31 M1-2FMQ2-1

DEPARTMENT OF THE ARMY TECHNICAL MANUAL TM 11-2434

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER ~~TO 16-30FMQ2-6~~

RADIOSONDE RECEPTOR AN/FMQ-2

RSCND

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

JULY 1951

TM 11-2434—TO 16-30FMQ2-6

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RADIOSONDE RECEPTOR AN/FMQ-2

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DEPARTMENTS OF THE ARMY AND
THE AIR FORCE
WASHINGTON 25, D. C., *16 July, 1951*

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RADIOSONDE RECEPTORS AN/FMQ-2 AND AN/FMQ-2A

CHANGES
No. 1

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *30 December 1952*

TM 11-2434/TO 16-30FMQ2-6, 16 July 1951, is changed as follows:

The title of the manual is changed to read: **RADIOSONDE RECEPTORS AN/FMQ-2 AND AN/FMQ-2A**

1. Scope

This manual contains instructions for the installation, operation, maintenance, and repair of Radiosonde Receptor **AN/FMQ-2(*)** **(figs. 1 and 3.1)**. In addition to * * * table of parts.

Note (Added). Official nomenclature followed by (*) indicates all models of the item of equipment included in this technical manual. Thus, Radiosonde Receptor AN/FMQ-2(*) represents Radiosonde Receptors AN/FMQ-2 and AM/FMQ-2A.

3. Purpose and Use

Radiosonde Receptor **AN/FMQ-2(*)** is an electronic, meteorological instrument specially designed for use with f-m (frequency-modulated) radiosondes. The instrument consists * * * a voltage regulator. All these components, except the antenna system, are contained in one rack **(figs. 1, 3, and 3.1)**.

a. Purpose. The primary purpose of Radiosonde Receptor **AN/FMQ-2(*)** is to receive and to record, in printed form, f-m signals from a balloon-carried radiosonde, such as Radiosonde AN/AMT-2A, whose transmitter is modulated at an a-f (audio-frequency) rate determined by the meteorological factors of the atmosphere. (Information on the * * * system (fig. 2).

* * * * *

4. Technical Characteristics

The general characteristics and performance data for the components of Radiosonde Receptor **AN/FMQ-2(*)** are listed in *a* through *f* below.

* * * * *

*b. Frequency Meter **TS-29(*)/FMQ-1.*** A-f range ---------- 0 * * * OD3/VR150 and OA3/VR75.

*c. Radiosonde Recorder **RD-3(*)/FMQ-1.*** Current range ----------0 * * * inch per minute.

*d. Amplifier **AM-7(*)/FMQ-1.*** Number of tubes * * * volts, 60 cps.

*e. Voltage Regulator **CN-2(*)/FMQ-1.*** Input ratings----------105 * * * cps. Phase ----------single.

* * * * *

The nomenclature column, paragraph 5, is changed as follows:

Nomenclature
Frequency Meter **TS-29(*)/FMQ-1.**
Radiosonde Recorder **RD-3(*)/FMQ-1.**
Amplifier **AM-7(*)/FMQ-1.**
Voltage Regulator **CN-2(*)/FMQ-1.**
Rack **MT-678(*)/FMQ-2.**
Radiosonde Receiver **R-228/FMQ-2.**

* * * * *

6. Description of Radiosonde Receptor AN/FMQ-2(*)

* * * * *

*b. Frequency Meter **TS-29(*)/FMQ-1*** **(figs. 3 and 3.1)**. The frequency meter * * * the radiosonde receiver. This current is measured by the visual meter on the front panel of the frequency meter, and by the recorder meter which is in the radiosonde recorder **(figs. 3 and 3.1)**. The following items are mounted on the front panel:

* * * * *

*c. Radiosonde Recorder **RD-3(*)/FMQ-1** and Amplifier **AM-7(*)/FMQ-1*** **(figs. 3 and 3.1)**. The radiosonde recorder, in combination with Amplifier **AM-7(*)/FMQ-1,** comprises an electromechanical device which makes a printed record of the frequencies measured by the frequency meter. During operation, the * * * in chapter 4.

d. Voltage Regulator ***CN–2(*)/FMQ–1.*** The voltage regulator is situated in the lower part of the rack assembly (**figs.** 3 **and 3.1**). The regulator unit * * * panel operating controls.

e. Rack ***MT–678(*)/FMQ–2*** (figs. 3, **3.1,** 4, **and 4.1**). The function of * * * the antenna assembly.

* * * * *

(4) Two dehumidifier lamps * * * climates is necessary. The lamps can be turned on and off by means of a single toggle switch. **In Rack MT–678/FMQ–2, this switch is located in front of the right-hand lamp, when viewing the rack from the rear** (fig. 4). **In Rack MT–678A/FMQ–2, it is located on the upper front panel, between the reed-type line-frequency meter and the ANT. SELECTOR switch** (fig. 3.1).

* * * * *

7. Packaging Data

Radiosonde Receptor **AN/FMQ–2**(*), less Radiosonde Receiver R–228/FMQ–2 and Antenna Assembly AS–389/FMQ–2, is packed for export in three separate boxes and packed for domestic shipment in four separate boxes, as listed in the charts below. Radiosonde Receiver R–228/FMQ–2 * * * and domestic shipment.

a. Packaged for Export.

Component	Box dimensions (in.)			Volume (cu. ft.)	Weight (lb.)
	Length	Width	Height		
Rack **MT–678(*)/FMQ–2,** Radiosonde Recorder **RD–3(*)/FMQ–1,** and Voltage Regulator **CN–2(*)/FMQ–1**	83	44	35	74	960
Frequency Meter **TS–29(*)/FMQ–1** and Amplifier **AM–7(*)/FMQ–1**	53	19½	16	9. 6	147
* *	*	*	*	*	*

b. Packaged for Domestic Shipment or for Short Movements by Using Troops.

Component	Box dimensions (in.)			Volume (cu. ft.)	Weight (lb.)
	Length	Width	Height		
Rack **MT–678(*)FMQ–2** and Radiosonde Recorder **RD–3(*)/FMQ–1**	84	40	35	68	625
Frequency Meter **TS–29(*)/FMQ–1**	20	13½	10¼	1. 6	42
Amplifier **AM–7(*)/FMQ–1**	20	11½	9½	1. 3	44
* *	*	*	*	*	*

* * * * *

7.1. Differences in Models
(Added)

Radiosonde Receptor AN/FMQ–2A differs from Radiosonde Receptor AN/FMQ–2 as follows:

a. Frequency Meter TS–29C/FMQ–1. Two capacitors C611 and C612 are connected to terminals on tube socket X607. Capacitor C611 is connected across pins 3 and 8. Capacitor C612 is connected across pins 5 and 8. These capacitors bypass parasitic oscillations generated by the thyratron tubes which occasionally affect the zero setting and l-f readings of meter M600. Pin 1 of tube socket X600 has been grounded to prevent stray pick-ups by the metal shield of tube V600. The addition of these capacitors reduces the use of the DEIONIZE switch, S601, to one function, that of correcting the operation of the circuit of the frequency meter when the visual meter, M600, is indicating in an off-scale condition. Depressing DEIONIZE switch S601 corrects this condition.

b. Radiosonde Recorder RD–3D/FMQ–1. Pins 1 and 7 of tube socket X401 in the preamplifier Radiosonde Recorder RD–3D/FMQ–1 are grounded. This provides a ground to the shield of the 6J5 tube and grounds the preamplifier chassis to the amplifier chassis through the cable instead of through the rack. This removes any possibility of nonoperation should a ground strap become disconnected.

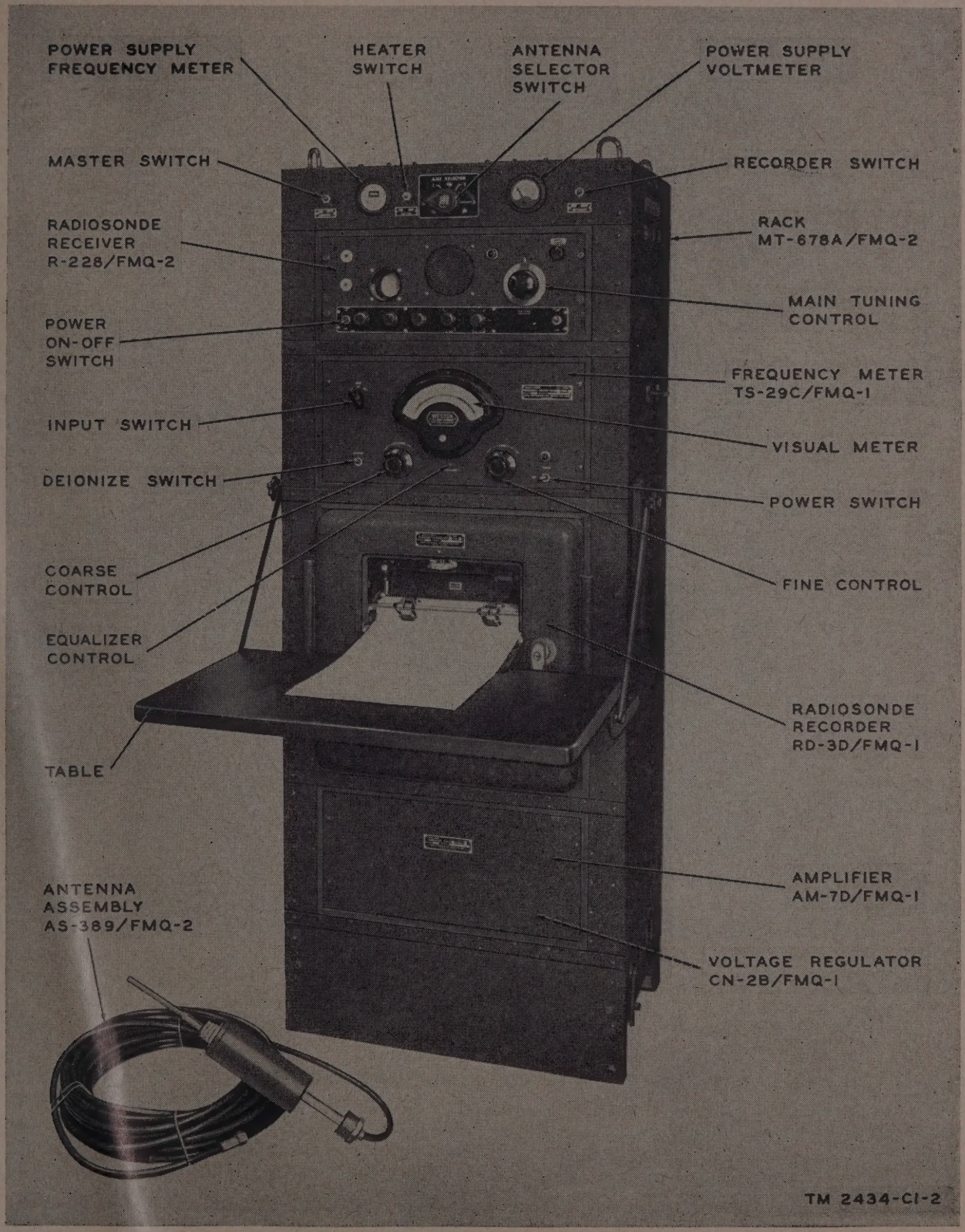


Figure 3.1 (Added) *Radiosonde Receptor AN/FMQ–2A, front view.*

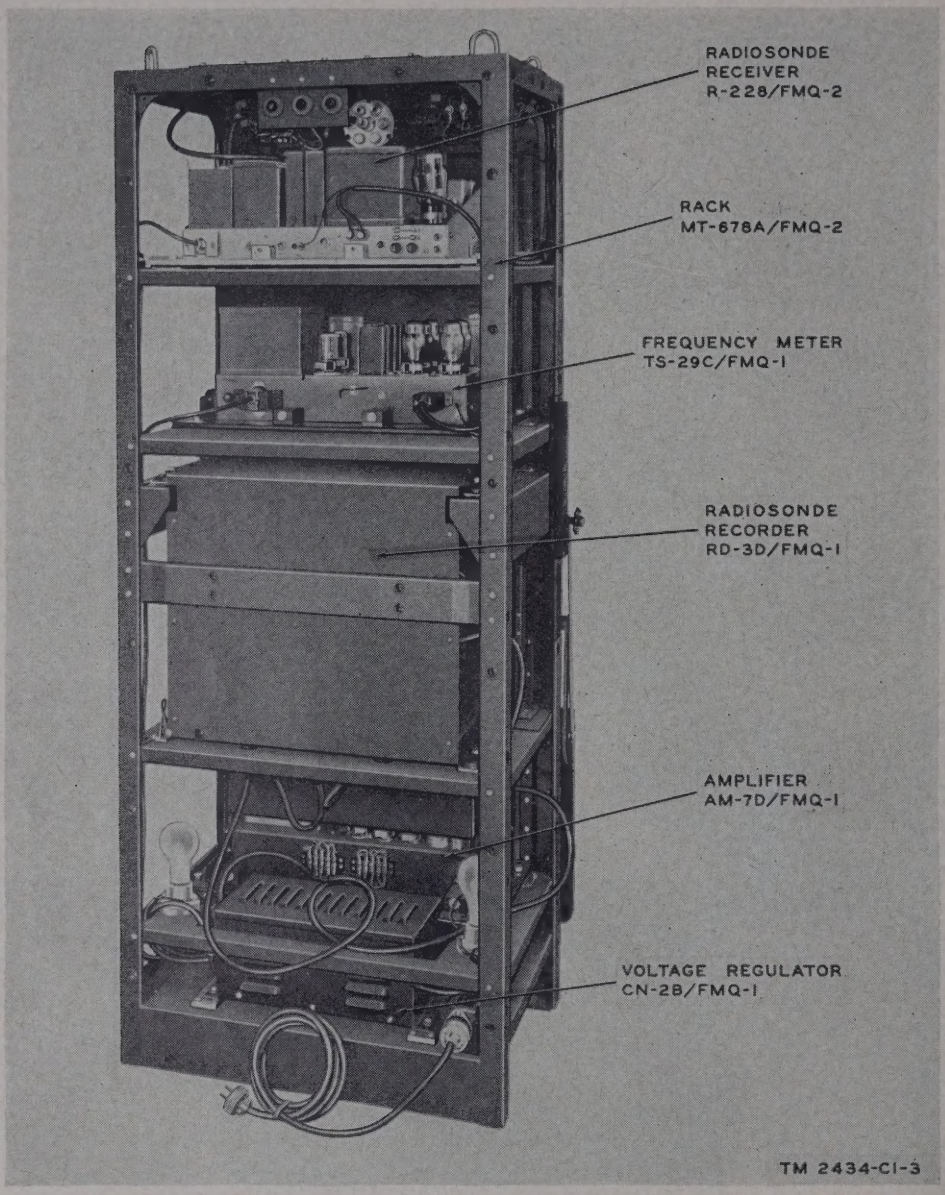


Figure 4.1 (Added) *Radiosonde Receptor AN/FMQ–2A, rear view.*

c. Amplifier AM–7D/FMQ–1. To prevent stray pick-up from the h-v windings of power transformer T201, which could falsely trigger the tapper bar, the wiring of Amplifier AM–7D/FMQ–1 has been changed by grounding the filament circuits of transformer T201 (terminals 9 and 11). Resistor R205 has been removed because it is not necessary when using the 6.3-volt secondary winding of the present transformer. In previous models, this resistor was needed as a dropping resistor, since transformer T201 has a 7.5-volt secondary.

d. Rack MT–678A/FMQ–2. Switch S505 which controls the heater lamp has been moved from its former location (the shelf in front of one of the lamps) to the control panel board at the top front of Rack MT–678A/FMQ–2. This switch is located between the reed-type line-frequency meter and the ANT. SELECTOR switch. An identification plate under the switch contains the words, "HEATER ON OFF."

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF RADIOSONDE RECEPTOR AN/FMQ-2(*)

* * * * *

10. Installation of Rack Assembly Components

All components, except * * * have been unpacked.

a. Frequency Meter ***TS-29(*)/FMQ-1,*** *Amplifier* ***AM-7(*)/FMQ-1,*** *and Radiosonde Receiver R-228/FMQ-2.*

(1) After Radiosonde Receptor **AN/FMQ-2**(*) has been unpacked, place the frequency meter amplifier, and radiosonde receiver components in position (figs. 3, **3.1**, 4, **4.1**) at their proper compartments.

* * * * *

b. Wire Connections.

(1) Connect the wiring for Radiosonde Receptor **AN/FMQ-2**(*) as shown in figures 10, **10.1**, and 11. Leads of the * * * in these figures.

* * * * *

(3) The antenna transmission * * * the radiosonde receiver.

Caution: Before connecting the radiosonde receptor to the power line, check all external and internal wiring (figs. 10, **10.1**, and 11). Carefully check the * * * to the equipment.

* * * * *

e. Installation of Ground Rod. Drive Ground Rod * * * a walking hazard.

Caution: Before connecting the radiosonde receptor to the power line, check all external and internal wiring as shown in **figures 10 and 10.1.** Carefully check the * * * to the equipment.

14. Controls and Instruments of Rack MT-678(*)/FMQ-2

(figs. 3, **3.1**, 4, **and 4.1**)

Controls and instruments	Function
ANT. SELECTOR switch (S504).	In installations involving * * * transmitter.
* *	* * *
Frequency * * * reed)--	Indicates * * * input.
HEATER ON OFF switch (S505).	**Controls the heater power to the two dehumidifier lamps.**

16. Controls and Instruments of Frequency Meter TS-29(*)/FMQ-1

(figs. 3 and 3.1)

Controls and instruments	Function
INPUT switch (S600)-------	This * * * 60~.
	* * *
	(2) In * * * radiosonde. **The DEIONIZE switch, S601, in Frequency Meter TS-29C/FMQ-1 should not be used in conjunction with the INPUT switch nor should it be used to check the zero setting of the visual and recorder meters (par. 7*a*).**
	(3) In * * * chapter 5.
* *	* * *
DEIONIZE switch (S601)---	Used * * * position. **In model TS-29C/FMQ-1. this switch is used only to deionize the thyratrons when they both become ionized at the same time. The position of the input switch is not important.**
* *	* * *

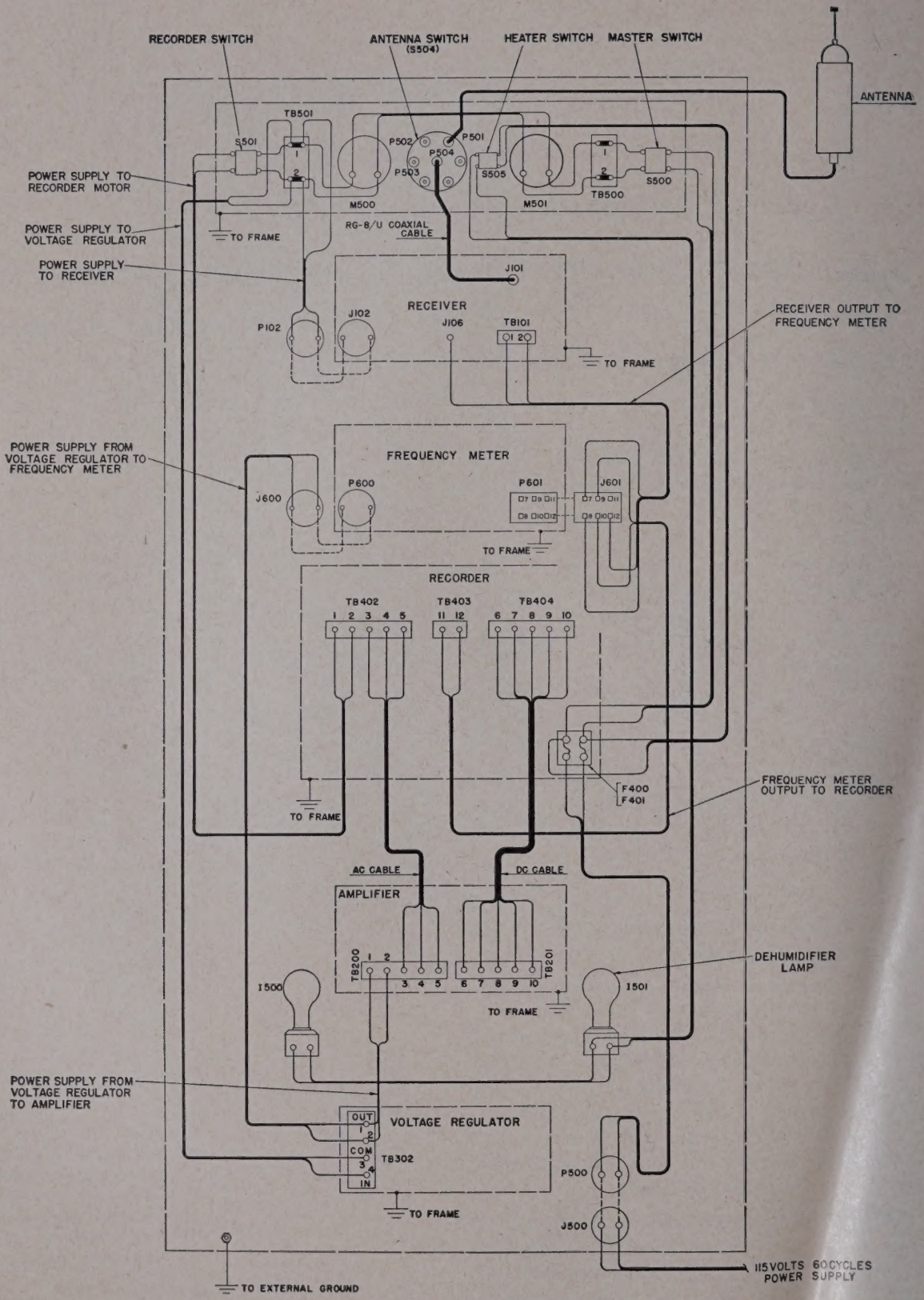


Figure 10.1 (Added) *Radiosonde Receptor AN/FMQ-2A, cording diagram.*

18. Preliminary Starting Procedure

Before using the * * * procedure given below.

* * * * *

h. Turn the INPUT switch, S600, on the frequency meter component to the SC position and, **on all models except Radiosonde Receptor AN/FMQ–2A,** momentarily press **the** DEIONIZE switch. Observe the reading * * * in paragraph 82*b*(3).

* * * * *

19. Starting Procedure

After the preliminary * * * as given below.

a. Step 1. Throw the MASTER * * * very cold climates. Turn on the dehumidifier lamps if preheating or drying is desired (**figs. 3.1 and** 4 and par. 6*e*(4)).

* * * * *

c. Step 3. Rotate the INPUT * * * the SC position. **On all models except Radiosonde Receptor AN/FMQ–2A, deionize** the thyratrons momentarily by pressing the DEIONIZE toggle switch. The visual meter * * * the proper readings.

* * * * *

21. Operating Instructions

a. General.

(1) The operation of * * * has been released. The instructions given below pertain to the operation of Radiosonde Receptor **AN/FMQ–2(**) and to the method of obtaining the record on the flight of the radiosonde. An accurate flight * * * are carefully followed.

* * * * *

e. Drift of Recorder Paper.

(1) The recorder zero * * * low-reference contacts.

(2) If it appears * * * a zero reading. **Do not use the DEIONIZE switch on Radiosonde Receptor AN/FMQ–2A.** Hold the INPUT * * * long temperature trace.

* * * * *

22. Stopping Procedure

After the record * * * a zero check. **Do not use the DEIONIZE switch on Radiosonde Receptor AN/FMQ–2A.** Then stop Radiosonde Receptor **AN/FMQ–2**(*) by turning the RECORDER ON-OFF switch and the MASTER ON-OFF switch to the OFF positions. Cut off the * * * indicate correct calibration.

23. General

The operation of Radiosonde Receptor **AN/FMQ–2**(*) may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In the following * * * unusual operating conditions.

28. Definition of Preventive Maintenance

Preventive maintenance is * * * they can occur. See **AR 750–5.**

32. Detailed Lubrication Instructions

* * * * *

e. Frequency Meter ***TS–29(*)/FMQ–1.*** Lubrication is not essential and therefore, no instructions are required.

33. Weatherproofing

* * * * *

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66 **and TB SIG 219.**

* * * * *

37. Equipment Performance Checklist for Radiosonde Receptor AN/FMQ-2(*)

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	*	*	* *	* *	*
	11	Visual meter M600_____	DEIONIZE * * * pressed.	Indicates zero. **The deionize switch must not be used for Radiosonde Receptor AN/FMQ-2A.**	Check * * * (Sec. I). Check * * * connections.
	*	*	* *	* *	*
	17	INPUT * * * S601__	Set * * * momentarily. **The DEIONIZE switch must not be used for Radiosonde Receptor AN/FMQ-2A.**	Recorder * * * zero.	Use * * * (par. 18).
	*	*	* *	* *	*

* * * * *

Figure 18. Radiosonde Receptor AN/FMQ-2(*), block diagram

Figure 19:

"AMPLIFIER AM-7B/FMQ-1" is changed to read: **AMPLIFIER AM-7(*)/FMQ-1.**

"VOLTAGE REGULATOR CN-2A/FMQ-1" is changed to read: **VOLTAGE REGULATOR CN-2(*)/FMQ-1.**

"FREQUENCY METER TS-29B/FMQ-1" is changed to read: **FREQUENCY METER TS-29(*)/FMQ-1.**

"RADIOSONDE RECORDER RD-3C/FMQ-1" is changed to read: **RADIOSONDE RECORDER RD-3(*)/FMQ-1.**

53. Frequency Meter TS-29(*)/FMQ-1 (figs. 77 and 77.1)

* * * * *

c. For *test purposes*, the input voltage is usually obtained from Frequency Standard **TS-65(*)/FMQ-1** and consists of either a square-wave or a modified square-wave of voltage, depending on the frequency of operation (fig. 34). *For purposes of* * * * *this input signal.*

54. Amplifier Stage in Frequency Meter

* * * * *

f. When the INPUT * * * tube is grounded. In this position of the switch, the meters can be calibrated to zero frequency (after momentarily depressing the DEIONIZE switch, S601 **except on Radiosonde Receptor AN/FMQ-2A).**

* * * * *

Figure 33. "R607" is changed to read: **R608** and "R608" is changed to read: **R607.**

57. Thyratron Stage Circuit Theory

* * * * *

b. A-F Input Signal Applied.

* * * * *

(2) At the same * * * of figure 32. When the difference of potential between the grid and cathode of the tube reduces (becomes less negative) to approximately −15 volts, the tube fires and plate current flows through resistor **R608.**

(3) The flow of current through the tube and resistor **R608** produces voltage drops around the circuit as shown by the solid line with an arrow in A of figure 33. Due to these * * * 884 during conduction.

* * * * *

(5) While the plate * * * (D of fig. 32.)) The capacitor charges exponentially through resistor **R607,** the charging circuit being shown by the dashed line with an arrow in A of figure 33. After charging, the * * * therefore 134 volts.

(6) During the second * * * is driven positive. When the grid voltage of tube V606 reaches the critical point (approximately −15 volts), this tube fires and its plate voltage immediately drops to +15 volts (D of fig. 32) as current flows through resistor **R607.** (See solid line with arrow in B of fig. 33.)

* * * * *

(8) After tube V606 fires, capacitor C610 charges to an opposite polarity through resistor **R608** in the circuit shown by the dashed line with an arrow in B of figure 33. The plate voltage * * * grid bias voltage.

* * * * *

58. Rectifier Stage in Frequency Meter

The rectifier stage * * * the rectifier tube.

* * * * *

b. Rectifier Tube.

* * * * *

(4) (Added) In Frequency Meter TS-29C/FMQ-1, the circuit of tube V607 utilizes two 270 $\mu\mu$f capacitors, C611 and C612, one from the plate (pin 3) to the cathode (pin 8) and one from the plate (pin 5) to the cathode (pin 8). These two capacitors tend to reduce the possibility of self-oscillation of thyratron tubes V605 and V606. The incorporation of these two capacitors in the circuit reduces the use of DEIONIZE switch S601 to one function; that of correcting the *off-scale* reading of the visual meter, M600, caused by ionization of thyratron tubes V605 and V606 which produces self-oscillation. When DEIONIZE switch S601 is depressed, the plate voltage is removed from thyratron tubes (V605 and V606), and this fault is corrected.

* * * * *

60. Radiosonde Recorder RD-3(*)/FMQ-1

* * * * *

b. A light beam * * * of the pointer. The pulse is then amplified by the pre-amplifier located in radiosonde recorder, and the amplified pulse is used to develop a large surge of current in the output of Amplifier **AM-7(*)/FMQ-1.**

* * * * *

64. Phototube Circuit

The phototube circuit * * * to voltage changes.

a. The phototube circuit consists of tube V400, capacitor C402, and resistor R400 shown in **figures 79 and 79.1.**

Note. **Figures 79 and 79.1 are** composite, schematic **diagrams** of the phototube, preamplifier, and amplifier circuits. Physically, the phototube * * * * of the diagram. All other parts shown in **these figures** are located on the chassis of Amplifier **AM-7(*)/FMQ-1.**

* * * * *

66. Amplifier AM-7(*)/FMQ-1
(figs. 79 and 79.1)

* * * * *

67. Power Supply for Amplifier AM-7(*)/FMQ-1
(figs. 79 and 79.1)
(Superseded)

a. Power transformer T201 operates on 115 volts a-c supplied through Voltage Regulator CN-2(*)/FMQ-1. The secondary of transformer T201 has four windings. One winding produces 6.3 volts for the filaments of tubes V202 and V401. Another winding has 5 volts a-c for the filaments of tube V203. The third winding provides 6.3 volts to power the exciter lamp I400 in the recorder. The fourth winding provides 1,060 volts, center tapped to furnish 530 volts a-c to each plate of tube V203. The full-wave rectified voltage output of tube V203, tube type 5U4G, is filtered by the network composed of capacitors C203 and C204 and filter choke L201. Four voltage regulator tubes, V204, V205, V206, and V207, across the output of the filter network, function as voltage regulators and as voltage dividers. The output of the power supply is divided as follows:

(1) Plate of tube V204 tapped for +315 volts.
(2) Plate of tube V205 tapped for +240 volts.
(3) Plate of tube V206 tapped for +90 volts.
(4) Plate of tube V207 grounded.
(5) Cathode of tube V207 tapped for −75 volts.

b. Resistor R204 (an adjustable resistor, with a movable tap) across tube V207 is tapped to provide −25 volts bias for tube V202.

Figure 40: "P400" is changed to read: **TB 400** and "P401" is changed to read: **TB 401.**

Figure 41: Add arrow after BEARING RETAINER pointing to bearing retainer on flange.

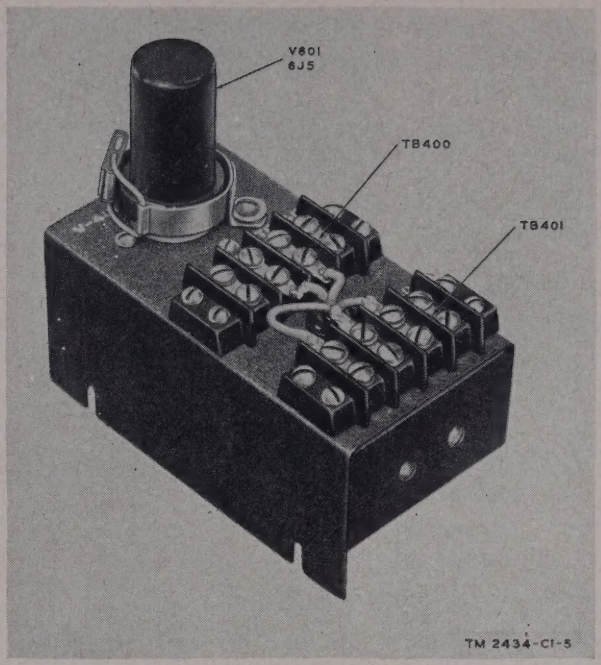


Figure 40.1 (Added) *Preamplifier for Recorder RD–3D/FMQ–1, top view.*

70. Voltage Regulator CN–2(*)/FMQ–1
(figs. 48 and 78)

The voltage regulator * * * over wide limits.

a. (Superseded) Transformer T302 has two primary windings which are connected in series across the a-c input voltage. The secondary of winding A is connected in series opposite to winding B. The windings are in a hermetically sealed case.

b. (Superseded) When the a-c voltage input increases in amplitude, the secondary voltage of windings A and B subtract to produce practically the original output voltage. If, on the other hand, the a-c voltage input decreases, the secondary voltage of windings A and B add to maintain the original output voltage.

c. (Superseded) Capacitor C302 partially resonates primary winding B and improves the regulation of the waveshape of the output voltage.

* * * * *

Figure 50: "R605" is changed to read: **R606** and "R606" is changed to read: **R605**.

72. Test Equipment

Equipment issued for use in installing, repairing, and calibrating Radiosonde Receptor **AN/FMQ–2** (*) includes the following:

* * * * *

c. Headset **HS–33**–(*), complete with Cord CD–307.

d. Frequency Standard **TS–65(*)/FMQ–1.**

* * * * *

73. Trouble-shooting Chart

The following chart * * * for the receiver.

Sympton	Probable trouble	Correction
* *	* * *	* *
3. No indication (visual meter) of modulated signal in Frequency Meter **TS–29(*)/FMQ–1.**	3. *a.* If * * * correctly.	3. *a.* Check and replace all faulty tubes in Frequency Meter **TS–29(*)/FMQ–1.** Check * * * trouble.
	3. *b.* If * * * properly.)	*b.* Check * * * trouble.
* *	* * *	* *

75. Trouble Shooting Voltage Regulator CN–2(*)/FMQ–1

Voltage Regulator **CN–2(*)/FMQ–1** seldom fails in service. If, however, it * * * the following procedures:

* * * * *

Figure 51: "CONNECTOR" is changed to **CONNECTED** in first line of note.

76. Replacement of Parts

* * * * *

b. Most of the parts in Radiosonde Receptor **AN/FMQ–2**(*) are readily accessible and may be replaced if found to be faulty. In all cases, * * * making the replacement.

* * * * *

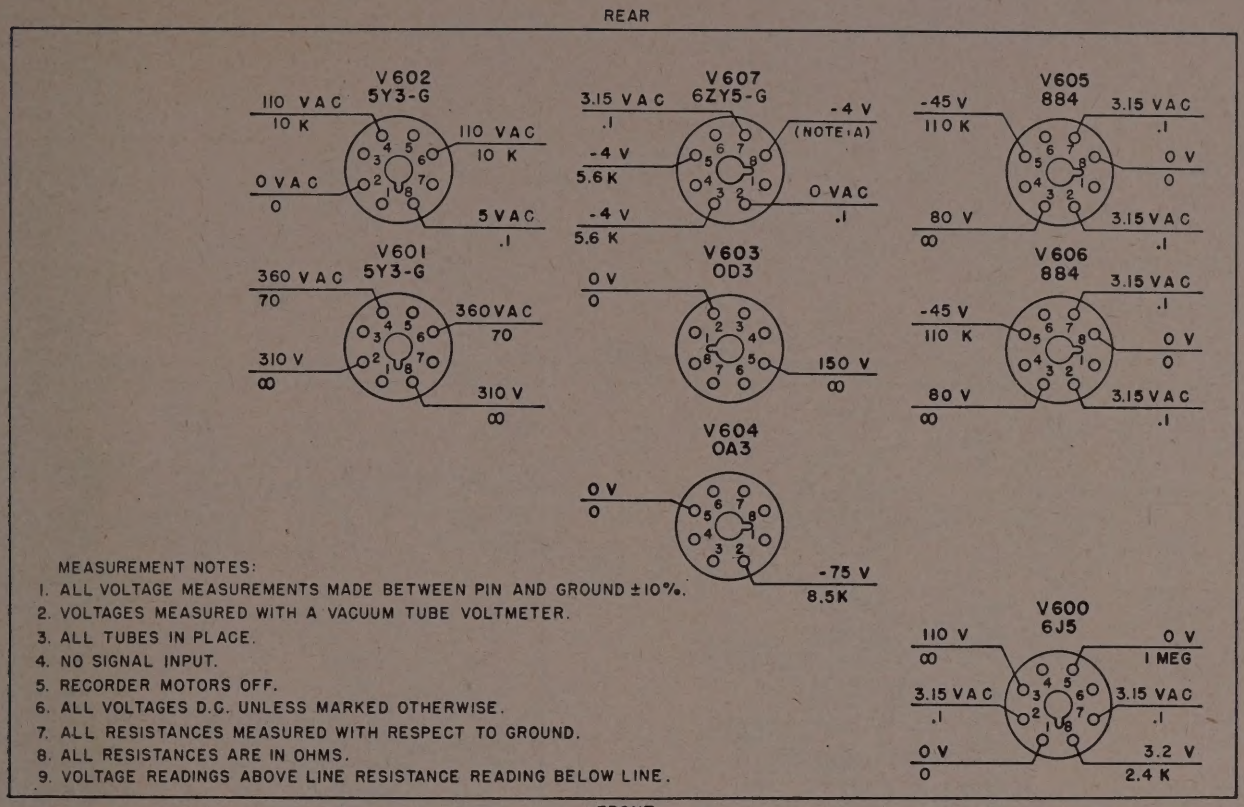


Figure 52 (Superseded) *Frequency Meter TS–29B/FMQ–1 and Frequency Meter TS–29C/FMQ–1, normal tube socket voltage and resistance measurements.*

Figure 58. Radiosonde Receiver R–228/FMQ–2, bottom view, all components except capacitors.

* * * * *

Figure 60. Radiosonde Receiver R–228/FMQ–2, rear view, location of parts.

81. Alinement of Frequency Meter TS–29(*)/FMQ–1

Alinement means making * * * can be determined.

82. Alinement Procedure For Frequency Meter

a. Requisites and Preparation for Alinement. Alinement can be * * * are functioning satisfactorily.)

* * * * *

(4) **For Radiosonde Receptor AN/FMQ–2 with** the INPUT switch (S600) on SC and the DEIONIZE switch (S601) momentarily depressed, the visual meter must read .0 and the recorder print falls where it may.

Note. Whenever the INPUT * * * be momentarily depressed.

(4.1) (Added) For Radiosonde Receptor AN/FMQ–2A, with the INPUT switch (S600) on SC, the visual meter must read 0 and the recorder print falls where it may.

Note (Added) The DEIONIZE switch never must be depressed to obtain a zero reading for Radiosonde Receptor AN/FMQ–2A.

* * * * * * * * * *

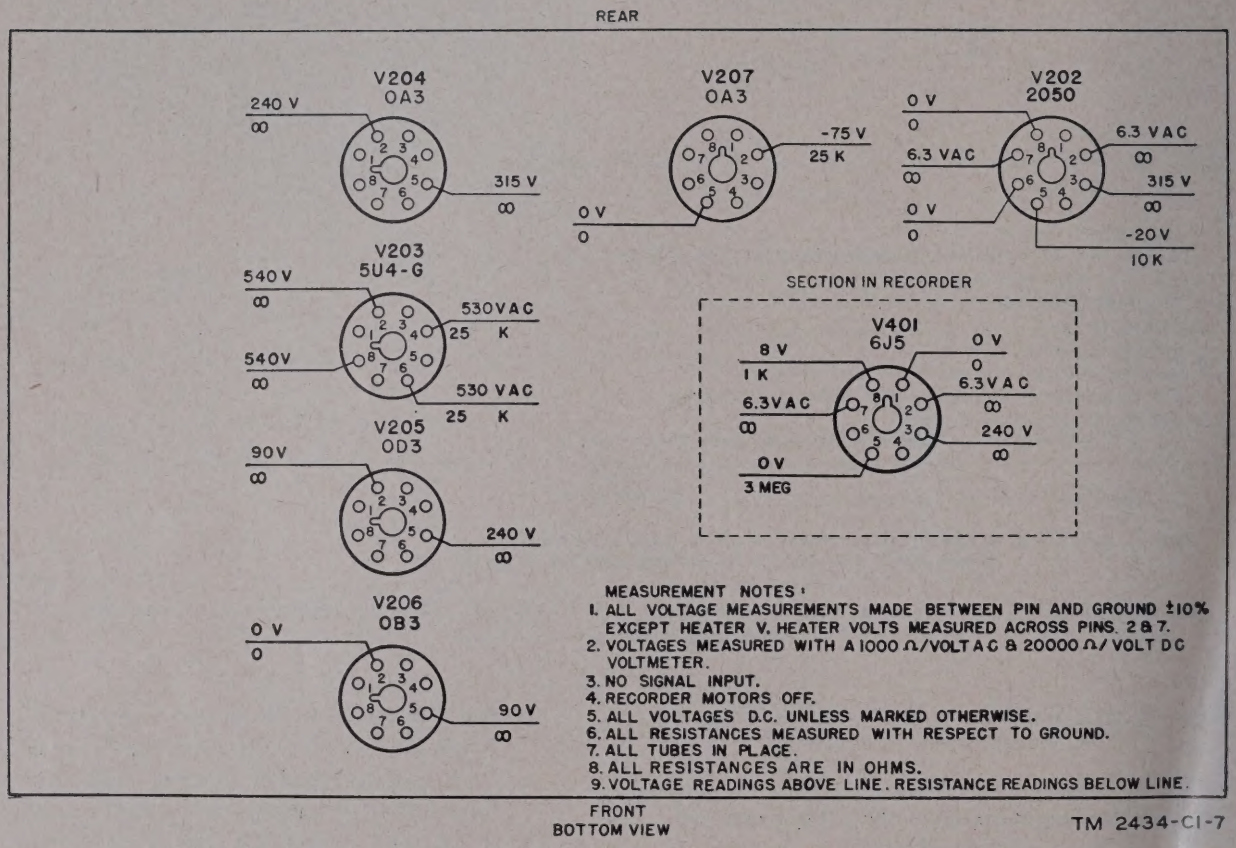


Figure 54 (Superseded) *Amplifier AM-7B/FMQ-1, normal tube socket voltage and resistance measurements.*

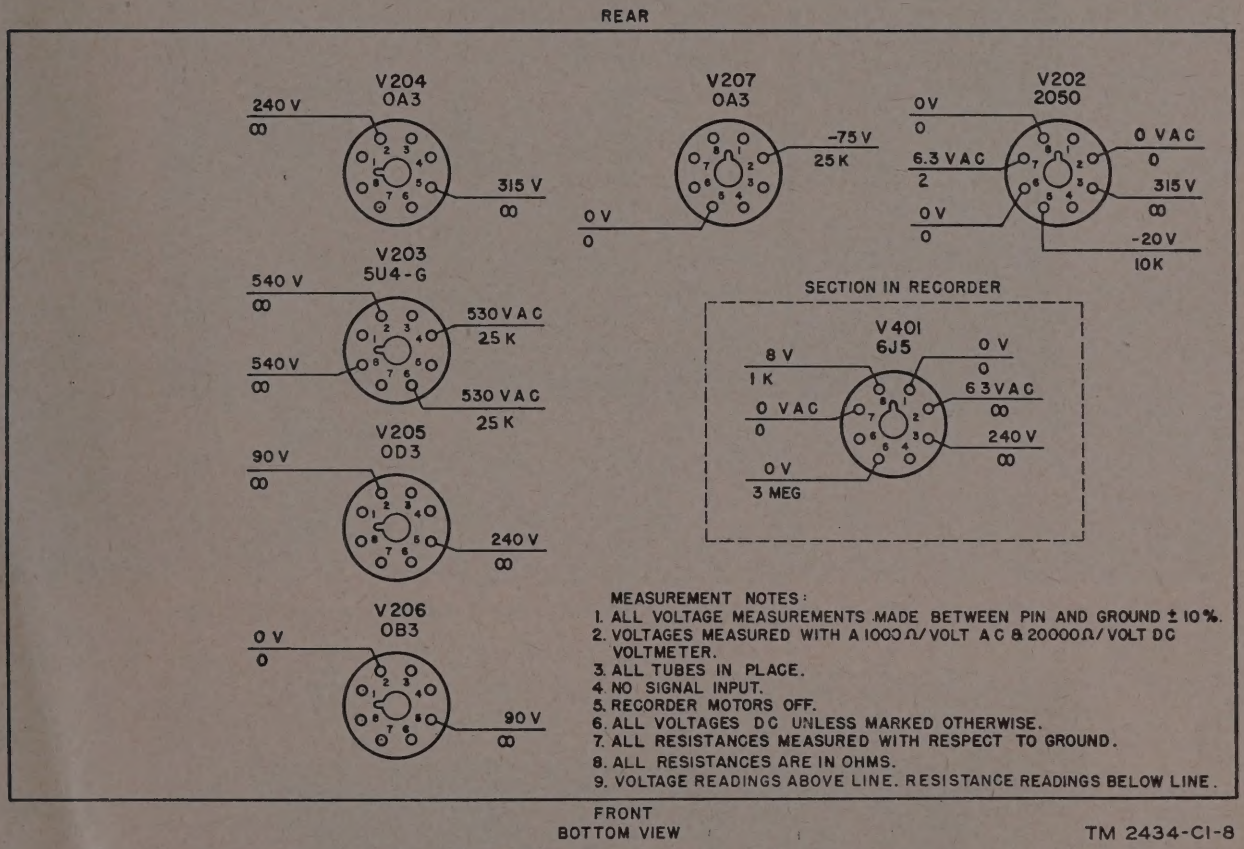


Figure 54.1 (Added) *Amplifier AM-7D/FMQ-1, normal tube socket voltage and resistance measurements.*

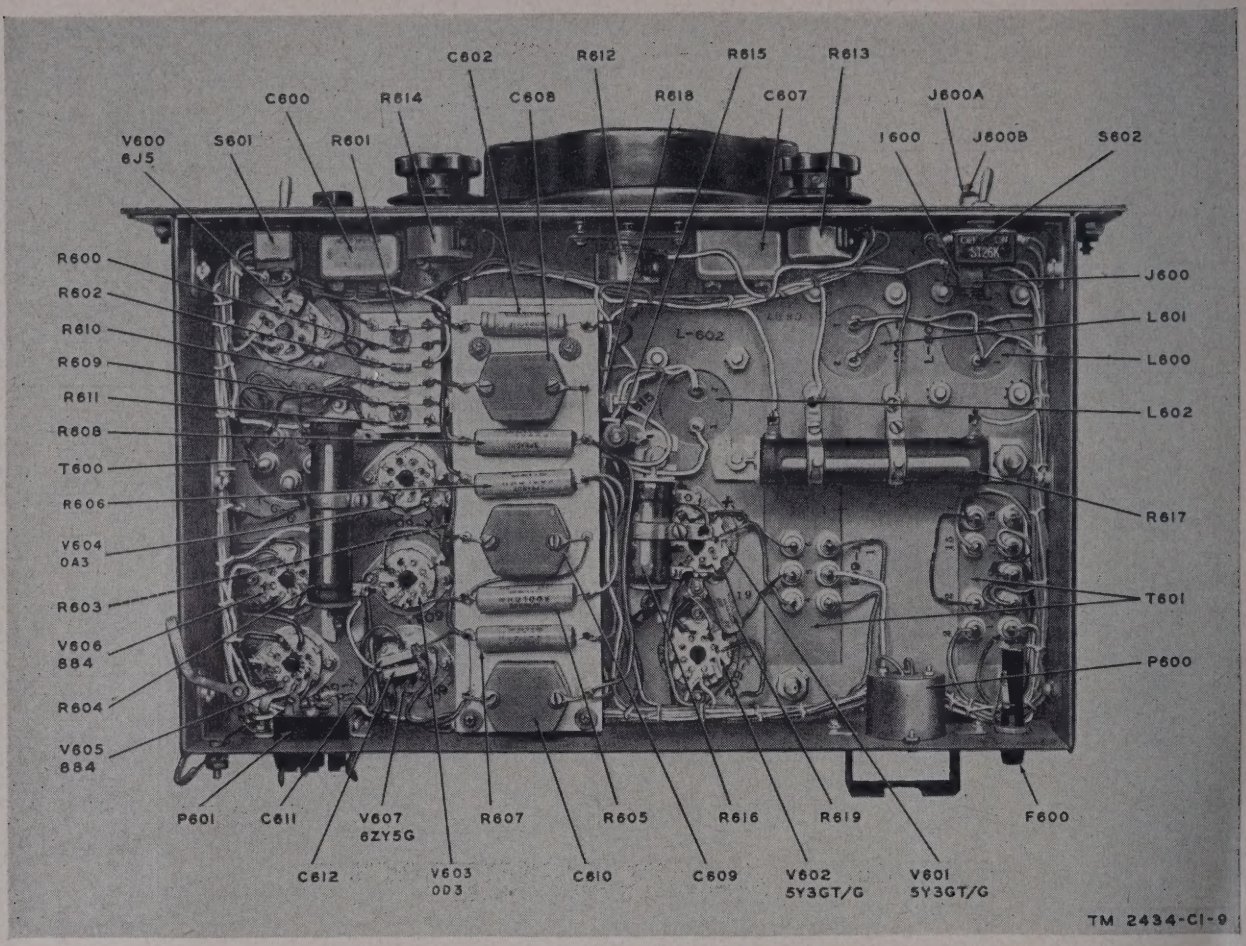


Figure 62.1 (Added) *Frequency Meter TS–29C/FMQ–1, bottom view, location of parts.*

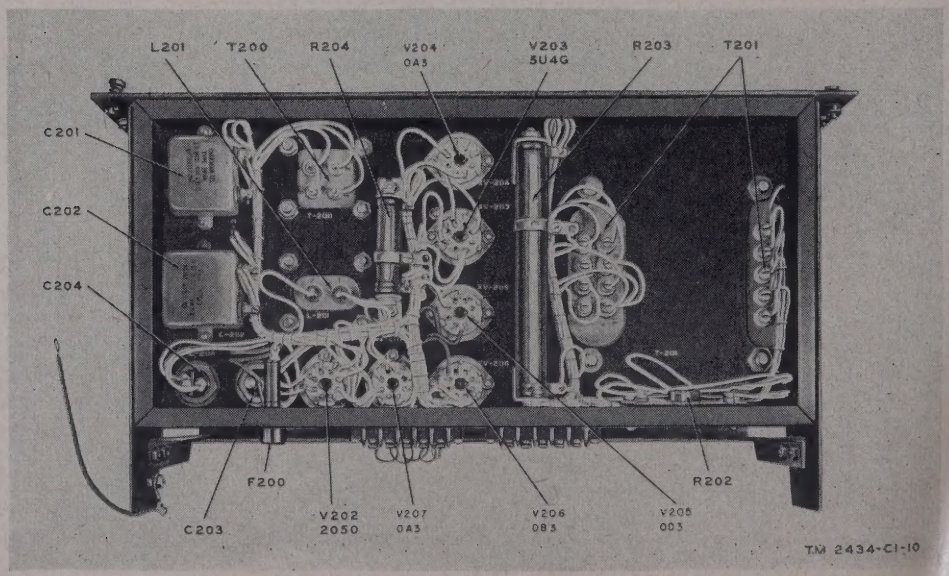


Figure 64.1 (Added) *Amplifier AM–7D/FMQ–1, bottom view, location of parts.*

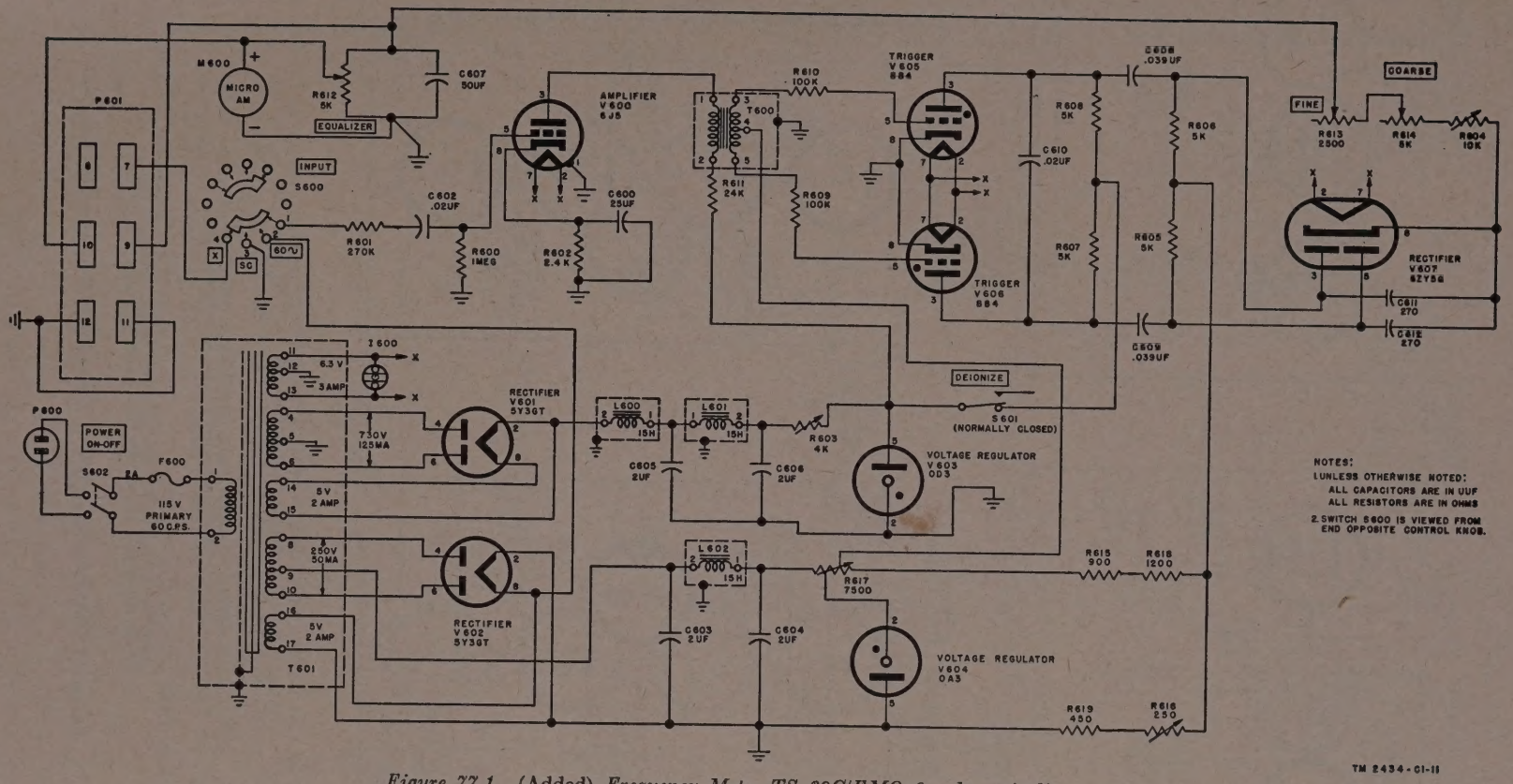
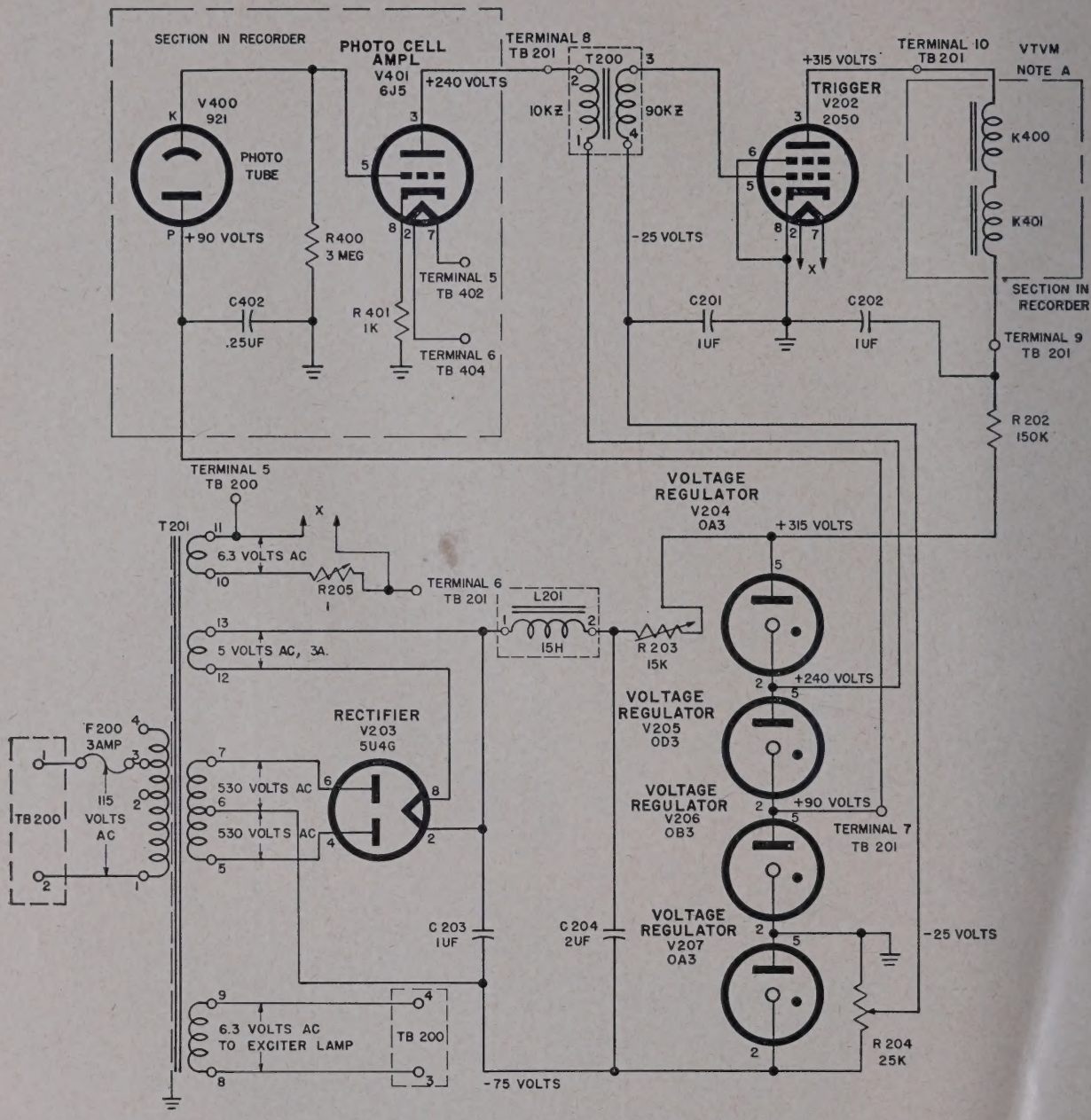


Figure 77.1 (Added) *Frequency Meter TS–29C/FMQ–2, schematic diagram.*

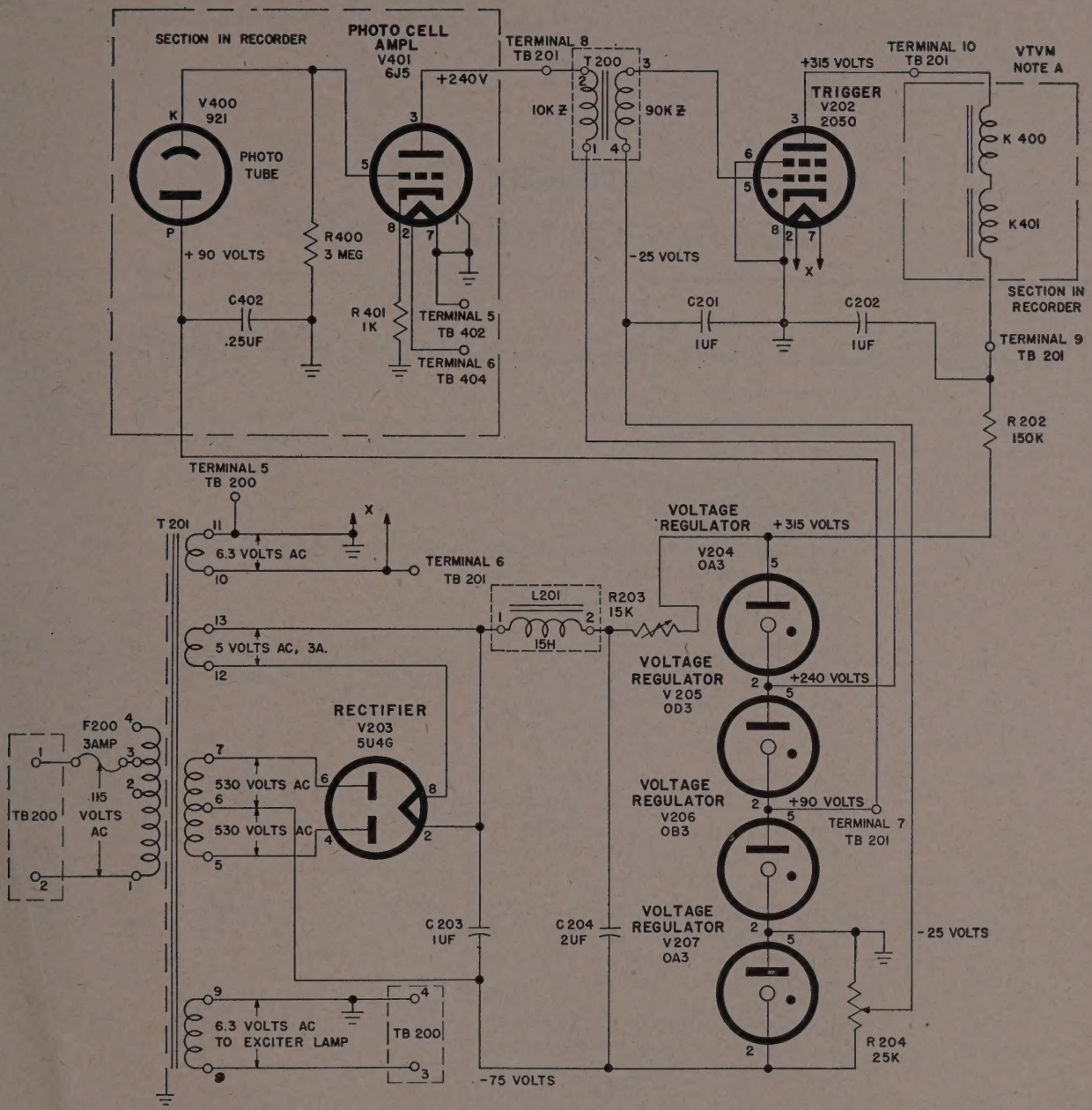


NOTES: 1. ALL VOLTAGES MEASURED WITH RESPECT TO GROUND ±10%.
2. VOLTAGES MEASURED WITH A 5,000-OHMS-PER-VOLT METER.
3. ALL RESISTANCE MEASURED WITH RESPECT TO GROUND ±10%.
4. ALL TUBES IN PLACE.
5. ALL MEASUREMENTS WITH NO INPUT TO RECORDER METER.
6. UNLESS OTHERWISE NOTED ALL CAPACITORS ARE IN UUF AND ALL RESISTORS ARE IN OHMS.

SPECIAL NOTES: A. +315 VOLTS WITH VTVM.
+240 VOLTS WITH 1,000-OHMS-PER-VOLT METER, 1,000-VOLT SCALE.
+190 VOLTS WITH 1,000-OHMS-PER-VOLT METER, 250-VOLT SCALE.

TM 2434-CI-12

Figure 79 (Superseded) *Amplifier AM-7B/FMQ-1, schematic diagram.*



NOTES: 1. ALL VOLTAGES MEASURED WITH RESPECT TO GROUND ± 10%.
2. VOLTAGES MEASURED WITH A 5,000-OHMS-PER-VOLT METER.
3. ALL RESISTANCES MEASURED WITH RESPECT TO GROUND ± 10%.
4. ALL TUBES IN PLACE.
5. ALL MEASUREMENTS WITH NO INPUT TO RECORDER METER.
6. UNLESS OTHERWISE NOTED, ALL CAPACITORS ARE IN UUF AND ALL RESISTORS ARE IN OHMS.

SPECIAL NOTES: A. +315 VOLTS WITH VTVM.
+240 VOLTS WITH 1,000-OHMS-PER-VOLT METER, 1,000-VOLT SCALE.
+190 VOLTS WITH 1,000-OHMS-PER-VOLT METER, 250-VOLT SCALE.

TM 2434-CI-13

Figure 79.1 (Added) *Amplifier AM-7D/FMQ-1, schematic diagram.*

APPENDIX II

IDENTIFICATION TABLE OF PARTS

* * * * * * *

2. Identification Table of Parts for Radiosonde Receptor AN/FMQ–2 and AN/FMQ–2A.

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	RADIOSONDE **RECEPTORS** AN/FMQ–2 **and AN/FMQ–2A:** F–M reception; 390–410 mc in 1 band.	Reception * * * radiosonde..	7A1326–2
	AMPLIFIERS AM–7B/FMQ–1, **AM–7C/FMQ–1, AM–7D/FMQ–1, and AM–7E/FMQ–1:** A-F; 22″ wd x 13″ d x 10″ h.	Builds * * * coils.....	7A46–7
*	* * *	* *	*
	FREQUENCY **METERS** TS–29B/FMQ–1 **and TS–29C/FMQ–1:** 0–200 cyc indicating in 100 meter graduations; 115 v, 60 cyc, 1 ph; 22″ wd x 13″ d x 10″ h.	Indicates * * * transmission.	7A889–29
*	* * *	* *	*
	RACKS MT–678/FMQ–2 **and MT–678A/FMQ–2:** steel; empty; approx 72″ h x 28″ wd x 26″ d; includes folding table.	Houses * * * AS–389/FMQ–2.	2Z7383–678
*	* * *	* *	*
	RADIOSONDE RECORDERS RD–3B/FMQ–1, RD–3C/FMQ–1, **and RD–3D/FMQ–1;** chart; printed dot type; approx 21″ **wd x 18¾″** h x 19″ d o/a; 100 v, 60 cyc.	Records * * * meter.....	7A1326–3
	VOLTAGE **REGULATORS** CN–2/FMQ–1, **CN–2A/FMQ–1, and CN–2B/FMQ–1:** input 90–130 v A-C, 2.3 amp, 60 cyc, output 115 v A-C, 1.3 amp, 60 cyc; approx 5⅜″ h x 5¾″ d x 15″ wd o/a.	Regulates * * * receptor....	7A1680
*	* * *	* *	*

5. Identification Table of Parts for Amplifiers AM–7B/FMQ–1, AM–7C/FMQ–1, and AM–7D/FMQ–1

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIERS AM–7B/FMQ–1, AM–7C/FMQ–1, and AM–7D/FMQ–1: approx 22″ wd x 13″ d x 10″ h.	Builds * * * coils.....	7A46–7
*	* * *	* *	*

6. Identification Table of Parts for Voltage Regulators CN–2A/FMQ–1 and CN–2B/FMQ–1

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	VOLTAGE REGULATORS CN–2A/FMQ–1 and CN–2B/FMQ–1: input 95–130 v, 2.3 amp, 60 cyc; output 115 v ±5%; 1.3 amp, 60 cyc; approx 5¾″ h x 5¾″ d x 15″ wd o/a.	Regulates * * * equipment	7A1680
*	* * *	* *	*

7. Identification Table of Parts for Radiosonde Recorders RD–3B/FMQ–1, RD–3C/FMQ–1, and RD–3D/FMQ–1

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	RADIOSONDE RECORDERS RD–3B/FMQ–1, RD–3C/FMQ–1, and RD–3D/FMQ–1: chart; printed dot type; 18¾″ h x 21″ wd x 19″ d; 110 v; 60 cyc.	Makes printed record of frequencies indicated by Frequency Meter TS–29(*)/FMQ–1.	7A1326–3
*	* * *	* *	*

8. Identification Table of Parts for Racks MT–678/FMQ–2 and MT–678A/FMQ–2

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	RACKS MT–678/FMQ–2 and MT–678A/FMQ–2: steel; empty; approx 72″ h x 28″ wd x 26″ d; includes folding table.	Houses * * * components	7A8337–47
*	* * *	* *	*

9. Identification Table of Parts for Frequency Meters TS–29B/FMQ–1 and TS–29C/FMQ–1

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	FREQUENCY METERS TS–29B/FMQ–1 and TS–29C/FMQ–1: u/w radiosonde equip; 0–200 cps in 1 band; 22″ wd x 13″ d x 10″ h.	Indicates * * * transmission	7A889–29
*	* * *	* *	*
C610	CAPACITOR * * * #CM60B203G	Plate * * * 55	3K6020323
C611, C612 (Added)	CAPACITOR, fixed: mica; 270 μμf ±10%; 500 vdcw; JAN type #CM20B271K.	Bypass parasitic oscillations generated by the thyratron tube V607.	3K2027121
*	* * *	* *	*

[AG 413.44 (19 Nov 52)]

By order of the Secretaries of the Army and the Air Force:

Official:
WM. E. BERGIN
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The Adjutant General

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NG: Same as Active Army except one copy to each unit.
ORC: Same as Active Army except one copy to each unit.
For explanation of distribution formula, see SR 310–90–1.

U. S. GOVERNMENT PRINTING OFFICE: 1953

MWO SIG 11–2590–3
TO 16–30 FIA 1–101

16-30 FIA 1-101

DEPARTMENT OF THE ARMY MODIFICATION WORK ORDER

Department of the Army . . . . . Washington 25, D. C., 8 September 1952

MODIFICATION OF AUDIO DISTRIBUTING CENTRAL AN/FIA–1 TO PROVIDE A REPLACEMENT FOR THE CRYSTAL ARM ASSEMBLY (BRUSH PL–20)

Note. Apply this modification in accordance with conditions specified in paragraph 8.

1. Major item affected:

Name: Audio Distributing Central AN/FIA–1.

Signal Corps stock No.: 6C190–1.

Reference: TM 11–2590.

2. Part modified:

Name: Console OA–23/FIA–1.

Signal Corps stock No.: 6C150–23.

3. Purpose of modification: To provide a replacement for the crystal-arm assembly (Brush PL–20) with a dual purpose arm assembly, upon failure of the original crystal-arm assembly.

4. Drawings required to apply modification:

a. Figure 1. Drilling layout and location of arm assembly wooden spacer block.

b. Figure 2. Installation of new arm assembly.

c. Figure 3. Location of resistor and leads for crystal-arm assembly.

d. Figure 4. Circuit diagram showing modification.

5. Parts affected by modification:

a. New parts required:

Signal Corps stock No.	*Quantity*	*Nomenclature or description*
2Z5727–177	1 (*ea*)	Modification kit consisting of the following:
6C174–8	1 (*ea*)	Arm, reproducer: sound; with dual purpose cartridge; frequency range 50–10,000 cps; two removable needles in cartridge; minimum needle pressure 6 grams; output .5 volt at 1000 cps; metal; opalescent gray; 11¾″ o/a lg; single ½″ hole mounting; for reproducing standard or microgroove recordings.
NSNR	1 (*ea*)	Block; as per Signal Corps dwg #SC–B–84312.
NSNR	1 (*ea*)	Label: decalcomania as per Signal Corps dwg #SC–B–68643.
6C295–5	4 (*ea*)	Needle: record; osmium (spares).
6C295–6	4 (*ea*)	Needle: record; osmium (spares).
3RC20BF305J	1 (*ea*)	Resistor: fixed, comp; 3 megohms ±5%, ½ watt insulated.
6L5000	3 (*ea*)	Washer: brass; No. 6; (cadmium plated) ⅜″ OD, .147″ ID, .032″ thk.

b. Alternate parts: None.

c. Discarded parts:

Signal Corps stock No.	*Quantity*	*Nomenclature or description*
6C173	1 (*ea*)	Arm assembly: sound reproducer, consists of arm wired, arm rest, round base, xtal or ceramic cartridge w/sapphire stylus.
3RC20BF515J	1 (*ea*)	Resistor: fixed, comp; 5.1 megohm.

d. Supply of parts required:

(1) Source of supply: Requisition through regular channels. Requisition for these parts will cite, as a basis, this modification work order number and date.

(2) Date available: August 1952.

6. Special tools, test equipment, jigs, and fixtures: None.

7. Special instructions:

a. Applied by: Field radio repair supervisor (MOS–1648) or equivalent Signal Service personnel.

b. Time required: Approximately 1 man-hour.

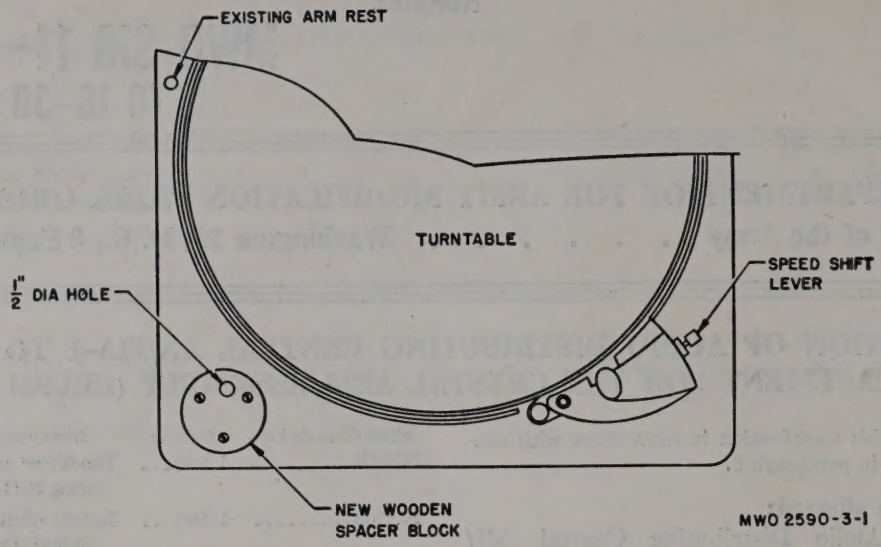


Figure 1. Drilling layout and location of arm assembly wooden spacer block.

c. Procedure of operation:

(1) Remove the dynamic reproducer head from the arm to prevent damage to the head.

(2) Remove the screws which hold the turntable assembly to the cabinet.

(3) Lift the turntable assembly up and place it in a vertical position on the top of the cabinet.

(4) Unsolder and remove the crystal-arm assembly leads from terminal board E2204 and terminal No. 1 of the equalizer (fig. 3).

(5) Remove the three screws which hold the crystal-arm assembly to the turntable base plate. Remove the assembly and the wooden spacer.

(6) Unsolder and remove the 5.1-megohm resistor R2201 which is connected between terminal board E2204 and terminal No. 6 on the equalizer.

(7) Mount the new wooden spacer block in position as shown in figure 1. Use the existing holes and the original screws.

(8) Using the half-inch hole in the block as a guide, locate and scribe the position of the hole on the turntable base plate. Remove the block.

(9) Using the scribed location, center-punch and drill a ⅝-inch hole in the turntable base plate.

(10) To fasten the new arm assembly to the new wooden spacer block, use one ¼-inch spacer, one ⅛-inch spacer, and the flat washer and nut (A of fig. 2).

(11) Mount the new arm assembly to the base plate in the position shown at B in figure 2. Use the original screws and the three No. 6 flat washers.

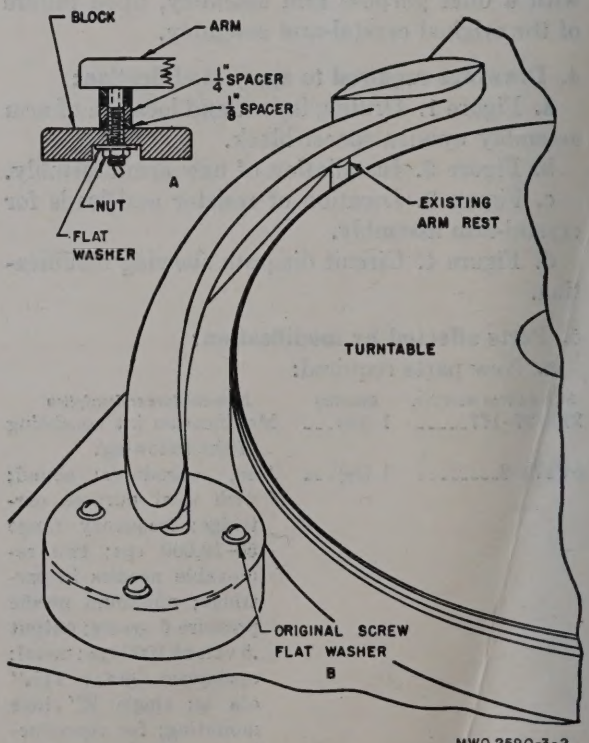


Figure 2. Installation of new arm assembly.

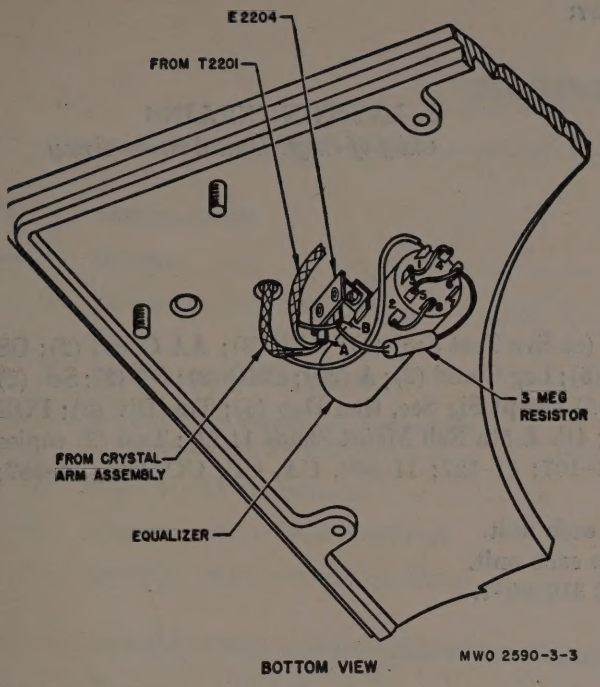


Figure 3. Location of resistor and leads for crystal-arm assembly.

(12) Connect and solder the shield lead from the new arm assembly to terminal A of terminal board E2204 (fig. 3).

(13) Connect and solder the inner conductor from the new arm assembly to terminal No. 1 of the equalizer (fig. 3).

(14) Connect and solder a 3-megohm resistor to terminal B of terminal board E2204 and to terminal No. 6 of the equalizer (fig. 3).

(15) Check the circuit (fig. 4).

(16) Replace the turntable assembly in the cabinet. Use the original screws.

(17) Replace the dynamic reproducer head in its original position.

(18) Apply the TURNOVER KNOB POSITION decalcomania to the turntable base plate, adjacent to the reproducer head, in accordance with instructions supplied with the decalcomania.

(19) Check the over-all performance of the equipment.

(20) Ink or paint the letters MWO SIG and the modification work order number, as shown on the front page of this publication, on the base plate adjacent to the new crystal reproducer. When modified equipment is packed or crated, clearly mark the letters MWO SIG and the modification work order number on the exterior of the case or crate.

(21) The new reproducer arm assembly, installed on the turntable assembly, is designed to reproduce both standard and microgroove LP (long playing) records, by means of two osmium-tipped needles. Rotating the turn-over knob to the 33⅓–45 position will permit the playing of LP records. The needles are held in the reproducer head by means of friction. To replace the needles in the reproducer head, lift the old needle out with the tip of a pen knife and press the new needle gently into position. Make sure the correct needle is used in each position. With the DYN–CRS selector switch in the CRS position, the new reproducer can be set up to play standard 78–33⅓ rpm recordings, or LP 33⅓ rpm microgroove recordings.

d. Operation performed by: Field maintenance or higher Signal Service organizations.

e. Comments with reference to published modification work orders: None.

f. Disposal of discarded parts: In accordance with existing regulations.

g. Precedence: NORMAL.

h. Report of completion: None required.

8. Remarks: This modification will be applied (only upon failure of the crystal arm assembly (Brush PL–20)) to all Audio Distributing Centrals AN/FIA–1 which are:

a. In the hands of using organizations.

b. In depot stock.

c. In the depot for repair.

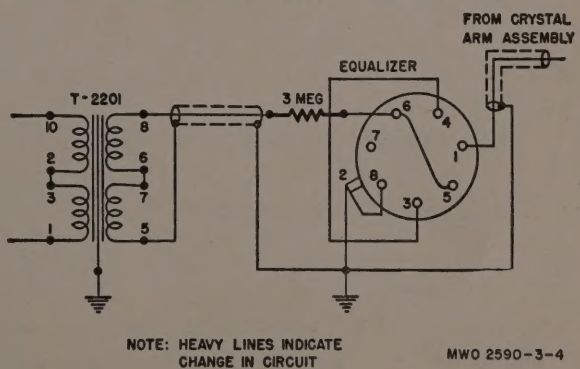


Figure 4. Circuit diagram showing modification.

[AG 300.4 (25 Aug 52)]

By order of the Secretary of the Army:

J. LAWTON COLLINS
Chief of Staff, United States Army

Official:
WM. E. BERGIN
Major General, USA
The Adjutant General

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WARNING

HIGH VOLTAGE
is used in the operation
of this equipment.

DEATH ON CONTACT
may result if operating personnel
fail to observe safety precautions.



First Aid for Electric Shock

RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire. Use extreme caution to avoid the resulting electric flash.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a medical officer, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only*, remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. If the method of transportation prohibits the use of the Shaeffer prone pressure method, other methods of resuscitation may be used. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing.

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such manner that:

(*1*) the operator's arms and thighs will be vertical while applying pressure on the small of the victim's back;

(*2*) the operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib;

(*3*) the heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim;

(*4*) the operator's elbows are straight and locked.

f. The resuscitation procedure is as follows:

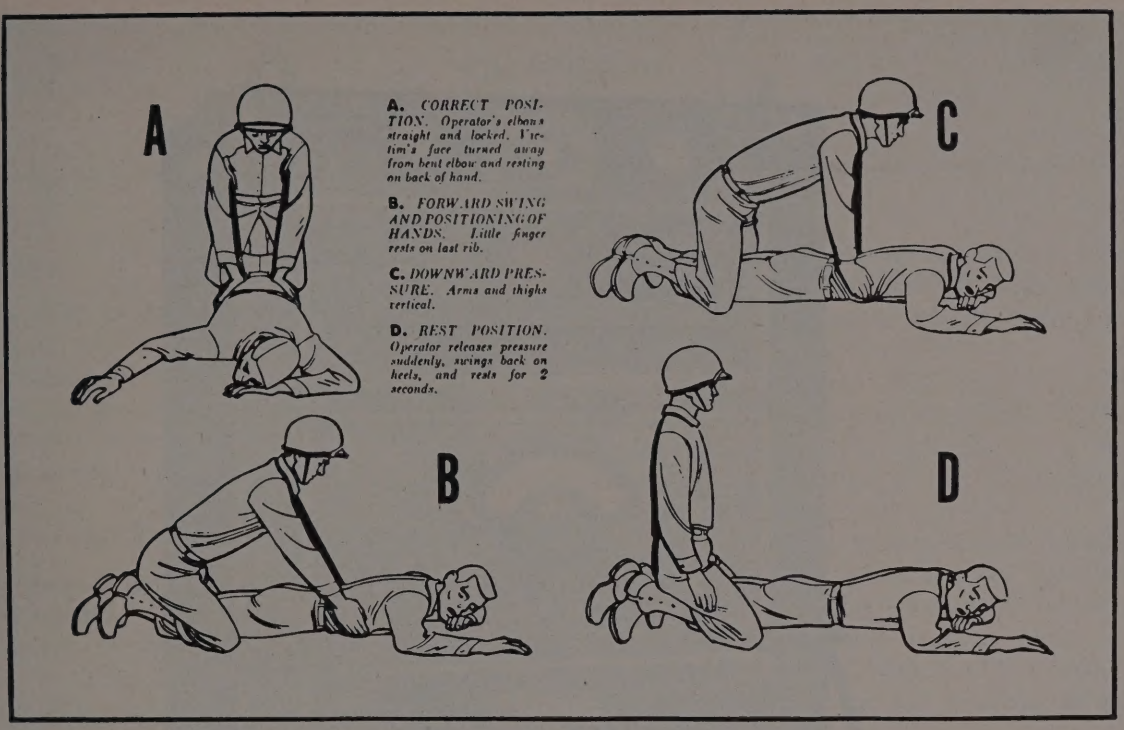
(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*2*) Swing back, suddenly releasing pressure, and sit on the heels.

(*3*) After 2 seconds rest, swing forward again, positioning the hands exactly as before, and apply pressure for another second.

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2-second rest makes a total of 4

TL15338-D



seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

h. Artificial respiration should be continued until the victim regains normal breathing or is pronounced dead by a medical officer. Since it may be necessary to continue resuscitation for several hours, relief operators should be used if available.

RELIEVING OPERATOR.

The relief operator kneels beside the operator and follows him through several complete cycles. When the relief operator is sure he has the correct rhythm, he places his hands on the operator's hands without applying pressure. This indicates that he is ready to take over. On the backward swing, the operator moves and the relief operator takes his position. The relieved operator follows through several complete cycles to be sure that the new operator has the correct rhythm. He remains alert to take over instantly if the new operator falters or hesitates on the cycle.

STIMULANTS.

a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then for only 1 or 2 seconds every minute.

b. After the victim has regained consciousness, he may be given hot coffee, hot tea, or a glass of water containing ½ teaspoon of aromatic spirits of ammonia. *Do not give any liquids to an unconscious victim.*

CAUTIONS.

a. After the victim revives, keep him LYING QUIETLY. Any injury a person may have received may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. Keep the victim lying flat on his back, with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully as he may suddenly stop breathing. *Never leave a resuscitated person alone until it is CERTAIN that he is fully conscious and breathing normally.*

TL15338-E



Figure 1. Radiosonde Receptor AN/FMQ–2.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

This manual contains instructions for the installation, operation, maintenance, and repair of Radiosonde Receptor AN/FMQ–2 (fig. 1). In addition to these instructions there are two appendixes covering a list of references and an identification table of parts.

2. Forms and Records

The following standard forms will be used for reporting unsatisfactory conditions of matériel and equipment, or improper preservation, packaging, packing, marking, loading, stowage, or handling thereof.

a. DD Form 6, Report of Damaged or Improper Shipment (Reports Control Symbols CS GLD–66 (Army) and AF–MC–U2 (Air Force)), will be filled out and forwarded as prescribed in SR 745–45–5/AFR71–4.

b. DA AGO Form 468, General—Unsatisfactory Equipment Report (Reports Control Symbol CS GLD–247), will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

c. AF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700–45–5 and AFR 65–26.

d. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

Radiosonde Receptor AN/FMQ–2 is an electronic, meteorological instrument specially designed for use with f-m (frequency-modulated) radiosondes. The instrument consists of an antenna assembly, a receiver, a frequency meter, a recorder, an amplifier, and a voltage regulator. All these components, except the antenna system, are contained in one rack (figs. 1 and 3).

a. PURPOSE. The primary purpose of Radiosonde Receptor AN/FMQ–2 is to receive and to record, in printed form, f-m signals from a balloon-carried radiosonde, such as Radiosonde AN/AMT–2A, whose transmitter is modulated at an a-f (audio-frequency) rate determined by the meteorological factors of the atmosphere. (Information on the theory and operation of Radiosonde AN/AMT–2A is given in TM 11–2433.) Whenever wind data is needed, Radio Set SCR–658 is used in conjunction with the radiosonde receptor as a system (fig. 2).

b. USE. A 403–mc (megacycle) f-m signal from the radiosonde is picked up by the antenna system of the radiosonde receptor and is fed to the following components. See the functional block diagram in figure 2.

(1) *Radiosonde receiver.* This component amplifies and converts the incoming signal into one of proper waveshape and magnitude for application to the frequency meter. In addition, a loudspeaker provides aural monitoring and an oscilloscope permits visual monitoring.

(2) *Frequency meter.* The a-f output of the receiver is converted to a pulsating d-c (direct-current) signal, whose average value is proportional to the output frequency of the receiver. This current actuates a micrometer which provides a visual indication of the audio frequency.

(3) *Radiosonde recorder and amplifier.* These two components are used to make a continuous printed record of the audio frequencies measured by the frequency meter. Since these frequencies are proportional to the atmospheric factors to be measured, the printed record or flight chart can

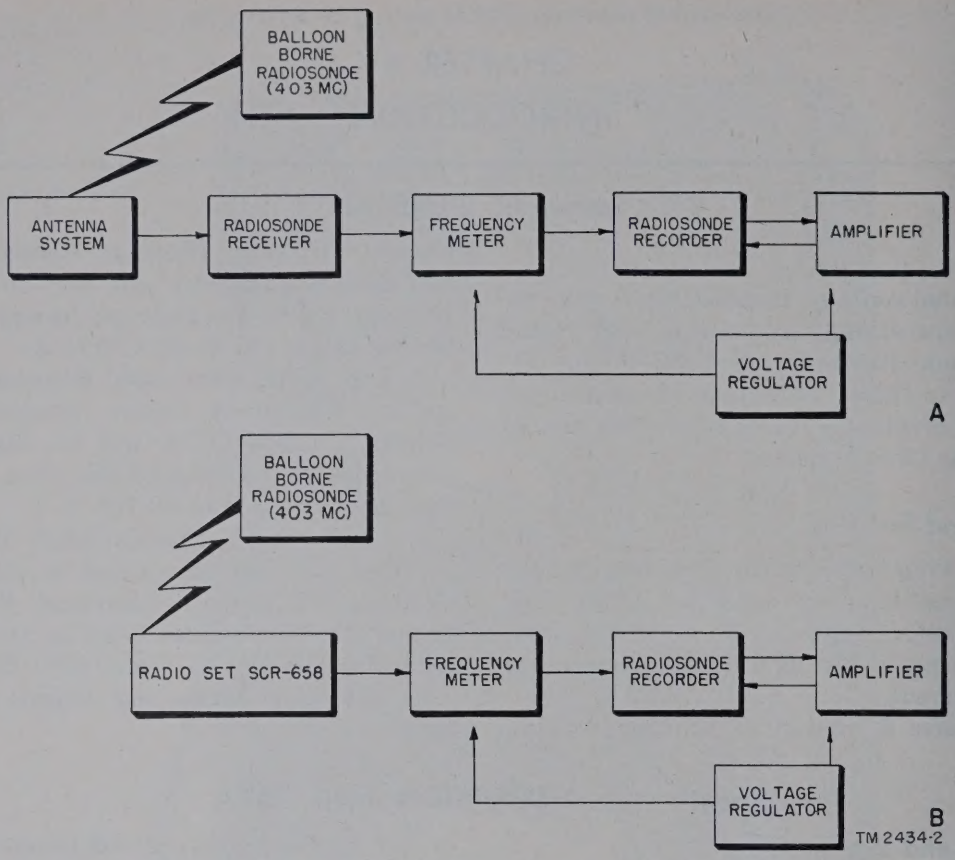


Figure 2. Components of 403-mc operation, block diagram.

be evaluated to obtain the values of these factors.

(4) *Voltage regulator.* The voltage regulator maintains the 115-volt, a-c (alternating-current) supply voltage to the frequency meter and amplifier at a constant level.

4. Technical Characteristics

The general characteristics and performance data for the components of Radiosonde Receptor AN/FMQ–2 are listed in *a* through *f* below.

a. RADIOSONDE RECEIVER R–228/FMQ–2.

Frequency range ..... 390 to 410 mc.
Type of receiver..... Superheterodyne.
Type of signal received. F-m.
Intermediate frequency . 21.25 mc.
Number of tubes..... 20.
Power supply ..... Self-contained, full-wave rectifier.
Ratings ..... 115 volts ± 10%, 1.25 amperes, 50/60 cycles, single phase.
Type of antenna..... Vertical, half-wave, concentric dipole.

b. FREQUENCY METER TS–29B/FMQ–1.

A-f range ..... 0 to 200 cps (cycles per second).
Number of tubes..... 8.
A-f amplifier ..... Tube type 6J5.
Two thyratrons.... Tube type 884.
Pulse rectifier ..... Tube type 6ZY5G.
Two power rectifiers ..... Tube type 5Y3GT/G.
Voltage regulators. Tube types OD3/VR150 and OA3/VR75.

c. RADIOSONDE RECORDER RD–3B/FMQ–1 AND RADIOSONDE RECORDER RD–3C/FMQ–1.

Current range ..... 0 to 500 microamperes.
Number of tubes (each unit) ..... 2.
Phototubes ..... Tube type 921.
Preamplifier ..... Tube type 6J5.
Paper feed ..... 4 inch per minute.

d. AMPLIFIER AM–7B/FMQ–1.

Number of tubes..... 6.
Thyratron ..... Tube type 2050.
Rectifier ..... Tube type 5U4G.
Two voltage regulators ..... Tube type OA3/VR75.

Voltage regulators . Tube types OD3/VR150 and OD3/VR105.

Power supply .....115 volts, 60 cps.

e. VOLTAGE REGULATOR CN–2A/FMQ–1.

Input ratings .....105 to 125 volts, 2.3 amperes, 60 cps ± 2 cps.

Output ratings .....115 volts ± .5%, 1.3 amperes, 60 cps ± 2 cps.

Phase .....Single.

f. ANTENNA ASSEMBLY AS–389/FMQ–2.

Antenna .....Vertical, half-wave, concentric dipole.

Transmission line .....Radio Frequency Cable RG–8/U, solid dielectric coaxial, 52 ohms characteristic impedance.

5. Table of Components

The table below lists the nomenclature, dimensions, weight, and quantity of the major components.

Nomenclature	Dimensions (in.)			Weight (lb.)	Quantity
	Depth	Width	Height		
Frequency Meter TS–29B/FMQ–1.	10	19	8¾	38	1
Radiosonde Recorder RD–3 ( ) /FMQ–1.	15	20½	18¾	110	1
Amplifier AM–7B/FMQ–1.	10	19	8½	40	1
Voltage Regulator CN–2A/FMQ–1.	5¾	13	6	31	1
Rack MT–678/FMQ–2.	16½	25	64		1
Radiosonde Receiver AN/FMQ–2.	16	19	6 31/32	60	1
Antenna Assembly AS–389/FMQ–2.					1

6. Description of Radiosonde Receptor AN/FMQ–2

a. RADIOSONDE RECEIVER R–228/FMQ–2 (fig. 3). The radiosonde receiver is a superheterodyne type designed for reception of f-m signals over a frequency range of 390 to 410 mc. The front panel contains the following items:

(1) A loudspeaker, for aural monitoring of the receiver, located directly in the center of the front panel.

(2) A cathode-ray oscilloscope, for visual monitoring of the receiver, found just to the left of the loudspeaker.

(3) A main tuning control, used for tuning the receiver, located to the right of the loudspeaker.

(4) An antenna trimmer control, for tuning the r-f (radio-frequency) input circuit, found in the upper right-hand corner of the panel.

(5) An r-f gain control, used to control the gain of the i-f (intermediate-frequency) amplifiers in the receiver, located in the center at the bottom of the panel and underneath the loudspeaker.

(6) An r-f gain switch, which permits the range of gain values for the i-f amplifiers to be varied, situated in the lower right-hand corner of the panel.

(7) A power switch, which controls the power to the unit, located in the lower left-hand corner of the panel.

(8) An indicator lamp, used to indicate power on, located to the right of the loudspeaker near the top of the panel.

b. FREQUENCY METER TS–29B/FMQ–1 (fig. 3). The frequency meter converts the a-f output of the radiosonde receiver or of Radio Set SCR–658, to a pulsating d-c, the average value of which is proportional to the output frequency of the radiosonde receiver. This current is measured by the visual meter on the front panel of the frequency meter, and by the recorder meter which is in the radiosonde recorder (fig. 3). The following items are mounted on the front panel:

(1) A visual meter, located in the center

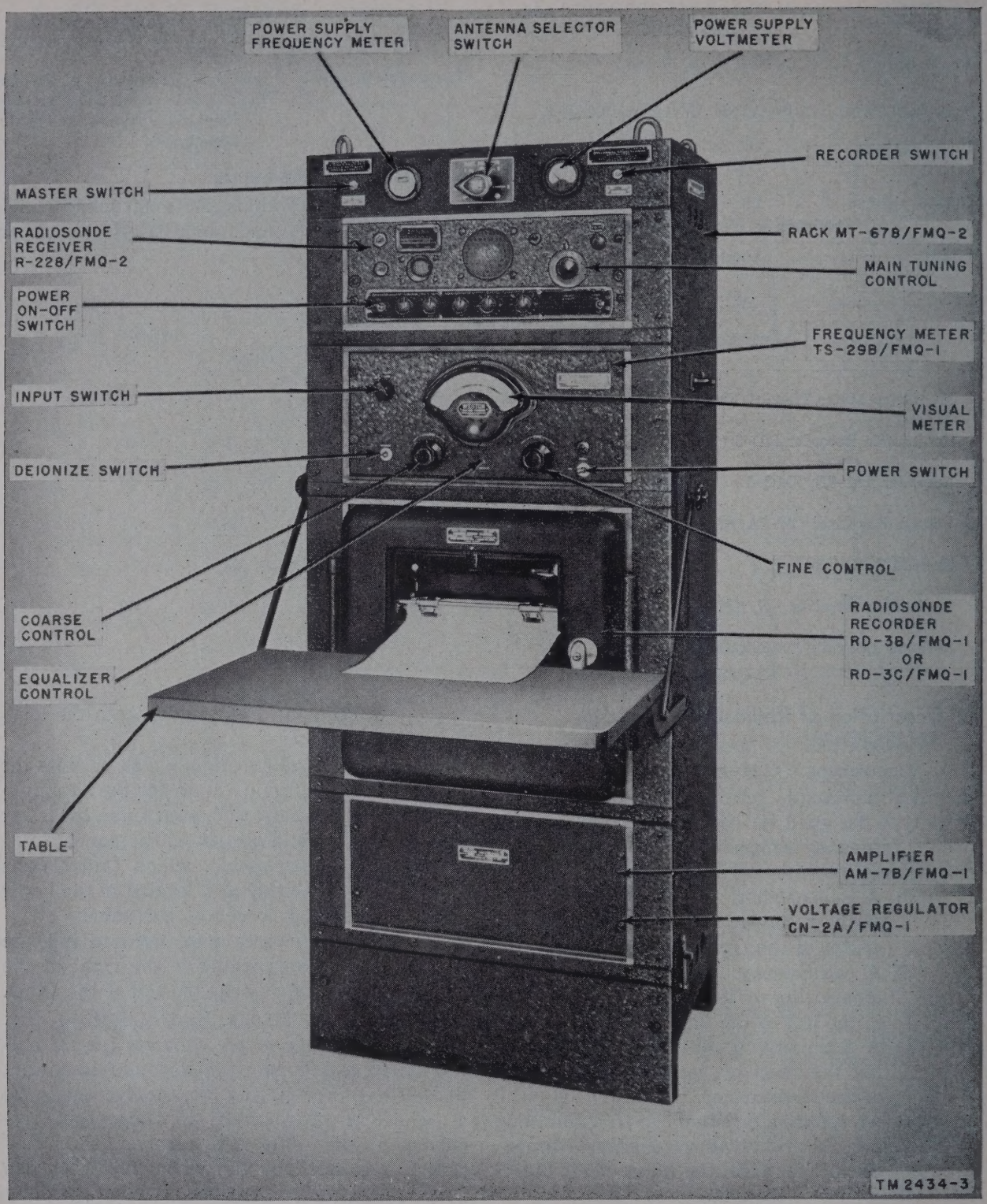


Figure 3. Radiosonde Receptor AN/FMQ–2, front view.

of the panel, graduated into 100 equal divisions, with each division representing a frequency of 1 bi-cycle per second (1 bi-cycle equals 2 cps).

(2) The INPUT switch, the COARSE calibration control, and the DEIONIZE switch, are located to the left of the visual meter on the front panel.

(3) Directly under the visual meter is a small hole in the front panel through which a screw driver may be inserted to make adjustments of the EQUALIZER control. During calibration of the equipment, this control is used to produce equal indication of the two meters.

(4) A FINE calibration control and POWER switch, located to the right of the visual meter.

c. RADIOSONDE RECORDER RD–3C/FMQ–1 AND AMPLIFIER AM–7B/FMQ–1 (fig. 3). The radiosonde recorder, in combination with Amplifier AM–7B/FMQ–1, comprises an electromechanical device which makes a printed record of the frequencies measured by the frequency meter. During operation, the recorder paper on which the printed record appears is constantly being moved through the printing mechanism at a rate of .4 inch per minute. The paper slides out over a small chute and inclined shelf onto an operations table. The paper moves at such a slow rate that the operator can make notations on the paper during operation. A complete description of the recorder is given in chapter 4.

d. VOLTAGE REGULATOR CN–2A/FMQ–1. The voltage regulator is situated in the lower part of the rack assembly (fig. 3). The regulator unit contains two specially designed transformers, in an hermetically sealed case, and one capacitor arranged in a circuit to produce a constant output voltage under load, even though the power input voltage may vary over wide limits. The voltage regulator has no front-panel operating controls.

e. RACK MT–678/FMQ–2 (figs. 3 and 4). The function of the rack assembly is to house all components of the radiosonde receptor except the antenna assembly.

(1) The radiosonde receiver is in the top compartment of the rack with the frequency meter, radiosonde recorder, recorder amplifier, and voltage regulator components, placed in that order, in the compartments beneath the receiver.

(2) An adjustable operations table, which can be used as a writing table when making an evaluation of the record as the signals are received, is attached to the front of the rack assembly.

(3) The rack assembly contains all cabling necessary for interconnections of the various components.

(4) Two dehumidifier lamps are in the lower part of the rack. These lamps may be turned on, when necessary, to prevent deterioration of the equipment because of high humidity or to prevent faulty operation and breakdown because of low ambient temperature. Therefore, their use in humid and cold climates is necessary. The lamps can be turned on and off by means of a single toggle switch located in front of the right-hand lamp, when viewing the rack from the rear.

(5) In the panel above the receiver are located a frequency meter of the vibrating reed type and a 0 to 150 volt a-c voltmeter. These meters are used to monitor the frequency and voltage of the input power to the equipment.

(6) An antenna selector switch of the coaxial type is located between these two meters. The MASTER and RECORDER ON-OFF switches are also located on this panel above the receiver.

(7) The side and rear cover plates are attached to the rack by means of quarter-turn fasteners (Camloc).

f. ANTENNA ASSEMBLY AS–389/FMQ–2 (fig. 12). The antenna assembly is a vertical half-wave concentric dipole designed for a center frequency of 400 mc and operates efficiently over the 390- to 410-mc range of the receiver.

(1) The antenna is composed of two quarter-wave sections mounted in line and separated by an insulator. The upper quarter-wave leg is a metal rod and the lower leg is a metal tube called a skirt. The characteristic im-

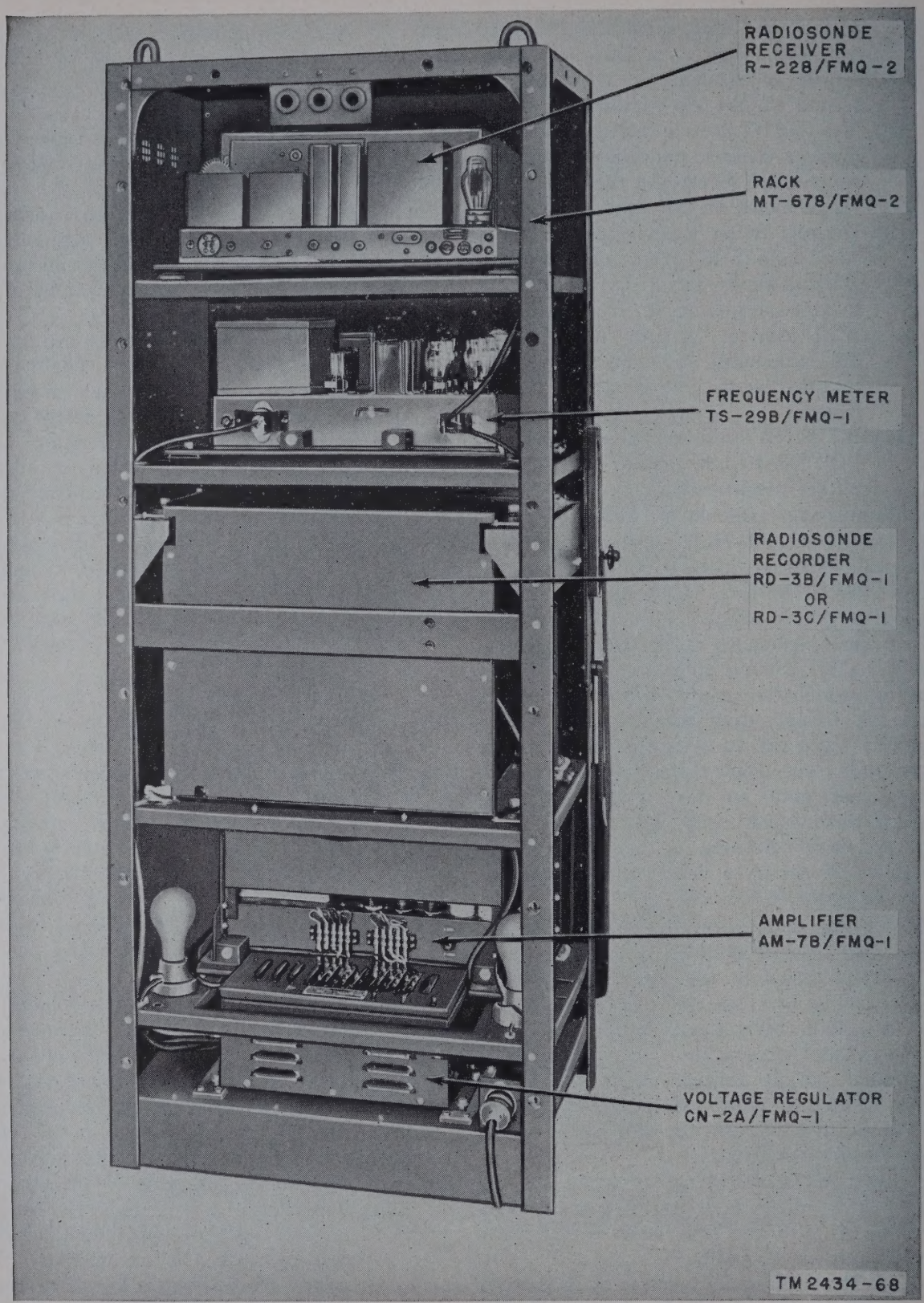


Figure 4. Radiosonde Receptor AN/FMQ–2, rear view.

pedance of the antenna assembly is approximately 52 ohms.

(2) One hundred feet of solid dielectric coaxial transmission line, Radio Frequency Cable RG–8/U, is supplied with each antenna. The characteristic impedance of the transmission line is 52 ohms. This value of impedance permits an impedance match to be effected between the coaxial line and the antenna assembly without the use of a matching section. The upper end of the line is assembled to a watertight insulator (part of a Radio Frequency Plug UG–21/U fitting). The lower end of the transmission line is fitted with a Radio Frequency Plug UG–21B/U male connector suitable for connection to the antenna input jack, Radio Frequency Receptacle UG–58/U.

(3) Figure 73 shows an exploded view of the antenna assembly. The unit is supplied in an assembled state. Figure 73 can be used as a reference if disassembly of the antenna unit becomes necessary.

7. Packaging Data

Radiosonde Receptor AN/FMQ–2, less Radiosonde Receiver R–228/FMQ–2 and Antenna Assembly AS–389/FMQ–2, is packed for export in three separate boxes and packed for domestic shipment in four separate boxes, as listed in the charts below. Radiosonde Receiver R–228/FMQ–2 and Antenna Assembly AS–389/FMQ–2 are packed in two wooden crates for both oversea and domestic shipment.

a. PACKAGED FOR EXPORT.

Component	Box Dimensions (in.)			Volume (cu. ft.)	Weight (lb.)
	Length	Width	Height		
Rack MT–678/FMQ–2, Radiosonde Recorder RD–3C/FMQ–1, and Voltage Regulator CN–2A/FMQ–1.	83	44	35	74	960
Frequency Meter TS–29B/FMQ–1 and Amplifier AM–7–B/FMQ–1.	53	19½	16	9.3	147
Spare parts box	48	36	18	18	200

b. PACKAGED FOR DOMESTIC SHIPMENT OR FOR SHORT MOVEMENTS BY USING TROOPS.

Component	Box Dimensions (in.)			Volume (cu. ft.)	Weight (lb.)
	Length	Width	Height		
Rack MT–678/FMQ–2 and Radiosonde Recorder RD–3C/FMQ–1.	84	40	35	68	625
Frequency Meter TS–29B/FMQ–1.	20	13½	10¼	1.5	42
Amplifier AM–7B/FMQ–1.	20	11½	9½	1.3	44
Spare parts box	48	36	18	18	200

c. PACKAGED FOR DOMESTIC AND OVERSEA SHIPMENT.

Component	Box Dimensions (in.)			Volume (cu. ft.)	Weight (lb.)
	Length	Width	Height		
Radiosonde Receiver R–228/FMQ–2.	33	29	20	11.07	120
Antenna Assembly AS–389/FMQ–2.	33	29	20	11.07	81
Spare parts box	23	12	10	1.6	58

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF RADIOSONDE RECEPTOR AN/FMQ–2

8. Siting

a. ANTENNA. To obtain optimum performance from the equipment, the antenna should be located in the best possible position.

(1) Depending on the tactical situation, choose a location in an open space, as far as practicable from obstacles such as buildings or steel towers, so that the distance from the antenna to an obstruction is at least 10 times the height of the obstruction.

(2) The antenna should be at least 200 feet from roads or parking areas, to avoid interference from automobile ignition systems. Avoid a location near a radio transmitter. Electrical machinery, high-tension power lines, teletypewriter lines and machines, and telephone lines frequently cause interference.

(3) Because of losses in a long transmission line, the location should be such that the length of transmission line to the building in which the rack assembly is to be installed should not exceed 100 feet. Try to locate the antenna as close as possible to the building in order that the shortest possible transmission line is used to minimize cable attenuation. If any length of line significantly less than 100 feet is used, the excess amount should be cut off at the receiver end. If it is impossible to locate the antenna near the ground in a favorable position, it may be mounted on a roof or any other elevated place. If interference from automobile traffic or other sources near the ground is encountered, it may prove better to increase the height of the antennas.

(4) In locating the antenna close to the building housing the receptor, be certain that the transmission line is not subjected to undue strain or pressure. The line should not be bent too sharply; bends with a radius of less than 2 inches should not be used.

b. RACK ASSEMBLY. The rack and its components should be installed in any indoor location which is dry and where the temperature will be more or less constant; that is, not near any direct source of heat or cold. A reasonably quiet location is desirable because tuning depends, to some extent, on aural reception. The location should be one where the rack assembly will be subjected to as little vibration as possible, and those locations near electrical machinery, high-tension power lines, and other noise-producing equipment should be avoided. A minimum access space of approximately 3 feet should be provided on all sides of the rack to permit access for servicing.

9. Unpacking, Uncrating, and Checking

The rack assembly, the radiosonde recorder, and the voltage regulator are shipped assembled, and all three are packed in a single crate. The antenna assembly, the radiosonde receiver, and the receiver mounting base are packed in individual packages, but all are placed in one wooden crate. See figures 6, 7, 8, and 9 for packaging data. Five boxes contain all components. To unpack the equipment, proceed as follows:

a. RACK ASSEMBLY CRATE.

(1) Unload the five uncrated boxes and place them near the position where the rack assembly will rest after installation is complete.

(2) Remove the lid and one side of the outer box containing the packaged rack. The lid and side are secured by nails which can be removed by a nail puller. Remove the excelsior and lift out the inner box, placing it in such

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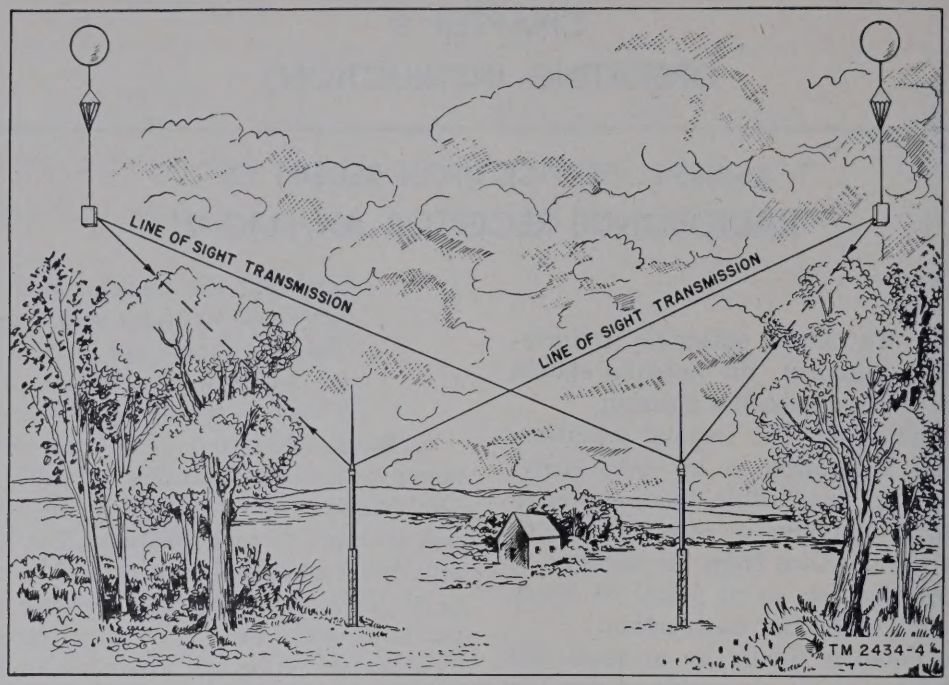


Figure 5. Line of sight transmission (two antenna installation shown).

a way that it rests upon its skid-base. Be careful not to drop or jar its contents.

(3) Remove the top, sides, and ends of the inner box by means of the nail puller, leaving the wrapped unit exposed on the skid-base.

(4) Open the outer waterproof wrap by cutting carefully at the seam, taking care not to cut too deeply. Lay the waterproof wrap down around the skid-base, thus exposing the moisture-vaporproof inner barrier.

(5) Open the moisture-vaporproof barrier by cutting along the heat-sealed seams. Lay the barrier material down, exposing the cushioned rack.

(6) Break the straps that hold the desiccant and remove the desiccant bags.

(7) Break the straps that hold the rack to the bolted pallet and ease the rack off the base and into an upright position.

(8) Remove all flexible corrugated paper cushioning. Remove the blocking and bracing of the recorder and voltage regulator from within the rack.

b. Radiosonde Receiver, Antenna Assembly, Frequency Meter and Amplifier Crate, and Spare Parts Crate.

(1) Break the straps on the nailed wooden shipping container (figs. 7, 8, and 9). Remove the top of the box by means of the nail puller.

(2) Remove sufficient excelsior to disclose the inner wrapped package; lift out the packaged item.

(3) Remove the outer waterproof wrap; remove the outer carton.

(4) Cut the moisture-vaporproof barrier along the heat-sealed seam and remove the barrier.

(5) Open the inner carton, remove the desiccant, and lift out the packaged item, removing all blocking and bracing. Install all tubes.

(6) Check contents of each box against the packing list to make certain that no parts are missing. Inspect all components for damaged parts.

10. Installation of Rack Assembly Components

All components, except the radiosonde recorder which is already placed in the rack,

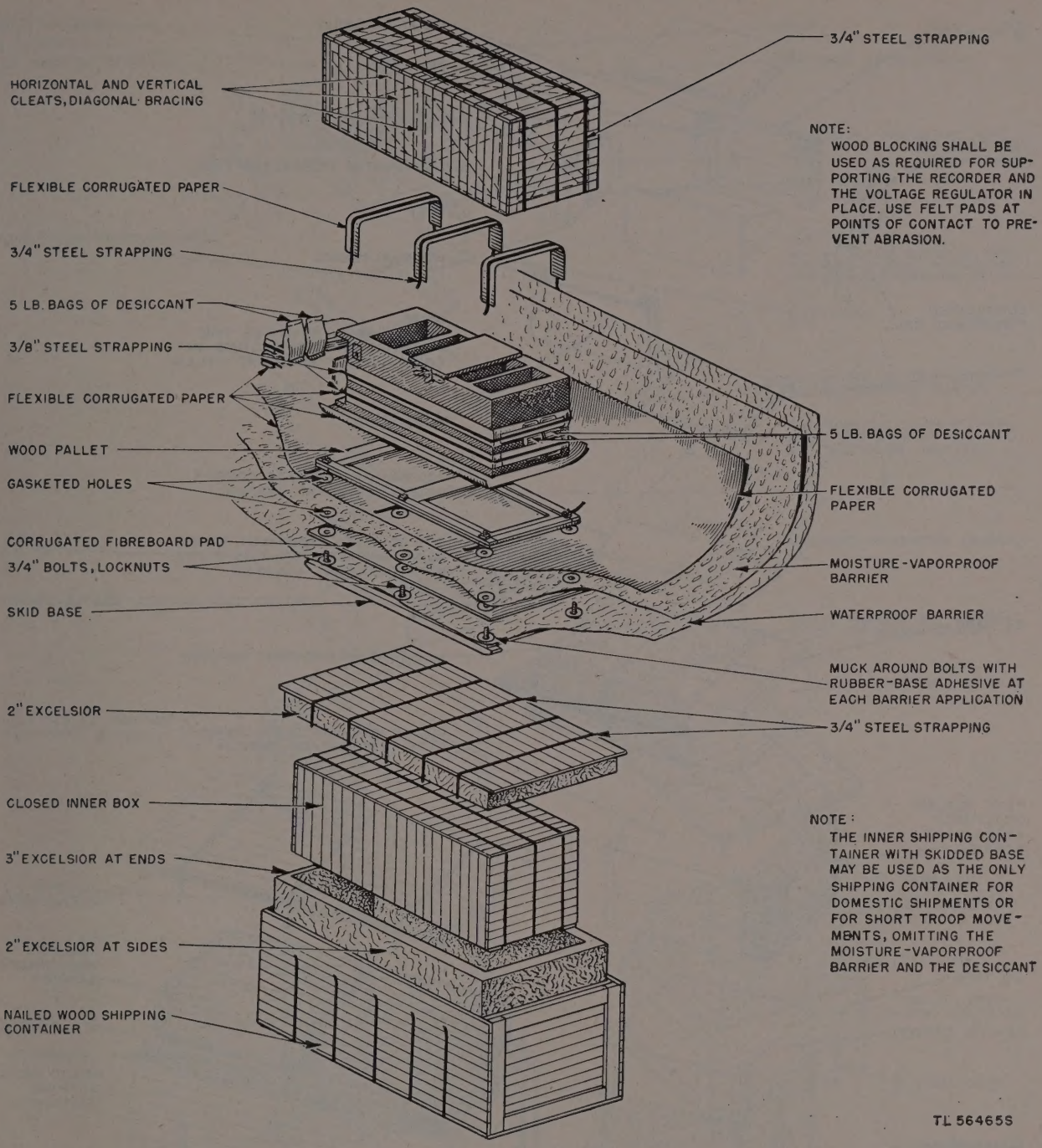


Figure 6. Packaging of rack assembly.

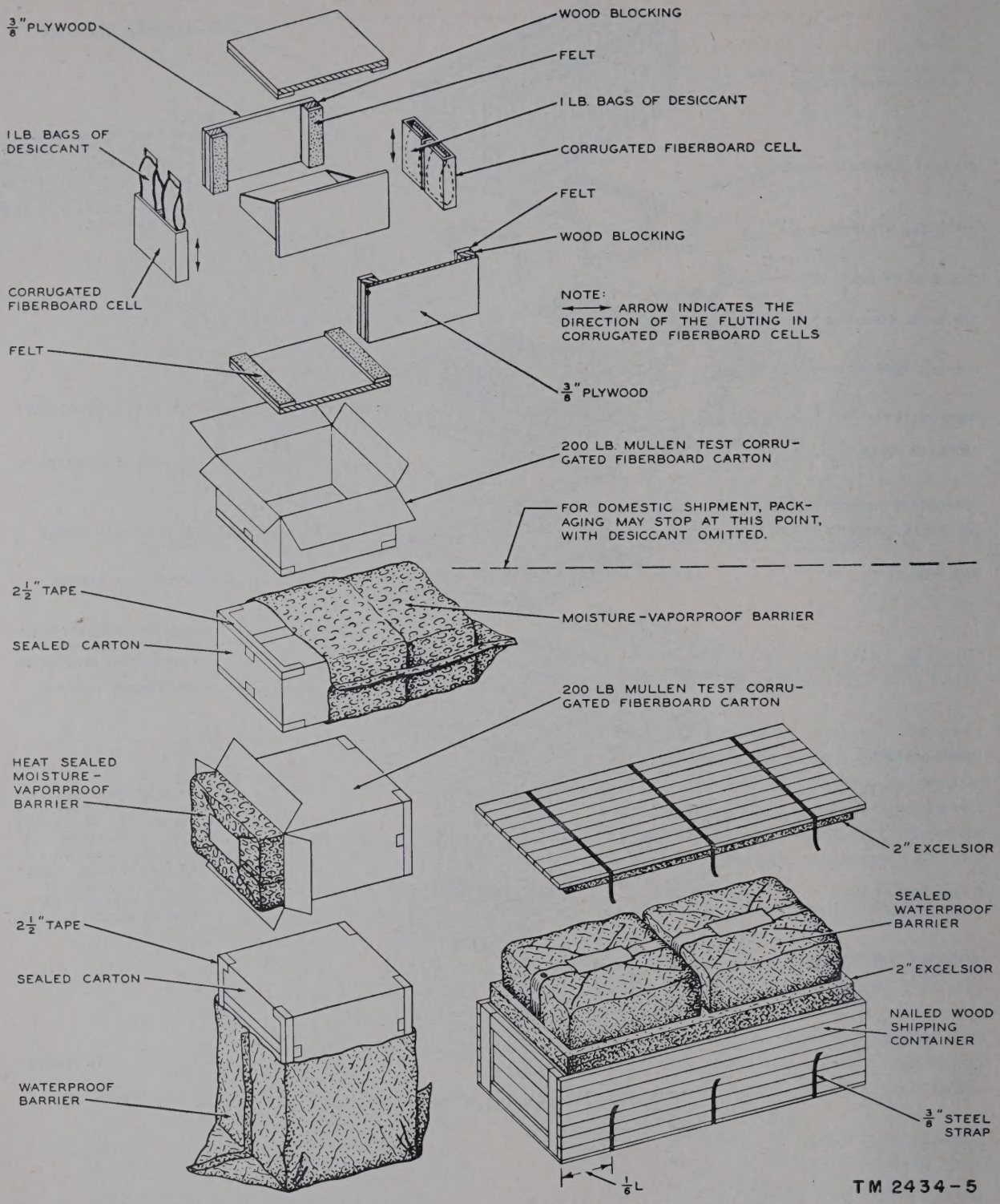


Figure 7. Packaging of frequency meter and amplifier.

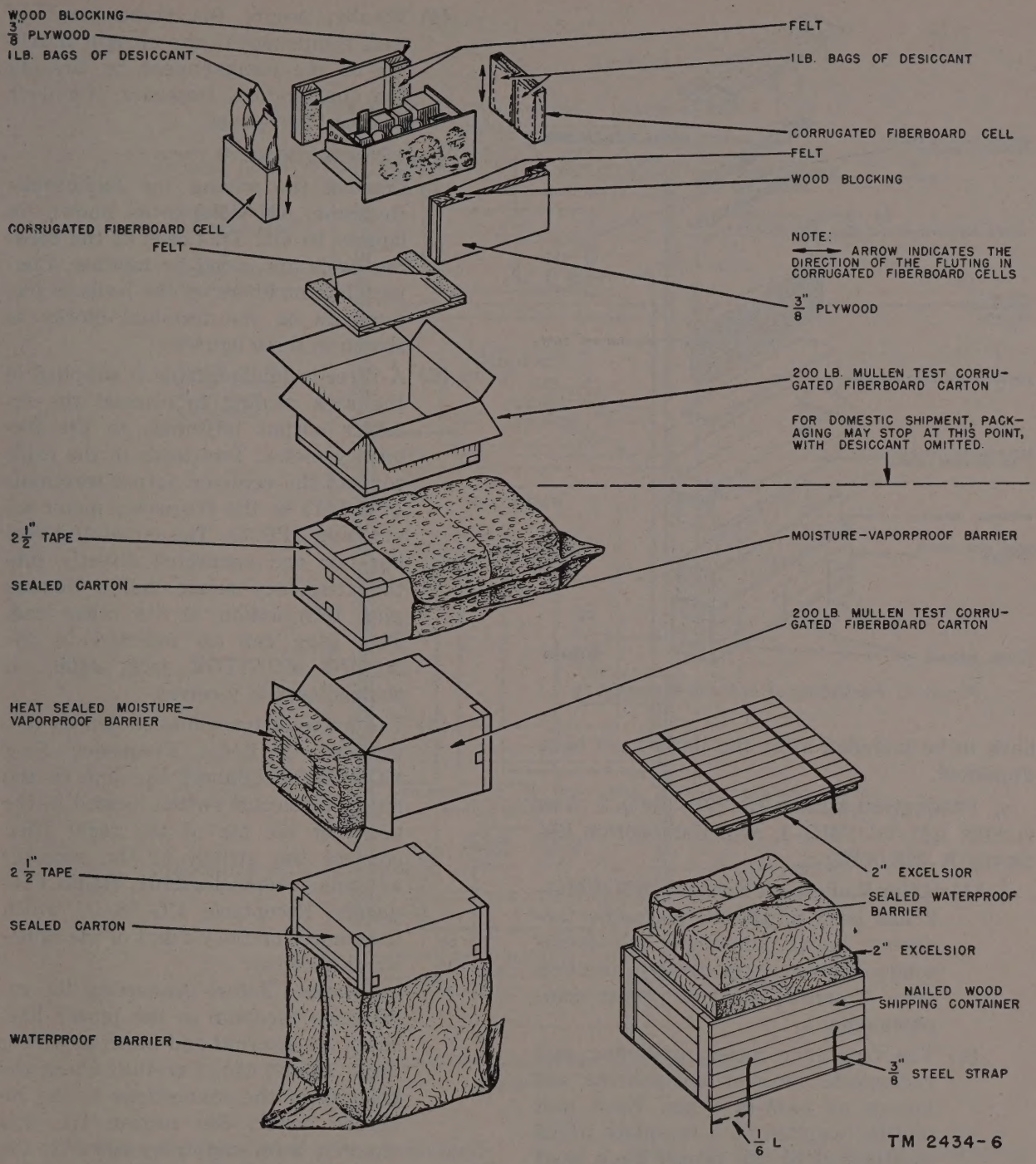


Figure 8. Packaging of radiosonde receiver.

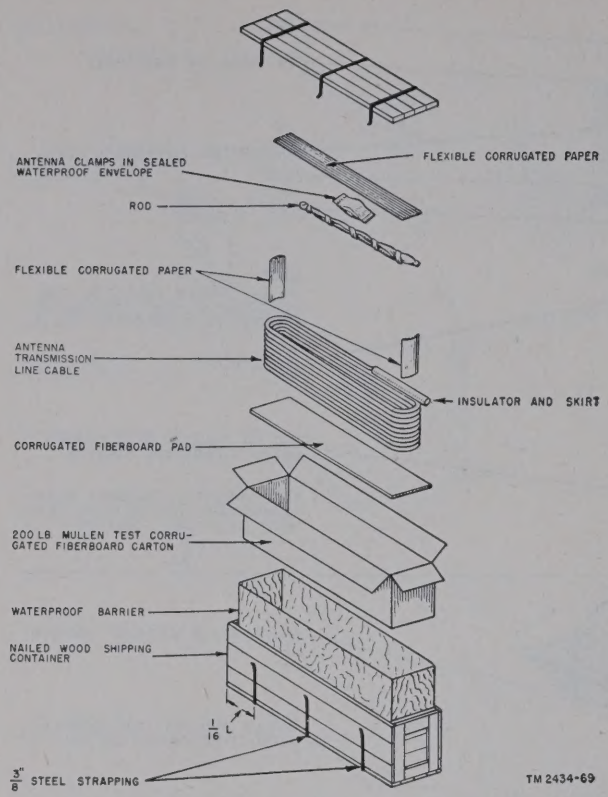


Figure 9. Packaging of antenna assembly.

have to be installed after the units have been unpacked.

a. FREQUENCY METER TS–29B/FMQ–1, AMPLIFIER AM–7B/FMQ–1, AND RADIOSONDE RECEIVER R–228/FMQ–2.

(1) After Radiosonde Receptor AN/FMQ–2 has been unpacked, place the frequency meter amplifier, and radiosonde receiver components in position (figs. 3 and 4) at their proper compartments.

(2) The frequency meter, amplifier, and radiosonde receiver components are known as *push-in* types. Each unit will be mounted on a sub-plate which is attached to the proper rack shelf by means of four shock mounts.

(3) Insert each of the components into the rack from the front, and slide them toward the rear until two holes, located at the rear of the chassis of the components, engage the spring-loaded tapered pins at the rear of the sub-plate.

(4) Finally, secure the front panel of each component to the upright brackets of the compartment by turning the quarter-turn fasteners (Camloc) in each front panel.

b. WIRE CONNECTIONS.

(1) Connect the wiring for Radiosonde Receptor AN/FMQ–2 as shown in figures 10 and 11. Leads of the cording cable are coded by number. Connect like numbers on the leads to like numbers on the terminal blocks as shown in these figures.

(2) A three-conductor cable is supplied in the rack cabling to connect the receiver output terminals to the frequency meter. Two leads in the cable connect the receiver output terminals (TB 101) to the frequency meter input plug (P601). The remaining lead has one end connected directly into the frequency meter and a banana plug termination at its other end. This plug can be inserted in the AUDIO MONITOR jack, J106, on the radiosonde receiver.

(3) The antenna transmission line is terminated in Radio Frequency Plug UG–21B/U. Connect the line to the antenna selector switch located in the panel at the top of the rack. Then connect the switch to the receiver antenna receptacle, J101, Radio Frequency Receptacle UG–58/U, which is mounted on the r-f unit of the radiosonde receiver.

Caution: Before connecting the radiosonde receptor to the power line, check all external and internal wiring (figs. 10 and 11). Carefully check the polarity of the connections to the recorder meter. See section III, this chapter, before applying power to the equipment.

c. INSTALLATION OF RECORDING PAPER. To install a paper chart roll, use the following procedure:

(1) Lower the operations table to a vertical position, after loosening the two knurled nuts on the sides of the rack assembly.

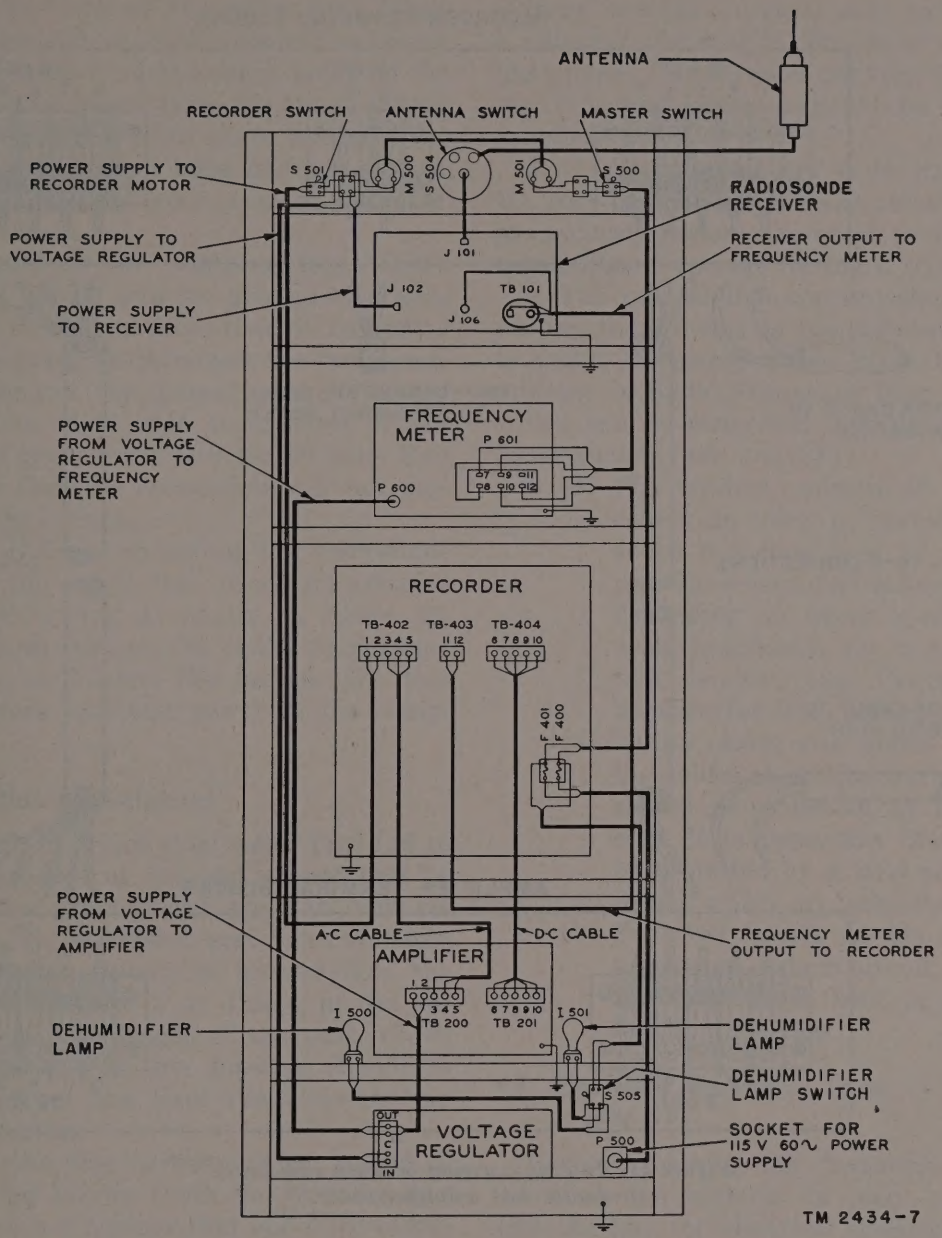


Figure 10. Radiosonde Receptor AN/FMQ–2, cording diagram.

(2) Open the front door of the radiosonde recorder.

(3) The radiosonde recorder assembly shown in figure 15 is pivoted at the lower front corners. Pull the recorder assembly forward from the top and allow it to revolve about its pivots until it has been lowered as far as it will go. In this position, the assembly is selfsupporting and the various parts are accessible for installation of the paper chart roll.

(4) Raise the pull-out arm catch (figs. 42 and 43).

(5) By means of the pull-out arm (fig. 15), raise the ribbon drive and tapper bar units.

(6) Release the pressure of the friction fingers on the spiral drum by pulling out on the friction finger rod.

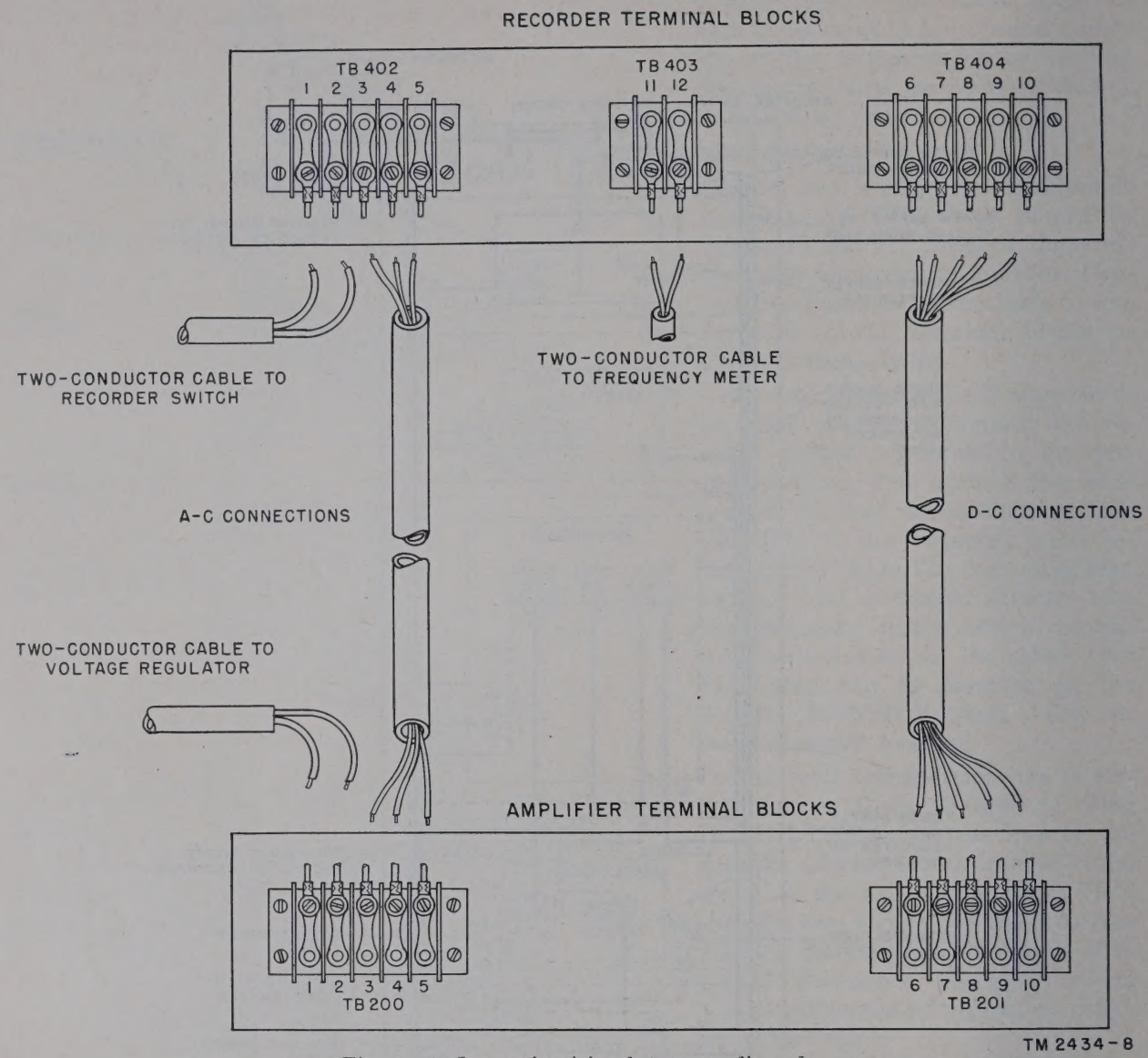


Figure 11. Interunit wiring between radiosonde recorder and amplifier units.

(7) Place the flat end of the paper chart roll into its normal position over the spring-loaded pivot point and push the roll to the right to allow the left end of the roll to fit into its bearing.

(8) Feed the paper over the spiral drum and under the friction fingers (fig. 15).

(9) Lower the ribbon drive and tapper bar units by returning the pull-out arm to its original position where it will be engaged with and retained by the pull-out arm catch.

(10) Restore the pressure of the friction fingers against the paper on the spiral drum by pushing in on the friction finger rod.

(11) Push the recorder back into the rack.

(12) Feed the paper under the paper set pointer on the left side of the recorder (fig. 15).

(13) Close recorder front door and raise the operations table.

d. INSTALLATION OF NEW RIBBON. When it becomes necessary to install a new ribbon, lift the spools off and slide the ribbon from under

the tapper bar and off the guide rolls. Then fasten the free end of a new ribbon to an empty spool by catching it on the sharp point on the hub of the spool. Next, place the spools on the spindles with ribbon spool shaft levers in the slots between the spool hubs and the ribbon. Make certain that the lever is inside the inner turn of the ribbon.

e. INSTALLATION OF GROUND ROD. Drive Ground Rod GP–29 into the ground at a location outside of and not more than 40 feet away from the building which houses the radiosonde receptor. Connect the ground clamp (located at the bottom right side front view of the rack) to the ground rod with No. 10 wire. Run the wire so that the connection will not present a walking hazard.

Caution: Before connecting the radiosonde receptor to the power line, check all external and internal wiring as shown in figure 10. Carefully check the polarity of the connections to the recorder meter. See section III, this chapter, before applying power to the equipment.

11. Installation of Antennas

a. A length of 1-inch steel water pipe (10 to 20 feet), threaded at one end, should first be obtained. If a ground-level site has been selected (par. 8), a wooden post approximately 4 inches square should be placed into the ground, to a depth of 3 or 4 feet, at the antenna location. The length of the post, which acts as a support for the antenna, should be determined from the local requirements for proper supporting.

b. Clamp the pipe to the post by means of straps and lag screws (with the threaded end on top) in such a manner that one-third of the pipe is supported and no more than 12 feet of the pipe is unsupported. Add guy wires wherever these support requirements cannot be met. The guy wires preferably should be of an insulating material, such as nylon rope. After threading the attached transmission cable through the pipe, the antenna is screwed to the top of the pipe. The pipe is so positioned on the post that the antenna, when screwed into place, will be placed as high as practical above the ground to avoid ground attenuation effects.

c. If the antennas have to be mounted above a large, metallic surface, such as the roof of a building, the roof is considered as a reflecting surface. The distance between the skirt and the reflecting surface should be as high as practical.

d. If the antennas are to be mounted over the roof of a building, make certain that they are securely fastened in order to minimize the possibility of damage during a strong wind.

e. The coaxial line transmission cable connecting the antenna to the radiosonde receiver is Radio Frequency Cable RG–8/U. It is terminated in Radio Frequency Plug UG–21B/U, which can be connected into the antenna selector switch (par. 10*b*(3)).

(1) The outdoor portion of the coaxial cables can either be buried in a trench about 6 inches deep or raised to a position several feet above the ground, depending on which method will be most practicable for a specific location. In either case, the cables should be protected from damage.

(2) If the cables run under a roadway, the cables should be buried deep and should be protected by a steel conduit. It is important that the cables be protected by a steel conduit at all points which are subjected to strain.

(3) To avoid breaks in the cable which may cause a short circuit, never allow the cable to be bent in a radius of less than 2 inches.

12. Electrical Resistance Tests (fig. 13)

Before covering the transmission line or screwing the antenna in place permanently, test the line for electrical resistance.

a. TESTING FOR SHORT CIRCUIT. Disconnect the coaxial cable from the antenna switch box. An ohmmeter with a high-resistance range connected across the receptor end of the cable should indicate 20 megohm or greater. If 20 megohm or greater resistance is not indicated, there is a short circuit which may be caused by loose solder, excess flux, or other foreign matter in the cable. If such a condition exists, disconnect the cable at some convenient point between the antenna and receiver and test each section independently until the short is found and removed.

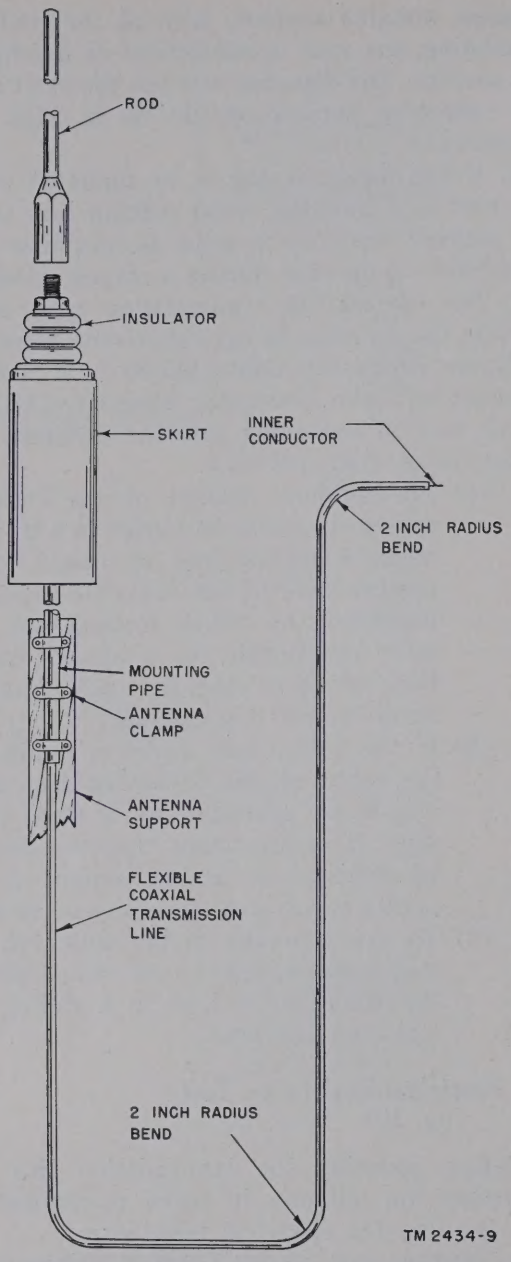


Figure 12. Antenna assembly, mounted.

b. TESTING FOR OPEN CIRCUIT. Disconnect the coaxial cable from the antenna switch box. Short the rod of the antenna to the skirt with a wire jumper, and connect an ohmmeter with a low-resistance range across the receptor end of the coaxial cable. The meter should indicate either a short circuit or a reading of a few ohms, the exact indication depending on the length of cable. If such an indication is not obtained, the cable must be checked, section by section, until the open is found.

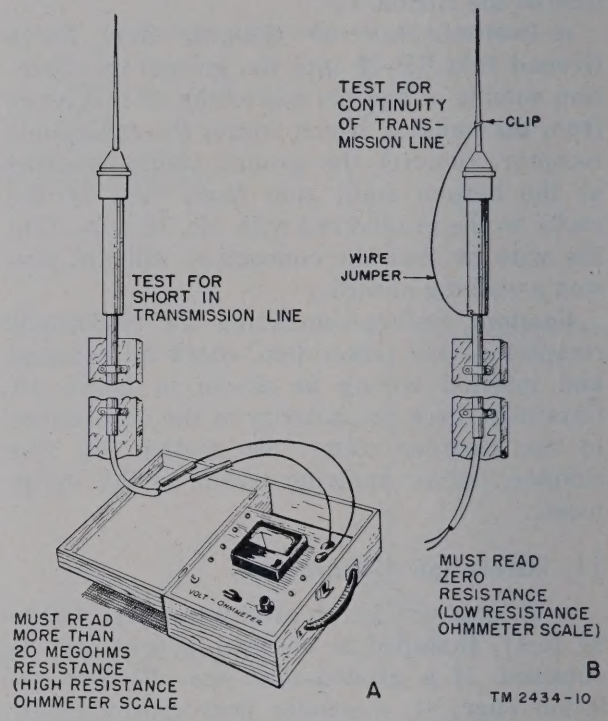


Figure 13. Electrical resistance tests.

13. Emergency Antenna

If it becomes necessary to use an emergency antenna, it can be made easily by taking a long piece of twisted-pair wire and untwisting part of it to a length of 7.4 inches (¼ wavelength at 403 mc). Thus, the twisted-pair wire will have free ends 7.4 inches long. These lengths of wire constitute an antenna if they are so mounted that one wire extends vertically downward and the other wire extends vertically upward. The remaining part of the twisted-pair wire can then serve as a transmission line to the two-wire antenna so constructed.

14. Controls and Instruments of Rack MT–678/FMQ–2 (figs. 3 and 4)

Controls and instruments	Function
ANT. SELECTOR switch (S504)	In installations involving two (or three) antennas, this coaxial type switch permits the selection of any one of these antennas for reception of the signals from the 403–mc radiosonde transmitter.
MASTER ON-OFF switch (S500)	Controls the power supply input to all units of the receptor.
RECORDER ON-OFF switch (S501)	Controls the power input for the recorder motors. The MASTER ON-OFF switch must be at the ON position before power can be applied to the recorder (motors) by means of the RECORDER ON-OFF switch.
Power supply voltmeter, 0–150 volts	Indicates the voltage of the a-c power supply to the unit.
Frequency meter (vibrating reed)	Indicates the frequency of the a-c power input.

15. Controls and Instruments of Radiosonde Receiver R–228/FMQ–2 (fig. 14)

Controls and instruments	Function
MAIN TUNING (C103)	Permits tuning the receiver to any specific frequency over a frequency range of 390 to 410 mc. The tuning dial is calibrated in mc with a calibration accuracy of plus or minus .2 percent.
R-F GAIN control (R139)	Controls the gain of the i-f amplifier system.
POWER ON-OFF switch (S101)	Used to turn the receiver either on or off. The MASTER ON-OFF switch (par. 14) must be at the ON position before the radiosonde receiver can be turned on.
SPKR. VOLUME control (R157)	Adjusts the audio volume of the loudspeaker. Adjustment of this control has no effect on the audio output to the frequency meter.
R-F GAIN LOW-HIGH switch (S102)	In the HIGH position, the gain of the i-f amplifier system can be controlled by the R-F GAIN control on the receiver. To reduce the gain of the i-f amplifier system for test purposes, the switch is placed in the LOW position.
ANT. trimmer control (C106)	Used to tune the r-f input circuit of the receiver under varying operating conditions.
INTENSITY control (R175)	Controls the intensity or brilliance of the oscilloscope pattern.
FOCUS control (R177)	Focuses the oscilloscope pattern into sharp, clear lines.
LOCKING control (R164)	Permits stationary waveforms to be obtained on the oscilloscope throughout the sweep frequency range of 8 to 250 cps.
Oscilloscope	Permits visual monitoring of the audio signal in the input to the output circuit of the radiosonde receiver.
Loudspeaker (LS101)	Permits aural monitoring of the audio signal as it appears from the output stage of the receiver.
Screw-driver adjustments: HOR. GAIN (R166)	Controls the height of the pattern visible on the oscilloscope.
VERT. GAIN (R173)	Controls the width of the pattern visible on the oscilloscope.

Controls and instruments	Function
HOR. POS. (R170)	Controls the horizontal position of the pattern visible on the oscilloscope.
VERT. POS. (R171)	Controls the vertical position of the pattern visible on the oscilloscope.
LOW R-F GAIN (R138)	When the R-F GAIN LOW-HIGH switch (S102) is in its LOW position, this resistor provides control of the gain of the i-f amplifier system.

16. Controls and Instruments of Frequency Meter TS-29B/FMQ-1 (fig. 3)

Controls and instruments	Function
INPUT switch (S600)	This switch has three positions: X, SC, and 60 ~. (1) In the X position, the output from the receiver is connected to the input of the frequency meter. It is placed in this position during reception and calibration. (2) In the SC (short circuit) position, the receiver output is disconnected and the frequency meter input is grounded. This control position, in conjunction with the DEIONIZE switch, is used to check the 0 setting of the visual and recording meters during alinement procedures. The SC position is also used to hold the recorder to zero prior to the upward flight of the radiosonde. (3) In the 60 ~ position, the frequency meter can be checked in order to adjust the radiosonde receptor before starting the preliminary performance test of the radiosonde. This position also permits the power supply frequency to be checked. For further information on alinement and calibration, see section III, chapter 5.
COARSE and FINE controls (R614 and R613)	Regulate the current to the recorder and visual meters. The controls are used to compensate for a-f shifts or drifts in the frequency of the signal from the radiosonde, and also when needed during the performance test, base line test, and flight operation.
DEIONIZE switch (S601)	Used to deionize the thyratrons in the frequency meter when the INPUT switch is in the SC position.
EQUALIZER (R612)..	Used only during recalibration procedures to adjust the settings of the visual and recorder meters so that they give similar indications.
POWER ON-OFF switch (S602)	Controls the a-c power input to the frequency meter. The MASTER ON-OFF switch must first be at the ON position.
Visual meter (M600)...	Provides a visual indication of the audio signals that appear as traces on the recorder chart.

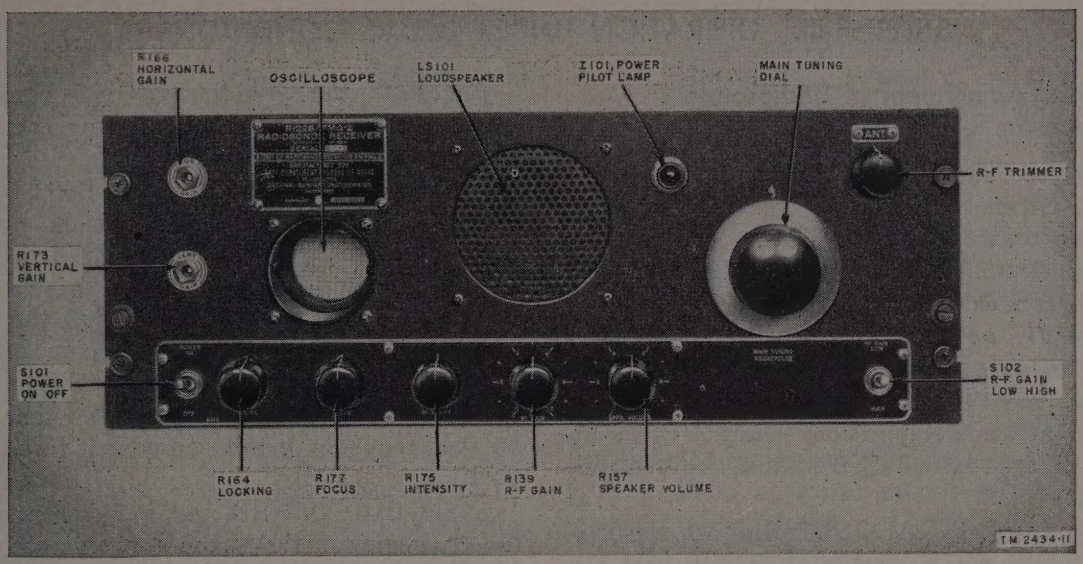


Figure 14. Radiosonde Receiver R–228/FMQ–2, controls.

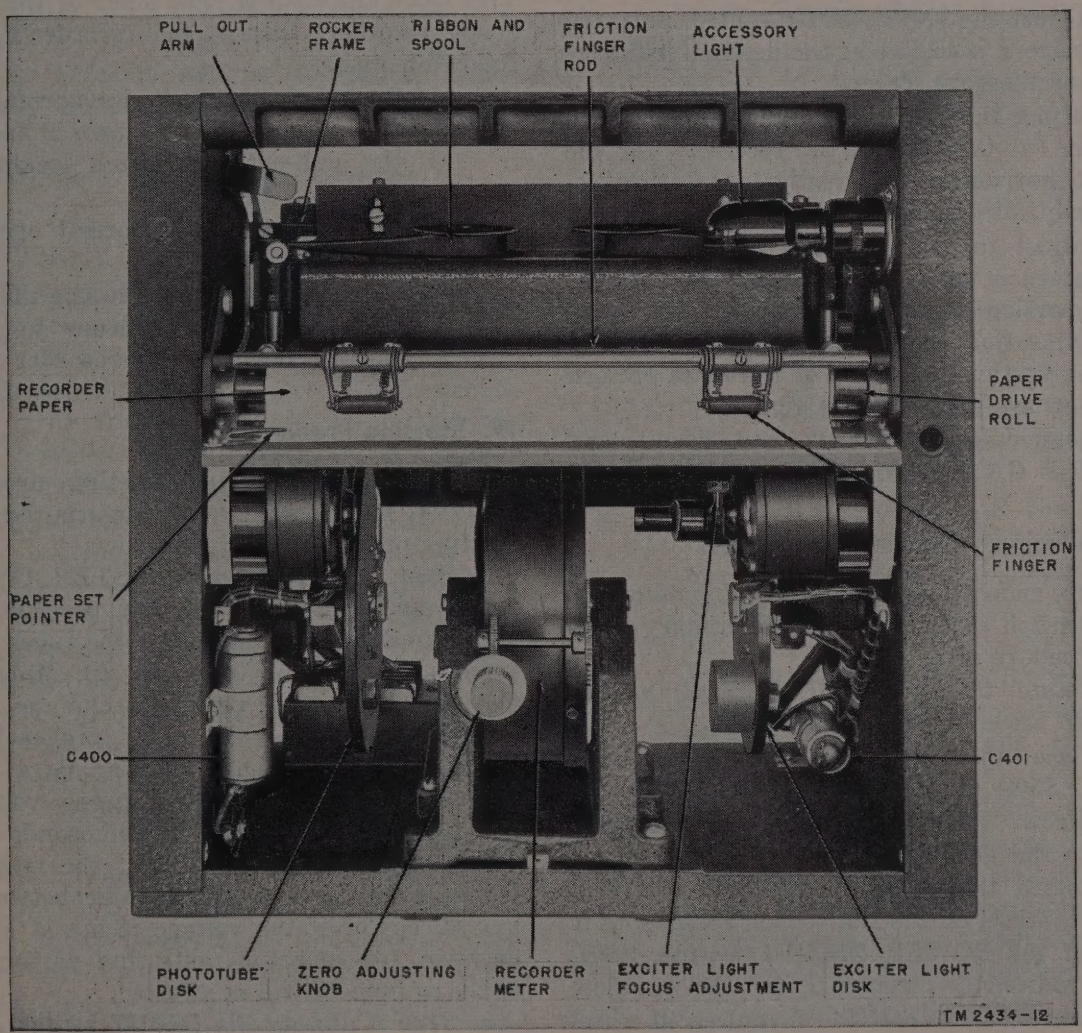


Figure 15. Radiosonde Recorder RD–3C/FMQ–1, front view.

17. Initial Adjustment of Radiosonde Receiver R–228/FMQ–2

After the radiosonde receiver has been installed, various adjustments of the unit must be made to set the nonoperating controls before the equipment is placed in operation.

a. Disconnect the antenna from the input jack, J101, or turn the ANT. SELECTOR switch to an open terminal.

b. Set the POWER ON-OFF switch on the receiver at the ON position. Allow a warm-up period of approximately 3 minutes before continuing.

c. Set the R-F GAIN control at 10, the R-F GAIN LOW-HIGH switch at HIGH, and the MAIN TUNING dial at 403 mc.

d. Adjust the INTENSITY control until the noise pattern is visible at the desired brilliance on the oscilloscope screen.

e. Adjust the HOR. POS. and VERT. POS. controls (at the rear of the receiver) for the correct horizontal and vertical centering respectively, of the oscilloscope pattern.

f. Adjust the HOR. GAIN control so that the pattern is entirely visible and occupies the major portion of the oscilloscope surface horizontally. Adjust the VERT. GAIN control so that the vertical deflection of the noise pattern is one or two graph spaces high.

g. Connect antenna back into circuit, and place R-F GAIN LOW-HIGH switch at LOW.

18. Preliminary Starting Procedure

Before using the starting procedure described in paragraph 19, perform the preliminary starting procedure given below.

a. Rotate the ANT. SELECTOR switch, S504, to select one of the antennas.

b. Place the MASTER ON-OFF power switch, S500 in the OFF position.

c. Throw RECORDER ON-OFF switch, S501 to the OFF position.

d. Rotate the SPKR. VOLUME and R-F GAIN controls on the radiosonde receiver to 0.

e. Set the POWER ON-OFF switch, S101, on the radiosonde receiver to the OFF position.

f. Rotate the INTENSITY control to a full counterclockwise position.

g. Rotate the MAIN TUNING control to approximately its dial setting for the signal expected (403 mc).

h. Turn the INPUT switch, S600, on the frequency meter component to the SC position, and momentarily press DEIONIZE switch. Observe the reading on the visual meter. If the needle does not rest at zero, reset the meter by following the instructions given in paragraph 82*b*(3).

i. Set the POWER ON-OFF switch, S602, on the frequency meter component to the OFF position.

j. Set the COARSE and FINE controls on the frequency meter to the approximate center of their control range.

k. Open the folding desk shelf of the radiosonde recorder. Inspect the recorder for the following items.

(1) Rocker frame is in its normal position with the pull-out arm in and with the pull-out arm catch locking the arm (fig. 15).

(2) Recorder is in its normal operating position.

(3) Friction fingers are pressing the paper against the spiral drum to insure smooth flow of the recorder chart.

19. Starting Procedure

After the preliminary starting procedure (par. 18) has been followed, perform the actual starting procedure as given below.

a. STEP 1. Throw the MASTER ON-OFF power switch, S500, to the ON position. Wait approximately 15 minutes for the tubes of the radiosonde receptor to warm up. More time may be required in very cold climates. Turn on the dehumidifier lamps if preheating or drying is desired (fig. 4 and par. 6*e*(4)).

b. STEP 2. Read the power supply voltmeter and frequency meter on the radiosonde receptor (or in Test Set I–209). If the frequency is not stable and not at a value between 58 and 62 cps or if the voltage is not at a value between 105 and 125 volts, the performance of the equipment will be affected.

c. STEP 3. Rotate the INPUT switch on the frequency meter to the 60 ~ position. Set the

POWER ON-OFF switch to the ON position. The visual meter on the panel of the frequency meter should read approximately 30 divisions when the COARSE and FINE controls are set to their mechanical center. Rotate the switch to the SC position. Deionize the thyratrons momentarily by pressing the DEIONIZE toggle switch. The visual meter should read zero. If these readings are not obtained, refer to section III, chapter 5, on alinement and adjustment, for the steps necessary to obtain the proper readings.

d. STEP 4. Throw the RECORDER ON-OFF switch to the ON position. Rotate the INPUT switch of the frequency meter to the SC position. Deionize the thyratrons momentarily by pressing the DEIONIZE switch. At this point the recorder should print approximately at the 0- and 100- division lines of the chart. Place the RECORDER ON-OFF switch to the OFF position. If the recorder is not functioning properly, refer to section II, chapter 5, for necessary adjustments.

20. Test Run of Radiosonde Receptor

a. IN USE WITH RADIOSONDE RECEIVER R–228/FMQ–2.

(1) Inspect and prepare the radiosonde, following the procedure given in TM 11–2433.

(2) Set the POWER ON-OFF switch to the ON position. Allow a warm-up period of approximately 3 minutes before continuing the test.

(3) Set the R-F GAIN control at the 5 setting. At the same time, set the R-F GAIN LOW-HIGH switch at LOW and the SPKR. VOLUME control at a setting between 6 and 8.

(4) Adjust the FOCUS and INTENSITY controls for the best definition with the desired intensity of the trace viewed on the oscilloscope.

Caution: Excessive intensity of traces and prolonged appearance of stationary spots on the oscilloscope screen will tend to shorten the life of the oscilloscope tube and possibly damage the tube permanently.

(5) Tune in the radiosonde signal by rotating the MAIN TUNING and ANT. trimmer controls until signal reception is made evident by appearance of the signal waveform on the oscilloscope screen, and by an audible reproduction of the signal modulation at the loudspeaker. Carefully adjust both controls for best reception as indicated by maximum upward deflection and minimum noise on the oscilloscope, and clearest audio reproduction from the loudspeaker.

(6) Adjust the LOCKING control to obtain a stationary pattern on the screen. This control may be adjusted to obtain one or more visible pulses on the screen. The operator should select the suitable setting.

(7) Connect the test switch to the radiosonde, and then operate the radiosonde. Refer to TB 11–2403–3.

(8) Turn the RECORDER ON-OFF switch to the ON position and turn the INPUT switch on the frequency meter to the X position.

(9) Adjust the radiosonde receiver for the best signal reception as described above.

(10) The recorder will now print graphic marks indicating the temperature, humidity, and high and low references. See TM 11–2433.

(11) The balloon and radiosonde now may be released in accordance with instructions in TM 11–2405.

b. IN USE WITH RADIO SET SCR–658.

(1) Inspect and prepare the radiosonde; place the radiosonde transmitter on the air.

(2) Turn the POWER ON-OFF switch, S101, to the ON position. Set the ANT. SELECTOR switch to a position which does not have an antenna connected to it.

(3) Tune Radio Set SCR–658 to the frequency of the radiosonde transmitter. The appearance of an audible sound in the loudspeaker of Radiosonde Receiver R–228/FMQ–2 indicates that the radiosonde transmitter and Radio Set SCR–658 are operating. See TM 11–1158A.

(4) Repeat steps (7) through (11) in *a* above.

21. Operating Instructions

a. GENERAL.

(1) The operation of the radiosonde is entirely automatic after the instrument has been released. The instructions given below pertain to the operation of Radiosonde Receptor AN/FMQ–2 and to the method of obtaining the record on the flight of the radiosonde. An accurate flight record of the radiosonde will result if these instructions are carefully followed.

(2) The radiosonde receptor requires continuous and careful attention. It is often possible for an experienced observer to evaluate the record during the ascent but this evaluation should not be allowed to interfere with the adjustments of the receiver system and frequency meter controls.

b. TUNING RADIOSONDE RECEIVER R–228/FMQ–2. See section IV, chapter 5.

c. ADJUSTING FREQUENCY METER. As each low-reference signal is being received, bring it to the 95.0 value on the recorder paper by means of the frequency meter adjustments (COARSE and FINE). Such adjustment at each low-reference signal may be needed if a drift or shift has occurred since the last low-reference contact. However, the adjustment should not be made until a readable low-reference value has been recorded. The adjustment should then be made quickly so that a suitable trace can be recorded during the time between the completion of the adjustment and the termination of the low-reference signal. If the ascensional rate is high, the recorded low-reference traces may be too short to provide a usable record both before and after the adjustment. In such instances no adjustment should be made because the low-reference record is usually so scattered that there is doubt as to the actual value of the low-reference frequencies of the traces.

(1) The low-reference adjustment should be made at the first steady low-reference signal received. After the radiosonde is released, the required correction should be considered as a drift for all signals except the first low-reference contact, unless the record indicates an abrupt change or shift.

(2) Because of the proximity effect of nearby objects, a rapid shift of audio frequencies may occur immediately after the radiosonde is released. That is, the first low-reference trace does not register at 95.0. The recommended procedure in this case is to assume that at release there existed a rapid shift or drift, which is equivalent to the amount of the correction required to bring the low-reference back to 95.0. Since this shift or drift takes place very rapidly, it can be treated as a shift on the record occurring at release. The above procedure is based on the assumption that the frequency meter is adjusted to 95.0 on the low-reference frequency during the baseline check or just prior to release of the radiosonde, and that the adjustment is not changed until the first low-reference contact is made during the sounding.

(3) The observer must use care in determining whether a-f changes shown by the low-reference traces occur as shifts or drifts, and at what points they occur. If the change occurs as a shift during the sounding, it is indicated usually as an abrupt change in the trace for one or more circuits (temperature humidity, etc.). A distortion or variation in the audio signal as heard from the loud speaker of the receiver, frequently will give the observer additional information as to the nature of the displacement and the point on the record at which it took place. A displacement also may be caused by defective ground equipment. Such displacements are usually greater and more erratic than those caused by the operation of a normal radiosonde, and no corresponding changes will be heard in the loudspeaker. If a displacement is caused by the recorder, the relationship between the visual meter and recorder will vary.

Therefore, it is important that the observer give the equipment continuous attention.

d. DESCENT RECORD. If the descent record is needed for the confirmation or correction of indicated ascent temperature values, the receiver system in use should be tuned carefully and the low-reference contacts adjusted to 95.0, as was accomplished during the ascent portion of the record. The high-reference trace is often required to determine the actual contact number corresponding to the highest altitude attained during the flight.

e. DRIFT OF RECORDER PAPER.

(1) The recorder zero should be checked whenever it is believed that the paper has drifted after the start of the observation. Such a drift frequently can be detected as a uniform drift occurring between consecutive low-reference contacts.

(2) If it appears that the paper is drifting, turn the INPUT switch to the SC position and depress the DEIONIZE switch momentarily to obtain a zero reading. Hold the INPUT switch at the SC position long enough for the recorder microammeter needle to reach the zero setting. This check should be made at a point in the record where no significant data will be lost, preferably during a long temperature trace.

(3) During flight, a zero check should be made at intervals to see if the zero setting of the recorder is in error. These zero checks should be frequent enough to determine (as long as the drift continues) the magnitude of the drift error for the various levels.

(4) When the recorder paper drift exceeds .3 ordinate at zero setting, a proportional correction should be applied to the temperature ordinates. (The correction is proportional since at the 95.0 setting, low-reference adjustment likewise compensates for the drift of the paper.) For example, a zero check is made 60 minutes after the baseline zero check; the paper has drifted 2.0 ordinates to the left so that the zero value is now recorded at 2.0 ordinates instead of .0 as indicated by the calibration. Check to determine whether a similar paper drift is indicated at the low-reference traces. If a uniform drift is indicated after release, it can be assumed the drift began after the first zero check. Therefore, the drift would be .5 ordinate at 15 minutes after the first zero check and 1.5 ordinates at the end of 45 minutes. Assume that at a significant level occurring 45 minutes after the original zero check that the temperature frequency is 30.0 ordinates, after recorder and frequency drift corrections have been applied. The correction would then be 65/95 or 1.5, or approximately 1.0. (Note that since the low-reference traces have been adjusted to 95.0, the amount of drift, or correction, is made to be zero at this point; the drift connection, however, is 1.5 at the correct zero setting point and 65/95 of 1.5, or 1.0 at the 30.0 setting.) Since the paper has drifted to the left, the value of 30.0 is too high. Therefore the correction would be 1.0 in negative direction, the corrected temperature frequency reading 29.0. Therefore, because of inaccuracies caused by drifting of the recorder paper and difficulties of correction, care should be taken to have the record paper alined properly prior to the beginning of the observation.

22. Stopping Procedure

After the record has been completed, operate the recorder with the INPUT switch in the SC position, and momentarily press the DEIONIZE switch to obtain a zero check. Then stop Radiosonde Receptor AN/FMQ–2 by turning the RECORDER ON-OFF switch and the MASTER ON-OFF switch to the OFF positions. Cut off the paper chart above the low-reference marks, leaving enough of the zero check to indicate correct calibration.

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Section IV. OPERATION UNDER UNUSUAL CONDITIONS

23. General

The operation of Radiosonde Receptor AN/FMQ–2 may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In the following paragraphs instructions are given on procedures for minimizing the effect of these unusual operating conditions.

24. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Handle the equipment carefully.

b. Keep the equipment warm and dry whenever possible.

c. Keep all covers on the rear of the equipment in place, operate the dehumidifier lamps continuously (they may be used for warmth as well as for drying purposes), and readjust the rocker-frame stop screws and the tapper-bar assembly by means of the vertical locknuts until the trace made by the tapper-bar has maximum legibility. Check calibration.

d. At extreme temperatures, the equipment must be completely covered, preferably with a large tarpaulin, until the time of operation.

e. When equipment which has been exposed to the cold is brought into a warm room, the equipment will sweat until it reaches room temperature. Dry the equipment by using a large fan to circulate air at the rear of the equipment. Remove the rear shields prior to operating the fan.

f. Replace the recorder ribbon with one that has been stored in a warm place.

25. Operation in Tropical Climates

When operated in tropical climates, equipment may be installed in tents, huts or, when necessary, in underground dugouts. When equipment is installed below ground or set up in swampy areas, moisture conditions are more acute than normal in the tropics. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the ambient air. To minimize this condition, turn on the dehumidifier lamps which are included in the equipment.

26. Operation in Desert Climates

a. Conditions similar to those encountered in tropical climates often prevail in desert areas. Use the same measures to insure proper operation of the equipment.

b. The main problem which arises with equipment operation in desert areas is the large amount of sand or dust and dirt which enters the moving parts of the equipment, such as motors, gears, etc. The ideal preventive precaution is to house the equipment in a dustproof shelter. Since, however, such a building is seldom available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials.

c. Never tie power cords, signal cords, or other wiring connections to either the inside or the outside of tents. Desert areas are subject to sudden wind squalls which may loosen the connections or break the lines.

d. Take care to keep the equipment as free from dust as possible. Make frequent preventive maintenance checks. Pay particular attention to the condition of the lubrication of the equipment. Excessive amounts of dust, sand, or dirt that come into contact with oil and grease result in grit, which will damage the equipment.

CHAPTER 3
ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

27. Tools and Materials

Tools and materials supplied and required with the equipment are listed in *a* and *b* below. The tools and materials contained in Tool Equipment TK–17/FMQ–1 are listed in Department of the Army Supply Catalog SIG 6–TK-17/FMQ–1.

a. TOOLS.

Tool Equipment TK–17/FMQ–1.

b. MATERIALS.

Orangestick.
Cheesecloth, bleached, lint-free.
Cloth, crocus, 9- by 11-inch sheets (Spec No. 42056–Navy).
Carbon tetrachloride.
Paper, sand, flint No. 000 and No. 0000, 9- by 11-inch sheets (Fed spec No. P–P–111).
Solvent, dry-cleaning (SD) (Fed spec No. P–S–661a).

28. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles before they can occur. See TM 38–650.

29. General Preventive Maintenance Techniques

a. Use No. 0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with Solvent (SD) ; then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a dry cloth.

c. For further information on preventive maintenance techniques refer to TB SIG 178.

30. Performing Preventive Maintenance Techniques

The preventive maintenance operations which follow should be performed by organizational personnel at intervals not more frequent than 1 month, unless authorized by the local commander. The most common trouble will be corrosion resulting from exposure to salt air and water.

Caution: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken. *Remove all power and other cables from the individual component units of the radiosonde receptor before performing any preventive maintenance.*

a. When performing preventive maintenance on the components of the radiosonde receptor, first loosen the quarter-turn fasteners (Camloc) on the front plate of each component and slide the chassis out of the rack. Place the unit in a position suitable for performing maintenance work.

b. Make a visual inspection in all components of the items which follow; tighten and/or clean if *necessary.*

(1) Tube sockets and pins, for loose contacts, dirt, and corrosion. Check vacuum tubes; replace them if *necessary.*

(2) Capacitors, for signs of break-down or deterioration. Check for damaged or misalined plates of a variable capacitor.

(3) Resistors, for blistering, discoloration, and other evidence of overheating.

(4) All rotary switches, for dirt, corrosion, loose contacts, and unsatisfactory mechanical action.

(5) Plugs and connectors, for dirt, corrosion, and loose contacts.

(6) Wires, cords, and cables, for cracks, cuts, and frayed insulation.
(7) All visible terminals and connections, for loose connections and corrosion.
(8) MFP coatings, for breaks. (Retouch with a brush, if necessary.)
(9) Finish, for scratches and bare spots. (Retouch, if necessary.)
(10) All jack contacts, for loose contacts, dirt, and improper action.
(11) Meters, for dirt, corrosion, and broken glass.
(12) Transformers and chokes, for blistering, corrosion, or leakage of insulation.
(13) Motors, for loose connections at the motor input and for proper mounting.
(14) Gears and rotary shafts, for cleanliness, corrosion, and proper mechanical motion.
(15) Antennas, for cleanliness, corrosion, proper mounting; antenna insulators, for signs of deterioration.
(16) Cabinet, chassis, and mountings, for dirt, rust, or corrosion.

c. If it is necessary to remove the miniature type tubes found in the radiosonde receiver component, a special tube puller packed in the equipment spare parts box is used. Great care must be taken when replacing miniature tubes so as not to bend the tube pins.

(1) If the oscilloscope tube in the radiosonde receiver must be replaced, proceed according to instructions given in paragraph 78*b*.
(2) For replacement or inspection of the tubes in the r-f unit it is necessary to remove the cover on the r-f unit compartment. The cover is held in place by Phillips-head captive screws around its outer edge. A little upward pressure is required to remove the cover after the captive screws are freed, due to the gripping action of the grounding fingers on the inside of the cover.
(3) For replacement of the type 2C40 tubes in the r-f unit, proceed according to instructions given in paragraph 78*c*.

d. All meters, except the power supply frequency meter and the recorder meter, should normally indicate zero when the equipment is turned off. Before deciding that a meter needs readjusting, tap the meter case lightly with the tip of one finger. This tapping may help the meter to overcome the slight friction which sometimes exists at bearings and which prevents an otherwise normal unit from coming to rest at zero. If adjustment of the zero setting is needed, insert the tip of a suitable screw driver into the slotted screw head located below the meter glass and *slowly* turn the adjusting screw until the pointer is at zero. Lightly tap the meter case again. View the meter face and pointer full on and not from either side. Avoid turning the screw too far because the needle may be bent or the hairspring damaged.

Section II. LUBRICATION

31. Lubrication of Radiosonde Recorder

Lubrication reference charts for the radiosonde recorder are shown in figures 16 and 17. No lubrication chart has been prepared for the other components of the radiosonde receptor. Detailed lubrication instructions for these components and for the components of radiosonde recorder are given below.

32. Detailed Lubrication Instructions

a. GENERAL.

(1) The type of lubricant to be used, the interval, and the specific instructions for each part of the radiosonde recorder are given in figures 16 and 17. Lubrication details for the light disk support shaft bearings and for the phototube disk support shaft bearings in the radiosonde recorder are given below.
(2) Gasoline will not be used as a cleaning fluid for any purpose. When the unit is overhauled or when repairs are made, parts should be cleaned with solvent (SD).
(3) Carbon tetrachloride will be used as a cleaning fluid only in the following cases: on electrical equipment where inflammable solvents cannot be used

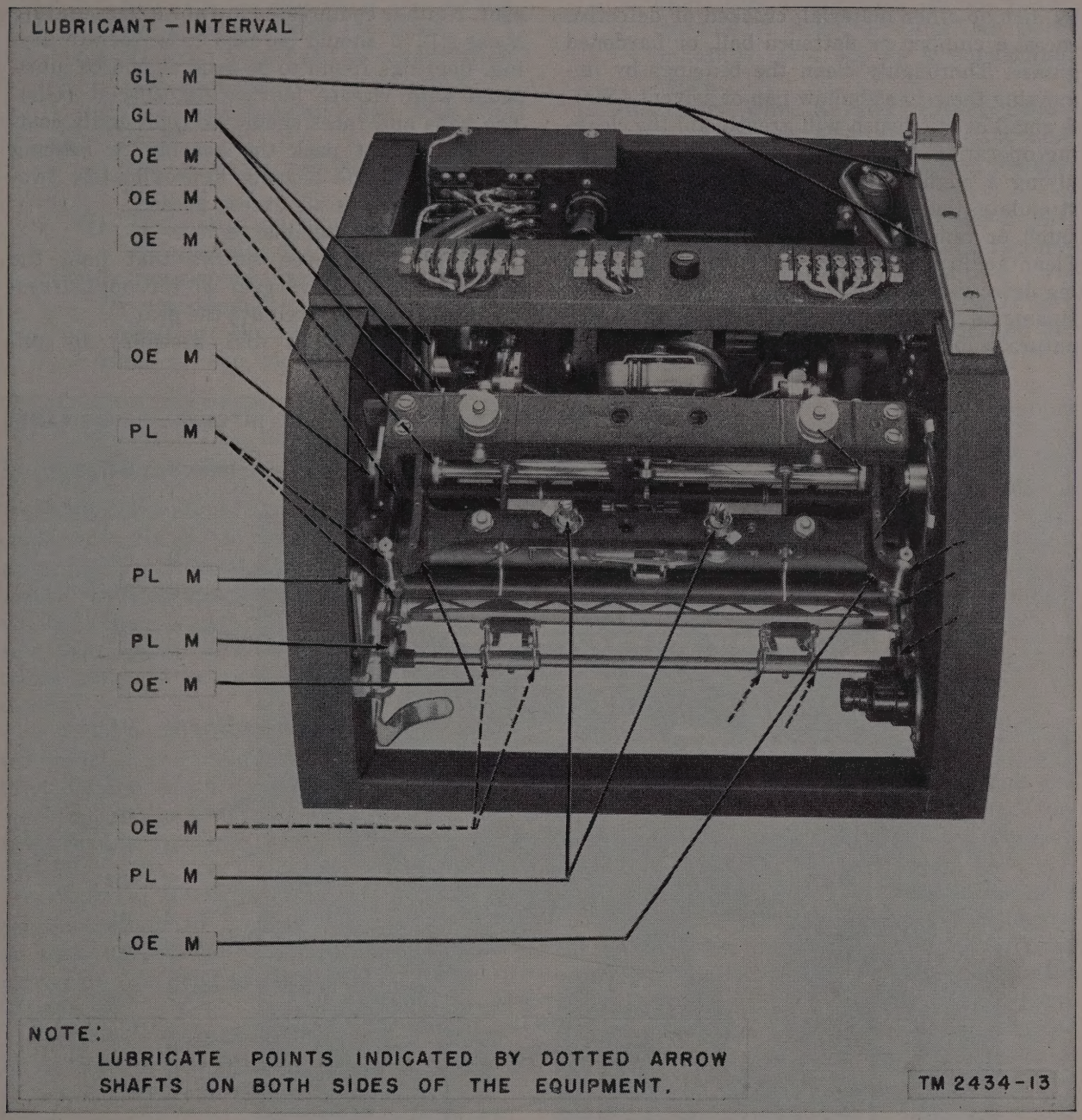


Figure 16. Lubrication reference data for radiosonde recorder, top view, titled out of rack.

because of fire hazard, and for cleaning electrical contacts including relay contacts, plugs, commutators, etc.

(4) Apply oil, lubricating, preservative, special (PL-Special) sparingly to springs and loops of all helical springs to prevent wear and rust.

Note. Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be shortened to compensate.

b. LIGHT DISK SUPPORT SHAFT BEARINGS. Every 6 months, or more often if conditions warrant, disassemble and remove the ball bearings as outlined below. Inspect for loose shaft fit and defects, such as binding or excessive wear, as evidenced by extreme wobble between inner and outer races. Defects may be caused

by dirt or other material, cracked or defective races, a chipped or flattened ball, or hardened grease. Thoroughly clean the bearings by immersing them in a shallow pan of solvent (SD). A small bristle brush will greatly aid the cleaning operation. Rotate the bearing by hand, applying a slight pressure on the outer race to stimulate the load. If the bearing seems to catch or bind, visually inspect for the cause. Clean again and recheck before marking bearing defective. Always use clean solvent for final rinsing of the bearing. Allow bearings to dry naturally before attempting to reapply lubricant. Neither compressed air nor a temperature above 212°F should be used to accelerate drying. Bearings found to be good should be lubricated with Grease lubricating, special (GL). The balls and races should be thoroughly coated, but do not pack the bearing or bearing housing. Fill the bearing approximately two-thirds full. Wipe off excess grease.

(1) To disassemble, remove—

(*a*) The three screws that hold the disk drive gear of the optical system and remove the gear.

(*b*) The light disk assembly by un-

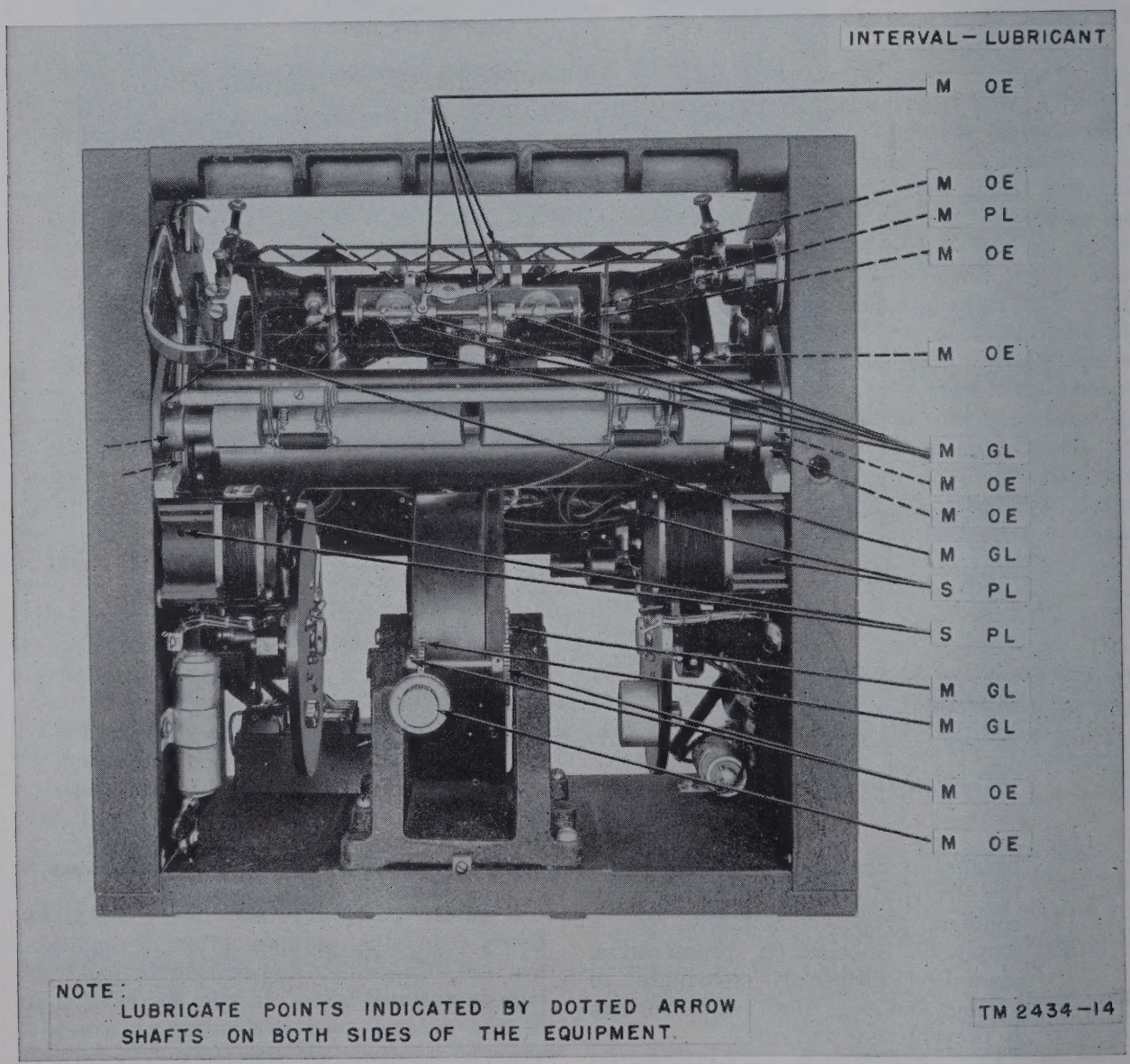


Figure 17. Lubrication reference data for radiosonde recorder, top view, paper chute removed.

screwing the thumbnut and pulling the assembly from the shaft.

(*c*) The two Allen head set screws from the optical disk drive gear hub.

(*d*) The gear hub and key from the shaft.

(*e*) The bearing retainer and outer bearing.

(*f*) The shaft and inner bearing from the inner side of the recorder frame.

(2) To reassemble—reverse the procedure for disassembly.

Caution: Do not lubricate the slip rings of the phototube and exciter light disk. Clean with carbon tetrachloride. A clean, dry, lint-free cloth or canvas will act as a burnishing agent.

c. PHOTOTUBE DISK SUPPORT SHAFT BEARINGS. The phototube disk assembly is disassembled and lubricated in the same manner as the light disk.

d. RADIOSONDE RECEIVER R–228/FMQ–2. The radiosonde receiver is lubricated at the factory and no further lubrication is needed.

e. FREQUENCY METER TS–29B/FMQ–1. Lubrication is not essential and therefore, no instructions are required.

Section III. WEATHERPROOFING

33. Weatherproofing

a. GENERAL. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. TROPICAL MAINTENANCE. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained in TB SIG 13 and TB SIG 72.

c. WINTER MAINTENANCE. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in TB SIG 66.

d. DESERT MAINTENANCE. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained in TB SIG 75.

e. LUBRICATION. The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69. Observe all precautions outlined in TB SIG 69 and pay strict attention to all lubrication orders when operating equipment under conditions of extreme cold or heat. Refer to section II, this chapter, for detailed instructions.

34. Rustproofing and Painting

a. When the finish on the chassis or cabinets has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section IV. TROUBLE SHOOTING ON ORGANIZATIONAL MAINTENANCE LEVEL

35. Visual Inspection

a. Failure of this equipment to operate properly will usually be caused by one or more of the following faults:

(1) Improperly connected power cable.

(2) Worn, broken, or disconnected cords or plugs.

(3) Burned-out fuses.

(4) Wires broken because of excessive vibration.

(5) Defective tubes.

b. When failure is encountered and the cause is not immediately apparent, check as many of the above items as is practicable before starting a detailed examination of the component parts. If possible, obtain information from the operator of the equipment regarding performance at the time trouble occurred.

c. Inspect the antenna system for obvious abnormalities.

36. Trouble Shooting by Using Equipment Performance Checklist

a. GENERAL. The equipment performance checklist (par. 37) will help the operator to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications, and the corrective measures the operator can take. *To use this list, follow the items in numerical sequence.*

b. ACTION OR CONDITION. For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the normal indications column.

c. NORMAL INDICATIONS. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. CORRECTIVE MEASURES. The corrective measures listed are those the operator can make without turning in the equipment for repairs. A reference in the table to material in chapter 5 indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is necessary. If the set is completely inoperative or if the recommended corrective measures do not yield results, trouble shooting is necessary. However, if the situation requires that operation be maintained and if the set is not inoperative, the operator must maintain the set in operation as long as it is possible to do so.

37. Equipment Performance Checklist for Radiosonde Receptor AN/FMQ–2

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	ANT. SELECTOR switch S504.	Selects the antenna to be used.		
	2	INPUT switch S600	Set switch to SC		
	3	Visual meter, M600, frequency meter component.		Indicates zero	Reset meter according to instructions in paragraph 82.
	4	MASTER ON-OFF switch S500.	Set to ON position		
	5	Power supply voltmeter M501, and frequency meter M500.	Proper line voltage and frequency.	Indicates values between 105 and 125 volts and 58 and 62 cycles.	Check operation of METER ON-OFF switch S500. Check operation of meters. Check fuses F400 and F401.
	6	INPUT switch S600	Set to the 60~position		
	7	POWER ON-OFF switch S602 on frequency meter component.	Set to ON position		
	8	COARSE AND FINE controls.	Set to mechanical centers		

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	9	Visual meter M600		Indicates approximately 30 divisions.	Check meter. Check tubes in frequency meter component. Check EQUALIZER control setting. Check POWER ON-OFF switch. Check cable from receiver output to frequency meter. Check connections at P601.
	10	INPUT switch S600	Rotate to SC position		
	11	Visual meter M600	DEIONIZE toggle switch S601 momentarily pressed.	Indicates zero	Check DEIONIZE switch. Trouble shoot (ch. 5, sec. I). Check INPUT switch S600 and its connections.
	12	MAIN TUNING control	Rotate control to approximate dial setting for 403-mc operation.		
	13	RECORDER ON-OFF switch S-501.	Set to ON position		
	14	Recorder trace		Indicates 0 and 100 divisions, with INPUT switch at SC and DEIONIZE switch momentarily pressed.	See item 12 above. Check recorder action and operation.
	15	INPUT switch S600	Set to X position	Signal trace recorded on flight chart.	Check antenna connections. Check INPUT switch. Check mechanical operation of recorder. Check cable and terminal connection.
	16	COARSE and FINE controls.	Rotate whenever low-reference traces received.	Low-reference traces will be shifted around the 95.0 recorder division mark.	If no shift of the trace is obtained, trouble shooting is necessary.
	17	INPUT switch S600 and DEIONIZE switch S601.	Set INPUT switch to SC position; depress DEIONIZE switch momentarily.	Recorder trace should register at zero.	Use proportional correction for paper drifting. (par. 18).

	No. Item	Item	Action or condition	Normal indications	Corrective measures
EQUIP PERF	18	Loudspeaker	SPKR. VOLUME control at center of its range.	Audible sound	Trouble shooting is necessary (chapter 5, section I).
	19	Oscilloscope	HOR. GAIN and VERT. GAIN controls at center. FOCUS and INTENSITY controls properly adjusted.	Pattern on screen	Trouble shooting necessary (chapter 5, section I).
STOP	20	RECORDER ON-OFF switch S501.	Set to OFF position	Recorder operation stops.	
	21	MASTER ON-OFF switch.	Set to OFF position		

CHAPTER 4
THEORY

38. General

The radiosonde receptor is used to receive, indicate, and record signals transmitted by 403-mc balloon-borne radiosondes. (As previously explained, the radiosonde receptor is used in conjunction with Radio Set SCR–658 whenever wind data is needed. TM 11–1158A explains the functioning of Radio Set SCR–658). The radiosonde transmits an f-m signal at 403 mc. The modulation occurs at an audio rate between 8 and 200 cps, the exact frequency rate varying in response to the changing pressure, temperature, and relative humidity conditions encountered by the radiosonde during its ascent. Thus, the transmission by the radiosonde consists of a continuous carrier wave whose frequency is dependent on the atmospheric conditions at the location of the radiosonde.

39. Block Diagram for Radiosonde Receptor (figs. 18 and 19)

In figure 18, the radiosonde receptor is represented by blocks which symbolize the basic components of the equipment. The interconnecting lines with arrows show the relationship of each component to the entire system. Radio Set SCR–658 is shown as a single block and, when this set is used, it replaces the antennas and receiver of the radiosonde receptor except for the first audio stage and speaker of the radiosonde receiver. In figure 19, the blocks are broken down to show the principal circuits of each component. Radio Set SCR–658 has been omitted from the diagram because functioning of this set is explained in TM 11–1158A. For purposes of explanation, the pictorial portion in figure 19 shows the recorder mechanism in simplified form.

a. ANTENNA SYSTEM. The antenna picks up the r-f signals transmitted by the radiosonde. These signals are carried to the receiver by means of a coaxial cable (transmission line).

b. RECEIVER. The receiver amplifies and converts the 403-mc r-f signals received from the antenna into a-f signals of correct amplitude and waveform (essentially a saw-tooth voltage) for operation of the frequency meter component. In addition, the receiver has a speaker output for aural monitoring purposes, an oscilloscope for visual monitoring, and a built-in power supply.

c. RADIO SET SCR–658. When signals from a 403-mc radiosonde (Radiosondes AN/AMT–2 and AN/AMT–2A) are to be recorded, the antenna system of the radiosonde receptor is not used, being replaced by the system of Radio Set SCR–658. During 403-mc operation, the frequency meter receives an a-f signal from Radio Set SCR–658. This signal has approximately the same amplitude and waveform as the a-f signal which is supplied to the frequency meter by the radiosonde receiver. A shielded cable (Cord CD–1312 of Radio Set SCR–658) carries the a-f signal from Radio Set SCR–658 to the frequency meter and to the output channel of the radiosonde receiver.

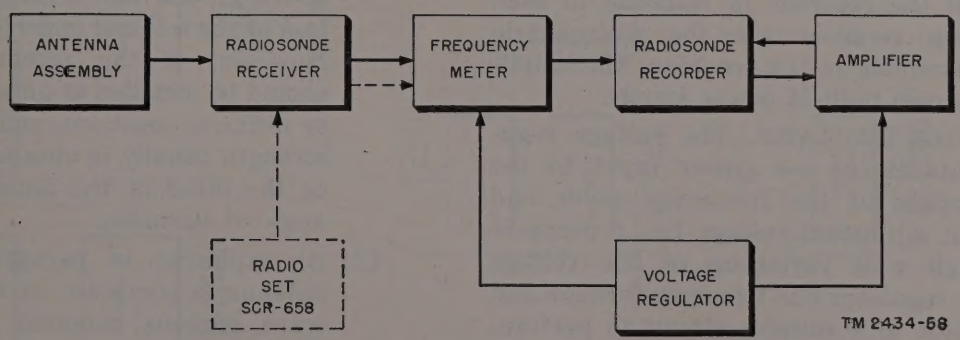


Figure 18. Radiosonde Receptor AN/FMQ–2, block diagram.

d. FREQUENCY METER. The frequency meter produces a pulsating current whose average or d-c value is proportional to the frequency of the a-f input signals. This current passes through two microammeters, the deflections of which indicate the a-f. The scales of the microammeters are graduated in bi-cycles per second (1 bi-cycle equals 2 cycles). One microammeter, called the *visual meter,* is located on the front panel of the frequency meter, and the other microammeter, called the *recorder meter,* is located on the recorder chassis. The frequency meter has its own built-in power supply and voltage regulator.

e. RECORDER.

(1) The recorder makes a continuous, printed record of the frequencies indicated by the frequency meter. The recorder is an electromechanical device and its principal components are the recorder meter, a photoelectric scanning assembly, and a printing mechanism. All moving parts within the recorder, with the exception of the ribbon drive mechanism, recording paper and its feed system, are held in precise synchronism by a system of gears which are rotated by a common drive motor.

(2) In actual operation, current pulses are produced when the pointer of the recorder meter blocks a beam of light directed from the photo electric scanning assembly. The current pulses, after amplification (*f* below), energize solenoids which in turn actuate a printing mechanism.

f. AMPLIFIER. The amplifier sends a uniform, heavy pulse of current through the tapper bar magnets of the recorder in response to each current pulse received from the photoelectric scanning assembly in the recorder. The amplifier has its own built-in power supply.

g. VOLTAGE REGULATOR. The voltage regulator maintains the a-c power input to the power supplies of the frequency meter and amplifier at a constant voltage (± .5 percent) even though wide variations of line voltage occur. The regulator has two transformers and one capacitor in a suitable circuit to perform this function.

40. Antennas

a. LINE OF SIGHT TRANSMISSION. Part of the electromagnetic energy radiated by the radiosonde antenna, after travelling through space, sweeps across the receiving antenna at the velocity of light, inducing in the receiving antenna a voltage which is proportional to the strength of the travelling electromagnetic wave. At a frequency of 403 mc, this energy is propagated in a direct line, commonly called *line of sight* transmission, and suffers little effect by absorption in the atmosphere of the earth or in the ground. This direct wave, however, is subject to reflection. Objects in the path of the wave therefore can deflect it and change its direction of travel. Thus, if a tree, building, or other objects obstruct the line of sight path between the radiosonde antenna and the antenna of the radiosonde receptor, the induced voltage may be attenuated or lost completely. For this reason, it is advantageous to install two antennas for each receptor, thus insuring, at any azimuth angle, an unobstructed line of sight path between the radiosonde and receptor antennas (fig. 5). Only one antenna is used at a time; the antenna which provides better signal strength is used. Each antenna has its own transmission line which carries the received energy from the antenna to the receiver.

b. ANTENNA. The antenna is a half-wave, center-fed, coaxial vertical antenna fed by a 52-ohm coaxial cable.

(1) The field pattern of the antenna in the horizontal plane is circular. This means that the antenna receives signals equally well at all azimuth angles. In the vertical plane, the field pattern varies with the height of the antenna above ground and with the composition of the soil and underlying terrain. However, if the receptor antenna should be installed at different heights or different locations, sufficient signal strength usually is obtained from one or the other of the antennas at any angle of elevation.

(2) As explained in paragraph 6*f*, the antenna is composed of two quarter-wave sections mounted in line and separated by an insulator. The upper

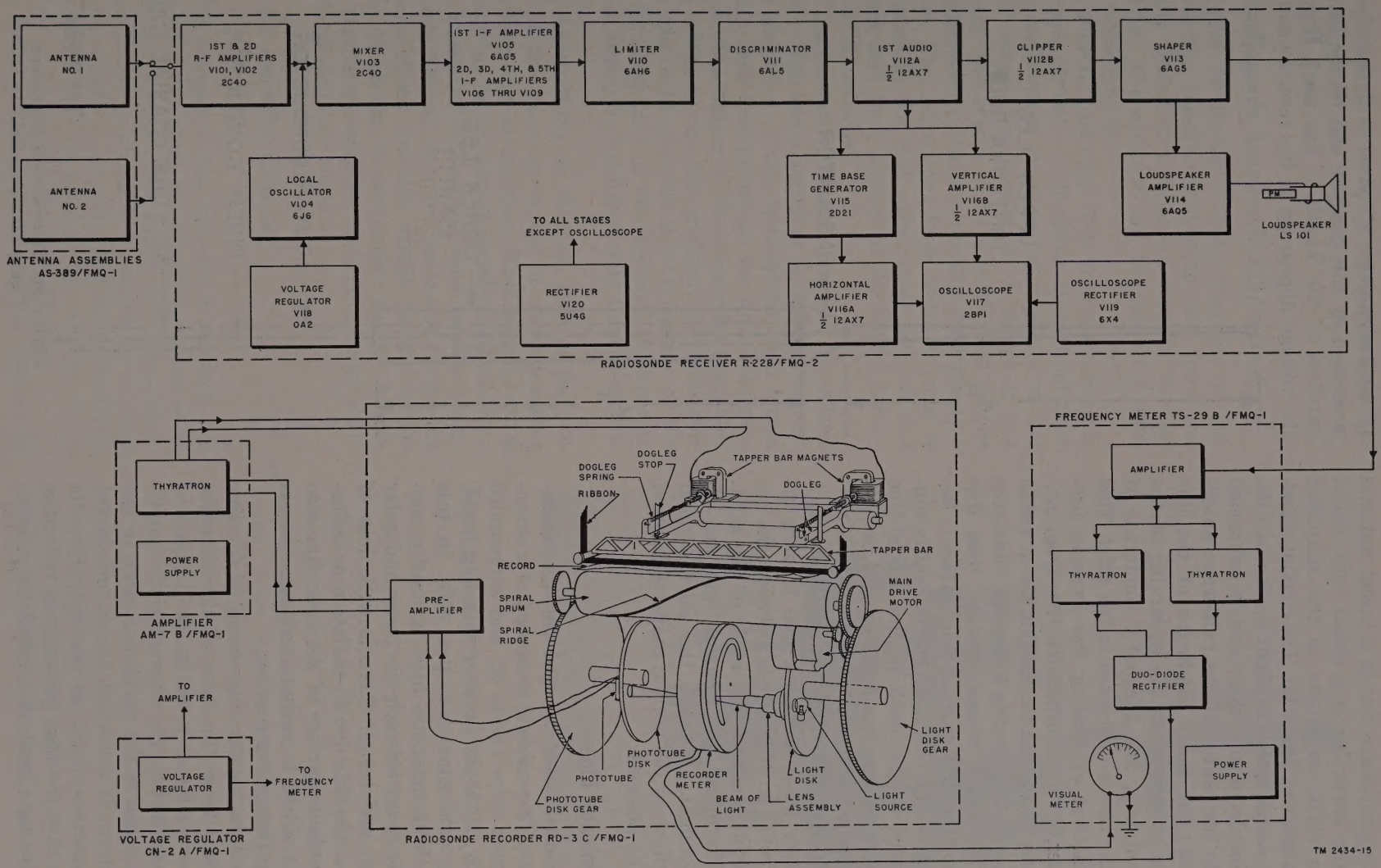


Figure 19. Complete pictorial block diagram of radiosonde receptor.

quarter-wave leg is a metal rod and the lower leg is a metal tube, called a *skirt,* as shown in the simplified sketch of figure 20. The coaxial transmission line is brought up through the inside of the skirt and is connected to the center of the half-wave antenna; the inner conductor of the line is connected to the upper leg of the antenna, and the outer conductor of the line is connected to the skirt. This method of feeding the antenna prevents the transmission line from acting as a parasitic element which would cause the antenna to acquire unwanted directional characteristics, thus distorting the normal field pattern. Because the electromagnetic field is confined to the inside of the coaxial line and because the fields around the antenna do not penetrate the outside surface of the skirt (or penetrate to a very small distance, due to skin effect), no field exists between the coaxial line and the inside of the skirt. Therefore, the coaxial line can be brought up inside the skirt without affecting the normal characteristics of the antenna.

41. Transmission Line

a. A coaxial cable is used for the transmission line. This cable is composed of a seven-strand copper wire inside of, and surrounded coaxially by, a tubular, copper shielding braid, or outside conductor (see par. 6*f*). In this line, the electromagnetic field is mostly confined to the space between the inner and outer conductors; and hence, there is little loss of power from the line due to radiation or induction. The outside surface of the outer line also serves as a shield to exclude unwanted waves originating from other sources.

b. The characteristic impedance of the line is determined from the ratio of the diameter of the inner conductor to the inside diameter of the outer conductor. The characteristic impedance in the case of the particular cable in use is 52 ± 3 ohms. If a coaxial line is terminated by an impedance equal to the characteristic impedance then the load presents no reflection to the incoming signal. A constant impedance of approximately 52 ohms will therefore be presented at the receiver end of the line, regardless of the length of line used. However, the voltage appearing at the receiver end may

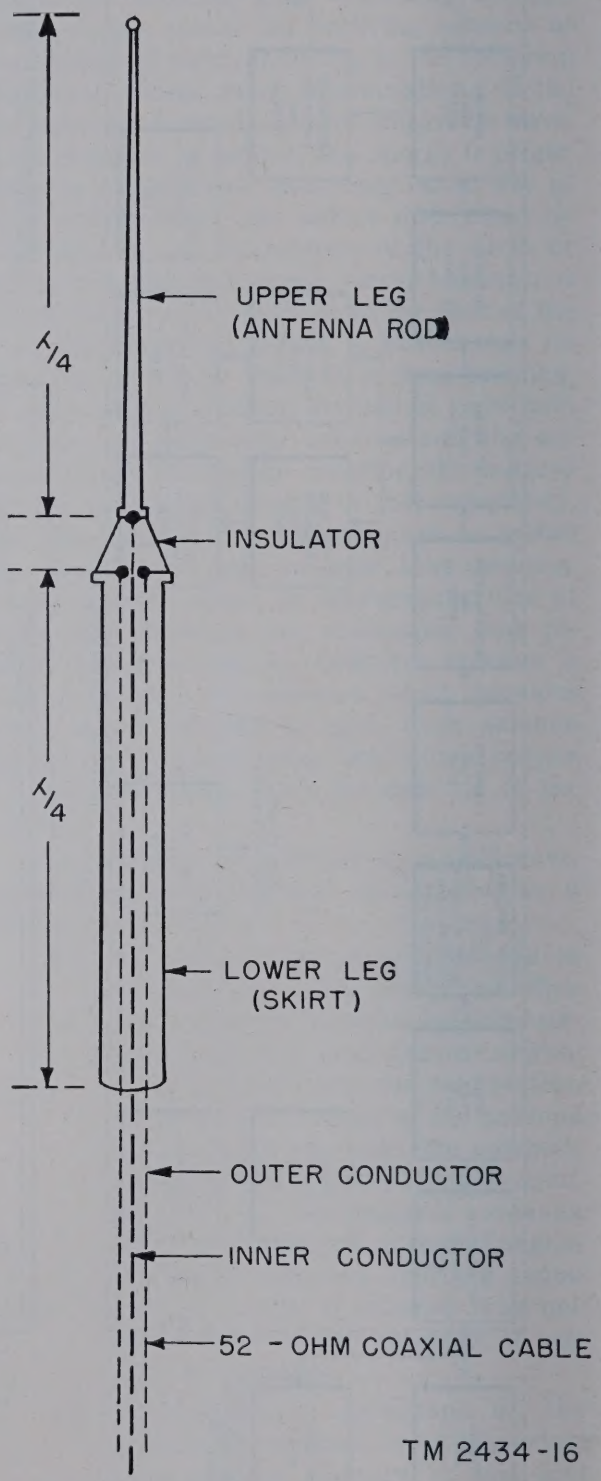


Figure 20. Coaxial vertical antenna, simplified diagram.

be significantly reduced by the normal attenuation characteristics of the line if the length of line used is too long.

42. Radiosonde Receiver R–228/FMQ–2

Figure 19 shows a block diagram of the radiosonde receiver indicating the functions of the different component circuits in the receiver. The circuits can be separated into four basic groups.

a. SIGNAL CIRCUITS. The received signal is fed through two r-f amplifier stages and then is mixed with a local oscillator signal in the mixer stage. The resultant i-f output is fed through five stages of i-f amplification before being applied to the limiter and discriminator stages. The a-f output from these circuits is amplified in the first audio stage, clipped and shaped, and then applied to the output terminals of the receiver.

b. OSCILLOSCOPE CIRCUIT. Part of the output of the first audio amplifier is fed to the vertical amplifier of the oscilloscope. This signal is also used to synchronize the time base generator. The output of the time base generator goes to the horizontal amplifier, and thus permits the oscilloscope to show a picture of the a-f signal output of the receiver. A separate power supply is furnished only for the oscilloscope.

c. AUDIO MONITOR CIRCUIT. Part of the output of the receiver is fed to a loudspeaker amplifier and loudspeaker. This permits aural monitoring of the output signal of the receiver.

d. POWER SUPPLY. A full-wave rectifier stage, suitably filtered, supplies the power for all the circuits of the receiver, except for the oscilloscope which has its own power supply. A voltage regulator regulates the voltage supplied to the local oscillator stage.

43. R-f Amplifier Circuits (fig. 23)

The r-f unit of the radiosonde receiver consists of a two stage r-f amplifier, a local oscillator and a mixer. The entire unit, mounted on a subchassis, is placed in a completely shielded compartment to provide sufficient shielding. The tubes may be reached by removal of the top cover of the shield compartment.

a. LIGHTHOUSE TUBE. The signal received by

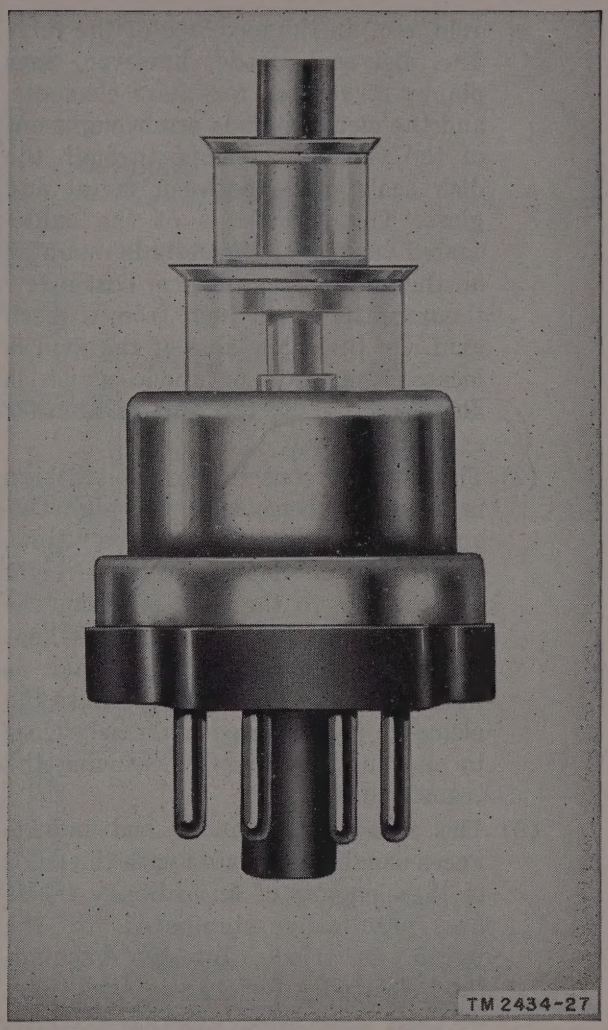


Figure 21. Lighthouse tube 2C40.

the antenna is fed from the ANT. SELECTOR switch, S504, to the antenna input jack, J101, located in the rear of the shield compartment around the r-f section of the receiver. From J101 it proceeds directly into the input circuit of the first r-f amplifier, V101, tube type 2C40. The construction of this tube as well as the circuit design associated with this tube is different from that for the ordinary type of r-f amplifier, mainly as a consequence of the high frequency of operation, namely, 403 mc.

(1) Tube 2C40 is a type of microwave tube known as a disk-seal triode. It is commonly called a *lighthouse* tube, a name derived from the shape and construction of the tube. Ordinary triodes use cylindrical forms for the different elements, such as the plate,

grid, etc., in the envelope of the tube. The disk-seal triode, however, uses planar structures for these elements, and the element leads are brought out of the vacuum envelope through the disk seals made between metal and glass. The cathode is of the oxide-coated variety and usually is mounted on the end of a cylindrical post a few thousandths of an inch from a mesh grid. On the other side of the grid is located the plate or anode which is also mounted at the end of another cylindrical post.

(2) This special construction and design is necessary because at the high frequency of operation the transit time, or time for an electron to travel from the cathode to the grid or from the grid to the anode, must be kept as small as possible. The planar or lighthouse style of triode permits the elements to be placed extremely close to one another, thereby reducing the transit time.

(3) The stray capacitances and inductances usually associated with the leads to the elements of an ordinary triode are practically eliminated in the lighthouse triode, for the vacuum-tube electrodes form an integral part of their associated external circuits. A cross-section view of the 2C40 tube is shown in figure 22.

(4) Because of the high operating frequency, ordinary lumped circuit elements cannot be effectively used with this type of tube. Instead, the tuned circuits in the cathode and plate leads of the tube are formed by a modified quarter-wave transmission line (fig. 24).

b. TRANSMISSION LINES (fig. 24).

(1) Two flat brass plates, about 1/16 inch thick, insulated from one another by a sheet of mica, are used in the plate circuit of the r-f amplifier tubes. One strap or plate is bolted directly to the chassis while the other is insulated from the chassis. Since a potential difference exists between the two plates and across the sheet of mica, a capacitive effect is said to exist between the two brass straps. The d-c voltage to the plate of the tube is applied through the insulated plate, which is maintained at the same r-f potential as the other strap. Referring to the simplified schematic (fig. 23) of the r-f amplifier stages, the insulated brass plate constitutes the plate r-f inductance L105. The capacitive effect existing between the two plates is represented by the reference symbol C104, drawn with dotted lines to signify that it is not an actual connection between the two inductances.

(2) A similar line exists in the cathode circuit. The insulated plate serves as the feed inductance, L103, for the heater voltage, while the other plate serves as an inductance, L102, in the input circuit to the cathode. C101 represents the capacitive effect existing between the two plates.

c. DETAILED DESCRIPTION (figs. 22 and 23).

(1) The antenna input signal is coupled from antenna connector, J101, by a short metal strap to the point of proper impedance on the cathode line, L102, of the first grounded grid r-f amplifier tube, V101. An antenna trimmer capacitor, C106, is placed in the cathode circuit to provide optimum tuning of the receiver input circuit. The cathode bypass capacitor, across the cathode bias resistor, R101, is part of the internal construction of tube type 2C40. Plate tuning is accomplished by varying plate tuning capacitor, C103A ((3) below). A metal strap fed through an opening in the subchassis couples the plate line (bottom of subchassis) to the cathode line (top of subchassis) of the second r-f amplifier tube, V102.

(2) The circuit of the second r-f stage is similar to that of the first stage. Cathode tuning is accomplished by means of a variable ceramic trimmer capacitor, C110, mounted adjacent to the cathode line. Plate tuning utilizes section C103B of the main tuning capacitor ((3) below).

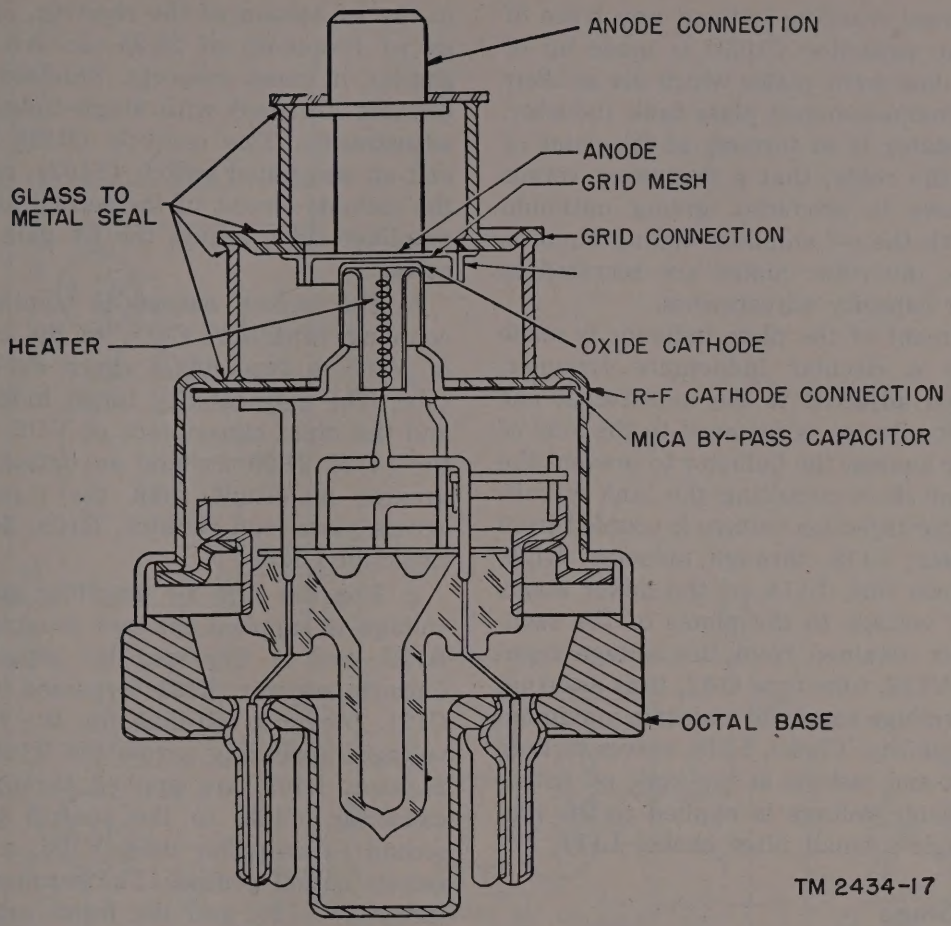


Figure 22. Cross-section view of 2C40 tube.

Note. To simplify circuit details, lumped tuned circuits have been substituted in the partial and complete schematics for the resonant lines.

(3) A front panel-mounted control dial MAIN TUNING, drives a three-section ganged capacitor. Sections C103A and C103B tune the r-f amplifier stages, and section C103C tunes the plate circuit of the local oscillator stage. The stators of capacitors C103A and C103B are silver-plated brass blocks of the split stator type, with semicircular recesses at their centers. These recesses accommodate the circular rotor. A ceramic shaft with a conductive surface of silver serves as the rotor section.

(4) A-c heater voltage is applied to the filaments of V101 and V102 through small filter chokes L101 and L107, respectively, as well as through another filter choke, L122, common to both filaments.

44. Local Oscillator Circuit (fig. 23)

a. This circuit produces a high-frequency output which is used to beat against the r-f input signal to form the i-f. A type 6J6 twin triode is used as the local oscillator tube, V104, in a fixed tuned-grid, tuned-plate circuit. The 6J6 tube is used because of its small size, short element leads, and its low interelectrode capacitances and low series lead inductances. The plate circuit is tuned to a frequency of 21.25 mc below the carrier frequency by the variable capacitor section, C103C.

b. This section of the tuning capacitor is coupled to the ceramic rotor shaft by means of a special shaft coupling which assures per-

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fect mechanical tracking without any trace of binding. The capacitor C103C is made up of two sets of dual rotor plates which use as their stator the channel-shaped plate tank inductor, L119. The stator is so formed, at the point of mesh with the rotor, that a frequency versus rotation curve is produced, giving optimum tracking with the r-f amplifier tuning circuits. In addition, the rotor plates are serrated to allow minor capacity adjustments.

c. Adjustment of the plate inductor is made possible by a circular inductance trimmer, L121, located adjacent to the inductor at one end. A sheet of mica is fastened to the side of the trimmer nearest the inductor to prevent the possibility of short-circuiting the tank circuit.

d. Oscillator injection voltage is coupled from plate inductor, L119, through inductor, L120, to the cathode line, L114, of the mixer stage. B+ supply voltage to the plates of the oscillator tube is obtained from the voltage regulator tube, V118, tube type OA2, thus assuring a constant voltage supply to maintain maximum oscillator stability. Choke, L118, serves to keep the filament and cathode at the same r-f potential. A-c heater voltage is applied to the filament through a small filter choke, **L117.**

45. Mixer Stage
(fig. 23)

a. The circuit elements associated with the mixer stage are similar to those used in the r-f amplifier stage. However, the mixer tube has only one transmission line acting as a tuned cathode circuit. The r-f signal from the second r-f amplifier stage and the local oscillator voltage are both applied to the cathode of the mixer tube through the cathode line inductance, L114. Variable trimmer capacitor C114 tunes the cathode of the mixer to provide an output in the plate circuit at the i-f of 21.25 mc. This output is fed to the input coupling circuit of the first i-f amplifier stage.

b. A-c heater voltage is applied to the filaments through a small filter choke, L113. The cathode bypass capacitor for the cathode bias resistor, R106, is contained within the tube.

46. I-f Amplifier Circuits
(fig. 25)

a. Five stages of amplification are contained in the i-f section of the receiver, operating at an i-f frequency of 21.25 mc. All stages are similar in most respects. Shielded i-f transformers are used with single-tuned, iron-core adjustments. Two controls (R138 and R139) and an associated switch (S102), connected in the cathode circuit of the second and third i-f amplifier tube, adjust the i-f gain of the receiver.

b. The mixer output is applied through coupling capacitor, C115, to the control grid of V105, a type 6AG5 sharp cut-off pentode tube. The permeability tuned inductor, L123, and the input capacitance of V105 resonate at the i-f of 21.25 mc and an output voltage of greater amplitude than the input, appears across plate load resistor, R109, decoupled by capacitor C120.

c. For the first i-f amplifier stage, screen voltage is supplied through dropping resistor, R112, and is bypassed by capacitor, C122. Cathode resistor, R111, bypassed by capacitor C121, provides self-bias for the tube. Signal voltages appearing across the V105 plate load resistor, R109, are applied through coupling capacitor, C123, to the control grid of the second i-f amplifier tube, V106, a type 6BA6 remote cut-off pentode. The permeability tuned inductor, L124, and the input capacitance of V106 resonate at the i-f frequency of 21.25 mc to form the input circuit for the control grid of V106. An amplified i-f signal appears across plate load resistor, R114, decoupled by capacitor, C124, and resistor, R113.

d. The input capacitance which forms part of the tuned-grid circuit of V106 is made up of two components. One represents the internal capacitance of the tube itself; the other is an additional capacitive effect which depends on the voltage amplification of the tube and on the type of load impedance. This latter component results from the Miller effect. If the amplification factor does not change, then the grid tank circuit can be initially tuned properly to the i-f (21.25 mc). However, if the amplification is made to change, then the input capacitance will similarly be changed, and the grid tank circuit will be detuned. Therefore, changing the R-F GAIN control setting, which causes the voltage amplification of the *variable-mu* tube, V106, to change, will detune the input circuit. The cathode resistor, R115, if left

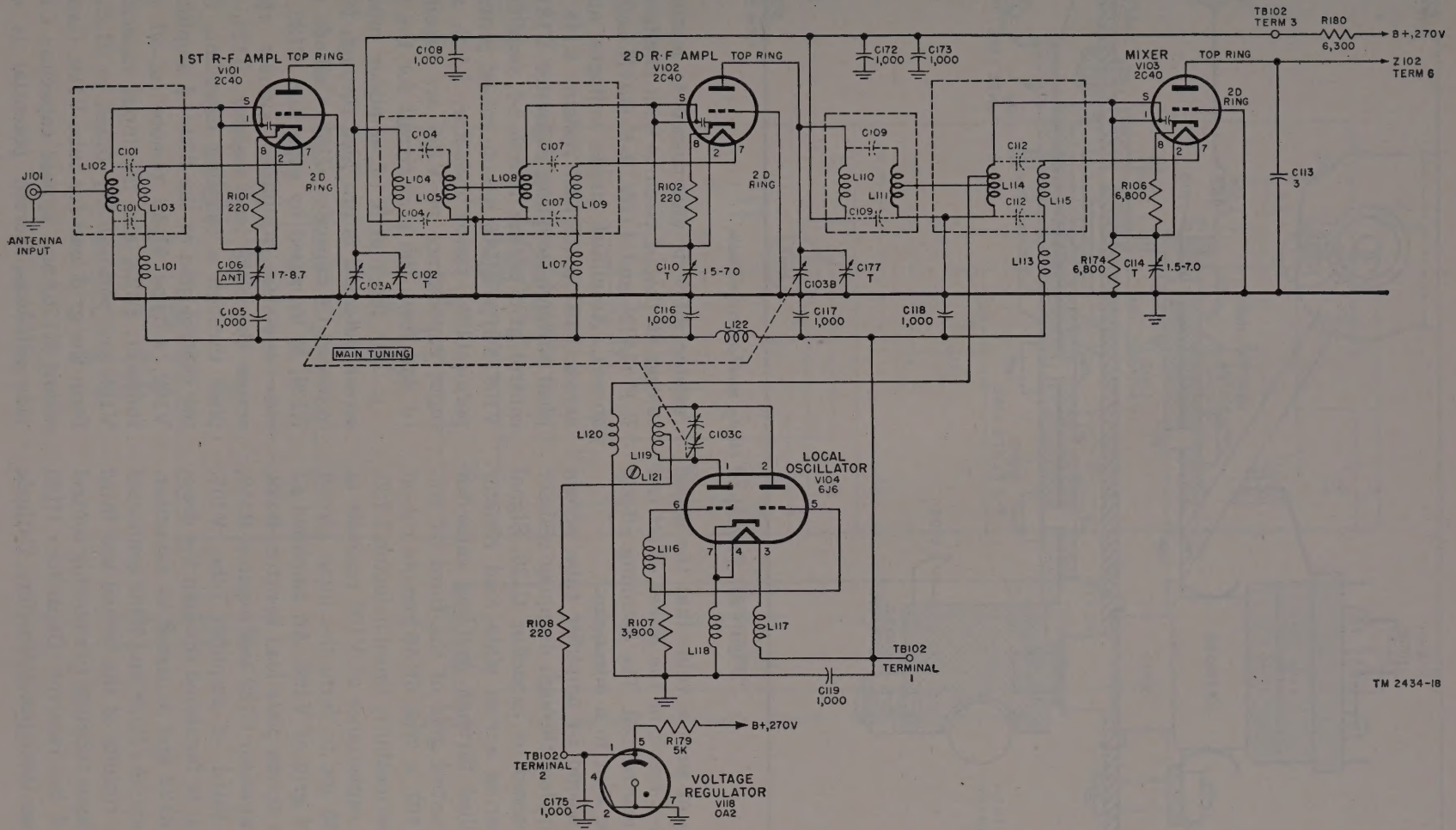


Figure 23. Radiosonde Receiver R–228/FMQ–2, r-f stages, simplified schematic.

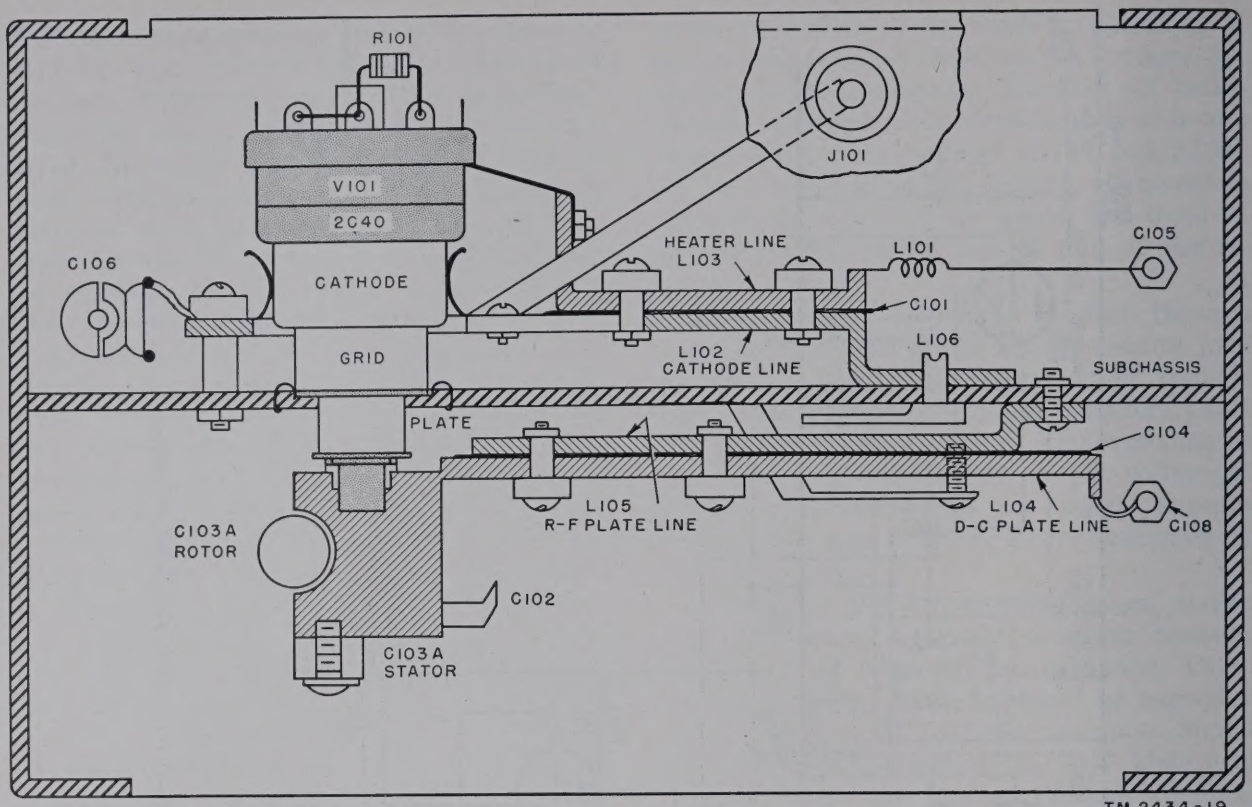


Figure 24. Typical r-f stage, mechanical details.

unbypassed, is of such a value that the added capacitance as a result of the Miller effect can be somewhat neutralized. The detuning effects can thereby be kept to a minimum.

e. For the second i-f amplifier tube, screen potential is supplied through dropping resistor R116 and bypassed by capacitor C126. Signal voltages appearing across plate load resistor R114 are applied through coupling capacitor C127 to the control grid of the third i-f amplifier tube, V107, a type 6BA6 remote cut-off pentode. The permeability tuned inductor, L125, and the input capacitance of V107 resonate at the i-f of 21.25 mc to form the input circuit for the control grid of V106. An amplified i-f signal appears across plate load resistor, R118, decoupled by capacitor C129 and resistor, R119.

f. For the third i-f amplifier tube, V107, screen potential is furnished through the dropping resistor R122 and bypassed by capacitor, C174. Potentiometers R138 and R139 connected in the cathode circuits of the second and third i-f amplifier stages function to smoothly control the i-f gain of the receiver. Capacitors C125 and C128 bypass these potentiometers. Cathode resistor R117 is unbypassed to minimize detuning of the i-f circuits with changes in the R-F GAIN and LOW R-F GAIN settings (*e* above). Amplified single voltages appearing across V107 plate load resistor R118 are applied through coupling capacitor C131 to the control grid of the fourth i-f amplifier tube, V108, a type 6BA6 remote cut-off pentode. The permeability tuned inductor, L126, and the input capacitance of V108 are tuned to the i-f and form the grid circuit for the tube.

g. For the fourth i-f amplifier tube, V108, screen potential is provided through R124 and bypassed by capacitor C133. Cathode resistor, R123, is bypassed by capacitor, C132, to provide self-bias. Amplified signals appearing across the plate load resistor, R121, are applied through a coupling capacitor, C134, to the control grid of the fifth i-f amplifier tube, V109, a type 6BA6 remote cut-off pentode. Inductor, L127, and the input capacitance of V109 are permeability tuned to 21.25 mc, to form the grid load for tube V109. Cathode resistor, R126, and bypass capacitor C137 provide self-bias. Screen potential is obtained

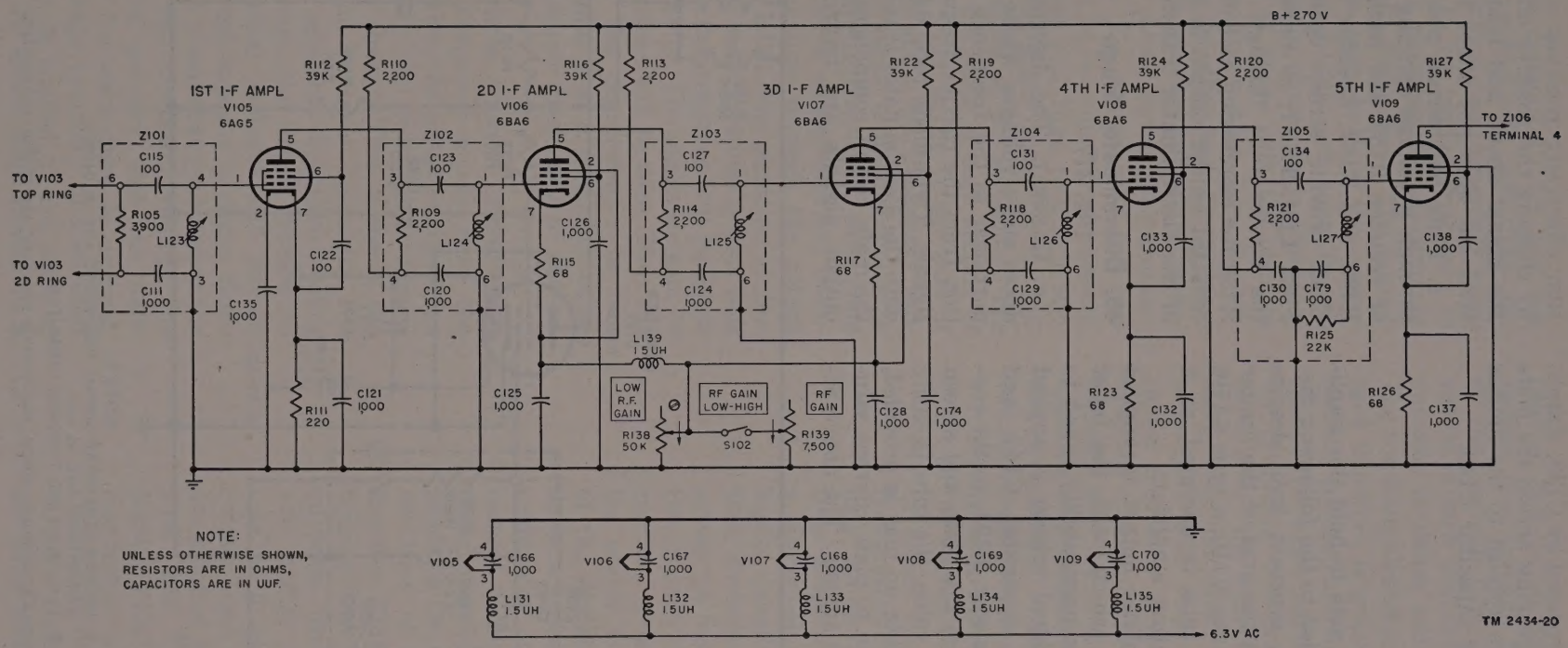


Figure 25. I-f amplifier, radiosonde receiver, simplified schematic.

through R127 and is bypassed by C138. Amplified signal voltages appearing across the plate load resistor, R128, are applied to the limiter stage through coupling capacitor C140.

47. Limiter Stage
(fig. 26)

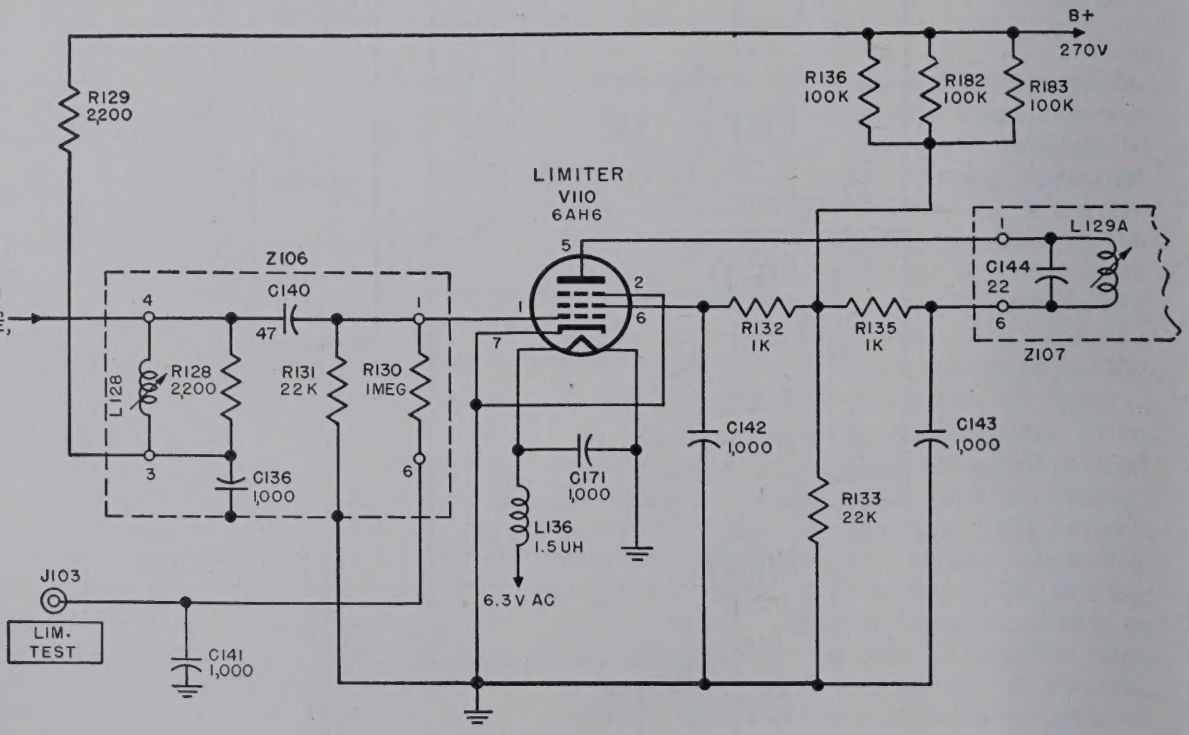
a. The limiter stage acts to hold the amplitude of the signal applied to the following discriminator stage at a constant level despite amplitude variations at the grid of the limiter tube. The f-m limiter tube V110, a type 6AH6 sharp cut-off pentode tube is operated as a plate saturated or limiting amplifier.

b. The fifth i-f amplifier output is applied across inductor, L128, which, with the input capacitance of V110, is permeability tuned to the i-f of 21.25 mc. Signal voltage is applied through the coupling capacitor, C140, and across the grid load resistor, R131, to the control grid of V110. Since the plate and screen potentials are at a low value, the tube is easily driven to cut-off and since no bias is provided, the tube is easily driven to plate current saturation by normal input signals. The above action effectively removes amplitude variations by clipping the positive and negative peaks of the signal above and below a predetermined level but does not affect frequency variation.

c. Plate and screen potentials are supplied through a voltage dividing network consisting of resistor R133 and parallel resistors R136, R183, and R182. Resistor R132 and capacitor C142 provide screen decoupling. Test point J103, LIM. TEST, is connected to the grid of the limiter tube through decoupling resistor R130 for monitoring and/or test purposes. The constant limiter output is applied to the input of the discriminator transformer unit, Z107.

48. Discriminator Stage
(fig. 27)

a. GENERAL. The discriminator circuit produces audio voltages whose amplitude are proportional to the frequency deviation or variation from the carrier frequency of the applied signals. Twin-diode tube 6AL5, V111, together with the discriminator transformer, Z107, form the main circuit components. The limiter stage output signals are impressed across trans-



NOTES:
1. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2. C141 IS A FEED THROUGH CAPACITOR.

TM 2434-21

Figure 26. Limiter stage, radiosonde receiver, simplified schematic.

former Z107 whose primary L129A and secondary L129B are coupled both inductively and capacitively. Both primary and secondary tuned circuits are tuned to the center frequency of the i-f bandpass by permeability adjustments.

b. CENTER CARRIER FREQUENCY. The secondary voltages across each half of the center-tapped transformer, L129B, are equal in amplitude but opposite in phase. Each secondary voltage is 90° out of phase with the primary voltage (one secondary voltage lags the primary voltage while the other leads the primary voltage by 90°). The primary voltage is coupled capacitively to the center tap of the secondary of the transformer. The reactance of this coupling is low, at the i-f intermediate frequency, compared to the load, and, thus, results in substantially little phase angle change in the primary voltage appearing at the secondary. The voltage applied to the plate of each section of discriminator tube V111 is the vector sum of the primary voltage and a half-secondary voltage. When the input signal to the discriminator is at the center carrier frequency, each plate voltage will be equal *in magnitude,* and therefore equal currents flow through the output resistors R142 and R143. The direction of flow of currents through these resistors is such that the voltages across the resistors will be equal but opposite in polarity. The algebraic sum of these voltages therefore will be zero. Thus the output voltage of the discriminator is zero when the input signal is at a frequency equal to the center or carrier frequency of the receiver (21.25 mc).

c. DEVIATION FROM CENTER FREQUENCY. When the signal frequency moves from the center frequency value, the phase relationships between the primary and secondary voltages of the transformer change. This is due to the fact that above the resonant frequency the secondary circuit appears capacitive; below the resonant frequency, the circuit appears inductive. The secondary voltages still remain equal in amplitude but opposite in phase. However, because of the phase changes between the primary and the half-secondary voltage, the vector sum of the primary and the half-secondary voltage for each tube is unequal. Thus, a larger voltage (primary plus one-half secondary voltage) is applied to the plate of one tube than to the other. This results in a heavier flow of current for this tube and a smaller flow through the other. The direction of the current flow through the output resistors is such that the voltages developed are opposite in phase and unequal in magnitude. The resultant algebraic sum of the resistor voltages therefore is greater than zero and has a polarity the sign of which depends on the direction of the larger current. Thus, when the center frequency deviates in one direction, one section of the discriminator tube conducts more than the other, and the output voltage is positive with respect to ground. When the center frequency deviates in the other direction, the other tube produces a greater flow of current and the resultant output voltage is negative with respect to ground. The coupling and circuit "Q's" are adjusted so that a linear voltage versus frequency curve is obtained over a relatively wide range of deviation.

d. CIRCUIT DETAILS.

(1) In actual operation, the f-m signals transmitted by the radiosonde are signals whose frequencies are shifted from a specified carrier frequency at a rate which depends on the meteorological quantities under investigation. This deviation from the carrier frequency is, however, only in one direction, namely, downward from the carrier. No deviation exists upward from the center frequency. This direction of the deviation is such that it produces a voltage output from the discriminator which is negative with respect to ground. The amplitude of these negative pulses of voltage depends on the amount of the frequency deviation of the transmitter carrier.

(2) Resistor R141 and capacitor C180 attenuate the higher audio filter frequencies, thus reducing interference and higher frequency noise which may be present at the discriminator output. Load resistors R142 and R143 are shunted by r-f bypass capacitors C147 and C148. Test point J104, DISC. TEST, is provided for discriminator alinement. The a-c discriminator output voltage is applied through coupling capacitor C149 to the audio amplifier.

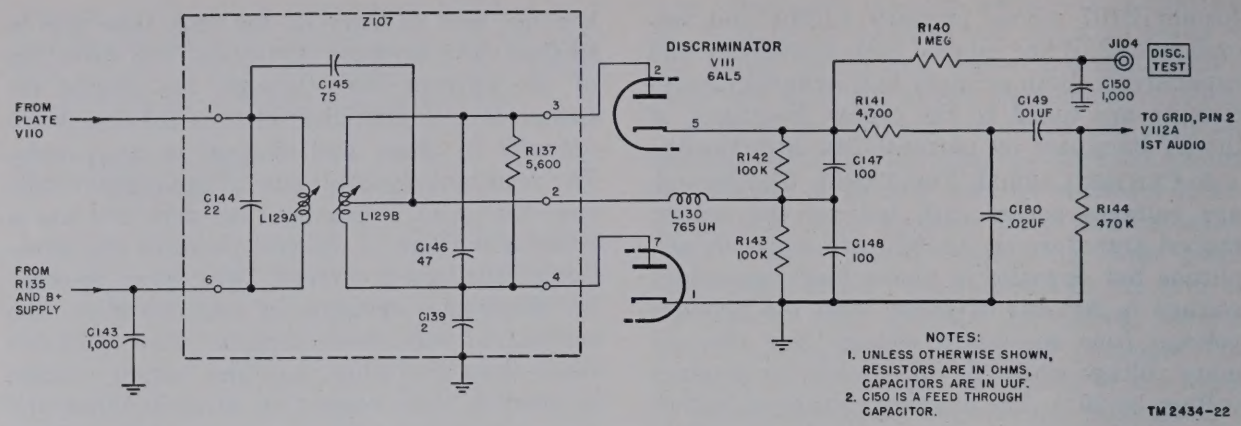


Figure 27. Discriminator stage, radiosonde receiver, simplified schematic.

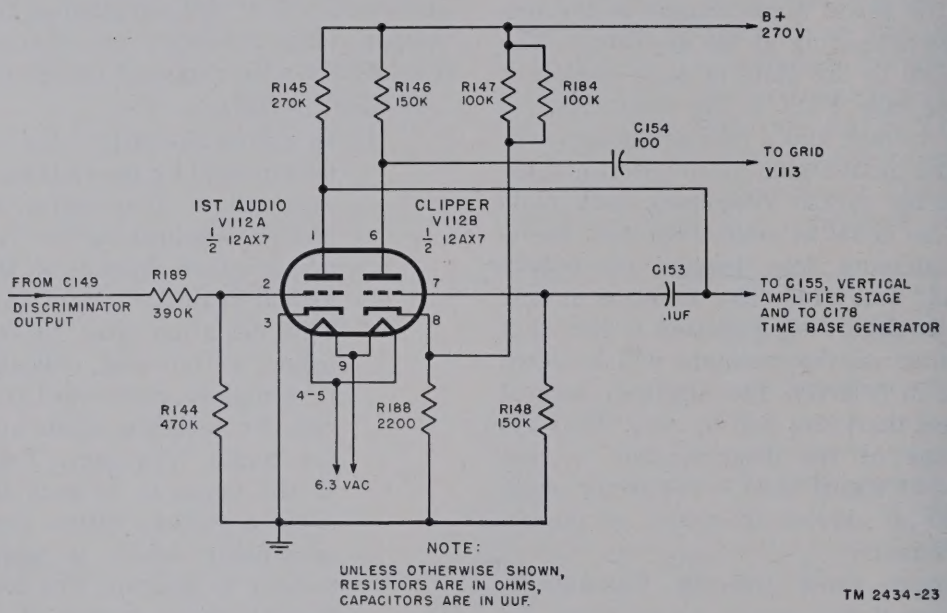


Figure 28. First audio amplifier and clipper circuit, radiosonde receiver, simplified schematic diagram.

49. First Audio Amplifier and Clipper Circuits (fig. 28)

The a-c component of the changing d-c output of the discriminator circuit is coupled to the input of V112, a type 12AX7 twin triode, used in an audio amplifier and clipper circuit.

a. The negative pulses from the discriminator circuit are applied through coupling capacitor C149 to the grid of the first audio tube, V112A. Resistors R144 and R145 comprise the grid and plate load components, respectively. The output positive pulses of increased amplitude appear across plate load resistor R145 and are applied through coupling capacitor C153 to the grid of the clipper section (tube V112B). Audio signals appearing across R145 are applied to the vertical amplifier through coupling capacitor C155 (fig. 31). A means of monitoring the audio signals at the plate of the first audio tube is provided by receptacle J105, 1ST AUDIO TEST (fig. 31), mounted on the rear chassis.

b. The clipper triode is operated with a fixed negative bias, greater than cut-off, so that only positive signals in excess of the cut-off voltage will appear as negative pulses across plate load resistor R146. Noise voltages are normally below this value and, in this way, tend to be eliminated from the output. The effect is to produce more satisfactory recording, since the recording apparatus will register noise impulses if they appear between desired signal pulses. Resistors R188, R147, and R184 supply the fixed negative bias. Pulses appearing across plate load resistor R146 are applied through coupling capacitor C154 to the shaper circuit.

50. Shaper and Output Circuits (fig. 29)

a. The shaper circuit functions to convert the waveform of the 8- to 250-cycle signal obtained from the clipper into a waveform of the correct shape for application to the frequency meter. A type 6AG5 sharp cut-off pentode is used as the shaper tube. Negative pulses from the clipper are applied to the control grid of the shaper tube after differentiation by capacitor C154 and resistor R150. This differentiation produces a positive voltage surge, or kickback, on the decay of the pulse which is applied to the control grid for the purposes of dis-

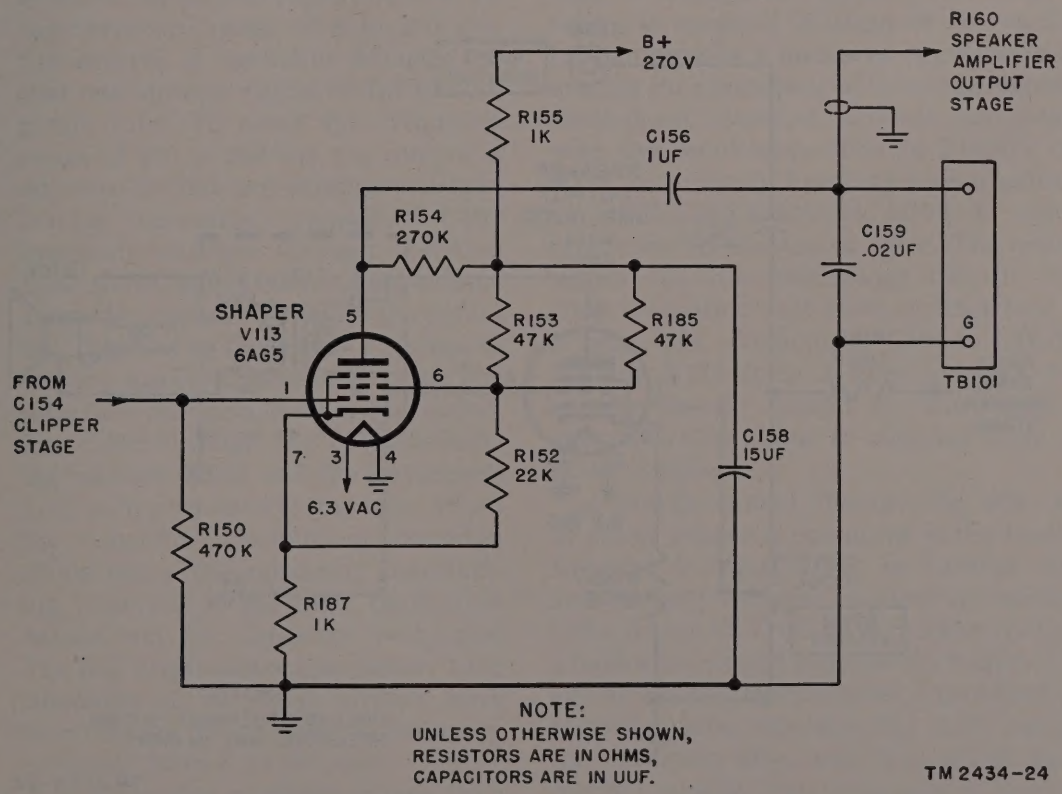


Figure 29. Shaper and output circuit, radiosonde receiver, simplified schematic diagram.

criminating against unwanted signals. The amplitude of the output of the differentiation circuit depends directly upon the width of the incoming signal. Thus, a signal of smaller width than proper will not produce a large enough postitive voltage at the output of the differentiation circuit to overcome the fixed bias on the shaper tube. The shaper tube is biased to cut-off by voltages developed across cathode resistor R187 which is part of a voltage divider network between B+ and ground.

b. The positive surge voltage applied to the control grid overcomes the fixed bias and permits the tube to conduct. When the tube conducts, the plate voltage drops to a minimum value, and at the same time capacitors C156 and C159 discharge rapidly through the tube. When the tube stops conducting, the capacitors will slowly charge to their original voltage values through R154. This results in a sawtooth waveform of voltage at output terminals TB101.

c. Screen and cathode bias are supplied from the B+ voltage supply through parallel resistors R153 and R185. Plate resistor R154 is decoupled by the resistance capacitance network of R155 and C158. The output voltage across C159 is applied to the frequency meter and to the speaker output amplifier stage.

51. Speaker Amplifier Stage (fig. 30)

A loudspeaker is mounted on the front panel of Radiosonde Receiver R–228/FMQ–2 and functions to audibly monitor the output of the receiver. This loudspeaker is driven by a speaker amplifier stage which uses a type 6AQ5 beam power tetrode. A SPKR. VOLUME control, R157, is mounted on the front panel to adjust the audio level of the loudspeaker. An additional monitoring means is provided by the audio monitor jack J–106.

52. Oscilloscope Circuit (fig. 31)

An oscilloscope circuit, comprising a vertical amplifier, a time base generator, a horizontal amplifier, and an oscillograph, functions to permit visual monitoring of the signal appearing at the plate of the first audio amplifier. Primarily the oscilloscope is provided as an aid

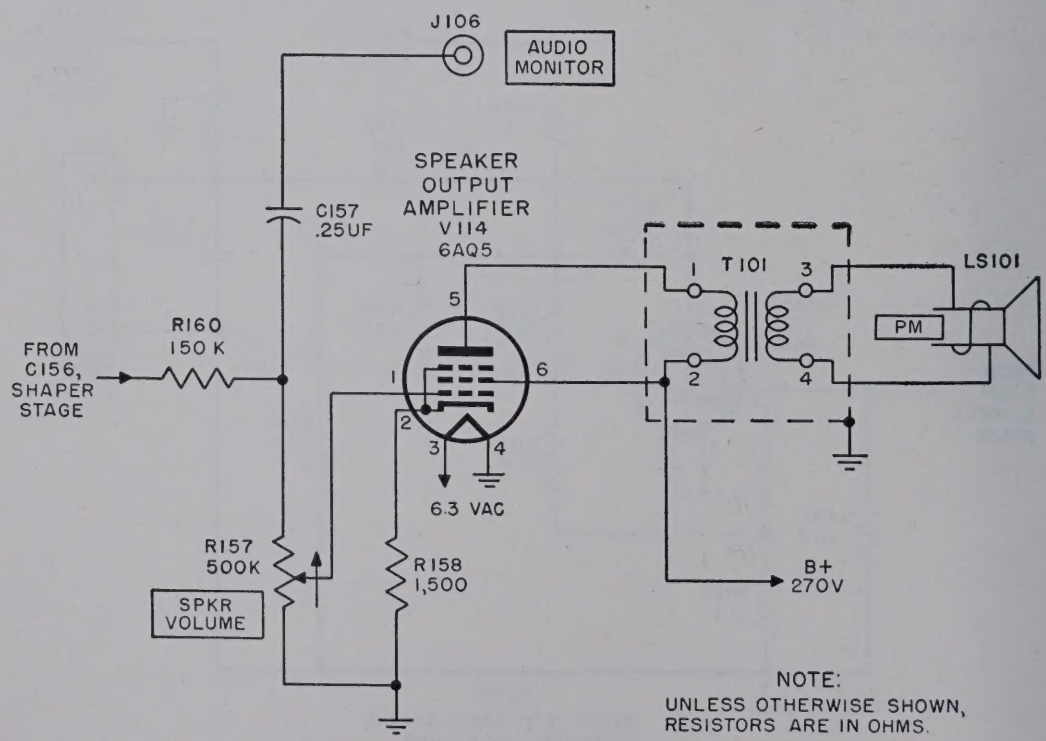


Figure 30. Speaker amplifier circuit, radiosonde receiver, simplified schematic diagram.

to tuning, although it also serves as an indication of the receiver operation.

a. VERTICAL AMPLIFIER CIRCUIT. One-half of a type 12AX7 twin-triode tube is used as an ordinary vertical amplifier. Signal voltages from the plate of the first audio tube are applied through coupling capacitor C155 to the control grid of the vertical amplifier. A VERT. GAIN control, R173, is mounted on the front panel to permit a gain adjustment of the stage. Mounted on the rear chassis is the VERT. POS. control, R171, which functions to position vertically the oscillograph pattern by regulating the bias placed on the cathode. Amplified signals appearing across the plate load resistor, R168, are applied to one of the vertical plates of the oscillograph tube, V117.

b. TIME BASE GENERATOR CIRCUIT.

(1) The time base generator stage uses a type 2D21 gas-filled tetrode in a circuit which functions to generate a saw-tooth sweep voltage for application to the horizontal amplifier, V116A. A LOCKING control, R164, adjusts the plate supply voltage of tube V115 to select the desired repetition rate. In the frequency range of 8 to 150 cps, the control is normally adjusted so that one pulse is visible on the oscillograph tube. To cover the frequency range of 150 to 250 cps, the control is adjusted so that two pulses are visible.

(2) During operation, capacitor C162 gradually charges through resistors R163, R164, and R186 until the voltage across the capacitor reaches the potential (applied to the plate) required to fire the gas-filled generator tube. The tube then conducts, discharging capacitor C162 through the current-limiting resistor, R162, and the low-impedance path presented by the tube. When the capacitor discharging potential drops below the minimum maintaining potential of the tube, conduction ceases and the capacitor recharges. The R-C (resistance-capacitance) time constants of the above circuits have been chosen to provide a frequency coverage from 8 to 250 cps.

(3) A small amount of signal voltage from the plate of the first audio tube is applied through coupling capacitor C178 to the grid of the time base generator tube, thus synchronizing the output of the generator and horizontal amplifier tubes with that of the vertical amplifier tube to provide a stationary pattern on the oscillograph tube.

c. HORIZONTAL AMPLIFIER CIRCUIT. The other half of the type 12AX7 twin-triode tube is used as the horizontal amplifier, V116A. The saw-tooth voltage generated by V115 is fed through coupling capacitor C160 to the control grid of the horizontal amplifier. Gain of the stage is made adjustable by placing the HOR. GAIN control R166, in the grid of the tube. The amplifier saw-tooth voltage appearing across the plate load resistor, R167, is applied to a horizontal plate of the oscillograph tube. Connected in the cathode of the tube is the HOR. POS. control, R170, which, by regulating the cathode bias, controls the horizontal position of the oscillograph pattern.

d. OSCILLOSCOPE. A type 2BP1 oscilloscope tube, V117, is used to visually show the signal voltage waveform at the plate of the first audio tube. A transparent screen with linear graph ruling is mounted in front of the oscilloscope tube to provide a means of comparatively calibrating the magnitude of incoming signals. Two front-panel mounted controls are associated with the oscilloscope tube; a FOCUS control, R177, to properly focus the screen pattern and an INTENSITY control, R175, to adjust the brightness of the screen trace. The negative B supply for the oscilloscope tube is obtained from a separate half-wave rectifier tube, V119, a type 6X4. Capacitors, C161A, C161B, and resistor R175 form a filter network for this supply. The B+ supply for the second anode and deflection plates is obtained from a type 5U4G rectifier.

e. POWER SUPPLY CIRCUIT (fig. 81). A built-in power supply is contained in the Radiosonde Receiver R–228/FMQ–2 to furnish all plate and filament voltages required by receiver circuits. A type 6X4 full-wave rectifier connected in a half-wave circuit supplies the negative B voltage for the oscillograph tube; a type OA2 voltage regulator tube regulates the plate voltage for the oscillator tube, and type 5U4G full-wave rectifier supplies the remainder of the receiver voltage requirements. Associated with the rec-

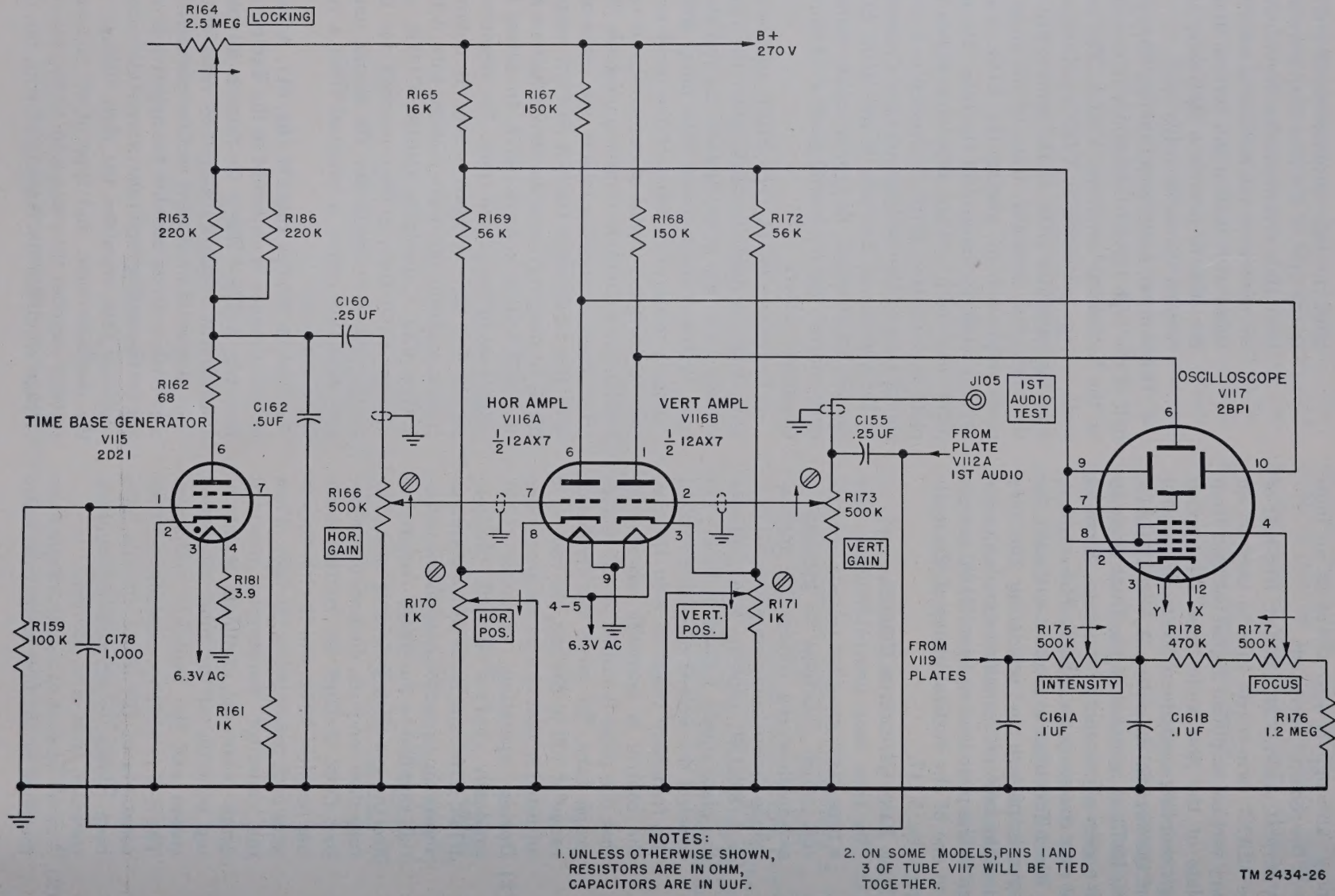


Figure 31. Oscilloscope circuit, radiosonde receiver, simplified schematic diagram.

tifier tube are a power transformer, T–102, and a capacitor input filter network. Each side of the primary winding is fused to prevent damage to the equipment due to line surges or overload. The power supply is designed to operate from a 115-volt a-c, single-phase, 60-cycle source of supply. B+ voltage of 270 volts at a drain of 155 ma is obtained at the output filter choke L138. Four filament windings of the power transformer are used to furnish the heater requirements of the receiver.

53. Frequency Meter TS–29B/FMQ–1 (fig. 77)

a. The frequency meter, consisting of an amplifier tube, V600, thyratron tubes V605 and V606, rectifier tube, V607, and meter circuits, develops a pulsating current whose d-c value is proportional to the frequency of the input signal. The measurement of this current indicates the frequency of the input signal.

b. The input signal is either the saw-tooth voltage from the radiosonde receiver or a saw-tooth voltage from Radio Set SCR–658. It is amplified by the amplifier tube, V600, applied in push-pull to the thyratron tubes V605 and V606, and then fed to the plates of the rectifier tube, V607. The output is taken off the cathode of this tube and directly fed to the circuit of the visual and recorder meters.

c. For *test purposes,* the input voltage is usually obtained from Frequency Standard TS–65( )/FMQ–1 and consists of either a square-wave or a modified square-wave of voltage, depending on the frequency of operation (fig. 34). *For purposes of explanation, the output voltage of the frequency standard is used as the input to the frequency meter and the waveforms shown at various test points and under various operating conditions are those obtained with this input signal.*

54. Amplifier Stage in Frequency Meter

a. The amplifier tube, V600, inverts and amplifies the input signal and applies the output across the primary of the transformer, T600.

b. The input signal is coupled to the grid of V600 through resistor R601 and capacitor C602. Resistor R601 is an isolating or decoupling resistor, used to prevent any interaction between the amplifier stage and the input signal source.

c. The grid leak resistor, R600, and coupling capacitor, C602, form an R-C coupling network. The values of the capacitor and resistor in this network have been so chosen that the waveform of the voltage across the resistor is essentially the same as the input voltage. When tube V600 is inserted into the circuit, the waveform at the grid will be flattened at the top due to grid limiting action (fig. 34A). On the positive excursions of the grid voltage, the grid becomes more positive than the cathode and grid current will start to flow. This flow of grid current through the grid leak resistor is of such a polarity as to prevent the grid voltage from rising further. Note in figure 34C that when the tube is out of its socket and no grid current flows, the top edges of the output voltage across the grid resistor are rounded out.

d. The linearity characteristic of the R-C coupling network is satisfactory at the 180-cycle input frequency, but causes distortion to the lagging edge of the negative alternation of the 40-cycle grid voltage (fig. 34B). A true linear R-C network at the very low audio frequencies requires extremely large values for the capacitor and resistor. Since the size of the grid resistor is usually limited by the tube characteristic, linearity cannot be obtained at all frequencies.

e. Bias voltage is obtained from the voltage drop across cathode resistor R602. C600 is the cathode a-f bypass capacitor.

f. When the INPUT switch, S600, is in its SC position, the input circuit to the amplifier tube is grounded. In this position of the switch, the meters can be calibrated to zero frequency (after momentarily depressing the DEIONIZE switch, S601).

g. When the INPUT switch is in its 60 ~ position, the switch connects a source of 3 to 5 volts, 60-cycle a-c to the input circuit of the amplifier tube. This voltage permits the frequency meter to be calibrated at a frequency of 60 cycles and also provides a simple means of checking the calibration and over-all operation when desired. Usual operation of the amplifier tube occurs when the INPUT switch is in the X position. In this position the amplifier tube is ready to receive a signal voltage from the radiosonde receiver.

55. Thyratron Stage in Frequency Meter

The thyratron stage converts the input voltage from the secondary of transformer T600 to a pulsating voltage of constant amplitude and waveshape, the frequency of which is the same as the frequency of the input wave.

a. Transformer T600 has a single primary winding and a center-tapped secondary winding. The center-tap is connected to −45 volts developed from a tap on the voltage dividing network, consisting of R617, R615, R618, R616, and R619, across the 75-volt, d-c bias supply. In this way, a negative bias of 45 volts is supplied to the grids of thyratron tubes V605 and V606 through the secondary winding and through resistors R610 and R609.

b. The a-f voltage appearing across the primary of the transformer is induced into the secondary winding and appears across the entire secondary winding with approximately the same amplitude and waveform as the primary voltage (fig. 34E and F). As measured from the center tap on the secondary to each end of the secondary winding, however, the amplitude of the total secondary voltage is halved. In addition, the instantaneous voltage across one side of the secondary has the opposite polarity to the voltage across the other side of the secondary, as shown by the inverted waveshapes in E and F of figure 34. Thus, during the first half-cycle of a-f voltage applied to the primary of the transformer, the voltage on the grid of the thyratron tube is positive with respect to the center tap as the grid of the other tube is negative. On the other hand during the second half-cycle of primary voltage, the polarities of the grid voltages are reversed.

56. Thyratron Tubes

a. Tubes V605 and V606 are tube type 884, gas-filled, thyratron triodes. These tubes differ in their operating characteristics from ordinary vacuum triodes. In the vacuum triode, plate current flow can be started, the amplitude of plate current can be controlled, and plate current flow can be stopped, all by the application of proper values of grid voltages. In the thyratron tube, however, the addition of a special grid structure and gas in the tube make the operating characteristics quite different. For a given plate voltage, the tube can be prevented from conducting by application of a negative bias voltage to the grid. However, if the grid is made more positive, a critical value of grid voltage will be reached when the gas in the tube breaks down, causing ionization of the gas, and plate current flows. At this time, the grid voltage loses complete control of the tube and the amount of plate current depends entirely on the value of plate voltage. The point where the grid voltage causes the gas to become ionized is called the *firing point.*

b. Once plate current starts to flow, it continues to do so regardless of grid potential as long as plate voltage is applied. If, however, the plate voltage is reduced below a minimum value, which in the case of type 884 tubes, is approximately 16 volts, plate current flow will stop. Once the plate current flow is stopped, sufficient negative voltage on the grid can prevent the tube from firing again even though a higher plate voltage is reapplied. Thus, the only function of the grid voltage is to control the firing point for the tube.

57. Thyratron Stage Circuit Theory

a. No A-F Input. In the absence of signal input to the frequency meter and with the DEIONIZE switch, S601, open, the thyratron tubes do not operate because there is no plate voltage for the tubes. Then, if the DEIONIZE switch is closed (normal position of switch), plate voltage is applied but the tubes still will not conduct because of the negative d-c bias voltage applied to the grids of the tubes. This bias voltage is sufficient to hold the tubes below cut-off. At this time, there is no voltage drop across resistors R607 and R608 (fig. 33) because there is no flow of current through the resistors, and as a result, the plates of both of the thyratron tubes are at a potential of +150 volts. Under these conditions, no voltage or potential difference exists across capacitor C610. Thus, before the a-f input voltage is applied, the thyratron tubes are nonconducting and there is zero voltage on C610.

b. A-F Input Signal Applied.

(1) During the first half-cycle of a-f input voltage, the grid of tube V606 remains negative as shown in figure 32B. This tube does not fire.

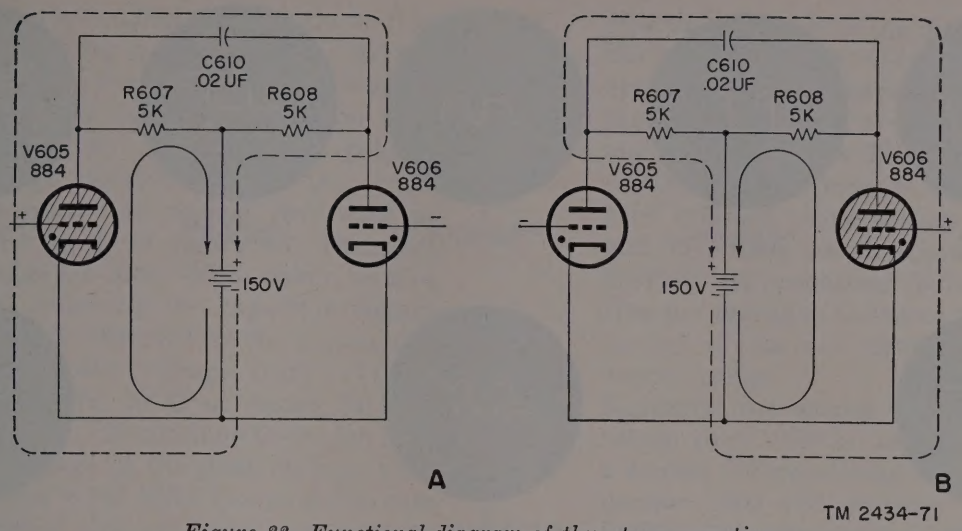


Figure 33. Functional diagram of thyratron operation.

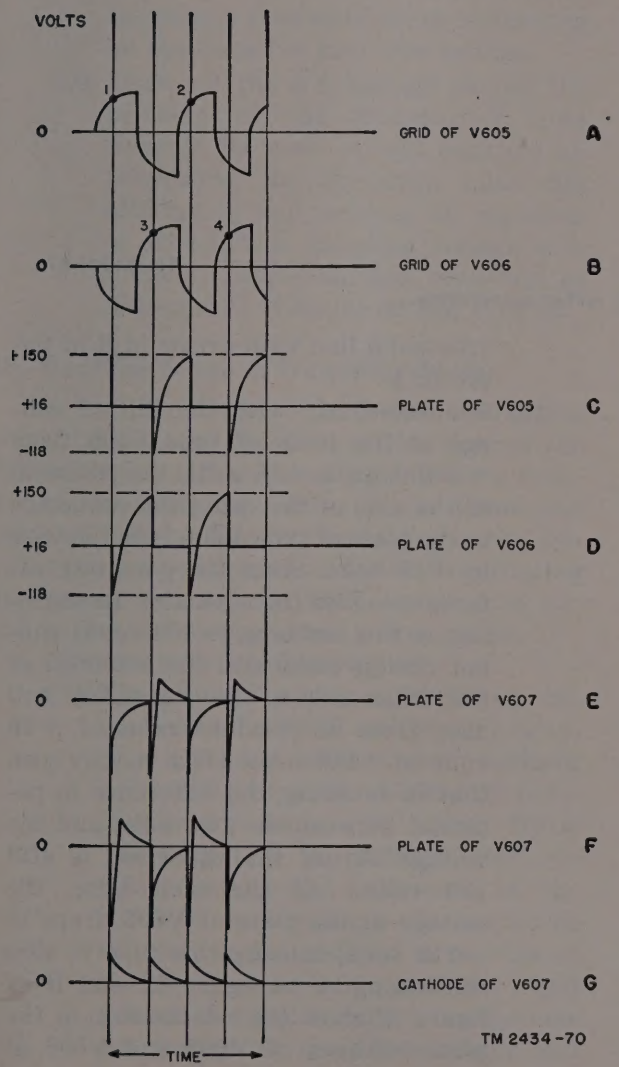


Figure 32. Theoretical waveforms in frequency meter.

(2) At the same time, the grid of tube V605 is driven positive, as shown in A of figure 32. When the difference of potential between the grid and cathode of the tube reduces (becomes less negative) to approximately −15 volts, the tube fires and plate current flows through resistor R607.

(3) The flow of current through the tube and resistor R607 produces voltage drops around the circuit as shown by the solid line with an arrow in A of figure 33. Due to these voltage drops, the plate of the tube no longer remains at +150 volts but is instantly reduced to +16 volts when current starts to flow in this circuit. Figure 32C shows the plate voltage at +150 volts before the tube fires and reduces to +16 volts instantaneously when the tube conducts (point 1). Sixteen volts is the normal voltage drop across the tube type 884 during conduction.

(4) Once plate current flow is started, the grid voltage loses control of plate current, which continues to flow as long as plate voltage is applied. This is shown in C of figure 32 by the constant level of plate voltage after the tube fires.

(5) While the plate voltage of tube V605 is at the +16-volt level, capacitor C610 attains a charge because of the difference of potential between its

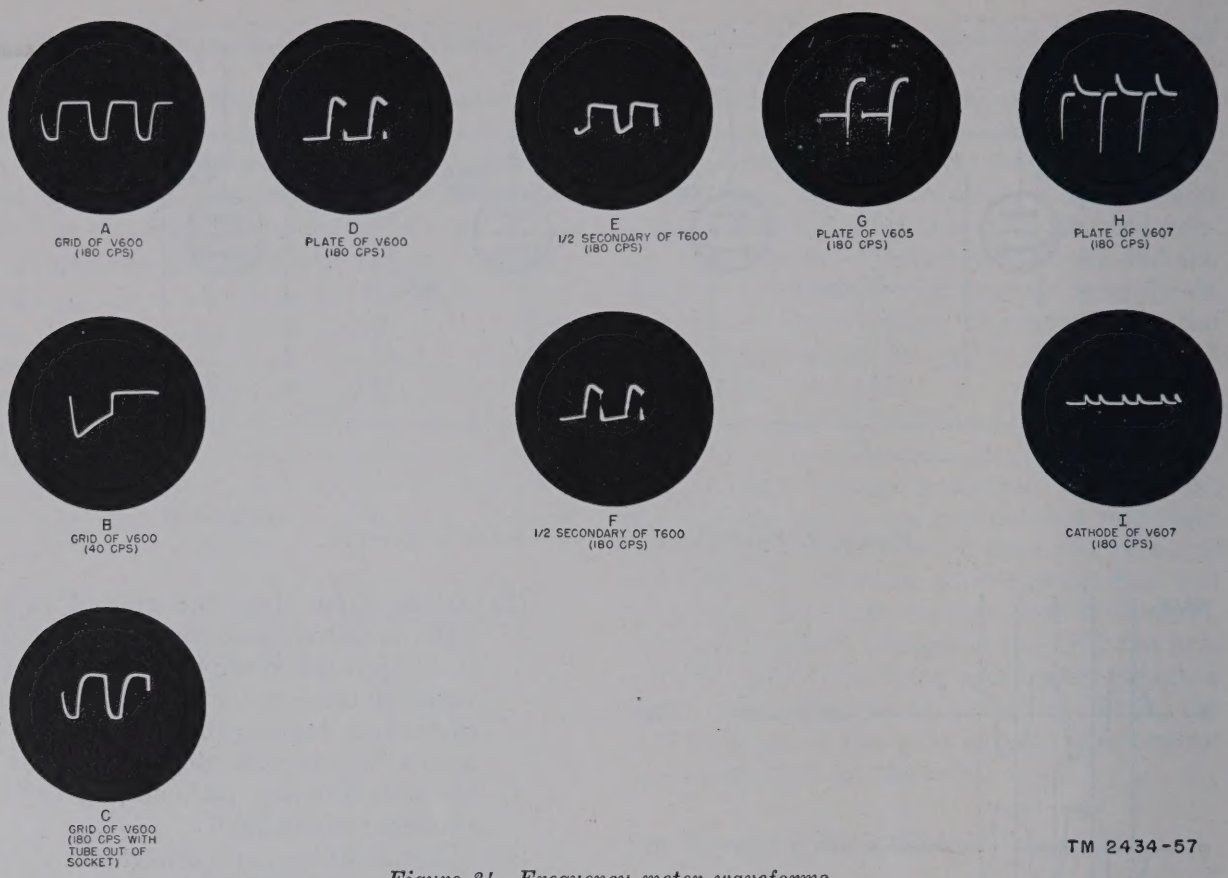


Figure 34. Frequency meter waveforms.

plates. (Since tube V606 still is not conducting the plate voltage is maintained at +150 volts (D of fig. 32).) The capacitor charges exponentially through resistor R608, the charging circuit being shown by the dashed line with an arrow in A of figure 33. After charging, the plate of the capacitor connected to the plate of tube V605 is at a potential of +16 volts while the other plate is at a potential of +150 volts; the voltage or potential difference across the capacitor is therefore 134 volts.

(6) During the second half-cycle of a a-f grid voltage, the voltage of the grid of tube V605 is driven negative while the grid of tube V606 is driven positive. When the grid voltage of tube V606 reaches the critical point (approximately −15 volts), this tube fires and its plate voltage immediately drops to +15 volts (D of fig. 32) as current flows through resistor R608. (See solid line with arrow in B of figure 33.)

(7) Simultaneously with the fall of voltage at the plate of tube V606 from +150 volts to +16 volts, the potential of the side of the capacitor connected to the plate of tube V606 falls likewise to +16 volts. Since the potential difference across the capacitor (amounting, in this instance, to 134 volts) cannot change suddenly; the potential of the other side of the capacitor will drop from its previous value of +16 volts to −118 volts. (It is readily seen that in so doing, the difference in potential between the two sides and the voltage across the capacitor is still 134 volts.) At the same time, the voltage at the plate of V605 drops to −118 volts, causing this tube to stop conducting. C of figure 32 and D of figure 32 show the relationship of the plate voltages of V605 and V606 at this time (point 2). Once the tube

ceases to conduct, it can only be fired by applying a voltage to the grid to overcome the negative grid bias.

(8) After tube V606 fires, capacitor C610 charges to an opposite polarity through resistor R607 in the circuit shown by the dashed line with an arrow in B of figure 33. The plate voltage of tube V605 starts to rise, also, following the capacitor voltage as can be observed by the exponential rise of plate voltage from −118 to +150 volts in C of figure 32. The capacitor will continue to charge until the voltage at the plate of tube V605 reaches +150 volts. However this tube does not fire until the next positive portion of the input voltage because the tube is prevented from conducting by the negative grid bias voltage.

(9) Thus, as the a-f voltage across the primary of the transformer goes through its positive and negative alternations, the thyratron tubes fire alternately and produce at the plate of each tube a pulsating voltage with the same amplitude and waveform as shown in C of figure 32 and D of 32.

58. Rectifier Stage in Frequency Meter

The rectifier stage converts the alternating pulsating voltages obtained at the plate of the thyratron tubes into pulsating full-wave rectified voltages for application to the visual and recorder meters. The rectifier stage in the frequency meter consists of an R-C differentiating network, a rectifier tube V607, and a meter circuit in the cathode leg of the rectifier tube.

a. DIFFERENTIATING NETWORKS.

(1) The voltage appearing between the plate of tube V605 and ground is applied across a differentiating network comprising capacitor C608 and resistor R606 in series with resistor R616. The output of the differentiator, obtained across the resistance of the network, is a voltage the amplitude of which is proportional to the *rate of change* of input voltage. If the input voltage changes rapidly, then the output voltage of the differentiator will have a large amplitude; if there is a slow or no change in the input voltage, the output voltage will have a small amplitude. The output voltage is, therefore, a series of sharp positive and negative pulses. Each positive (or negative) pulse repeats once during each cycle of input voltage (figs. 32 and 34). As a result, the number of positive (or negative) pulses occurring per second is the same as the frequency of the a-f input to the frequency meter.

(2) Similarly, the output voltage of thyratron tube V606 is impressed across a second differentiating network (capacitor C609 and resistors R605 and R616). The differentiated voltage output from the network (across the resistance R605) is identical to that appearing across the resistance of the first R-C differentiating network except for a phase shift of 180°. This is shown in figure 32.

b. RECTIFIER TUBE.

(1) The voltage pulses appearing across resistor R606 in series with an adjustable resistor, R616, are applied between one plate of the rectifier tube, V607, tube type 6ZY5G, and ground while the voltage pulses appearing across resistor R605 (also in series with resistor R616) are applied between the other plate of the rectifier tube and ground. The presence of negative pulses on the plates of the tube prevents the tube from conducting. Only the positive pulses of voltage at the plates of the rectifier tube permit current to flow through the tube and through the cathode resistances.

(2) Since the series of pulses on one plate are displaced by 180° with respect to the series of pulses appearing at the other plate, cathode current flows twice within the period of one cycle of the repetition of positive pulses. That is, one section of the rectifier tube conducts for a brief period (a pulse of current) as a positive pulse voltage appears at the plate of this section of the tube. Simultaneously, a negative pulse voltage is applied to

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the other plate, preventing the second section from conducting. A half-cycle later, the other section of the tube conducts briefly because, at that time, a positive pulse voltage is applied to the plate of that section while a negative pulse prevents the first section of the tube from conducting. Two pulses of cathode current are thus developed during each cycle of input voltage to the frequency meter. The frequency of the current pulses is therefore twice that of the input voltage. Figure 32 shows the relationship between the various voltages in this circuit.

(3) With no signal input to the frequency meter, there is no current flow through the cathode circuit of tube V607 because the plates of the tubes are held slightly negative with respect to the cathode by the application of a −4-volt potential to the plates of the tubes. This negative voltage is obtained from the voltage divider resistors R615, R616, and R618 across the bias voltage supply, as shown in figure 77. R616 is an adjustable resistor with a movable sliding tap to be used only when an adjustment of the −4-volt potential is required. When a signal is applied, the positive voltage pulses on the plates override this negative −4-volt bias and permit the rectifier tube sections to conduct alternately, as explained previously.

c. METER CIRCUIT (fig. 50).

(1) The recorder and visual meters are connected in series with each other, and this combination is placed in the cathode circuit of the rectifier tube, V607. The meters indicate the amount of cathode current. The meter pointers do not deflect for each current pulse flowing through the meter coils, because the meter pointers cannot follow the fluctuations of current fast enough. Instead, the meters will indicate the *average* current flowing in the cathode circuit. This average cathode current is directly proportional to the number of current pulses per second occurring in the cathode circuit.

(2) At the lower a-f frequencies, where the time between pulses is increased, the meter will tend to read full deflection corresponding to maximum amplitude of the current pulses. The meter pointer then moves back and forth from zero to some reading at nearly the frequency rate of the input signal. Capacitor C607 provides insurance against this meter fluctuation. This capacitor, in combination with resistor R612 and the d-c resistance of the meter coils, comprises an R-C network, with the capacitor charging during each pulse period and discharging during the period between pulses. This action produces a filtering or smoothing effect.

(3) Resistor R612 (EQUALIZER) is a variable resistor which can be varied from the front panel by means of a screw driver. This control balances the current flow of the visual and recorder meters so that identical meter readings can be obtained. This is accomplished by partial shunting of each meter by this control.

(4) Because no current flows in the cathode circuit with no signal input to the frequency meter (INPUT switch SC position), both meters read 0. With an input signal of a known frequency, such as a 60-cycle signal (INPUT switch at 60 ~ position), the cathode current can be adjusted, by means of the variable resistor R604 and potentiometers R614 and R613, until the meters read 30 bi-cycles (60 cycles).

(*a*) Resistor R604 is an adjustable resistor with a movable tap that is adjusted when the frequency meter is originally calibrated and does not normally require any further adjustment.

(*b*) Potentiometer R614 (COARSE control) is used to obtain an approximate calibration. After this approximate calibration is obtained, potentiometer R613 (FINE control) is used for more precise calibration (par. 82).

59. Power Supply in Frequency Meter

The power supply in the frequency meter provides the heater voltages for the tubes and the d-c operating voltages for all circuits. The a-c input for this supply is obtained from the voltage regulator (par. 70) which insures a constant 115-volt a-c input voltage. One power transformer and two rectifiers are used in this power supply (fig. 77).

a. Transformer T601 (fig. 77) has five secondary windings: One winding furnishes 6.3 volts a-c for the heaters of tubes V600, V605, V606, and V607. Two windings furnish 5 volts a-c for the filaments of the rectifier tubes V601 and V602. Two remaining windings furnish 385 volts a-c and 125 volts a-c for the plates of the tubes V601 and V602, respectively.

b. Rectifier tube V601, a tube type 5Y3GT/G full-wave, high-vacuum rectifier tube, functions as a conventional full-wave rectifier.

(1) Choke coils L600 and L601 with capacitors C605 and C606 make up a two-section, choke-input filter which provides a plate supply voltage with good filtering and good regulation.

(2) Resistor R603 and Tube V603, a tube type OD3/VR150 gas voltage-regulator tube, are connected across the output of the rectifier, V601. The combination holds the output voltage at +150 volts for any normal load current. Resistor R603 is a current limiting resistor whose value is varied by moving a sliding contact along the exposed wire of the resistor.

c. Rectifier tube V602, tube type 5Y3GT/G, full-wave, high-vacuum tube, is used to form the negative bias voltage supply.

(1) A single-section, capacitor-input filter, comprised of choke coil L602 and capacitors C603 and C604, provides sufficient filtering and regulation of the output voltage. Additional regulation is furnished by the series combination of resistor R617 and another gas voltage-regulator tube V604, a tube type OA3/VR75.

(2) Resistors R615, R616, R618, and R619 comprise a voltage dividing network across the output of the rectifier. Resistor R617 is an adjustable resistor with two movable taps along its body. One tap is used to permit adjustment of the regulation of the negative bias voltage supply. The other tap is used to permit adjustment of the negative bias on the center tap of the secondary of transformer T600.

60. Radiosonde Recorder RD–3C/FMQ–1

a. The radiosonde recorder prints a record of the positions of the pointer on the recorder meter. The position of the indicator is determined by the output current of the frequency meter. This current is proportional to the modulation frequencies of the radiosonde transmitter. Thus, the prints on the recorder chart indicate the audio modulation frequencies.

b. A light beam in the photoelectric scanning assembly (fig. 15) sweeps across the pointer of the recorder meter once during each cycle of operation (every 2 seconds) and produces a small electrical pulse, the time phase of which is dependent on the position of the pointer. The pulse is then amplified by the pre-amplifier located in the radiosonde recorder, and the amplified pulse is used to develop a large surge of current in the output of Amplifier AM–7B/FMQ–1.

c. This large current surge passes through the coils of the tapper bar magnets, causing the printing mechanism to tap a dot on the recorder paper. The placement of this dot on the horizontal (X axis), of the paper gives an indication of the af measured by the frequency meter. In continuous operation, a pulse recurs every 2 seconds and causes the printing mechanism to tap a dot every 2 seconds. Even when the a-f input is constant, the dots are not superimposed on each other because the recorder paper feeds at a constant speed of .4 inch per minute. The coordinates of the paper thus represent time (Y axis) and audio frequencies (X axis).

d. A rotating helix cylinder (fig. 39) located beneath the chart paper and tapper bar is synchronized to rotate at a ratio of 4:1 with the scanning assembly. When the scanning assembly passes the 0 position of the recorder meter, the helix simultaneously passes the 0 position of the chart.

61. Recorder Meter

a. As shown in the block diagram of figure 19, the recorder meter is connected in series with the visual meter and the output current is divided between them by means of an equalizing control (R612) in the frequency meter. When this control is correctly adjusted, the pointer of the recorder meter moves through a 90° arc and the pointer of the visual meter moves from 0 to 100 bi-cycles as the a-f input to the frequency meter is varied from 0 to 200 cps. For example, if the a-f input to the frequency meter were 100 cps, the pointer of the visual meter would rest at 50 bi-cycles on the meter scale while the pointer of the recorder meter would rest midway between its 0° and 90° positions shown in figure 35. Or, if the a-f input were 150 cps, the visual meter would indicate 75 bi-cycles and the pointer of the recorder meter would rest in the position shown in figure 35.

b. Electrically, the recorder meter is a standard 500-ua d-c meter. Mechanically, however, it differs from the standard type of meter. The meter assembly is mounted in a circular cast iron case (fig. 36). This case has a concentric glass window on each side so that a beam of light can be projected through the case.

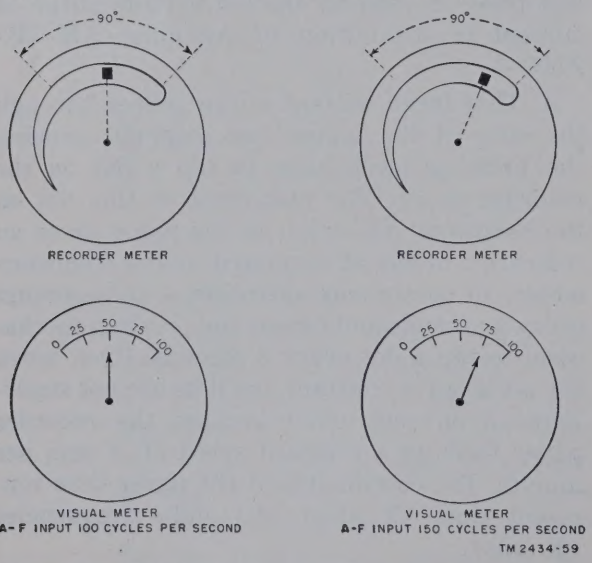


Figure 35. Relationship of pointers of visual and recorder meters with a-f inputs to the frequency meter of 100 and 150 cps.

62. Scanning Assembly

a. A main drive motor, (fig. 19) in combination with a gear assembly, drives the light disk gear and the phototube disk gear continuously at a speed of 1 revolution every 2 seconds. The two gears rotate in precise synchronism in the same direction and at the same speed.

b. Connected to the shaft of one gear is the exciter light disk. A lens assembly and a small lamp, which serves as a light source, are mounted on this disk. The lens assembly focuses the light into a narrow beam and projects this beam onto one side of the stationary recorder meter case. As the exciter light disk rotates at its speed of 1 revolution every 2 seconds, the beam of light traces a circular path on one side of the meter case. This path of light is shown by the circle with dashed lines in figure 37. Note that as the light beam passes through each 360° revolution, it sweeps in succession the following:

(1) Tapered portion of the glass window.
(2) Nontapered portion of the glass window.
(3) Metal side of the meter case.

c. During operation, the rectangular shaped pointer of the meter rests at some position along the portion of the glass window, the exact position of the pointer depending on the a-f input frequency to the frequency meter. Thus, the beam of light passes by the pointer of the meter once during each revolution of the exciter light disk or once every 2 seconds. In passing the meter pointer, the beam of light is suddenly interrupted and, during this instant, no light passes through the glass windows of the meter case to the phototube, V400, tube type 921.

d. The other gear, called the phototube disk gear, is used to rotate the phototube disk (fig. 19). The phototube is attached to this disk in such a position that it is always directly opposite the light source. During operation, the two gears, rotating in synchronism, turn the exciter light disk and phototube disk also in synchronism. The circle of revolution for the phototube has the same radius as the path of the light beam. Thus light will strike the phototube whenever the beam of light passes through the glass windows. During each 360° revolution, the beam of light acts on the phototube as follows:

(1) As the light beam passes through the tapered portion of the glass window, a gradually increasing amount of light strikes the phototube.

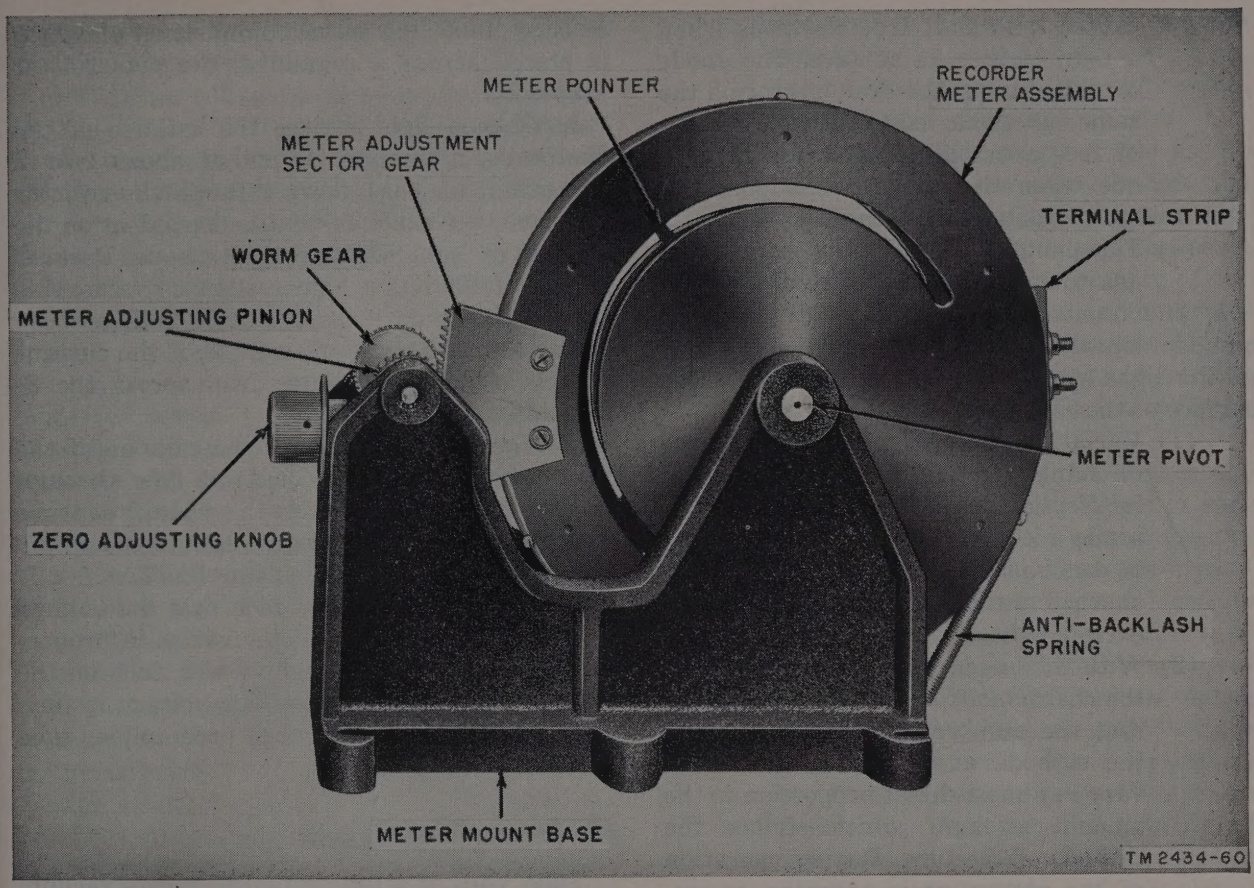


Figure 36. Recorder meter assembly.

(2) As the light passes through the non-tapered portion of the glass window, a constant amount of light strikes the phototube except when the beam passes the pointer of the meter. (No light reaches the phototube when the beam strikes the pointer of the meter.)

(3) During the time that the beam is striking the side of the metal case, no light reaches the phototube.

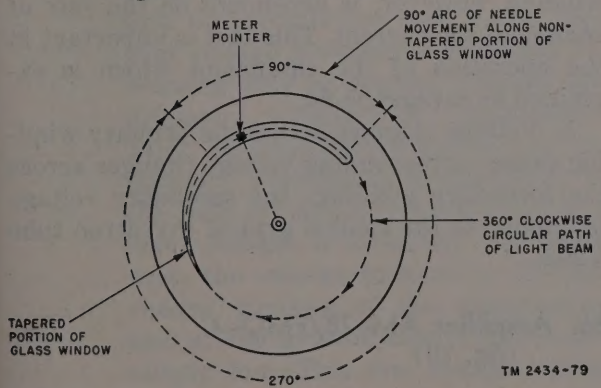


Figure 37. Functional diagram of recorder meter.

63. Phototube

a. Tube V400, tube 921, is a cartridge type, gas phototube. It consists of a cathode and an anode but does not operate in the same way as a conventional diode tube. The phototube also is constructed differently.

(1) In a conventional diode, the cathode resembles a long, thin rod located at the center of the tube, and the anode is usually a hollow tube placed outside of, and coaxial to, the cathode.

(2) In the phototube, on the other hand, the anode resembles a long, thin rod and is placed at the center of the tube. The cathode consists of a relatively large, semicircular cylinder placed so that the anode lies at the axis of the cylinder.

(3) The cathode of the diode requires heat to make it emit free electrons. The cathode of the phototube is coated with a photo-sensitive material which

causes it to emit free electrons when a light strikes its surface. The anode of either tube, however, performs the same functions, namely, the attraction of free electrons emitted by the cathode when the anode has a potential more positive than the cathode.

(4) The phototube is filled with an inert gas to increase its sensitivity.

b. The number of electrons emitted by the cathode depends on the color and the quantity of the light which strikes the photo-sensitive surface of the cathode.

(1) Variation of electron emission because of changes in the color of the light can be disregarded because, in the radiosonde receptor, the color of the light is constant, being determined by the characteristics of the lamp used in the exciter light.

(2) With an anode potential of 90 volts, the characteristics of the tube are such that the number of electrons leaving the cathode and reaching the anode vary in almost direct proportion to the amount of light which strikes the cathode of the tube. During operation of the photoelectric scanning assembly, the quantity of light which strikes the cathode is not constant, as explained in paragraph 62*d*. Therefore, the number of electrons which leave the cathode varies in response to the amount of light which passes through the glass window of the recorder meter.

64. Phototube Circuit

The phototube circuit develops a voltage which varies in accordance with the amount of light which falls on the phototube. In other words, the phototube circuit converts light changes to voltage changes.

a. The phototube circuit consists of tube V400, capacitor C402, and resistor R400 shown in figure 79.

Note. Figure 79 is a composite, schematic diagram of the phototube, preamplifier, and amplifier circuits. Physically, the phototube, preamplifier, and tapper coils are located in the radiosonde recorder and, for this reason, are shown inside the dash-dot lines of the diagram. All other parts shown in this figure are located on the chassis of Amplifier AM–7B/FMQ–1.

b. The phototube is connected in series with resistor R400, the series combination of which is placed across a regulated, d-c potential of +90 volts.

c. When a light strikes the cathode of the phototube, a minute current of about 1 or 2 microamperes (ua) flows through the resistor and tube; the exact current is dependent on the amount of light striking the cathode. Because resistor R400 has a high resistance value, this small current develops a sizable voltage drop across the resistor. For example, if the current flow is 1 ua the voltage drop across the 3-megohm resistor is 3 volts.

d. When no light strikes the cathode of the phototube, there is no electron flow through the resistor and tube. As a result, the tube acts as an infinitely high resistance and no voltage appears across resistor R400.

e. Therefore, it can be seen that the voltage appearing across the resistor varies in proportion to the amount of light which falls on the cathode of the phototube. This voltage is then applied to the control grid of preamplifier tube V401.

65. Preamplifier Circuit

Tube V401 is a tube type 6J5 triode vacuum tube. Cathode bias is obtained by the voltage drop appearing across resistor R401 as a result of the flow of plate current through the resistor.

a. The plate of the tube is connected to a regulated, d-c potential of +240 volts through the primary winding of transformer T200. The current which flows through this winding varies in response to the grid voltage. As a result, this current varies in proportion to the amount of light which strikes the phototube. The amplitude of voltage developed across the winding, however, is dependent on the *rate of change* of the current. This fact is important in the operation of the equipment which is explained in paragraph 64.

b. Voltage changes across the primary winding cause corresponding voltage changes across the secondary winding; the secondary voltage is applied to the control grid of thyratron tube V202.

66. Amplifier AM–7B/FMQ–1 (fig. 79)

Tube V202, tube type 2050, is a thyratron (gas

tetrode) tube. See paragraph 56 for general theory of thyratron tubes.

a. With no voltage induced in the secondary of transformer T200, the d-c potential applied to the tube holds the tube beyond cut-off and no current flows through the tube nor through tapper coils L400 and L401 of the plate circuit. That is, the cathode of the tube is at ground or the zero reference potential, and 25 volts of negative grid bias voltage is applied to the grid of the tube. This bias voltage is obtained from the slider on variable resistor R204, which is connected across a regulated, d-c potential of 75 volts. Because there is no current flow in the plate circuit, there is no voltage drop across resistor R202 of the tapper coils (L400 and L401) after capacitor C202 attains its charge. (C202 will charge through the voltage regulator tubes and R202 to a voltage of +315 volts.) The plate of the tube, therefore, is at a potential of +315 volts during this time.

b. The characteristics of tube type 2050 are such that, with a plate potential of +315 volts, the firing point of the tube occurs when the grid voltage is approximately −4 volts. Once the tube has fired, the grid voltage loses control and current continues to flow until the plate voltage is reduced to below +8 volts (minimum plate potential permissable for conduction).

c. The voltage developed in the phototube circuit as a result of the scanning of the light beam is as follows:

(1) As the light beam moves steadily along the tapered portion of the glass window of the recorder meter, a gradually increasing amount of light strikes the cathode of the phototube. As a result, a gradually increasing positive voltage is developed at the grid of preamplifier tube V401. This grid voltage produces a *gradually increasing flow of current* through the primary winding of transformer T200. Because the voltage across the primary winding is proportional to the *rate of current change,* the primary voltage is relatively low. Likewise, the voltage induced in the secondary winding of the transformer and at the grid of tube V202 is relatively low. This low voltage makes the grid of the tube more postive but not enough to cause the thyratron tube to fire and conduct current. Thus, during this travel of the light beam, the thyratron tube does not fire.

(2) Also, tube V202 does not fire as the beam of light sweeps through the nontapered portion of the glass window up to the point where the beam strikes the rectangular pointer of the meter. While the light beam strikes the phototube with a constant illumination, there is no change of current flow or voltage in the amplifying circuit.

(3) When the beam of light strikes the pointer of the meter, the light is suddenly cut off from the phototube and the voltage at the grid of the preamplifier tube suddenly falls to zero. As a result, there is a sudden *decrease* of plate current through the primary of transformer T200. This sudden change in current produces a large voltage across the primary and secondary windings and at the grid of the thyratron tube. However, the polarity of this voltage is such that the grid is driven more negative and this circuit remains inoperative. Thus, the beam of light, upon reaching the pointer of the meter, still produces no current in the tapper coils.

(4) As the beam of light leaves the pointer of the meter, light is suddenly returned to the phototube and the voltage at the grid of the preamplifier tube suddenly rises from zero to a relatively high positive value. As a result, there is now a sudden *increase* of current through the primary winding of transformer T200 with a large voltage (proportional to the rate of change of current) instantaneously appearing across the primary and secondary windings and at the grid of the thyratron tube.

(*a*) This voltage has a sufficient positive amplitude to overcome the fixed bias voltage on the grid, and the firing point for the tube (approximately −4 volts) is reached. At this time, the gas in the tube ionizes and

begins to conduct current. This current, flowing through the plate circuit of tube V202, energizes tapper coils L400 and L401 and causes the recorder to tap a print.

(*b*) At the same instant that the gas ionizes, capacitor C202, which was previously charged to the same potential as the plate of tube V202 (315 volts), rapidly discharges through the low-resistance path presented by the tapper coils in series with the tube. (During conduction, the cathode-to-plate resistance of the tube falls to an extremely low value while the resistance of the tube is extremely high during a period of nonconductance.) The discharge of the capacitor lowers the plate potential of the tube to a value below that which is necessary to keep the gas ionized (below +8 volts), and the tube stops conducting. The tube then remains inoperative until another large postive voltage appears at its grid to overcome again the fixed negative bias voltage. The recurrence of such a postive voltage appears once during each 360° revolution of the scanning assembly, that is, at the instant the beam of light leaves the pointer of the meter. Therefore, the tapper coils are energized for only one brief period during each cycle of normal operation.

67. Power Supply for Amplifier AM–7B/FMQ–1
(fig. 79)

a. Power transformer T201 and exciter lamp transformer T202 operate on 115 volts a-c supplied through Voltage Regulator CN–2A/FMQ–1. The secondary of transformer T201 has three windings. One winding produces 6.8 volts a-c, reduced to 6.3 volts a-c by resistor R205, for the filaments of tubes V401 and V202. Another winding has 5 volts a-c for the filament of tube V203. The third winding is 1,200 volts a-c, center-tapped to furnish 600 volts a-c on each plate of tube V203. The rectified voltage output of tube V203, tube type 5U4G, is a full-wave rectifier type, filtered by the network composed of capacitors C203 and C204 and filter choke L201. Four voltage-regulator tubes, V204, V205, and V206, and V207 across the output of the filter network, function both as voltage regulators and voltage dividers. The output of the power supply is tapped or divided as follows:

(1) Plate of tube V204 tapped for +315 volts.
(2) Plate of tube V205 tapped for +240 volts.
(3) Plate of tube V206 tapped for +90 volts.
(4) Plate of V207 grounded.
(5) Cathode of V207 tapped for −75 volts. Resistor R204 (an adjustable resistor, with a movable tap) across tube V207 is tapped to provide −25 volts bias for tube V202.

b. Transformer T202 has a secondary winding which supplies 7 to 8 volts to power the exciter lamp in the lens assembly (fig. 39).

68. Printing Mechanism
(figs. 38 through 47)

a. Each time current flows in the tapper coils, the magnet of each coil is energized, causing the armature bar to be drawn upward. The upward movement of the armature bar forces the tapper bar rapidly downward, and a print is produced as the tapper bar strikes a typewriter ribbon against the recorder paper. This print is made at the point where the tapper bar intersects the raised spiral ridge, or helix, on the rotating spiral drum assembly (figs. 39 and 71).

b. The armature bar is pivoted on ball bearings, and its motion is passed on to the tapper bar by the doglegs (figs. 44 and 45). When the magnets pull the armature bar up rapidly, the doglegs and tapper bar move downward, striking the dogleg stops. The stops prevent further motion of the armature bar and the rear portion of the doglegs. But the tapper bar and front part of the doglegs continue downward because of their momentum and rotate about the dogleg pivots until the bar taps and makes a print. This latter motion stretches the dogleg

springs which (after a tap) draw the tapper bar away from the paper. Thus, the tapper bar is provided with a snap action which improves the quality of the print.

c. The helix is a spiral ridge (figs. 39 and 71) which extends about 1/32 inch above the surface of the drum so that when the tapper bar strikes downward, an impression will be made only at the point where the ridge and tapper bar collide. At that point the ribbon will be pressed against the paper, making a dot. To insure that the helix is always in the correct position to produce a dot (which indicates the position of the pointer of the meter) on the recorder paper, the rotation of the spiral drum assembly is synchronized with the rotation of the phototube scanning assembly. To accomplish this synchronization, a common drive motor and set of gears are used. The helix, however, rotates four times as fast as the phototube scanning assembly (par. 69).

d. The main drive motor is a synchronous motor. A starting capacitor is placed in the circuit to make the motor start in the right direction.

e. The print is made on graduated chart paper which is drawn past the tapper bar by the paper drive roll and the friction fingers at a uniform rate of .4 inch per minute. The paper feed is propelled by another synchronous motor which also uses a starting capacitor. There are 100 graduations across the paper at .1-inch intervals, each graduation representing 1 bi-cycle. Also, the paper is graduated lengthwise at .4-inch intervals, each horizontal line representing one minute. There are 20 yards of paper on one roll.

f. The ribbon drive and its reverse mechanism is powered by a small induction motor. This motor is geared down to a slow speed for driving the main shaft drive gear.

g. The whole printing mechanism is mounted on the rocker frame (fig. 41). By cam action, the rocker frame is rocked back and forth once during each revolution of the phototube scanning assembly. The purpose of this movement is to raise the ribbon and tapper bar away from the paper between taps so that the print can be seen.

h. The pull-out arm moves the rocker frame, with its printing mechanism, away from the helix so that recorder paper can be installed. The recorder can be tilted forward for adjustment purpose.

69. Over-all Functioning of Radiosonde Recorder

Figures 46 and 47 are composite drawings which simplify the relationship of various parts and voltages in the radiosonde recorder.

a. In figure 46, it is assumed that the a-f signal input to the frequency meter is 150 cps.

(1) Under this condition, the pointer of the visual meter on the frequency meter will register 75 bi-cycles (fig. 46).

(2) Likewise, one edge of the pointer of the recorder meter will rest at an angle of 67.5°, when 0° represents 0 bi-cycle and 90° represents 100 bi-cycles (fig. 46).

(3) The beam of light, in making its clockwise excursions, traces the path shown by the dotted lines in C of figure 46. As the beam of light passes the 0° position of the meter pointer, maximum light reaches the phototube (beam of light in nontapered portion of glass window), and maximum voltage is generated in the phototube circuit (D of fig. 46). This voltage then remains constant at this high level as the beam passes through the window until it strikes the pointer of the meter. As it sweeps by the pointer, light is suddenly shut off and then just as suddenly returned to the phototube. As a result, the phototube circuit voltage suddenly falls to zero and then suddenly returns to its maximum value (fig. 46). As explained previously, the tapper bar magnets are energized only when the light leaves the pointer of the recorder meter. Therefore, at this time, the tapper bar strikes down and makes a dot on the recorder paper.

(4) The position of the rotating helix when the tapper bar operates is shown in E of figure 46. Note that the point on the helix which coincides with the tapper bar will make the print at 75 divisions on the recorder paper (F of fig. 46). Thus, if the a-f input to the frequency meter is

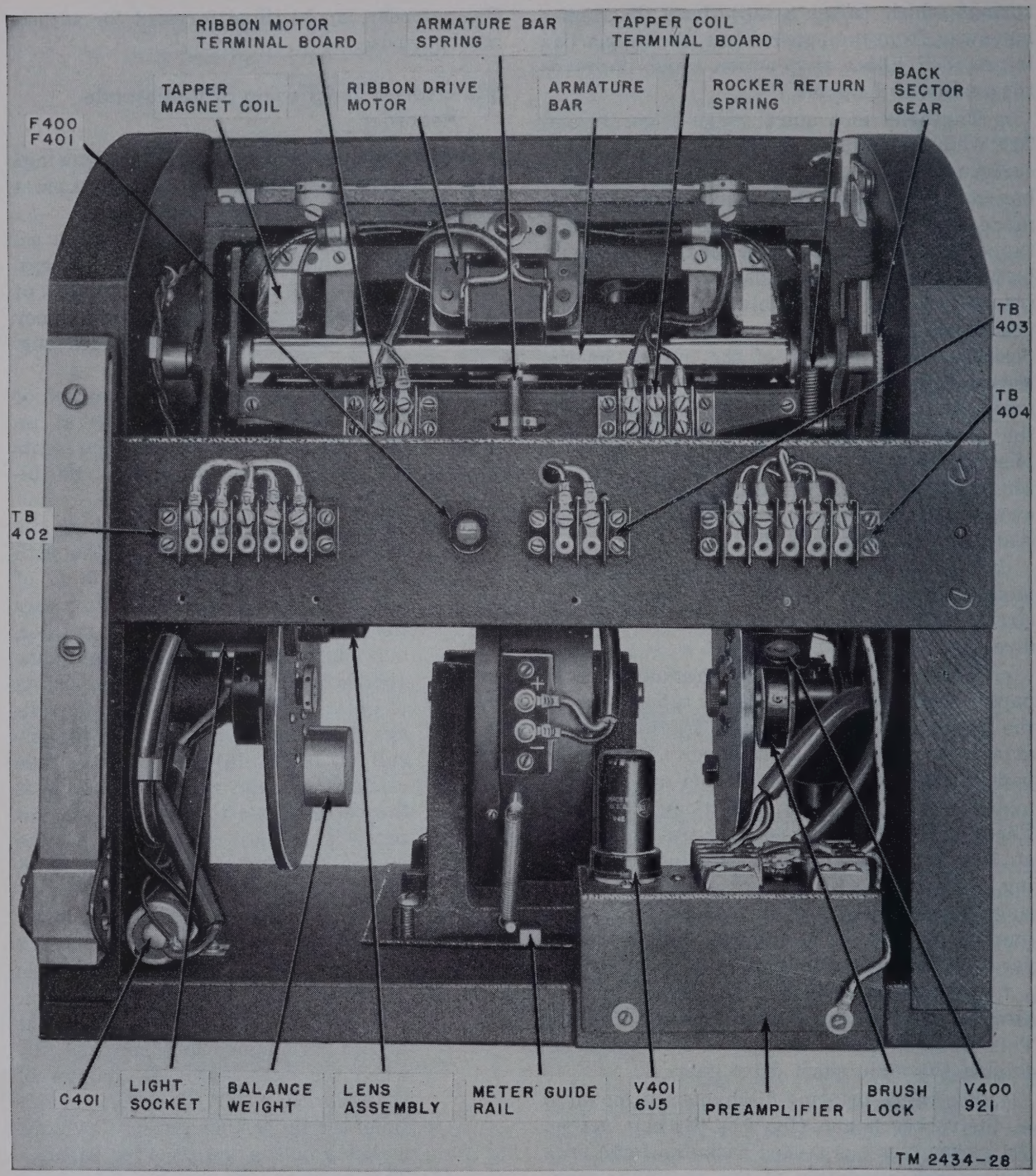


Figure 38. Radiosonde Recorder RD–3C/FMQ–1, rear view.

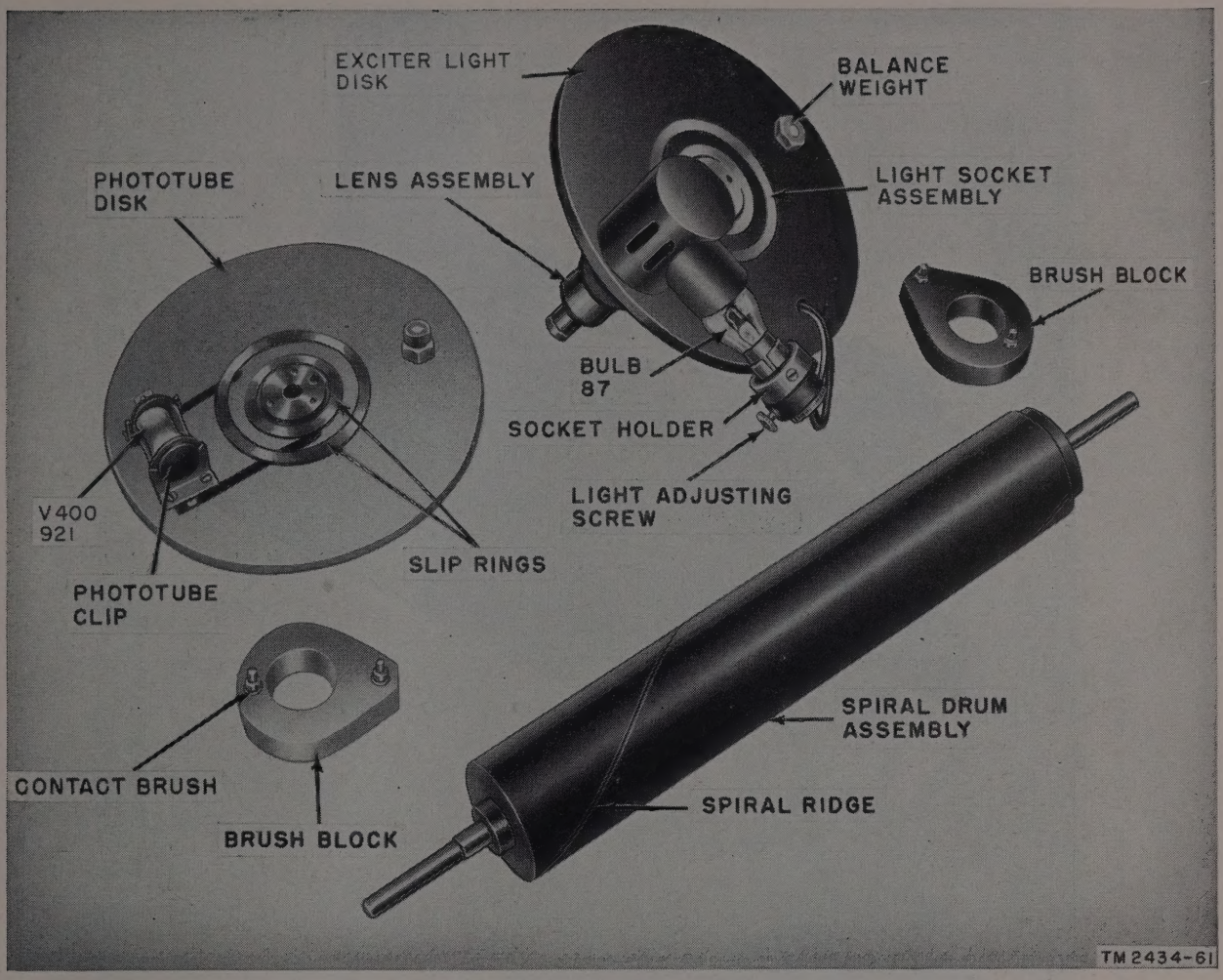


Figure 39. Scanning assembly.

held constant at 150 cps, the recorder will print every two seconds and produce a print on the recorder paper at 75 divisions to correspond to the 75-bi-cycle (67.5°) position of the meter pointer. The paper feed constantly moves the paper past the tapper bar at a rate of .4 inch per minute so that an average of 30 prints, placed one under the other, will appear every .4 inch.

(5) The beam of light, in sweeping from the 0° to 90° positions, requires an elapsed time of .5 second (360° equals 2 seconds). The rotation of the helix is synchronized with the rotation of the phototube scanning assembly so that the helix makes one complete revolution during this .5 second period. In making this revolution, the helix is synchronized with the scanning assembly so that it is always in the correct position to record the position of the pointer on the meter.

(6) As the beam of light passes out of the glass window and continues its clockwise rotation, it passes in succession the 90° to 180°, 180° to 270° and 270° to 360° (0°) arcs, as shown in C of figure 46. During each of these arcs, the helix makes another complete revolution, however, because the tapper bar is not normally actuated during this time, no print is made on the paper. Thus, the helix makes four revolutions for each revolution of the phototube scanning assembly. Only during the 0° to 90° arc is the tapper bar actuated and a print made.

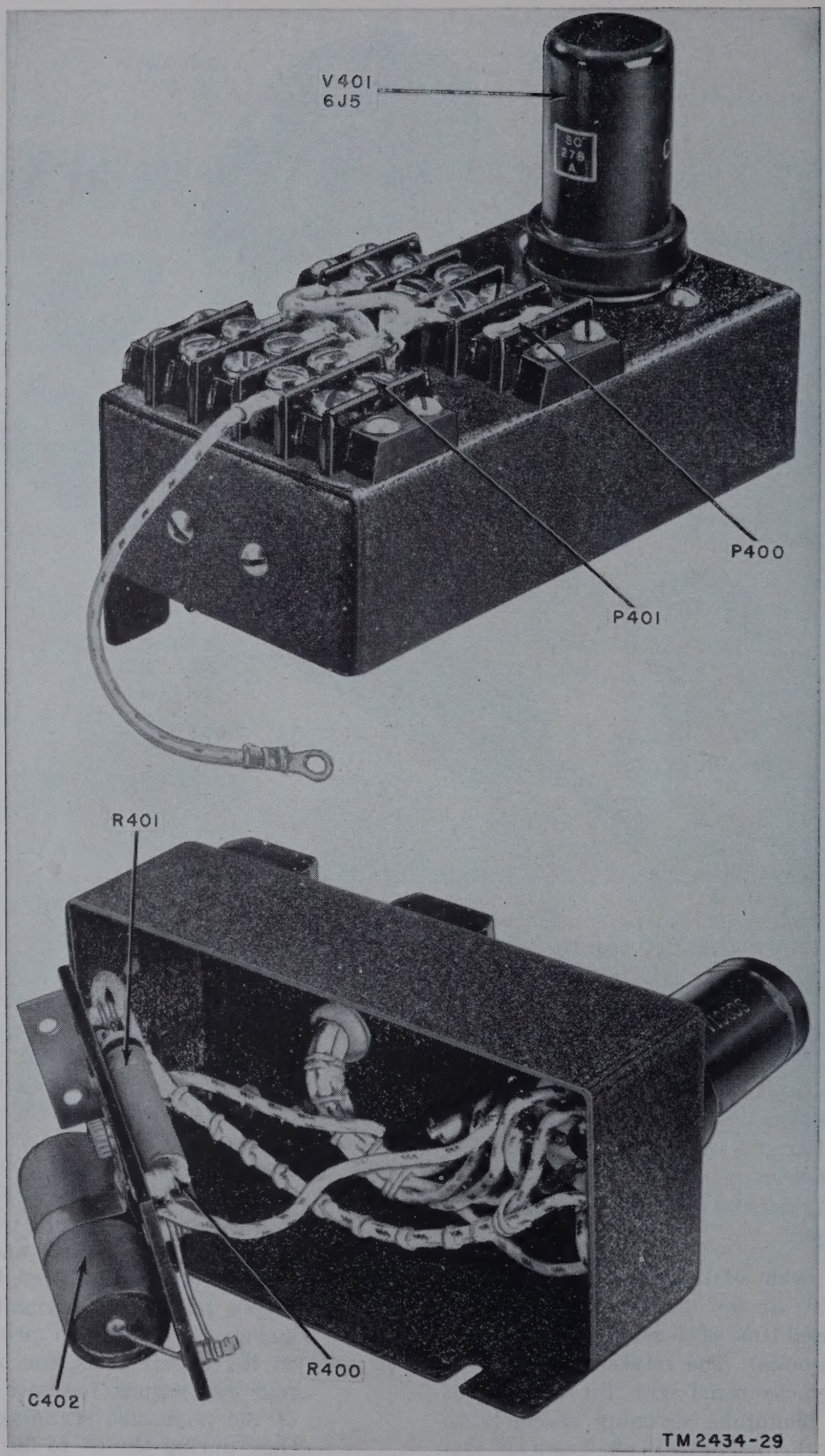


Figure 40. Preamplifier.

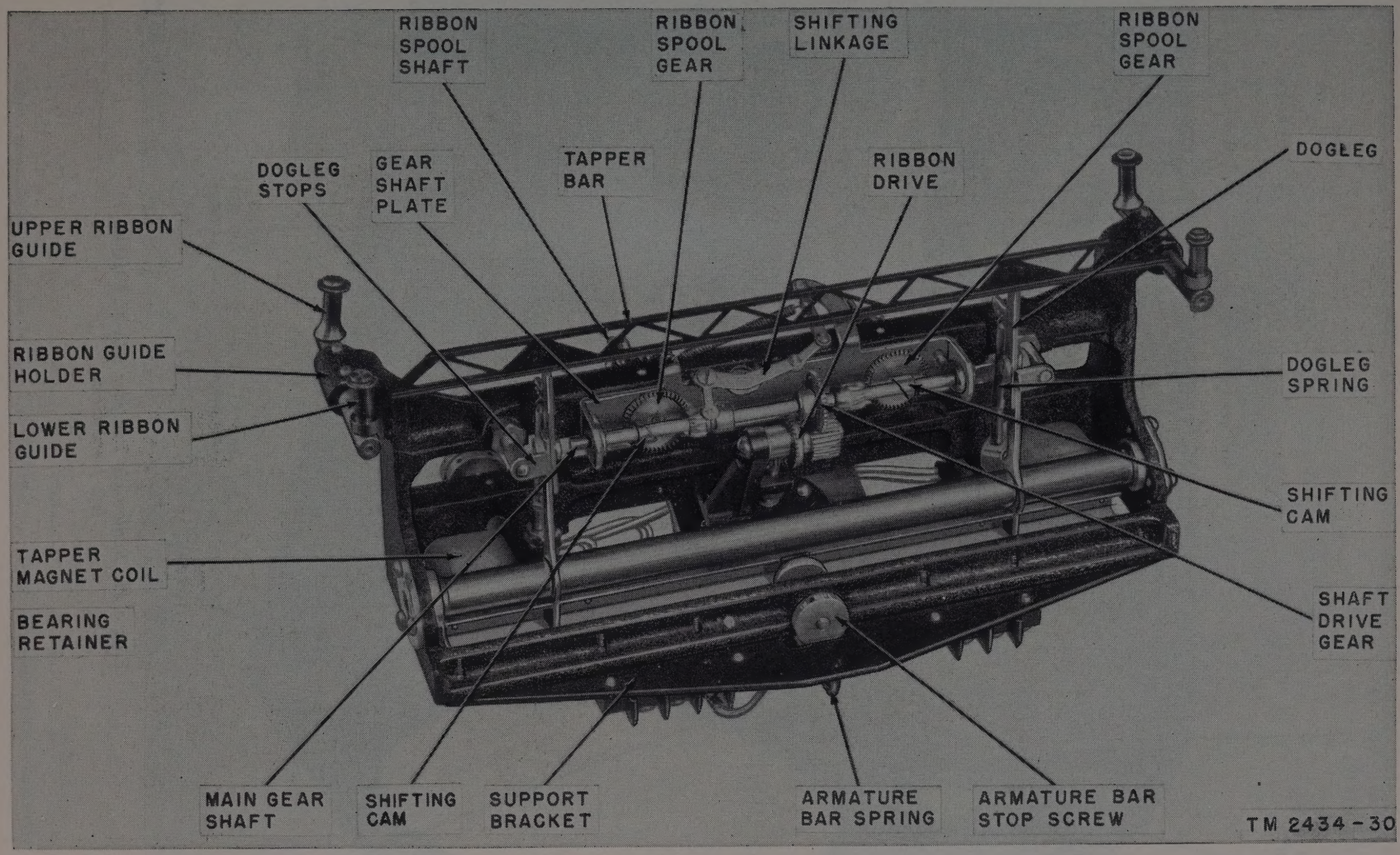


Figure 41. Rocker frame assembly.

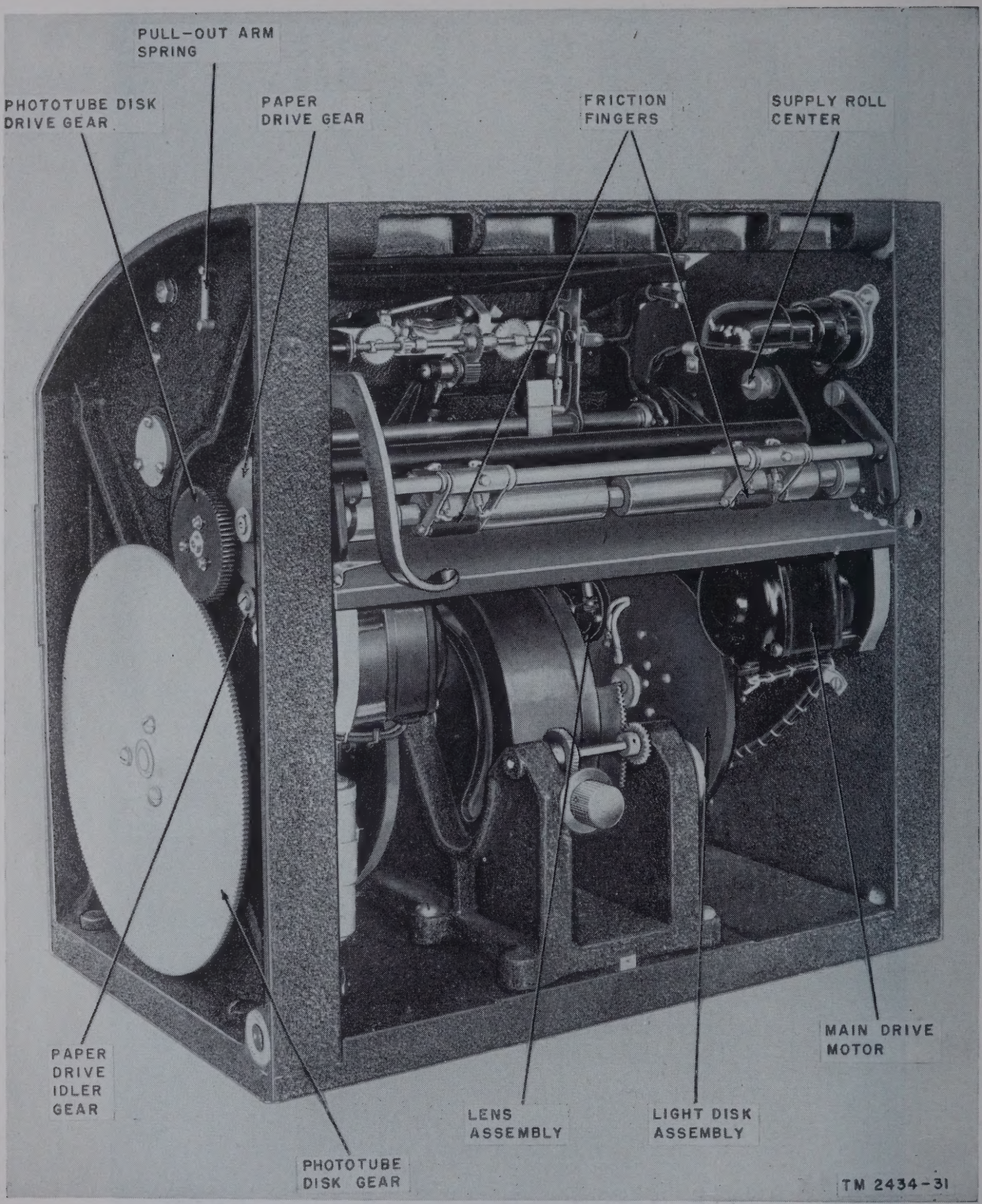


Figure 42. Radiosonde Recorder RD–3C/FMQ–1, left front view.

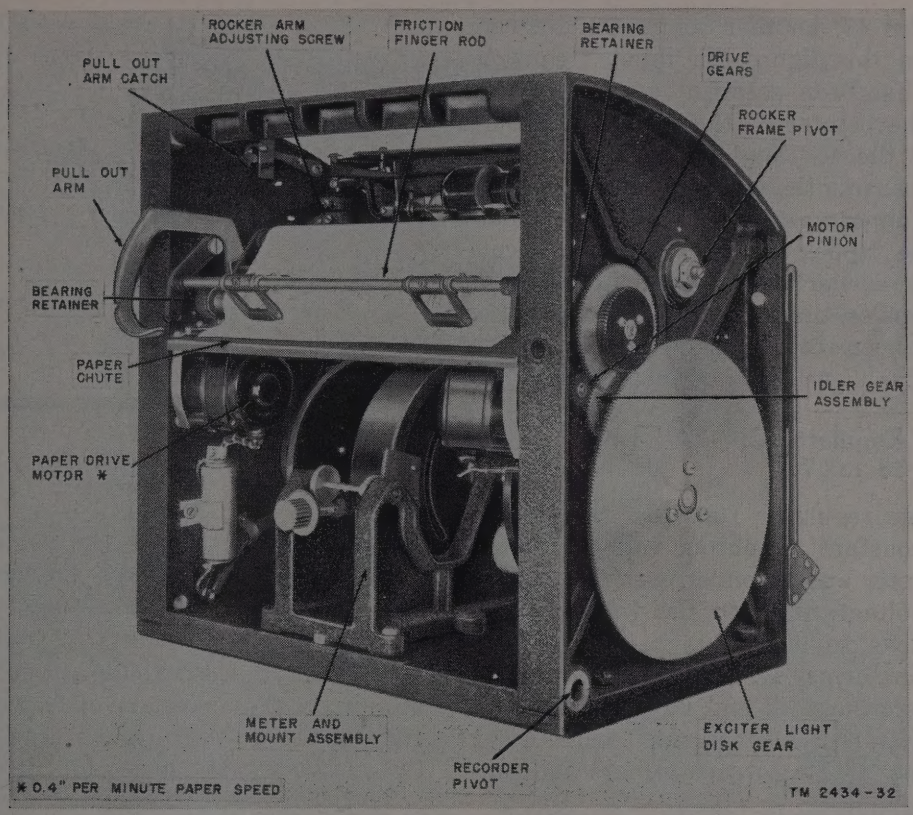


Figure 43. Radiosonde Recorder RD–3C/FMQ–1, right front view.

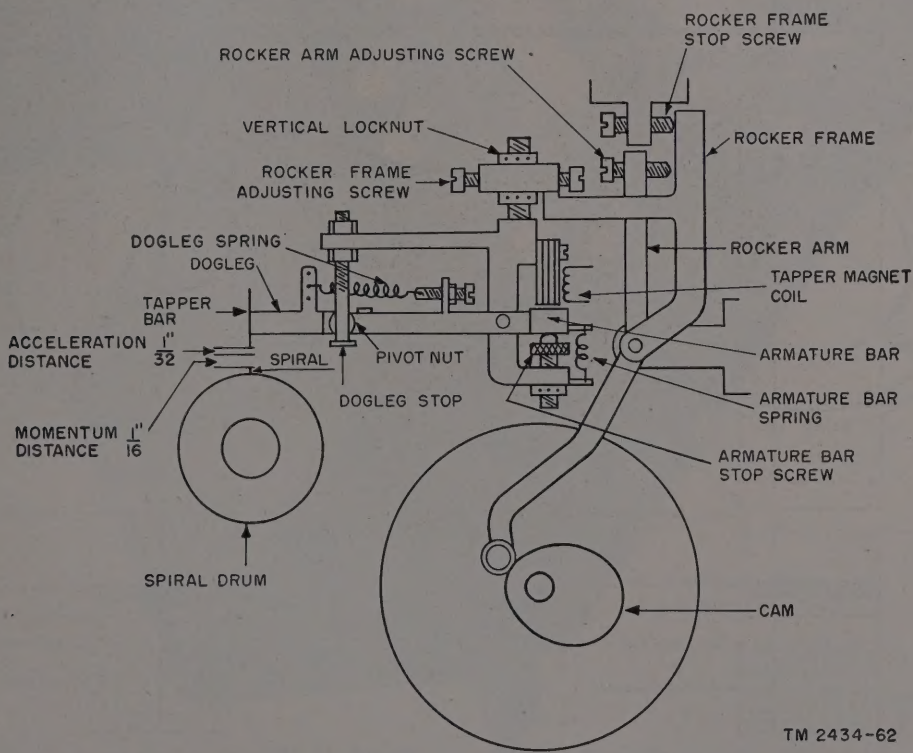


Figure 44. Radiosonde Recorder RD–3C/FMQ–1, sketch of adjustment locations.

b. In figure 47, another composite diagram is shown. In this figure, an input frequency of 100 cps has been assumed (A of fig. 47). Note that the pointer of the meter (C of fig. 47) rests at the 45° angle in the path of the light beam, causing the phototube voltage (D of fig. 47) to appear earlier in the cycle. Also, note that the tapper bar is actuated at a correspondingly earlier time to produce a print at 50 divisions on the paper (F of fig. 47), the helix having been rotated to the position shown in E of figure 47 at this instant.

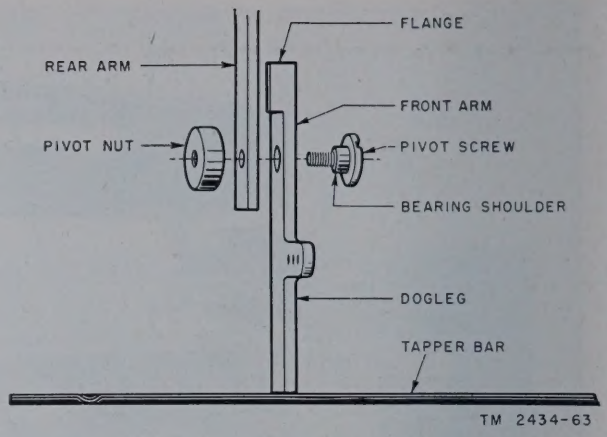


Figure 45. Detailed sketch of dogleg joints.

70. Voltage Regulator CN–2A/FMQ–1 (figs. 48 and 78)

The voltage regulator (fig. 48) furnishes a practically constant a-c output voltage for the frequency meter and amplifier even though the power a-c voltage input to the voltage regulator varies over wide limits.

a. The transformer assembly, T302, consists of two transformers, A and B, assembled and connected within a hermetically sealed case. The primaries of these transformers are connected in series across the a-c input voltage and the secondaries are connected in series opposition. Most of the output voltage is contributed by the secondary of transformer B.

b. When the a-c voltage input increases in amplitude, the secondary of transformer B contributes less to the output voltage although the two secondary voltages add (in opposition) to

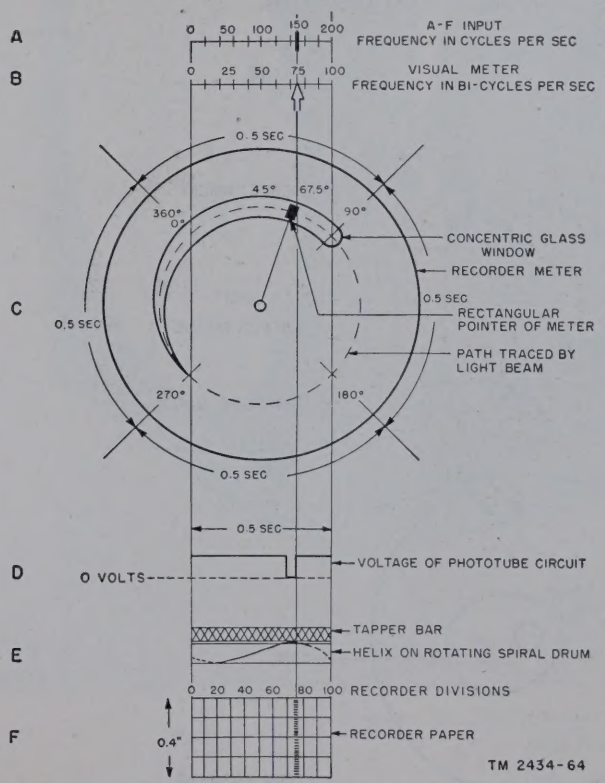


Figure 46. Functional diagram of radiosonde recorder operation, a-f input 150 cps.

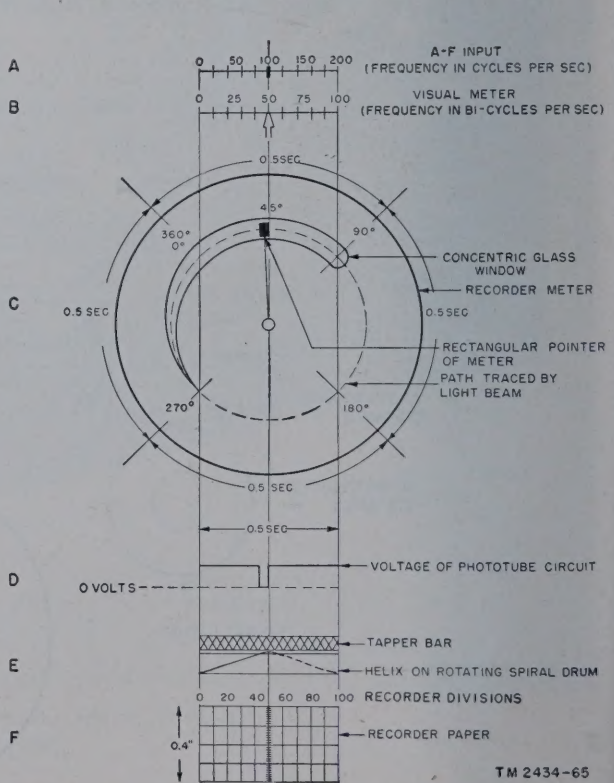


Figure 47. Functional diagram of radiosonde recorder operation, a-f input 100 cps.

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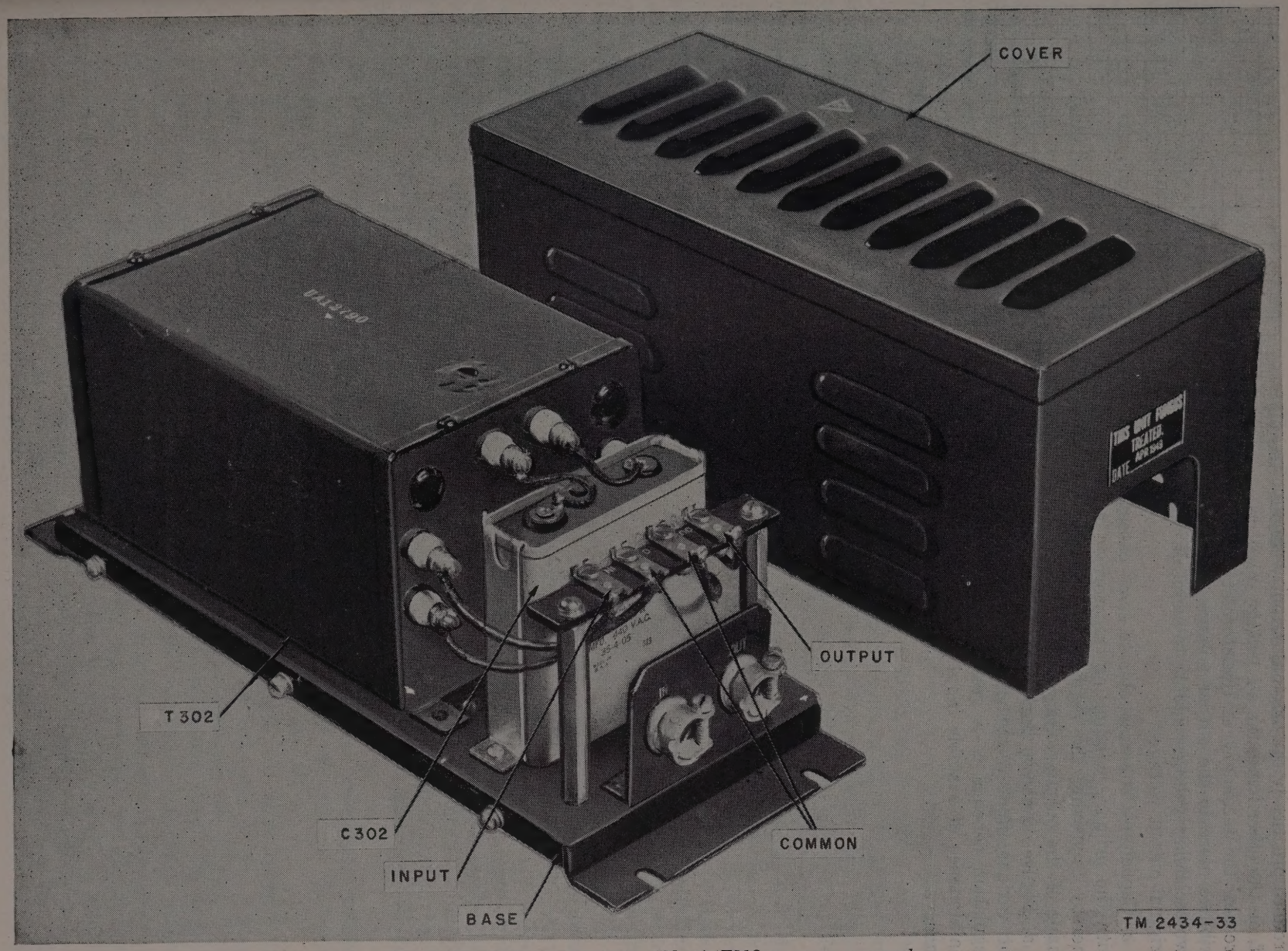


Figure 48. Voltage Regulator CN–2A/FMQ–1, cover removed.

produce practically the original output voltage. If, on the other hand, the a-c voltage input decreases, the secondary of transformer B contributes more to the output voltage, with the two secondary voltages adding to maintain the original output voltage.

c. Capacitor C302 resonates to some extent with the primary winding of transformer A, thereby improving the regulation and waveshape of the output voltage.

d. Figure 49 shows the regulation provided for various input frequencies. Note that the regulation depends to a great extent on the maintenance of a stable input power line frequency.

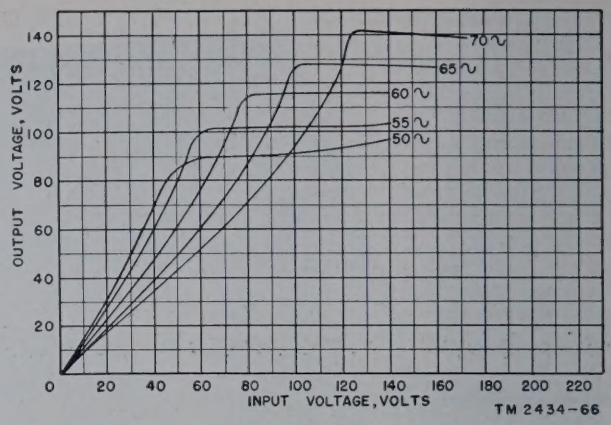


Figure 49. Voltage Regulator CN–2A/FMQ–1, frequency voltage regulation curves.

CHAPTER 5

FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenace responsibility is limited only by the tools and test equipment available, and by the skill of the repairman.

Section I. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When servicing the equipment, be extremely careful; high voltage is present. Always turn off the power before making resistance checks in the equipment. Keep one hand in your pocket when measuring socket voltages. Before touching any part of the equipment after the voltage is shut off, short the part to ground.

71. Trouble-Shooting Procedures

a. SECTIONALIZATION AND LOCALIZATION. The first step in servicing a defective radio set is to sectionalize the fault. Sectionalization means tracing the fault to the *major component or circuit* responsible for the abnormal operation of the set. The second step is to localize the fault. Localization means tracing the fault to the defective part responsible for the abnormal condition. Some faults such as burned-out resistors, r-f arcing, and shorted transformers often can be located by sight, smell, and hearing. The majority of faults, however, must be localized by *checking voltage and resistance.*

b. TESTS. The tests listed below aid in isolating the source of trouble. Remember that the servicing procedure should cause no further damage to the radio set. First, trouble should be localized to a single stage or circuit; then the trouble may be isolated within that stage or circuit by appropriate voltage, resistance, and continuity measurements.

(1) *Visual inspection.* Through this inspection alone, the repairman frequently discovers the trouble or determines the stage in which the trouble exists. This inspection is valuable in order to avoid additional damage which might occur through improper servicing methods and to forestall future failures.

(2) *Operational test.* The operational tests (pars. 81 through 87) are important because they frequently indicate the general location of trouble. In many instances the information gained will indicate the exact nature of the fault. In order for this information to be fully utilized, all symptoms must be interpreted in relation to one another.

(3) *Trouble-shooting chart.* The trouble symptoms listed in this chart (par. 73) will aid in localizing trouble.

(4) *Intermittents.* In all these tests the possibility of intermittents should not be overlooked. This type of trouble may appear when the set is tapped or jarred. Look for loose connections; it is possible that the trouble is not in the set itself but in the installation, such as cord connections, etc.

c. VOLTAGE MEASUREMENTS. Voltage measurements are an almost indispensable aid to the repairman, because most troubles either result from abnormal voltages or produce abnormal voltages. Voltage measurements are always made between two points in a circuit, and the circuit need not be interrupted. Complete information on normal operation voltages is given in this section.

(1) Unless otherwise specified, voltages are measured between the indicated points and ground.

(2) Always begin the measurements by setting the voltmeter on the highest range in order that the voltmeter will not be overloaded. Then, if necessary, set the voltmeter to a lower range.

(3) In checking cathode voltage, remember that a reading can be obtained when the cathode resistor is actually open; the resistance of the meter may act as a cathode resistor. Thus the cathode voltage may be approximately

normal only as long as the voltmeter is connected between cathode and ground. An abnormally high plate voltage may indicate an open cathode resistor.

72. Test Equipment

Equipment issued for use in installing, repairing, and calibrating Radiosonde Receptor AN/FMQ–2 includes the following.

a. Tool Equipment TK–17/FMQ–1.
b. Test Unit I–176 or Multimeter TS–352/U.
c. Headset HS–33–( ), complete with Cord CD–307.
d. Frequency Standard TS–65 ( )/FMQ–1.
e. Expendable Hardware Items MK–27/FMQ–1.
f. Signal Generator TS–497/URR.
g. Output Meter TS–585/U.
h. Oscilloscope TS–34/AP
i. Electronic Multimeter TS–505/U.

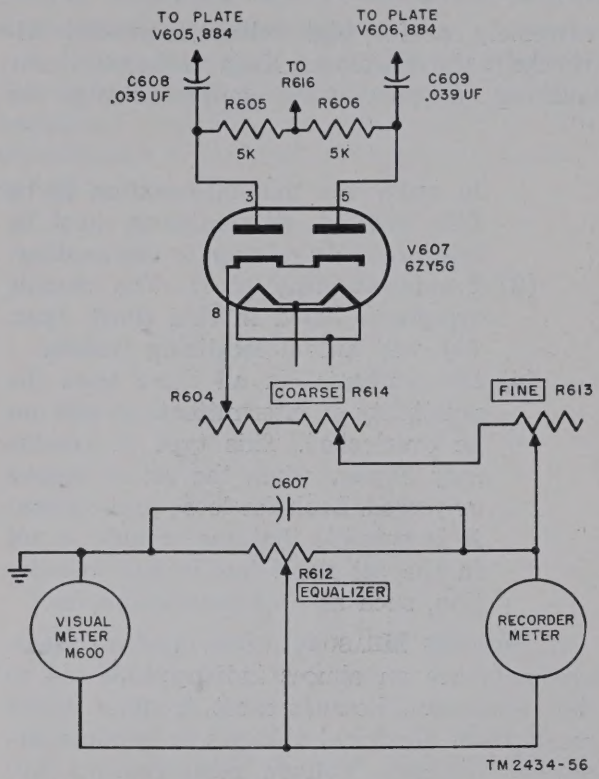


Figure 50. Visual and recorder meter circuit, simplified schematic.

73. Trouble-Shooting Chart

The following chart is supplied as an aid in locating trouble in the amplifier, the radiosonde receiver, and the frequency meter components of the radiosonde receptor. This chart lists the symptoms which the repairman observes, either visually or audibly, while making a few simple tests. Once the trouble has been localized to a stage or circuit, a tube check and voltage and resistance measurements of this stage or circuit should ordinarily be sufficient to isolate the defective part. Normal voltage and resistance measurements are given in figures 52, 53, and 54. Figures 57 through 66 show location of parts and components of these major components of the radiosonde receptor, figure 76 indicates the actual physical location of the components connected on the terminal boards of the radiosonde receiver, and figure 80 gives the practical wiring diagram for the receiver.

Symptom	Probable trouble	Correction
1. No noise or signal heard from speaker.	1. Radiosonde receiver not operating properly.	1. Trouble shoot receiver.
2. Noise is heard but no signal.	2. *a.* Antenna system not functioning properly.	2. *a.* Check and replace antennas that are cracked, bent, or corroded.
	b. Bad connections between antenna and receiver.	*b.* Check and replace all bad or cracked connections between antennas and receivers.
	c. R-f stage of receiver not operating.	*c.* Check tubes V101 through V104. Replace these tubes if faulty. Check socket voltages and resistances (fig. 53). Trace fault back to origin.

Symptom	Probable trouble	Correction
Note. Make sure that source of signal, namely the radiosonde, is functioning properly. Also check to see if receiver is tuned to proper frequency.		
3. No indication (visual meter) of modulated signal in Frequency Meter TS–29B/FMQ–1.	3. *a.* If the INPUT switch is turned to the 60 ~ position and no indication is received on the visual meter, the frequency meter is not functioning correctly.	3. *a.* Check and replace all faulty tubes in Frequency Meter TS–29B/FMQ–1. Check socket voltages and resistances (fig 52). Localize trouble.
	b. If an indication is observed when the INPUT switch is turned to the 60 ~ position, the output circuit of receiver is functioning improperly. (If Radio Set SCR–658 is used to receive instead of Radiosonde Receiver R–228/FMQ–2, Radio Set SCR-658 is not functioning properly.)	*b.* Check and replace all bad tubes V110 through V113. Check socket voltages and resistances (fig. 52). Localize trouble.
4. Frequency meter indication is steady but incorrect.	4. *a.* Frequency meter not functioning.	4. *a.* Refer to step 3 above.
	b. Output circuit of receiver (or Radio Set SCR-658) not functioning properly.	*b.* Refer to step 3 above.
	c. Alinement may be required.	*c.* Refer to section III, chapter 5, for alinement procedure.
5. Frequency meter indication is not steady, but good signal received in speaker.	5. Frequency meter is not functioning properly.	5. Refer to step 3 above.
6. Pilot light I101 does not light with S101 in its ON position.	6. *a.* Open fuses F101 and F102.	6. *a.* Replace F101 and/or F102.
	b. A-c power cord is open.	*b.* Replace a-c power cord if found open.
	c. Plug P101 defective.	*c.* Replace plug P101.
	d. Jack J102 defective.	*d.* Replace jack J102.
	e. POWER switch S101 defective.	*e.* Replace S101.
	f. Power transformer T102 defective.	*f.* Replace T102.
7. At LIM. TEST jack J103, objectionable noise received.	7. *a.* Noisy V101, V102, or V103.	7. *a.* Replace V101, V102, or V103, if found noisy.
	b. Defective antenna connections.	*b.* Replace defective connections.

Symptom	Probable trouble	Correction
8. At LIM. TEST jack J103, background noise is received but no signal.	8. *a.* Defective tubes V101, V102, V103, and V104.	8. *a.* Replace V101, V102, V103, and V104.
	b. Oscillator needs alinement.	*b.* Aline oscillator in accordance with paragraph 87.
9. At LIM. TEST jack J103, low or no background noise or signal received.	9. *a.* Defective tubes V101 through V109.	9. *a.* Replace any defective tube or tubes V101 through V109.
	b. I-f needs alinement.	*b.* Aline i-f according to instructions in paragraph 85.
	c. R-F GAIN control R139 defective.	*c.* Replace control R139.
	d. Components of r-f and i-f circuits defective.	*d.* Check components of r-f and i-f circuits. Use voltage and resistance diagram (fig. 53).
10. At the DISC. TEST jack J104, no audio signal received.	10. *a.* Defective tubes V110 and V111.	10. *a.* Replace tube V110 or V111, or both.
	b. Defective components of limiter and discriminator circuits.	*b.* Check circuit operation and components, using socket voltages and resistance diagram (fig. 53).
	c. Z107 assembly needs alinement.	*c.* Aline Z107 assembly in accordance with paragraph 84.
11. At the DISC. TEST jack J104, distortion exists as indicated by incorrect output waveform.	11. Z107 assembly out of alinement.	11. Aline Z107 assembly, refer to paragraph 84.
12. At the 1st AUDIO TEST jack J105 no signal received.	12. *a.* Defective tube V112.	12. *a.* Replace tube V112.
	b. Defective components of 1st audio stage.	*b.* Trouble shoot 1st audio circuit. Check socket voltage and resistance diagram (fig. 53).
13. At AUDIO MONITOR jack J106, no signal is received.	13. *a.* Defective V112 and V113.	13. *a.* Replace V112 or V113, or both.
	b. Defective components of clipper and shaper circuits.	*b.* Trouble shoot clipper and shaper circuits. Check socket voltages and resistance diagram (fig. 53).
14. No speaker output.	14. *a.* Defective V114.	14. *a.* Replace tube V114.
	b. Defective speaker volume control R157.	*b.* Replace speaker volume control R157.

Symptom	Probable trouble	Correction
	c. Open resistor R158.	*c.* Replace resistor R158.
	d. Open or defective transformer T101.	*d.* Replace transformer T101.
15. No image on screen of oscilloscope V117.	15. *a.* Defective tubes V117 and V119.	15. *a.* Replace tubes V117 or V119, or both.
	b. Defective components of oscilloscope and oscilloscope rectifier stages.	*b.* Trouble shoot these stages, using socket voltage and resistance diagram, figure 53.
	c. Incorrect settings of positioning controls R170 and R171.	*c.* Correct the settings of controls R170 and R171.
	d. Incorrect voltages at pins 1 and 6 of V116.	*d.* Check voltages, refer to diagram on figure 53.
	e. Open or defective intensity control R175.	*e.* Replace intensity control R175.
16. No vertical deflection on oscilloscope.	16. *a.* Defective tube V116.	16. *a.* Replace tube V116.
	b. Defective components of vertical amplifier circuit.	*b.* Trouble shoot circuit. Check socket voltages and resistances (fig. 53).
17. No horizontal deflection of oscilloscope.	17. *a.* Defective tubes V115 and V116.	17. *a.* Replace tube V115 or V116, or both.
	b. Defective circuit components of time base generator and horizontal amplifier circuits.	*b.* Trouble shoot these circuits. Check socket voltages and resistances (fig. 53).
18. No focusing.	18. Defective resistors R175 through R178.	18. Replace any defective resistors R175 through R178.

74. Trouble-Shooting Radiosonde Recorder

a. RECORDER NOT PRINTING. If the recorder is not printing, although the frequency meter is properly indicating the modulation frequency of the transmitted signal, the trouble may be sectionalized as follows:

(1) Leave the MASTER ON-OFF switch ON.

(2) Turn the RECORDER ON-OFF switch OFF.

(3) Remove the front cover plate from the meter and scanning assembly section. Then rotate the phototube disk by hand until the phototube is at the front of the recorder.

(4) With the RECORDER ON-OFF switch OFF, place the thumb on the contact at one end of the phototube socket and the index finger on the contact at the other end of this socket. Then remove the thumb and finger from this position.

(*a*) If the tapper bar operates as the contacts are touched, all components from the phototube socket through the preamplifier and amplifier to the tapper coils are functioning. Therefore, the trouble is caused by the light assembly or by poor alinement. If this is so, see (5) below.

(*b*) If, on the other hand, the tapper bar does not function, and the tapper bar armature has sufficient clearance from the tapper coils, check

or replace all tubes in the preamplifier and amplifier circuits. The voltage regulator tubes normally operate with a distinctive glow; thyratron tube 2050 should be checked by replacement. If the tubes are not at fault, remove, check, and clean the phototube disk, commutator rings, and brushes for dirt or excessive wear. If normal operation of the recorder is still not obtained, the preamplifier or amplifier circuits are at fault ((6) below).

(5) If, in the test in (4) above, the tapper bar operates, check the phototube by using a focused light or flashlight. Flash the light on and off *with the beam aimed at the phototube.*

(*a*) If the tapper bar operates as a result of this test, the trouble is in the exciter lamp assembly. If so, check to see whether the optical system is properly focused. Clean the recorder meter glass if the glass is dirty.

(*b*) If, on the other hand, the tapper bar does not operate when the flashlight test is made, replace the phototube. (When replacing the phototube, observe correct polarity.)

(6) To determine whether the trouble is in the preamplifier or in the amplifier circuits ((4)(*b*) above), make the following check:

(*a*) Set the voltage range of the test voltohmmeter to the 250-volt position. Connect the negative test lead of the meter to the chassis and connect the positive lead to terminal No. 3 on the d-c terminal strip. A reading of 240 volts, representing the plate potential of the preamplifier tube, should be obtained.

(*b*) If large fluctuations or instability of plate voltage is indicated by the voltohmmeter and it is known that good voltage regulator tubes are in use, the trouble may be overcome by replacing audio transformer T–200. A faulty transformer is the cause of intermittent or erratic operation of the recorder or printing mechanism.

(*c*) If only a slight movement of the meter occurs during the measurement of this plate voltage with the RECORDER ON-OFF switch ON and if the movement occurs at the scanning rate (once every 2 seconds), the pulse produced by the phototube circuit is being amplified by the preamplifier. Therefore, the trouble is sectionalized to the amplifier or tapper coils.

b. ERRATIC OPERATION OF TAPPER BAR. Erratic operation of the tapper bar may be localized by using the method of analysis given in *a*(6) above. That is, the cause of the erratic operation of the tapper bar may be localized by observing the movement of the voltohmmeter needle. Frequently this defect is caused by an incorrect bias voltage for tube 2050 (V202). This voltage is obtained from a tap on resistor R204.

c. PAPER FEED DIFFICULTY.

(1) If, during operation of the recorder, the paper does not feed out straight, the cause is probably either misalinement or a change in spring tension of the friction finger rod assembly. When correction of misalinement does not rectify the trouble, a temporary repair can be made by inserting small props between the paper chute and on top of each of the two motors; one motor is mounted on each side of the recorder. A new friction rod assembly should be installed for permanent repair.

Caution: Do not allow the rear edge of the paper chute to touch or rub against the paper drive roll.

Note. A calibration check is required following any maintenance or readjustments of the recording system. See Section III, chapter 5, for adjustment and calibration procedures.

(2) The gathering of the paper under the paper drive roll has been eliminated by a new design of the paper drive roll and the paper chute. Three fingers on the chute extend into grooves in the roll, thereby eliminating gather-

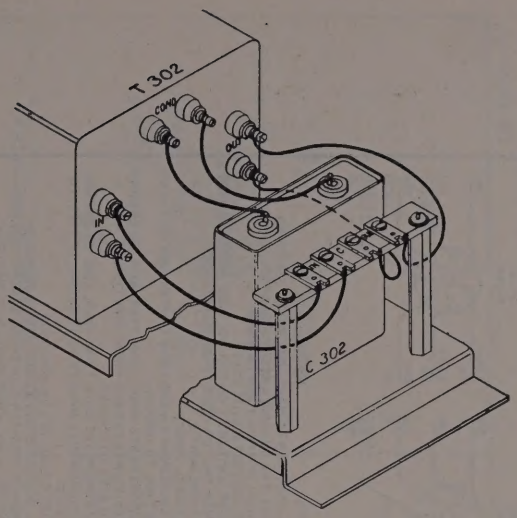
ing. Both new parts constitute an assembly which must be installed as such when either part is replaced.

75. Trouble Shooting Voltage Regulator CN–2A/FMQ–1

Voltage Regulator CN–2A/FMQ–1 seldom fails in service. If, however, it is necessary or desirable to check its operation, use the following procedures:

a. The output voltage of the regulator should be 115 volts when the input voltage is between 95 and 130 volts at a frequency of 60 cps (fig. 49). If the voltage regulator fails to produce a satisfactory output, check the input voltage. It should be between 105 and 125 volts at a frequency of 60 cps ±2 cps.

b. If the input voltage and frequency are normal, disconnect the unit from the power source and check the transformer windings for open or short circuits (fig. 51).

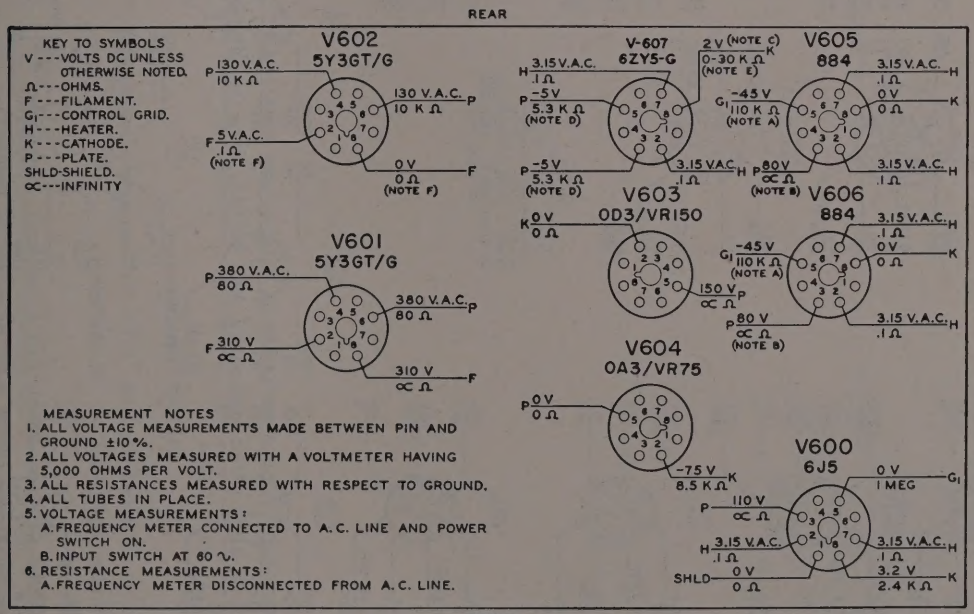


OHMMETER CONNECTOR TO EITHER TERMINAL OF LARGE CAPACITOR C302 AND ANY OTHER TERMINAL EXCEPT ADJACENT CAPACITOR TERMINAL WILL SHOW COMPLETE CIRCUIT. DISCHARGE CAPACITOR BY SHORTING BEFORE TOUCHING.

VOLTAGE REGULATOR CONTINUITY CHECK

TM 2434-34

Figure 51. Voltage Regulator CN–2A/FMQ–1 continuity check.



SPECIAL NOTES:
A. -45 VOLTS, VTVM, TUBE DEIONIZED. 1 VOLT, 5,000-OHMS-PER-VOLT METER, TUBE DEIONIZED.
B. +75 VOLTS, 884'S FIRING. 150 VOLTS, 884 DEIONIZED. +15 VOLTS, 884 IONIZED.
C. +1.8 VOLTS, 884'S FIRING. 0 VOLTS, 884'S NOT FIRING.
D. -4 VOLTS, VTVM, -2.5 VOLTS, 5,000-OHMS-PER-VOLT METER.
E. DEPENDS ON SETTING OF R604, R613, R614.
F. FILAMENT READINGS MAY BE FOUND REVERSED.

TM 2434-35

Figure 52. Frequency Meter TS–29B/FMQ–1, normal tube socket voltage and resistance measurements.

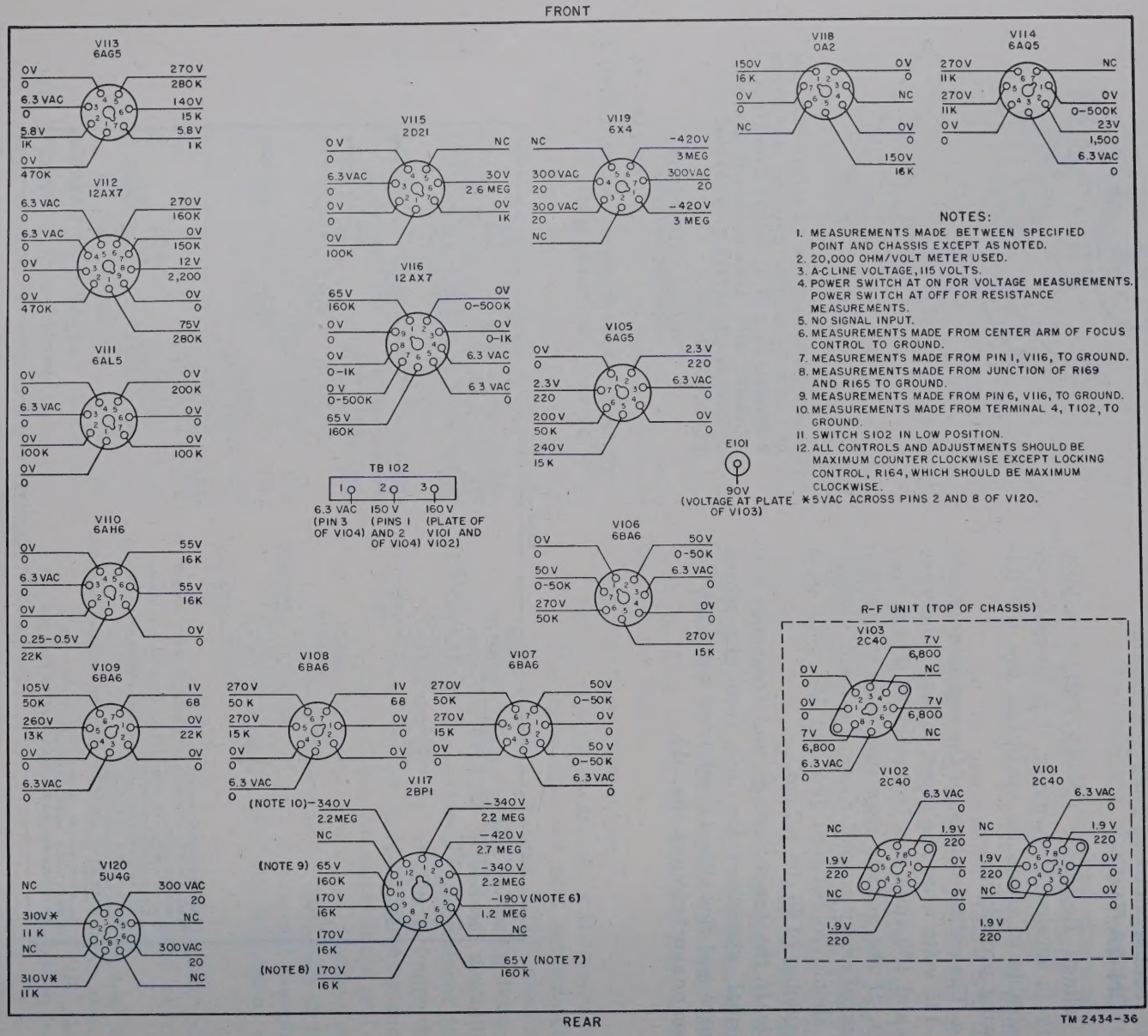


Figure 53. Radiosonde Receiver R-228/FMQ-2, normal tube socket voltage and resistance measurements.

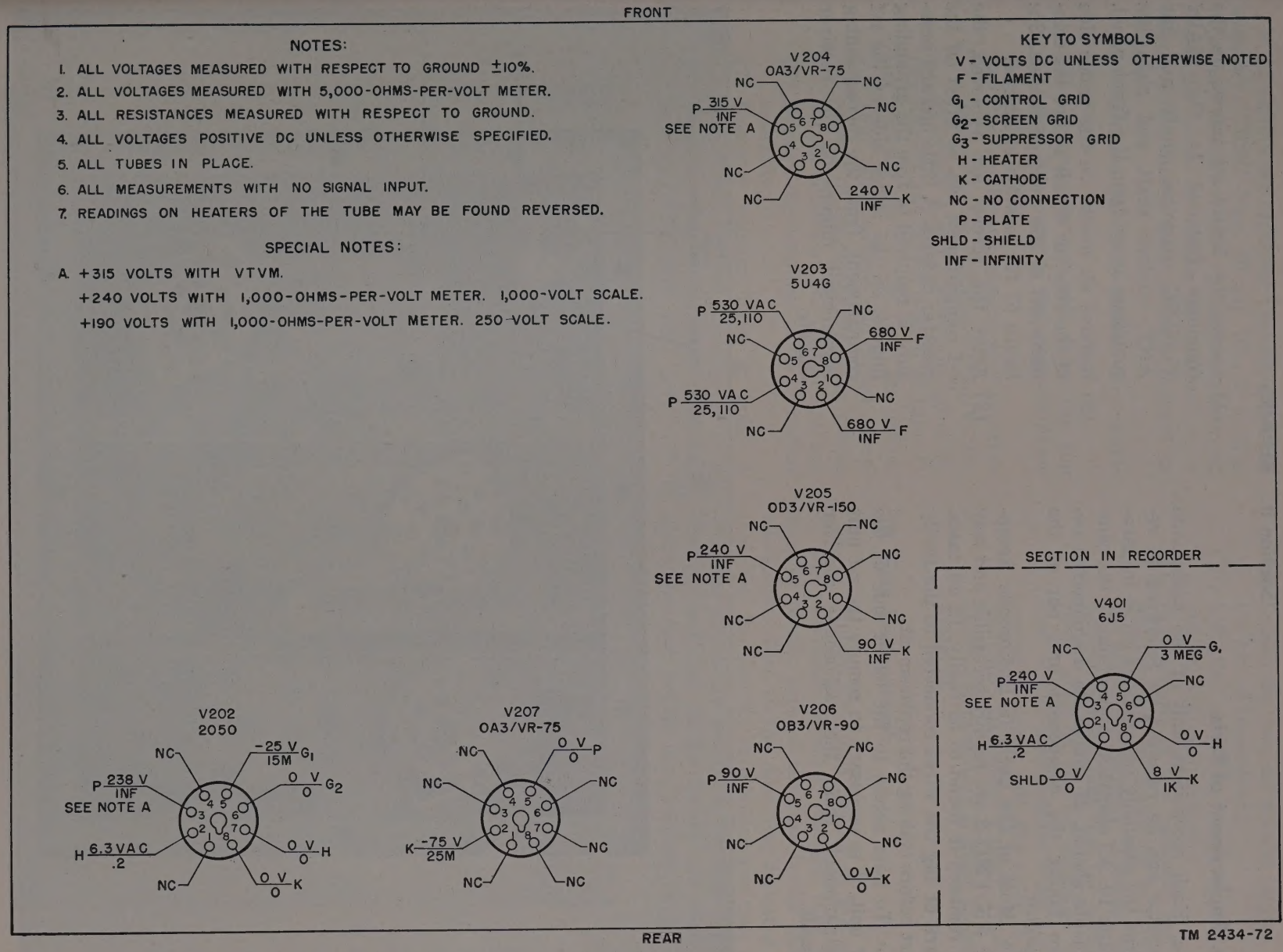


Figure 54. Amplifier AM–7B/FMQ–1, normal tube socket voltage and resistance measurements.

76. Replacement of Parts

a. Each component unit of the radiosonde receptor can be removed by following in reverse the assembly instructions given in paragraph 10. All electrical connections to the components should, of course, be disconnected before taking the component unit out of the receptor.

b. Most of the parts in Radiosonde Receptor AN/FMQ–2 are readily accessible and may be replaced if found to be faulty. In all cases, mark or tag the wires connected to the faulty part before making the replacement.

c. To gain access to the under side of the r-f unit, it is necessary to remove the r-f unit compartment from the radiosonde receiver chassis.

(1) Loosen the Bristo set screws on the couplings fastened to the MAIN TUNING capacitor shaft and the ANT. control shaft and slide the couplings away from the front panel.

(2) Remove all screws on the under side of the receiver which secure the compartment of the receiver chassis. See figure 67 for location of screws.

(3) After the screws are removed, the r-f compartment can be lifted off the receiver chassis. A little upward pressure is required to free the grounding fingers, on the under side of the r-f compartment, from the corresponding engagement fingers on the receiver chassis.

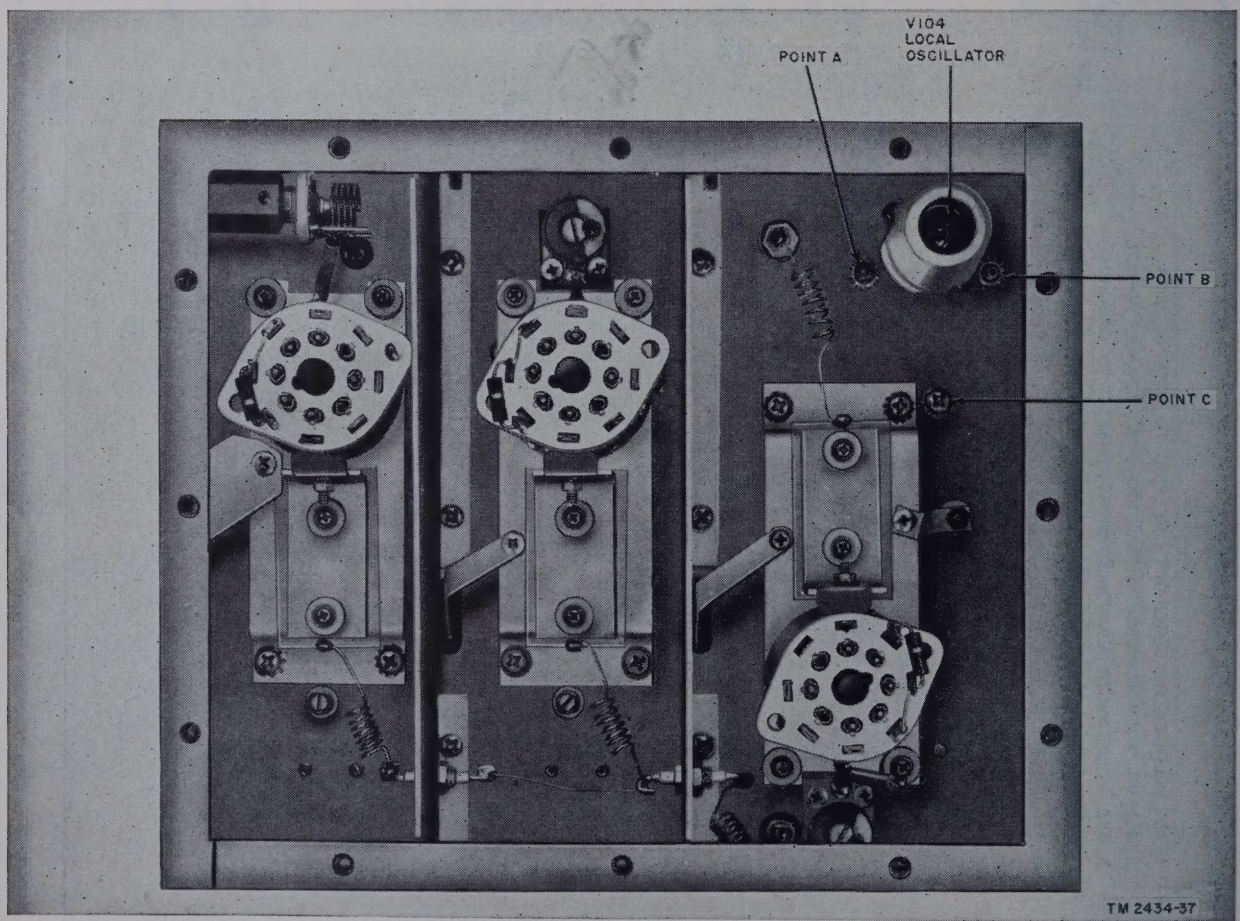


Figure 55. R-f unit, radiosonde receiver, top view.

d. To remove the oscillator variable capacitor assembly, C103C (figs. 66 and 70), it is first necessary to remove the r-f unit compartment from the receiver chassis as outlined in *c* above. After this is accomplished, proceed as follows:

(1) Remove the cover of the r-f compartment.
(2) Viewing the r-f unit from the top (fig. 55), remove the local oscillator tube, V–104.
(3) Remove the two nuts located on either side of the local oscillator tube, V–104, at points A and B shown in figure 55.
(4) Remove the screw located at point C.
(5) Viewing the r-f unit from the bottom (fig. 56), remove the metal wrap-around of the compartment by taking out all screws on the outside surface.
(6) Remove the coupling on the capacitor assembly.
(7) Unsolder resistor R108 at point A (fig. 56).
(8) Unsolder the brown wire connected at point B (fig. 56).
(9) Loosen the two set screws located on the hub of the assembly.
(10) Lift the oscillator assembly C103C out of the compartment.
(11) Replacement of the assembly can be accomplished by following in reverse the above instructions. However, it is extremely important that the ceramic rotor shaft in the r-f amplifier section of the maintenance capacitor is correctly alined with the rotor in the oscillator assembly, C103C. Correct alinement procedure is given in paragraph 86.

77. Fuse Replacement

a. To replace the fuses located at the rear of the radiosonde receiver chassis, turn the knurled plastic caps of the fuse holder about one-quarter turn in the direction indicated on the caps. Remove the fuse holder and take the old fuse out of its socket in the fuse holder. Place a new fuse in the socket and then replace the fuse holder into position in the re-

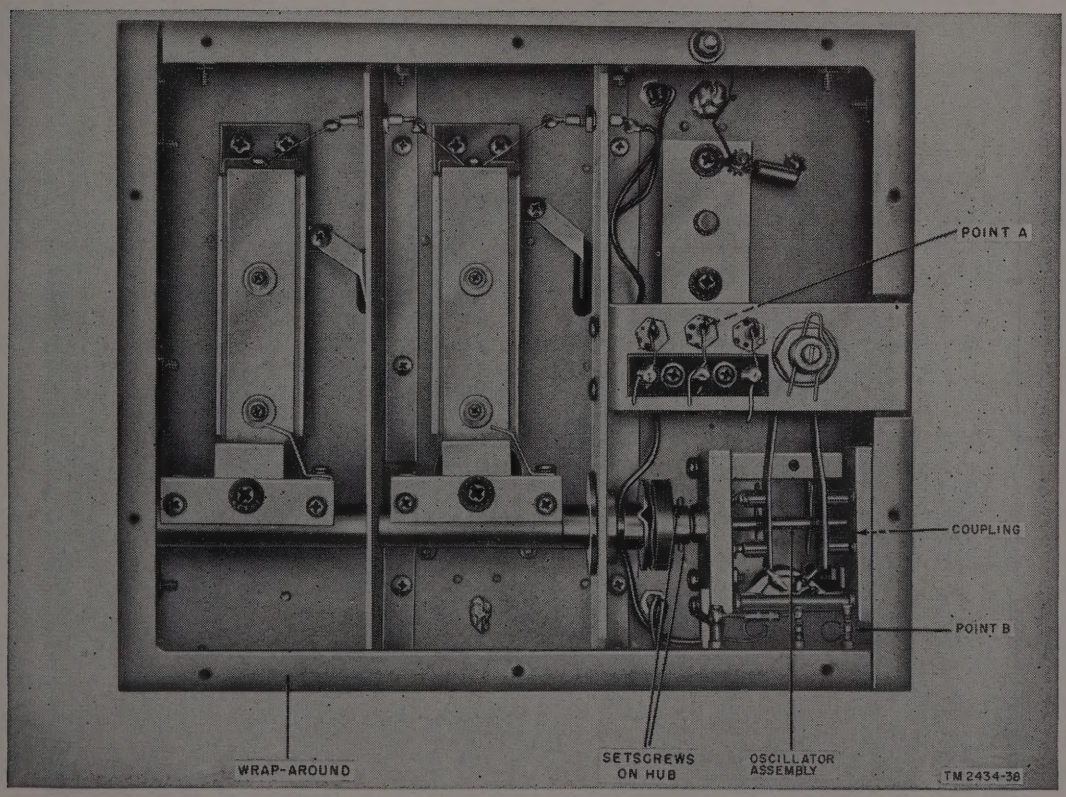


Figure 56. R-f unit, radiosonde receiver, bottom view.

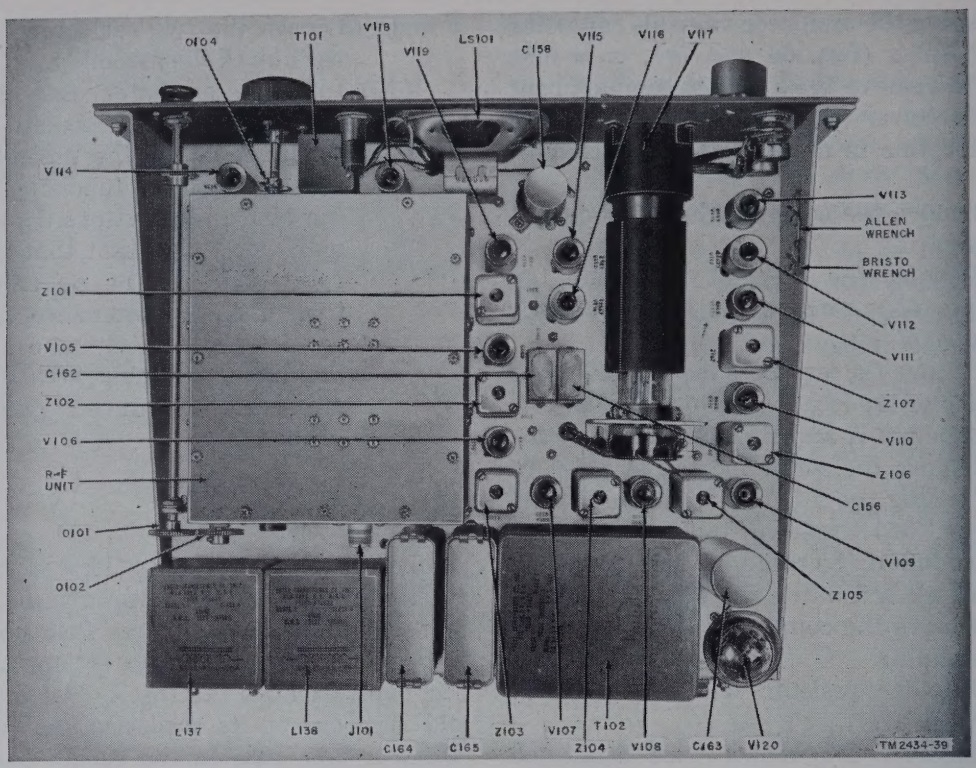


Figure 57. Radiosonde Receiver R–228/FMQ–2, top view, location of components.

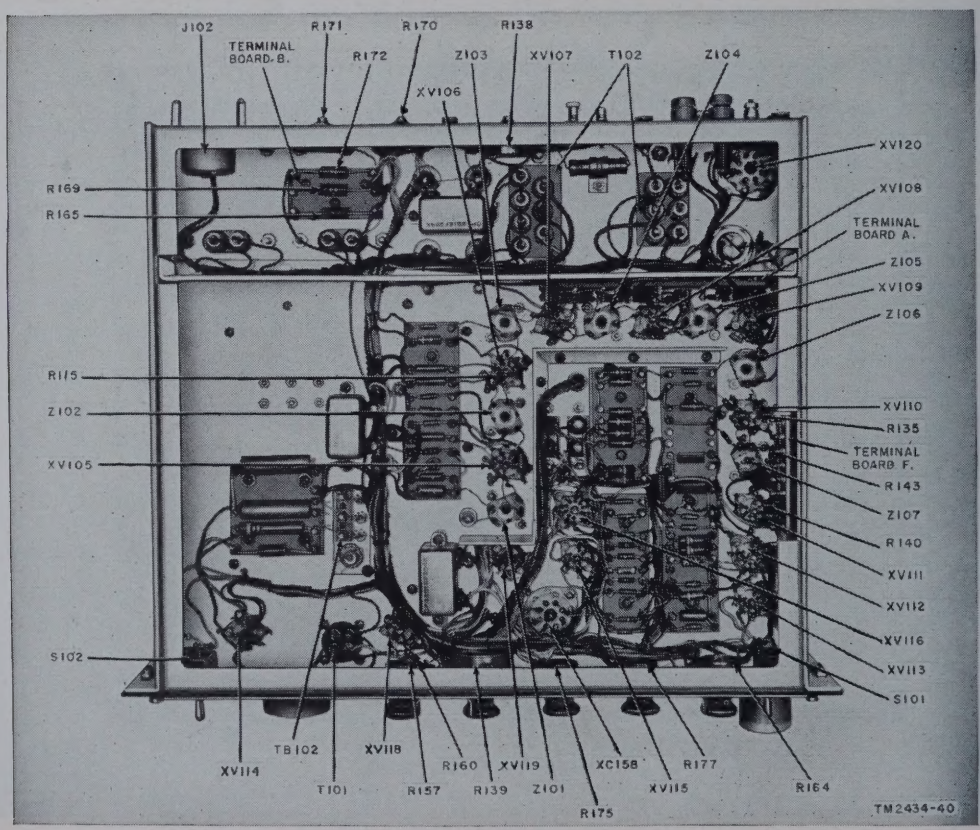


Figure 58. Radiosonde Receiver R–228/FRMQ–2, bottom view, all components except capacitors.

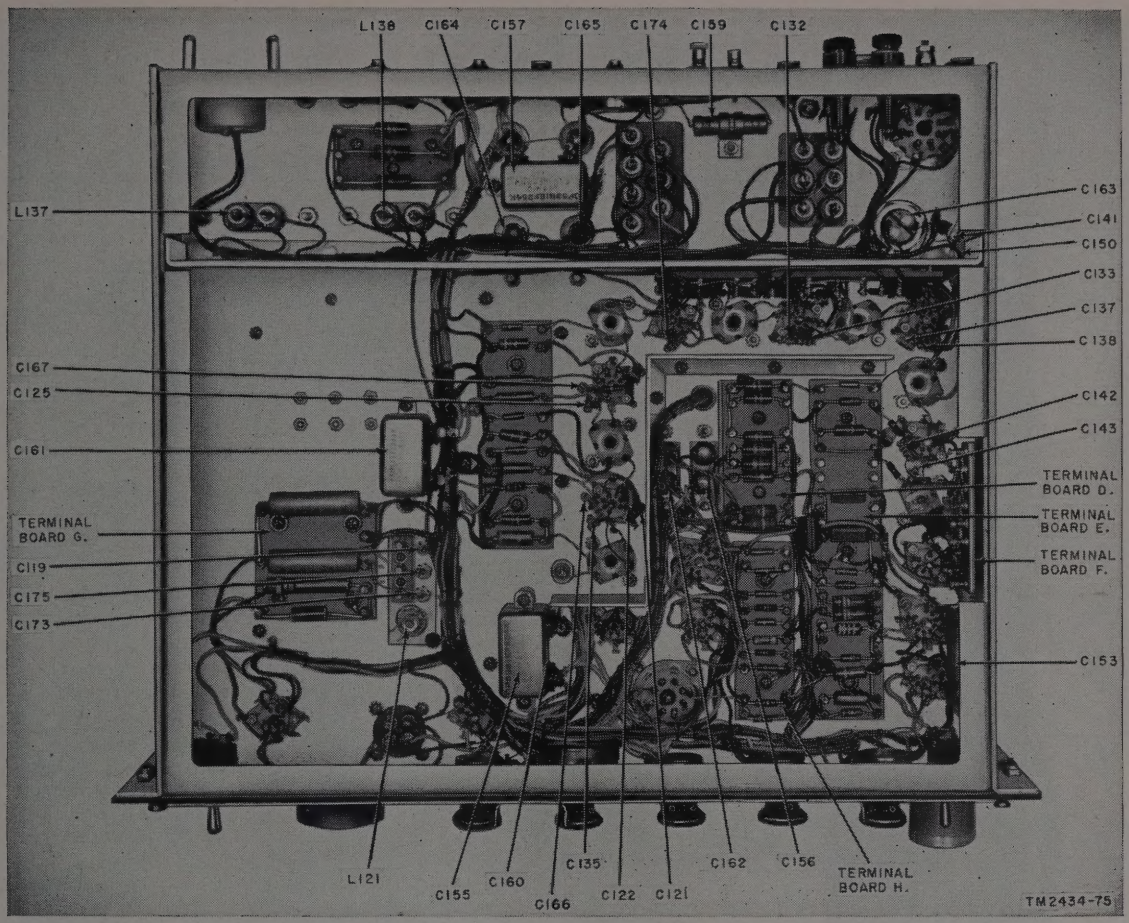


Figure 59. Radiosonde Receiver R–228/FMQ–2, bottom view, location of capacitors.

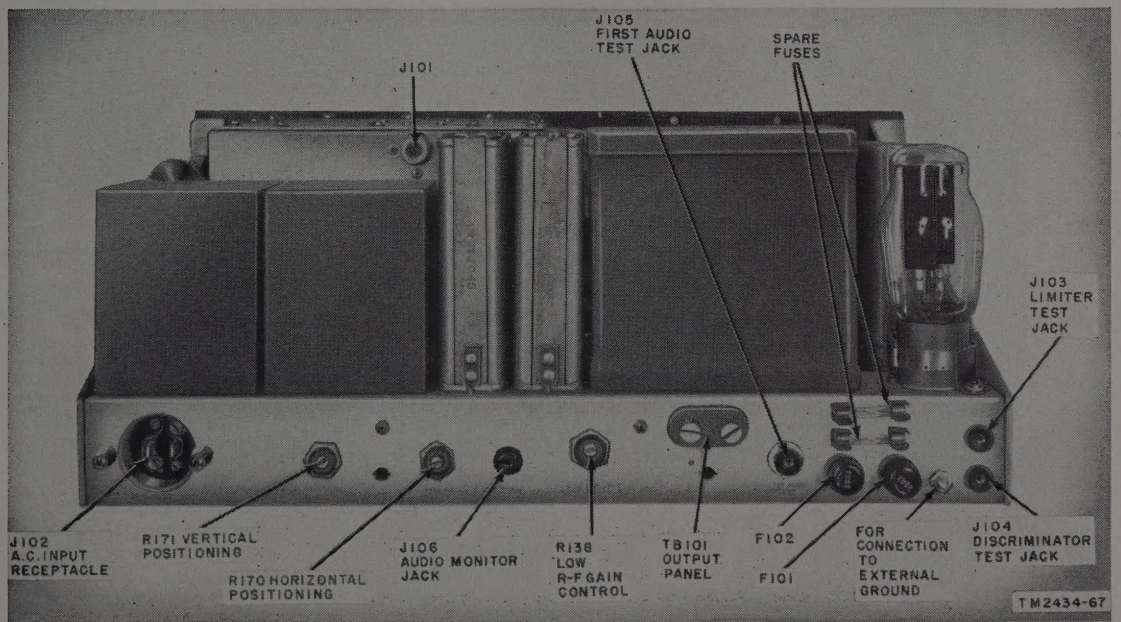


Figure 60. Radiosonde Receiver R–228/RMQ–2, rear view, location of parts.

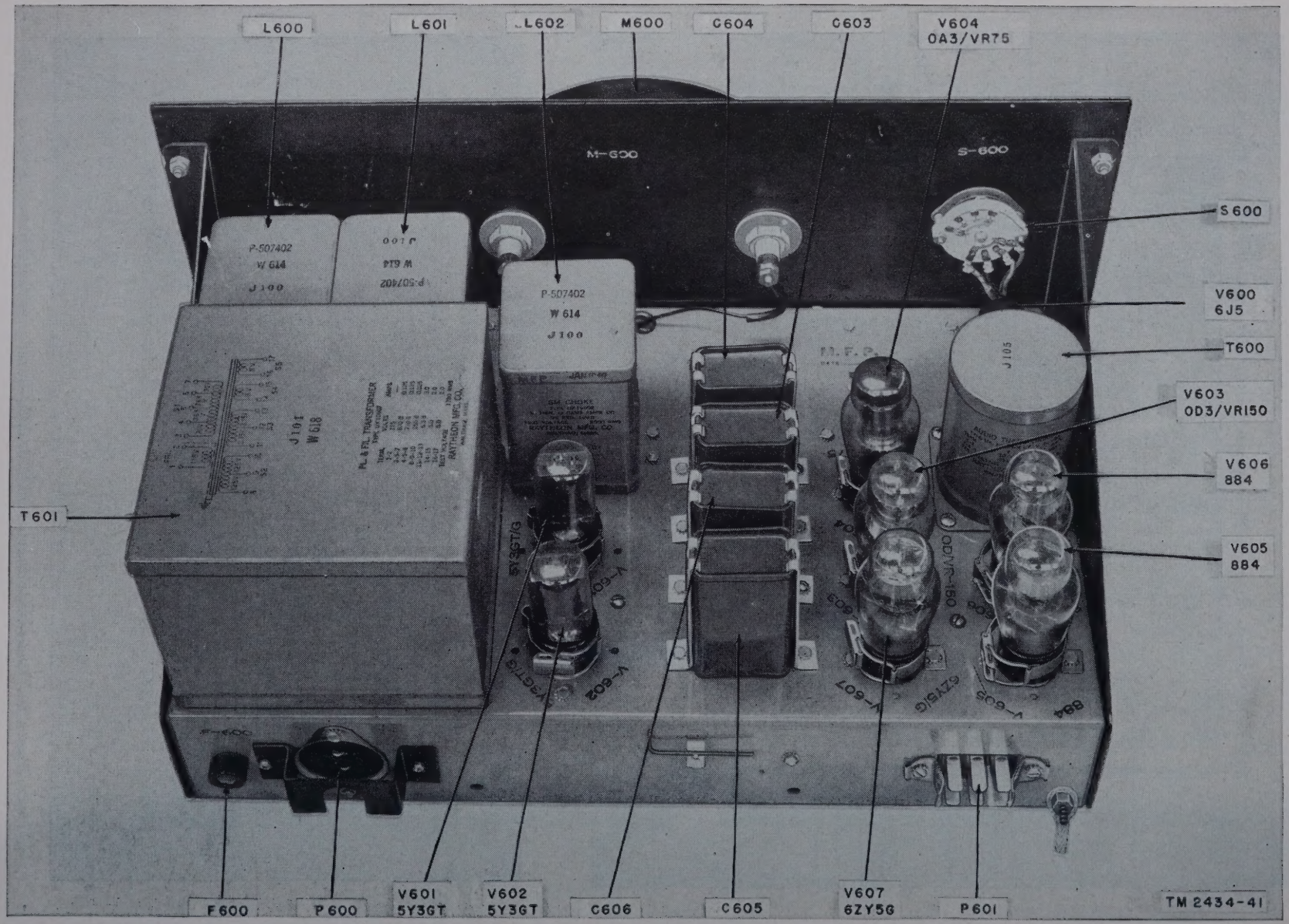


Figure 61. Frequency Meter TS–29B/FMQ–1, rear view location of parts.

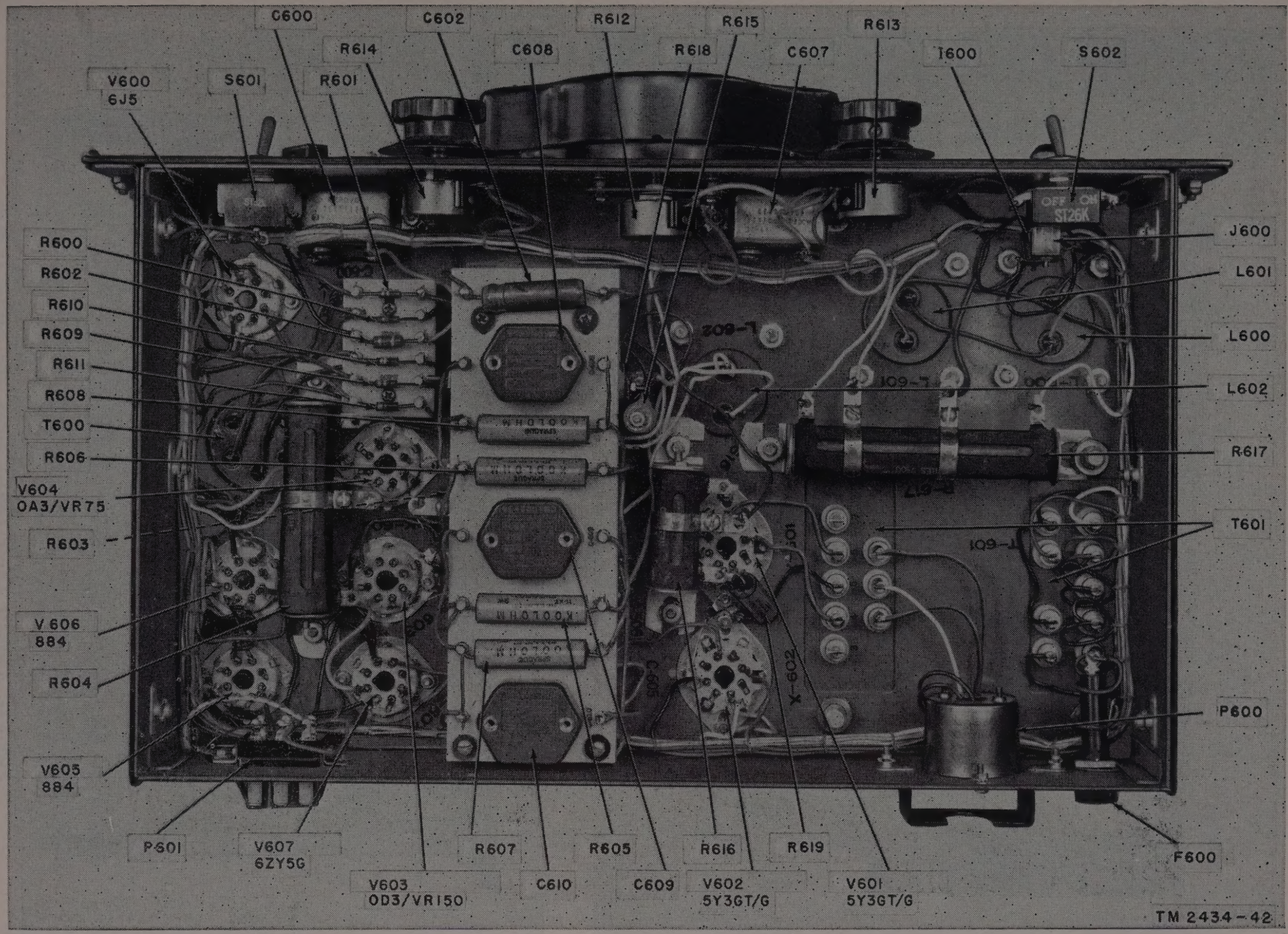


Figure 62. Frequency Meter TS–29B/FMQ–1, bottom view, location of parts.

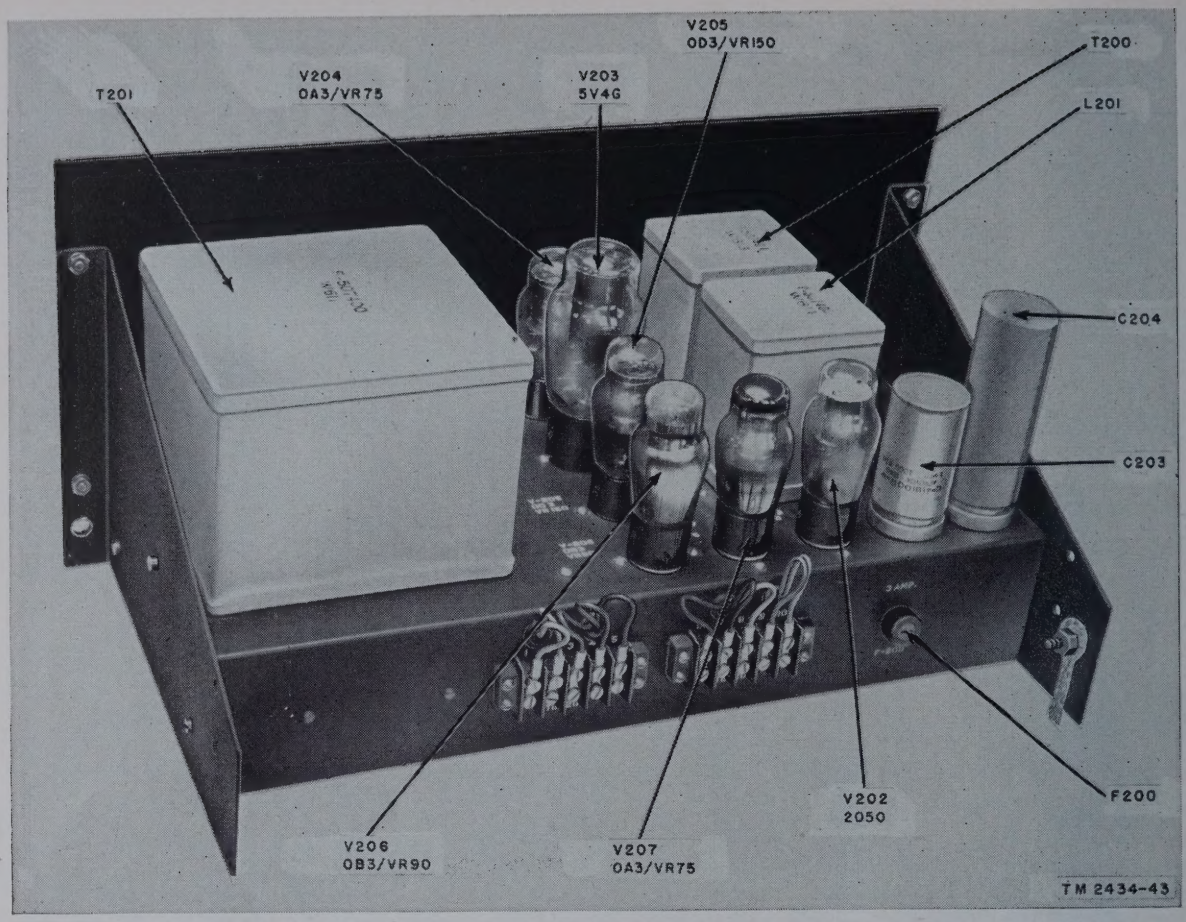


Figure 63. Amplifier AM–7B/FMQ–1, rear view, location of parts.

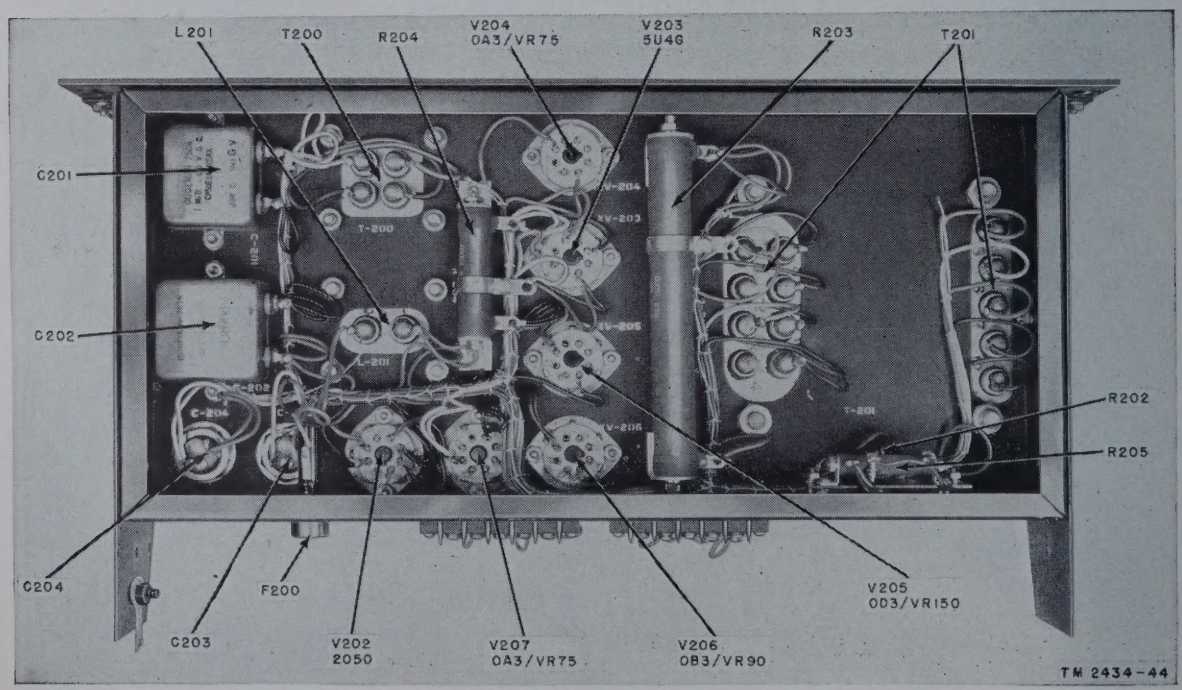


Figure 64. Amplifier AM–7B/FMQ–1, bottom view, location of parts.

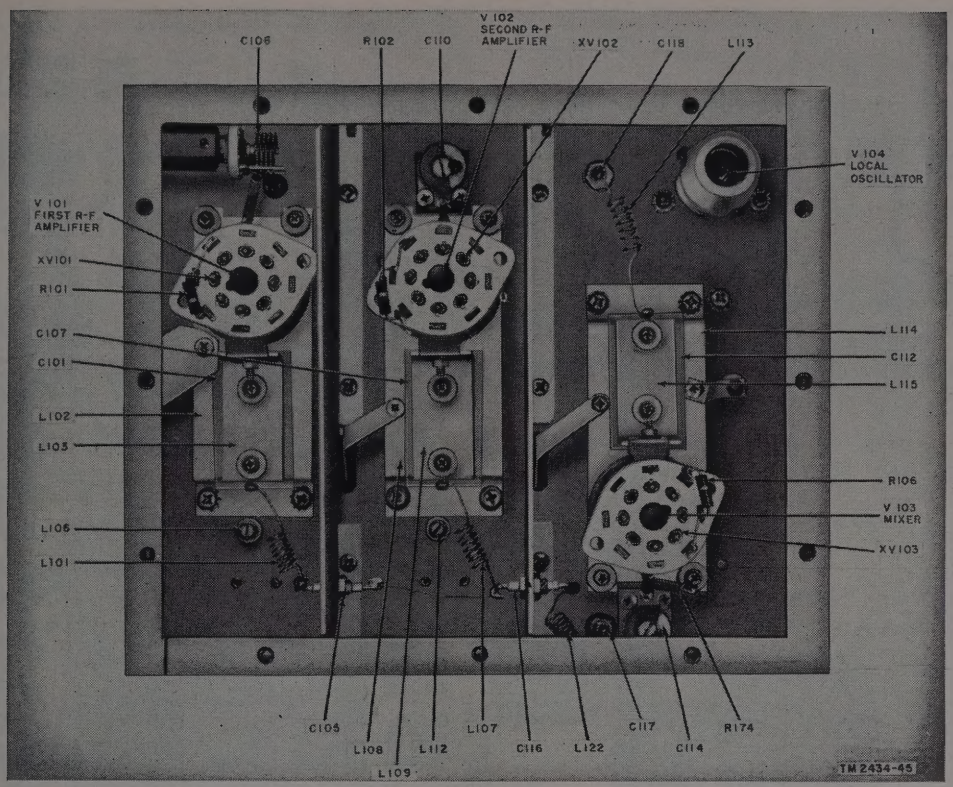


Figure 65. R-f unit, radiosonde receiver, top view, location of components.

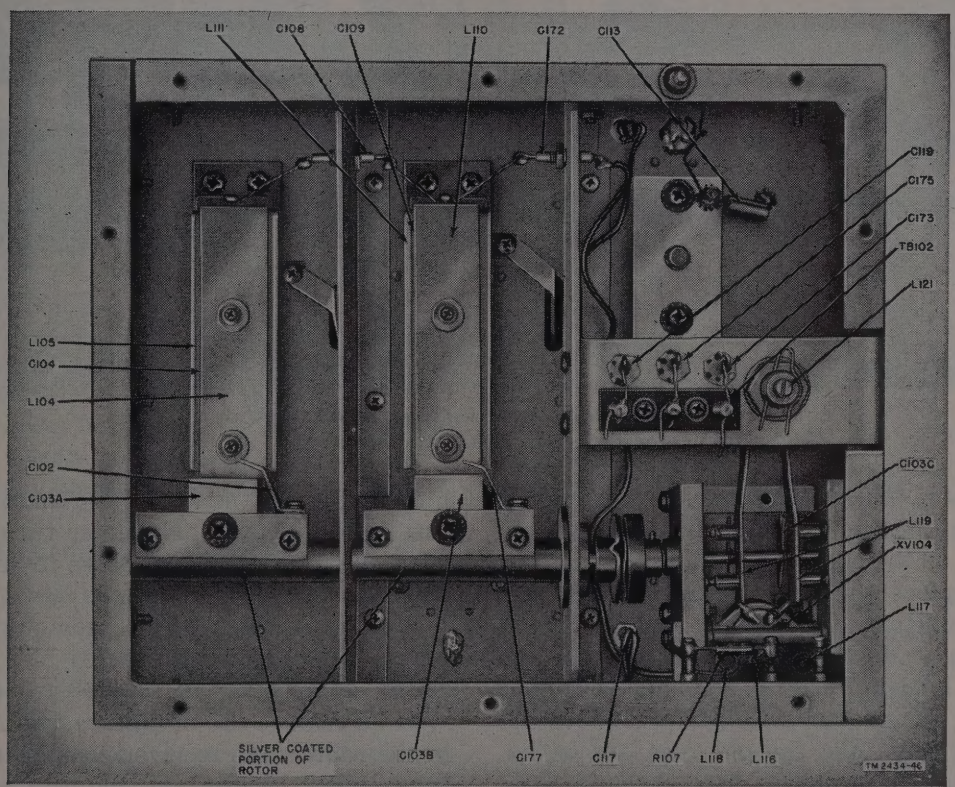


Figure 66. R-f unit, radiosonde receiver, bottom view, location of components.

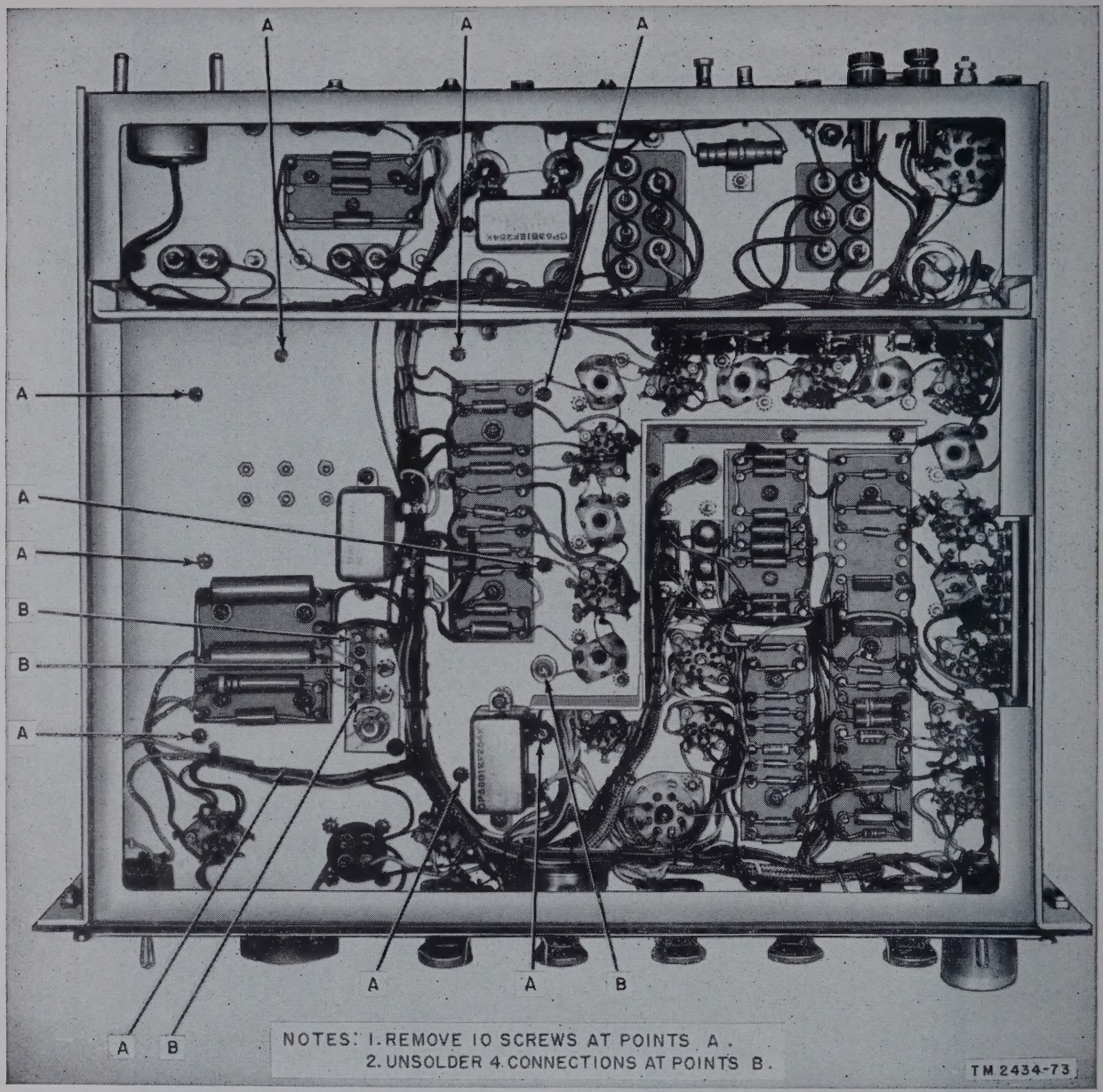


Figure 67. Radiosonde Receiver R–228/FMQ–2, bottom view, removal of r-f unit.

ceiver chassis. Turn the knurled caps about one-quarter turn in the direction opposite to that shown on the caps.

b. To replace the fuse located at the rear of the amplifier and frequency meter chassis, insert a screw driver into the slot in the cap of the fuse holder. Turn the screw driver about one-quarter turn counterclockwise. Remove the fuse holder and take the old fuse out of its socket in the fuse holder. Place a new fuse in the socket and then replace the fuse holder into position in the respective chassis. Turn the fuse holder about one-quarter turn in a clockwise direction until it appears to be in position tightly.

78. Tube Replacement

a. To remove the miniature type tubes found in the radiosonde receiver component, a special tube puller, packed in the equipment spare parts box, is used. Great care must be taken

when replacing miniature tubes so as not to bend the tube pins.

b. To replace the oscilloscope tube in the radiosonde receiver proceed as follows:

(1) Loosen the clamp about the base of the tube.

(2) Remove the celluloid graph screen at the face of the tube by prying up the two fingers holding the graph screen in place. The tips of these fingers are set in niches on the inside of the oscillograph light shield.

(3) Remove the tube through the opening in the front panel of the radiosonde receiver by pressing forward on the key of the tube socket until the tube is released.

(4) The insertion of the new oscillograph tube is accomplished by reversing the order of the above steps.

c. To replace the type 2C40 tubes in the r-f unit proceed as follows:

(1) Loosen the 3/16-inch hex nut that grips the heater strap connected to pin 7 of the tube. A 3/16-inch open-end wrench is needed for this operation.

(2) Grasp the socket of the tube and pull upward to free the tube.

(3) Plug the new tube into position and tighten the 3/16-inch nut sufficiently to insure good electrical contact for the heater. Do so, however, without exerting too much pressure in order to avoid the possibility of breaking the screw.

d. To remove rectifier tube 5U4G, V120, in the radiosonde receiver, release the safety clamp around the base of the tube, before pulling the tube out of its socket. Make sure that the safety clamp is tightened after the new tube has been placed back into the socket.

79. Basic Adjustment of Recorder

The following adjustments should be made when the equipment is first assembled, or when major repair of the equipment has been made, or when the equipment has undergone severe shock treatment.

a. Adjust the position of the exciter lamp to get the maximum intensity of light on the target of the phototube. This is accomplished by means of the thumb adjusting screw, accessible from either the front or the rear of the recorder (figs. 15 and 38) on the base of the light disk assembly (fig. 39).

b. Adjust the lens assembly of the optical system so that the beam of light is in sharp, narrow focus on the pointer of the recorder meter and is parallel to the edge of the pointer. A thumbscrew for this focus adjustment is accessible from either the front or the rear of the recorder (figs. 15 and 38).

c. To prevent interference with other adjustments (fig. 44) proceed as follows:

(1) Lower the dogleg stops so that the end of the bolt is flush with the top of the nut.

(2) Raise the lower ribbon guides as far as possible.

(3) Raise the magnet cores as far away from the armature bar as possible.

(4) Raise the tapper bar by lowering the armature bar stop screw.

(5) Turn the rocker arm adjusting screw counterclockwise until it is flush with the rocker arm.

d. Remove all perceptible friction from the dogleg joints (fig. 45). Adjustment of the dogleg joints is rather difficult and should be done with the utmost care. For this adjustment, the dogleg springs must be removed and the rocker frame must be opened away from the spiral drum by use of the pull-out arm.

(1) To test for friction, place one finger under the middle of the bar and raise the tapper bar until the flange touches the rear arm. Move the bar up and down very slowly for a distance of about ¼ inch. If there is any friction, the pressure of the tapper bar against the finger will be slightly greater when raising the bar than when lowering it. Even the slightest friction detected in this manner must be removed.

(2) The following chart lists four conditions that may cause friction in the dogleg joints and the methods for correcting these causes.

Cause	*Corrective measures*
Burred, dirty, or gummy surfaces in the joint.	Polish off burrs with a piece of crocus cloth, and clean and oil the surfaces of the joint.

Cause	*Corrective measures*
Contact surfaces of the front and rear arms of doglegs not parallel.	This indicates that one of the arms or the tapper bar has become bent or twisted. Arms may be straightened with long-nosed pliers. The tapper bar has a preformed curve, and care must be used so as not to straighten the bar beyond this point.
Bearing shoulder not wide enough to permit rear arm to move without binding.	Replace pivot screw.
Two rear arms too close or too far apart in comparison to two front arms.	Bend the two rear arms very slightly. These arms are made of light metal and may be bent by hand.

(3) The following chart lists the four conditions that may cause excess looseness in the dogleg joints and the methods for correcting them.

Cause	*Corrective measures*
Hole in the front arm too large for the pivot bolt, causing front-to-rear looseness of front arm.	Change either front arm or pivot bolt, or both.
Bearing shoulder too wide, due to excessive wear of pivot bolt or front arm, causing side movement of front arm.	Remove a small portion of shoulder on pivot bolt with a file. Be careful not to make the shoulder too short.
Front arm flanges not touching rear arms of both doglegs. When lifting tapper bar, flanges on each side must touch at exactly the same time.	Usually, if one side touches before the other, the contact surface of the flange can be filed slightly to correct the trouble. If the difference is too much to be removed by filing the flange surface, it may be necessary to bend the part which is out of shape.
Dogleg pivot bolt too loose.	It should be tight enough to hold the bearing shoulder firmly against the rear arm and tight enough not to jar loose with vibration.

e. Adjust the dogleg springs so that their combined equal tension will support a weight of 1 or 2 ounces suspended from the center of the tapper bar. The spanner wrench (1.7 ounces) found in the spare parts box is convenient for this purpose. Suspend the spanner wrench from the center of the tapper bar with a small piece of wire or string. Loosen the locknuts on each of the dogleg spring adjustment screws. Turn each of the adjusting screws the same amount so that each of the dogleg springs has equal tension. The combined tension of the dogleg springs should be just enough to keep the tapper bar in a raised position. Tighten the locknuts and remove the spanner wrench from the tapper bar.

f. Center the rocker frame adjusting screws and vertical locknuts (fig. 44).

Note. Loosen the vertical locknuts before turning the rocker frame adjustment screws.

g. Turn the rocker frame stop screw counterclockwise until it is just flush with the retainer boss. Then turn it clockwise five turns. The rocker frame must make solid contact with this screw (fig. 44).

h. Adjust the recorder to the 0–100 printing position by means of the rocker frame adjusting screws, and obtain a clearance of about .002 inch (one thickness of recorder paper) between the tapper bar and spiral drum by use of the armature bar stop screw.

Note. 0–100 printing is not absolutely required if 95, 50, and 20 cannot be alined properly (par. 82) when recorder is printing 0–100 exactly.

i. The core of the tapper bar coil should be placed four thicknesses of recorder paper from the armature bar. To make this adjustment, first loosen the four screws which hold the cores in place. Insert four thicknesses of recorder paper (about .008 inch) between the magnets and the armature bar. Move the tapper bar cores so that they fit snugly against the paper and then tighten the screws.

j. Adjust the tapper bar so that it is exactly level with respect to the spiral drum by use of the vertical locknuts.

k. Raise the dogleg stops so that they lightly touch the doglegs (fig. 44).

l. Obtain a clearance of 1/16 inch between the tapper bar and the spiral drum by adjusting the rocker frame stop screw (fig. 44).

m. Turn the rocker arm adjusting screw in the direction necessary to obtain a clearance of approximately 1/64 inch between it and the rocker frame (fig. 44). The rocker arm adjusting screw must not touch the rocker frame while the recorder is in any printing position.

n. By use of the armature bar stop screw, obtain a clearance of 3/32 inch between the tapper bar and the spiral drum (fig. 44).

o. Adjust the lower ribbon guides so that they hold the ribbon approximately 1/32 inch below the tapper bar.

80. Correcting Faulty Print

Faulty print will be apparent in all or part of the following ways: wrong intensity of print; dissimilar printing of the 5 and 95; irregular, drifting erratic, or extra print; 0 falls out of place; or improper spacing of the 0 print from the 100 print. The faults should be corrected in the order stated above, unless it is obvious that a preliminary correction of some fault must be made before the sequence can be followed. Assuming the basic adjustments have been made (par. 79), the procedure given below should be followed for the correction of faulty print of the recorder.

a. WRONG INTENSITY OF PRINT. It is normal for the recorder to print the 5 and 95 light, the 0 and 100 medium (see note in par. 79*h*) and the 50 slightly heavy. To correct the intensity of the print, use only the armature bar stop screw to adjust the distance through which the force of the tapper bar coils act upon the armature bar. To increase the intensity of the print, lower the armature bar away from the tapper bar coils. This increases the acceleration distance of the tapper bar (fig. 44). To decrease the intensity of the print decrease the acceleration distance.

Caution: Adjusting the rocker frame stop screw to overcome this difficulty requires a calibration check of the recorder.

b. DISSIMILAR PRINTING OF 5 AND 95. The 5 and 95 prints are dissimilar if one is darker than the other, or if there is a shadow or phantom print on one side. This condition may be corrected as follows:

(1) Remove all friction or excess looseness from the dogleg joints.
(2) Be sure the vertical locknuts hold the tapper bar level with respect to the spiral drum.
(3) Adjust the dogleg stops so that both doglegs strike the stops at the same time.
(4) Be sure that the tapper bar coil cores are equidistant from the armature bar.
(5) Be sure that the dogleg springs have equal tension.

c. DRIFTING, ERRATIC, OR EXTRA PRINT. Faulty electrical parts such as dirty or worn slip rings and brushes, loose parts on the scanning assembly, varying current from the frequency meter, or faulty action of the recorder amplifier will cause the recorder to print unevenly. Remove the brushes and disks, and clean the contact surfaces with crocus cloth. Tighten all loose parts and check the mechanical adjustment by referring to paragraph 79*a, b, d, k, m, n,* and *o.*

d. 0 PRINT OUT OF PLACE. This condition may be corrected by use of the recorder meter zero adjusting knob (fig. 36). The recorder is printing 0 correctly if the left-hand edge of the black print coincides with the calibration zero indicator located on the paper chute.

Note. Calibration ZERO should not exceed chart zero ± .3 bi-cycle.

e. IMPROPER SPACING OF THE 0 PRINT FROM THE 100 PRINT. The spiral ridge is mounted on the spiral drum so that the proper spacing of the 0 print from the 100 print is obtained when the tapper bar is parallel with the horizontal axis of the spiral drum (fig. 71). Adjustment is made by use of the rocker frame adjusting screws (after loosening the vertical locknuts), two located on the left side and two located on the right side of the rocker frame. If the tapper bar is in position AB, as shown by the dotted line (fig. 71), the 0 and 100 prints will be too close together; but with the tapper bar in the position indicated by the solid line, the spacing between 0 and 100 will be correct (par. 79*h*).

Section III. ALINEMENT AND ADJUSTMENT

81. Alinement of Frequency Meter TS–29B/FMQ–1

Alinement means making the visual meter on the panel of the frequency meter and the recorder print indicate the input frequency as accurately as possible so that a minimum applied correction will be necessary in computation of a flight. It is especially important to have zero-correction for the low-reference frequency, since this is the reference trace from

which the final meteorological values can be determined.

82. Alinement Procedure for Frequency Meter

a. REQUISITES AND PREPARATION FOR ALINEMENT. Alinement can be accomplished after the following requisites and preparations have been fulfilled. (First, determine that all parts of the ground station and power supply are functioning satisfactorily.)

(1) With a 190-cycle input, the visual meter must read 95.0 and the recorder must print 95.0.

(2) With a 40-cycle input, the visual meter falls where it may and the recorder must print 20.0.

(3) With a 100-cycle input, the visual meter must read 50.0±.3 and the recorder must print 50.0±.3.

(4) With the INPUT switch (S600) on SC and the DEIONIZE switch (S601) momentarily depressed, the visual meter must read .0 and the recorder print falls where it may.

Note. Whenever the INPUT switch is in its SC position, the DEIONIZE switch should be momentarily depressed.

(5) The output leads of a suitable frequency generator, such as Frequency Standard TS–65/FMQ–1 should be attached to the output terminals of the receiver (TB101).

(6) The R-F GAIN control *must* be turned to 0 to prevent interference.

(7) A shielded cable should also be used to minimize interference.

(8) Connect the shield to the ground terminal of the frequency generator and to the ground terminal of the receiver (terminal labeled G on TB101).

(9) Connect the inner wire to the ungrounded terminals (terminal 7 of P601 and the other terminal of TB101).

(10) After making this connection, test to see that it was made with proper polarity by selecting the lowest frequency of the signal generator, which is 10 cycles. If it is connected incorrectly, there will be no deflection of the visual meter.

(11) The output control should be turned up all the way.

b. ALINEMENT PROCEDURE.

(1) Let the recorder print for 15 minutes so that the paper will be feeding out straight and so that the ground station will become warm. Also, let Frequency Standard TS–65/FMQ–1 warm up for 15 minutes.

(2) Adjust the recorder meter assembly (fig. 36), if necessary, so that the curved window is concentric with the path of the exciter light beam.

(3) With the INPUT switch (S600) at SC, adjust the visual meter to mechanical 0 by means of the zero adjusting screw on the front of the meter. Use the zero adjusting knob to make the recorder print zero. This knob shifts the meter assembly so that no light passes through the meter to the photo tube in the preamplifier of the recorder.

(4) With a 190-cycle input, adjust the EQUALIZER and COARSE and FINE calibration controls (R612, R613, and R614, respectively) until both the recorder print and the visual meter register 95.0 bi-cycles.

(5) With a 40-cycle input, check the 20 print. If the recorder does not indicate exactly 20.0, correct 6/5 of the error by use of the zero adjusting knob (fig. 36). For example, if the recorder prints 20.5 turn the zero adjusting knob until the recorder prints 19.9.

(6) Repeat subparagraph (4) and (5) above until the recorder and visual meter indicate 95.0, with a 190-cycle input, and the recorder prints 20.0, with a 40-cycle input.

(7) With a 100-cycle input, check the 50 print. If it is not correct within ±.3 bi-cycle, move the recorder meter assembly backward or forward sufficiently to correct 5 times the error. For example, if the recorder prints 50.4, slide the meter forward until the recorder prints 48.4. (Loosen the recorder meter assembly mounting screws to adjust the meter; then re-

tighten.) Then start the alinement procedure, beginning with (3) above. If the recorder prints 49.6, slide the meter backward until the recorder prints 51.6.

(8) When the foregoing procedure of alinement is complete, the COARSE and FINE calibrators (R614 and R613) should be resting in about the center of their range of adjustment. If they are not, center them and adjust resistor R604, which is in series with the COARSE and FINE controls, until the visual meter and recorder give the correct indications of 190 cycles.

83. Calibration of Visual Meter and Recorder

a. GENERAL. Calibration is the process whereby two correction graphs are made; one is for the recorder and one is for the visual meter. The graphs show the corrections which are necessary if accurate computation of frequencies from the printed records or from observed indications on the visual meter is to be made. Two sets of data are noted for each frequency trace produced by Frequency Standard TS–65/FMQ–1, one set is determined by first going down the scale, and the other set is determined by going up the scale. This will tend to eliminate meter pointer friction error. The correction figures are calculated for use in plotting the graphs. The use of a table similar to table I will aid in the tabulation of data.

b. PRELIMINARY. The alinement of the frequency meter and the recorder is preliminary to calibration. The ground station and the power supply for the station must be in excellent condition. It should be noted that after alinement the recorder zero print may not be on the zero line of the recorder paper. This new position for the zero print is known as *calibration zero.* Calibrations should be repeated as often as possible and the interval between calibrations should not exceed 1 month.

c. CALIBRATION PROCEDURE.

(1) Before making the calibration run, let the recorder print for 15 minutes so that the paper will be running out straight and so the ground station component will have reached operating temperature. Also let Frequency Standard TS–65/FMQ–1 warm up for 15 minutes. This may be omitted if the ground station equipment was not turned off following the alinement procedure.

Table I. Sample calibration table.

Input frequency	Recorder and visual meter should read—	Recorder reads—		Recorder average correction	Visual meter reads—		Visual meter average correction
		Down	Up		Down	Up	
190	95.0	95.0	95.0	.0	95.0	95.0	.0
180	90.0	90.0	90.0	.0	90.1	90.0	.0
160	80.0	80.0	80.0	.0	80.1	80.1	−.1
140	70.0	70.2	70.1	−.2	70.0	70.0	.0
120	60.0	60.3	60.2	−.2	60.0	60.0	.0
100	50.0	50.1	50.1	−.1	50.1	50.0	.0
80	40.0	40.0	40.0	.0	40.1	40.1	−.1
60	30.0	30.0	29.9	.0	30.1	30.1	−.1
40	20.0	20.0	20.0	.0	20.0	20.0	.0
20	10.0	9.9	9.9	+.1	10.0	9.9	.0
10	5.0	4.9	4.9	+.1	5.0	5.0	.0
SC	.0	.1		+.1	.0		.0

(2) Check the print of the line frequency against the print of the 60-cycle output of the frequency standard generator.

(*a*) Print the 60-cycle signal as derived from the signal generator for ¼ inch on the record paper.

(*b*) Print the trace made with the INPUT switch at SC for ¼ inch.

(*c*) Turn the INPUT switch (S600) of frequency meter to 60 cycles and let the recorder print 1 inch of this trace. It is permissible for this print to be slightly irregular, but it must not vary more than 1 cycle (½ bi-cycle). Furthermore, it must agree with the 60-cycle print from the frequency standard generator within ±2 cycles.

(3) Starting with 190 cycles, switch in the frequencies in the order indicated on the sample calibration table. Go down the scale to 0, then up the scale to 190 cycles. Let the recorder print about ¼ inch of a trace on each frequency. Read the visual meter at each frequency and read the recorder print to the nearest 1/10 of a bi-cycle. Enter the readings in the appropriate columns.

(4) At the end of the calibration run, check the recorder for the location of the calibration zero print (*b* above), and check the line frequency.

(*a*) Check the recorder operation by printing the 60-cycle signal from the frequency standard generator for ¼ inch. This print must not have changed during the calibration run.

(*b*) Print a trace when the INPUT switch is at SC for ¼ inch.

(*c*) Print a trace for the line frequency for 1 inch (INPUT switch S600 on 60 ~ position). This print must agree with the previous line frequency check.

(*d*) Print a trace for 2 feet when the INPUT switch is at SC.

The recorder will be printing on calibration zero. Adjust the zero indicator pointer (located on the paper chute) to calibration zero.

(5) Compute the average corrections to the nearest 1/10 of a bi-cycle, making certain to use the proper sign (+ or −). For example, if the recorder prints 70.3 down the frequency scale and 70.2 up the frequency scale, when it should have printed 70.0 both times, the average correction is −.25 which reduced to the nearest tenth is −.2. If between 10 and 95 any average correction is greater than .3, investigate the possibility of reducing the error by moving the recorder meter assembly and realining (par. 79).

(6) Referring to table I, the figures in the down column should be the same or larger than the figures in the up column. If any pair of figures differs by more than .2 bi-cycle, there is excessive drag in the meter movement and the meter should be replaced.

(7) Attach a sample of the calibration zero to the ground station so that the operator may set the zero adjustment of the recorder before every flight.

(8) Use the average correction figures to plot the two calibration curves. Plot them on the record paper just above the calibration run, between the 0 and 100 prints of the 1-foot SC run. Leave enough space above the calibration to include the information in (10) below. Select two heavy, solid, horizontal lines for base lines, and label one line *Recorder Calibration Curve* and label the other line *Visual Meter Calibration Curve*. Plot the correction figures, using the base lines as .0 correction with plus corrections above the base line and minus correction below the base line. Plot the points 1/10 inch from the base line for each 1/10 bi-cycle in the correction figure. Connect the points with straight lines.

(9) Make a copy of the calibration table on the record paper above the calibration curves.

(10) Enter the following data above the calibration table:

(*a*) Name of station; call letters.

(*b*) Serial numbers of ground station and frequency standard generator.

(*c*) Date.
(*d*) Remarks, including repair or adjustment which was necessary.
(*e*) Signature of the maintenance man.
(*f*) Signature of the weather officer.

84. Alinement of Radiosonde Receiver R–228/FMQ–2
(fig. 57)

a. GENERAL. Applicable electrical adjustments for the radiosonde receiver consists of i-f amplifier alinement, discriminator alinement, and alinement of the r-f unit. It should be noted that all i-f and r-f adjustments have been carefully made before shipment. Any realinement, therefore, should not be undertaken unless there is ample evidence that it is required as determined by trouble-shooting checks and by performance tests.

b. TEST EQUIPMENT AND TOOLS USED FOR ALINEMENT PROCEDURES.

(1) An electronic voltmeter, such as Electronic Multimeter TS–505/U.
(2) A signal generator, such as Signal Generator TS–497/URR, with an output impedance of 52 ohms and a frequency range covering 400 mc.
(3) An insulated i-f alinement tool (one is packed in the equipment spare parts box).
(4) A No. 6 Bristo wrench (one is mounted on the left side bracket of the receiver).
(5) A medium sized screw driver.
(6) A medium sized Phillips screw driver.

85. I-f Amplifier and Discriminator Alinement Procedure

The five i-f transformers and the discriminator transformer (Z107) are tuned by means of screw-driver type, iron-core adjustments. All adjustments are accessible at the top of the chassis, except the primary of the discriminator transformer. See figure 68 for location of top chassis adjustments, and see figure 58 for location of bottom chassis adjustments (Z107).

a. Connect Electronic Multimeter TS–505/U to the LIM. TEST jack, J103, and chassis. Set the voltmeter range on the 4-volt scale.

b. Remove the cover of the r-f unit and connect Signal Generator TS–497/URR to pin 1 or pin 2 of the mixer tube, V103, and chassis. Adjust the generator for an unmodulated output at a frequency of 21.25 mc.

c. Adjust the receiver controls as follows:
(1) Set the POWER ON-OFF switch, S101, at ON.
(2) Set the RF GAIN LOW-HIGH switch, S102, at HIGH.
(3) Set the RF GAIN control at 10.

d. Adjust the output of the generator to obtain a reading on the voltmeter.

e. Adjust, *in turn,* the i-f inductors, L123, L124, L125, L126 and L127, for maximum voltmeter reading. Reduce the output of the generator, as necessary, to keep an on-scale voltmeter reading.

f. Repeat the adjustments in *e* above to assure accurate i-f alinement.

g. Move the voltmeter connection from the LIM. TEST jack to the DISC. TEST jack, J104.

h. Before adjusting the discriminator primary inductor, L129A, it is necessary to detune the secondary inductor, L129B. Turn the adjusting screw for L129B out as far as it will go and adjust L129A for maximum voltmeter reading.

i. Adjust L129B to obtain a zero reading on the voltmeter. Note that a reading of opposite polarity will be obtained if the adjusting screw is turned to a point beyond zero meter reading.

j. Repeat *h* and *i* above to assure accurate discriminator alinement.

k. After the discriminator alinement is completed, equal amounts of generator detuning on either side of the center frequency of 21.25 mc should result in equal but opposite polarity voltmeter readings. If the voltmeter readings are not equal, readjust L129A slightly to correct the dissimilar readings.

l. As a final check, operate receiver normally but without antenna (or input signal from signal generator.) The electronic multimeter should read zero. If it does not, readjust L129B for zero reading.

86. R-f Amplifier Alinement Procedure

R-f alinement consists of the adjustment of the stages of the two r-f amplifiers, the mixer, and the oscillator. The type of adjustments involved in the alinement of these stages is such that the original alinement, made previous to shipment, is of a permanent nature. Realine-

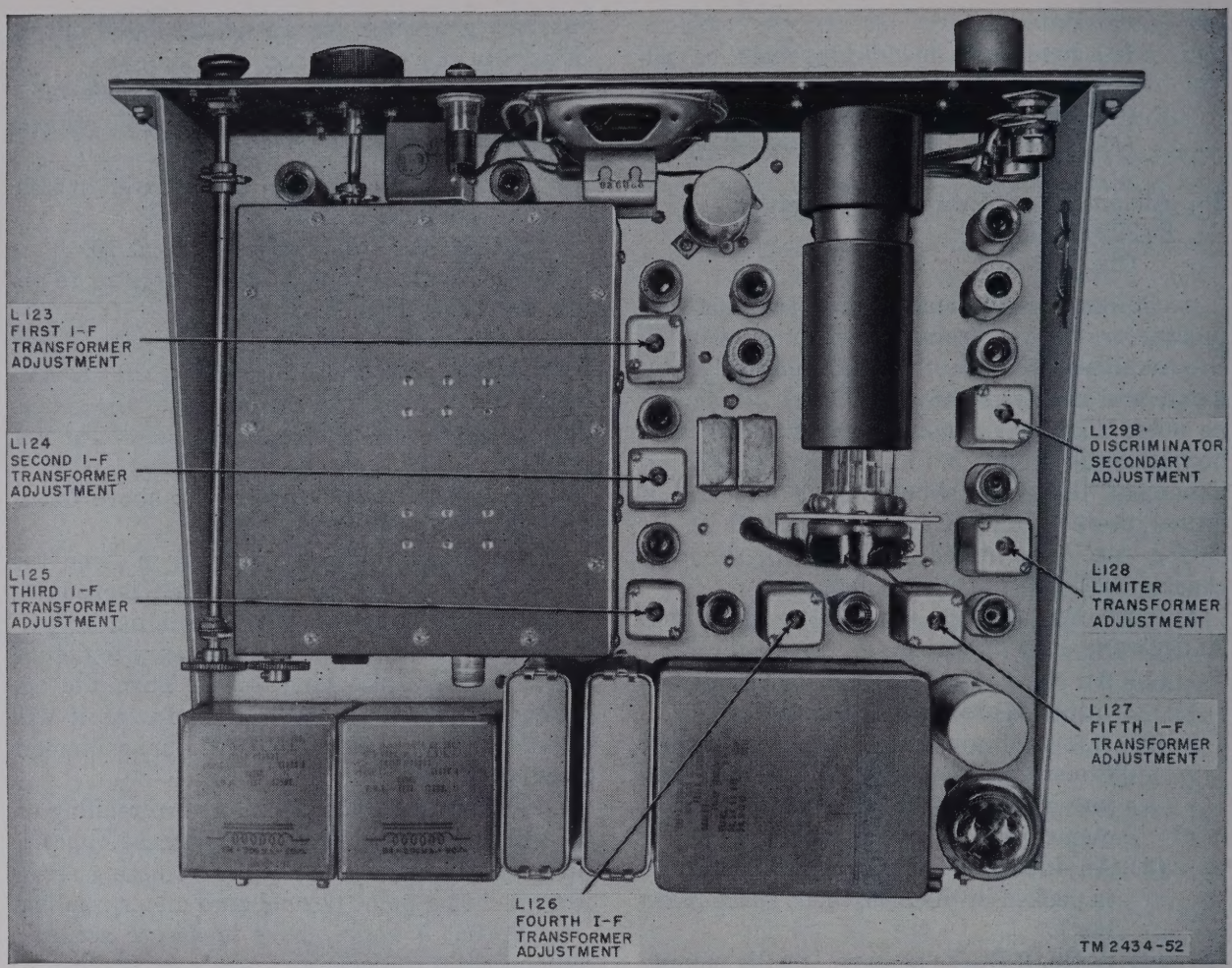


Figure 68. Radiosonde Receiver R–228/FMQ–2, top view, location of i-f transformer adjustments.

ment should not be attempted unless the performance test (par. 90) reveals the necessity of doing so. Replacement of the oscillator capacitor assembly C103C will necessitate realinement (par. 87). Replacing tubes V101, V102, V103, or V104 will necessitate realinement of the adjustments for the specific stage involved. For example, if the 2d r-f amplifier tube, V102, has to be replaced, C110 and L112 will need readjustment. See figure 69 for the location and identification of all r-f adjustments, except for the variable oscillator inductor, L121, which can be seen in figure 66.

a. Remove the cover of the r-f unit compartment by releasing the Phillips-head captive screws around the outer edges of the cover.

b. Set the MAIN TUNING dial at approximately 400 mc. If the calibration is unknown due to repair involving removal of the MAIN TUNING dial, it will be necessary to determine the approximate 400-mc setting by the mechanical setting of the ceramic rotor shaft of the r-f amplifier section of the main variable capacitor.

(1) Remove the 2d r-f amplifier tube, V102. The tube cannot be removed until the 3/16-inch hex nut securing the heater strap connection is loosened.

(2) Look down into the opening left by the removal of the tube and rotate the MAIN TUNING dial in a counterclockwise direction until the silvered surface of the rotor just begins to mesh with the stator block (fig. 66). Ample illumination must be obtained to observe this condition.

(3) Turn the dial counterclockwise, from this point, until the silvered surface is observed to be in complete mesh

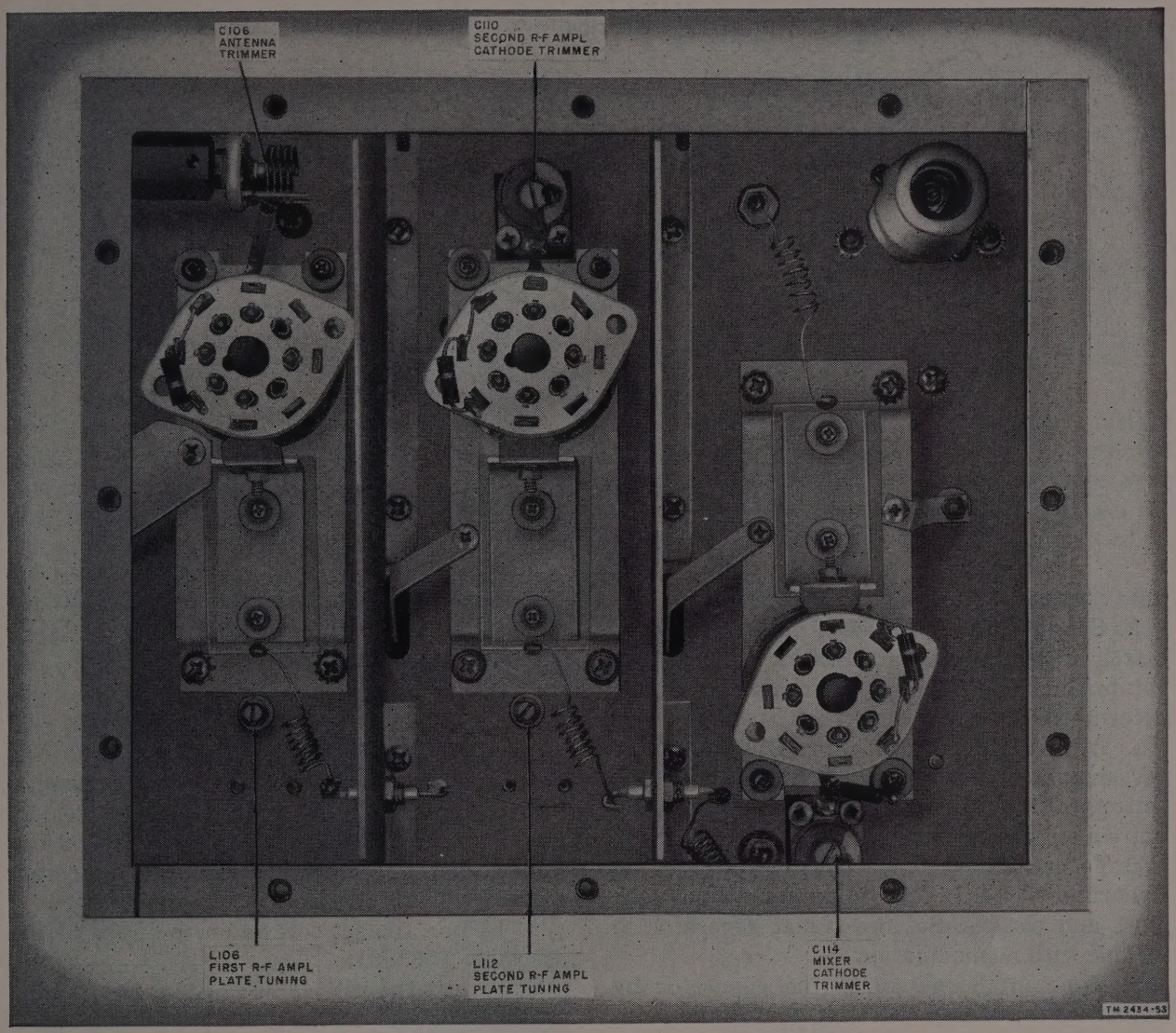


Figure 69. R-f unit, top view, location of r-f adjustments.

with the stator. Make sure that the rotor is not turned beyond the point of complete mesh.

(4) Rotate the MAIN TUNING DIAL 45° in a *clockwise* direction.

(5) Replace the 2d r-f amplifier tube and tighten the nut on the heater connection.

c. Set the trimmer capacitor C114 at the center of its capacity range and set the trimmer capacitor C110 at 1/3 of maximum capacity. Refer to figure 72 for capacity settings of these trimmers. Adjust inductance trimmers L106 and L112 (fig. 65) so that the screwdriver slot is at a 45° angle from the horizontal or vertical axis.

d. Connect Electronic Multimeter TS–505/U to the LIM. TEST jack, J103, and chassis. Set the voltmeter range on the 4-volt scale.

e. Set the receiver controls as follows:

(1) Set the POWER ON-OFF switch at ON.

(2) Set the RF GAIN control at 10.

(3) Set the RF GAIN LOW-HIGH switch at HIGH.

f. Adjust inductance trimmers L121, L112, and L106, *in turn,* for maximum reading on the voltmeter.

g. Repeat the foregoing adjustments until all three adjustments are at the settings providing maximum voltmeter reading. Any readjustment of one of the trimmers will prob-

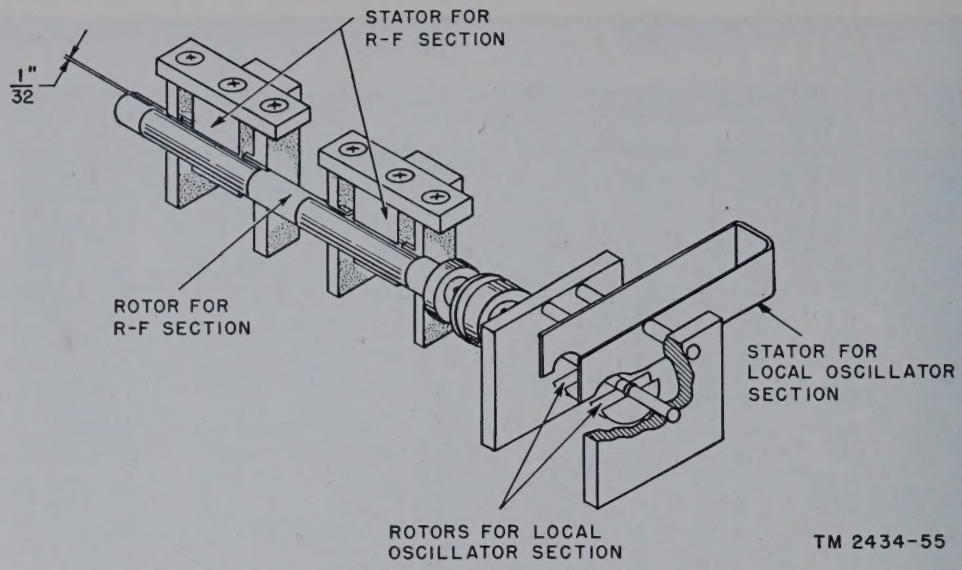


Figure 70. Mechanical alinement of rotors of main tuning capacitor.

ably necessitate adjustment of the others.

h. Set the MAIN TUNING dial at approximately 393 mc. If the calibration is unknown, rotate the dial 45° clockwise from the setting determined in *b* (3) above.

i. Adjust trimmer capacitors C110 and C114 for maximum voltmeter reading. Check the setting of inductance trimmer L121; it may require a slight adjustment.

j. To calibrate the receiver, connect Signal Generator TS–497/URR to antenna input jack J101 and chassis. Set the signal generator to 400 mc with no modulation.

k. Tune in the signal of the generator by adjusting the MAIN TUNING dial to the point of maximum voltmeter reading. Decrease the generator output as necessary to maintain an on-scale voltmeter reading. When the maximum reading is obtained, loosen the set screws on the rear hub of the coupling on the MAIN TUNING dial shaft and set the MAIN TUNING dial at 400 mc.

87. Alinement of Oscillator Variable Capacitor Assembly

Whenever the oscillator capacitor assembly has to be removed and replaced, it is extremely important that the ceramic rotor of the r-f amplifier stage is correctly alined with the rotors of the oscillator stage.

a. Loosen the set screws on the hubs of the assembly (fig. 66).

b. Adjust the rotor shaft so that the gap between the stator blocks in the r-f section of the oscillator assembly and the silvered surface of the rotor is 1/32 inch.

c. Set the rotors in the oscillator section (fig. 70) so that the outside straight edges of each

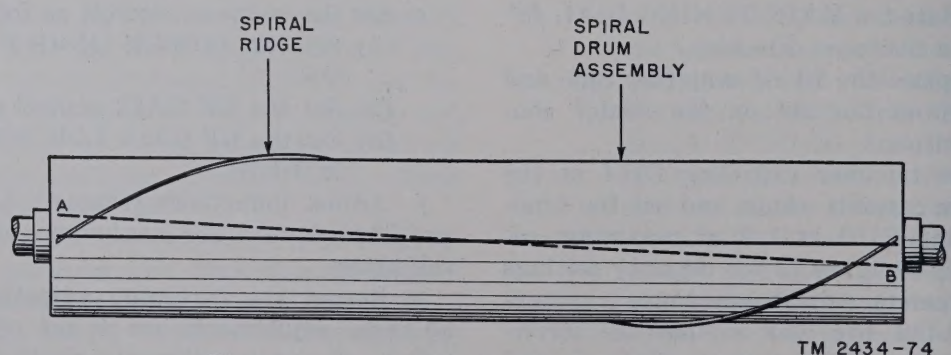


Figure 71. Relationship between principal axis of spiral drum and tapper bar.

pair of rotors are parallel with the edges of the stator.

d. Tighten all set screws, making sure that the rotor positions do not change in the process. Incorrect alinement of the rotors will prevent proper receiver tracking and thus impair the sensitivity of the receiver.

e. Perform electrical realinement of the r-f unit after the oscillator assembly has been replaced and the rotors alined. Refer to paragraph 86 for the necessary r-f alinement procedures.

Section IV. FINAL TESTING

88. General

This section is intended as a guide to be used in determining the quality of a repaired Radiosonde Receiver R–228/FMQ–2. The minimum test requirements outlined in paragraphs 89 through 92 may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation. The other components of the radiosonde receptor are tested during the repair procedures for these components. The test given below must be made in the order shown, since the accuracy and effectiveness of the tests of any specific section of the receiver are based on the fact that all previous sections have been checked and found to be functioning properly.

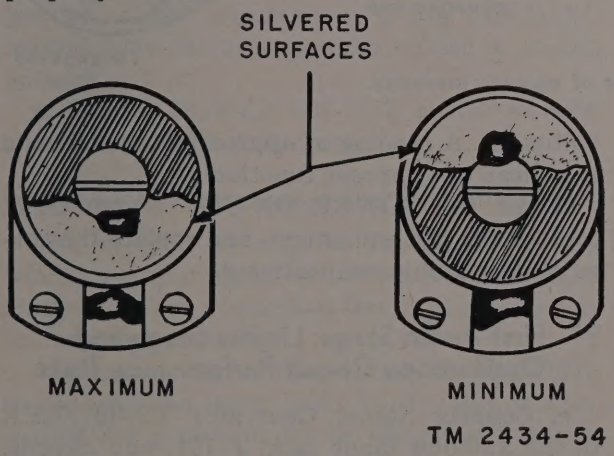


Figure 72. Capacity settings of trimmers.

89. I-f System and Discriminator Performance Tests

a. Disconnect the antenna, remove the receiver from the rack, and remove the cover of the r-f unit compartment. The cover is held in place by Phillips-head captive screws around its outer edge. A slight upward pressure is required to remove the cover after the captive screws are freed, due to the gripping action of the grounding fingers on the inside of the cover. Remove the oscillator tube, V–104, from its socket. A special tube puller is packed in the equipment spare parts box to facilitate removal.

Caution: Care must be taken when testing interior of the r-f unit, since a 6.3-volt potential exists on the heater strap of the three type 2C40 tubes, and accidental contact between the strap and chassis will result in a short circuit of the filament supply.

b. Connect Signal Generator TS–497/URR to pin 1 or 2 of mixer tube V–103 and chassis. Adjust the generator for an unmodulated output of 1,000 microvolts at 21.25 mc (the i-f of the receiver). See figure 65 for location of the mixer tube.

c. Connect Electronic Multimeter TS–505/U to the LIM. TEST jack, J–103, and chassis. Set the voltmeter on the 4-volt scale.

d. Connect power to the receiver and adjust controls as follows:

(1) Set the POWER ON-OFF switch to ON.

(2) Set the R-F GAIN LOW-HIGH switch to HIGH.

(3) Set the R-F GAIN control at 10.

(4) A reading of at least 1.25 volts on the voltmeter indicates proper functioning of the i-f system. If proper functioning is indicated, proceed with the following discriminator test.

e. Change the connection of the voltmeter to the DISC. TEST jack, J–104, and set the voltmeter on the 40-volt scale.

f. The voltmeter should read zero when the generator is set at 21.25 mc. Rotate the frequency control of the generator 450 cycles higher and then lower than the center frequency of 21.25 mc. The voltmeter reading should be approximately 10 volts positive at the higher frequency and, conversely, 10 volts negative at the lower frequency setting.

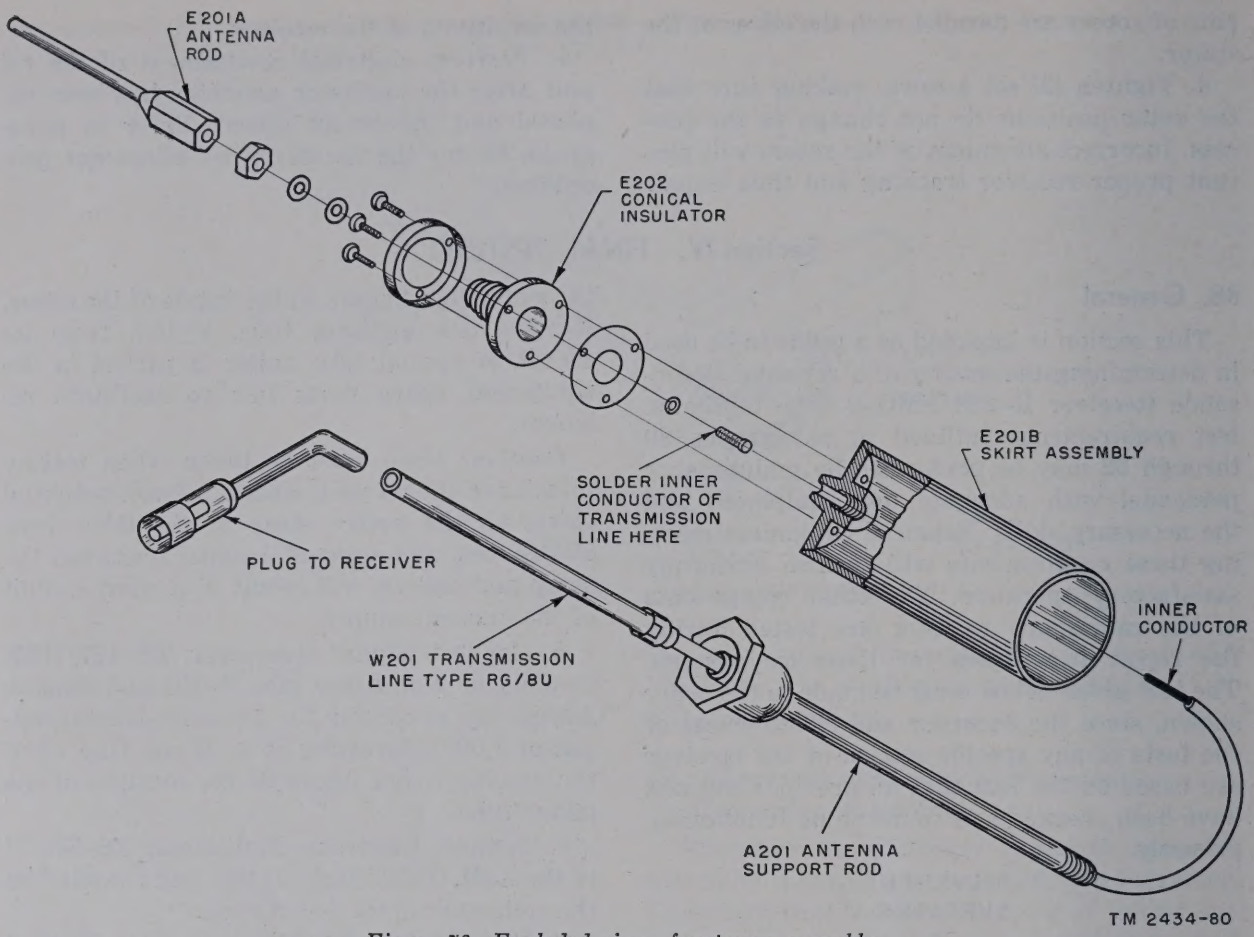


Figure 73. Exploded view of antenna assembly.

g. Set the POWER ON-OFF switch to OFF, remove the test equipment, and return the oscillator tube to its socket. Leave the cover of the r-f unit compartment off if the following test of the r-f unit is to be made.

90. R-f Unit Performance Tests

a. The term *r-f unit* refers to the r-f amplifier, mixer, and oscillator stages, V–101 through V–104.

b. Connect Signal Generator TS–497/URR to the antenna input jack, J–101, and chassis. Adjust the generator for an unmodulated output of 1 microvolt at 400 mc.

c. Adjust the receiver controls as follows:

(1) Set the POWER ON-OFF switch ON.

(2) Set the RF GAIN LOW-HIGH switch at HIGH.

(3) Set the RF GAIN control at 10.

(4) Adjust the MAIN TUNING and ANT. trimmer controls for maximum reading on the voltmeter. A reading of approximately 2.5 volts is indicative of proper functioning.

d. Set the POWER ON-OFF switch OFF, remove the test equipment, and replace the cover of the r-f unit compartment.

91. First Audio Stage, Limiter Stage and Oscilloscope Circuit Performance Tests

a. Connect Signal Generator TS–497/URR to the antenna input jack, J–101, and chassis. Adjust the generator for an output of 2 microvolts at 400 mc, modulated 30 percent at 400 cps.

b. Connect Output Meter TS–585/U, to the 1st AUDIO TEST jack, J–105, and chassis. Adjust the range of the output meter for an input impedance of 20,000 ohms and for a full-scale reading of 50 mw (milliwatts).

c. Adjust the receiver controls as follows:

(1) Set the POWER ON-OFF switch to ON.

(2) Set the RF GAIN LOW-HIGH switch at HIGH.

(3) Set the RF GAIN control at 10.

(4) Adjust the MAIN TUNING and ANT. trimmer controls for maximum reading on the output meter. Two output indications will be noted when tuning these controls. The output indication of *greatest* magnitude indicates correct tuning.

d. An output meter reading between 5 and 7 mw shows that the first audio stage is operating properly.

e. The efficiency of the limiter stage can be determined by increasing the output of the signal generator to approximately 100,000 microvolts. If no great change in the output meter reading is indicated, then proper limiting action exists.

f. With the controls and test equipment adjusted as indicated above, the performance of the oscilloscope circuits can be checked by advancing the LOCKING control to 10 and observing the waveform on the oscilloscope. The waveform should be the same as that shown on figure 74. Also, the FOCUS and INTENSITY controls should perform their prescribed functions of changing the focus and intensity of the picture. Slight adjustment of the LOCKING control may be necessary to obtain a steady pattern.

g. Set the POWER ON-OFF switch to OFF and remove the test equipment.

92. Over-all Performance and Sensitivity Tests

The receiver is said to function correctly when an output signal of correct waveform and magnitude, for a specified input, is obtained at the output terminals.

a. Connect Signal Generator TS–497/URR, to the antenna input jack, J–101, and chassis. Adjust the generator for an output of 2 microvolts or greater at 400 mc, modulated 30 percent at 400 cps.

b. Connect Electronic Multimeter TS–505/U across the OUTPUT terminal panel, TB101 (connect the negative lead to the terminal marked G). Set the voltmeter on its 40-volt, a-c scale.

c. Adjust the receiver controls as follows:

(1) Set the POWER ON-OFF switch ON.

(2) Set the RF GAIN LOW-HIGH switch at HIGH.

(3) Set the RF GAIN control at 10.

(4) Adjust the MAIN TUNING and ANT. trimmer controls for maximum reading on the voltmeter.

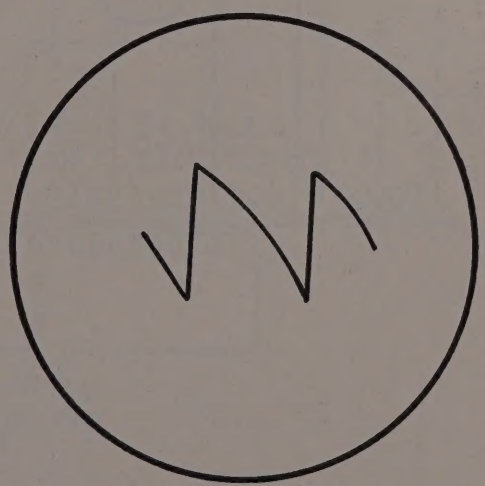
(5) Set the SPKR. VOLUME control between 6 and 8.

d. A voltmeter reading of 15 volts rms (root mean square) indicates that the output signal is of a proper magnitude. An audible response from the loudspeaker serves to indicate that the loudspeaker and its associated circuit are functioning properly.



TM 2434-77

Figure 74. Test waveform for oscilloscope circuit check.



TM 2434-78

Figure 75. Test waveform for over-all receiver check.

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e. To check that the output signal is of correct waveshape, disconnect the voltmeter and connect Oscilloscope TS–34/AP in its place. The wave form observed on the oscilloscope should be the same as that shown on figure 75, to indicate proper output waveshape. The waveform observed on the receiver oscilloscope should be the same at that shown in figure 74.

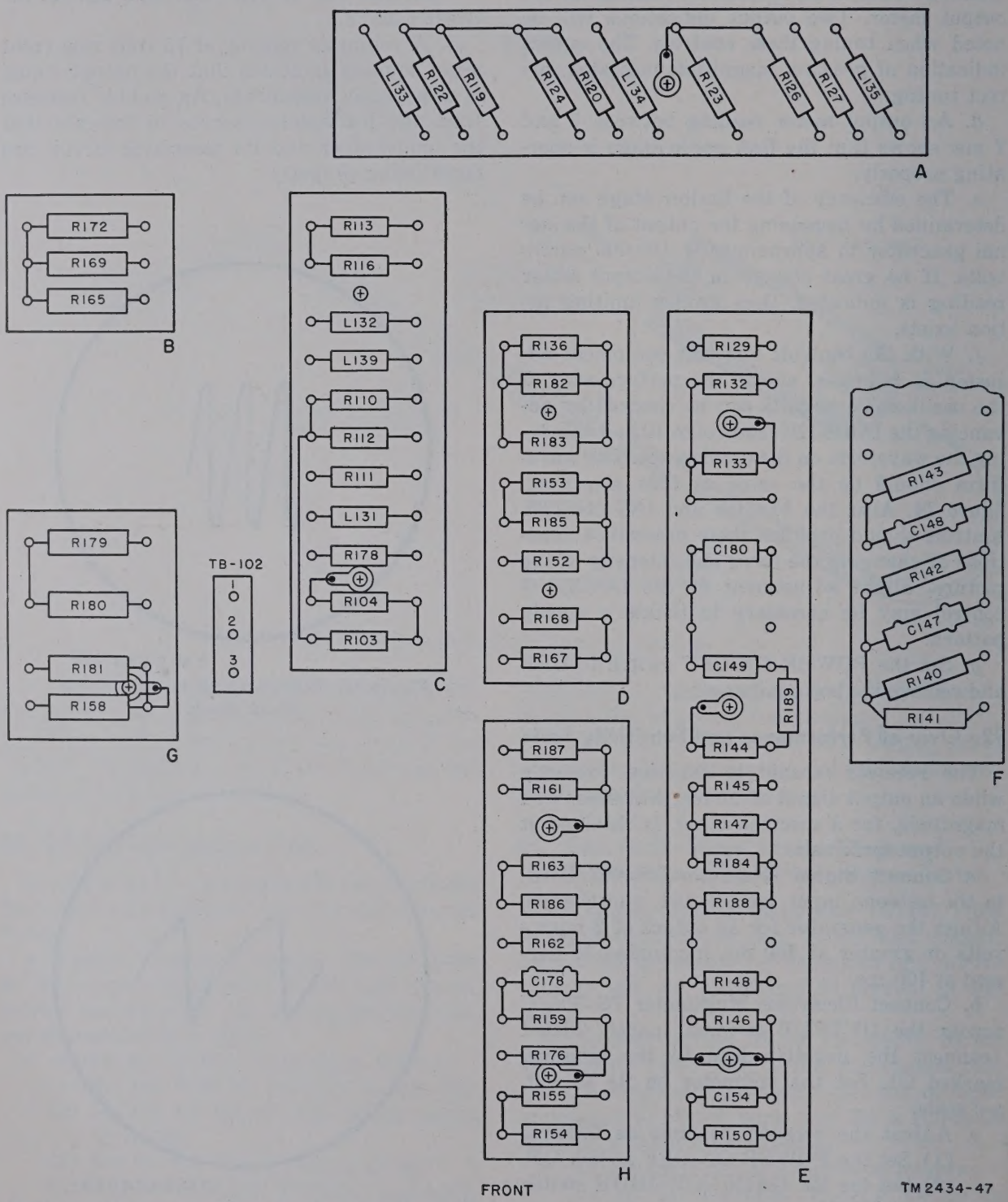


Figure 76. Radiosonde Receiver R–228/FMQ–2, terminal board components.

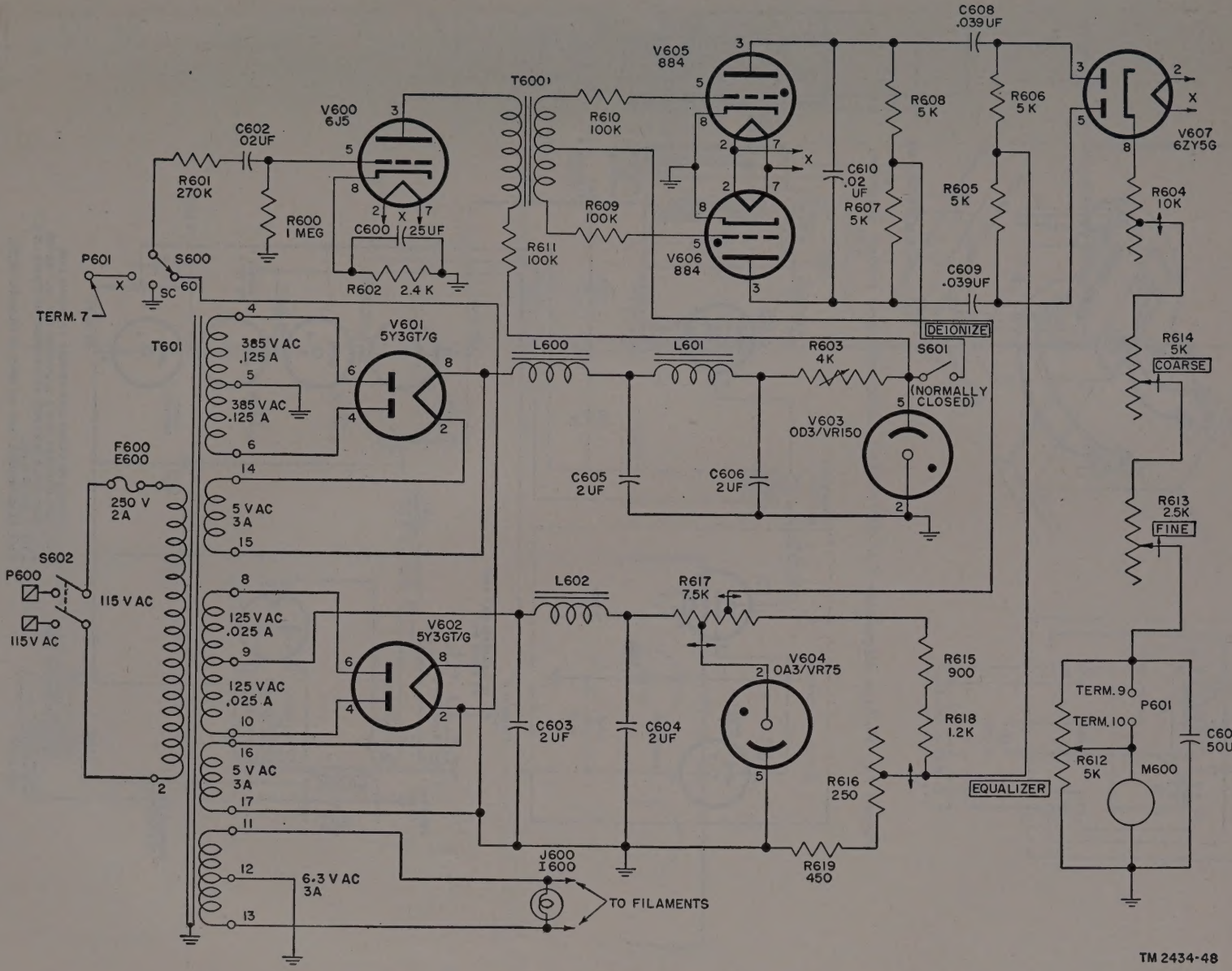


Figure 77. Frequency Meter TS–29B/FMQ–2, schematic diagram.

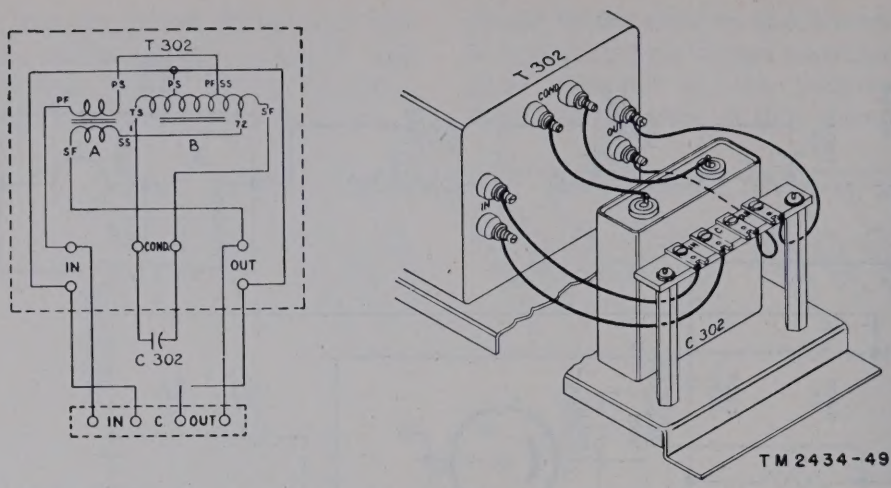


Figure 78. Voltage Regulator CN–2A/FMQ–1, schematic and wiring diagram.

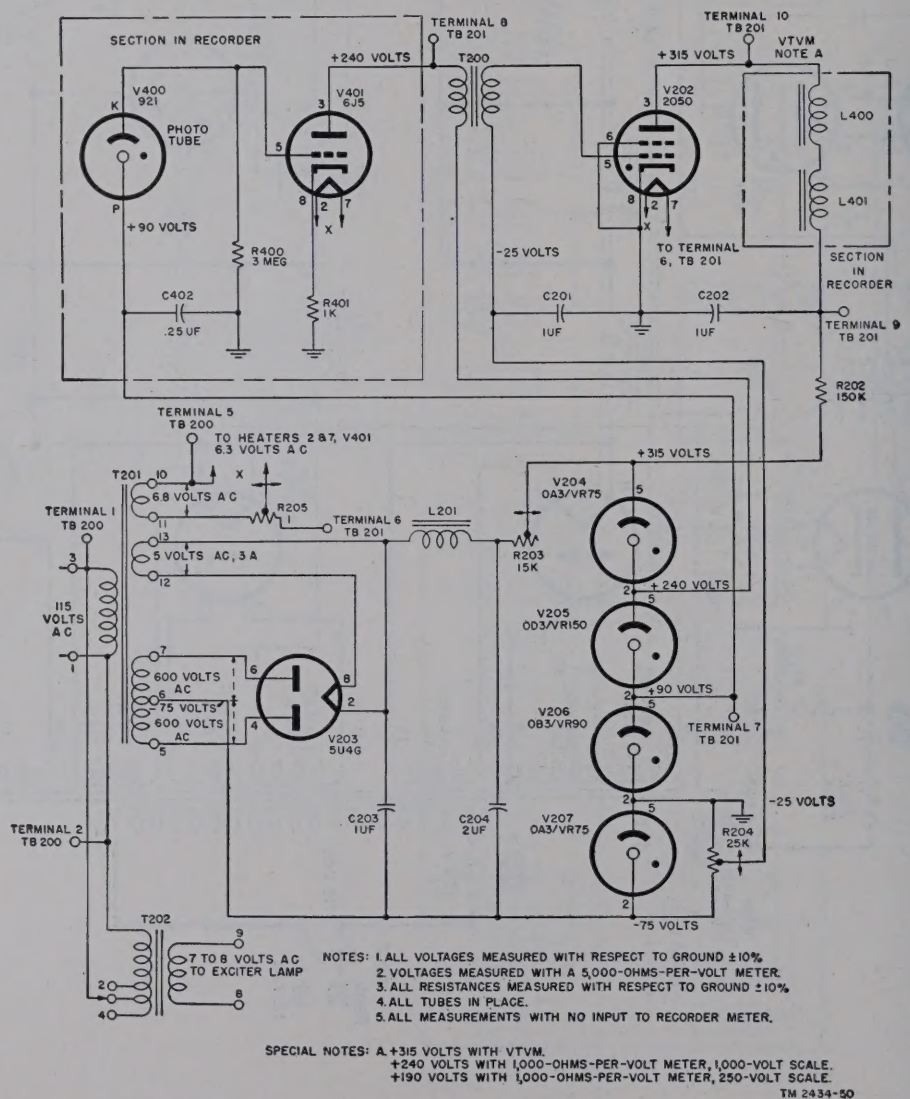
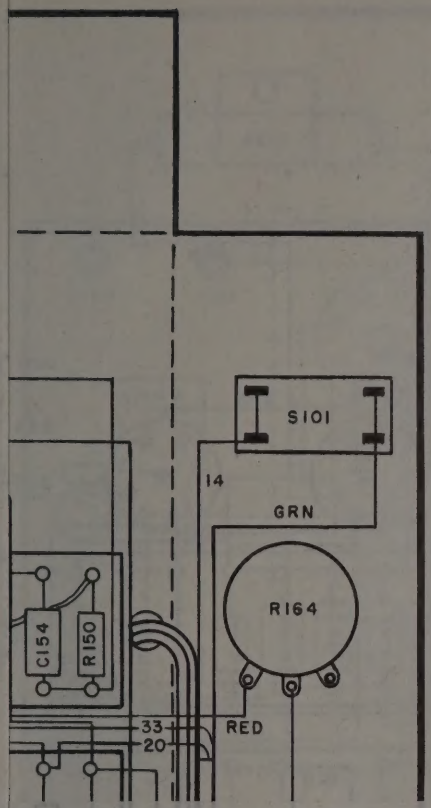
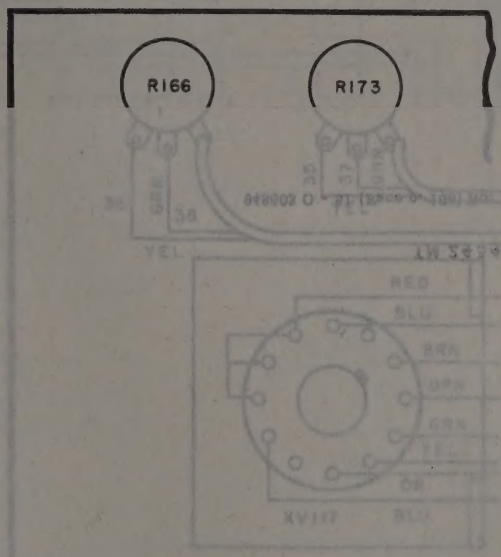
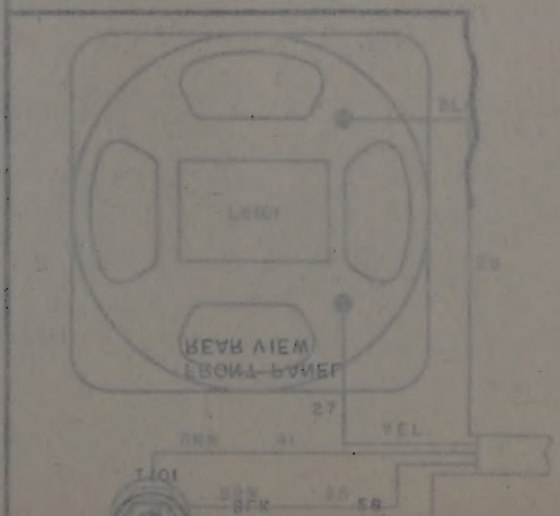


Figure 79. Amplifier AM–7B/FMQ–1, schematic diagram.


S101
14
GRN
R164
C154
R150
33
20
RED


R166
R173


REAR VIEW
27
YEL

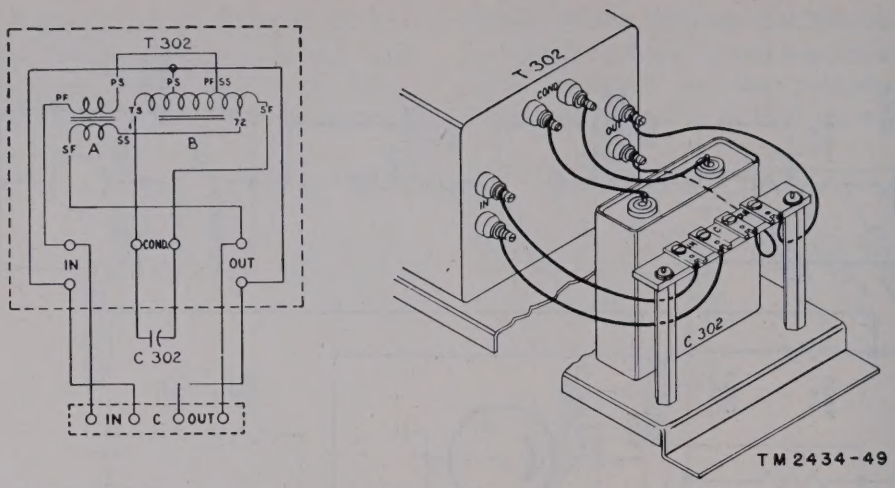


Figure 78. Voltage Regulator CN–2A/FMQ–1, schematic and wiring diagram.

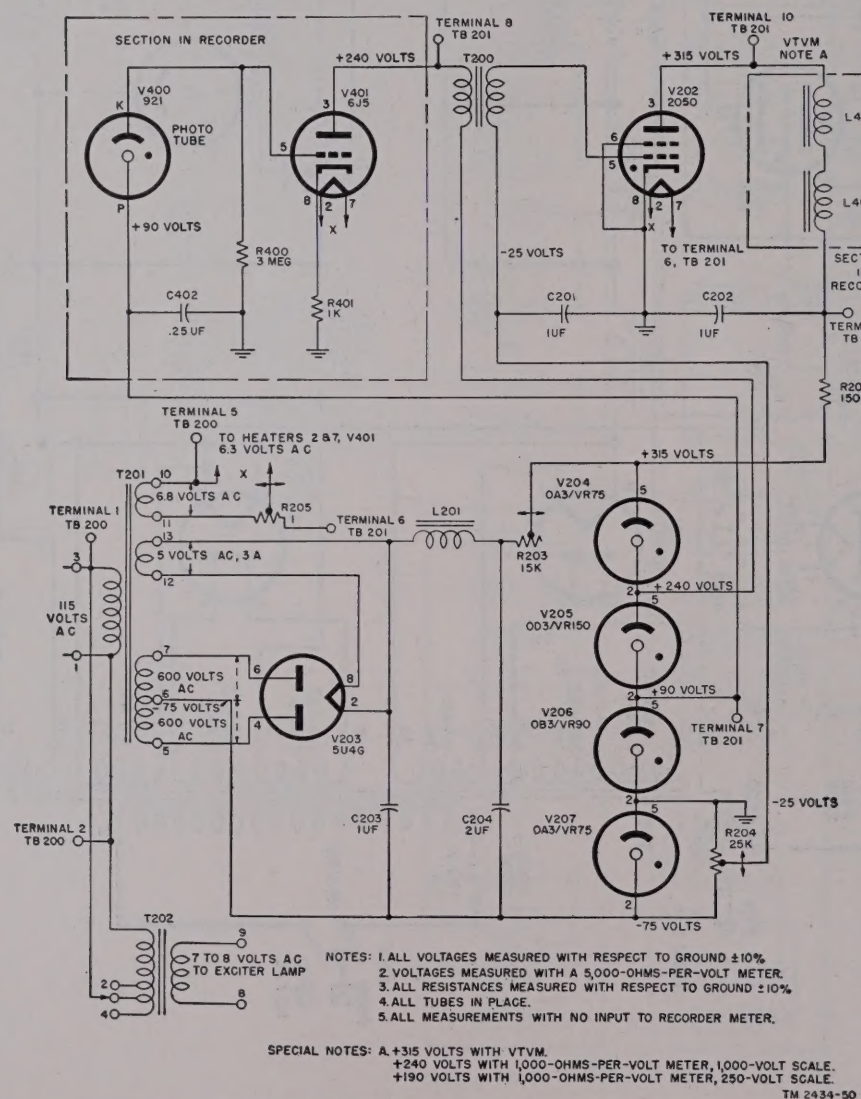


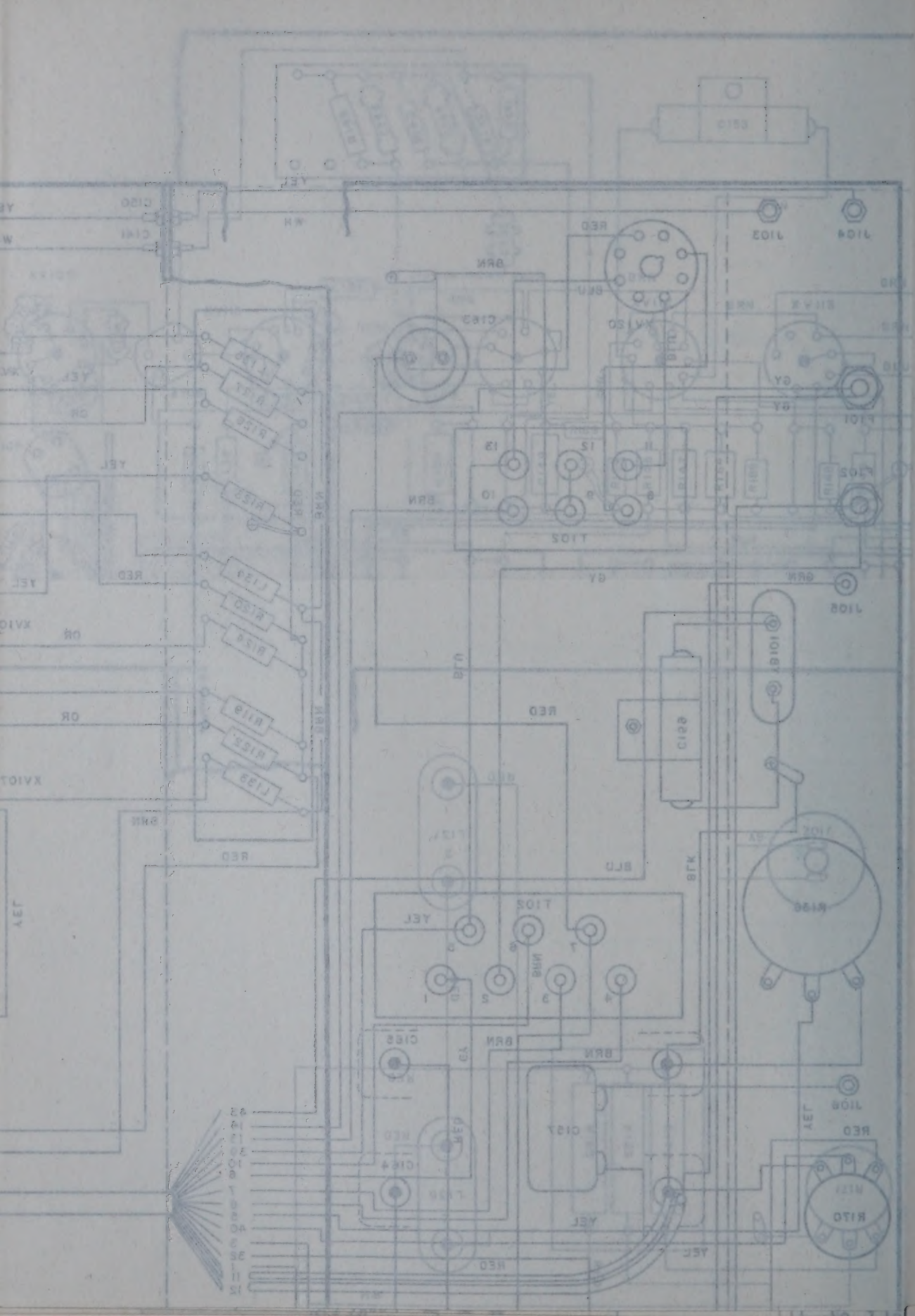
Figure 79. Amplifier AM–7B/FMQ–1, schematic diagram.

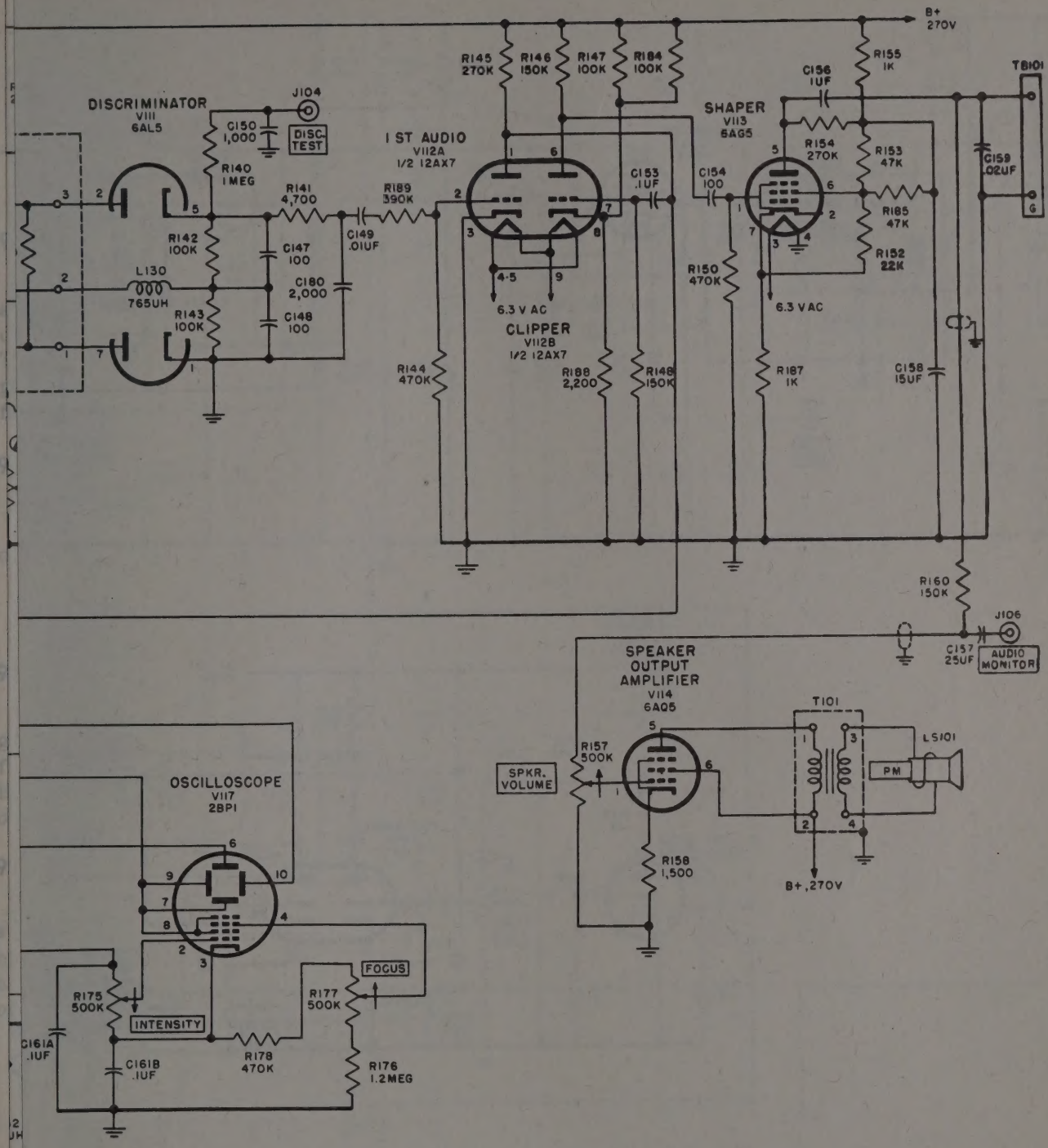
FRONT PANEL
REAR VIEW

FIGURE 80.—*Radiosonde receiver R–228/FMQ–2, practical wiring diagram.*

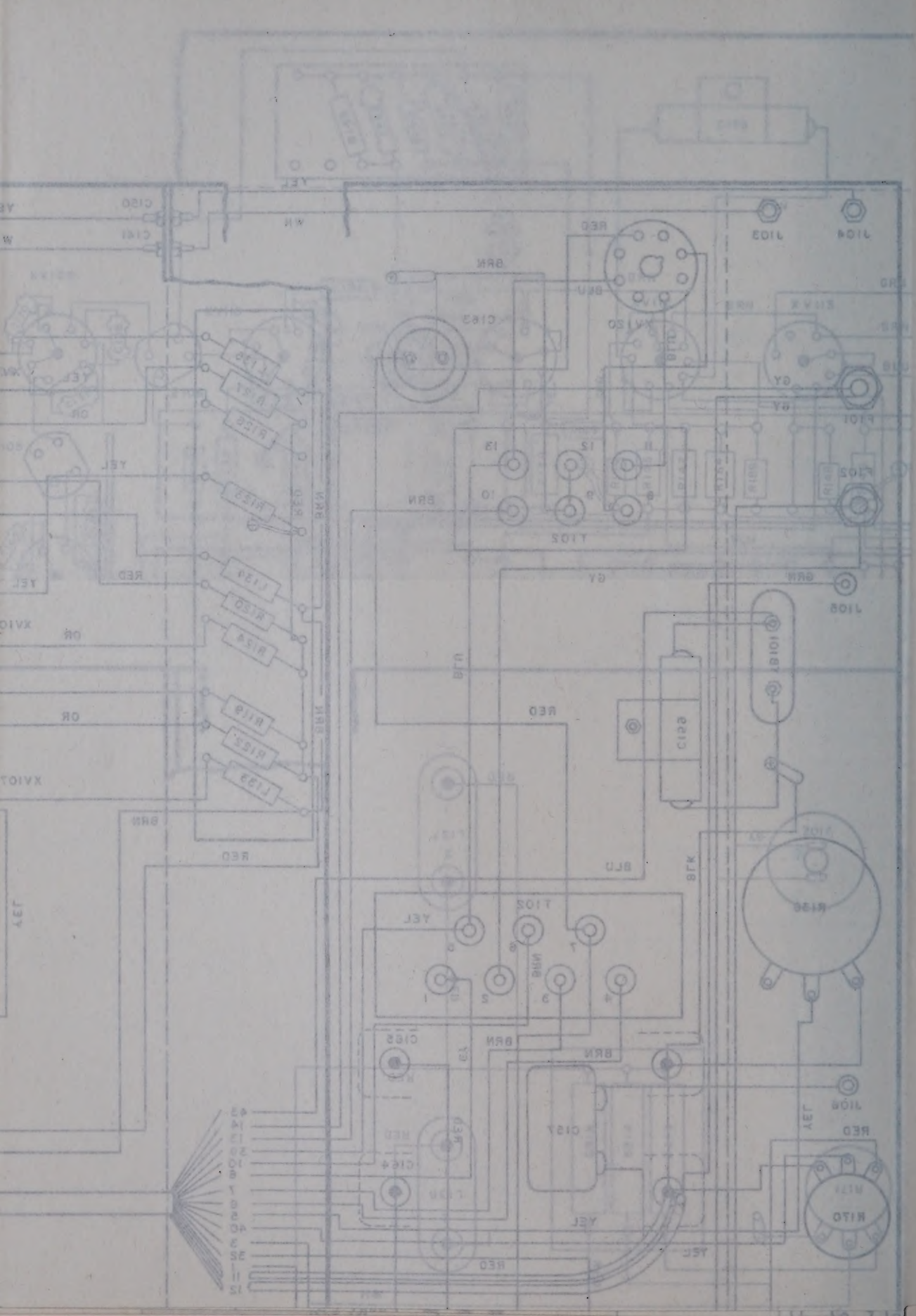
TM 2434–76

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B+ 270V
DISCRIMINATOR
V111
6AL5
J104
C150 1,000
DISC. TEST
R140 1 MEG
R141 4,700
R142 100K
L130 765UH
R143 100K
C147 100
C180 2,000
C148 100
C149 .01UF
1 ST AUDIO
V112A
1/2 12AX7
R189 390K
R145 270K
R146 150K
R147 100K
R184 100K
C153 .1UF
4-5
6.3 V AC
CLIPPER
V112B
1/2 12AX7
R144 470K
R188 2,200
R148 150K
SHAPER
V113
6AG5
C156 1UF
R155 1K
R154 270K
R153 47K
C154 100
R185 47K
R152 22K
R150 470K
6.3 VAC
R187 1K
C158 15UF
TB101
C159 .02UF
R160 150K
J106
C157 25UF
AUDIO MONITOR
SPEAKER OUTPUT AMPLIFIER
V114
6AQ5
R157 500K
SPKR. VOLUME
R158 1,500
T101
LS101
PM
B+, 270V
OSCILLOSCOPE
V117
2BP1
R175 500K
INTENSITY
C161A .1UF
C161B .1UF
R178 470K
R176 1.2MEG
R177 500K
FOCUS

TM 2434-51



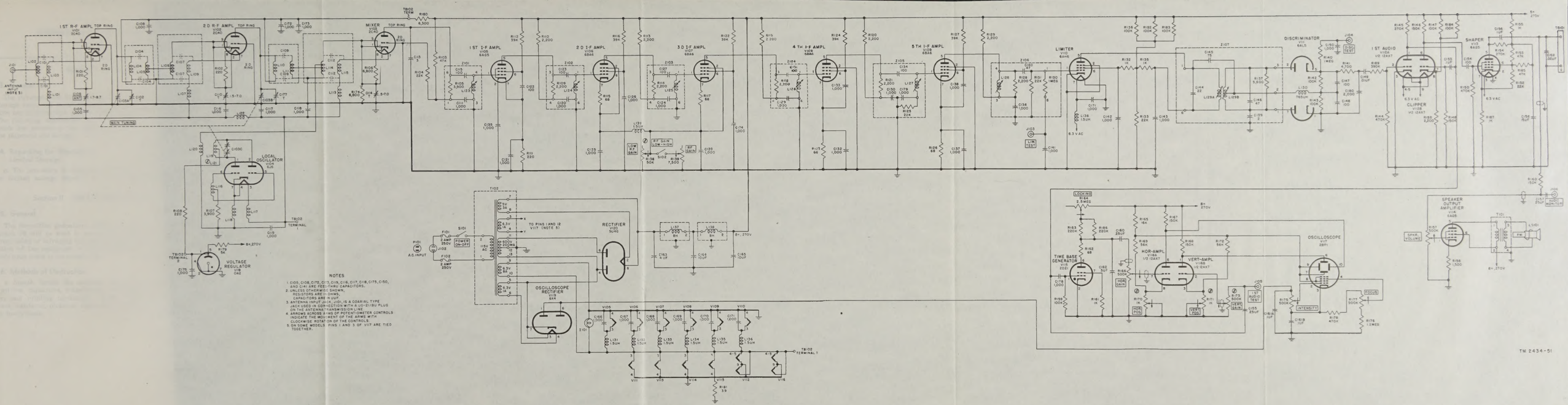
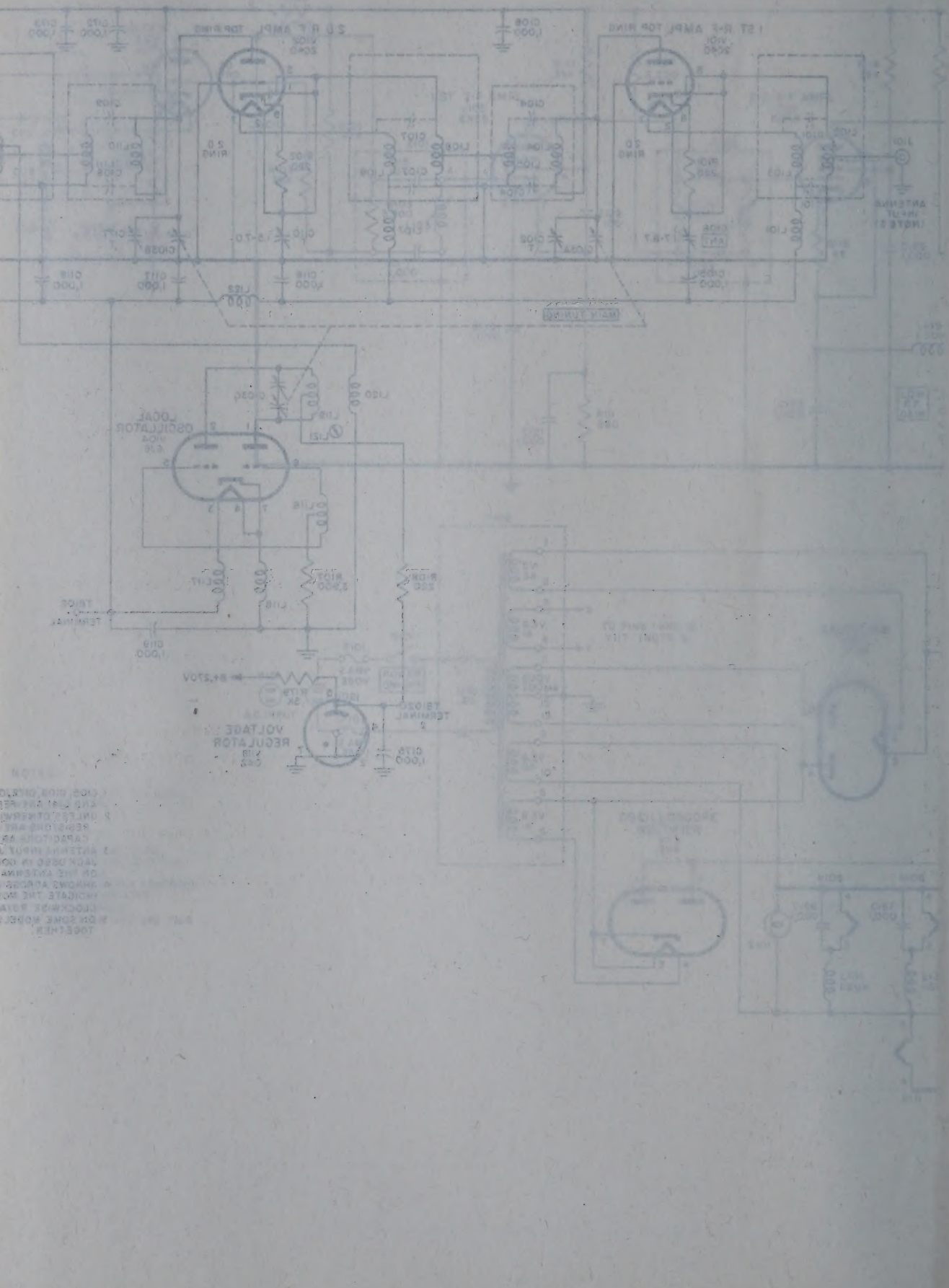


FIGURE 81.—*Radiosonde receiver R-288/FMQ-2, schematic diagram.*



CHAPTER 6
SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

93. General

The circumstances involved in shipment and storage vary, and therefore no definite procedure can be given that applies in all situations. The following instructions are intended as a guide for preparing the radiosonde receptor for shipment and storage.

94. Repacking for Shipment or Limited Storage

a. The procedure in repacking for shipment or limited storage depends on the material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraphs 7 and 9 and follow in reverse order the instructions given.

b. Whenever practicable, place a dehydrating agent such as silica gel inside the packing. Protect the equipment with a waterproof paper barrier. Seal the seams of the paper barrier with a waterproof sealing compound or tape. Pack the protected equipment in a padded wooden case, providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the packing case.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

95. General

The demolition procedures outlined in paragraph 96 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished *only* upon order of the commander.

96. Methods of Destruction

a. Smash. Smash the controls, tubes, coils, switches, capacitors, transformers, loudspeaker, and printing mechanism, using sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut cords, and wiring, using axes, handaxes, or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical manuals, using gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend panels, cabinets, and chassis.

e. Explosives. If explosives are necessary, use firearms, grenades, or TNT.

f. Disposal. Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes, or throw them into streams.

g. Destroy. Destroy everything.

APPENDIX I
REFERENCES

Note. For availability of items listed, check SR 310–20–3 and SR 310–20–4. Check Department of the Army Supply Catalog SIG 1 for Signal Corps supply catalogs.

1. Army Regulations

AR 380–5 ..... Safeguarding Military Information.

2. Supply Publications

SIG 1 ..... Introduction and Index.
SB 11–47 ..... Preparation and Submission of Requisitions for Signal Corps Supplies.
SB 11–76 ..... Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

3. Publications on Auxliliary Equipment and Test Equipment

TM 11–300 ..... Frequency Meter Sets SCR–211–(*).
TM 11–303 ..... Tests Sets I–56–C, I–56–D, I–56–H, and I–56–J.
TM 11–321 ..... Test Set I–56–E.
TM 11–472 ..... Repair and Calibration of Electrical Measuring Instruments.
TM 11–2501 ..... Test Set I–209–A.
TM 11–2602 ..... Frequency Standard TS–65/FMQ–1.
TM 11–2602A ..... Frequency Standard TS–65A/FMQ–1.
TM 11–2627 ..... Tube Tester I–177 and I–177–A.
TM 11–2689 ..... Oscilloscope I–245–B.
TM 11–5030 ..... Signal Generator TS–497A/URR.

4. Painting, Preserving, and Lubrication

TB SIG 13 ..... Moistureproofing and Fungiproofing Signal Corps Equipment.
TB SIG 69 ..... Lubrication of Ground Signal Equipment.
TM 9–2851 ..... Painting Instructions for Field Use.

5. Camouflage

FM 5–20 ..... Camouflage, Basic Principles.

6. Decontamination

TM 3–220 ..... Decontamination.

7. Demolition

FM 5–25 ..... Explosives and Demolitions.

8. Other Publications

FM 24–18 ..... Field Radio Techniques.
FM 72–20 ..... Jungle Warfare.
SR 310–20–3 ..... Index of Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Graphic Training Aids, Joint Army-Navy-Air Force Publications, and Combined Communications Board Publications).
SR 310–20–4 ..... Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrications Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.
TB SIG 4 ..... Methods for Improving

the Effectiveness of Jungle Radio Communication.

TB SIG 25 ..... Preventive Maintenance of Power Cords.

TB SIG 54 ..... Working Through Jamming with Frequency Modulated Radio Sets.

TB SIG 66 ..... Winter Maintenance of Signal Equipment.

TB SIG 72 ..... Tropical Maintenance of Ground Signal Equipment.

TB SIG 75 ..... Desert Maintenance of Ground Signal Equipment.

TB SIG 123 ..... Preventive Maintenance Practices for Ground Signal Equipment.

TB SIG 178 ..... Preventive Maintenance Guide for Radio Communication Equipment.

TB SIG 223 ..... Field Expedients for Wire and Radio.

TB 11–499–( )* .. Basic Radio Propagation Predictions.

TB 11–2403–3 ..... Field Construction of Radiosonde Test Switch to Supersede Test Equipment TS–30/FMQ–1.

TM 11–310 ..... Schematic Diagrams for Maintenance of Ground Radio Communication Sets.

TM 11–314 ..... Antennas and Antenna Systems.

TM 11–453 ..... Shop Work.

TM 11–455 ..... Radio Fundamentals.

TM 11–466 ..... Radar Electronic Fundamentals.

TM 11–483 ..... Suppression of Radio Noises.

TM 11–486 ..... Electrical Communication Systems Engineering.

TM 11–499 ..... (Preliminary), Radio Propagation Handbook.

TM 11–660 ..... Introduction to Electronics.

TM 11–1158A ..... Radio Set SCR–658.

TM 11–2405 ..... Meteorological Balloons.

TM 11–2433 ..... Radiosonde AN/AMT–2A.

TM 11–4000 ..... Trouble Shooting and Repair of Radio Equipment.

TM 38–650 ..... Basic Maintenance Manual.

*A new TB in this series is issued monthly, which gives propagation predictions three months in advance.

9. Abbreviation

a-c	alternating-current
a-f	audio frequency
cps	cycles per second
d-c	direct-current
f-m	frequency-modulated
i-f	intermediate-frequency
mc	megacycle
r-f	radio-frequency
R-C	resistance-capacitance
rms	root mean square
uuf	micromicrofarad

APPENDIX II
IDENTIFICATION TABLE OF PARTS

1. Requisitioning Parts

The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as the specific T/O&E, T/A, SIG 7–8–10, SIG 10, list of allowances of expendable material, or other authorized supply basis. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1, Introduction and Index.

2. Identification Table of Parts for Radiosonde Receptor AN/FMQ–2

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RADIOSONDE RECEPTOR AN/FMQ–2: F-M reception; 390–410 mc in 1 band.	Reception and recording meteorological data transmitted by audio-modulated radiosonde.	7A1326–2
	AMPLIFIER AM–7B/FMQ–1: A-F; approx 28″ wd x 26″ d x 24″ h.	Builds up pulse received from recorder scanning system to energize recorder tapper coils.	7A46–7
	ANTENNA ASSEMBLY AS–389/FMQ–2: ½ wave coax dipole; 1 piece; freq 400 mc.	Picks up r-f energy transmitted by radiosonde.	2A264–389
	CABLE WC–679: ins; single #10 AWG stranded cond.		1B1679
	CABLE ASSEMBLY, power: two #18 AWG stranded copper cond; rubber jacketed; round, 7/16″ diam; 10 ft lg including term; w/ Hubbell #9102; 2 cont female connector other end; Friez dwg #507593–1.	For a-c supply	3E7293
	CONNECTOR, plug: 2 female curved cont; straight type; 2¼″ lg x 1⅜″ diam; Hubbell #7224.	For a-c cord	6Z3150
	CONNECTOR, plug: 2 male curved cont; straight type; twist lock; 1⅞″ lg x 1⅜″ diam; Hubbell #9102.	For a-c cord	6Z1735.2
	FREQUENCY METER TS–29B/FMQ–1: 0–200 cyc indicating in 100 meter graduations; 115 v, 60 cyc, 1 ph; 28″ wd x 26″ d x 12″ h.	Indicates modulation frequency of radiosonde transmission.	7A889–29B
	GROUND ROD MX–148/G: galv steel; 72″ lg x ¾″ diam.	Establishes ground connection for equipment.	3Z3300–148
	RACK, MT–678/FMQ–2: steel; empty; approx 72″ h x 28″ wd x 26″ d; includes folding table.	Houses radiosonde receptor components, except Antenna Assembly AS–389/FMQ–2.	2Z7383–678

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RADIOSONDE RECEIVER R–228/FMQ–2: F-M and pulsed reception; freq range 390–410 mc in 1 band.	Receives data transmitted by radiosonde.	2C4180–228
	RADIOSONDE RECORDERS RD–3B/FMQ–1 and RD–3C/FMQ–1: chart; printed dot type; approx 21″ and 17″ h x 18″ d o/a; 100 v, 60 cyc.	Records frequencies indicated by frequency meter.	7A1326–3
	VOLTAGE REGULATOR CN–2/FMQ–1: input 90–130 v A-C, 2.3 amp, 60 cyc, output 115 v A-C, 1.3 amp, 60 cyc; approx 5⅜″ h x 5¾″ d x 15″ wd o/a.	Regulates a-c power supplied to frequency meter and amplifier components of the radiosonde receptor.	7A1680
	WIRE, electrical: Sig C Cable WC–679; insulated; single #10 AWG cond; copper; .275″ OD; 7 #18 AWG strands; black; rubber ins; impregnated black braid.	Grounding lead	

3. Identification Table of Parts for Radiosonde Receiver R-228/FMQ–2

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RADIOSONDE RECEIVER R–228/FMQ–2: F-M (F9) and pulsed (P9) reception; freq range 390–410 mc in 1 band.		2C4180–228
	ALIGNMENT TOOL TL–385/U: ¼″ wd metal scdr on 1 end, other end ¼″ hex socket end opening.		6Q335
TB101	BOARD, terminal: freq meter connector; 2 nickel pl brass binding posts w/2 tin pl brass solder lugs; 1$\frac{3}{32}$″ wd x 1½″ lg x ¾″ h o/a.	Frequency meter connector	3Z770–2.48 (Peculiar)
C103	CAPACITOR KIT: main tuning capacitor	First and second r-f and Oscillator Tuning.	3DE1 (Peculiar)
C105, C108, C116, C117, C118, C119, C141, C150, C172, C173, C175.	CAPACITOR, fixed: ceramic; 1000 uuf ± 20%; 500 vdcw; Erie type 357.	C105: V101 heater bypass. C108: V101 plate filter. C116 and C117: V101k, V102 heater bypasses. C118: V103 heater bypass. C119: C104 heater bypass. C141: J103 bypass. C150: J104 bypass. C172 and C173: V101, V102 plate filters. C175: V104 plate filter.	3DA1–242
C106	CAPACITOR, variable: air; plate meshing type; single sect; 8.7 uuf max, 1.7 uuf min. capacity; Johnson Part No. 160–104.	Antenna trimmer	3D9008VE7
C110, C114	CAPACITOR, variable: ceramic; 1.5 to 7 uuf; JAN type #CV11A070.	V102 cathode trimmers	3D9007V–17

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C113	CAPACITOR, fixed: ceramic; 3 uuf ±.5 uuf; 500 vdcw; JAN type #CC21SL030D.	V103 plate bypass.	
C121, C122, C125, C126, C128, C132, C133, C135, C137, C138, C142, C143, C166, C167, C168, C169, C170, C171, C174, C178.	CAPACITOR, fixed: ceramic; 1000 uuf −0% +70%; 300 vdcw; Central Radiolab Part No. DA505–104.	C121 and C135: V105 cathode bypasses. C122: V105 screen bypass. C125: V106 cathode bypass. C126: V106 screen bypass. C128: V107 cathode bypass. C132: V108 cathode bypass. C133: V108 screen bypass. C137: V109 cathode bypass. C138: V109 screen bypass. C142: V110 screen bypass. C143: V110 plate bypass. C166: V105 heater bypass. C167: V106 heater bypass. C168: V107 heater bypass. C169: V108 heater bypass. C170: V109 heater bypass. C171: V110 heater bypass. C174: V107 screen bypass. C178: Sync isolating.	3DA1–264
C147, C148	CAPACITOR, fixed: ceramic; 100 uuf ±10%; 500 vdcw; JAN type #CC30SL101K.	VIII cathode bypasses	3D9100–271
C149	CAPACITOR, fixed: mica; 10,000 uuf ±10%; 300 vdcw; JAN type #CM35B103K.	V112A grid coupling	3K3510321
C153	CAPACITOR, fixed: paper; 100,000 uuf ± 10%; 600 vdcw; JAN type #CP29A1EF104K.	V112B grid coupling	3DA100–688
C154	CAPACITOR, fixed: mica; 100 uuf ± 5%; 500 vdcw; JAN type #CM20B101J.	V113 grid coupling	3K2010122
C155, C157, C160	CAPACITOR, fixed: paper; 250,000 uuf ± 10%; 600 vdcw; JAN type #CP53B1EF254K	C155: V116B grid coupling. C157: J106 coupling. C160: V116 grid coupling.	3DA250–362
C156	CAPACITOR, fixed: paper; 1 uf + 20% − 10%; 600vdcw; JAN type #CP61B1EF105V.	V113 plate	3DB1–137
C158	CAPACITOR, fixed: electrolytic; 15 uf; 450 vdcw; JAN type #CE51F150R.	V113 voltage divider bypass	3DB15–60
C159	CAPACITOR, fixed: paper; 20,000 uuf ±10%; 600 vdcw; JAN type #CP29A1EF203K.	Output filter	3DA20–181
C161	CAPACITOR, fixed: paper; 2 sect; 100,000 uuf ± 10%; 600 vdcw ea sect; JAN type #CP53B4EF104V.	V117B supply filter	3DA100–770
C162	CAPACITOR, fixed: paper; 500,000 uuf + 20% −10%; 600 vdcw; JAN type #CP61B1EF504V.	V115 plate bypass	3DA500–515
C163	CAPACITOR, fixed: paper; 4 uf ± 10%; 600 vdcw; JAN type #CP41B1EF405K.	Power supply filter	3DB4–264

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C164, C165	CAPACITOR, fixed: paper; 10 uf + 20% − 10%; 600 vdcw; JAN type #CP70B10F106V.	Power supply filters	3DB10–233
C180	CAPACITOR, fixed: mica; 2000 uuf ±5%; JAN type #CM30B202J.	V112A grid coupling	
0111, 0105	CLAMP: electron tube clamp; split clamp type.	V120 clamp	2Z2642.242 (Peculiar)
L130	COIL, R-F: choke; unshielded	L129B center tap choke	3C326–2868 (Peculiar)
L131, L132, L133, L134, L135, L136, L139.	COIL, R-F: choke; unshielded	L131: V105 heater choke. L132: V106 heater choke. L133: V107 heater choke. L134: V108 heater choke. L135: V109 heater choke. L136: V110 heater choke. L139: RF GAIN control decoupling choke.	3C326–6072 (Peculiar)
P101	CONNECTOR, plug: 3 wire connector, pol; straight.	A-c power input plug	6Z7591–4.1
J101	CONNECTOR, receptacle: 1 round female coax cont; straight type.	Antenna input connector	2Z3062–211 (Peculiar)
J102	CONNECTOR, receptacle: 3 male cont, 2 curved blades, 1 round ctr prong, pol; flush mtg type.	A-c power input receptacle	6Z7798–4
J103, J104, J105	CONNECTOR, receptacle: single round female cont; straight.	J103: Limiter test point J104: Discriminator test point. J105: First audio test point.	2ZK5531.9
J106	CONNECTOR, receptacle: single round female cont; straight.	Audio monitor test point	2Z5531.6
N102	CONTACT, case: for gnd partition	R-f unit compartment grounding contacts.	2Z3191–219 (Peculiar)
E108	COUPLING, flexible: shaft coupling; consists of brass coupling disk, one hub; bakelite coupling disk, other hub.	Coupling between tuning dial and C103C.	2Z3295–110 (Peculiar)
E110	COUPLING, flexible: shaft coupling; hub on spider, rivet on each end of flexible brass disk.	Coupling between C103C and C103B.	2Z3295–111 (Peculiar)
O104	COUPLING, flexible: tuning shaft coupling	Antenna trimmer shaft	2Z3295–112 (Peculiar)
N101	DIAL: calibrated in mc; nickel-silver	Main tuning dial	2Z3723–141 (Peculiar)
O103	DRIVE, dial: tuning dial drive	Tuning dial drive	2Z3876–114 (Peculiar)

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
Z101	FILTER, band pass: 21.25 mc peak freq, 2.9 mc band width; 1⅛" sq x 3⅝" lg o/a; input and output impedance 3900 ohms.	V103 to V105 i-f coupling	3Z1892–35.3
Z102, Z103, Z104	FILTER, band pass: 21.25 mc peak freq, 3.75 mc band width; 1⅛" sq x 3⅝" lg o/a; input and output impedance 2200 ohms.	Z102: V105 to V106 i-f coupling Z103: V106 to V107 i-f coupling Z104: V107 to V108 i-f coupling	3Z1892–35.2
Z105	FILTER, band pass: 21.25 mc peak freq, 3.5 mc band width; 1⅛" sq x 3⅝" lg o/a; input and output impedance 2200 ohms.	V108 to V109 i-f coupling	3Z1892–35 (Peculiar)
Z106	FILTER, band pass: 21.25 mc peak freq, 3.6 mc band width; 1⅛" sq x 3⅝" lg o/a; input and output impedance 2200 ohms.	V109 to V110 i-f coupling	3Z1892–35.1 (Peculiar)
F101, F102	FUSE FU–27: 2 amp type	A-c line fuses	3Z1927
XF101, XF102	FUSE HOLDER: extractor post type; accom 1 #3 AG cartridge fuse.	XF101: F101 holder XF102: F102 holder.	3Z3285–6.7
E102	INSULATOR, standoff: round post shape; white ceramic, glazed on sides, unglazed ends; ⅞" lg o/a; ⅜" OD.	Terminal lug support	3G350–86 (Peculiar)
O110	KNOB: round w/pointer index; black bakelite; for ¼" diam shaft; arrow marking.	General purpose control knob	2Z5822–358 (Peculiar)
I101	LAMP LM–52: 6–8 v, .15 amp; miniature bayonet base.	On-off power indicator	2Z5952
W101, W102, W103	LEAD, electrical: bare solid copper cond, .010" thk x 5/32" wd 1 end, tab on opposite end ½" lg x ½" wd w/⅛" wd slot ⅜" d, cond silver pl; 1 3/16" lg w/1/16" offset.	W101: V101 heater lead W102: V102 heater lead. W103: V103 heater lead.	3E7998–1.4 (Peculiar)
XI101	LIGHT, indicator: w/lens; for miniature T–3¼ bayonet base lamp	I101 socket	2Z5991–155
L137, L138	REACTOR: 8 hy at 200 ma; 90 ohms D-C resistance; HS metal case.	Filter reactor	3C323–6Z46 (Peculiar)
R101, R102, R108, R111.	RESISTOR, fixed: comp; 220 ohms ± 10%; ½ w; JAN type #RC20BF221K.	R101: V101 cathode bias R102: V102 cathode bias. R108: V104 plate filter. R111: V105 cathode bias.	3RC20BF221K
R103, R153, R185	RESISTOR, fixed: comp; 47,000 ohms ±10%; 1 w; JAN type #RC30BF473K.	R103: V103 plate filter R153 and R185: V113 voltage divider.	3RC30BF473K
R104, R133, R152	RESISTOR, fixed: comp; 22,000 ohms ±10%; 1 w; JAN type #RC30BF223K.	R104: V103 plate bleeder R133: V110 screen bleeder. R152: V113 voltage divider.	3RC30BF223K
R106, R174	RESISTOR, fixed: comp; 6800 ohms ±10%; ½ w; JAN type #RC20BF682K.	R106: V103 cathode bias R174: V103 cathode loading.	3RC20BF682K
R107	RESISTOR, fixed: comp; 3900 ohms ±10%; ½ w; JAN type #RC20BF392K.	R107: V104 grid	3RC20BF392K

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R110, R113, R119, R120, R129, R188	RESISTOR, fixed: comp; 2200 ohms ±10%; 1 w; JAN type #RC30BF222J.	R110: V105 plate filter. R113: V106 plate filter. R119: V107 plate filter. R120: V108 plate filter. R129: V109 plate filter. R188:	3RC30BF222J
R112, R116, R122, R124, R127.	RESISTOR, fixed: comp; 39,000 ohms ±10%; 1 w; JAN type #RC30BF393K.	R112: V105 screen dropping. R116: V106 screen dropping. R122: V107 screen dropping. R124: V108 screen dropping. R127: V109 screen dropping.	3RC30BF393K
R115, R117, R123, R126, R162.	RESISTOR, fixed: comp; 68 ohms ±10%; ½ w; JAN type #RC20BF680K.	R115: V106 cathode bias. R117: V107 cathode bias. R123: V108 cathode bias. R126: V109 cathode bias. R162: V115 plate current limiting.	3RC20BF680K
R132, R135, R155, R161, R187.	RESISTOR, fixed: comp; 1000 ohms ±10%; ½ w; JAN type #RC20BF102K.	R132: V110 screen dropping. R135: V110 plate filter. R155: V113 voltage divider. R161: V115 screen. R187:	3RC20BF102K
R136, R142, R143, R147, R159, R182, R183, R184.	RESISTOR, fixed: comp; 100,000 ohms ±10%; 1 w; JAN type #RC30BF104K.	R136 and R182: V110 plate and screen supply voltage dividers. R142 and R143: V111 diode loads. R147 and R184: V112B cathode voltage dividers. R159: V115 grid. R183:	3RC30BF104K
R138	RESISTOR, variable (potentiometer): comp; 50,000 ohms ±20%; 2 w; JAN type #RV4AWSA503F.	LOW R.F. GAIN control	3RV45026
R139	RESISTOR, variable (potentiometer): WW; 7500 ohms ±10%; 3 w; JAN type #RA25A1FK752FK.	RF GAIN control	3RA7210
R140	RESISTOR, fixed: comp; 1 meg ±10%; ½ w; JAN type #RC20BF105K.	Discriminator test isolating	3RC20BF105K
R141	RESISTOR, fixed: comp; 4700 ohms ±10%; ½ w; JAN type #RC20BF472K.	V111 de-emphasis	3RC20BF472K
R144, R150, R178	RESISTOR, fixed: comp; 470,000 ohms ±10%; ½ w; JAN type #RC20BF474K.	R144: V112A grid. R150: V113 grid. R178: V117 screen dropping.	3RC20BF474K
R145, R154	RESISTOR, fixed: comp; 270,000 ohms ±10%; ½ w; JAN type #RC20BF274K.	R145: V112A plate filter. R154: V113 plate load.	3RC20BF274K
R146, R148, R160, R167, R168.	RESISTOR, fixed: comp; 150,000 ohms ±10%; 1 w; JAN type #RC30BF154K.	R146: V112B plate filter. R148: V112B grid. R160: Audio monitor isolating.	3RC30BF154K

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
		R167: V116A plate filter. R168: V116B plate filter.	
R157	RESISTOR, variable (potentiometer): comp; 500,000 ohms ±20%; ⅛ w; JAN type #RV2APF-K504F.	SPKR. VOLUME control	3RV55035
R158	RESISTOR, fixed: comp; 1500 ohms ±5%; 2 w; JAN type #RC42BF152J.	V114 cathode bias	3RC42BF152J
R163, R186	RESISTOR, fixed: comp; 220,000 ohms ±10%; ½ w; JAN type #RC20BF224K.	V115 time constants	3RC20BF224K
R164	RESISTOR, variable (potentiometer): comp; 2.5 meg ±20%; 2 w; JAN type #RV4APFK 255F.	Locking control	3RV62510
R165	RESISTOR, fixed: comp; 16,000 ohms ±5%; 2 w; JAN type #RC42BF163J.	V116 cathode voltage divider	3RC42BF163J
R166, R173	RESISTOR, variable (potentiometer); comp; 500,000 ohms ±20%; ⅛ w; JAN type #RV2AWSA504F.	R166: HOR. GAIN control R173: VERT. GAIN control.	3RV55034
R169, R172	RESISTOR, fixed: comp; 56,000 ohms ±5%; 2 w; JAN type #RC42BF563J.	R169: V116A cathode voltage divider. R172: V116B cathode voltage divider.	3RC42BF563J
R170, R171	RESISTOR, variable (potentiometer): WW; 1000 ohms ±5%; 2 w; JAN type #RA15A25A102AJ.	R170: HOR. POS. control R171: VERT. POS. control.	3RA5723
R175, R177	RESISTOR, variable (potentiometer): comp; 500,000 ohms ±20%; ⅛ w; JAN type #RV2APFK504B.	R175: INTENSITY control R177: FOCUS control.	3RV55033
R176	RESISTOR, fixed: comp; 1.8 meg ±10%; ½w; JAN type #RC20BF185K.	V117 screen bleeder	3RC20BF185K
R179	RESISTOR, fixed: WW; 5000 ohms ±5%; 9 w; 200°C max continuous oper temp; JAN type #RW56J502.	V118 dropping	3RW28520
R180	RESISTOR, fixed: WW; 6300 ohms ±5%; 9 w; 200°C max continuous oper temp; JAN type #RW56J632.	V101, V102 plate dropping	3RW29113
R181	RESISTOR, fixed: WW; 3.9 ohms ±10%; 2 w; 110° C max continuous oper temp; JAN type #RU6C3R9K.	V115 filament dropping.	3RU12004
R189	RESISTOR, fixed: composition; 390,000 ohms ±10%; ¼ w; JAN type #RC10BF394K.	V112A grid coupling resistor	3RC10BF394K
O107	SCALE: voltage pattern evaluation; transparent cartographic film disk.	V117 scale	2Z8076–133 (Peculiar)
O106	SHIELD, tube: hollow cylinder shape w/mtg ft ea end; 2.085″ ID x 4″ lg w/o mtg ft, 2⅛″ OD.	V117 shield	2Z8304.191 (Peculiar)

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
XC101	SOCKET, tube: octal; under chassis saddle mtg w/4 gnd lugs; JAN type #TSB8T102	C158 socket	2Z8678.327
XV101, XV102, XV103.	SOCKET, tube: octal; under chassis wafer mtg.	Tube sockets	2Z8761–5 (Peculiar)
XV–104	SOCKET, tube: 7 axial miniature cont; under chassis wafer mtg.	V104 socket	2Z8677.149 (Peculiar)
XV105, XV106, XV107, XV108, XV109, XV110, XV111, XV113, XV114, XV115, XV118, XV119.	SOCKET, tube: 7 axial miniature cont; under chassis wafer mtg.	XV105: V105 socket. XV106: V106 socket. XV107: V107 socket. XV108: V108 socket. XV109: V109 socket. XV110: V110 socket. XV111: V111 socket. XV113: V113 socket. XV114: V114 socket. XV115: V115 socket. XV118: V118 socket. XV119: V119 socket.	2Z8677.148 (Peculiar)
XV112, XV116	SOCKET, tube: 9 axial miniature cont; under chassis wafer mtg.	XV112: V112 socket. XV116: V116 socket.	2Z8679.31 (Peculiar)
XV117	SOCKET, tube: 12 med axial cont; 1 piece saddle mtg.	V117 socket	2Z8682.23 (Peculiar)
XV120	SOCKET, tube: std octal; 1 piece saddle mtg.	V120 socket	2Z8677.333 (Peculiar)
LS101	SPEAKER, dynamic: cone type, 4″ diam; PM field.	Loudspeaker	6C43–37
S101, S102	SWITCH, toggle: DPST; JAN type, #ST22K.	S101: POWER ON-OFF switch. S102: R-F GAIN LOW-HIGH switch.	3Z9863–22K
T101	TRANSFORMER, A-F: plate coupling type; pri 10,000 ohms impedance, secd 8 ohms impedance; HS metal case, iron core.	Audio output transformer	2Z9632.520 (Peculiar)
T102	TRANSFORMER, power: fil and plate type; input 115 v, 60 cyc, 1 ph; secd #1, 6.3 v at 1 amp, secd #2, 6.3 v at 1 amp, secd #3, 5 v at 3 amp, secd #4, 6.3 v at 8 amp, secd #5, 600 v at 200 ma, CT.	Power transformer	2Z9613.623 (Peculiar)
Z107	TRANSFORMER, discriminator: 21.25 mc.	Discriminator transformer	2Z9643.339 (Peculiar)
V101, V102, V103	TUBE, electron: JAN–2C40	V101: First-r-f amplifier V102: Second-r-f amplifier. V103: Mixer.	2J2C40
V104	TUBE, electron: JAN–6J6	Local oscillator	2J6J6

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
V105, 113	TUBE, electron: JAN–6AG5		2J6AG5
V106, V107, V108, V109.	TUBE, electron: JAN–6BA6	V106: Second i-f amplifier. V107: Third i-f amplifier. V108: Fourth i-f amplifier. V109: Fifth i-f amplifier.	2J6BA6
V110	TUBE, electron: JAN–6AH6	Limiter	2J6AH6
V111	TUBE, electron: JAN–6AL5	Discriminator	2J6AL5
V112, V116	TUBE, electron: JAN–12AX7	V112: First audio and clipper. V116: Horizontal and vertical deflection amplifier.	2J12AX7
V114	TUBE, electron: JAN–6AQ5	Speaker output amplifier	2J6AQ5
V115	TUBE, electron: JAN–2D21	Time base generator	2J2D21
V117	TUBE, electron: JAN–2BP1	Oscillograph	2J2BP1
V118	TUBE, electron: JAN–OA2	Voltage regulator	2JOA2
V119	TUBE, electron: JAN–6X4	Oscillograph supply rectifier	2J6X4
V120	TUBE, electron: JAN–5U4G	Rectifier	2J5U4G
	TUBE PULLER TL–201:		6R7442
	WRENCH: Allen hex key, short series for Allen #8 socket head set screw, Allen #4 socket head cap screw, and Allen #5 and #6 flat head cap screw.		6R57400
	WRENCH: "Bristo" set screw; for Bristo #6 multiple-spline set screw.		6R55230

4. Identification Table of Parts for Antenna Assembly AS–389/FMQ–2

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	ANTENNA ASSEMBLY AS–389/FMQ–2; ½ wave coax dipole; receiving; brass, silver pl; 1 piece; 18″ lg x 2½″ idam o/a less approx 100 ft AN R-F Cable RG–8A/U; 1″ thd pipe cap on bottom for mtg; fixed; freq 400 mc; approx 52 ohm coax transmission line feed; incl approx 100 ft AN R-F Cable RG–8A/U terminated w/AN R-F Plug UG–21B/U; p/o AN Radiosonde Receptor AN/FMQ–2; Natl Co #SA: 5295.	Picks up energy transmitted by radiosonde.	2A264–389
	ANTENNA SECTION: 1 pole of ½ wave coax dipole, receiving; p/o AN Antenna Assembly AN–389/FMQ–2; brass, silver pl; 400 mc receiving, 50 ohm coax transmission line feed; round rod w/hex shaped base; 5 37/64″ lg x ½″ OD o/a; single ¼″–28 thd x ⅝″ d tapped hole in hex base f/mtg Natl Co #SA: 6162.		2A291–39

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	CABLE RG–8A/U; coax; 52 ohms impedance, 29.5 uuf/ft; 4000 v RMS max oper; 7 strands #21 plain copper wire: outer cond, .340″ max OD, plain copper, single braid, polyethylene dielectric, .285″ OD; outer covering, .405″ OD, polyvinyl employing nonmigratory plasticizers; designed for low temp use, same as RG–8/U except cable jacket improved to meet low temp requirements; NME spec JAN–C–17 w/exceptions.	R-f transmission line from antenna to radiosonde receiver.	IF425–8A
	INSULATOR, standoff: conical shape; glazed ceramic; 1⅜″ lg x 2⅛″ OD o/a x 17–64″ ID; 3 mtg holes 3/16″ diam spaced 120 deg apart; p/o AN Antenna Assembly AS–389/FMQ–2; Natl Co #M282–1.	.....	3G350–87
	PLUG UG–21B/U; 1 round male coax cont; straight, type "N"; approx 2¼″ lg x 25/32″ diam o/a; nominal impedance 50 ohms, constant characteristic up to 3000 mc; cylindrical brass, silver pl body; low loss ploymeric syn resin insert; .437″diam cable opening in clamping nut; ⅝″–24 NEF female thd on coupling nut; ANRFCCC dwg#RE49F402.	Coupling to r-f input jack on radiosonde receiver.	2Z7390–21B

5. Identification Table of Parts for Amplifier AM–7B/FMQ–1

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	AMPLIFIER AM–7B/FMQ–1: approx 28″ wd x 26″ d x 24″ h.	Builds up pulse received from recorder scanning system to energize recorder tapper coils.	7A46–7
	BOARD, terminal: 5 solder lugs w/term; black phenolic; 3¾″ lg x 1½″ wd x ⅞″ thk o/a; Friez dwg #504365.	.....	7A371–6
C201.....	CAPACITOR, fixed: paper; 1 uf ±10%; 600 vdcw; max o/a dimen 2″ lg x 1¾″ wd x 1″ h; JAN Type #CP53B1EF105K.	A-f bypass, grid circuit of tube V202.	3DB1–139
C202.....	CAPACITOR, fixed: paper; 1 uf ±10%; 1000 vdcw; max o/a dimen 2″ lg x 2″ wd x 1⅛″ h; JAN type #CP53B1EG105K.	Plate voltage source for tube V202. Refer to paragraph 67.	3DBI–140
C203.....	CAPACITOR, fixed: paper; 1 uf ±10%; 1000 vdcw; body dimen 3⅜″ lg x 1½″ diam; JAN type #CP41B1EG105K.	Filter, power supply.....	3DB1–56
C204.....	CAPACITOR, fixed: paper; 2 uf ±10%; 1000 vdcw; body dimen 4½″ lg x 1½″ diam; JAN type #CP41B1DG205K.	Filter, power supply.....	3DB2–74
F200.....	FUSE, cartridge: 3 amp; 25 v; glass body; ferrule term 1¼″ lg x ¼″ diam o/a; Bendix-Friez part/dwg #507308–1.	Overload protection.....	3Z1950

948603—51—9

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	HOLDER, fuse: extractor post; for single #3AG fuse; bakelite body w/copper clips; 23/32" OD x 2½" lg x ½" diam; Littel fuse #341001.	Holds cartridge fuse	3Z3275
L201	REACTOR: filter choke; single winding; 15 hy; 85 ma, 375 ohms D-C resistance; HS metal case; 2⅞" wd x 4⅞" h x 2½" d o/a.	Filter, power supply	7A702–6
R205	RESISTOR, adjustable: WW; 1 ohm ±5%; 10 w; 1¾" lg x 5/16" diam; IRC #ABA.	Adjustment of voltage for tube heaters.	3Z5991–88
R203	RESISTOR, adjustable: WW; 15,000 ohms; 75 w; 6½" lg x ¾" diam; IRC #ESA.	Series regulation	3Z6615–86
R204	RESISTOR, adjustable: WW; 25,000 ohms ±10%; 25 w; 2½" lg x 9/16" diam; IRC #DHA.	Voltage divider	3Z6625–76
R202	RESISTOR, fixed: comp; 150,000 ohms ±10%; 2 w; max body dimen 1.78" lg x .405" diam; JAN type #RC41BF154K.	Charging resistor for capacitor C202.	3RC41BF154K
	SOCKET, tube: std octal; isolantite; 1⅞" lg x 1½" wd x ¾" thk; Natl Co #CIR–8.		2Z8678.53
T200	TRANSFORMER, A-F: plate coupling type; pri 10,000 ohms; secd 90,000 ohms impedance; inclosed metal case; 2⅞" lg x 2⅛" wd x 2⅜" h; Thordarson #T57A36.	Interstage, tubes V401 and V202.	2ZK9717–57A36
T201	TRANSFORMER, power plate and fil, pri tapped 105/115/125 v, 60 cyc; secd #1, 1120 v, 150 ma, CT; secd #2, 6.3 v, 5 amp; secd #3, 6.3 v, 3 amp; secd #4, 5 v, 3 amp; HS metal case; 5¾" wd x 5¾" d x 5 11/16" h o/a.	Power	7A1860.2–6
V202	TUBE, electron: JAN–2050	Thyratron amplifier	2J2050
V203	TUBE, electron: JAN–5U4G	Rectifier	2J5046
V204, V207	TUBE, electron: JAN–OA3/VR75	Voltage regulators	2JOA3/VR75
V205	TUBE, electron: JAN–OD3/VR150	Voltage regulator	2JOD3/VR150
V206	TUBE, electron: JAN–OB3/VR90	Voltage regulator	2JOB3/VR90

6. Identification Table of Parts for Voltage Regulator CN–2A/FMQ–1

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	VOLTAGE REGULATOR CN–2A/FMQ–1: Input 95–130 v, 2.3 amp, 60 cyc; output 115 v ±5%; 1.3 amp, 60 cyc; approx 5¾" h x 5¾" d x 15" wd o/a.	Regulates a–c power supplied to portion of equipment.	
C302	CAPACITOR, fixed: paper; 5 uf +10%, −2.5%; 440 vacw; Ray Theon #35–416P2.	Voltage regulating.	

7. Identification Table of Parts for Radiosonde Recorders RD–3B/FMQ–1 and RD–3C/FMQ–1

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RADIOSONDE RECORDERS RD–3B/FMQ–1 and RD–3C/FMQ–1: chart; printed dot type; 17″ h x 21″ wd x 18″ d; 110 v; 60 cyc.	Makes printed record of frequencies indicated by Frequency Meter TS–29B/FMQ–1.	7A1326–3
	BAR, tapper: includes 1 left front dog and 1 right front dog; brass; nickel pl; 10½″ lg x 1¼″ wd x 2$\frac{1}{16}$″ o/a; Friez #507228.	.....	7A1326–3/A5
	BEARING, ball: single row, angular; plain, ⅛″ bore, ½″ OD x $\frac{11}{64}$″ wd; Norma-Hoff #S–0.	For rocker arm assembly.....	
	BEARING, ball: single row angular; plain; bore 5 mm, OD 16 mm x 5 mm wd; Norma-Hoff #E–5.	For rocker frame.....	3H310–2
	BEARING, ball: single row angular; bore 8 mm, OD 24 mm x 7 mm wd o/a; SKF #E–8.	For rocker frame, paper drive shaft, and brush blocks.	3H2335/5
	BEARING, ball: single row angular; bore 12 mm, OD 32 mm x 7 mm wd o/a; Norma-Hoff #E–12.	For photocell and optical system drive shaft.	3H1601/2
	BOARD, terminal: 2 brass, nickel pl screw term; molded bakelite; 1⅝″ lg x 1⅛″ wd x ½″ thk o/a; Jones HB #2–141.	.....	2Z9402.44
	BOARD, terminal: 3 brass, nickel pl screw term; molded phenolic board; 2$\frac{1}{16}$″ lg x 1⅛″ wd x ½″ thk o/a; Jones HB #3–141.	Tapper coil terminal board...	2Z9403.6
	BOARD, terminal: 4 brass, nickel pl screw term; molded bakelite; 2⅝″ lg x 1⅛″ wd x ½″ thk; o/a; Jones HB #4–141.	.....	2Z9404.1
	BOARD, terminal: 5 brass, nickel pl screw term; bakelite; 2$\frac{15}{16}$″ lg x 1⅛″ wd x ½″ thk; Jones HB #5–141.	.....	2Z9405.1
	BOARD, terminal: 5 screw term; bakelite; 3¾″ lg x 1¼″ wd x ⅞″ thk o/a; Friez dwg #32812.	.....	7A371–5
	BRUSH, electrical contact; slip rings; copper graphite; ½″ lg x $\frac{5}{32}$″ diam o/a; Chas E Chapin #680.	.....	7A1326–3/B4
	CAM: rocker arm; phosphor bronze and brass; 1$\frac{7}{16}$″ lg x 1$\frac{11}{32}$″ wd x $\frac{27}{64}$″ thk o/a w/2 #6–32 hex socket set screws, ⅛″ lg; Friez #32406.	.....	7A1326–3/C3
C400.....	CAPACITOR, fixed: paper, oil filled; 1 uf +15%−0%; 220 vacw; 3¼″ lg x 1$\frac{1}{32}$″ diam; Holtzer #100295.	Starting, for paper drive motor.	3DB1.295–1

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C401	CAPACITOR, fixed: paper, 1.2 uf ±10%; 220 vacw; 3¼″ lg x 1 1/16″ diam; Holtzer #PC–103509.	Starting, for main drive motor.	3DB1A2–1
C402	CAPACITOR, fixed: paper; 250,000 uuf ±10%; 400 vdcw; body dimen 2 5/16″ lg x ¾″ diam w/13/16″ lg bracket; JAN type #CP28A1EE254K.	Preamplifier	3DA250–279
	CLIP: electron tube; phosphor bronze; U shaped, 1 1/32″ h x 1″ wd w/one 7/16″ flange on 1 leg of U; Friez #507234–2.		7A525
	CLIP: electron tube; phosphor bronze, nickel pl; "U" shaped, 1 1/32″ h x 1″ wd w/one 7/16″ flange on 1 leg of U; Friez #507234–1.		7AK1326–3/C1
L400, L401	COIL, solenoid: D-C resistance 610 to 725 ohms; bar shape; 1 5/16″ lg x 1 5/16″ x 15/16″ o/a.	For energizing tapper bar mechanism.	7A702.3
M400	CONTROL, light beam: 0–500 ma meter movement; cylindrical case w/rectangular mtg base; approx 7″ OD x 2¼″ d o/a; Friez #P–35664.	Interrupts light beam between light source and photocell in accordance w/electrical pulses.	7A1326–3/M2
	DISK, mounting: plastic and copper; complete less lens assembly; 6 7/16″ OD x 2 9/16″ o/a; Friez part # OAP–32415 less part #507406.	Mounts optical system	7A1326–3/2
	DISK, mounting: plastic and copper; complete less photoelectric cell; 6 7/16″ OD x 1½″ thk o/a; Friez part #OAP–32414 less part #A–507231.	Mounts photoelectric cell	7A1326–3/16
	DRUM, spiral: brass; c/o rod shaft, spiral drum, drum ends; 15 9/16″ lg x 1⅞″ OD o/a; Friez #P32445.		7AK1326–3/D1
	FUSE FU–27: cartridge; 2 amp, 250 v; glass body; ferrule term.; 1¼″ lg x ¼″ diam o/a.	Overload protection	3Z1927
F400, F401	FUSE, cartridge: 6 amp, 250 v; ferrule term; o/a dimen 2″ lg x 9/16″ diam; Navy spec #17–F2 (a-c line).	Overload protection	3Z2606.16
	GEAR: bevel; phosphor bronze; straight teeth; 12 teeth; .291″ OD x ¼″ bore x 17/64″ thk; Friez #506958.	Engages long face pinion of motor drive for tape reverse.	7A1326–3/3
	GEAR: spur; phosphor bronze, nickel pl; straight teeth; 18 teeth; ⅜″ OD o/a x .126″ bore x 23/64″ thk; Friez #32209.	Motor pinion of tape reverse assembly.	7A1326–3/6
	GEAR: spur; lacquered bakelite gear, nickel pl brass hub; straight teeth; 24 teeth; 13/16″ OD x .187″ bore x 25/64″ thk; Friez #32454.	For 1,050-rpm motor drive shaft.	7A1326–3/G15
	GEAR: spur; brass, nickel pl; straight teeth; 24 teeth; .812″ OD x .187″ bore x ⅜″ thk; Friez #35663.	Meter adjustment	7A1326–3/5

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	GEAR: spur; brass, nickel pl; straight teeth 31 teeth; .515″ OD x .187″ bore x 13/32″ thk; Friez #32821.	For paper drive motor (.4″ paper drive).	7A1326–3/P1
	GEAR: spur; phosphor bronze, nickel pl; straight teeth; 50 teeth; 13/16″ OD x .187″ bore x 11/32″ thk; Friez #32198.	Meshes with spur gears of tape reverse assembly.	7AK1326–3/G1
	GEAR: spur; lacquered fiber gear, nickel pl brass hub; straight teeth; 67 teeth; 2 3/8″ OD x 5/16″ bore x 13/16″ thk; Friez #32400.	Drive for spiral drum assembly.	7A1326–3/G12
	GEAR: spur; brass, nickel pl; straight teeth; 153 teeth; 2 27/64″ OD x 5/16″ bore x 11/32″ thk o/a; Friez #32816.	Drive for paper roll.....	7A1326–3/G10
	GEAR: spur; brass, nickel pl; straight teeth; 268 teeth; 8.437″ OD x 3/4″ bore x .128″ thk; Friez #32279.	Drive for optical and phototube disks.	7A1326–3/G13
	GEAR: worm; stainless steel; helical teeth; single LH thd; .374″ OD x .187″ bore x 5/8″ lg; Friez #506916.	For rotating meter (see worm gear).	7A1326–3/15
	GEAR: worm; phosphor bronze, nickel pl; straight teeth; 50 teeth; 1 1/16″ OD x .187″ bore x 13/32″ thk; Friez #506915.	For rotating meter.....	7A1326–3/4
	GEAR ASSEMBLY: bevel and spur; phosphor bronze, nickel pl; 13/16″ diam o/a x .187″ bore x 29/64″ thk; bevel gear 36 teeth, spur gear 30 teeth; Friez #32195.	For tape reverse.....	7AK1326–3/G4
	GEAR ASSEMBLY: spur; bronze, nickel pl and bakelite, lacquered; 1 9/16″ OD x 1/4″ bore x 11/32″ thk; large gear 48 teeth, small gear 24 teeth; Friez #A–32489.	For slow-speed drum drive....	7A947.1
	GEAR ASSEMBLY: spur, phosphor bronze nickel pl and bakelite lacquered; 13/16″ OD o/a x .187″ bore x 5/16″ thk; large gear 50 teeth, small gear 18 teeth; Friez #32207.	Meshes with motor pinion at tape reverse assembly.	7AK1326–3/G2
	GEAR ASSEMBLY: spur; phosphor bronze nickel pl and bakelite, lacquered; 13/16″ OD x .187″ bore x 17/64″ thk; large gear 50 teeth, small gear 18 teeth; Friez #32204.	Meshes with drive gear for tape reverse.	7A1326–3/G3
	GEAR ASSEMBLY: spur; brass, nickel pl; .952″ OD x 1/4″ bore x 13/32″ thk; large gear 59 teeth, small gear 39 teeth; Friez #32820.	Meshes with pinion of paper drive motor.	7A1326–3/G9
	GEAR ASSEMBLY: spur; brass hub and lacquered fibre gear; 3 11/32″ OD x 5/16″ bore x 13/16″ thk; large gear 105 teeth, small gear 67 teeth; Friez #32435.	For spiral drum drive.....	7A1326–3/H4
	HOLDER, contact brush: black plastic, lacquered; pear shaped; 2 1/2″ lg x 2″ wd x 1/2″ thk o/a; Friez #507210.	.....	

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	HOLDER, fuse: extractor post; bakelite body; 10 amp max; 2⅛″ lg x ¾″ diam o/a; Littlefuse #341001.	For single #3AG fuse	3Z3275
	HOLDER, tape guide: lower; brass, nickel pl; 1⅝″ lg x .311″ diam o/a; Friez #31765.		7A1326–3/19
	HOLDER, tape guide: upper; brass, nickel pl; 13/16″ lg x .311″ diam o/a; Friez #31766.		7A1326–3/8
	HUB: brass, nickel pl; .4375″ ID x 2″ OD x 11/16″ thk o/a; Friez #31794.	Fastens to large drive gear	7A1326–3/9
	INSERT, brush holder: brass, nickel pl; 25/32″ lg x ¼″ diam, w/hole .157″ diam x ⅝″ d; Friez #32429.		7A1326–3/1
	KNOB: round; brass, nickel pl; for ¼″ diam shaft; single #5–40 x 3/16″ hex socket, cup point set screw; 1¼″ diam x ⅝″ lg o/a; knurled; Friez #36240.	Meter zero adjustment	7A1050–4
	LAMP, incandescent: 6–8 v, 15 cp; round clear bulb; 2″ lg x 1″ diam; bayonet base; Mazda #87 (for optical disk assembly).	Light source for photocell	6Z6806.6
	LAMP, incandescent: 115 v 7 w; bulb C7 frosted; 2½″ lg o/a; candelabra screw base; C7A fil; GE #7C7/W.	To illuminate recorder	6Z6825.1
	LAMPHOLDER: candelabra bayonet base; bakelite; 125 v, 75 w; approx dimen 4¾″ h x 2½″ wd o/a; w/snap-on lamp shade; Marks Prod #W–0682.		7A1055A
	MODIFICATION KIT MX–636/FMQ–1: for Radiosonde Recorder RD–3/FMQ–1, p/o Radiosonde Receptor AN/FMQ–1; Sig C dwg #SC–D–14918–A through #SC–D–14922–A and #SC–B–15669–A.	Replaces ribbon reversing assembly.	7A1123–636
	MOTOR, A-C: capacitor-start sync type; 1 rpm; closed frame; keyed shaft to fit Woodruff #201 key; 2 11/16″ lg x 2 9/16″ wd x 2 9/16″ h; shaft ½″ lg x 3/16″ diam; 115 v A-C, 60 cyc, single ph; Friez #P–507066.	For paper drive	7A1129–1
	MOTOR, A-C: capacitor-start sync type; 1050 rpm; closed frame; keyed shaft to fit Woodruff #201 key; 3 15/16″ lg x 2 9/16″ wd x 2 9/16″ h; shaft ½″ lg x 3/16″ diam; 115 v A-C, 60 cyc, single ph; Friez #507061.	For main drive	7A1129–4
	MOTOR, A-C: induction type; .004 hp; open frame; w/set screw fastened pinion; 2 19/32″ lg x 2 11/32″ h x 1¾″ d o/a; shaft .1247″ diam x ⅝″ lg; 115 v A-C, 60 cyc, single ph, ½ amp, 14 w; Friez #506956 and #32209.	For ribbon reverse assembly	7A1129
	NUT, hexagon: brass, nickel pl; #5–40; 1/16″ thk; 3/16″ wd across flats; Friez #32933.	For locking adjusting screw on spiral drum.	6L3105–40–3.1A

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	NUT, hexagon: brass, nickel pl; 5/16"–18; 3/16" thk; 7/16" wd across flats; Friez #32810.	For eccentric screw	6L3505–18–7.1
	NUT, hexagon: brass, nickel pl; 5/16"–48; 15/16" thk; 3/4" wd across flats; w/6 radially drilled holes; Friez #40909.	Secures rocker frame pivot	7A1148–1
	NUT, round: brass, nickel pl; #10–32 thd; 3/16" thk; 3/4" diam; 3/32" radially drilled holes 90 deg apart; Friez #31730–B.	For rocker frame adjusting screw.	
	NUT, round: stainless steel; #5–40; 7/64" thk; 3/8" diam; Friez #31724.	For pivot screw locknut for tapper bar.	6L3655–40
	NUT, round: brass, nickel pl; 5/16"–48; 7/8" diam x 3/16" thk; w/6 radially drilled holes; Friez #31747.	For rocker frame	7AK1326–3/N1
	NUT, thumb: brass, nickel pl; 5/16"–18; 5/16" thk; 7/8" OD; knurled top; Friez #32425.	For fastening phototube and light disk to shaft.	6L3885–18–14.1
	OPTICAL SYSTEM: for optical disk; c/o optical elements in metal case; approx dimen 2 15/32" lg x 1" diam o/a; Friez #507406, ST–591.	Focuses photocell light source.	7AK1326–3/05I
	PIN, roller: stainless steel; 1 15/64" lg x 1/4" diam; w/head 3/64" thk x 1/4" diam; Friez #31769.	Secures tape guides to rocker frame.	7A1326–3/10
	POINTER, indicator: paper set; brass; nickel pl; 1 1/2" lg x 1 1/8" wd x 5/64" thk o/a; w/pointer 1 1/8" lg; Friez #36098.		7A1326–3/P4
R400	RESISTOR, fixed: comp; 3 meg ±5%; 2 w; max body dimen 1.78" lg x .405" diam; JAN type #RC42BF305J.	Grid, tube V401, pre-amplifier.	3RC42BF305J
R401	RESISTOR, fixed: comp; 1000 ohms ±10%; 2 w; max body dimen 1.78" lg x .405" diam; JAN type #RC42BF102K.	Cathode, tube V401, pre-amplifier.	3RC42BF102K
	RIBBON, printing: black; 1/2" wd; 36 ft. lg; metal spool; Fed spec DDD–R–311, type A, class #1.		
	ROLLER, guide: ribbon, lower; brass; nickel pl; 49/64" lg x 3/8" diam o/a; Friez #31767.		7A1326–3/G49
	ROLLER, guide: ribbon, upper; brass; nickel pl; 25/32" lg x 7/16" diam o/a; Friez #31768.		7A1326–3/G50
	ROLLER ASSEMBLY, guide: brass and rubber; c/o hub assembly, springs, and rubber rollers; 1 5/8" lg x 1 1/2" h x 1 1/2" d o/a; Friez #32790.	Maintains pressure on paper on chart roll.	7AK1326–3/R1
	SCREW, set: slotted, headless; stainless steel; #5–40; 5/8" lg w/cone point; Friez #32739.	For adjusting spiral drum assembly.	6L18505–10.35

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	SCREW, machine: Fil H; brass, nickel pl; #2–56; 5/16″ lg w/3/16″ lg thd; head 3/32″ thk x 3/16″ diam w/1/8″ lg x .125″ diam shoulder; Friez #32267.	For friction roller assembly. . .	6L15002–5.10
	SCREW, machine: Fil H; brass, nickel pl; #3–48; 7/32″ lg w/1/8″ lg thd; Friez #500255–4.	Secures cap spring holder on supply roll assembly.	6L6348–3–1.7
	SCREW, machine: F Fil H; brass, nickel pl; #4–40; 1/4″ lg w/13/64″ lg thd; head 3/32″ thk x 1/4″ diam; Friez #32211.	Secures long face pinion assembly to pinion shaft.	6L20804–5–1.54
	SCREW, machine: F Fil H; stainless steel; #5–40; 3/16″ lg w/9/64″ lg thd; head 3/32″ thk x 5/16″ diam; Friez #32222.	For idler gear and pullout arm catch.	6L20905–4–1.10
	SCREW, machine: F Fil H; brass, nickel pl; #5–40; 5/16″ lg w/.227″ lg thd; head 5/16″ diam x 1/16″ thk; 2 shoulders, .155″ diam x .069″ lg, 7/32″ diam x 1/64″ lg; Friez #31723.	Pivot screw for tapper bar. . . .	6L15005–6.54
	SCREW, machine: F Fil H; brass, nickel pl; #10–32; 3/4″ lg; 2 flats on thd end, 3/32″ across x 3/16″ lg w/.063″ hole through flats; Friez #31725.	For dogleg spring.	6L20810–7–1.4
	SCREW, machine: F Fil H; brass, nickel pl; #10–60; 11/16″ lg w/19/32″ lg thd; head 3/16″ thk x 5/16″ diam; Friez #31745.	Rocker frame stop screw.	6L7060–11.54
	SCREW, machine: F Fil H; brass, nickel pl; #12–32; 1/2″ lg; head 3/16″ thk x 5/16″ diam; Friez #32230.	Center adjusting.	6L7232–8.54
	SCREW, machine: hex head; brass, nickel pl; #10–32; 7/32″ lg w/5/32″ lg thd; head 3/32″ thk, 3/8″ across flats; Friez #32896.	For idler gear stud.	6L20810–5.81N
	SCREW, machine: RH; brass, nickel pl; #3–48; 1/4″ lg; Friez #500205–8.	Secures tape reverse assembly.	6L6348–5.5
	SCREW, set: hex socket; steel; nickel pl; #6–32; 1/8″ lg w/cup point; Friez #500718–4.	For meter mount assembly, recorder assembly, tape guide holders.	6L18506–2.40
	SCREW, set: hex socket; steel, nickel pl; #6–32; 3/16″ lg w/cup point; Friez #500718–6.	For tape guide holders.	6L18506–3.40
	SCREW, set: hex socket; hardened steel, nickel pl; #8–32; 1/8″ lg w/cup point; Friez #500719–4.	For contact brush holder.	6L18508–240.
	SCREW, thumb: knurled head; brass, nickel pl; #6–32; 11/32″ lg thd full lg; oval point; head 7/64″ thk x 13/32″ diam; Friez #502304.	Clamp for optical socket assembly.	6L17006–7–1.5
	SCREW, thumb: knurled head; brass, nickel pl; #10–32; 23/32″ lg w/1/4 lg thd; flat point; head 3/16″ thk x 15/32″ diam; shoulder 1/4″ diam x 3/8″ lg; Friez #32449.	Light adjusting screw for optical system.	6L7032–11–1.24

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	SCREW, thumb; knurled head; brass, nickel pl; #10–32 thd; 15/16″ lg w/27/32″ thd; flat point; head 1/8″ thk x 3/4″ diam; shank 1/4″ diam x 1/8″ lg on opposite side of head from thd; Friez #31727–A.	Rocker frame adjusting screw.	
	SHADE, lamp: reflector; bakelite; approx dimen 2 3/8″ lg x 1 1/2″ OD o/a; Friez dwg #500127, item #111.	Protects accessory lamp	6Z8100
	SOCKET, tube: std octal; isolantite; 1 7/8″ lg x 1 1/2″ wd x 3/4″ thk; Natl Co #CIR–8.	For preamplifier	2Z8678.53
	SPRING: helical compression; .013″ diam steel music wire, nickel pl; 7/16″ lg x 9/64″ OD; 7 turns; ends flat and sq; Friez #32900.	For contact brush holder	7A1326–3/S7
	SPRING: helical compression; .031″ diam music wire; 9/16″ lg x 9/32″ OD; 7 turns; plain flatted ends; Friez #31740.	For supply roll	7A1326–3/14
	SPRING: helical extension; .020″ diam music wire; 3/4″ lg x 3/16″ OD; close wound; .147″ diam parallel eye term; Friez #32740.	For friction finger	7A1326–3/18
	SPRING: helical extension; .041″ diam music wire; 1 1/16″ lg x 1/4″ OD; close wound; 1.4″ diam parallel eye term; Friez #32462.	For rocker return	7A1326–3/S6
	SPRING: helical extension; .020″ diam phosphor bronze wire; 1 3/8″ lg x 9/32″ OD; close wound; 1/8″ diam parallel eye term; Friez #32229.	Return for tapper bar	7A1326–3/S10
	SPRING: helical extension; .020″ diam music wire; 1 3/8″ lg x 3/16″ OD; close wound; 1/4″ diam parallel eye term; Friez #31722.	For doglegs	7A1326–3/S8
	SPRING: helical extension; .020″ diam nickel pl music wire; 1 11/64″ lg x 11/54″ OD; close wound; 1/8″ diam parallel eye term; Friez #35676.	For pull-out arm catch	7A1326–3/S9
	SPRING: helical extension; .021″ diam beryllium copper; 1 9/16″ lg x 9/64″ OD; approx 65 turns; 1/8″ diam parallel hook term; Sig C dwg #SC–D–14919–A, item 8.	For ribbon reversing	7A1326–3/21
	SPRING: helical extension; .032″ diam phosphor bronze music wire; 2″ lg x 9/32″ OD; close wound; 7/32″ diam parallel eye term; Friez #34173.	Antibacklash on meter mount assembly.	7A1326–3/S11
	SPRING: helical extension; .025″ diam music wire, nickel pl; 2 13/16″ lg x 1/4″ OD; close wound; 1/4″ diam parallel eye term; Friez #32779.	For rocker arm return	7A1326–3/13

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	STUD: stainless steel; 1 9/32" lg x 1/2" wd x 3/8" h o/a, shoulder .218" lg x 1/2" wd x 3/8" h; #5–40 x .283" d female thd 1 end, #10–32 x 1/4" d female thd other end; Friez #32234.	For paper drive idler gear	7A1687–3
	STUD: stainless steel; 43/64" lg x 1/2" wd x 3/8" h o/a, shoulder .235" lg x 1/2" wd x 3/8" h; #5–40 x .346" d female thd one end, #10–32 x 1/4" d female thd other end; Friez #32484.	For spiral drum idler gear	7A1687–3.1
	STUD: brass nickel pl; 11/16" lg x 1/2" diam o/a, shoulder 1/16" thk x 1/2" diam; 5/16"–18 x 11/32" lg male thd 1 end, #5–40" x 1/4" d eccentric female thd other end; Friez #32497.		7A1687–2
	STUD: brass; 1 15/16" lg 5/16"–48 thd 1 13/32" lg; Friez #31746.	For locknut on rocker frame	6L31224–1
	SUB-ASSEMBLY: recorder meter and mount; meter 0–500 ua; 10" lg x 8" h x 5" wd; Friez #35670.		7A1326–3/44
	SUB-ASSEMBLY: rocker frame; approx o/a dimen 12" lg x 6 1/2" wd x 5 1/4" h; Friez #AV573483.		
V400	TUBE, electron: JAN–921	Photocell	25921
V401	TUBE, electron: JAN–655	Preamplifier	2J655
	WINDOW, glass: 5 21/32" diam x 1/8" thk; #P–32264.	For microammeter on meter mount assembly.	2ZA1352–115
	WORM, gear: stainless steel; single LH thd; .379" OD x .187" bore x 5/8" lg; Friez #506916.	For rotating meter helical teeth.	7A1326–3/15
	WRENCH: set screw; 1/16" across flats; "L" shaped, 1 leg 1 3/4" lg other leg 1/2" lg; steel; Friez #500730–2.	For Allen No. 5 and No. 6 hex head socket set screws.	6R57400–6
	WRENCH: set screw; 5/64" across flats; "L" shaped, 1 leg 1 7/8" lg other leg 5/8" lg; steel; Friez #500730–3.	For Allen No. 8 hex head socket set screw.	6R57400
	WRENCH: spanner; for 3/4" diam serrated nut; 3 7/16" lg x 5/8" wd x 1/4" thk; steel; flat straight handle; Friez #36365.	Special for Friez #31747 nut	6R57505
	WRENCH: key set screw type; hex; 1/16" across flats; 7" lg x 5/16" across hex flats; brass handle; harden steel key; Friez #508593–1–B.	For Allen No. 5 or No. 6 set screw.	

8. Identification Table of Parts for Rack MT–678/FMQ–2

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RACK ASSEMBLY MT–678/FMQ–2: steel; empty; approx 72″ h x 28″ wd x 26″ d; includes folding table.	Houses radiosonde receptor components.	7A8337–47
	BOARD, terminal: 2 double brass, nickel pl screw term; molded bakelite; 1⅛″ wd x ½″ h x 1¾″; Jones HB #2–141.	Connection strips for meters. .	2Z9402.44
	CONNECTOR, female contact: 2 parallel pol cont; straight; 1⅜″ diam x $^{61}/_{64}$″; Hubbell #7257.	A-c connector for frequency meter and radiosonde receiver.	6Z3150–4
	CONNECTOR, female contact: 2 parallel cont; straight; 1½″ lg x 1$^{5}/_{16}$″ diam o/a; Hubbell #7084.	A-c connector for frequency Meter TS–29A/FMQ–1.	6Z3150–5
	CONNECTOR, female contact: 6 parallel cont; straight; 2$^{9}/_{16}$″ h x 1½″ wd x 1$^{1}/_{16}$″ thk o/a; Jones HB #S–406–CCT.	For control cable for frequency meter.	2ZK8639.10A
	CONNECTOR, male contact: JAN type #UG–21/V.	R-f input to receiver.	
	CONNECTOR, male contact: Sig C Plug PL–259; single round cont; straight 1½″ lg x $^{23}/_{32}$″ diam o/a; Sig C dwg #SC–D–5888.	R-f input to receiver.	2Z7226–259
	CONNECTOR, male contact: 2 rectangular pol cont; straight; 1$^{19}/_{32}$″ diam x 1$^{9}/_{32}$″ h; Hubbell "Twist Lock" #9105.	A-c input to rack assembly. . .	6Z7813
	KNOB: round; phenolic; for ¼″ diam shaft; 2 #8–32 set screws; w/white pointer; 1⅛″ diam x ⅝″ h; GR #637–A.	Antenna selector switch.	2ZK5822–32
	LAMP, incandescent: 120 v, 100 w; bulb A–23, inside frosted; medium screw base; Mazda #100–A23.	Dehumidifier lamps.	6Z6820–4
	LAMPHOLDER: medium screw base; porcelain body; base dimen 2$^{15}/_{16}$″ x 2$^{23}/_{32}$″ ; Hubbell #9402.	Sockets for dehumidifier lamps.	6Z7803–1
M500.	METER, voltmeter: A-C; 0–150V; round, bakelite flush mtg case; 2.695″ diam flange x 2.21″ diam body x 1.75″ d max body dimen; JAN type #MR25W150AC VV.	Indicates voltage of a-c power input.	3F8150–50
M501.	METER, frequency indicator: A-C; 58/62 cyc, 115 v; round, molded flush mtg case; 2$^{11}/_{16}$″ diam flange x 2$^{5}/_{32}$″ diam body x 1$^{29}/_{32}$″ d; J–B–T Inst #21–FX.	Indicates frequency of a-c power input.	3F2745–8
S500, S501, S505. . .	SWITCH, toggle: DPST; 25 amp; 125 v; bakelite body; 1$^{21}/_{64}$″ h x $^{49}/_{64}$″ wd x 1$^{1}/_{16}$″ d; JAN type #ST–52K.	S500: MASTER ON-OFF switch. S501: RECORDER ON-OFF switch. S505: Dehumidifier switch.	3Z9863–52K

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
S504	SWITCH, rotary: coaxial; 4 position connector plates and connectors brass silver pl; alum case; Friez #513621–B.	ANT. SELECTOR switch	

9. Identification Table of Parts for Frequency Meter TS–29B/FMQ–1

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	FREQUENCY METER TS–29B/FMQ–1: u/w radiosonde equip; 0–200 cps in 1 band; 28″ wd x 26″ d x 12″ h.	Indicates modulation frequency of radiosonde transmission.	
C600	CAPACITOR, fixed: electrolytic; 25 uf; 100 vdcw; max dimen 1 13/16″ lg x 1″ wd x 15/16″ h; JAN type #CE63F250H.	Cathode bypass, for tube V600.	3DB25–67
C602	CAPACITOR, fixed: paper; 20,000 uuf ±10%; 400 vdcw; max dimen 1 5/16″ lg x 1/2″ diam; JAN type #CP25A1EE203K.	Coupling to grid, V600	3DA20–157
C603 through C606	CAPACITOR, fixed: paper; 2 uf ±10%; 600 vdcw; body dimen 1 3/16″ lg x 3 1/4″ h x 1 1/16″ wd; JAN type #CP70E1BF205K (CP07FA4).	Power supply, filters	3DB2–73
C607	CAPACITOR, fixed: electrolytic; 50 uf; 25 vdcw; max dimen 1 13/16″ lg x 1″ wd x 15/16″ h; JAN type #CE63F500F.	L-f filter, meter circuit	3DB50–54
C608, C609	CAPACITOR, fixed: mica; 39,000 uuf ±2%; 600 vdcw; body dimen 1 25/32″ max lg x 1 11/32″ max wd x 49/64″ thk; JAN type #CM60B393G.	Coupling to plate, V607	3K6039323
C610	CAPACITOR, fixed: mica; 20,000 uuf ±2%; 1200 vdcw; body dimen 1 25/32″ max lg x 1 11/32″ max wd x 49/64″ thk; JAN type #CM60B203G.	Plate, for tubes V605 and V606. Refer to paragraph 55.	3K6020323
P600	CONNECTOR, male contact: 2 rectangular parallel cont; straight; body dimen 1 1/4″ diam x 1 1/4″ lg; Hubbell #4897.	A-c plug	6Z7816
P601	CONNECTOR, male contact: 6 phosphor bronze pol cont; straight; 1 7/16″ lg x 1″ wd x 13/16″ d less cont; Jones HB #P–406–AB.	Power connector	2Z7228.29
F600	FUSE, cartridge: 3 amp; 250 v; glass body; ferrule term; 1 1/4″ lg x 1/4″ diam o/a.	Overload protection	
E600	HOLDER, fuse: extractor post; for single #3AG fuse; bakelite; 250 v, 10 amp max; 2 1/8″ lg x 5/8″ OD; Littelfuse #341001.	Holds Fuse FU–27	3Z3275
E601, E602	KNOB, round: black bakelite; for 1/4″ diam shaft; 2 #10–32 set screws; white indicator line; 2 1/16″ diam x 7/8″ thk; ICA #1171.	For COARSE and FINE controls.	2Z5844–3

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
E603	KNOB, bar: black bakelite; for ¼" diam shaft; 2 #6–32 set screws; metal pointer ¼" lg attached; 1 3/16" lg x ¾" wd x 5/8" thk; Natl Co. #SA1690.	For INPUT control	2Z5821–65
I600	LAMP, incandescent: 6–8 v; .15 amp; bulb T–3¼ clear; 1⅛" lg o/a; miniature bayonet base; GE #47.	For pilot light	
J600	LIGHT, indicator: w/faceted green jewel; for T–3¼" miniature bayonet base lamp; steel socket and mtg frame; 1 7/16" lg x 15/16" diam o/a; Drake Mfg #50 (on-off indicator).	Pilot light	2Z5991–1
M600	METER, ammeter: D-C; 0 to 500 ua; fan shaped surface mtg, switchboard type case; pressed steel w/dull black finish; 6 3/16" h x 7⅞" wd x 3 3/16" d o/a; Weston #271.	Visual meter (0–100 divisions).	3FK875–7
L600, L601, L602	REACTOR: filter choke; single winding; 15/32 hy; 85ma, 375 ohms D-C resistance; 2⅞" lg x 2½" d x 4⅞" o/a.	Power supply filters	3C574A
R600	RESISTOR, fixed: comp; 1 meg ±10%; ½ w; max dimen .655" lg x .249" diam; JAN type #RC21BF105K.	Grid resistor, V600	3RC21BF105K
R601	RESISTOR, fixed: comp; 270,000 ohms ±10%; ½" w; max body dimen .655" lg x .249" diam; JAN type #RC21BF274K.	Isolation, grid circuit of tube V600.	3RC21BF274K
R602	RESISTOR, fixed: comp; 2400 ohms ±5%; ½" w; max body dimen .655" lg x .249" diam; JAN type #RC21BF242J.	Cathode resistor for tube V600.	3RC21BF242J
R603	RESISTOR, adjustable: WW; 4000 ohms ±10%; 20 w; 2" lg x 9/16" diam; IRC #DGA.	Series regulation	3Z6400–104
R604	RESISTOR, adjustable; WW; 10,000 ohms ±10%; 40 w; 3½" lg x ¾" diam excluding term; cement coated, moistureproof; IRC #ENA.	CALIBRATION control	
R605 through R608	RESISTOR, fixed: WW; 5000 ohms ±5%; 10 w; max dimen 2 1/16" lg x 5/8" diam; JAN type #RW56J502.	R605 and R606: Plate load, tube V607. R607 and R608: Plate loads, tubes V605 and V606.	3RW28520
R609, R610	RESISTOR, fixed: comp; 100,000 ohms ±10%; ½ w; max body dimen .655" lg x .249" diam; JAN type #RC21BF104K.	Grid limiters, tubes V605 and V606.	3RC21BF104K
R611	RESISTOR, fixed: comp; 24,000 ohms ±5%; ½" w; max body dimen .655" lg x .249" diam; JAN type #RC21BF243J.	Series plate, tube V600	3RC21BF243J

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R612	RESISTOR, variable (potentiometer): WW; 5000 ohms ±10%; 2 w; 3 term; body 1.28″ diam x .62″ d, shaft ¼″ diam x ½″ lg; screwdriver slot; JAN type #RA20A5A502AK.	EQUALIZER control	3RA6912
R613	RESISTOR, variable (potentiometer): WW; 2500 ohms ±10%; 2 w; 3 term; body dimen 1.28″ diam x .62″ d, shaft ¼″ diam x 1″ lg; JAN type #RA20A1RE252AK.	FINE control	3RA6314
R614	RESISTOR, variable (potentiometer): WW; 5000 ohms ±10%; 2 w; 3 term; body 1.28″ diam x 1″ lg; JAN type #RA20A1RE502AK.	COARSE control	3RA6916
R615	RESISTOR, fixed: WW; 900 ohms ±10%; 10 w; JAN type #RW32D901.	Part of voltage divider, power supply.	
R616	RESISTOR, adjustable: WW; 250 ohms ±10%; 25 w; 2″ lg x ¾″ diam; IRC #EMA.	Part of voltage divider, power supply.	3Z6025–107
R617	RESISTOR, adjustable: WW; 7500 ohms ±10%; 50 w; 4½″ lg x ¾″ diam; IRC #EPA.	Series regulation	3Z6575–4.1
R618	RESISTOR, fixed: WW; 1200 ohms ±10%; 10 w; 1¾″ x 5/16″ diam; Ohmite "Brown Devil" (used on order No. 11092–SCGDL–43 only).	Part of voltage divider power supply.	3ZK5412
R619	RESISTOR, fixed: WW; 450 ohms ±5%; JAN type #RW55J451.	Part of voltage divider, power supply.	
X600, X603, through X607.	SOCKET, tube: std octal; isolantite; 1⅞″ lg x 1½″ wd x ¾″ thk; Natl Co. #CIR–8.		2Z8757.3
X601, X602	SOCKET, tube: std 4 cont; isolantite; 1⅞″ lg x 1½″ wd x ⅜″ thk; Natl Co. #CIR–4.		2Z8678.53
S600	SWITCH, rotary: 2 pole, 3 position; single sect; isolantite body; 1 25/32″ lg x 1⅞″ x 1½″ o/a; Oak #22743–HIC.	INPUT switch	3Z9825–62.256
S601	SWITCH, toggle: DPST; 30 v, 30 amp; bakelite body; 49/64″ wd x 1 21/64″ h x 1 1/16″ lg; momentary off, normally closed; JAN type #ST–52L.	DEIONIZE switch	3Z9849.113
S602	SWITCH, toggle: DPST; 125 v, 6 amp; bakelite body; max body dimen 1 25/32″ h x 23/32″ wd x 31/32″ d; JAN type #ST–26K.	POWER ON-OFF switch	3Z9863–26K
T600	TRANSFORMER, A-F: plate coupling type; pri 10,000 ohms, secd 40,000 ohms impedance, CT; drawn steel, upright fully shielded case; 2½″ diam x 3¼″ h; HS; UTC #86884.	Coupling, plate circuit of V600 and grid circuits of V605 and V606.	7A1860–4

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
T601	TRANSFORMER, power: plate and fil; pri 115 v, 50/60 cyc; secd #1, 435/365/CT/365/435 v, 125 ma; secd #2, 250 v, 25 ma, CT; secd #3, 6.3 v, 3 amp, CT; secd #4, 5 v, 3 amp; secd #5, 5 v, 3 amp; HS; 5¾" lg x 5¾" h x 4½" d; Natl Co. #J104.	Power	7A1860.2–4
V601, V602	TUBE, electron: JAN–543GT/G	Rectifiers	2J543GT/G
V603	TUBE, electron: JAN–OD3/VR–150	Gas regulator	2JOD3/VR150
V604	TUBE, electron: JAN–OA3/VR–75	Gas regulator	2JOA3/VR15
V605, V606	TUBE, electron: JAN–884	Thyratrons	2J884
V607	TUBE, electron: JAN–6ZY5G	Rectifier	2J6ZY5G
	WASHER, cup: brass, nickel pl; ¼" ID, 9/16" OD x ⅛" thk; Grammes Wire Prod #2222.		6L50244N1
	WRENCH: set screw; "L" shaped; legs 1¾" lg and ½" lg; 1/16" across flats; Allen #6.		6R57400–6

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