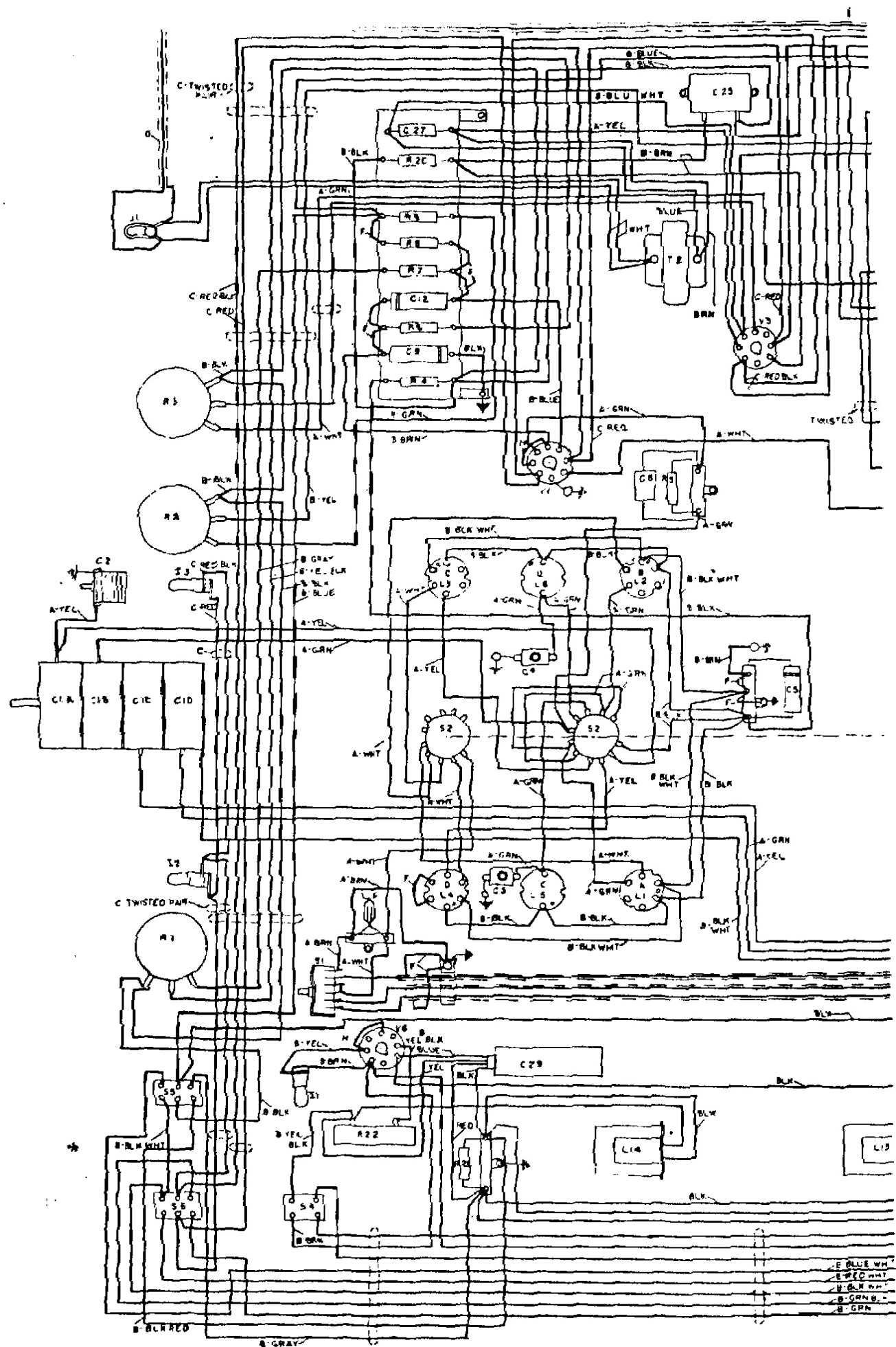
Three signals are required, having a frequency accuracy of 1/2 of ~~1% or better~~, one being between 500 and 650 kc, the second between 200 and 260 kc and the third between 80 and 105 kc. Tune in the highest frequency signal on range D, adjust the regeneration just above the oscillation point and the r-f gain at least 1/4 turn below maximum. Adjust the trimmer on the rear gang and the one marked D on the rear surface of the coil bracket until zero beat is obtained with the dial set accurately to the known frequency of the test signal. Tune in the second frequency on range C and adjust for zero beat, using only the trimmer marked C on the rear surface of the coil shield. Proceed in the same manner for the lowest frequency signal, tuning it in on range B, and adjusting only the trimmers on the next to the rear gang.

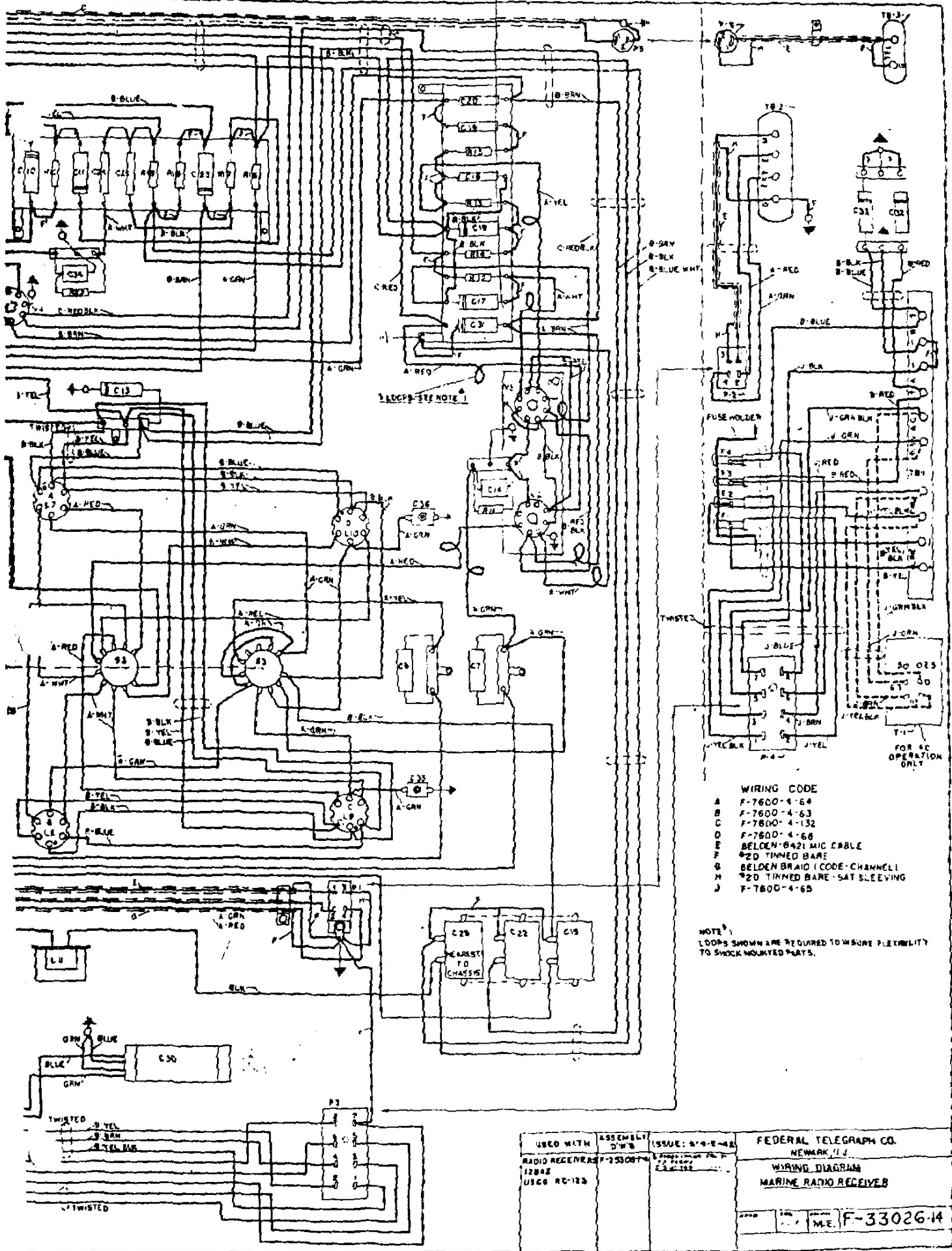
If the dial calibration still appears to be inaccurate, the difficulty should be brought to the attention of an authorized service agent.

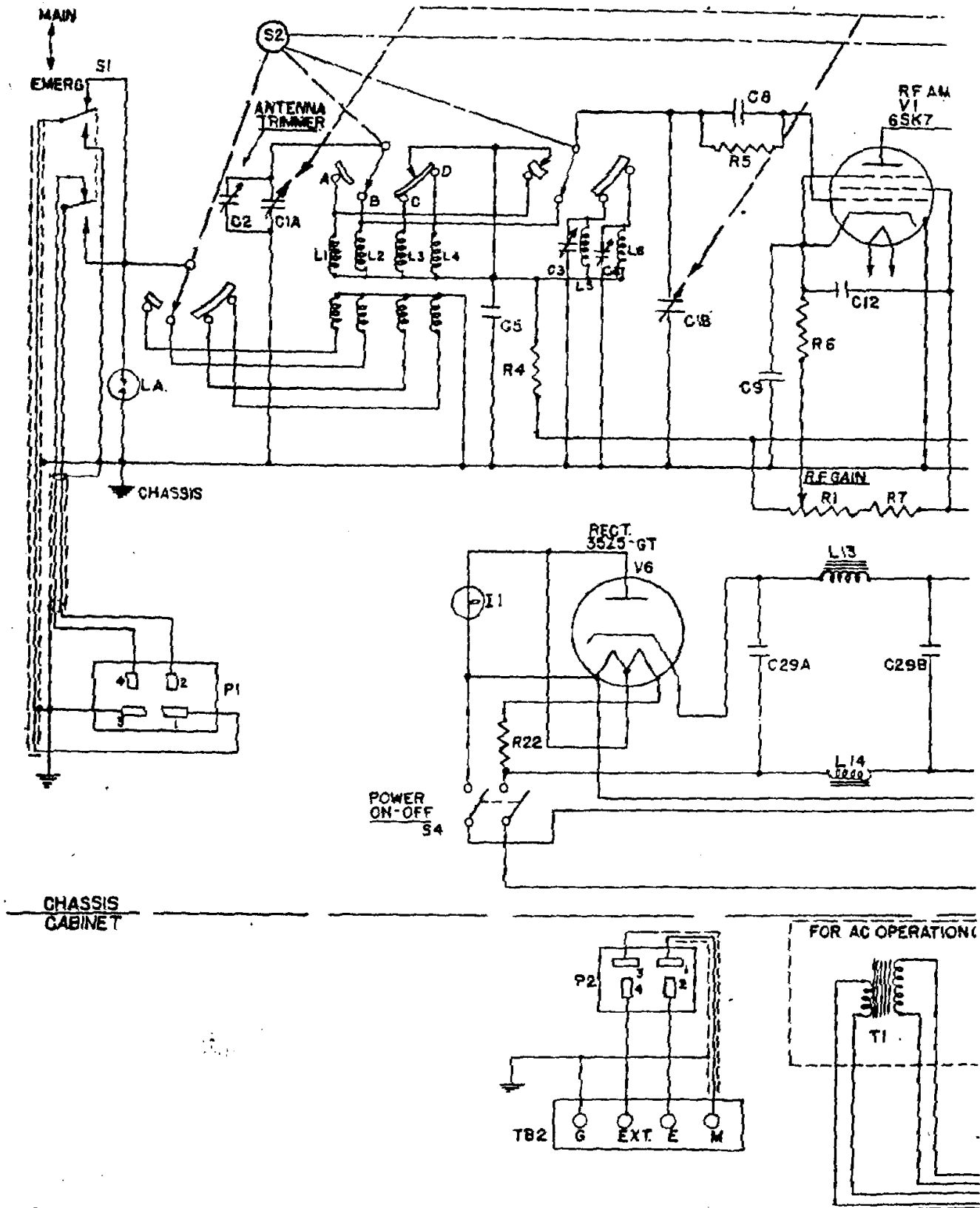
6.5 Trimming of the R-F Grid Circuit

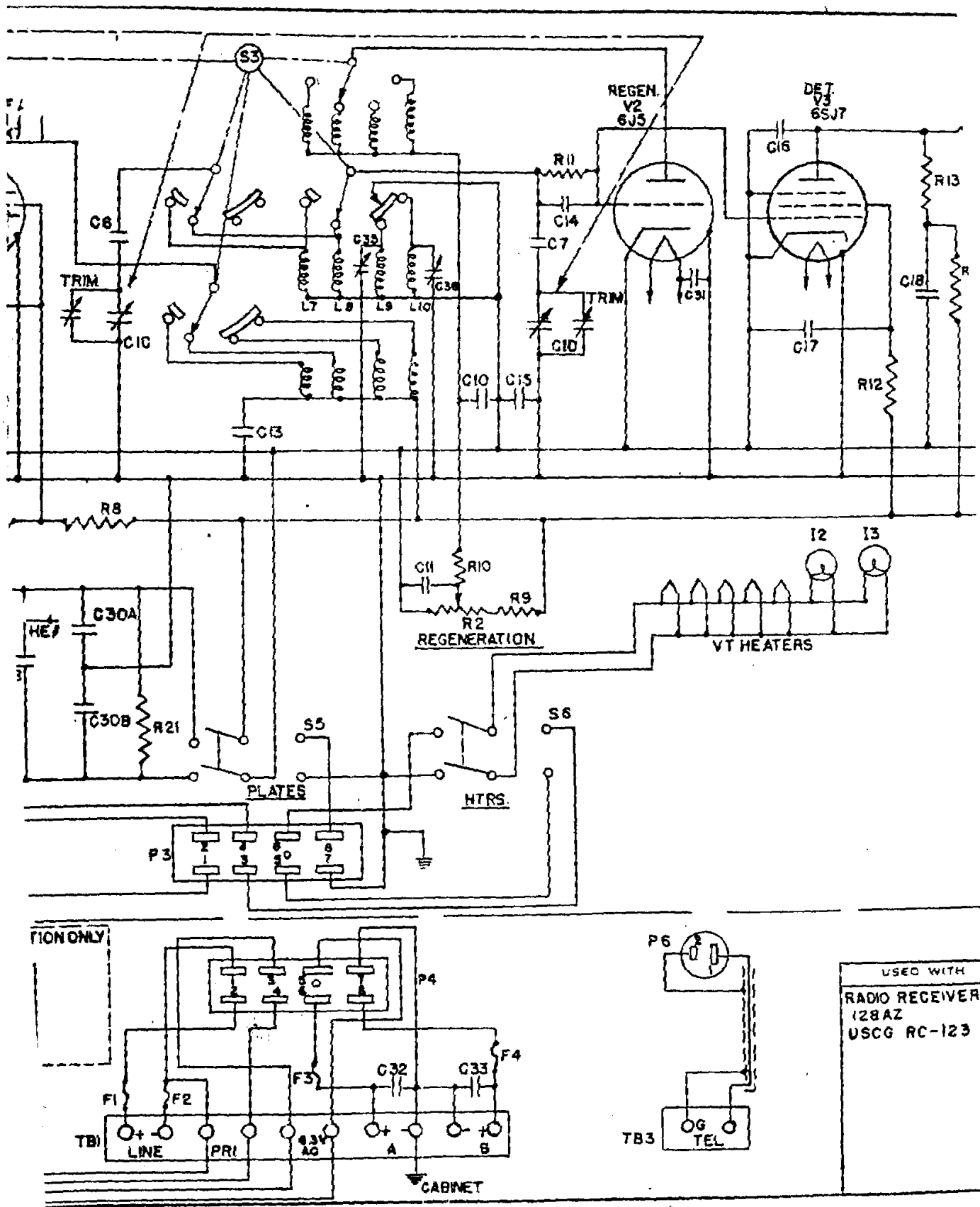
On each of the ranges C and D there are three tuned circuits. The frequency of the receiver is determined by the tuning of the detector circuit. The r-f grid tuned circuit is designed to track with the detector circuit. The antenna tuned circuit is provided with a manually controlled trimmer on the front panel. Two small trimming capacitors are provided in the r-f grid tuned circuits: C3 for range C; and C4 for range D. These trimmers are adjustable with a screwdriver through two holes in the top of the chassis, between the gang capacitor and the panel, and marked with the letters C and D, respectively.

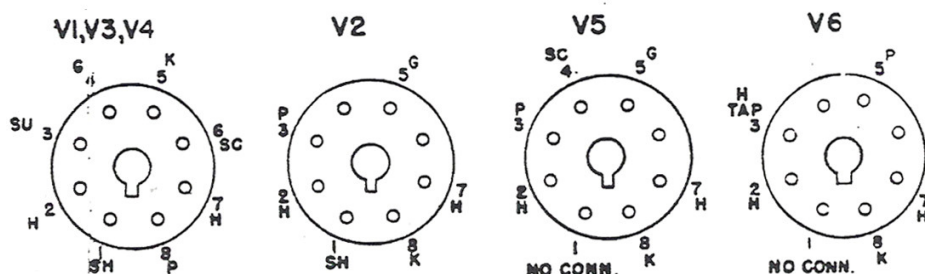
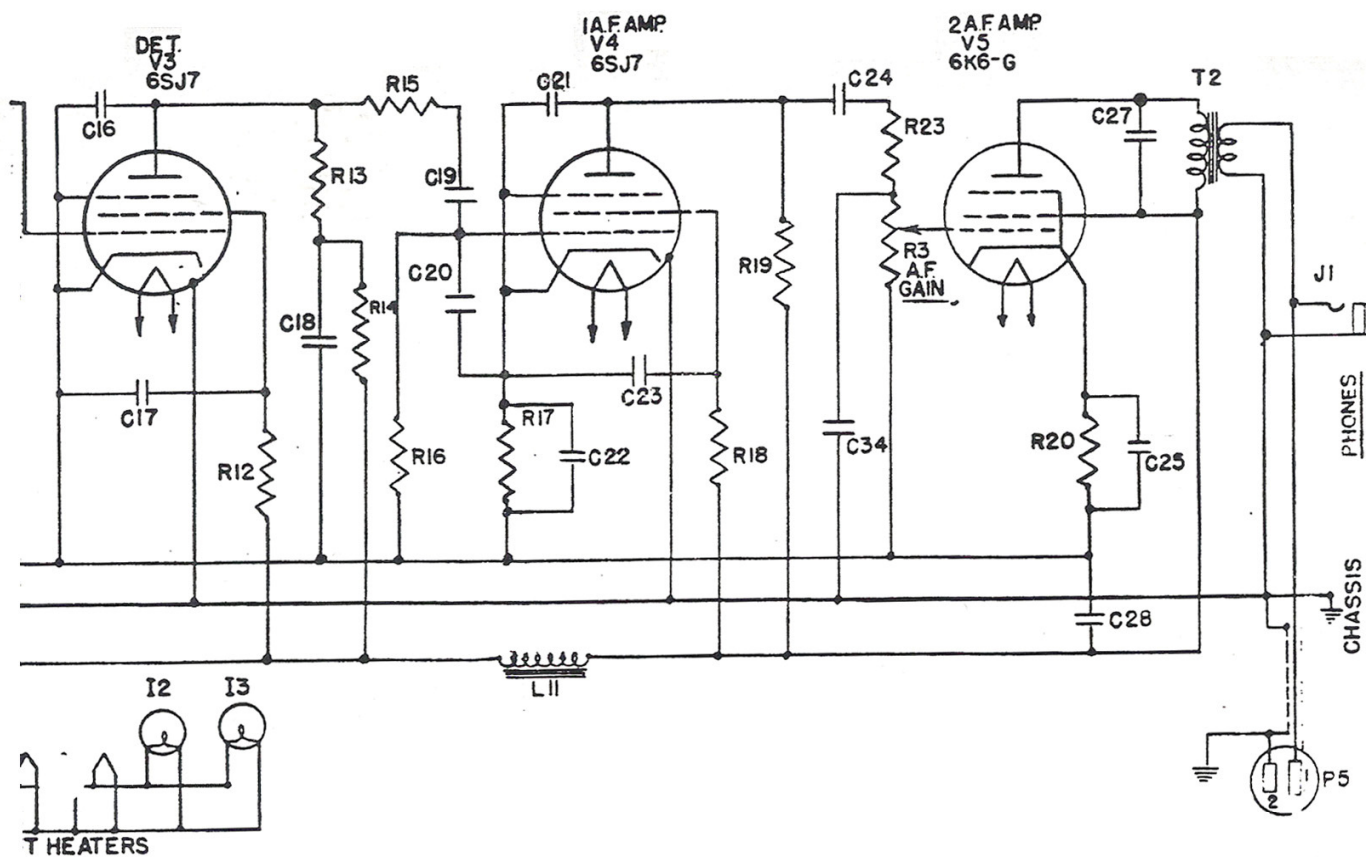
If these circuits appear to require trimming, withdraw the chassis from the cabinet, tune in a signal or background noise on range D, in the region from 500 to 650 kc. Adjust the trimmer marked D for maximum response to the signal or noise. On range C, tune in a signal or background noise in the region from 200 to 260 kc and adjust the trimmer marked C for maximum response.











BOTTOM VIEW OF SOCKETS

USED WITH	ASSEMBLY DWG.	ISSUE. A 3-24-42 H.H.	FEDERAL TELEGRAPH CO. NEWARK, N.J.
RADIO RECEIVERS 128AZ USCG RC-123	F-25305-1-4		
SCHEMATIC DIAGRAM MARINE RADIO RECEIVER			
		H.W.R.	F-31953-3 L

RADIO RECEIVER 128A2

VOLTAGE CHECK AT TUBE SOCKETS

All tubes in their respective sockets.
6 volt A battery. 90 volt B battery.
Chassis is negative in every measurement.
Regeneration just above point of oscillation.
USE 1000 OHMS-PER-VOLT METER

<u>Prong</u>	<u>V1</u>	<u>V2</u>	<u>V3</u>	<u>V4</u>	<u>V5</u>
1	0	0	0	0	-
2	0	0	0	0	0
3	(a)(d)	(c)(d)	0	0.4(e)	86
4	0	-	0	0	88
5	(a)(d)	0	0	0.4(e)	0
6	(b)(d)	-	16(d)	11 (d)	-
7	5	6	6	6	6
8	90	0	16(d)	14 (d)	9.0(f)

- (a) R-F gain max. 2.5 volts; R-F gain min. 31 volts.
(b) R-F gain max. 50 volts; R-F gain min. 62 volts.
(c) Regeneration max. 14 volts; regeneration min. 0 volts.
(d) Use 150 volt range.
(e) Use 7.5 volt range.
(f) Use 75 volt range.

DC RESISTANCE VALUES IN OHMS

All Values Are $\pm 10\%$ Except R22

R1	50,000	R11	1.0 meg	R21	47,000
R2	50,000	R12	470,000	R22	550
R3	500,000	R13	100,000	R23	1.0 meg
R4	10,000	R14	47,000		
R5	100,000	R15	27,000	F4	7.4
R6	680	R16	470,000		
R7	47,000	R17	1,800		
R8	27,000	R18	1.0 meg	L11	200
R9	100,000	R19	270,000	L13	405
R10	47,000	R20	1,800	L14	405

<u>RF Coil</u>	<u>Circuit and Range</u>	<u>Primary</u>	<u>Secondary</u>	<u>Tickler</u>
L1	Ant. A	29.	139.	-
L2	Ant. B	4.0	23.3	-
L3	Ant. C	2.1	13.6	-
L4	Ant. D	0.84	5.4	-
L5	R.F. C	-	13.6	-
L6	R.F. D	-	5.4	-
L7	Det. A	33.	139.	9.8
L8	Det. B	6.6	23.3	1.4
L9	Det. C	4.1	13.6	0.86
L10	Det. D	1.4	5.4	0.42

Transformer T1: Primary 58; Secondary 0.35

Transformer T2: Primary 1400; Secondary 34.

TABLE OF REPLACEABLE PARTS

REF. NO.	STOCK NO.	NAME OF PART	DESCRIPTION	FUNCTION	DRAWING NO.
Radio Receivers 128A and 128AY					
TB2		Terminal Board	4 Terminal H. B. Jones Type 50	Antenna	P-25302-1-2
TB3		Terminal Board	2 Terminal H. B. Jones Type 50	Phone	P-25302-1-3
V1		Tube	6SK7 (or 6SK7-GT)	R-F Amplifier	
V2		Tube	6J5 (or 6J5-GT or 6J5-G)	Oscillator	
V2A		Tube	6SJ7 (or 6SJ7-GT)	Detector	
V4		Tube	Same as V3	1 A-F Amplifier	
V5		Tube	6K6-G (or 6K6-GT)	2 A-F Amplifier	
V6		Tube	35Z5-GT	Rectifier	

TABLE OF REPLACEABLE PARTS

REF. NO.	STOCK NO.	NAME OF PART	DESCRIPTION	FUNCTION	DRAWING NO.
Radio Receivers 128A and 128AY					
F3		Fuse	5 Amp., Type 3AG	A Battery	Littlefuse 1080
F4		Fuse	1/8 Amp., Type 3AG	B Battery	Littlefuse 1044
I1		Pilot Light	6 - 8 V., .15 Amp. Bayonet Base Brown Bead		Mazda 47
I2		Dial Light	Same as I1		
I3		Dial Light	Same as I1		
J1		Jack	Midget Open Circuit	Phone	Vakley A1
L1		Coil	Ant. Coil Band A		F-25325-2-1
L2		Coil	Ant. Coil Band B		F-25325-2-3
L3		Coil	Ant. Coil Band C		F-25326-2-1
L4		Coil	Ant. Coil Band D		F-25326-2-4
L5		Coil	R-F Coil Band C		F-25326-2-2
L6		Coil	R-F Coil Band D		F-25326-2-5
L7		Coil	Det. Coil Band A		F-25325-2-2
L8		Coil	Det. Coil Band B		F-25325-2-4
L9		Coil	Det. Coil Band C		F-25326-2-3
L10		Coil	Det. Coil Band D		F-25326-2-6
L11		Choke	20 H., 200 Ohm	Isolating Output	F-7726-1
L12		Choke	22 H., 35 MA, 405 Ohms Thornderson T-68C08, less Nameplate		F-25481-1
L13		Choke	Same as L12	Filter	
L14		Choke	Same as L12	Filter	

TABLE OF REPLACEABLE PARTS

REF. NO.	STOCK NO.	NAME OF PART	DESCRIPTION	FUNCTION	DRAWING NO.
Radio Receivers 128A and 128AY					
C20		Capacitor	Same as C6		
C21		Capacitor	Same as C8		
C22		Capacitor	Same as C15		
C23		Capacitor	Same as C5		
C24		Capacitor	Same as C6		
C25		Capacitor	Same as C15		
C26		Capacitor	Same as C10		
C27		Capacitor	.004 MF. Molded Mica		F-9234-2-23
C28		Capacitor	Same as C15		
C29		Capacitor	8 - 8 MF. Electrolytic in Can, Separate Leads 450 V.		Cornell-Dubilier KR 588A
C30		Capacitor	8 - 8 MF. Replacement Paper 450 V. (Actually 3 - 3 MF.)		Cornell-Dubilier PE CE 4808
C31		Capacitor	Same as C5		
C32		Capacitor	Same as C10		
C33		Capacitor	Same as C10		
C34		Capacitor	Same as C14		
C35		Capacitor	2 - 15 Mmf. Mica-Isolantite	Trimmer	Electro Motive Type 45-2P1 or equal
C36		Capacitor	Same as C35	Trimmer	
F1		Fuse	1 Amp., Type 3AG	Line	
F2		Fuse	Same as F1	Line	Littlefuse 1040

TABLE OF REPLACEABLE PARTS

REF. NO.	STOCK NO.	NAME OF PART	DESCRIPTION	FUNCTION	DRAWING NO.
Radio Receivers 128A and 128AY					
C1		Capacitor	Four Gang 402 Mmf. each Radio Condenser Co. Model 419	Tuning	F-24859-1
C2		Capacitor	100 Mmf. Straight Line Capacity	Antenna Trimmer	Hammarlund SM-100
C3		Capacitor	30 Mmf. Mica Trimmer. Solder lugs to be 90° to rear face of condenser base	Trim C	MEQ-30 Hammarlund
C4		Capacitor	Same as C3	Trim D	
C5		Capacitor	.05 Mf. 400 V. Paper Tubular	Coupling	Aerovox 484
C6		Capacitor	Same as C5		
C7		Capacitor	Same as C5		
C8		Capacitor	.001 Mf. Molded Mica		F-9234-2-19
C9		Capacitor	Same as C5		Aerovox 484
C10		Capacitor	.1 Mf. 400 V. Paper Tubular		
C11		Capacitor	Same as C10		
C12		Capacitor	Same as C5		
C13		Capacitor	Same as C5		
C14		Capacitor	.00025 Mf. Molded Mica		F-9234-2-5
C15		Capacitor	1.0 Mf. 200 V. Paper, Metal Case		Terminals per F-5617-2-1 Aerovox 261
C16		Capacitor	Same as C8		
C17		Capacitor	Same as C5		
C18		Capacitor	Same as C5		
C19		Capacitor	Same as C8		