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Marlyene A. Harrison; Chief, Freedom of Information (NAIC/MSIR), Air Intelligence Agency, Wright-Patterson AFB, OH...

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OPERATIONS ANALYSIS REPORT

A SHORT SURVEY OF JAPANESE RADAR
VOLUME III

20 November 1945

Prepared by
2d & 3d Operations Analysis Section, FEAF
and
Air Technical Intelligence Group, FEAF
(ATIG Report No. 115)

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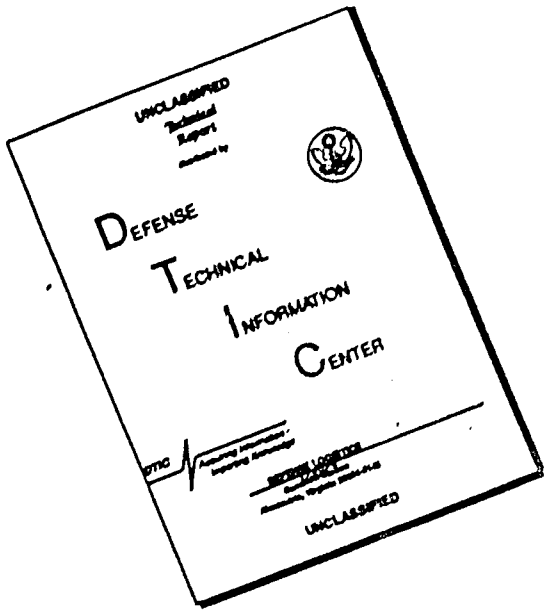

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A SHORT SURVEY OF JAPANESE RADAR

Volume III

Table of Contents

Table of Contents (Continued)

V - JAPANESE NAVY RADARS - EQUIPMENT MANUFACTURED AND PLANNED

1. General. The same introductory remarks apply to the "Navy Radar Book" as to the "Army Radar Book" of Section IV (Volume II). In the following pages the principal navy sets are briefly described with block diagrams and with pictures where new ones taken in Japan are available. The Japanese Navy built a complete line of ground based early warning and fire control equipment quite independent of those used by the army. They also built airborne search and track radars for their bombers and night fighters which, while similar to the army's sets, were of their own design. The navy did not, however, build or operate any Type A (Doppler principle air warning) sets. The equipment described in this ~~section then~~ will all be Type B (impulse principle), except for the FM low altitude altimeter.

The information and block diagrams were supplied principally by members of the electronics division of the Second Naval Technical Institute, Imperial Japanese Navy. Certain data, however, are from manufacturers and other sources.

TABLE OF RADARS OF THE JAPANE

Prepared for the U S N, 5th Fleet.

A. Land-Based Radars

No.	Name	Designation	Object	Research started	Research finished	Remarks	Installation	Frequency (wave length)	Power Output (Peak)	Pulse length	Repetition Frequency	Transmitter: Oscillation Circuit	Transmitter: Oscillator Valve	Receiver: Intermediate Frequency	Receiver: Detector	Receiver: Local Oscillator	Sca
1	Mark-1 Model-4	14	Long range anti-air warning	1945 1	1945 5	in use	Bonin Islands	50 Mc (6 m)	100 kW	20 μs	250 ps		TR-594A ×2	8.5 Mc	UN-954	UN-955	120
2	Mark-3	RD	Anti-air warning	1941 11	1942 10	replaced, but not used	Important Bomb ns used	5 m	500 kw	Continuous			P-220 ×2	3.5Mc, 200kc	UN-954	UN-955	75
3	Type-2 Mark-1 Model-1	11	Anti-air warning	1941 4	1942 3	out of use	Iwo Jima	188 Mc (3 m)	5 kW	20 μs	1,000 ps	Resonator-type	TR-593A ×2	21.5Mc, 3.5Mc	UN-954	UN-955	120
4	Type-2 Mark-1 Model-1-B	11-1	Anti-air warning	1941 11	1942 5	out of use	Iwo Jima	100 Mc (3 m)	5 kW	20 μs	1,000 ps	LC-Circuit	TR-593A ×2	21.5Mc, 3.5Mc	UN-954	UN-955	120
5	Type-2 Mark-1 Model-1-2	11-2	Anti-air warning	1942 5	1943 5	in use	Iwo Jima	100 Mc (3 m)	40 kW	20 μs	500 ps	LC-Circuit	TR-1501 ×2	21.5Mc, 3.5Mc	UN-954	UN-955	120
6	Type-2 Mark-1 Model-1-3	11-3	Anti-air warning	1943 5	1943 7	in use	Iwo Jima	100 Mc (3 m)	40 kW	20 μs	500 ps	LC-Circuit	TR-1501 ×2	21.5Mc, 3.5Mc	UN-954	UN-955	75
7	Prototype Air Warning Radar	11-3 Kai	Anti-air warning	1945 1	1945 5	not yet used	Iwo Jima	100 Mc (3 m)	40 kW	20 μs	500 ps	LC-Circuit	TR-1501 ×2	21.5Mc, 3.5Mc	UN-954	UN-955	75
8	Type-3 Mark-1 Model-3 (Land-based)	13	Small size anti-air warning	1943 4	1943 8	in use	Iwo Jima	150 Mc (2 m)	10 kW	10 μs	500 ps	LC-Circuit	T-311 ×2	14.5Mc	UN-954	UN-955	75
9	Type-3 Mark-1 Model-1	11-K	Medium size anti-air warning	1943 5	1943 10	in use	Iwo Jima	150 Mc (2 m)	10 kW	20 μs	500 ps	LC-Circuit	T-311 ×2	21.5Mc, 3.5Mc	UN-954	UN-955	75
10	Type-2 Mark-1 Model-2	12	Portable anti-air warning	1942 4	1942 12	in use	Iwo Jima	200 Mc (1.5 m)	5 kW	10 μs	1000 ps	LC-Circuit	T-310 ×2	21.5Mc, 3.5Mc	UN-954	UN-955	120
11	Type-2 Mark-1 Model-2-2	12-Kai 2	Portable anti-air warning	1944 8	1945 12	in use	Iwo Jima	150 Mc (2 m)	5 kW	10 μs	1000 ps	LC-Circuit	T-310 ×2	21.5Mc, 3.5Mc	UN-954	UN-955	120
12	Type-2 Mark-1 Model-2-3	12 Kai 3	Portable anti-air warning	1944 5	1944 9	in use	Iwo Jima	150 Mc (2 m)	5 kW	10 μs	500 ps	LC-Circuit	T-310 ×2	21.5Mc, 3.5Mc	UN-954	UN-955	75
13	Prototype Mark-4 Model-3	L_2	Search-light control	1944 1	1944 4	out of use	Battery	1.5 m	7 kW	4 μs	1000 ps	LC-Circuit	T-311 ×2	14.5Mc	UN-954	UN-955	Same as above
14	Prototype Mark-4 Model-3-1	L_{21}	Search-light control	1944 1	1944 4	in use	Battery	1.5 m	10 kW	3 μs	1000 ps	LC-Circuit	TA-1504 ×2	15 Mc	UN-954	UN-955	75
15	Prototype Mark-4 Model-3-2	L_{22}	Search-light control	1944 4	1945 7	in use	Battery	1.5 m	13 kW	3 μs	1000 ps	LC-Circuit	TA-1504 ×4	15 Mc	UN-954	UN-955	75
16	Prototype Mark-4 Model-1	S_3	Anti-aircraft fire control	1942 8	1944 8	in use	Battery	1.5 m	13 kW	3 μs	1000 ps	LC-Circuit	TA-1504 ×4	15 Mc	UN-954	UN-955	Same as above
17	Prototype Mark-4 Model-2	S_{32}	Anti-aircraft fire control	1943 1	1944 10	in use	Battery	1.5 m	13 kW	3 μs	1000 ps	LC-Circuit	TA-1504 ×4	14.5Mc	UN-954	UN-955	75
18	Prototype Radar for A.A. Control	S_{2A}	Anti-aircraft fire control	1944 9	1946 12	not yet used	Battery	58 cm	6 kW	1.5 μs	3750 ps	Resonator-type, Oscillator-Mixer, Local-oscillator, Beacon-receiver Oscillator (Paraboloid mirror)	T-221 ×2	21.5Mc, 8.75Mc	2400	UN-955B	75
19	Prototype Mark-6 Model-1	61 (S_{61})	Altitude measurement	1944 12	1945 4	in use	Air Fields	60 cm	150 kW	2.5 μs	(1875 ps) 1,000 ps	Resonator-type, Oscillator-Mixer, Local-oscillator, Beacon-receiver Oscillator (Paraboloid mirror)	RT-326	21.5Mc, 8.75Mc	2400	UN-955B	75
20	Prototype Mark-6 Model-2	62	Friend aircraft locator	1945 1	1945 6	not yet used	Air Fields	2 m	10 kW	10 μs	500 ps	LC-Circuit	T-311 ×2	14.5 Mc	UN-954 (Mixer-2)	UN-955	Same as above
21	Prototype Mark-6 Model-3	63	Foe aircraft locator	1945 1		in development	Air Fields	3 m	40 kW	20 μs	416.7 ps	LC-Circuit	T-311 ×2	21.5Mc, 3.5Mc	UN-954	UN-955	75
22	Radar to guide boats	FH	To guide friendly boats	1944 12	1945 7	in development	Sea Shore	1.5 m	13 kW	4 μs	1000 ps	LC-Circuit	TA-1504 ×4	15 Mc	UN-954	UN-955	
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B. Shipborn Radars

No.	Name	Designation	Object	Research started	Research finished	Remarks	Installation	Frequency (wave length)	Power Output (Peak)	Pulse Length	Repetition Frequency	Transmitter: Oscillation Circuit	Transmitter: Oscillator Valve	Receiver: Intermediate Frequency	Receiver: Detector	Receiver: Local Oscillator	Sca
1	Type-3 Mark-1 Model-3	13 (for Ship)	Anti-air warning	1943 9	1944 2	in use	Both Sides of Mizzen mast	2 m	10 kW	10 μs	500 ps	LC-Circuit	T-311 ×2	14.5 Mc	UN-954	UN-955	75
2		13 (for Submarine Anti-Air Surface)	Anti-air warning	1943 9	1944 5	in use	Iwo Communication Mast	2 m	10 kW	10 μs	500 ps	LC-Circuit	T-311 ×2	14.5 Mc	UN-954	UN-955	75
3		13 (for Submarine Anti-Surface)	Anti-air warning	1943 9	1944 7	in use	Iwo Conning Tower	2 m	10 kW	10 μs	500 ps	LC-Circuit	T-311 ×2	14.5 Mc	UN-954	UN-955	75
4		13 (for Small Vessels)	Anti-air warning	1943 9	1944 7	in use	Foremast	2 m	10 kW	10 μs	500 ps	LC-Circuit	T-311 ×2	14.5 Mc	UN-954	UN-955	75
5	Type-2 Mark-2 Model-1	21	Anti-air warning	1942 1	1943 4	in use	Bridge (covered, Pendant use)	1.5 m	5 kW	10 μs	1000 ps	LC-Circuit	T-310 ×2	21.5 Mc	UN-954	UN-955	120
6		21 Kai 1	Anti-air warning	1942 6	1942 12	out of use	Fore top	1.5 m	5 kW	10 μs	1000 ps	LC-Circuit	T-310 ×2	21.5 Mc	UN-954	UN-955	120
7		21 Kai 2	Anti-air warning	1943 1	1943 6	in use	Fore top	1.5 m	5 kW	10 μs	1000 ps	LC-Circuit	T-310 ×2	21.5 Mc	UN-954	UN-955	120
8		21 Kai 3	Anti-air & anti-surface warning	1943 8	1944 2	out of use	Fore top	1.5 m	10 kW	1 μs	1000 ps	LC-Circuit	T-311 ×2	14.5 Mc	UN-954	UN-955	75
9		21 Kai 4	Anti-air warning and anti-surface warning	1944 4	1944 9	research stopped	Fore top	1.5 m	10 kW	1 μs	1000 ps	LC-Circuit	T-311 ×2	14.5 Mc	UN-954	UN-955	75
10		21 Kai 5	Anti-air warning and anti-surface fire control	1944 5	1944 9	not yet used	Fore top	1.5 m	10 kW	1 μs	1000 ps	LC-Circuit	T-311 ×2	14.5 Mc	UN-954	UN-955	75
11		F8	Anti-surface warning	1944 5	1944 10	research stopped		1.5 cm	1 kW	1 μs	1000 ps	Resonator-type	1N	21.5Mc, 8.75Mc	2400	UN-955B	120
12	Type-3 Mark-2 Model-3	23 (Sg)	Anti-surface fire control	1943 10	1944 3	not yet used	Fore top	20 cm	5 kW	1 μs	1000 ps	Resonator-type		21.5Mc, 8.75Mc	2400	UN-955B	120
13	Prototype Mark-2 Model-4	24	Anti-surface fire control	1943 11	1945 4	research stopped		10 cm	1 kW	1 μs	1000 ps	Resonator-type, Rotating wave		15 Mc	Crystal		75
14	Prototype Mark-2 Model-2	22 Kai 1	Anti-surface warning	1941 10	1942 6	out of use	Fore or Mizzen Mast	10 cm	500 w	10 μs	2,500 ps	Magnetron	V-57	Super-regenerative	M-66		120
15		22-Kai 2	Anti-surface warning	1942 6	1942 12	out of use	Fore or Mizzen Mast	10 cm	2 kW	10 μs	2,500 ps	Magnetron	V-57	Autodyne	M-66 A		120
16		22-Kai 3	Anti-surface warning	1942 10	1943 6	in use	Conning Tower of Submarine	10 cm	2 kW	10 μs	667 ps	Magnetron	V-57	14.5 Mc	Crystal	M-66	75
17		22-Kai 4	Anti-surface warning	1943 12 (T2) 1944 4 (T3)	1944 9	in use	Fore or Mizzen Mast	10 cm	2 kW	10 μs	1,500 ps	Magnetron	V-57	14.5 Mc	Crystal	M-66	75
18	Prototype Mark-3 Model-1	220	Anti-surface fire control	1944 2	1945 3	not yet used	Fore Mast, Sea Shore	10 cm	2 kW	10 μs	1,500 ps	Magnetron	V-57	14.5 Mc	Crystal	M-66	75
19	Prototype Mark-3 Model-3	$105S_1$	Anti-surface fire control	1944 6	1945 1	research stopped		10 cm	2 kW	10 μs	1,500 ps	Magnetron	V-57	14.5 Mc	Crystal	M-66	75
20	Prototype Mark-3 Model-2	$105S_2$	Anti-surface fire control	1944 2	1944 9	not yet used	Fore Mast of Battle ship, Sea Shore	10 cm	2 kW	10 μs	1,500 ps	Magnetron	V-57	14.5 Mc	Crystal	M-66	75
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C. Airborn Radars

No.	Name	Designation	Object	Research started	Research finished	Remarks	Installation	Frequency (wave length)	Power Output (Peak)	Pulse Length	Repetition Frequency	Transmitter: Oscillation Circuit	Transmitter: Oscillator Valve	Receiver: Intermediate Frequency	Receiver: Detector	Receiver: Local Oscillator	Sca
1	Type 3 Air Mark-6 Model-4 Radar	H-6	Patrol and search	1941 11	1942 9	in use	Large & Small Aircraft, Observer's Seat	2 m	2 kw	1 μs	1,000 ps	Blocking Oscillator		14 Mc	Fine 1N21 Fine 2405A	UN-954	120
2	Type-4 Air Mark-6 Model-3 Radar	FM-3	Patrol and search	1944 2	1944 9	out of use	Small Aircraft, Observer's Seat	2 m	2 kw	1 μs	1,000 ps	Modulated Oscillator		14 Mc	Fine 1N21 Fine 2405A	UN-954	120
3	Prototype 19 Air Mark-1 Model-12 Radar	FH-4	Patrol and search	1944 10	1945 6	not yet used	Small Aircraft, Observer's Seat	2 m	2 kw	1 μs	1,000 ps	Blocking Oscillator		14 Mc	Fine 1N21 Fine 2405A	UN-954	75
4	warning Radar for Large Aircraft	FW-4	Patrol and search	1944 6	1947 7 (research stopped)	not yet used		2 m	2 kw	1 μs	1,000 ps	Modulated Oscillator		14 Mc	Fine 1N21 Fine 2405A	UN-954	120
5	Prototype 19 Air Mark-1 Model-11 Radar	N-6	Patrol and search	1943 3	1944 10 (research stopped)	not yet used	Small Aircraft, Observer's seat	4.2 m	2 kw	1 μs	1,000 ps	Modulated Oscillator		14 Mc	Fine 1N21 Fine 2405A	UN-954	75
6	Prototype 18 Air Mark-6 Model-2 Radar	FD-1	Patrol and search	1944 12	1944 2 (research stopped)	not yet used		60 cm	2.5 kw	4 μs	1,000 ps	Modulated Oscillator		14 Mc	Fine 1N21 Fine 2405A	UN-954	75
7	Prototype 18 Air Mark-6 Model- Radar	FD-2	Night fighter	1944 6	1944 8	not yet used	Transmitter, Receiver, Indicator, Ba	60 cm	2.5 kw	4 μs	1,000 ps	Modulated Oscillator		14 Mc	Fine 1N21 Fine 2405A	UN-954	75
8	Prototype 19 Air Mark-2 Model-11 Radar	Spacker-3	Night fighter	1944 9	1945 7	not yet used		2 m	3 kw	4 μs	1,500 ps	Modulated Oscillator		14 Mc	Fine 1N21 Fine 2405A	UN-954	75
9	Prototype 5 Model-1 (F.C.)	M-13	F.C. Transmitter-receiver	1944 10	1945 7	not yet used	Bottom	2 m	50 kw			Modulated by Thyratron	5D4				
10	Prototype Model-1 Height Measuring Radar	FH-1	Height measure		1945 7	in use	In the Wings	66 cm	0.1 kw	Continuous		Self Oscillator					
11	Prototype 19 Air Mark-3 Model-10 Radar	S-1	Night fighter	1944 9		in use		10 cm	6 kw	1 μs	1,000 ps	Magnetron	V-57A			UN-954	120
12	Prototype 7 Air Mark-7 Model-2 Radar	FTB	Radar counter measure	1944 1	1944 6	not yet used	Large Air craft, Observer's Seat										
13	Prototype 7 Air Mark-7 Model-1 Radar	FTC	Radar counter measure				Large Aircraft, Observer's Seat										

D. Land-Based and Shipborn Radar Counter Measure

No.	Name	Designation	Object	Research started	Research finished	Remarks	Installation	Frequency Band (wave length)
1	Radar Counter Measure Mod-3	27	R.C.M. for meter wave	1944 1	1944 6	in use	Surface and Submarine Ships and Submarine Ships Fore and Submarine Ships Land	75 Mc – 6 Mc 6 Mc – 0.75 m 600 Mc – 1000 Mc 10 m – 0.03 m
2	Radar Counter Measure Model-3		R.C.M. for meter wave	1944	1944 6	in use		
3	Rocket antenna		R.C.M. for meter wave	1943 6	1944 12	in use	Surface and Submarine Ships	6 m – 0.75 m
4	Meteor antenna		R.C.M. for meter wave	1943 6	1944 12	in use	Surface and Submarine Ships	6 m – 0.75 m
5	Ø antenna		R.C.M. for meter wave	1944 6	1944 12	not yet used	Surface and Submarine Ships	6 m – 0.75 m
6	Mark-60 Antenna		R.C.M. for meter wave	1944 6	1944 12	in use	Surface and Submarine Ships	6 m – 0.03 m
7	Spherical Antenna		R.C.M. for meter wave	1945 3	1945 7	not yet used	Surface and Submarine Ships	0.15 m – 0.03 m

RADARS OF THE JAPANESE NAVY

October 25, 1945

RADAR DEPATMENT,
THE SECOND NAVAL TECHNICAL INSTITUTE.

Transmitter: Application	Transmitter: Oscillator Valve	Receiver: Intermediate Frequency	Receiver: Detector	Receiver: Local Oscillator	Scope Representation: Disp.	Scope Representation: Sweeping Axis	Scope Representation: Scale	Antenna: Type	Antenna: Gain	Antenna: Beam Angle Horizontal	Antenna: Beam Angle Vertical	Max. Range: Mean Scale Effective	Max. Range: Max. Scale Effective	Min. Distance	Accuracy of Range: Indication	Accuracy of Range: Distance Determination	Accuracy of Bearing: Indication	Accuracy of Bearing: Angle Determination	Spare Parts	No. of Operators	Degree of Operating Difficulty	Maintenance	No.
	TR-586A ×2	8.5 Mc	UN 956	UN-955	120.	Sector Sweep.	Electric	Multiple Yagi Ant.	14 db	±15°	±15°	550 m 460 m				± 5 km	± 5 km	± 5°~6°	~ 30°		3	None	Almost no Trouble	1
	P-220 ×2	3.5Mc, 200c.	UN 956	UN-955	75.	Linear		Horizontal Dipole with Reflector	3 db	60°		200 m						—			4	None	Ordinary	2
	TR-593A ×2	215Mc, 35Mc	UN 956	UN 955	120.	Linear	Electric	Yagi Ant. 3×2 Rec. Ant. 3×2	12.5 db 12.5 db	±14°	±40°	150 m 150 m	150 m	5 m	±5~2m	3 km	± 2°~3°	~ 30°		2	2	Slight		3
	TR 593A ×2	215Mc, 35Mc	UN 956	UN 955	120	Linear	Electric	Yagi Ant. 3×2 Rec. Ant. 3×2	12.5 db 12.5 db	±14°	±40°	150 m 150 m	150 m	5 m	±1~2m	3 km	± 2°~3°	~ 30°			2	None		4
	TR-1501 ×2	215Mc, 35Mc	UN 956	UN 955	120.	Linear	Electric	Yagi Ant. 2×4 Rec. Ant. 3×6	12 db 14 db	± 32° ± 22°	±17°	300 m 200 m	300 m	5 km	±1~2km	3 km	± 3°~4°	~ 20°				None		5
	TR-1501 ×2	215Mc, 35Mc	UN 956	JN 955	75.	Linear	Optical	Yagi Ant. 2×4 Rec. Ant. 3×6	12 db 14 db	± 32° ± 22°	±17°	300 m 200 m	300 m	5 km	±1~2km	3 km	± 3°~4°	~ 20°			2	None	Ordinary (As Part Trouble)	6
	TR-1501 ×2	215Mc, 35Mc	UN 956	UN-955	75.	Warning: Linear Range, Bearing: Manual		Combination 5×3 + 4×4	16.5 db	±11°	±17°	300 m 200 m	300 m	5 km	±1~2km	3 km	~ ±1°	~ 20°				None		7
	T - 311 ×2	14.5 Mc	UN 954	UN 955	75.	Linear	Mechanical	Combination 6×3 + 2×6	12 db	± 32°	±17°	150 m 150 m	150 m	5 km	±2~3km	3 km	±10°	~ 60°	Monitoring Vacuum Tubes in Use ×3	2		None		8
	T - 311 ×2	215Mc, 35Mc	UN 954	UN-955	75.	Linear	Optical	Combination 6×3 + 2×6	16 db	±17°	±16°	150 m 150 m	150 m	5 km	±2~3km	3 km	± 3°	~ 30°			2	None		9
	T - 310 ×2	215Mc, 35Mc	UN 954	UN 955	120	Linear	Electric	Tx. Ant. 6×2 Rec. Ant. 6×2	14 db 14 db	±11°	±40°	150 m 100 m	150 m	5 km	±1~2km	2 km	± 5°	~ 20°	Number of Resistances in Use ×3			None	Ordinary (As Part Trouble in Main Transmitting Room)	10
	T - 310 ×2	215Mc, 35Mc	UN 954	UN 955	120	Linear	Electric	Combination 5×3 + 4×4	16.5 db	±14°	±35°	150 m 100 m	150 m	5 km	±1~2km	2 km	± 7°	~ 30°				None		11
	T - 310 ×2	215Mc, 35Mc	UN 954	UN 955	75	Linear	Mechanical	Tx. Ant. 2×6 Rec. Ant. 2×6	12 db	± 32°	±17°	300 m 150 m	300 m	5 km	±2~3km	2 km	±10°	~ 60°	Number of Resistances in Use ×3			None		12
	T - 311 ×2	14.5 Mc	UN 954	UN 955	Selective Reception 75		120 & Logarithmic	Yagi Ant. 6×2	16 db	A-Scope ± 21° B-Scope ± 20°	± 50 B-20°	150 m 80 (20) m	1500 m	200 m	± 5°	1000 m	± 5°	~ 40°				None		13
	TA 1504 ×2	15 Mc	UN 954	UN 955	75.	Logarithmic	Electric	Multiple Yagi, Yagi 1+2 Rec. 2×6	5 db 15 db	A-20°~11° A-30°~11° B-30°~30° B-30°~30°		15 (30)	1000 m	150 m	500 m	± 15°	± 30°				None		14
	TA 1504 ×4	15 Mc	UN 954	UN 955	75.	Logarithmic	Electric	Multiple Yagi, Yagi 1+2 Rec. 2×6	8 db 15 db	—	—	150 20 (40)	600 m	100 m	50 m	± 15°	10				None		15
	TA 1504 ×4	15 Mc	UN 954	UN 955	Sector Sweep, Range Measurement 75	Logarithmic	120 & Electric	Tx. Ant. 4×4 Rec. Ant. 4×6 2×6	15 db 15 db	—	—	300 20 (40)	1500 m	100 m	1000 m	± 1°	± 10°				None	Troubles of Parts Frequently	16
	TA 1504 ×4	14.5 Mc	UN 954	UN 955	75	Logarithmic	Electric	Yagi, Tx. & Rec. 2×6	16 db	A-30°~11° A-30°~11° B-30°~30° B-30°~30°		150 20 (50)	600 m	50 m	500 m	± 1°	± 10°				None		17
	T - 321 ×2	215Mc, 375Mc	2400	UN 955B	75	Warning: Linear Range & Bearing: Manual		Paraboloid 75 cm	33 db	± 10°	± 10°	150 m 100 m	6,000 m	50 m	Kanawa Hospital	± 0.6°	Kanawa Hospital				None		18
	RT 326	215Mc, 875Mc	2400	UN 955B	75.	Warning: Linear Range & Bearing: Manual		Paraboloid 75 cm	33 db	± 4°	± 4°	150 m 100 m	6,000 m	200 m	Beach Hospital	± 0.6°	Kanawa Hospital				None		19
	T 311 ×2	14.5 Mc	UN 954 Mo-2	UN 955	Selective Reception 120 75	Logarithmic	Electric	2×4 vertical	16.5 db	± 11°	± 17°	150 m 100 m	1,000 m	150 m	500 m	± 0.6°					1st Adjustment Difficult	At first Many Troubles Broke Down, but yet Trouble	20
	T 311 ×2	215Mc, 35Mc	UN 954	UN 955	75	Linear	Electric	Combination 5×3 + 4×4	16.5 db	± 11°	± 17°	300 m 200 m	Kanawa Hospital	1,000 m	Beach Hospital	Kanawa Hospital					Ordinary	Ordinary	21
	TA 1504 ×4	15 Mc	UN 954	UN 955				Combination 6×3 + 2×6	16.5 db	± 11°	± 17°	40 20		150 m	1000 m	± 1°							22
																							23
																							24
																							25

Transmitter: Application	Transmitter: Oscillator Valve	Receiver: Intermediate Frequency	Receiver: Detector	Receiver: Local Oscillator	Scope Representation: Disp.	Scope Representation: Sweeping Axis	Scope Representation: Scale	Antenna: Type	Antenna: Gain	Antenna: Beam Angle Horizontal	Antenna: Beam Angle Vertical	Max. Range: Mean Scale Effective	Max. Range: Max. Scale Effective	Min. Distance	Accuracy of Range: Indication	Accuracy of Range: Distance Determination	Accuracy of Bearing: Indication	Accuracy of Bearing: Angle Determination	Spare Parts	No. of Operators	Degree of Operating Difficulty	Maintenance	No.
	T - 311 ×2	14.5 Mc	UN 954	UN 955	75	Linear	Mechanical	2×4 Horizontal	12 db	± 32°	±17°										None	Few Troubles	1
	T - 311 ×2	14.5 Mc	UN 954	UN 955	75	Linear	Mechanical	2×4 vertical	16 db	± 11°	±16°									2	None	Antenna System gave Trouble	2
	T - 311 ×2	14.5 Mc	UN 954	UN 955	75	Linear	Mechanical	Yagi Ant.	7 db	±30°	±27°								Number of Vacuum Tubes in Use ×3		None	do	3
	T - 311 ×2	14.5 Mc	UN 954	UN 955	75	Linear	Mechanical	2×4 Ant.	12 db	± 11°	±17°										None	do	4
	T - 310 ×2	215Mc, 35Mc	UN 954	UN 955	120	Linear	Electric	6×2 Ant. 6×2 Ref.	11 db 14 db	± 11°	±40°	150 m 100 m	150 m	5 km	±1~2km	2 km	± 5°	~ 20°	Number of Resistances in Use ×3		None		5
	T - 310 ×2	215Mc, 35Mc	UN 954	UN 955	120	Linear	Electric	4×2 Ant. 3×2 Ref.	12 db 14 db	± 17° ± 22°	±40°	150 m 100 m	150 m	5 km	±1~2km	2 km	± 5°	~ 20°	in Use ×3		Slight	Antenna System gave Trouble	6
	T - 310 ×2	215Mc, 35Mc	UN 954	UN 955	120	Linear	Electric	4×3 Ant.	14 db	± 17°	±30°	150 m 100 m	150 m	5 km	±1~2km	2 km	± 5°	~ 20°	Number of Resistances in Use ×3		None	No Trouble	7
	T - 311 ×2	215Mc, 35Mc	UN 954	UN 955	75	Linear	Optical Electric	4×3 Ant.	14 db	± 17°	±30°	150 m 100 m	150 m	5 km	±1~2km	2 km	± 5°	~ 20°	Number of Resistances in Use ×3	3	Difficult	Trouble in Beach Area	8
	T - 311 ×2	215Mc, 35Mc	UN 954	UN 955	120.	Linear	Electric	4×4 Horizontal	15 db	± 17°	±30°	150 m 100 m	150 m	5 km	±1~2km	2 km	± 5°	~ 20°			Difficult	Trouble in Beach Area	9
	T - 311 ×2	215Mc, 35Mc	UN 954	UN 955	120.	Linear	Electric	4×4 Horizontal	15 db	± 17°	±17.5°	150 m 100 m	150 m	5 km	±1~2km	2 km	± 5°	~ 20°			Difficult	Ordinary	10
	SN 7 ×2	215Mc, 875Mc	2400	UN 955B	120	Curve	Mechanical	Tx. Parabolic 1.2m dia. Rec. 2 No. Rotating	11 db 11 db	± 25°	± 25°	33 33	1 km	Beach Hospital	150 m	± 3°	Beach Hospital			1	None	Not yet Tested	11
	T 321	215Mc, 875Mc	2400	UN 955B	75	Warning: Linear Range & Bearing: Manual		Tx. Parabolic 1.2m dia. Rec. 2 No. Rotating	11 db 11 db	± 25°	± 25°	33 33	1 km	Beach Hospital	150 m	± 3°	14°			1	None	Trouble in Beach Area	12
	LO 2×2 ×2	15 Mc	Crystal	LO 1	75	Logarithmic	Electric	Tx. Parabolic 2.4m dia. Rec. 2 No. Rotating	13 db 13 db	± 9°	± 9°	33 33	5 km	± 150 m	150 m	± 0.5°	14°			3	None	Some Area Trouble	13
	M 310		M 60		120	Linear	Electric	Parabolic 0.8×1.7m	15 db	± 15°	± 15°	150 m 100 m	15 km	150 m	15 km	± 1°	± 30°			3	Difficult	Some Area Trouble	14
	Autodyne		M 60 A		120	Linear	Electric	Horn 400mm	13 db	± 15°	± 15°	150 m 100 m	15 km	150 m	15 km	± 1°	± 60°			2	Slight	Some Area Trouble	15
	M 312 B	14 ± 1 Mc	Crystal	M 60 S	75	Linear		Horn 300mm	13 db	± 15°	± 15°	150 m 100 m	15 km	150 m	15 km	± 1°	± 60°			1	None	No Trouble	16
	M 312 A	14 ± 1 Mc	Crystal	M 60 S	75	Linear	Electric	Horn 430mm	11 db	± 17°	± 17°	150 m 100 m	15 km	150 m	15 km	± 1°	± 60°		Number of Resistances in Use ×3 Number of Vacuum Tubes in Use ×4	1	None	No Trouble	17
	M 312 A	14 ± 1 Mc	Crystal	M 60 S	75	Warning: Linear Range & Bearing: Semi-auto		Parabolaid	25 db	± 5°	± 5°	150 m 100 m	15 km	150 m	15 km	± 100~150m	± 5°		Number of Magnetron in Use ×6	3~4	Slight	No Trouble	18
	M 312 A	14 ± 1 Mc	Crystal	M 60 S	75	Warning: Linear Range & Bearing: Semi-auto		Horn 400mm	13 db	± 15°	± 15°	150 m 100 m	15 km	150 m	15 km	± 100~150m	± 60°			4	None	No Trouble	19
	M 312 A	14 ± 1 Mc	Crystal	M 60 S	75	Warning: Linear Range & Bearing: Semi-auto		Horn 400mm	13 db	± 15°	± 15°	150 m 100 m	15 km	150 m	15 km	± 100~150m	± 60°			4	None	No Trouble	20
																							21
																							22

Transmitter: Application	Transmitter: Oscillator Valve	Receiver: Intermediate Frequency	Receiver: Detector	Receiver: Local Oscillator	Scope Representation: Disp.	Scope Representation: Sweeping Axis	Scope Representation: Scale	Antenna: Type	Antenna: Gain	Antenna: Beam Angle Horizontal	Antenna: Beam Angle Vertical	Max. Range: Mean Scale Effective	Max. Range: Max. Scale Effective	Min. Distance	Accuracy of Range: Indication	Accuracy of Range: Distance Determination	Accuracy of Bearing: Indication	Accuracy of Bearing: Angle Determination	Spare Parts	No. of Operators	Degree of Operating Difficulty	Maintenance	No.
ng Oscillator	T 311 ×2	15 Mc	UN 956 1N 26DSA	JN 955	120	Linear	Mechanical														None	Ordinary	1
ted Oscillator	T 313 ×2	15 Mc	UN 956 1N 26DSA	UN 955	120	Sensitivity	Mechanical														None	Ordinary	2
ng Oscillator	T 311 ×2	15 Mc	UN 956 1N 26DSA	UN 955	75	Linear Logarithmic	Mechanical														None	Ordinary	3
ted Oscillator	T 309 ×2	15 Mc	UN 956 1N 26DSA	JN 955	120	Linear	Mechanical																4
ted Oscillator	T 319 ×2	15 Mc	UN 956 1N 26DSA	UN 955	75	Logarithmic	Mechanical														Some		5
ted Oscillator	T 321 ×1	15 Mc	UN 956 1N 26DSA	UN 955	75	Sensitivity	No trouble														None	Ordinary	6
ted Oscillator	T 321 ×1	15 Mc	UN 956 1N 26DSA	UN 955	75	Sensitivity	No trouble														None	Ordinary	7
ted Oscillator	T 319 ×2	15 Mc	UN 956 1N 26DSA	JN 955	75	Indicator & Locator															None	Ordinary	8
ed by Thyratron	T 304		1N 955		(Earphone)			(Visual Antenna, non-directional)													Slight	Ordinary	9
Oscillator	T 304 A		1N 955	M 60	D.C. Amplifier			Doublet	8 db	—	—										None		10
tron	T 314	14 Mc		M 955	120	Indicator		Rotating Ant. & Reflector	18 db	± 3°	± 12°										Slight	Ordinary	11
		14 Mc	1N 955 ×2 1N 26DSA	JN 955	(Earphone)			Parasol Ant. & Reflector	15 db	± 50°													12
		14 Mc	1N 955 ×2 1N 26DSA	JN 955	(Earphone) & Meter			Parasol Ant. & Reflector	15 db	± 50°													13

Antenna: Type	Antenna: Axial	Antenna: Gain	Antenna: Beam Angle Horizontal	Antenna: Beam Angle Vertical	Spare Parts	No. of Operators	Degree of Operating Difficulty	Maintenance	No.
Horizontal	Parasol antenna, Rotating + Fixed					1	None	No Trouble	1
All around	Metal antenna + Reflector								
Directional	Parabolic Drie type / Mark 6 / Portable					1	None	No Trouble	2
All around	Spherical antenna								
Rotating, Plane	Directional	1 db	35°~50°	30°			None		3
Fixed	All around	1 db					None		4
Fixed	All around	1 db					None		5
Portable	Directional	5 db	40°~60°	40°~60°		1	Difficult, Till shoot hole	No Trouble	6
Fixed	All around	20 db					None	No Trouble	7

2

RADAR NO. 11

ANTI-AIR WARNING

Corresponding Allied Designation: Mark 1 Model 1 Modifications 1 and 2.

Technical Characteristics:

f = 100 MC/S. 40 KW. 200 Km.
Accuracy: Range, ± 1-2 Km; Azimuth, ± 2-3°.

Number Built = 80. Number Installed = Many

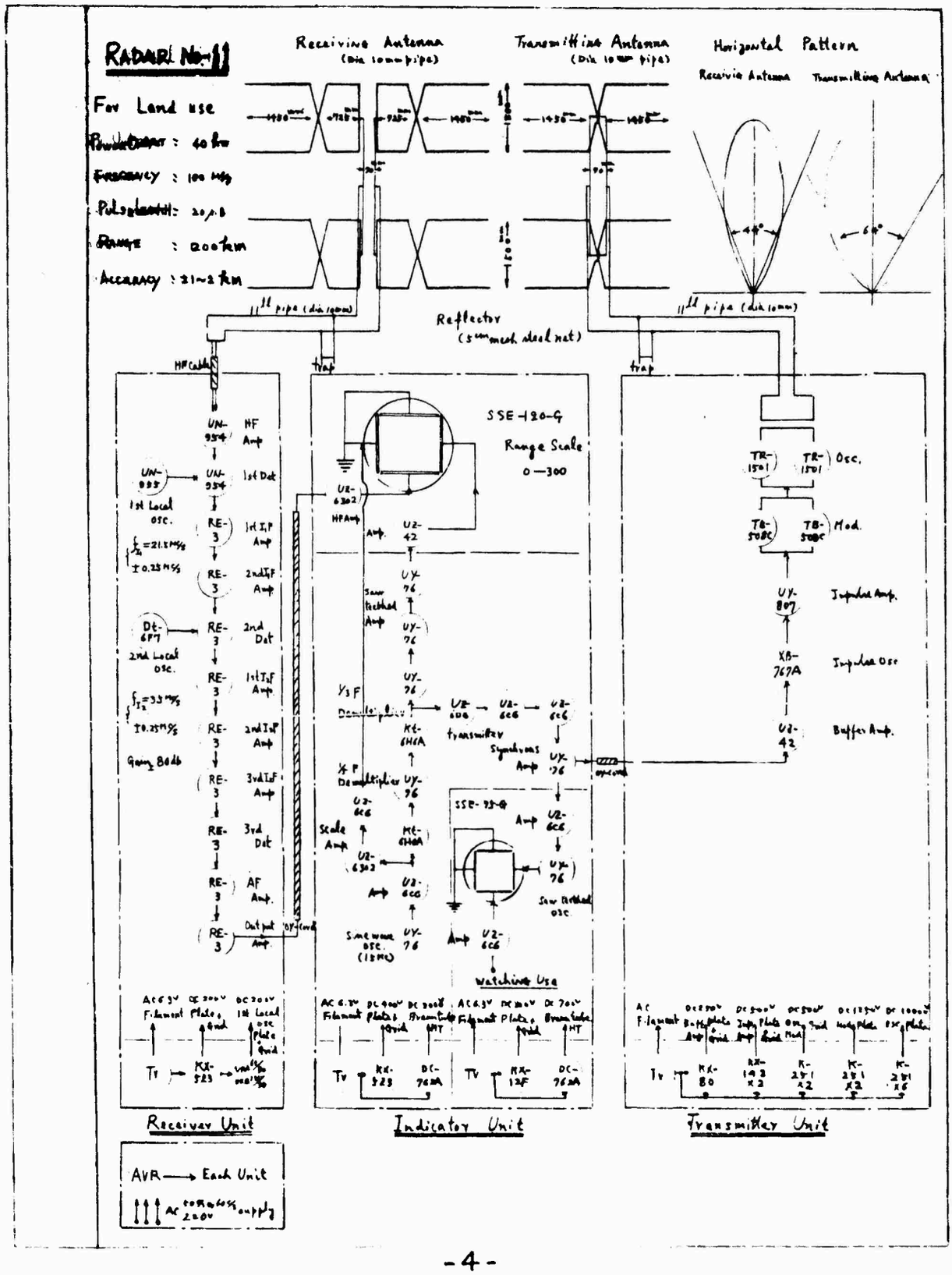
Description:

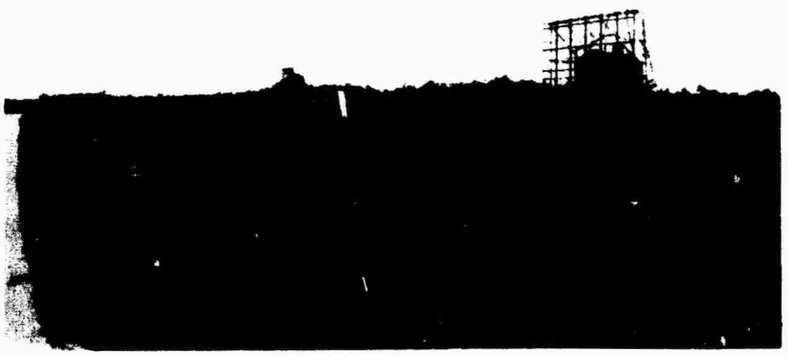
Radar No. 11, which is the navy's abbreviation for Mark 1 Model 1, was the first of the Japanese radars to be seen by American forces. Early types were captured at Guadalcanal and in the Aleutians. Research was begun on it in April 1941 and completed a year later. It corresponds in Japanese radar history to the SCR-270 in American. Quite a number of them were standing guard on Honshu and Kyushu shores awaiting the anticipated invasion of late 1945.

This set is a straightforward 100 MC/S radar, using a 15 kc sine wave base oscillator with demultipliers to establish the prf of 1000. A pair of large transmitting triodes (TR-1501) is used to obtain a 40 kw peak power output in the later models. Display is on a 120 mm A-tube with 0-300 km range scale.

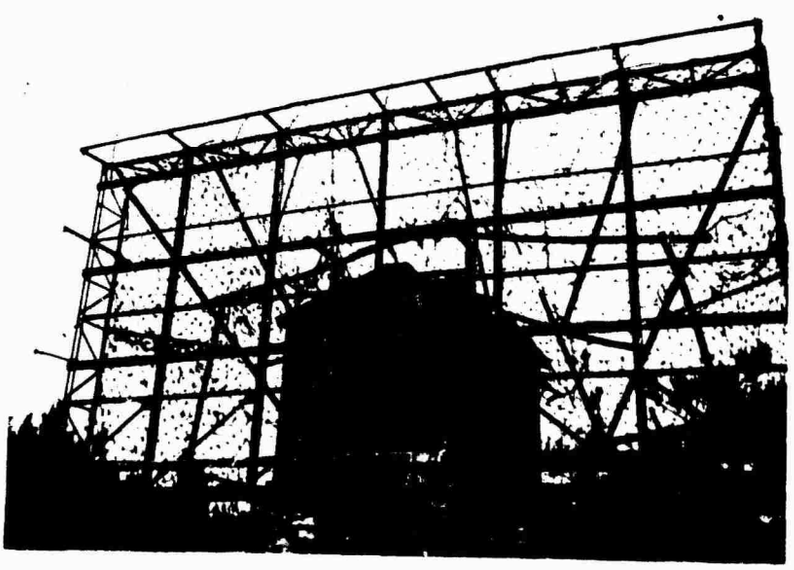
As with many of the Japanese radars, the house containing the equipment supports the antenna mattress array and rotates with it on a circular track. Short transmission lines are obtained by this means as well as no need for troublesome rotary joints. The antenna itself for the 11-2 and 11-3 models as shown in the block diagram is in two parts, the left half a 3 x 4 array for receiving and the right a 2 x 4 array for transmitting. The dipoles are mounted /4 distance in front of the wire mesh reflector.

No. 11 is a very large and cumbersome set primarily designed for fixed installations and although it gave an excellent account of itself, the Japanese found it necessary to develop a number of lighter and more readily portable sets for their needs in island to island hopping in the south and southwest Pacific expansions. These are described in the following pages.

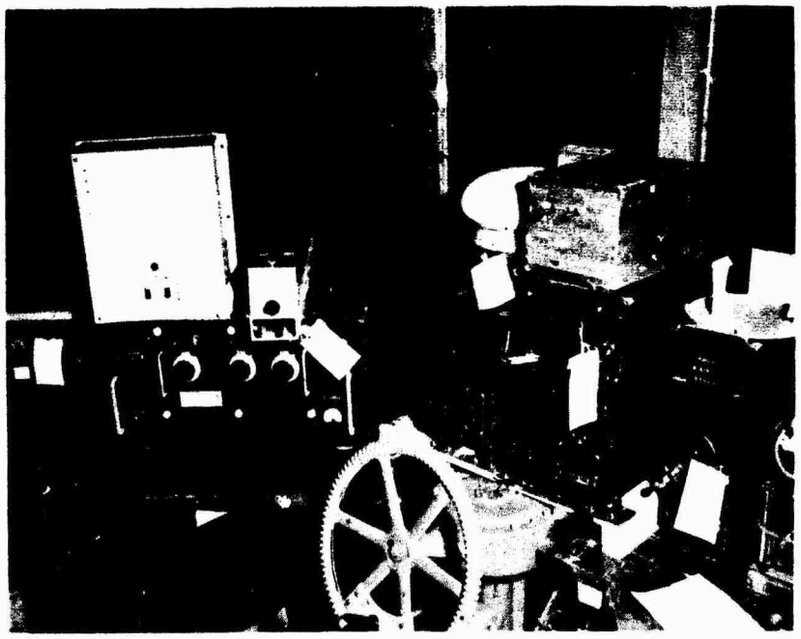

RADAR No-11
For Land use
Power Output : 40 kw
Frequency : 100 Mc/s
Pulse Length : 20 μs
Range : 200 km
Accuracy : ±1~2 km
Receiving Antenna
(Dia 10mm pipe)
Transmitting Antenna
(Dia 10mm pipe)
Horizontal Pattern
Receiving Antenna
Transmitting Antenna
46°
64°
Reflector
(5mm mesh steel net)
HF Cable
trap
SSE-120-G
Range Scale
0—300
Osc.
Mod.
Impulse Amp.
Impulse Osc
Buffer Amp.
Watching Use
Receiver Unit
Indicator Unit
Transmitter Unit
AVR ⟶ Each Unit
AC power supply



Type 11 Early Warning Radar with a Commanding View at Chigasaki.

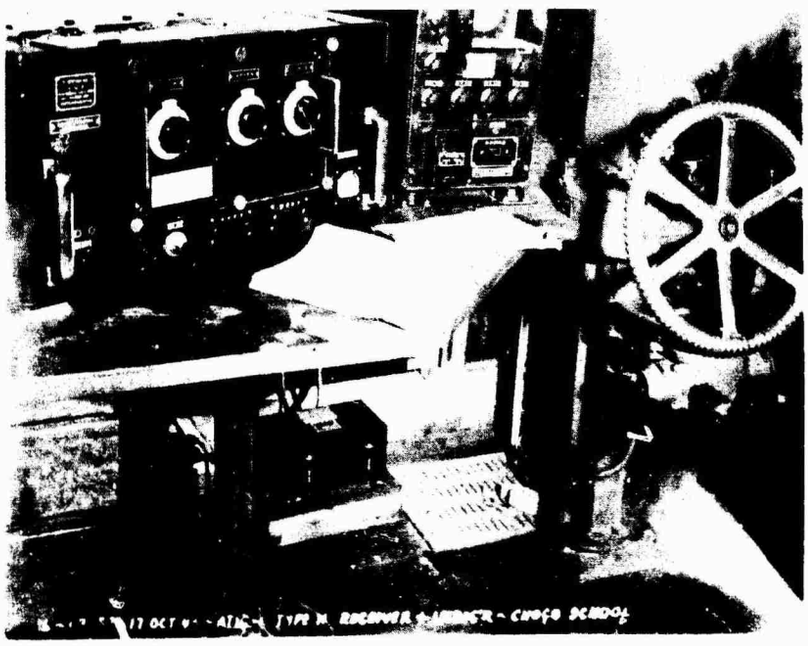


A Rope Netting Helps Camouflage this Type 11 Antenna at Chigasaki.



Type 11 Set (Type II, Mk 1 Model 1 Modif 3)
Showing Operator's Table.

Transmitter of Type 11 Used Two Paralleled Triodes No. TR-150.



Receiver and Indicator of Type 11

Handwheel or Motor Turning of the Antenna is Possible.

RADAR NO. 12

PORTABLE ANTI-AIR WARNING

Corresponding Allied Designation: Mark 1 Model 2.

Technical Characteristics:

f = 200 MC/S. 5 KW. Range 100 km.
Accuracy: Range, ± 1-2 km; Azimuth, ± 5°.

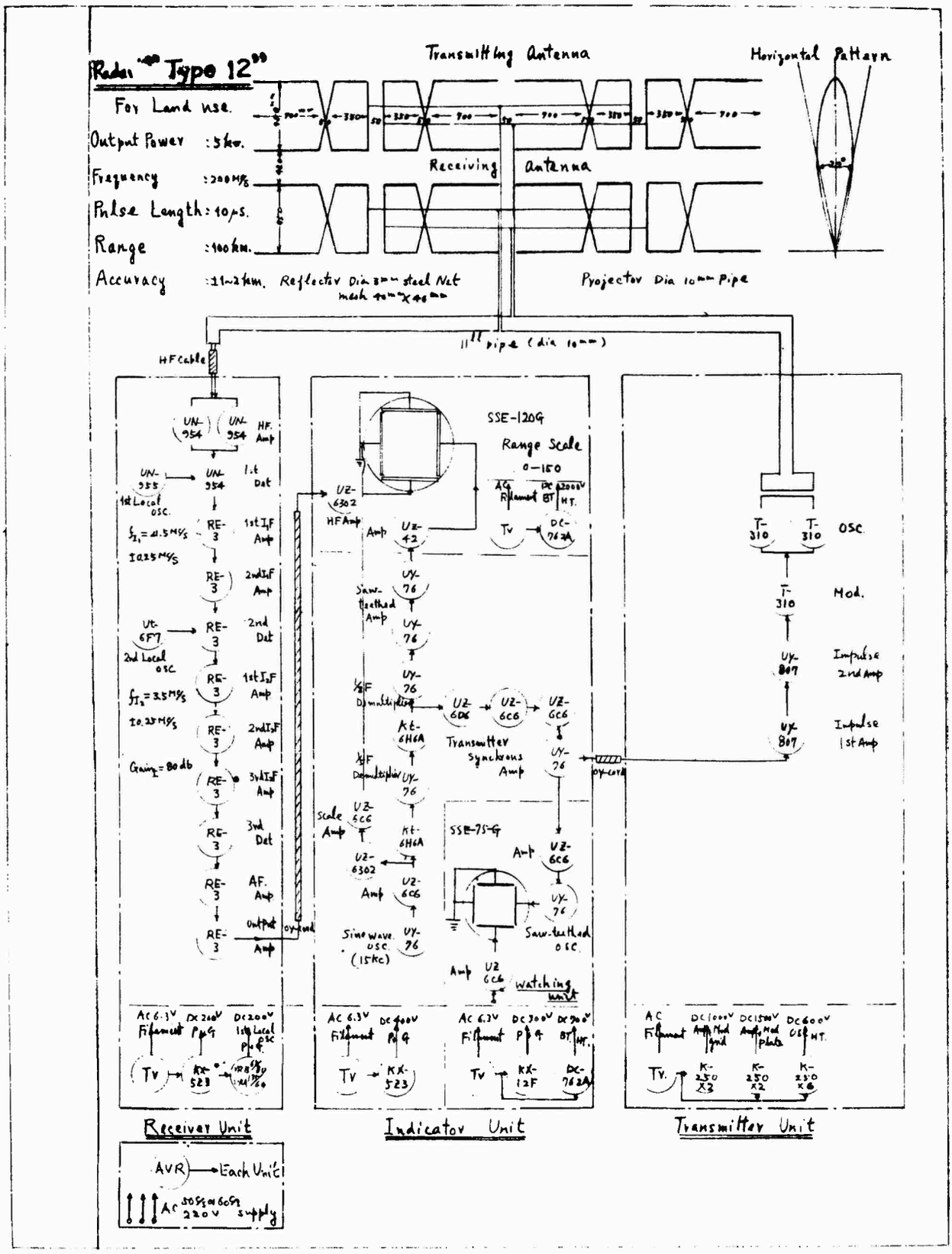
Number Built = ? Number Installed = Many

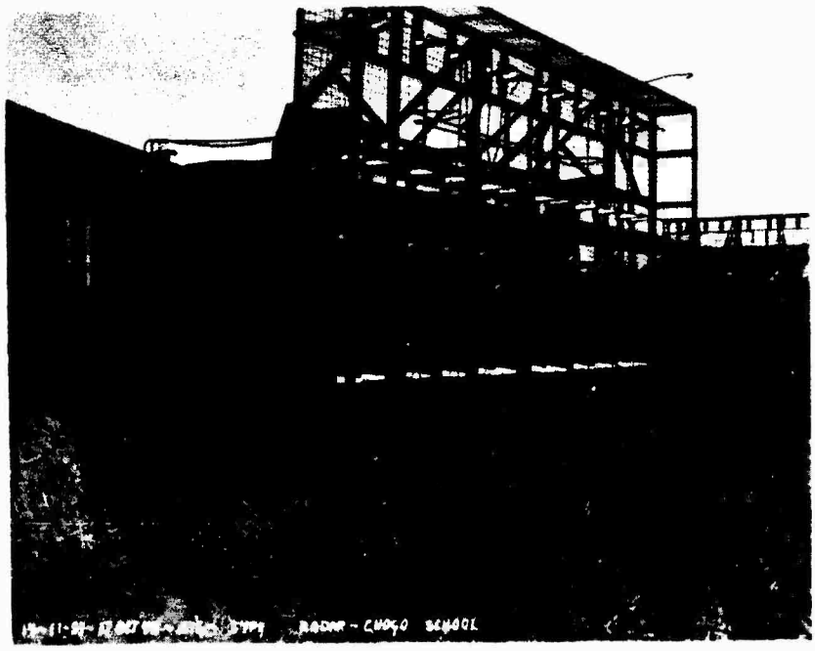
Description:

Radar No. 12 was developed as the first portable set to use in place of the bulky No. 11. Raising the frequency to 200 MC/S greatly reduced the antenna size as seen on the photographs (to about 14' x 7'). The transmitting antenna was placed in the upper bay and an identical receiving antenna in the lower bay. In this manner a quite narrow beam of 22° was projected, less than half that of the No. 11 set. The power output, however, was only 5 kw. Operations people report that this set was one of the least satisfactory of their warning radars with frequent breakdowns and an unstable transmitter frequency. Nevertheless many were seen in the Solomons, New Guinea and the Netherlands East Indies, with a few even on the Japanese home islands as standby equipments.

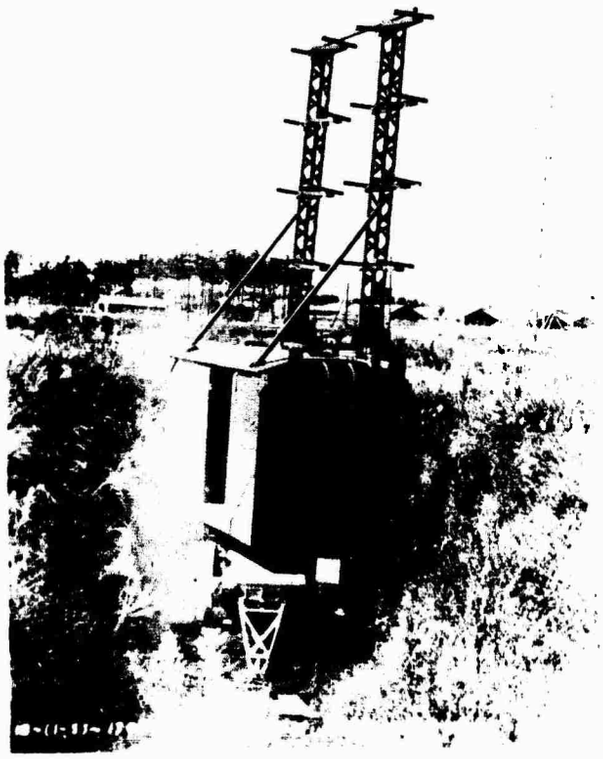
The circuits and display of the target information follow closely those of No. 11.

It should be noted that the later sets labelled No. 12-Kai (or Modification)-2 and 12-Kai-3 are at a lower frequency (150 MC/S) and have quite different antenna structures. In the frequently seen Kai-3 for instance two of the triangular girders used as antennas for Radar No. 13 are mounted side by side at the rear edge of the revolving cabin's roof; one carries the 2 x 4 transmitting antenna and the other a 2 x 4 receiving antenna. Photos of this set are also shown below.

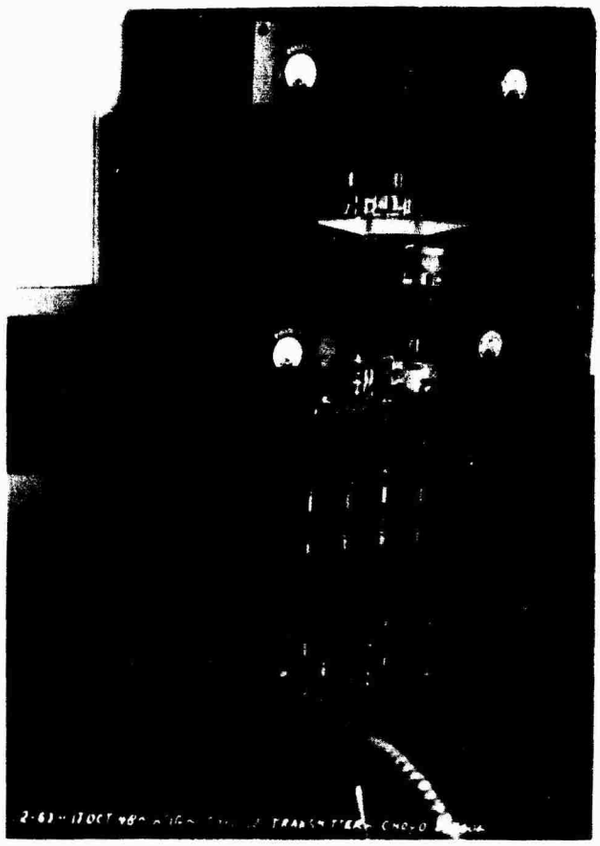

Radar "Type 12"
For Land use.
Output Power : 5kw.
Frequency : 200 M/s
Pulse Length : 10 μs.
Range : 100 km.
Accuracy : ±1~2 km.
Transmitting Antenna
Receiving Antenna
Horizontal Pattern
Reflector Dia 3m steel Net mesh 10mm × 40mm
Projector Dia 10mm Pipe
11" pipe (dia 10mm)
HF cable
SSE-120G
Range Scale 0-150
SSE-75-G
Sine wave osc. (15kc)
Saw-tooth osc
Watching unit
Transmitter Synchronous Amp
Receiver Unit
Indicator Unit
Transmitter Unit
AVR → Each Unit
AC 50~ or 60~ 220V supply



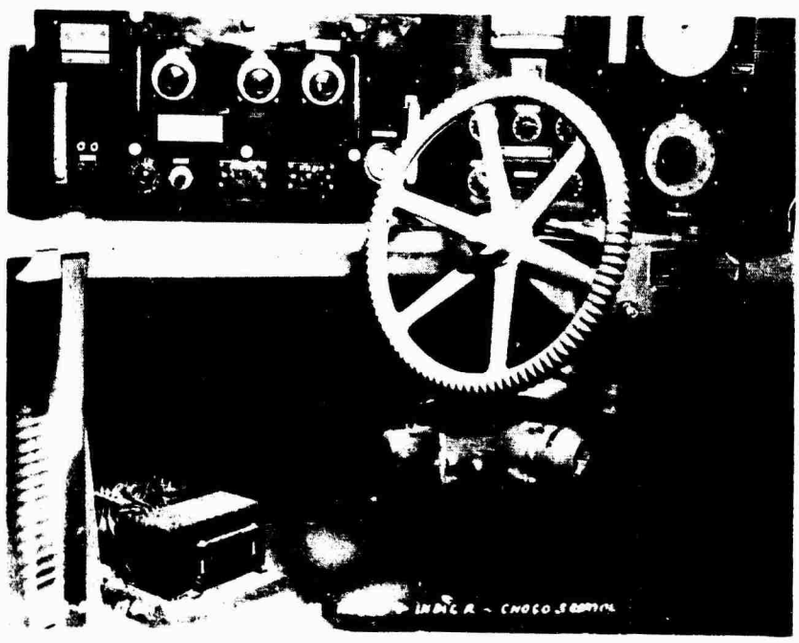
Type 12 Portable Early Warning Radar --
Original Design at 200 MC--Chogo.



Later Version
(Modification 3)
of Type 12 Port-
able Radar which
works at 150 MC
Chogo.



Transmitter
for
Type 12,
Modification 3
(200 MC).



Receiver and Indicator for Type 12 Sets.

RADAR NO. 13

SMALL SIZE ANTI-AIR WARNING - FOR LAND, SHIPS, AND SUBMARINES

Corresponding Allisd Designation: Mark 1 Model 3.

Technical Characteristics:

f = 150 MC/S. 10 KW. Range 100 Km.
Accuracy: Range, ± 2-3 Km; Azimuth, ± 10°.

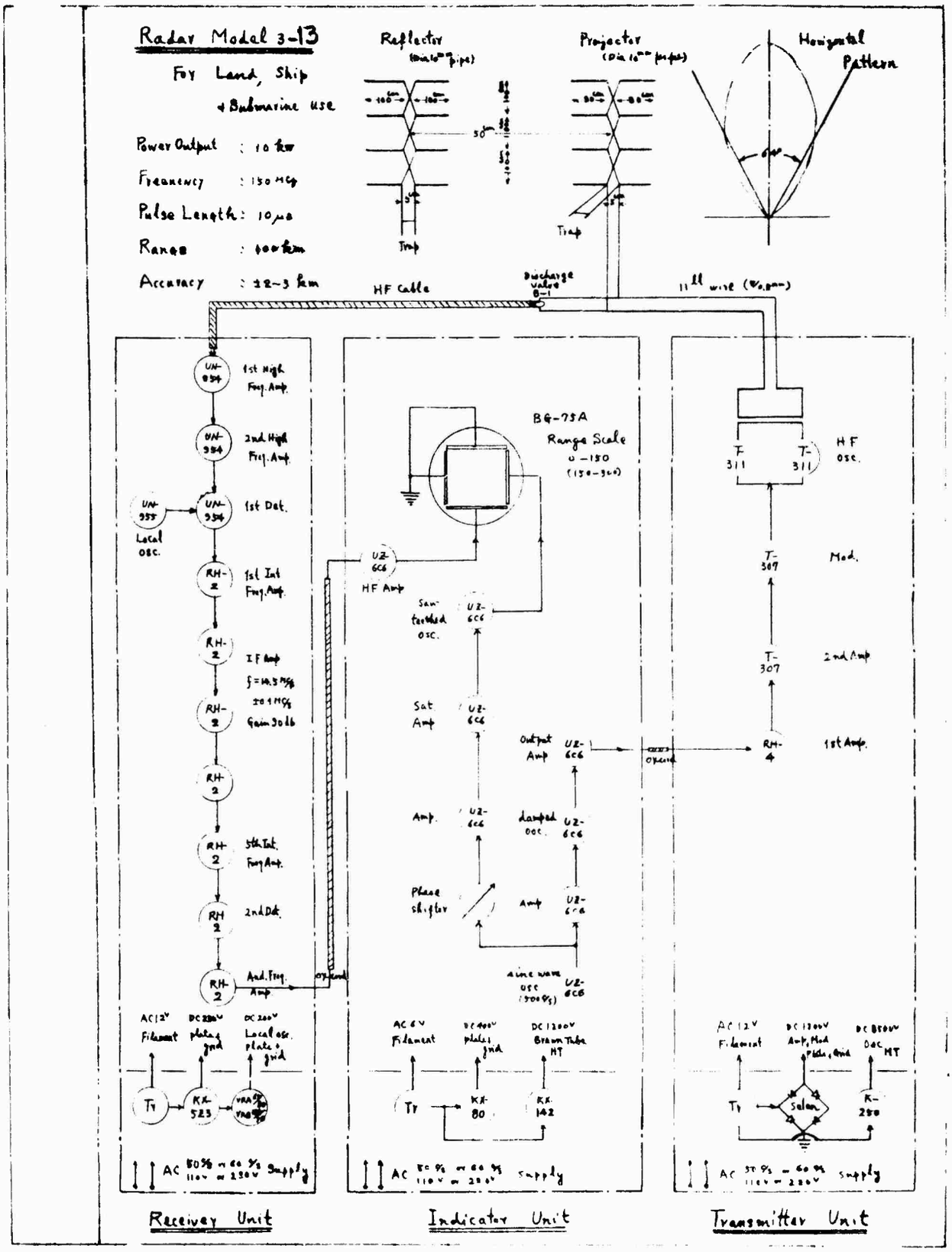
Number Built = 1500. Number Installed = Many

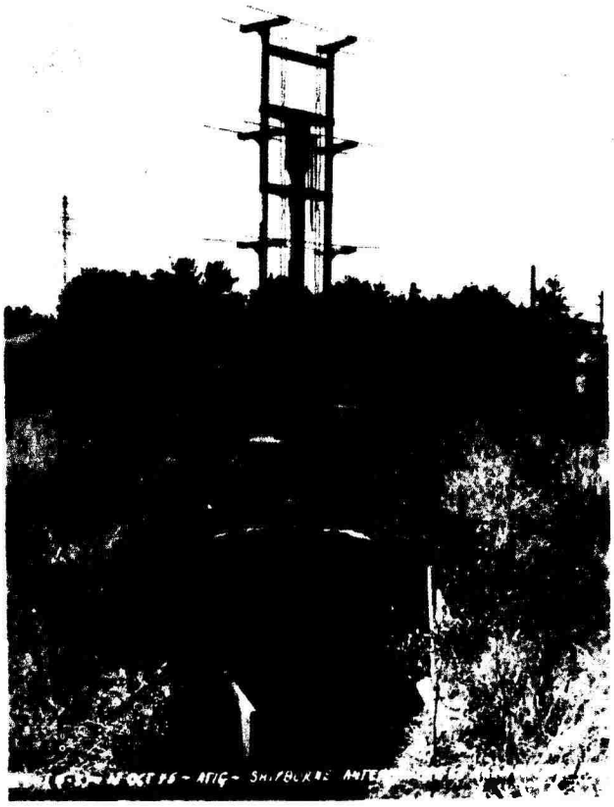
Description:

This is a small sized land radar operating at 150 MC/S which found wide use throughout ths Pacific islands whers a light and easily transportsd squipment was nesded. In many land installations a single triangular cross-section girder was erected carrying a 2 x 4 element array backed by an identical reflector array. (This is one-half of the antenna ussd in the No. 12-Kai-3 sst seen on a previous page.) For installation on a ship or small vesssl the more rugged mechanical construction shown in one of the photos bslow is used. This is also suitabls for land installations.

A very elementary circuit is used, the transmitter being pulsed by a 500 cps sine wave oscillator. A singls A-type display has scales rsading 0-150 km and 150-300 km. Sincs a singls antenna is used for both transmitting and receiving a gas dischargs "valvs" is placed across the recsivsr transmission line to protsct that unit from ths hsavy transmitter pulse. The antenna azimuth is indicated to ths operator by a sslsyn driven dial at the sst.

The No. 13 sets wers considsred highly satisfactory by operating personnsl.

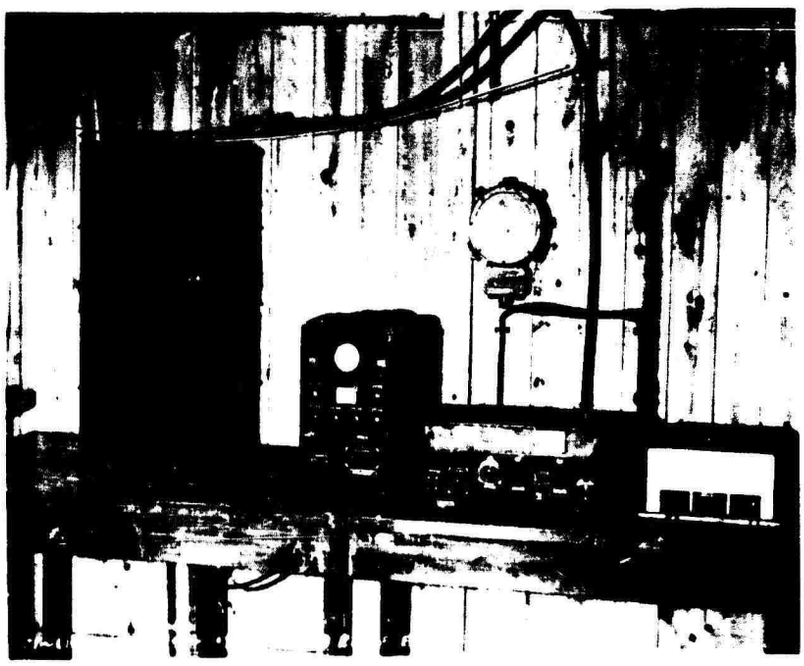

Radar Model 3-13
For Land, Ship & Submarine use
Power Output : 10 kw
Frequency : 150 MCs
Pulse Length : 10 μs
Range : 400 km
Accuracy : ±2-3 km
Reflector
Projector
Horizontal Pattern
Trap
HF Cable
Discharge valve TR-1
11 ll wire (¾.8mm)
UN-954 1st High Freq. Amp.
UN-954 2nd High Freq. Amp.
UN-955 Local osc.
UN-954 1st Det.
RH-2 1st Int Freq. Amp.
RH-2 IF Amp
RH-2 Gain 30 db
RH-2 5th Int. Freq Amp.
RH 2 2nd Det.
RH-2 Aud. Freq. Amp.
AC 12V Filament
DC 250V plate & gnd
DC 200V Local osc. plate & gnd
Ty
KK-523
AC 50% or 60% 110v or 230v Supply
Receiver Unit
BG-75A Range Scale 0-150 (150-300)
UZ-6C6 HF Amp
Sensitized osc.
Sat Amp
Amp.
Phase shifter
Output Amp
damped osc.
Amp
sine wave osc (1500 ~s)
AC 6V Filament
DC 400V plate & gnd
DC 1200V Braun Tube HT
KK-80
KK-142
AC 50% or 60% 110v or 230v Supply
Indicator Unit
F-311 T-311 HF osc.
T-309 Mod.
T-307 2nd Amp
RH-4 1st Amp.
Output
AC 12V Filament
DC 1200V Amp, Mod Plate & gnd
DC 8500V Osc HT
Ty
Selen
K-280
AC 50% - 60% 110v - 230v Supply
Transmitter Unit



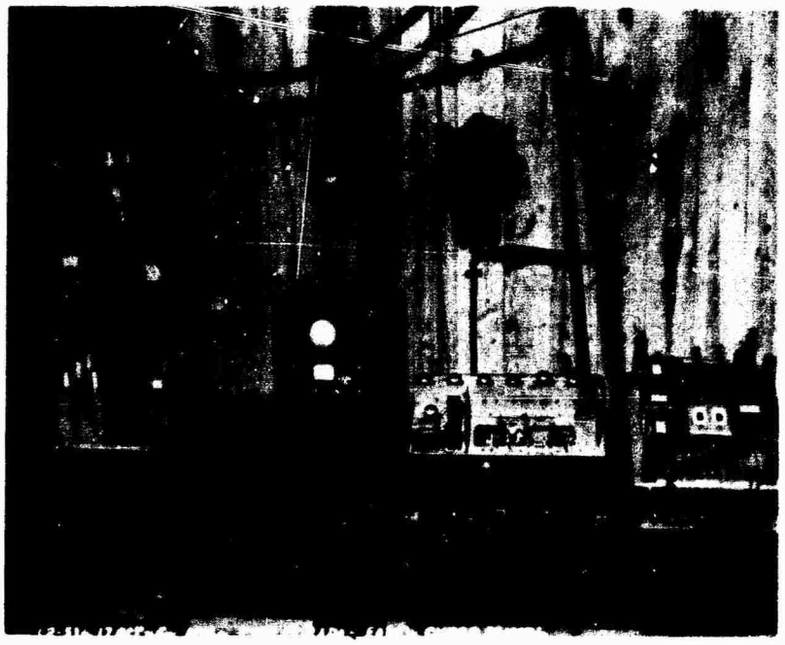
A Type 13 Antenna Suited for Ship Installation.

(For land commonly use one triangular cross-section girder for support).

(Chogo)



Type 13 Equipment - Note Small Size of Components.



Type 13 Equipment with Covers Removed.

RADAR NO. 11K

MEDIUM SIZE ANTI-AIR WARNING - LAND BASED

Corresponding Allied Designation: Type 3 Mark 1 Model 1.

Technical Characteristics:

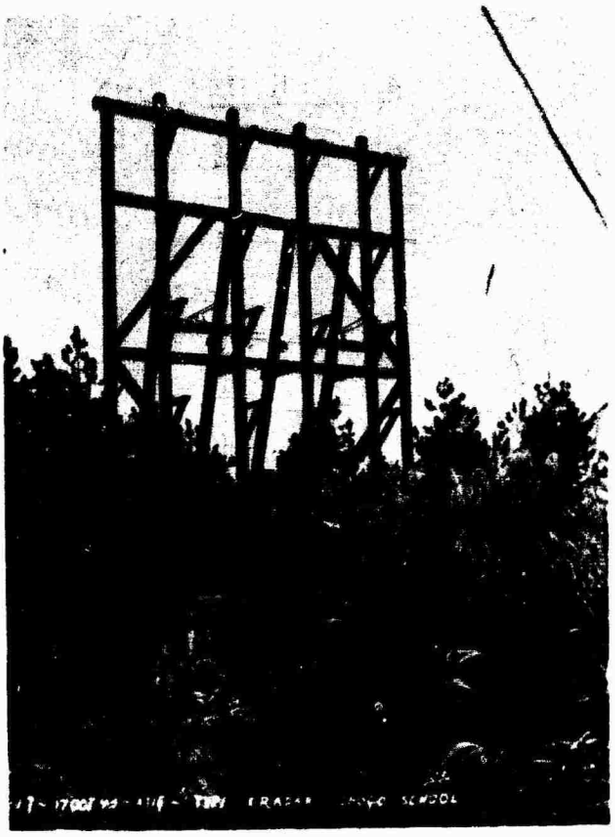
f = 150 MC/S. 10 KW. Range, 150 km.
Accuracy: Range, ± 2-3 km; Azimuth, ± 5°.

Number Built = 50 (?) **Number Installed** = Few

Description:

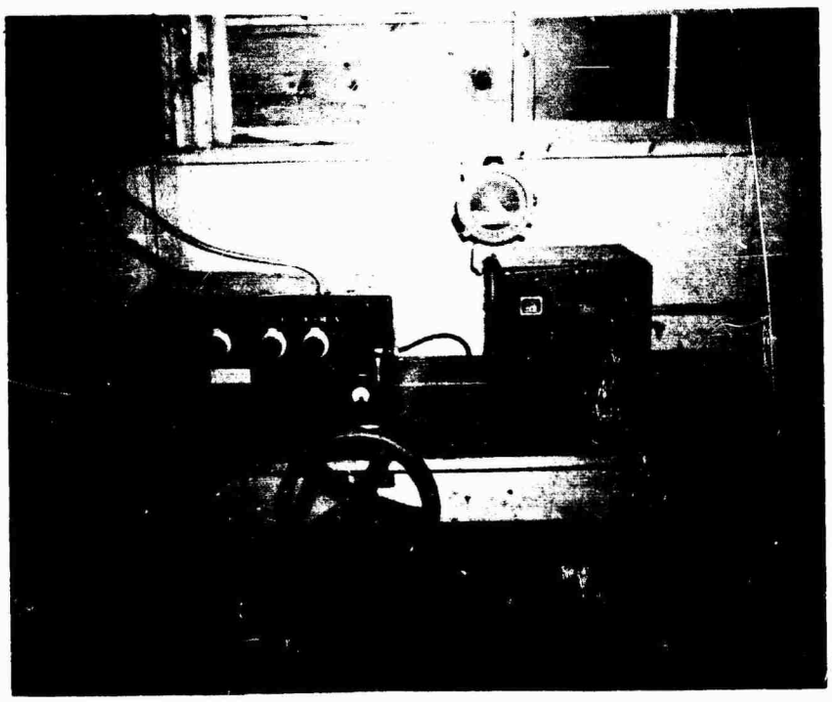
Radar 11K was a relatively recent attempt to solve the aircraft warning problem at locations where the large No. 11 radar could not readily be installed, and yet give better range than either the No. 12 or 13 sets. It was designed for easy installation and mass production. However, it got into the field fairly late and not too many were installed by the time the war ended. Several were used in the Nansei Shoto islands (Okinawa group) including one at Minami Daito Shima.

The components are principally drawn from those used in other sets, No. 12 contributing the transmitter (with higher power tubes) and the receiver.



Model 11 k
(Model 11 Simplified)

Chogo



Receiver and Indicator for Type 11k.

Test Equipment and Azimuth
Indicator for Type 11k Radar.

RADIO DETECTOR NO. 14

LONG RANGE ANTI-AIR WARNING

Corresponding Allied Designation: ----

Technical Characteristics:

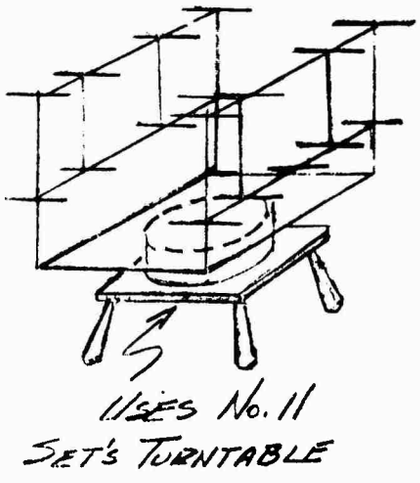
f = 50 MC/S. 100 KW. Range 450 Km.
Accuracy: Range ± 5 Km; Azimuth, ± 3-4°.

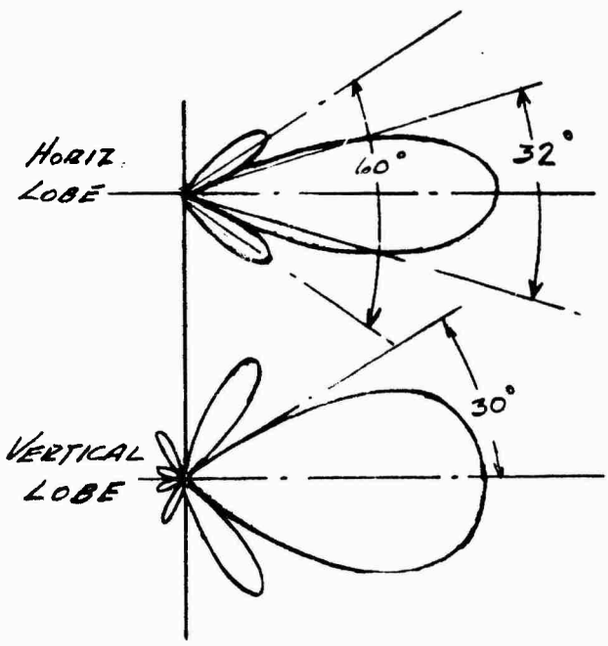
Number Built = 20 planned, 7 built. Number Installed = 3.

Description:

During the winter of 1944-45 the B-29 raids on the Japanese homeland began to mount in intensity. The navy was unable to pick them up consistently at long distances. A new long wave (6 meter), very high power (100 kw) set was quickly designed, Feb to May 1945, and the first equipments were crash manufactured by Tokyo Shibaura in 3 weeks. One set was installed at Cape Iro-Zaki near Shimoda, another at Toi-misaki on the very southeast tip of Kyushu and a third at Shionomisake near Osaka. Detection of approaching B-29s at distances greater than 300 km was reported.

The antenna is a large rotatable structure bearing an array of 2 Yagi antennas. Below is given a rough sketch of its construction. There is no rotary r.f. joint, a fixed cable being used, so antenna is swung back and forth at a rate of 180° per minute but does not rotate. Very simple circuits were used, the display being A-type on a 120 mm cathode ray tube. Range is accurately determined by means of a series of marker pips dropping below the scope's base line. Prf was set by a 250 cps master oscillator.

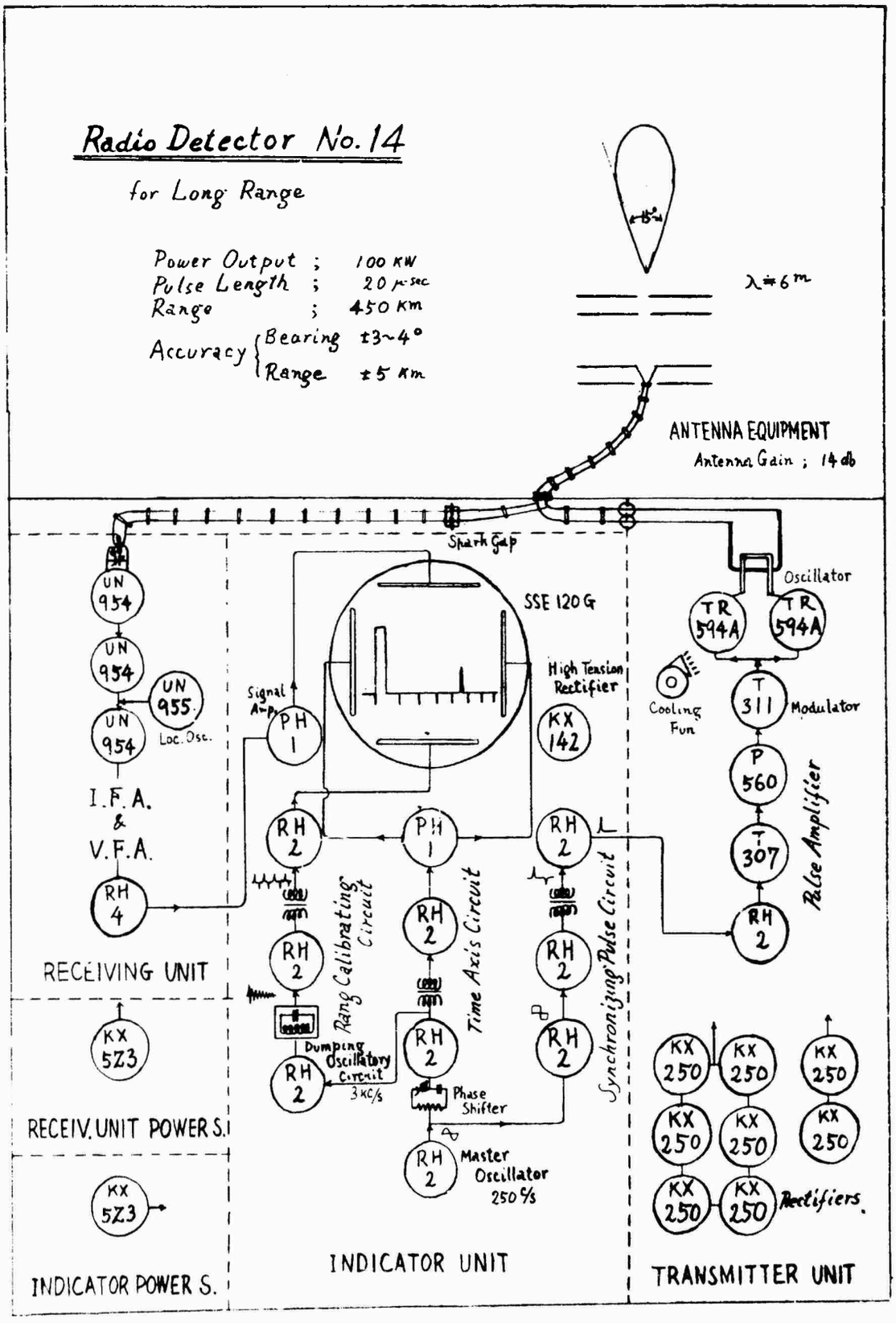




Radio Detector No. 14

for Long Range

Power Output ; 100 KW
Pulse Length ; 20 μ sec
Range ; 450 Km
Accuracy { Bearing ±3~4°
Range ±5 Km



RADAR NO. 21

ANTI-AIR WARNING - SHIPBORNE

Corresponding Allied Designation: Mark 4 Model 2, several modifications.

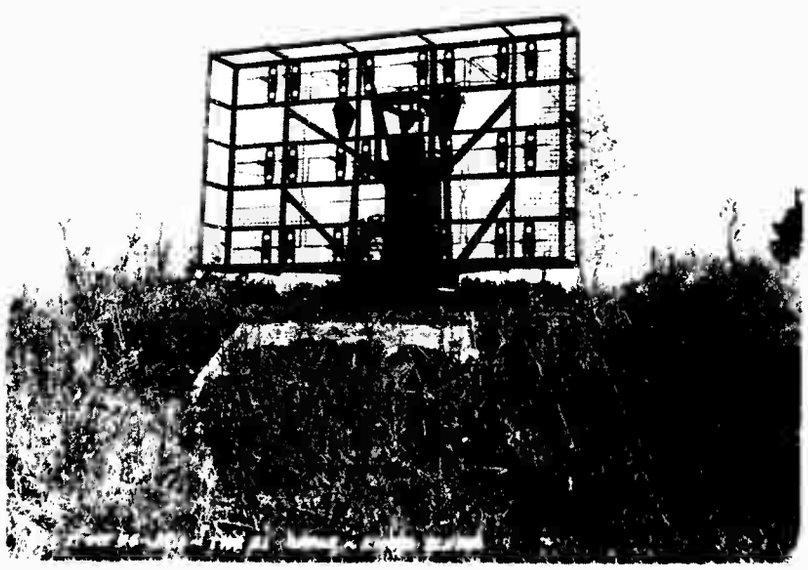
Technical Characteristics:

f = 200 MC/S. 5 KW. Range, 100 km.
Accuracy: Range, ± 1-2 km; Azimuth, ± 5°.

Number Built = 250 (?) Number Installed = ?

Description:

The 21 set utilizes the same equipment as the No. 12 200 MC/S set originally built for land use, but with a different antenna. Several antennas were used, the last one on Kai (Modification)-2 being shown in the photo below. This antenna is small and rugged and is designed to be installed on the top of the ships foremast.



Type 21 Antenna for Ship Installation.

Radar "Type 21"

For Ship use

Output Power : 5 kw.

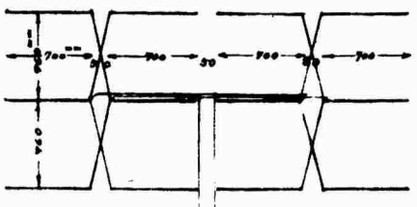
Frequency : 200 M/s.

Pulse Length: 10 μs.

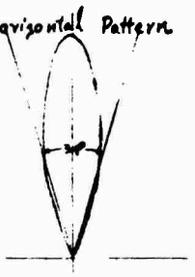
Range : 100 km.

Accuracy : ±1~2 km.

Antenna.



Horizontal Pattern



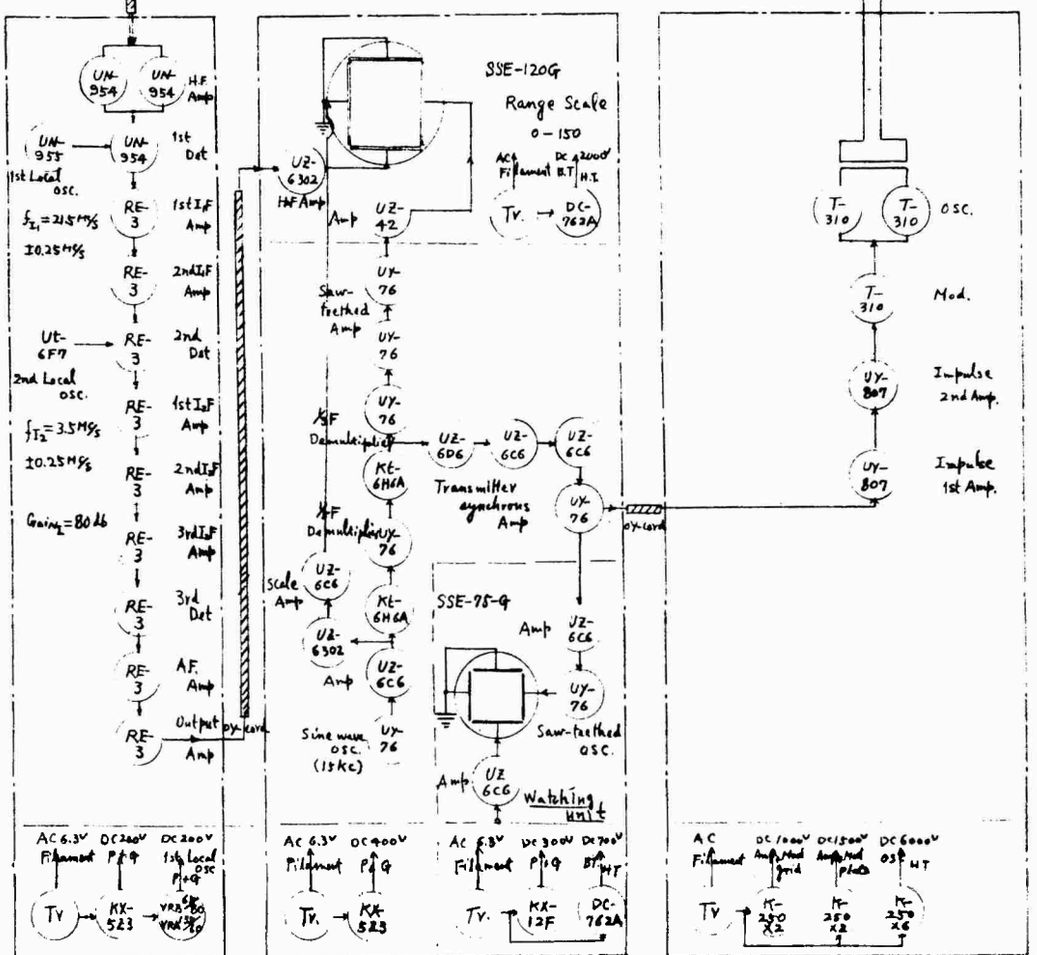
Reflector Dia 3mm Steel Net mesh 40mm × 40mm

Discharge Tube

Projector : Dia 10mm Pipe

11 pipe (dia 10 mm)

HF Cable



Receiver Unit

Indicator Unit

Transmitter Unit

ATR → Each Unit.

AC 50~60 c/s 220 V supply

RADAR NO. 22

ANTI-SURFACE WARNING FOR SHIP USE

Corresponding Allied Designation: Mark 2 Model 2, Modifications 2-3-4.

Technical Characteristics:

Wavelength = 10 cm. 2 KW. Range 25 Km against battleship.
Accuracy: Range, ± 100-250 M; Azimuth, ± 2-3°.

Number Built = 500. Number Installed = Large Number.

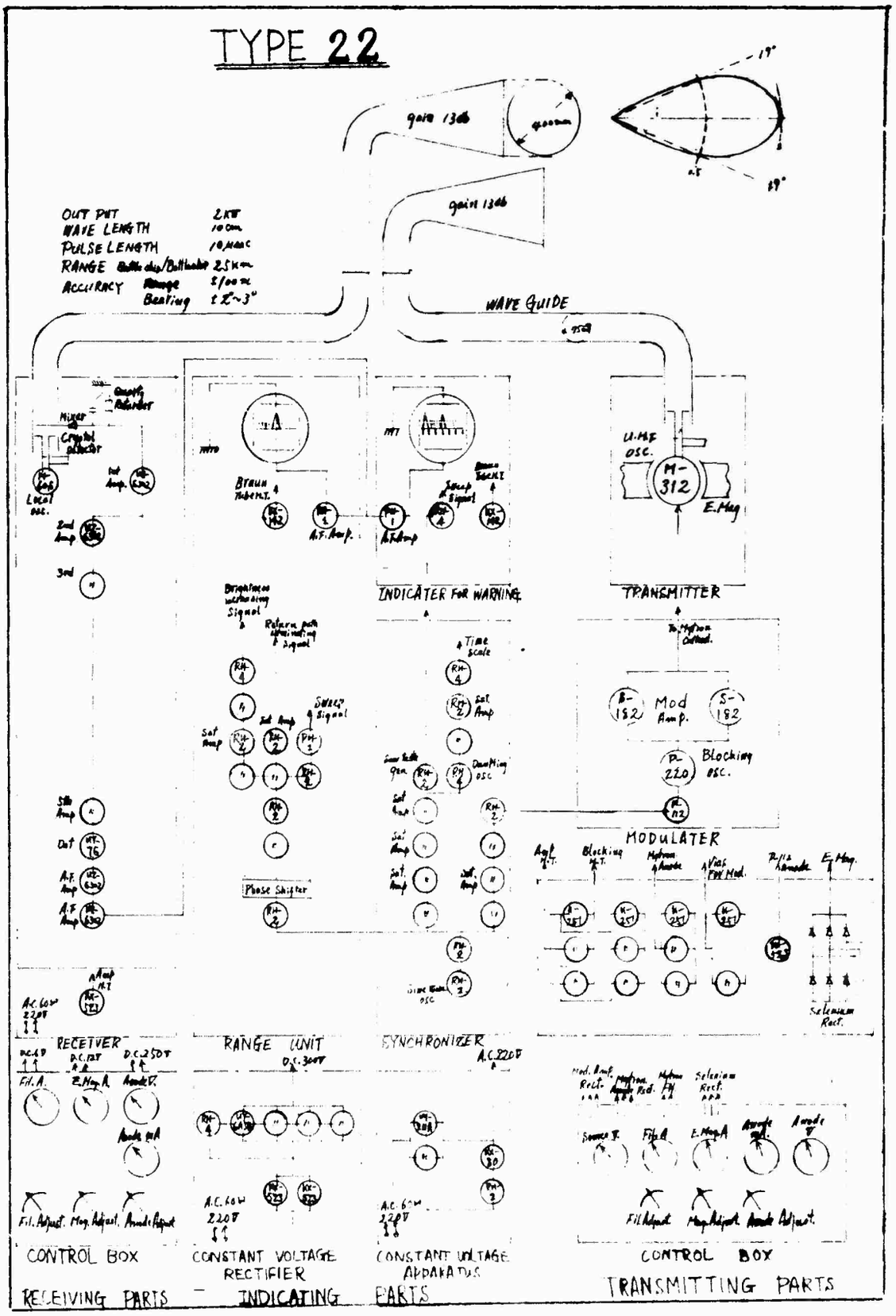
Description:

Shipborne warning radar No. 22 appears to have been one of the most satisfactory equipments used by the Japanese navy. Large numbers were installed. Research began on this 10 cm set in October 1941 and the equipment went through numerous modifications and improvements during the following 3 or 4 years. A pair of small horns, one for transmitting and one for receiving, and mounted to rotate on a base in such a way as to always point in the same direction at once, provide a simple and rugged antenna structure without need for the loss inherent in the T-R tube arrangement. The set is very heavy being comprised of more than a dozen components as follows:

Transmitter parts:	Transmitter
	Cooler
	Pulse Modulator
	Rectifier
	Control Box
Receiver parts:	Receiver
	Control Box
Indicator parts:	Synchronizer
	Range Unit
	Indicator for warning
	Rectifier
Radiator parts:	Wave guide
	Transmitting horn
	Receiving horn

The transmitter is powered by an M-312 magnetron, the anode being water cooled by a motor driven pump. Peak power is approximately 2 kw, with 11000 volts applied to the magnetron. A blocking oscillator provides the 10 microsecond keying pulse at a rate of 2500 per second controlled by a tuning fork. The receiver is a superheterodyne with crystal detector and magnetron M-60-[illegible] local oscillator. The Intermediate Frequency is 14.5 mc, the total receiver gain amounting to 120 db.

TYPE 22


gain 13db
19°
8.5°
89°
gain 13db
OUT PUT 2KW
WAVE LENGTH 10cm
PULSE LENGTH 10 Micro sec
RANGE 2.5km
ACCURACY Range ± 100m
Bearing ± 2°~3°
WAVE GUIDE
Mixer
Crystal detector
Local osc.
1st Amp.
2nd Amp.
3rd
Braun Tube
A.F. Amp.
INDICATER FOR WARNING
TRANSMITTER
U.H.F. osc.
M-312
E.Mag
Brightness modulating Signal
Return path signal modulating Signal
Sweep Signal
Sat Amp
Phase Shifter
Time scale
Sweep Gen.
Blocking osc.
MODULATER
Agl
Blocking
Modulator
Anode
Vias FM Mod.
Pulse Remote
E.Mag.
Selenium Rect.
RECEIVER
RANGE UNIT
SYNCHRONIZER
A.C.220V
D.C.300V
Fil. A.
E.Mag A.
Anode V.
Anode mA
Fil. Adjust.
Mag. Adjust.
Anode Adjust.
Source V.
CONTROL BOX
RECEIVING PARTS
CONSTANT VOLTAGE RECTIFIER
INDICATING
CONSTANT VOLTAGE APPARATUS
PARTS
CONTROL BOX
TRANSMITTING PARTS

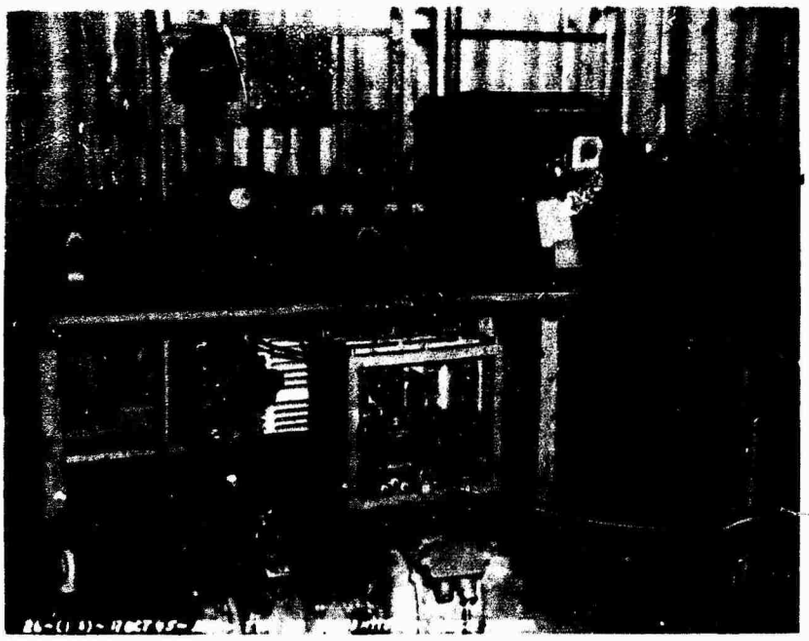
The display is on two Type A cathode ray tubes. One tube called the "Indicator for Warning" shows all target echoes up to 60 km, with range pips appearing every 5 km. A 3 microsecond range pulse is moved along as the range crank is turned. The second, or "Range Operator's", scope gives an expanded view of about 1000 meters of the range as selected by the range crank. A magnifying glass in front of the scope gives it a size equivalent to a 5" tube. The true range is read on a dial when the target pip's leading edge is set just even with a vertical line inscribed up the face of the scope.

Detailed Schematic diagrams of the No. 22 set are included in Appendix II.

A somewhat simplified version of the No. 22 set called Modification-3 is installed on the conning tower of submarines; it uses two horns mounted side by side as shown in one of the photos below. Presentation is of the A-type on a single 75 mm scope. Range from a submarine is about 10 km on a battleship.

Row of No. 22 Shipborne sets Installed in Huts for Training at Navy School--Chogo.

Synchronizer for Type 22 Radar.

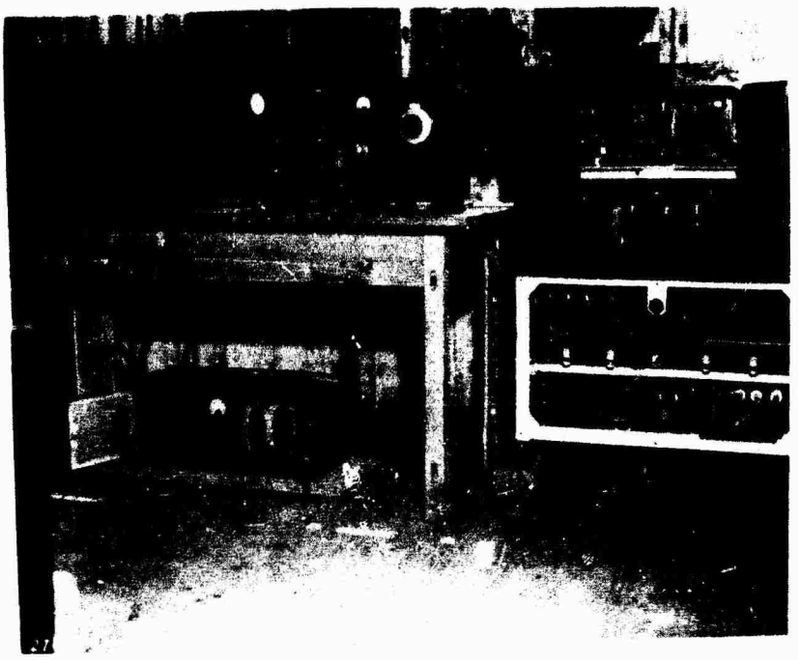


Shipborne 10 cm Radar No. 22 for Surface Search.

Identification of Units:

In foreground: Antenna turning motor.
Under bench, left to right: Antenna control handles, Rectifier,
On bench, left to right: Receiver, Indicator for Warning, Receiver control panel, Transmitter, Transmitter Control Panel.
On wall: Antenna azimuth indicator.

(Remainder of No. 22 bench set up shown on next page)



Shipborne 10 cm Radar No. 22 Surface Search.

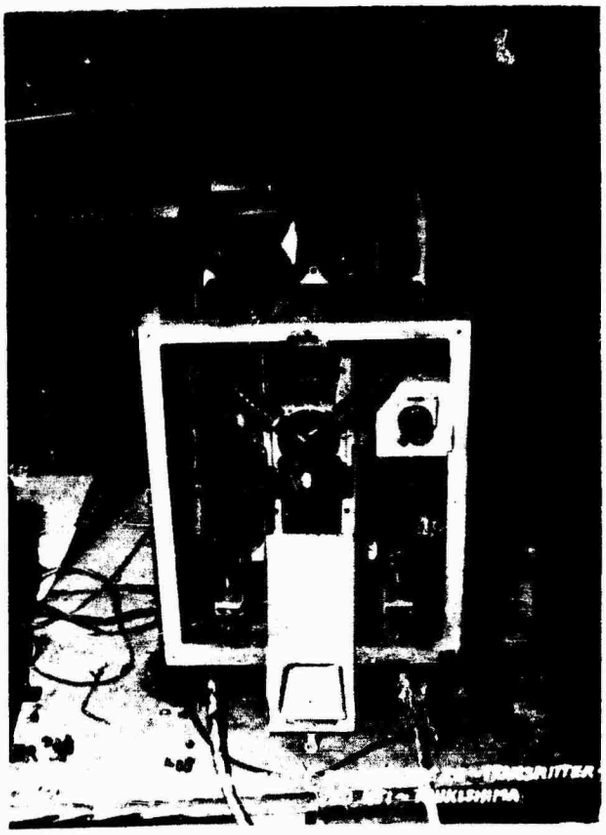
Identification of Units:

Under bench: Rectifier.

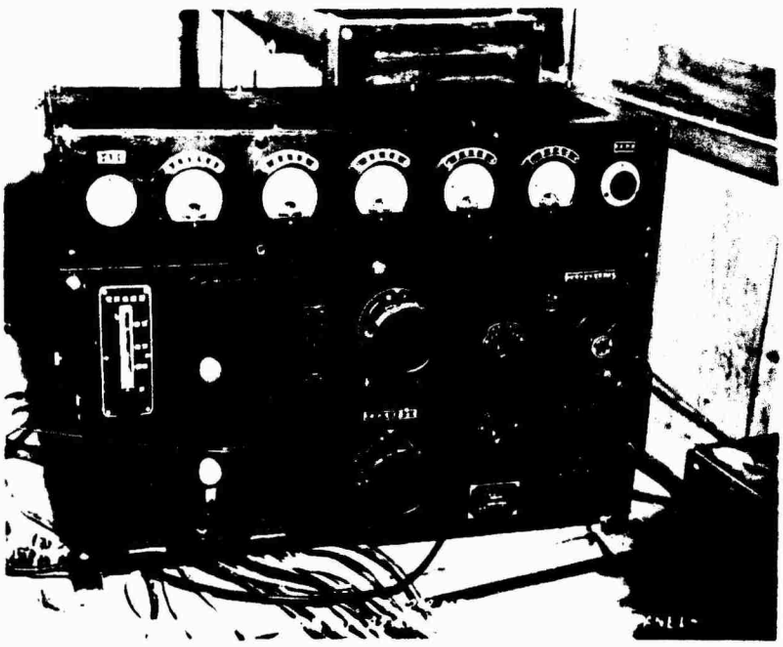
On Bench: Range Unit, Monitoring A-scope, Test Equipment.

To Right of Bench: Power Rectifier.

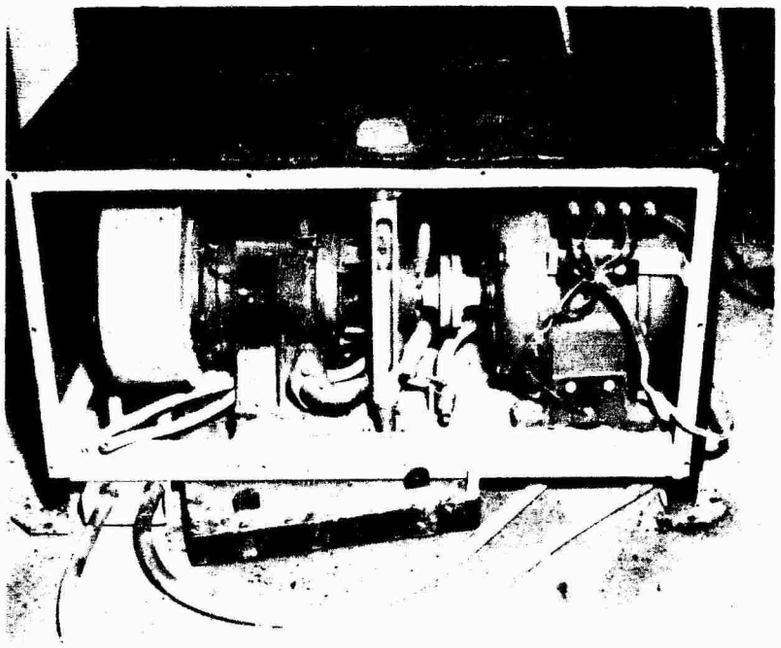
(Remainder of No. 22 bench set up shown on preceding page)



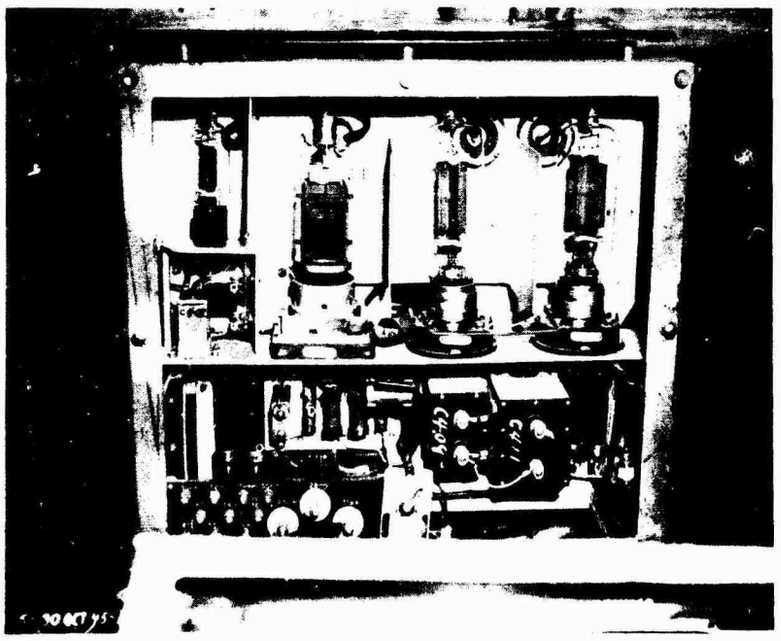
Transmitter for No. 22 Radar, Showing Rear of Water Cooled Magnetron.



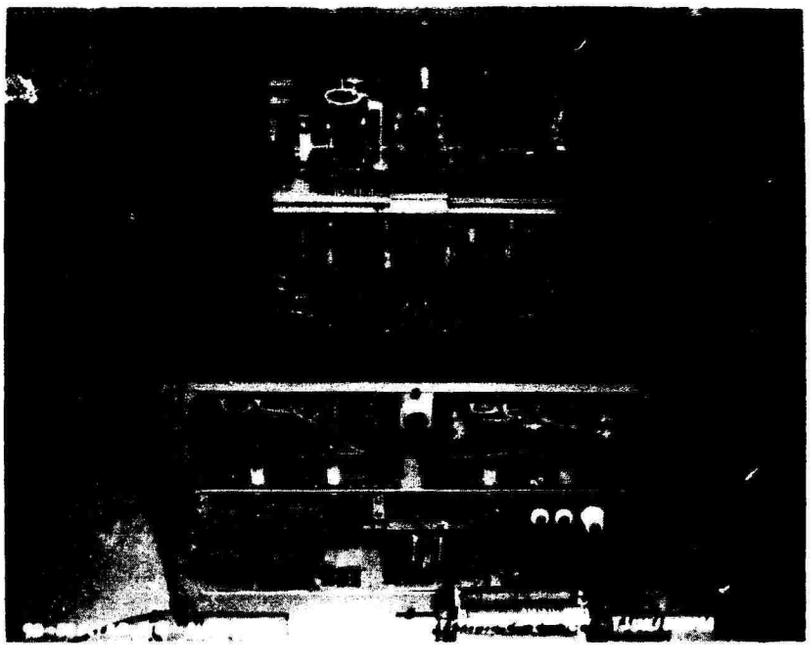
Transmitter Control Panel - Radar No. 22.



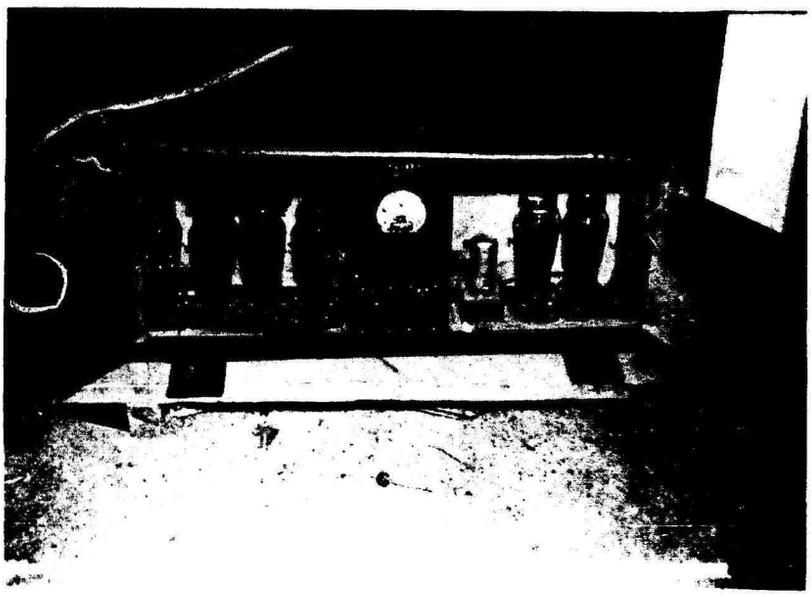
Cooling Water Pump for Magnetron.



Pulse Modulator - Type 22 Radar.



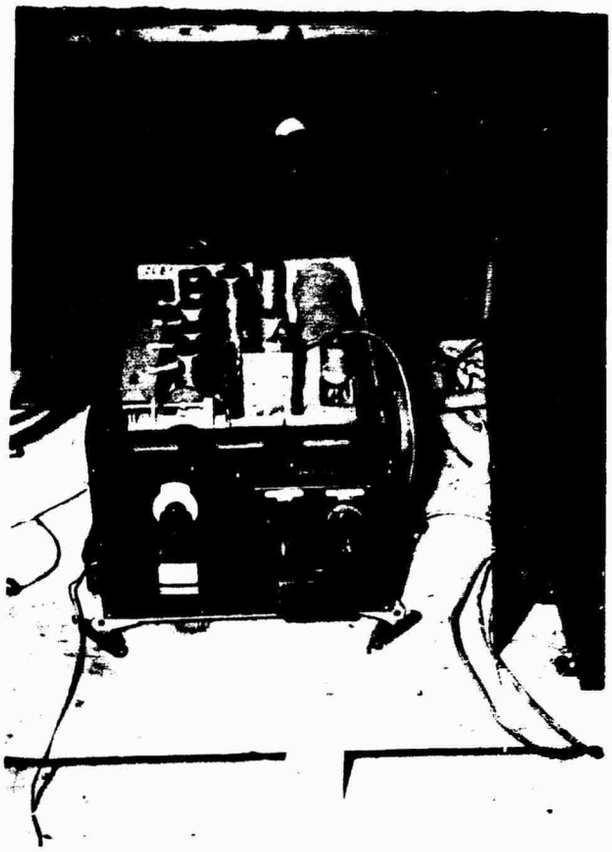
Power Rectifier for Type 22 Radar.



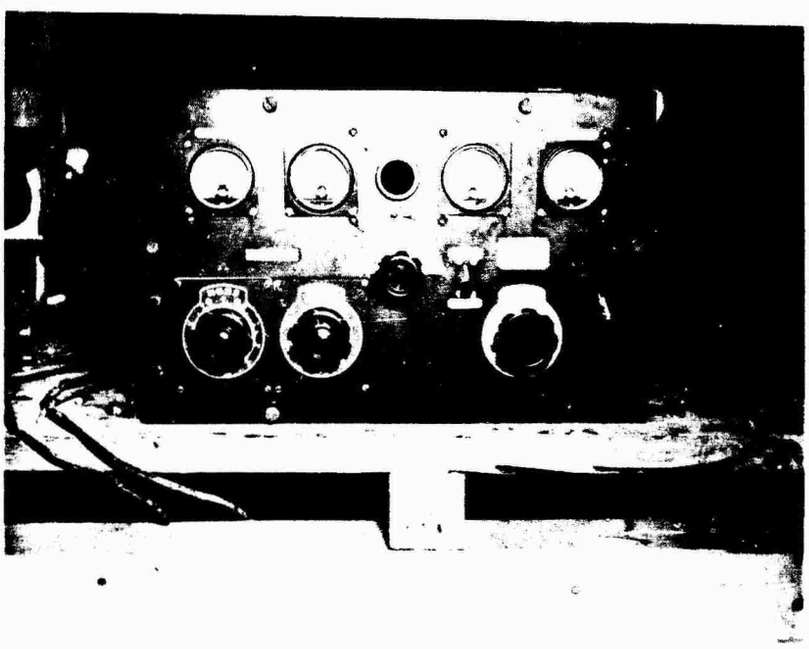
Reotifier for Receiver and Indicator - Type 22 Radar.

"Constant Voltage" Apparatus - No. 22 Radar.

Constant Voltage Control Panel.

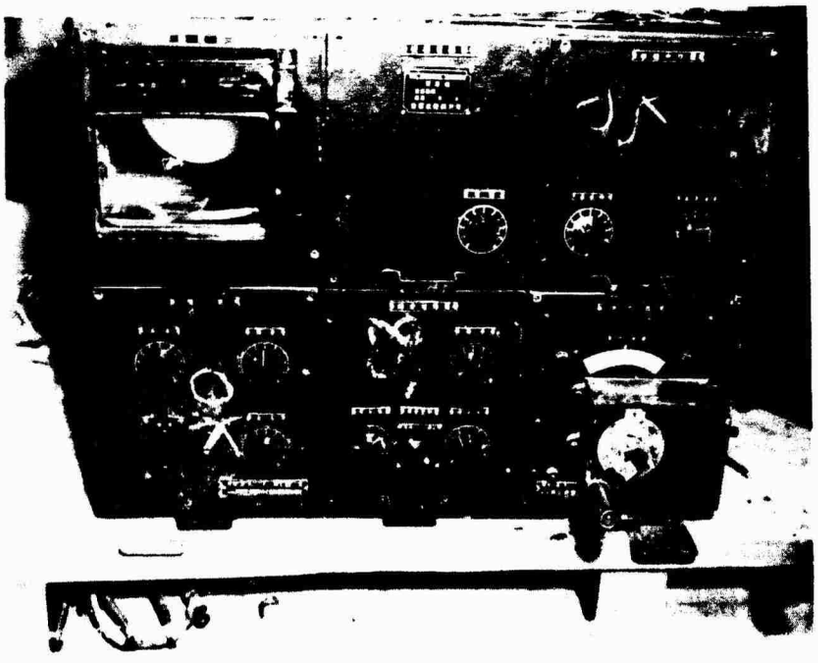


Receiver Unit for Type 22 Radar.



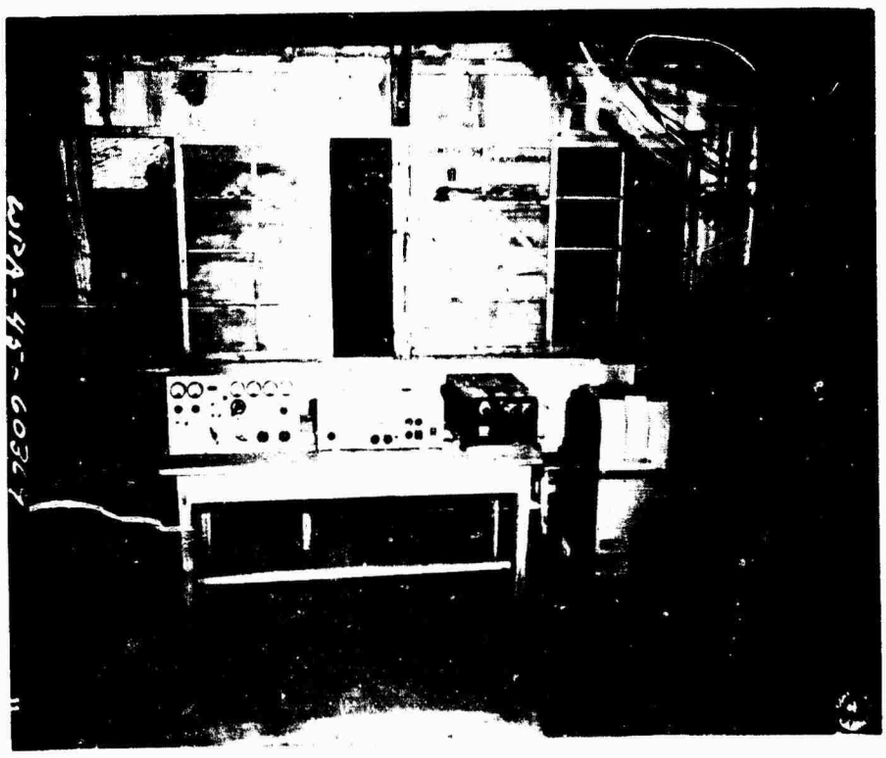
Receiver Control Panel - Type 22 Radar.

Indicator for Warning -- Type 22 Shipborne Radar.



Range Unit - Type 22 Radar.

Antenna for
10 cm Radar
No. 22 - Kai-3
for Submarine
Installation.



No. 22 - Kai-3 Set for Submarine Use.

H-6

AIRBORNE PATROL AND SEARCH - LARGE PLANES

Corresponding Allied Designation: ----

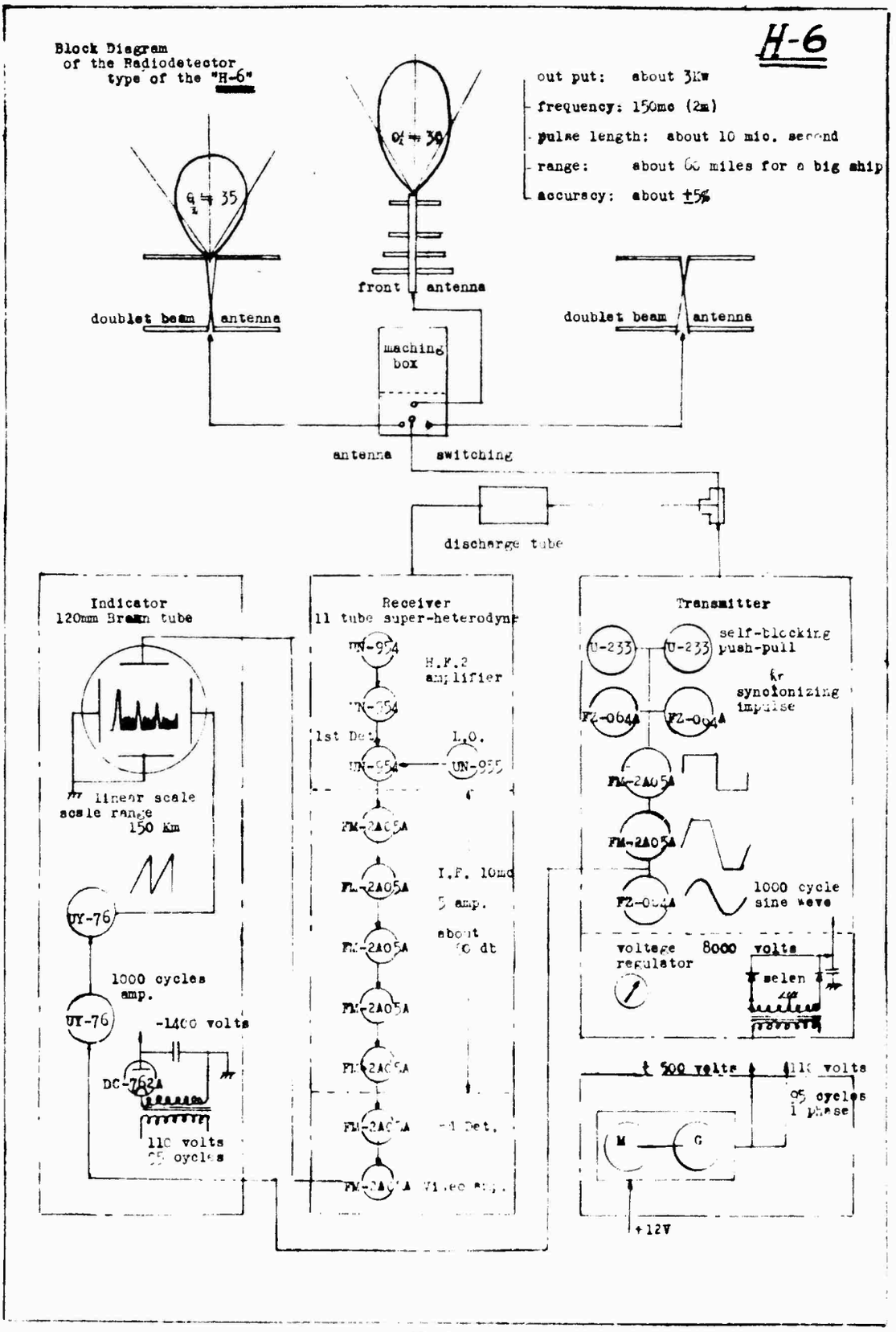
Technical Characteristics:

f = 150 MC/S. 3 KW. Range 60 miles for a large ship.
Acouracy: Range, ± 5%; Azimuth, ± 3°.

Number Built = 2000+ Number Installed = Many

Description:

This was the first Japanese navy airborne radar and, like the army's Taki-1, could use any one of three antennas at will, giving it both search and homing abilities. This equipment gave very satisfactory search service as long as high definition was unnecessary.


H-6
Block Diagram
of the Radiodetector
type of the "H-6"
out put: about 3Kw
frequency: 150mc (2m)
pulse length: about 10 mic. second
range: about 66 miles for a big ship
accuracy: about ±5%
θ½ = 35
θ½ = 30
front antenna
doublet beam antenna
doublet beam antenna
maching box
antenna switching
discharge tube
Indicator
120mm Braun tube
linear scale
scale range
150 Km
UY-76
1000 cycles
amp.
UY-76
-1400 volts
DC-763A
110 volts
cycles
Receiver
11 tube super-heterodyne
UN-954
H.F.2
amplifier
UN-954
1st Det.
L.O.
UN-955
FM-2A05A
I.F. 10mc
amp.
about
db
FM-2A05A
FM-2A05A
FM-2A05A
FM-2A05A
FM-2A05A
-1 Det.
FM-2A05A Video amp.
Transmitter
U-233
U-233
self-blocking
push-pull
for
synchonizing
impulse
FZ-064A
FZ-064A
FM-2A05A
FM-2A05A
FZ-064A
1000 cycle
sine wave
voltage regulator
8000 volts
selen
500 volts
110 volts
cycles
1 phase
M
G
+12V

FK-3

PATROL AND SEARCH - SMALL PLANES

Corresponding Allied Designation: ----

Technical Characteristics:

f = 150 MC/S. 2 KW. Range 30 miles against a large ship.
Accuracy: Range ± 5%; Azimuth, ± 3°.

Number Built = 200 Number Installed = A few; none used in combat.

Description:

FK-3 was developed from the original airborne search set H-6, and is considerably lighter and smaller making it suitable for smaller aircraft. It weighs only 40 kg. Two scopes in parallel are provided so that both observer and pilot can keep watch for targets.

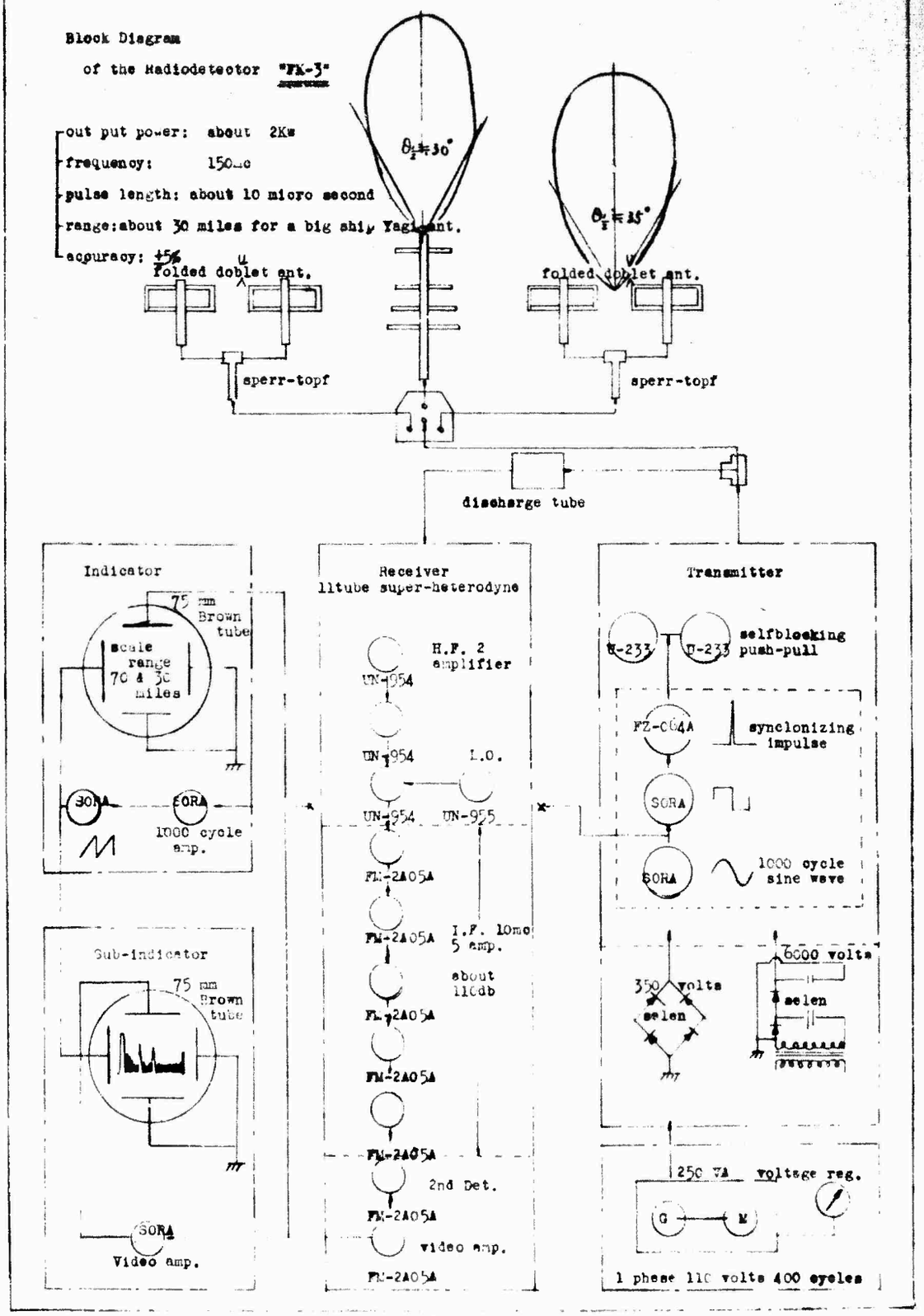
The production models of this set began to appear in the middle of 1945; the job from research and specifications to final manufactured product took but 8 months.

Bench Installation of FK-3 Radar -
2d Naval Technical Institute - Kanazawa.

Block Diagram

of the Radiodetector "FK-3"

- out put power: about 2Kw
- frequency: 150mc
- pulse length: about 10 micro second
- range: about 30 miles for a big ship Yagi ant.
- accuracy: ±5%



N-6

AIRBORNE PATROL AND SEARCH - SMALL PLANES

Corresponding Allied Designation: ----

Technical Characteristics:

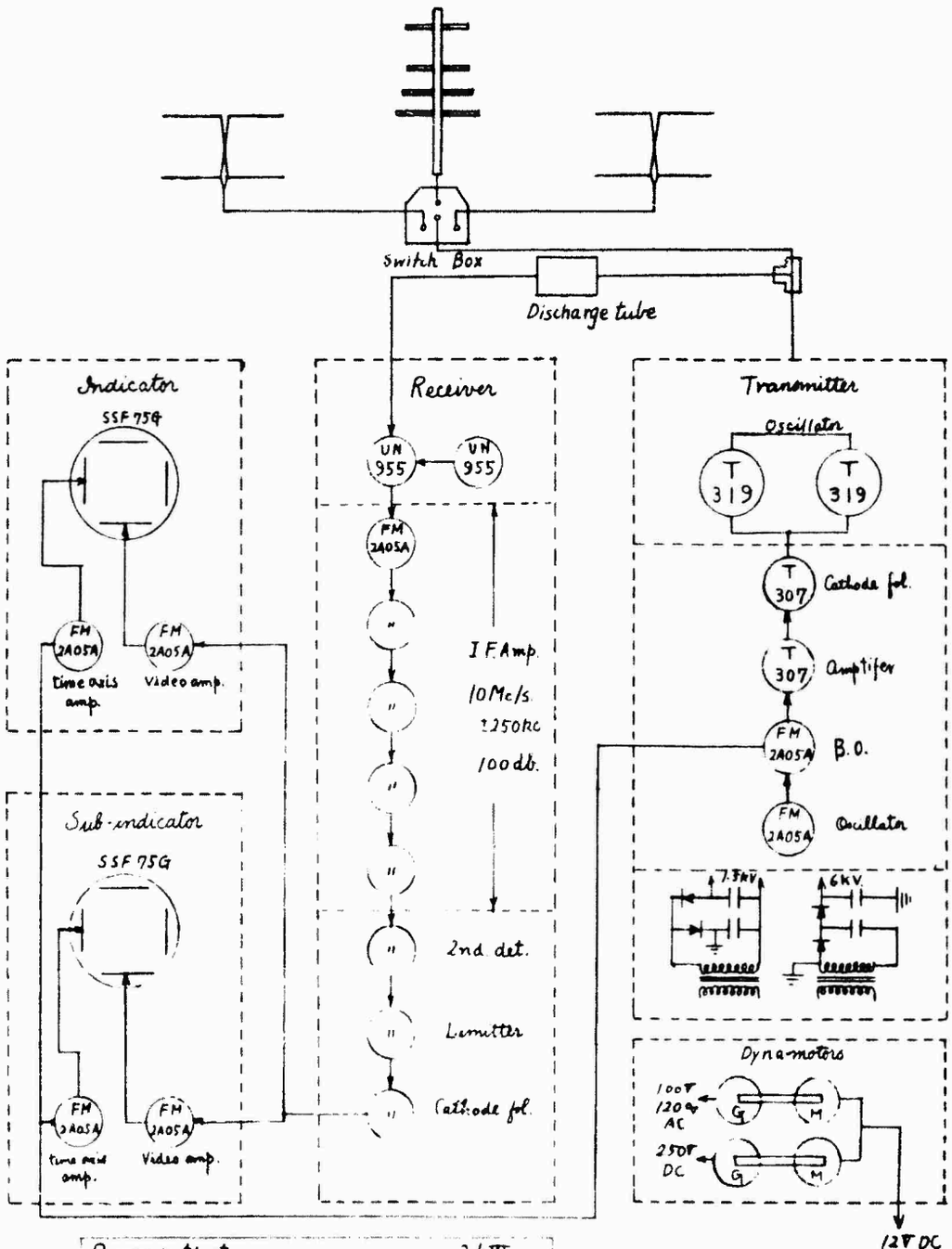
f = 250 MC/S. 2 KW. Range, 40 Km against large ships.
Accuracy: Range, ± 5%; Azimuth, ± 3°.

Number Built = 20. Number Installed = 0.

Description:

This set was designed for small patrol and search planes and used a nose Yagi antenna with doublets on either side of the fuselage. However, difficulty arose in the r.f. receiving end of the set and research on it was discontinued.

RADAR FOR SMALL PATROL PLANE USE (No)



Power output	2 kW
Frequency	250 Mc/sec
Pulse length	7 μ sec.
Range	20km for a destroyer
Accuracy	± 5 %

FK-4

PATROL AND SEARCH - LARGE PLANES

Corresponding Allied Designation: ----

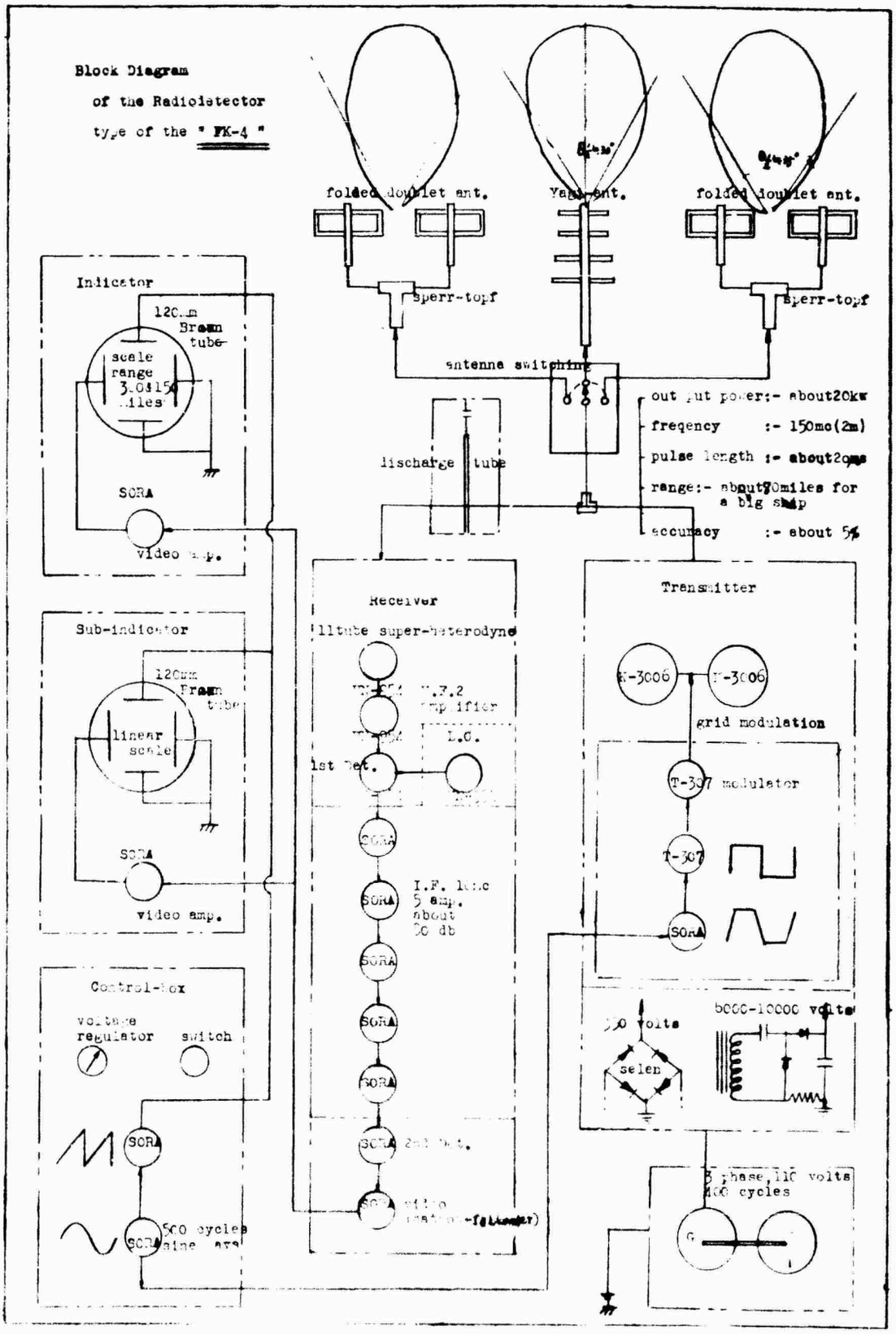
Technical Characteristics:

f = 150 MC/S. 20 KW. Range 150 Km against a large ship.
Accuracy: Range, ± 5%; Azimuth, ± 3°.

Number Built = 0. Number Installed = 0.

Description:

This was to have been a high powered patrol and search set for large airplanes. However experimental work on the prototype was stopped in July 1945 because of air raids. A choice of any one of 3 antennas for transmitting-receiving is available. Two scopes, one for the pilot and one for the radar observer, are provided.


Block Diagram
of the Radiodetector
type of the " FK-4 "
folded doublet ant.
Yagi ant.
folded doublet ant.
Sperr-topf
Sperr-topf
antenne switching
Indicator
120mm
Braun
tube
scale
range
3.0&150
miles
SORA
video amp.
discharge tube
out put power:- about20kw
freqency :- 150mc(2m)
pulse length :- about2oms
range:- about80miles for
a big ship
accuracy :- about 5%
Receiver
lltube super-heterodyne
L.O.
1st Det.
SORA
I.F. line
5 amp.
about
30 db
SORA
SORA
SORA
SORA
SORA
video
Transmitter
T-3006
T-3006
grid modulation
T-307 modulator
T-307
SORA
Sub-indicator
120mm
Braun
tube
linear
scale
SORA
video amp.
Control-box
voltage
regulator
switch
SORA
500 cycles
SORA
b000-10000 volts
selen
3 phase,110 volts
400 cycles

RADAR NO. 51

PATHFINDER

Corresponding Allied Designation: ----

Technical Characteristics:

Wavelength 10 cm. 6 KW. Range 20 Km. PRF = 600/sec. Pulse width = 1.5 μs.
Transmitter Tube: Magnetron, M-314, 4 cavity electromagnet of 1200 gausses. Antenna Rotation 1 per sec. Weight = 250 kg.

Number Built = 2 or 3. Number Installed = 1 for testing.

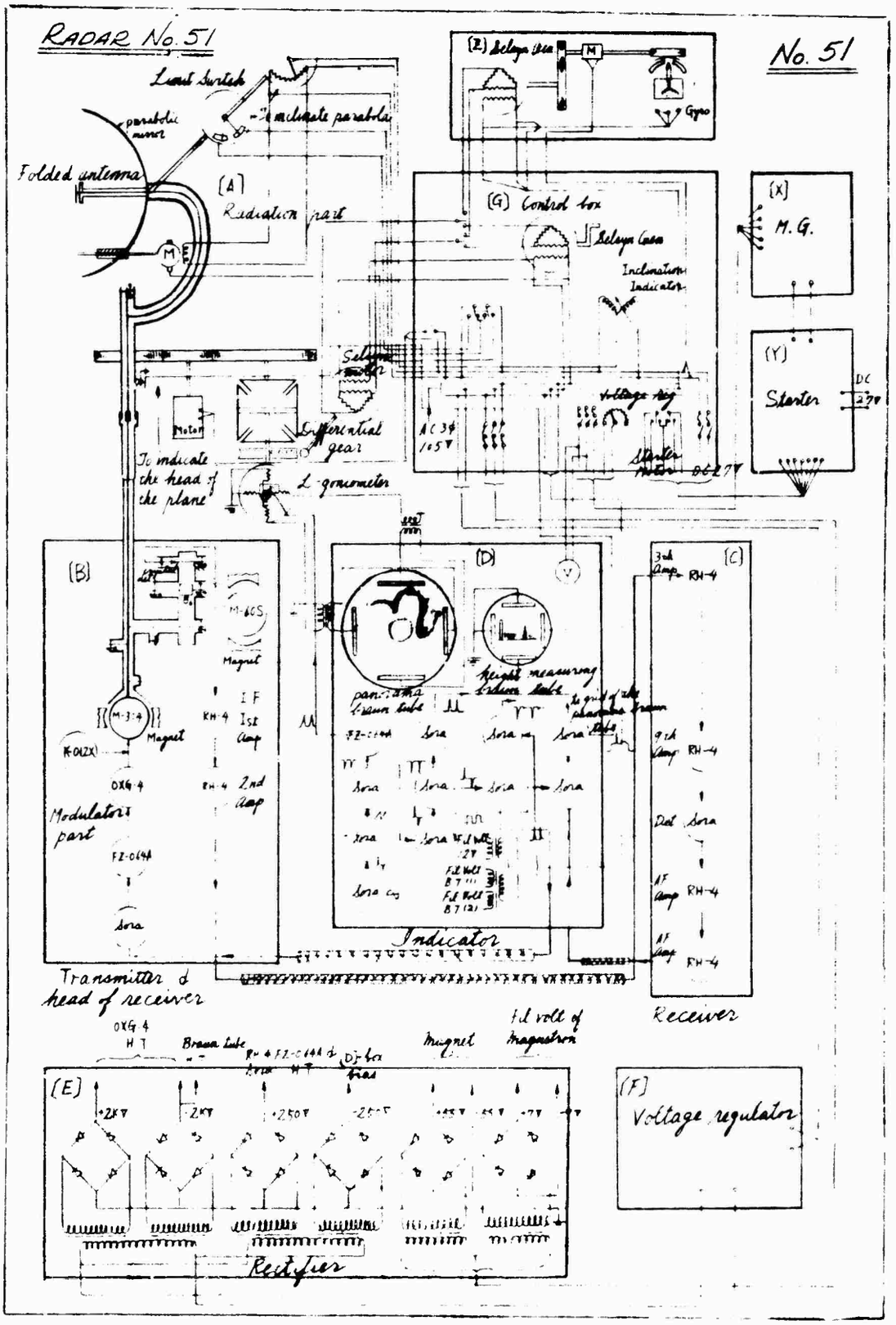
Description:

The Pathfinder, No. 51, is the Japanese navy's counterpart of the American ASG and SCR-717B. It is a 10 centimeter, magnetron powered set with a north stabilized 150 mm PPI oscilloscope tube. Arrangement is made for a lubber line to show the heading of the plane at any instant. A second A-display scope reads altitude.

Elaborate silver plated plumbing is used to connect the transmitter and receiver to the main transmission line. A cartridge type crystal, inserted in this complex is the first detector for the superheterodyne receiver which has a 9 tube IF amplifier at 14 MC/S; a T-R tube protects the receiver. A small M-60S magnetron is used as the local oscillator. The antenna as seen in the photos is a parabola clipped at top and bottom and carries a folded antenna with parasitic reflector in front of it. Power is supplied by a 25 v dc dynamotor furnishing 1500 watts of 400 cycle AC at 105 volts.

Preliminary flight results showed that shorelines could be distinguished at 20 km. No ships were seen except from a land based installation of No. 51 at the Kanazawa laboratories.

An interesting sidelight on this set arises from the statement made by navy officers at the 2d Naval Technical Institute that the system characteristics for the No. 51 radar had come from Germany where the equipment was known as the "Rotterdam Gerate." It is believed that the information was obtained from an early Model of H2S equipment carried by a British plane forced down over Rotterdam in the early days of the European War.


RADAR No. 51
No. 51
Limit Switch
parabolic mirror
Folded antenna
(A) Radiation part
(G) Control box
Relays Case
Inclination Indicator
(X) M. G.
(Y) Starter
DC 27V
Selsyn motor
Differential gear
To indicate the head of the plane
L goniometer
Voltage reg
AC 3φ 105V
Starter Motor
(B)
M-6CS
Magnet
IF Ist Amp
RH-4
2nd Amp
Modulator part
(D)
Indicator
(C)
Receiver
Transmitter & head of receiver
OXG-4
HT
Braun tube
Magnet
Fil volt of magnetron
(E)
Rectifier
(F)
Voltage regulator

This information was received in Japan in 1944. The navy asked the 2d Technical Institute to make such an equipment for them. An attempt was first made to modify the shipborne No. 22 set but not very successfully. A model of the present 51 design was completed in February 1945, and test flown in July at Misawa airfield. It was reportedly completely destroyed in the 9-10 August air raids.

Circuit schematics of the No. 51 set are included in Appendix II of this Survey.*

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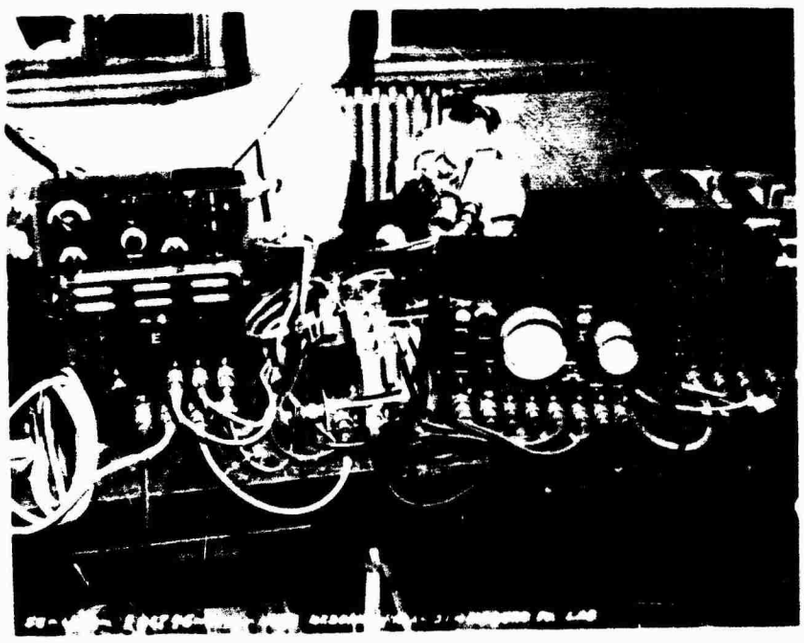
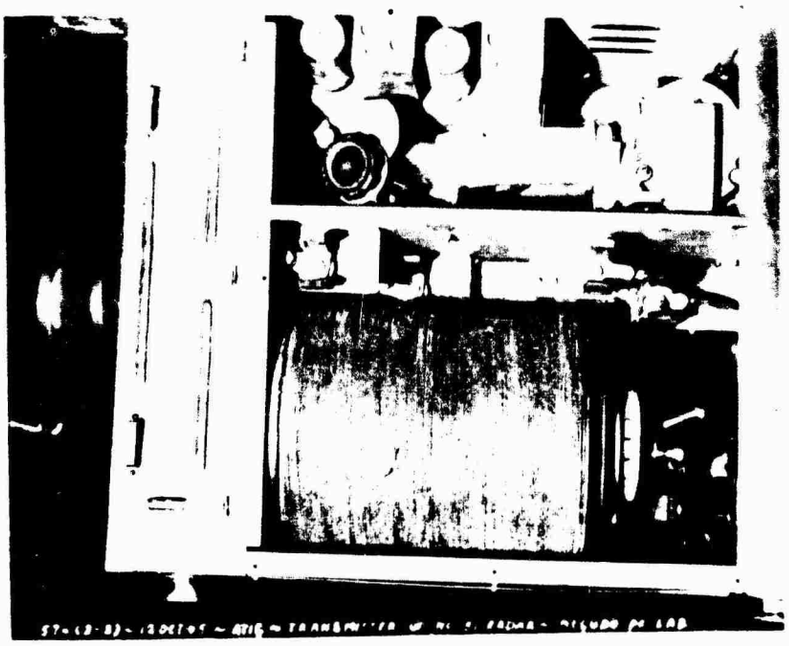
*The bench model of the No. 51 at the Naval Technical Institute is being shipped to the U.S. by the Air Technical Intelligence Group, Far East Air Forces. A manual of operation will also be available through this unit.

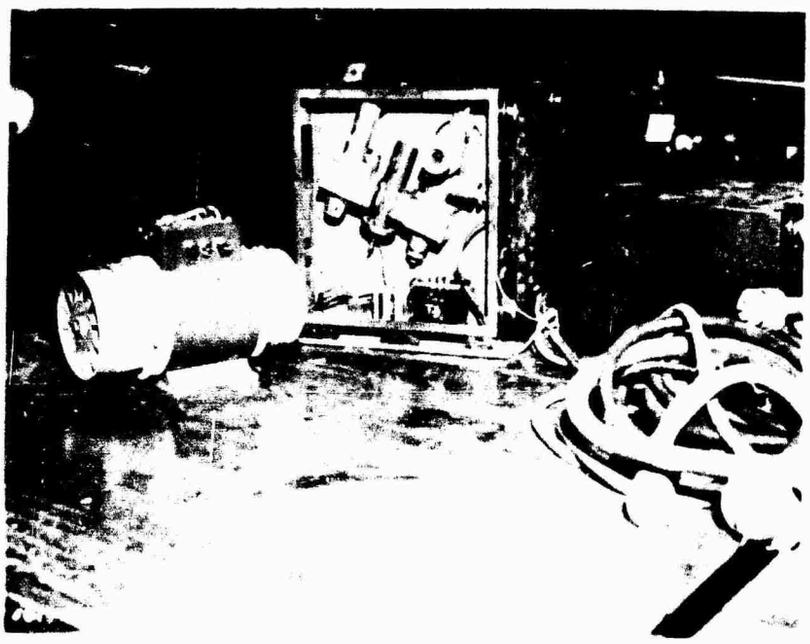


No. 51 - Navys "Pathfinder" - 10 CM
Airborne Search Radar - Meguro Park.



Detail of Transmitter - Showing Electromagnet
with Magnetron Inserted Axially.

Cut Paraboloid Reflector with Folded Dipole Antenna and Reflector; and Rotary Joint of Airborne Set No. 51.



High Frequency "Plumbing" and 400 Cycle Dynamotor for No. 51 Set.

L-2 AND L-3

SEARCHLIGHT CONTROL

Corresponding Allied Designation: Mark 4 Model 3.

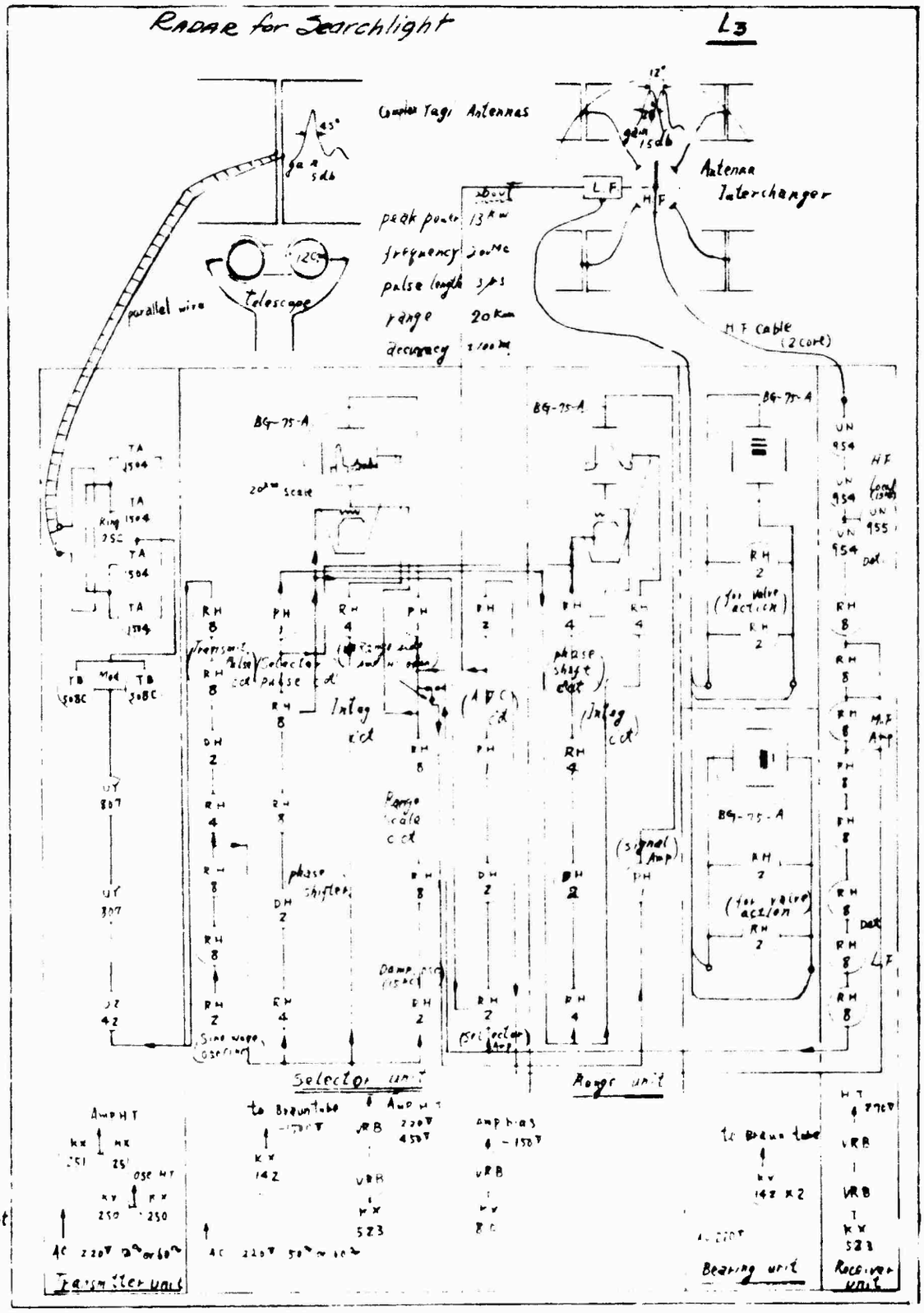
Technical Characteristics:

f = 200 MC/S. L-2: 10 KW. Range 15 Km.
L-3: 13 KW. Range 20 Km.
Accuracy: Range, L-2, ± 150 M; Azimuth, ± 1.5°.
Range, L-3, ± 100 M; Azimuth, ± 1.5°.

Number Built = L-2's: 170 Number Installed = Many
L-3's: 70 = Few

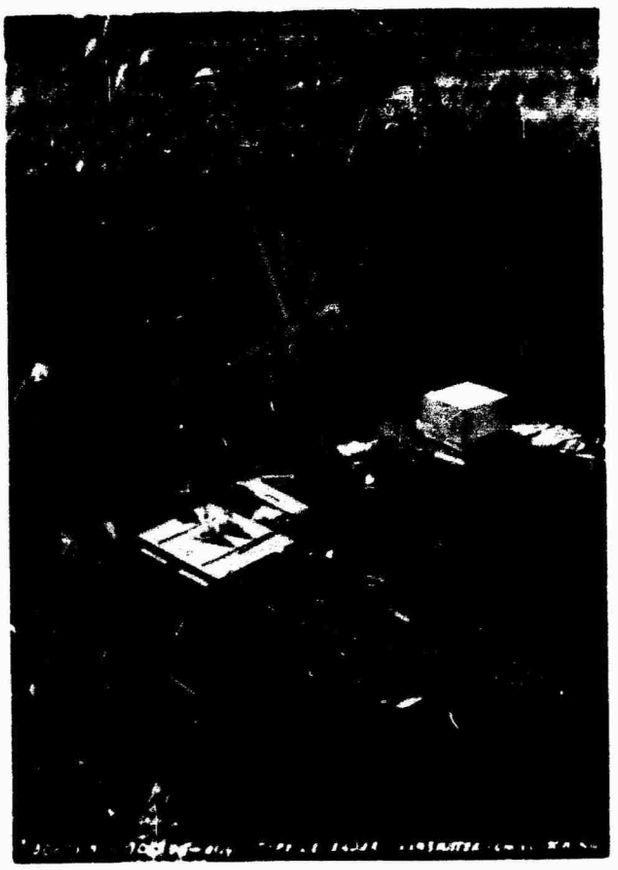
Description:

The L-3 set so closely resembles the L-2 that it is difficult at first glance to tell them apart. The L-3 has slightly higher power and consequently improved range and is provided with an additional cathode ray tube with expanded range scale. The transmitter consists of a pair of Yagi arrays mounted on a turntable. The receiving antenna is mounted on a framework fastened to the light itself perhaps 50 yards distant from the transmitter. It consists of 4 separate Yagi antennas. The signals received by them are switched from one to the other in rapid sequence. The comparison of strengths of these signals then gives a means for determining which direction to move the light to get on target. An operator at the receiver hut watches an A-scope on which all target echoes show up to 20 km. He moves by means of a hand crank range knob a bright spot along the axis until it coincides with the left edge of a target echo. All targets appearing to the right of this spot for a range of 1000 meters are gated over to the vector display at the transmitting station. (In the L-3 model this same 1000 yards is displayed in expanded form across the face of a second A-scope by means of which the operator can obtain more accurate range estimates. This expanded scope is not supplied in the L-2 set.) The operator who rides around with the mount has control over the rotary motion by means of a pair of handle grips; he can by the same controls alter the elevation angle of the antenna. The rider is supplied with a 75 mm cathode ray tube on which a vector type of display shows him which way to move the antenna for exact centering. If the target is exactly centered a small bright spot only shows in the center of the scope. If the target is higher than the antenna axis a bright line on the scope extends upwards from the center spot. Likewise a line shows to the right if the antenna is off center left. Errors in both elevation and azimuth produce a sloping line pointing from the center spot in exactly the direction the antenna should be moved to get "on target." Hence the name vector presentation. The rider also has a pair of 20 power 120 mm objective lens field glasses through which he spots the planes visually whenever possible. The searchlight is connected to the transmitter turntable by selsyns and follows automatically the movements of the transmitting antenna so that when the transmitting antenna is "On Target" the

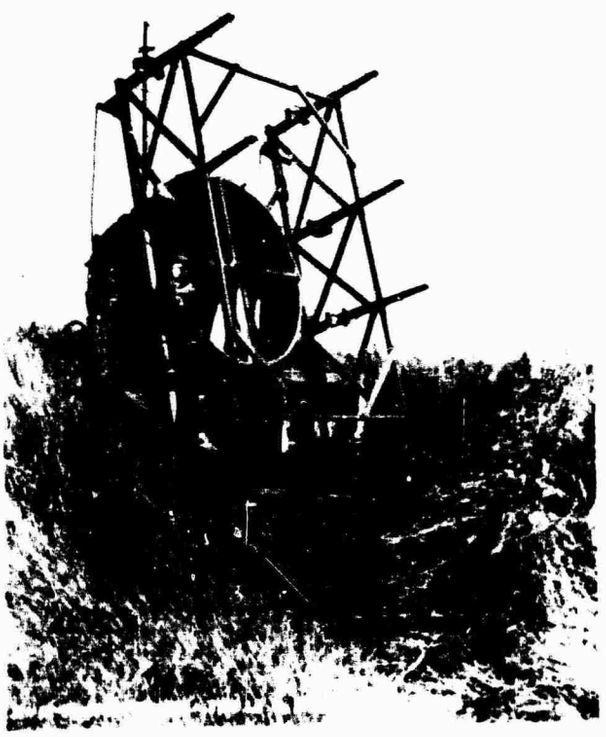

Range for Searchlight
L3
Centre Yagi Antennas
gain 5db
gain 15db
Antenna Interchanger
L.F.
H.F.
peak power 13 KW
frequency 30 Mc
pulse length 3 μs
range 20 Km
accuracy ± 100 M
parallel wire
Telescope
H.F. cable (2 core)
BG-75-A
20" scale
Transmitter pulse
Selector pulse
Range scale
phase shifter
Selector unit
Ranger unit
Bearing unit
Receiver unit
Transmitter unit
to Braun tube
Amp H.T.
A.C. 220V 50 or 60 ~

the searchlight is also On Target.

The Sumitomo Company manufactured about 70 of the L-3 equipments, but nearly 60 of them were destroyed in the factory by bombings. Only a few of this latest model actually saw use.



An Operator rides around on this turntable which carries the antenna and the transmitter of the L-2



Four sets of Antennas are mounted on the Searchlight frame; by equalizing the signals from opposite antennas the light is held "On Target"

S-3 - (or TYPE 41)

ANTI-AIRCRAFT FIRE CONTROL

Corresponding Allied Designation: Mark 4 Model 1.

Technical Characteristics:

f = 200 MC/S. 15 KW. 20 Km.
Accuracy: Range, ± 100 M; Azimuth, ± 1°.

Number Built = 80. Number Installed = Numerous

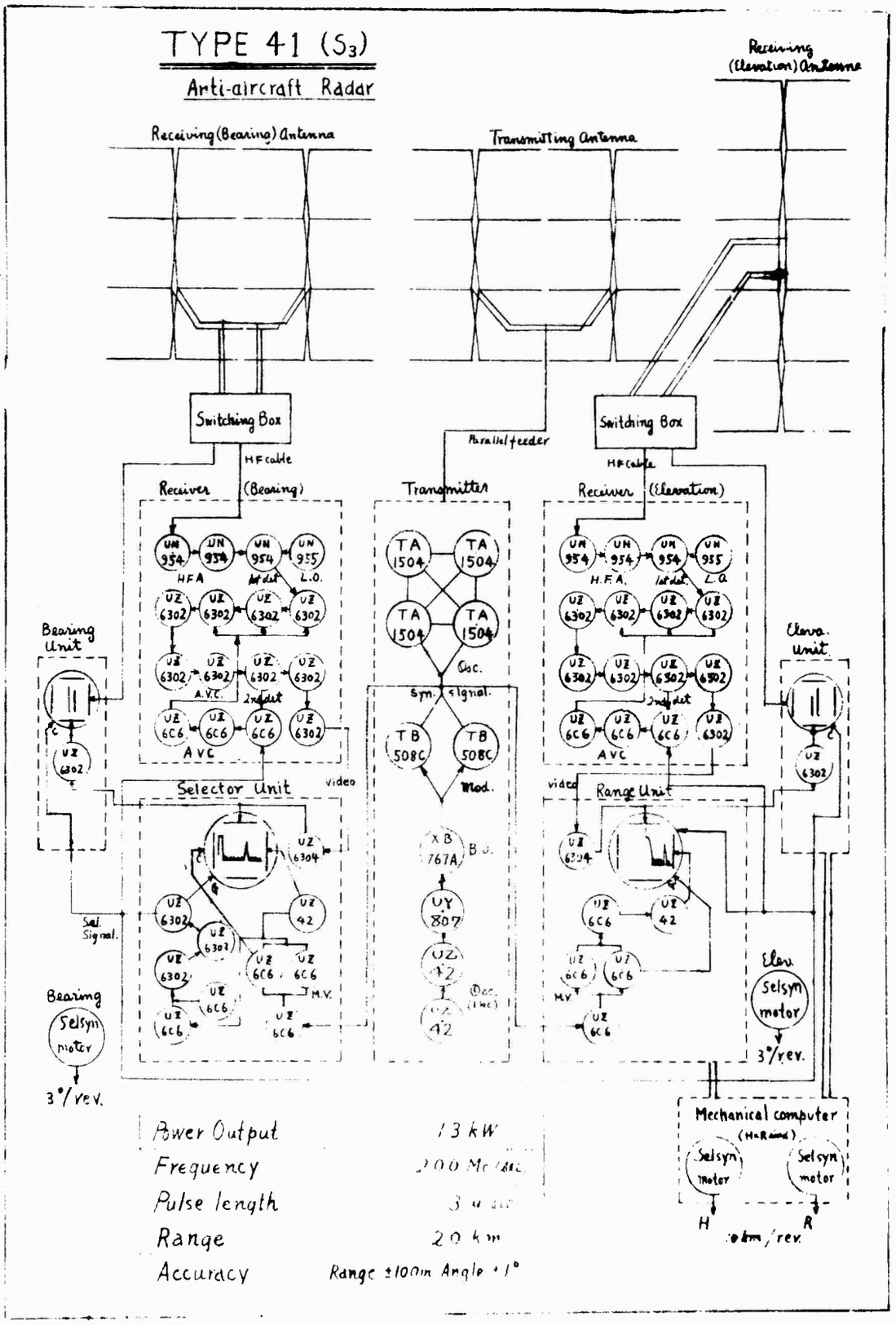
Description:

This equipment is a close copy of the American SCR-268. In May 1942 the Japanese captured a "268" at Corregidor. "Research" on the S-3 is indicated by the Japanese navy laboratory as having begun in August 1942, and was completed a year later.

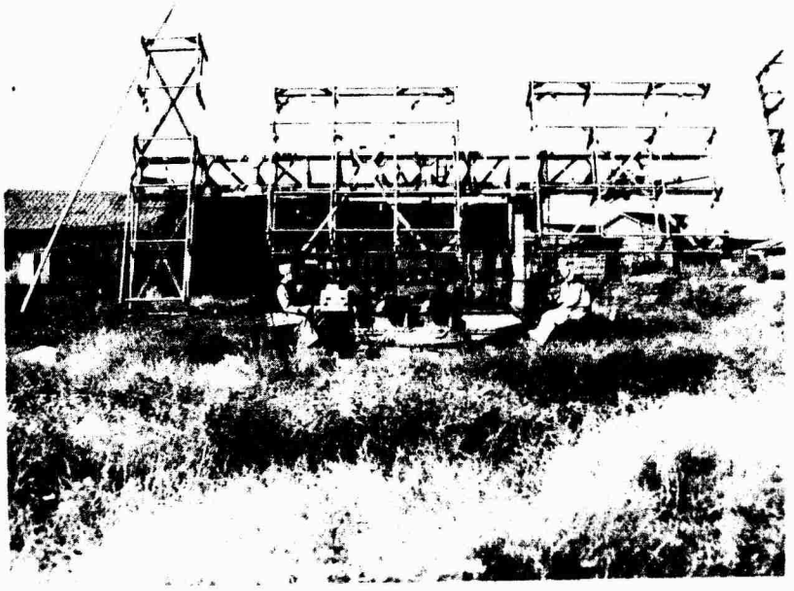
Difficulties in manufacture arose which held down production at the Sumitomo company to 5 per month. Moreover in the field it was found to be a most difficult and complicated set to maintain. This led to the development of other more satisfactory types of S/L and AA control radars. Four scopes are used, an A-type range scope showing all targets on the scale to 150 km, a selector scope on which a particular target is chosen, and two pip matching scopes, one for azimuth and one for elevation centering.

TYPE 41 (S_3)

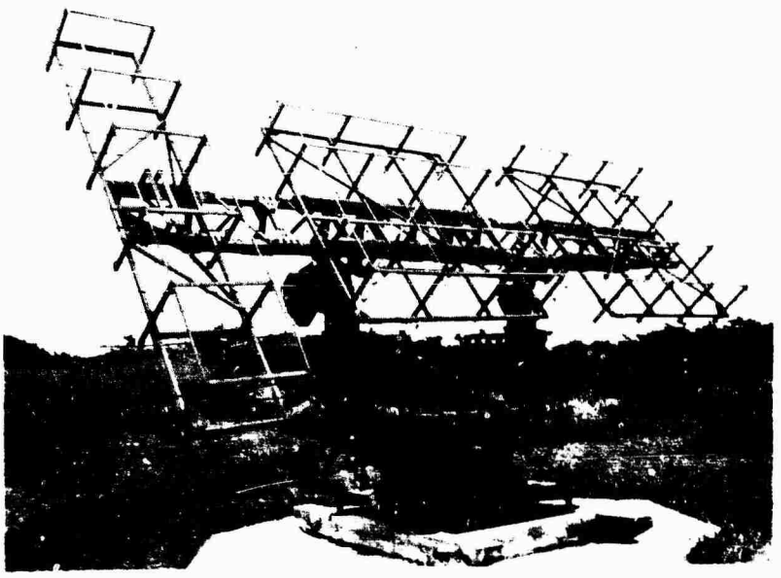
Anti-aircraft Radar



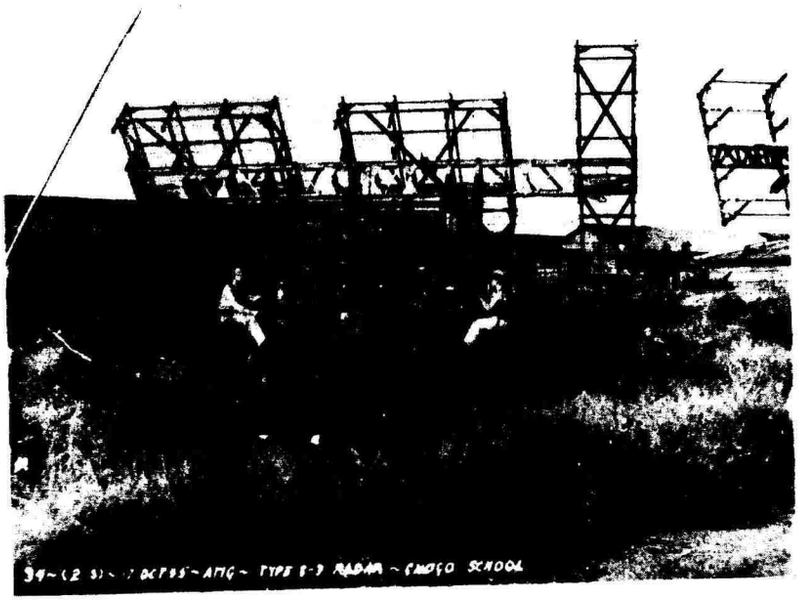
Power Output	13 kW
Frequency	200 Mc/sec
Pulse length	3 μ sec
Range	20 km
Accuracy	Range ±100m Angle ±1°



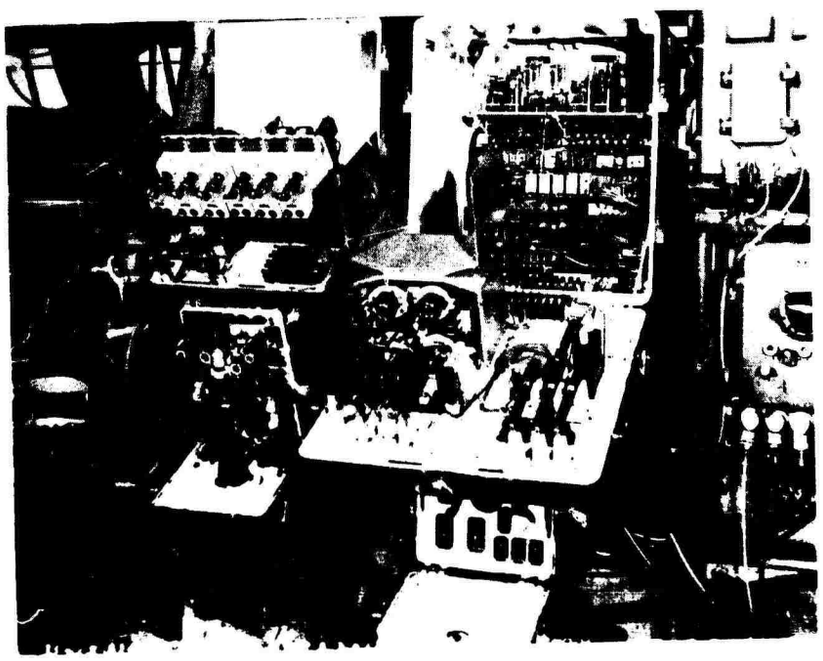
S-3 Navy Fire Control Radar -- Similar to American SCR-268 -- Chogo.



Detail of Antenna, S-3 Radar -- Chigasaki.



Rear View of S-3 Radar -- Chogo.



Equipment Compartments Opened, Showing
Easy Access for Maintenance -- S-3.

S-23

ANTI-AIRCRAFT FIRE CONTROL

Corresponding Allied Designation: Mark 4 Model 2.

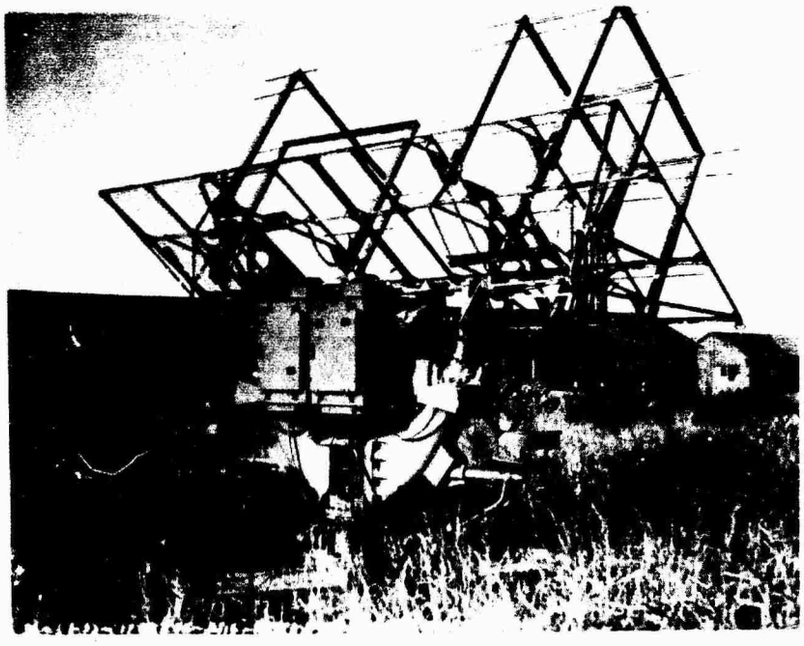
Technical Characteristics: (same as L-2)

f = 200 MC/S. 10 KW. Range = 15 Km.
Accuracy: Range, ± 150 M; Azimuth, ± 1.5°; elevation, ± 1.5°.

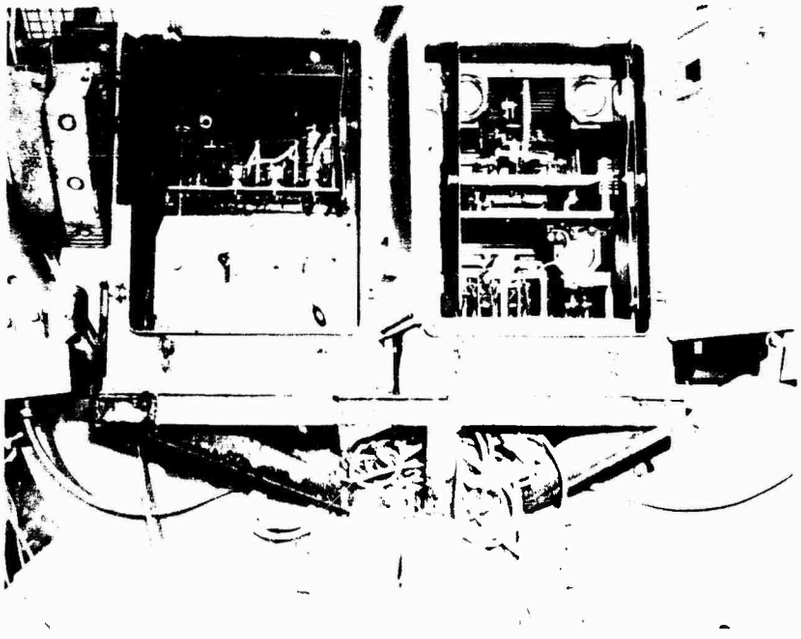
Number Built = 20. Number Installed = 0.

Description:

The S-23 was a stopgap set built to use until the S-24 would be ready. It used the equipment from the L-2, with a simple array antenna. The whole set was mounted on the turntable formerly used for their acoustical detectors. Range and accuracy were about the same as the S/L sets, which were not good enough for AA firing. The S-24 was finished almost as soon as the S-23, the latter then was obsolete before it was used.



First Japanese Navy Fire Control Radar S-23
Adapted from L-2 Searchlight Controller.



Equipment detail of the S-23 radar.

S-24

ANTI-AIRCRAFT FIRE CONTROL

Corresponding Allied Designation: Mark 4 Model 2, Modification 2.

Technical Characteristics:

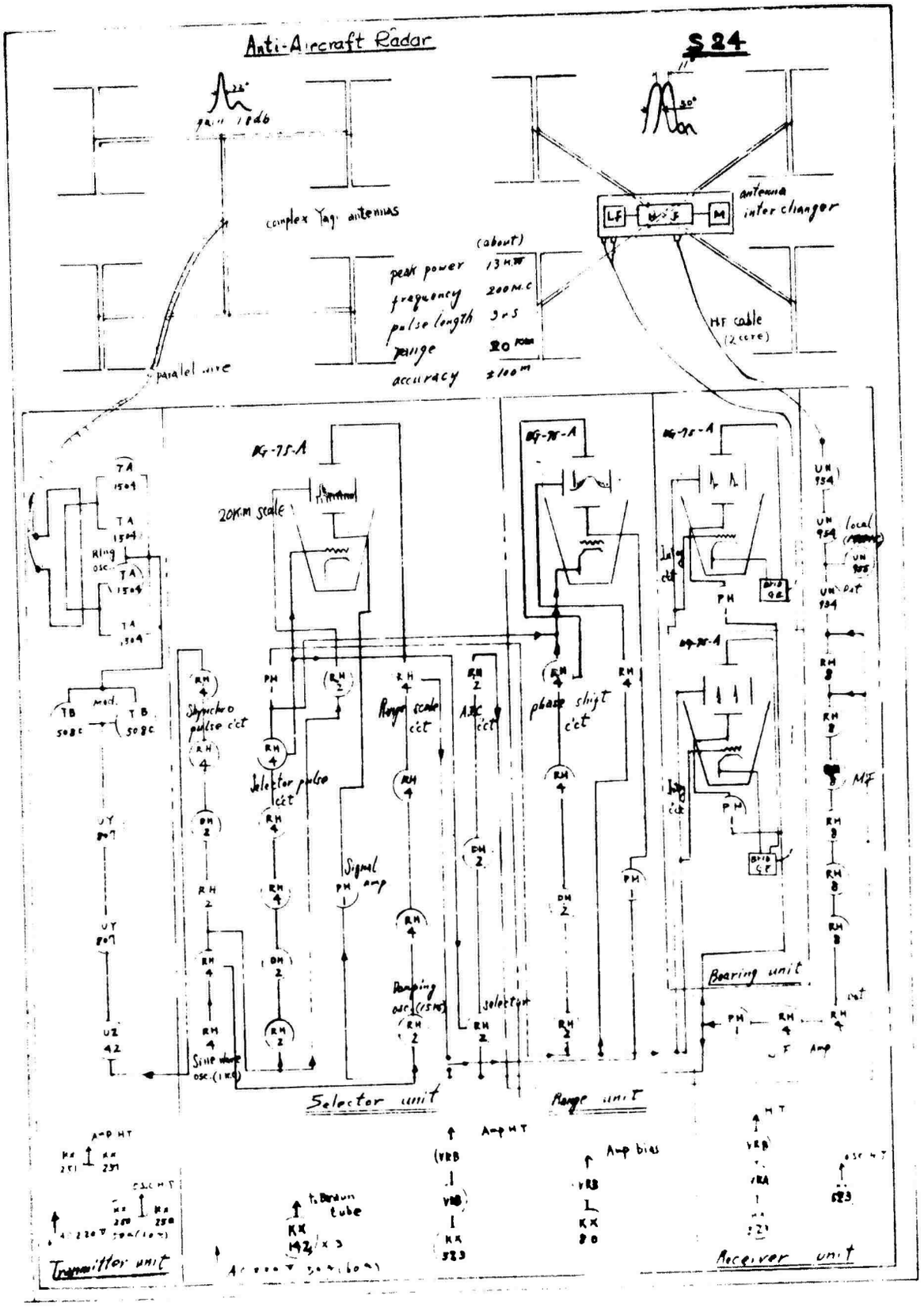
f = 200 MC/S. 13 KW. Range 20 Km.
Accuracy: Range, ± 50 M; Azimuth, ± 1°.

Number Built = 80. Number Installed = About 60.

Description:

While the S-3 (SCR-268 copy) was undergoing "research", another set to do the same fire control job, the S-24, was under development. This appears to have been an adaptation of a British SLC model. It turned out to be both more accurate than S-3 and considerably easier to maintain.

The presentation is by means of four cathode ray tubes. One is a range tube with all returning echoes showing and a rough scale below the base line with range marker pips. Another range tube has a magnified horizontal scale so that a range marker can be placed accurately against the returned signal. This act also gates the pulse over to the azimuth and elevation pip matching scopes, where operators attempt to stay on target by pip matching.


Anti-Aircraft Radar
S 24
gain 18db
complex Yagi aitennas
antenna inter changer
LF
M
(about)
peak power 13 M.W
frequency 200 M.C
pulse length 3 μS
range 20 KM
accuracy ±100 M
H.F cable
(2 core)
parallel wire
RG-75-A
20 K.M scale
TA 1509
TA 1504
Ring osc.
TB 508C
Mod.
UY 807
UZ 42
Synchro pulse c'ct
Selector pulse c'ct
Range scale c'ct
A.F.C c'ct
phase shift c'ct
Signal amp
Sine wave osc. (1 KC)
Damping osc. (15 KC)
Selector
Selector unit
Range unit
Bearing unit
M.F
Local
Beat c'ct
Bal c'ct
Trans-mitter unit
Receiver unit
Cathode ray tube
A-p H.T
A-p bias
Osc H.T
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KK 239
KK 280
KK 258
KK 523
KK 521
KK 80
KK MZ4
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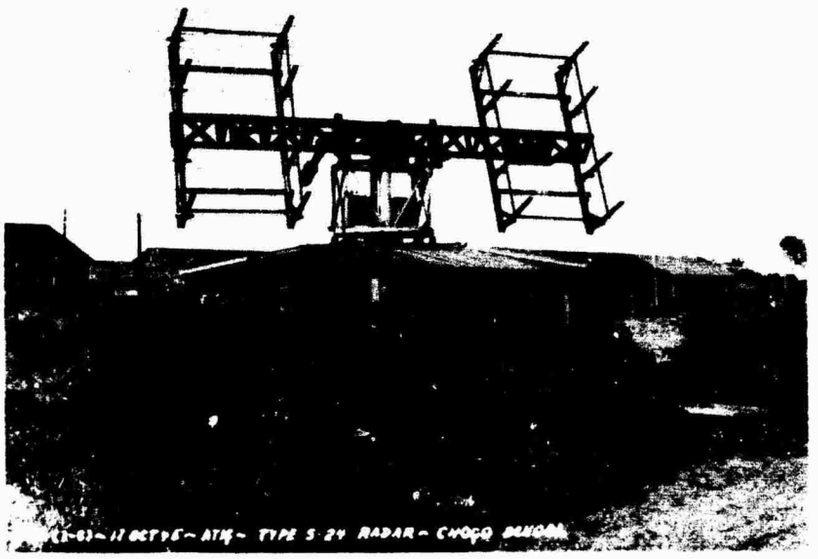
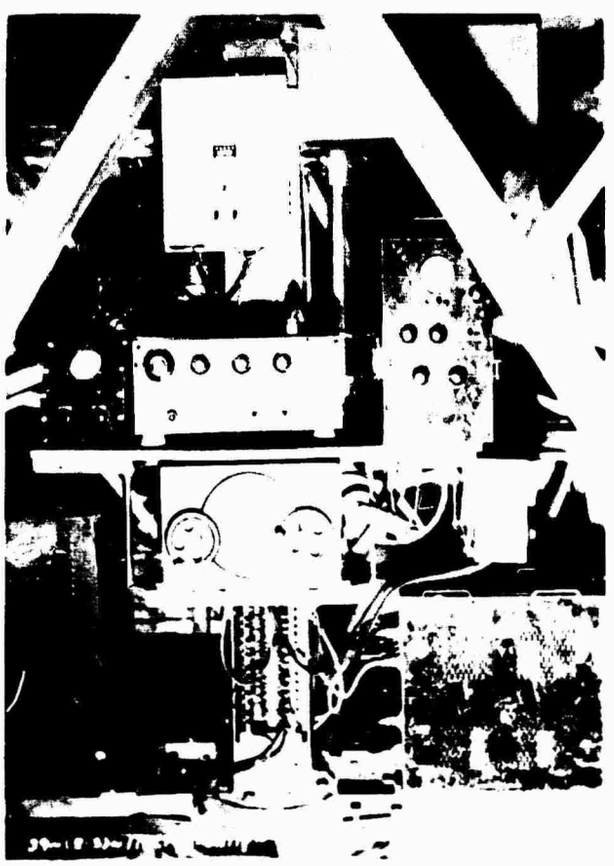
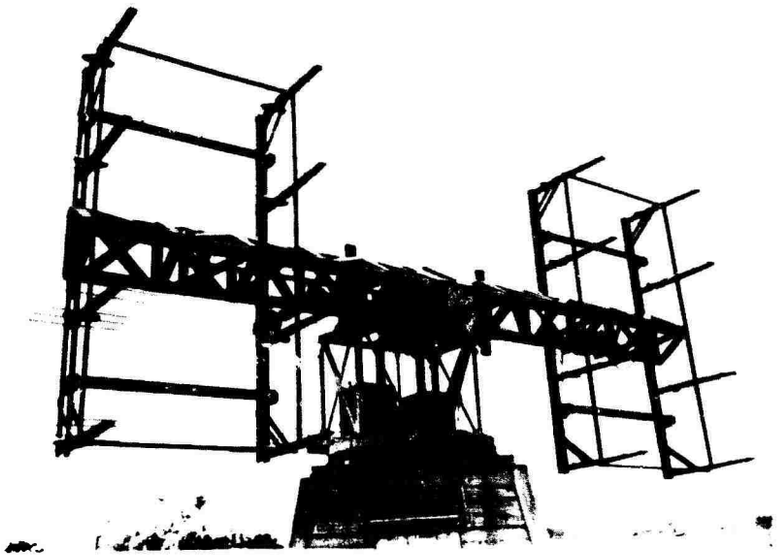


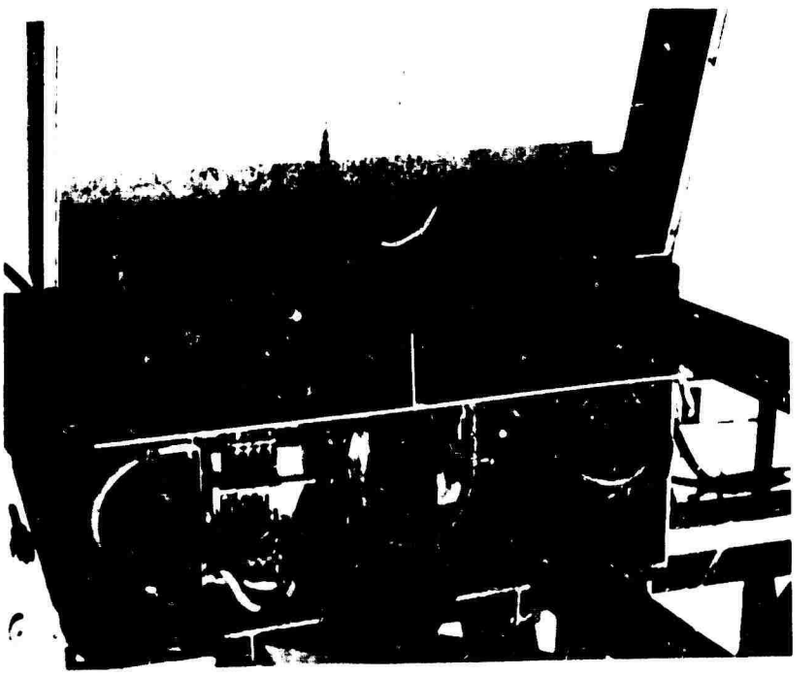
S-24, Navys Latest (In Use) Land Based Antiaircraft Fire Control Radar -- Chogo.



Receiver and Indicator Equipment, S-24. The operators and equipment ride around on a turn table inside the hut.



Detail of Antenna of S-24 Radar.



Lobing Switch and Motor Located on Back of S-24 Antenna.

HAMA 61 (or S_{8B})

FOR ALTITUDE MEASUREMENT

Corresponding Allied Designation: ----

Technical Characteristics:

f = 500 MC/S. 10 KW. Range 50 Km.
Accuracy: Range, ± 200 M; Azimuth, ± 0.3°; Elevation, ± 0.5°.

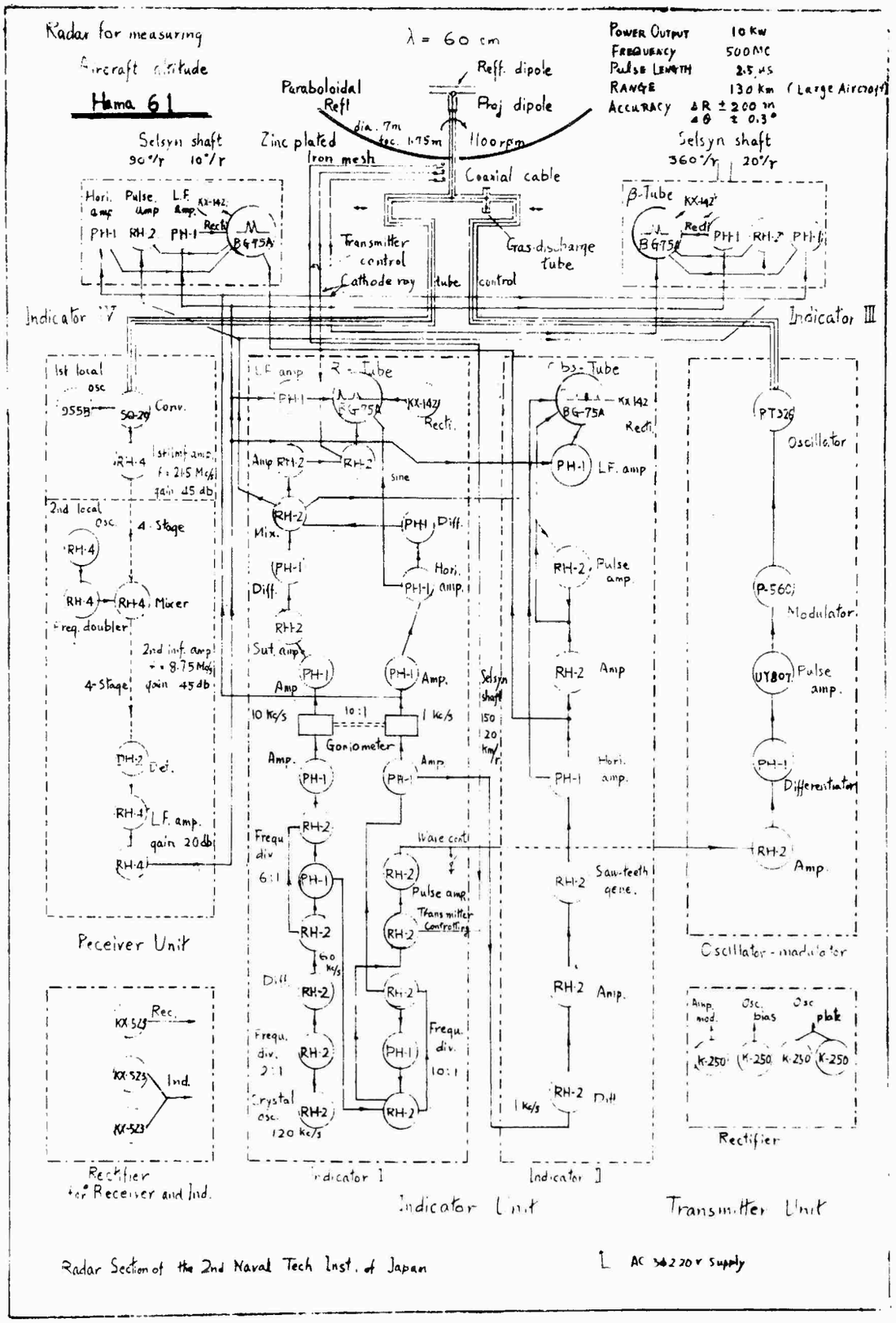
Number Built = 3. Number Installed = 0.

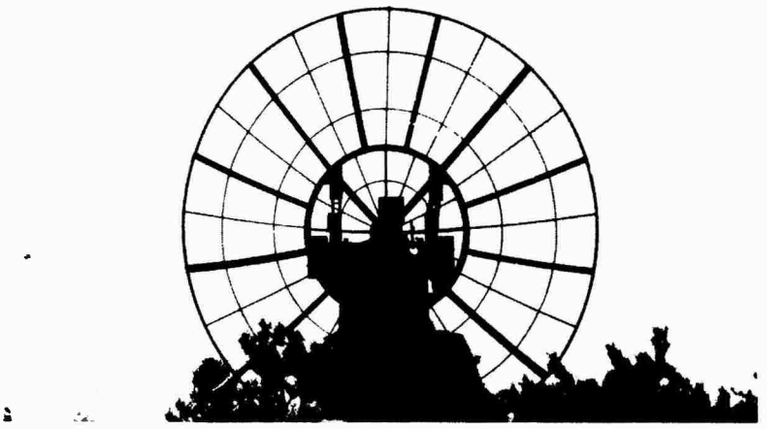
Description:

Originally a 58 cm set known as S-8 was designed for a shipboard locator; however it did not prove superior to the No. 22 equipment already in use so the plans were altered slightly and No. 61 was devised to fill the need for measuring airplane heights from the ground.

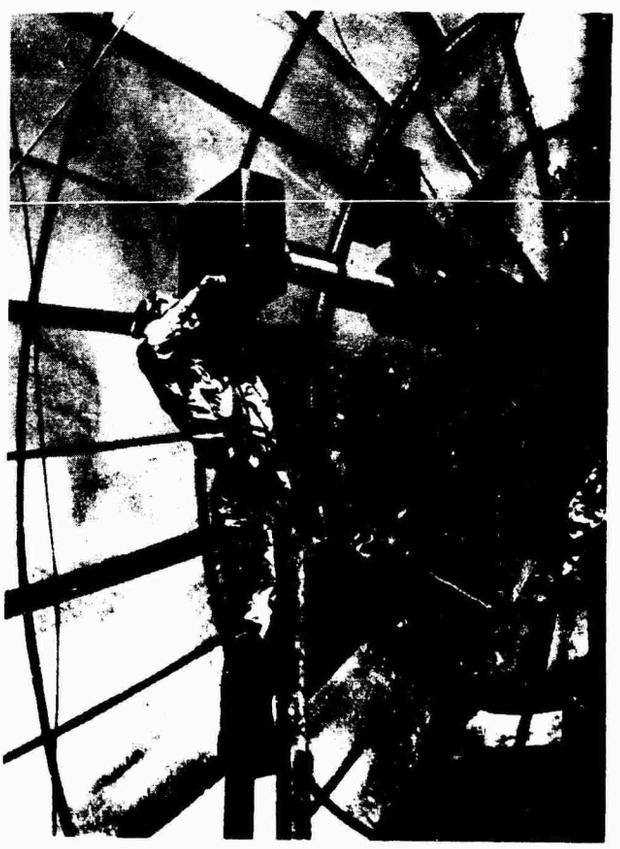
It appears to be a rough Japanese-made copy of the German Wurzburg. It has the same r.f. frequency of 500 MC/S. The paraboloid antenna is 7 meters in diameter and puts out a 4° beam from an offset dipole which is rotated at 1100 rpm to give lobing in both horizontal and vertical directions. The display is on 4 cathode ray tubes; one is an observer's tube which shows all the targets on an A-type scope with 135 km range; another reads range to the target desired and gates the target pip for viewing in split form and height matching on the azimuth and vertical angle scopes. A commutator on the dipole rotating motor shaft is used to switch the video signals to the proper scope deflection plates. The "gate" used here, however, is quite large being some 10 km long so that occasionally several targets may be included at one time. To care for this contingency the azimuth and elevation operators can push a button which collapses the spread in their otherwise split presentation. This calls the attention of the selector operator who then puts a "black spot" on the particular target desired. When this is done the pip to be spread and matched is exactly centered on the azimuth and elevation scopes.

With this equipment it would be difficult to search for targets so it is used in conjunction with a longer wavelength set (such as Radar No. 63) until the latter has selected a special target for No. 61. In GCI practice the No. 61 set would be put on the enemy fighter for close tracking, while Set No. 62 would track the friendly fighter.

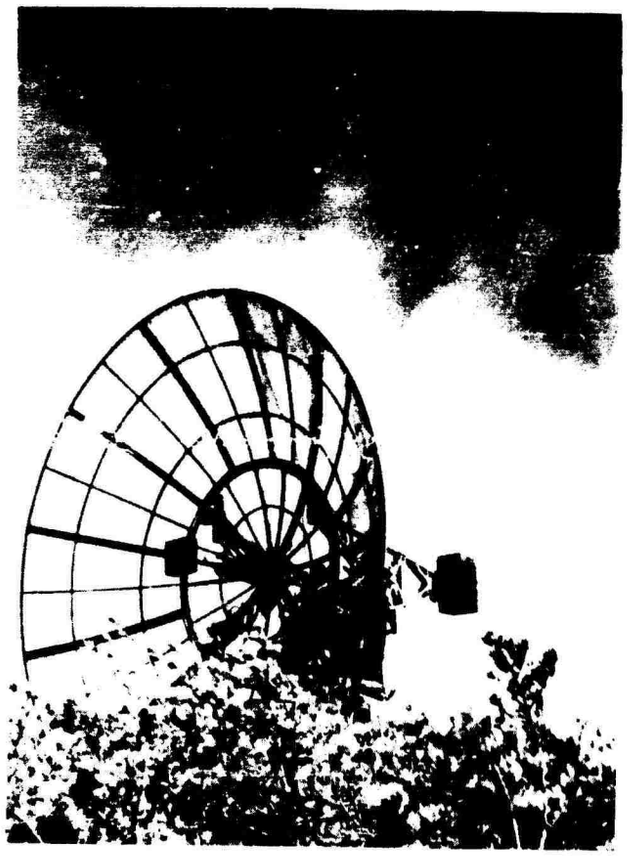

Radar for measuring
Aircraft altitude
Hama 61
λ = 60 cm
Paraboloidal Refl
Reff. dipole
Proj dipole
dia. 7m
Zinc plated iron mesh
Coaxial cable
Selsyn shaft
90°/r 10°/r
Selsyn shaft
360°/r 20°/r
Power Output 10 Kw
Frequency 500Mc
Pulse Length 2.5 μs
Range 130 km (Large Aircraft)
Accuracy ΔR ± 200 m
Δθ ± 0.3°
Transmitter control
Cathode ray tube control
Gas discharge tube
Indicator V
Indicator III
Receiver Unit
Oscillator-modulator
Rectifier for Receiver and Ind.
Indicator I
Indicator II
Rectifier
Indicator Unit
Transmitter Unit
Radar Section of the 2nd Naval Tech Inst. of Japan
AC 50/220 V Supply



Hama 61 Antenna - Head on View - Chigasaki.



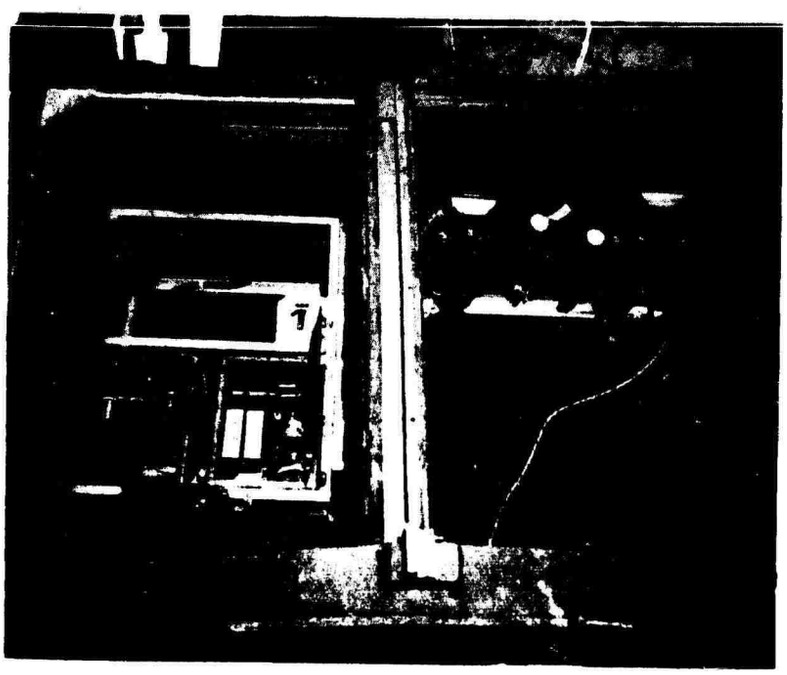
Detail of Box Housing Offset Rotating Dipole.



Hama 61 Radar for Tracking Enemy Planes (500 MC/S) Resembles German Wurzburg

---

Chigasaki



Transmitter Close up from Below - Hama 61.

TYPE 32-(or $10S_2$) AND 31

ANTI-SURFACE FIRE CONTROL FOR SHIPS

Corresponding Allied Designation: ----

Technical Characteristics:

Wavelength = 10 cm. 2 KW. Range 35 Km against battleship.
Accuracy: Range, ± 100 M; Azimuth, ± $1/2^0$.

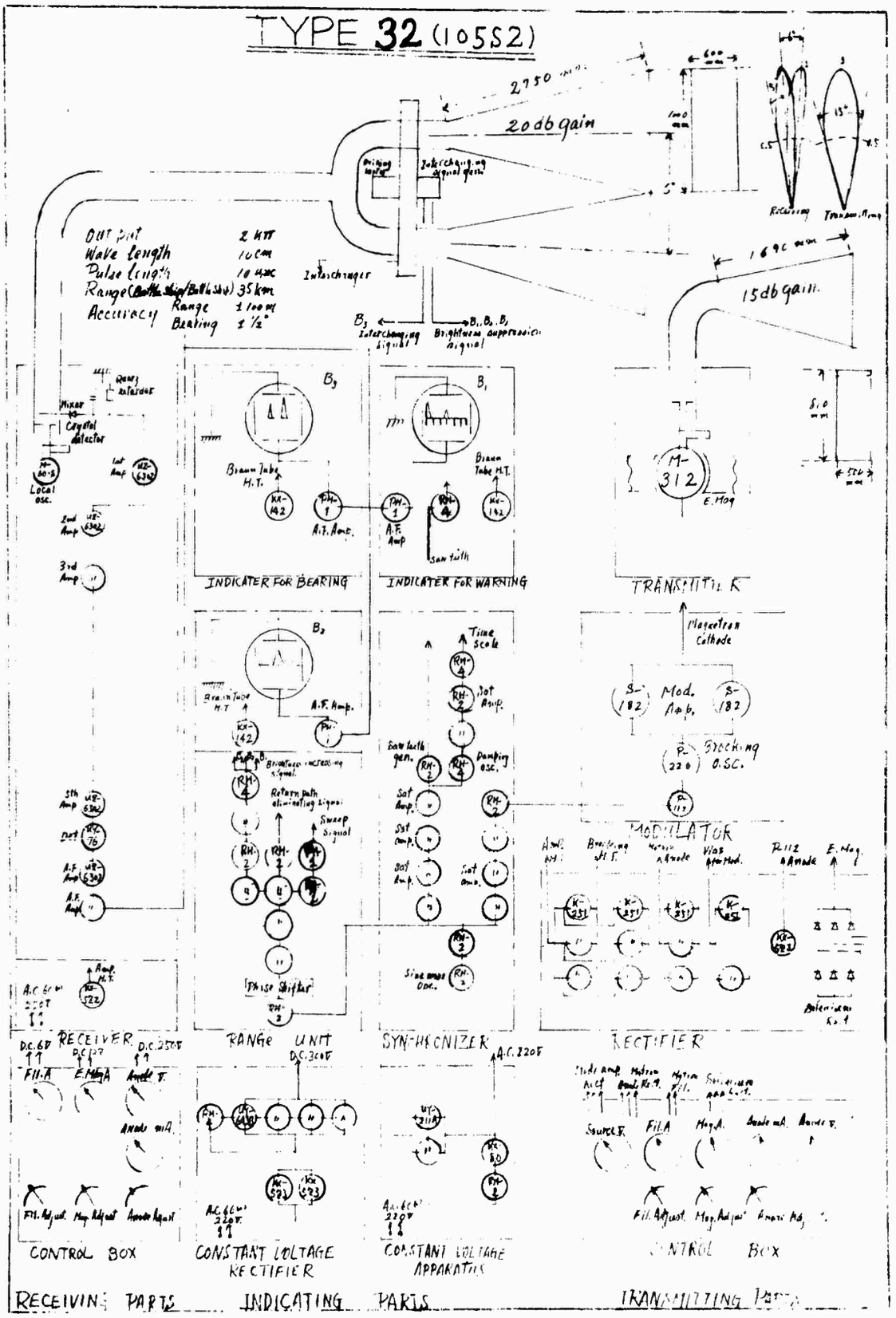
Number Built = 60. Number Installed = 0.

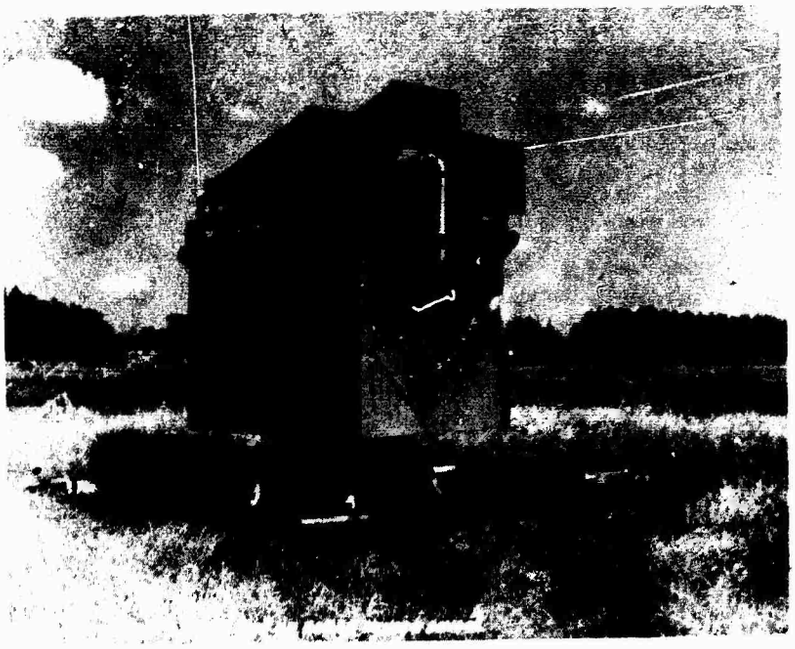
Description:

This is a simple modification of the No. 22 shipborne 10 cm search set, in which the receiver is alternately switched to each of a pair of receiving horns with slightly diverging axes. This produces a pair of lobes with about 6^0 spread. The received signal pips are matched in magnitude on a suitable "Bearing" cathode ray tube to obtain an azimuth accuracy in the order of ± $1/2^0$. A variety of horns have been tried, some round and some square in cross-section, some long and some short.

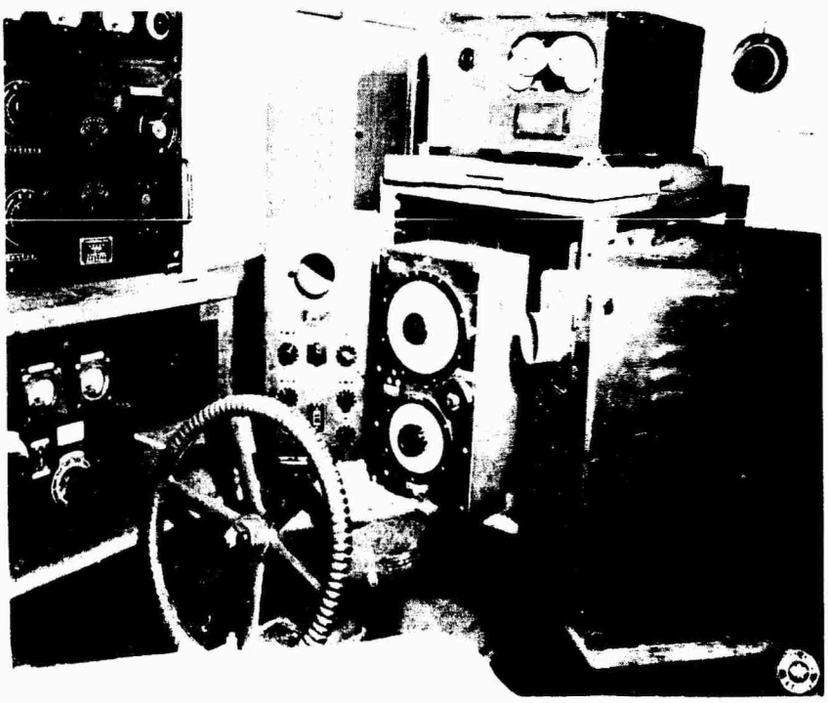
In order to increase the azimuthal accuracy a paraboloid reflector with a dipole moved rapidly horizontally was being experimented with on the No. 32 set at the navy's test station at Tsukishima on the eastern outskirts of Tokyo. Photos of this trial installation are also shown. It was designated as set No. 31.

TYPE 32 (1055Z)

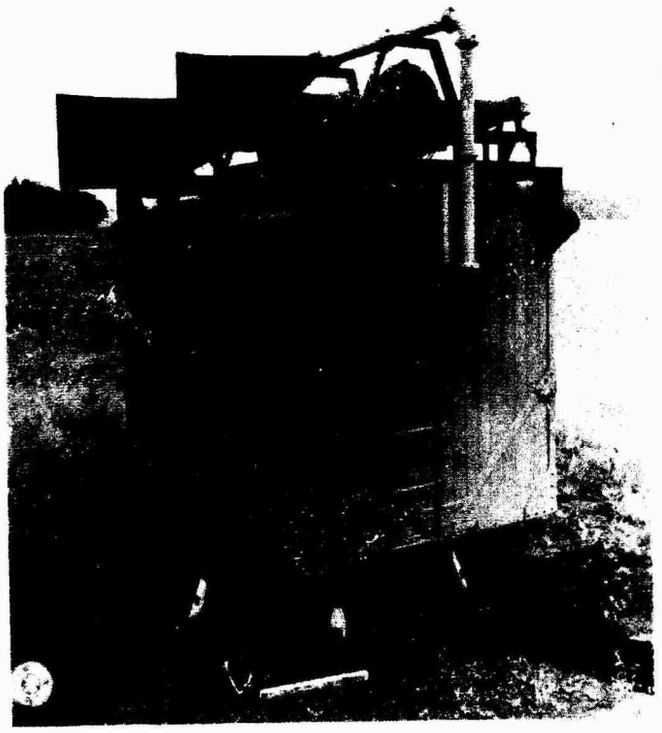




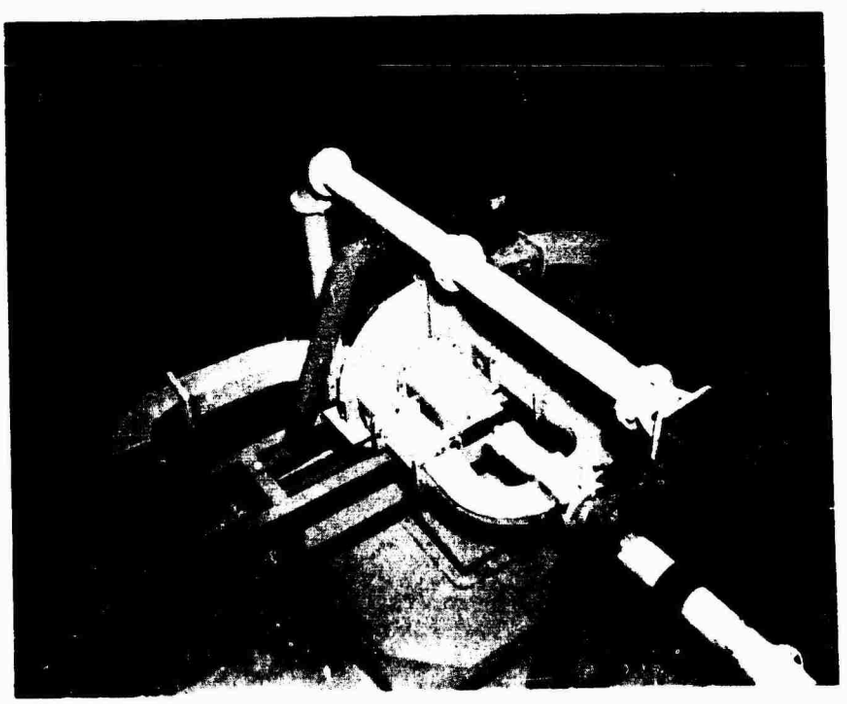
Type 32 10 CM Surface Fire Control Radar -- Chogo.



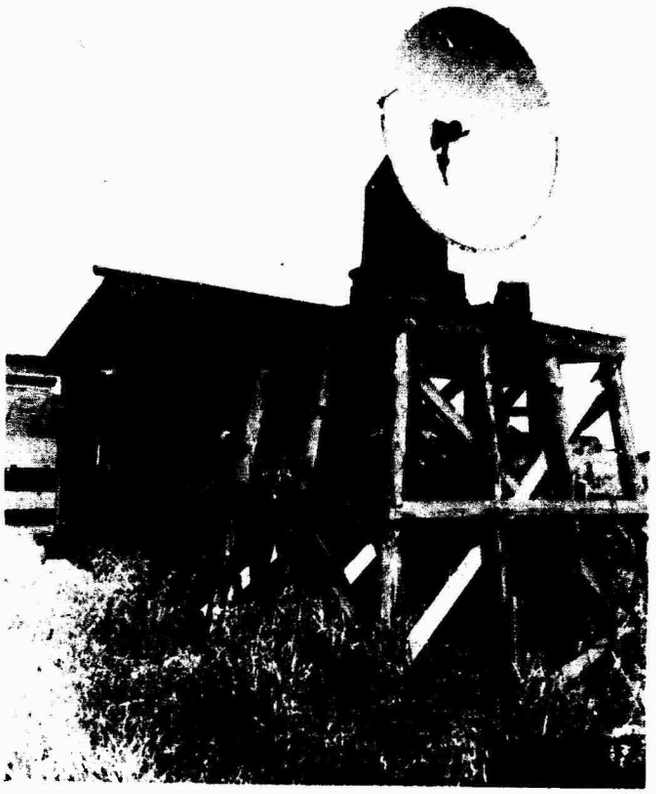
Operators Position in No. 32 Set Shown Above.



Rear View of No. 32 Fire Control Set Showing Horn and Wave Guide Construction.

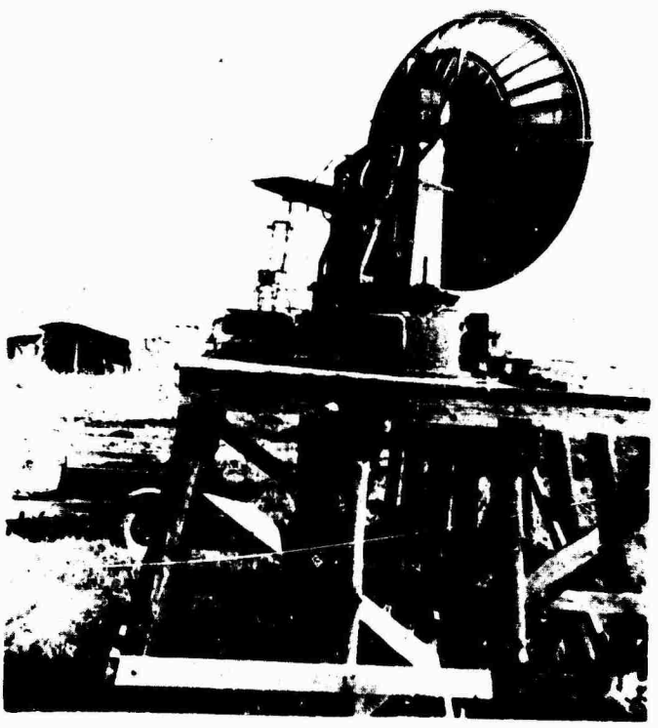


Detail of Lobe Switch on Receiving Antennae of Radar No. 32.



No. 31
Experimental
10 CM Paraboloid
Antenna with
Horizontal Lobe
Switching

Tsukishima.



Rear View of
Experimental
10 CM Parabola.

FD2 RADAR

NIGHT FIGHTER

Corresponding Allied Designation: ----

Technical Characteristics:

f = 500 MC/S. 2.5 KW. Range 3 Km against medium-sized aircraft.
Accuracy: Range, ± 5%; Azimuth, ± 0.5°.

Number Built = 100. Number Installed = NONE IN COMBAT

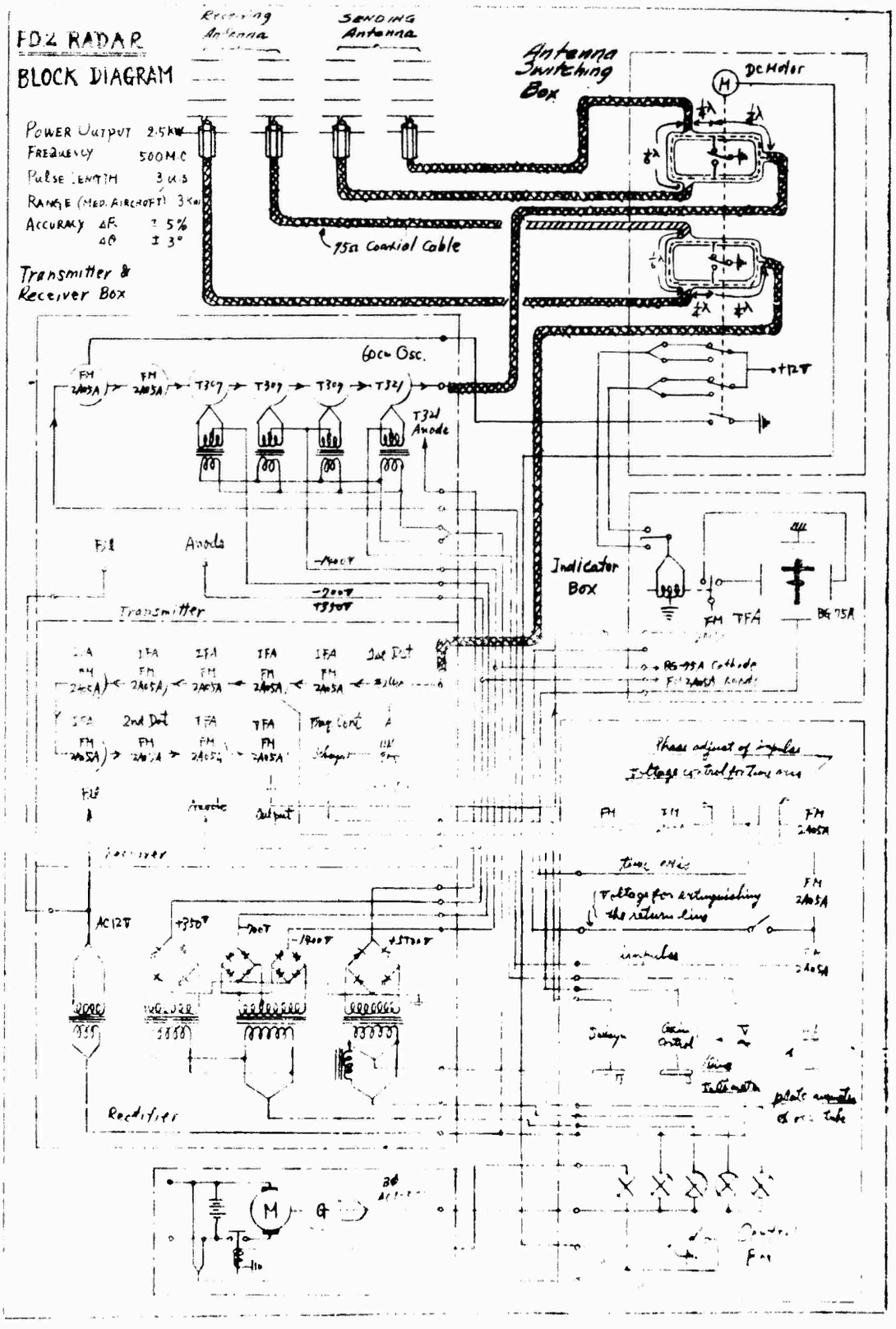
Description:

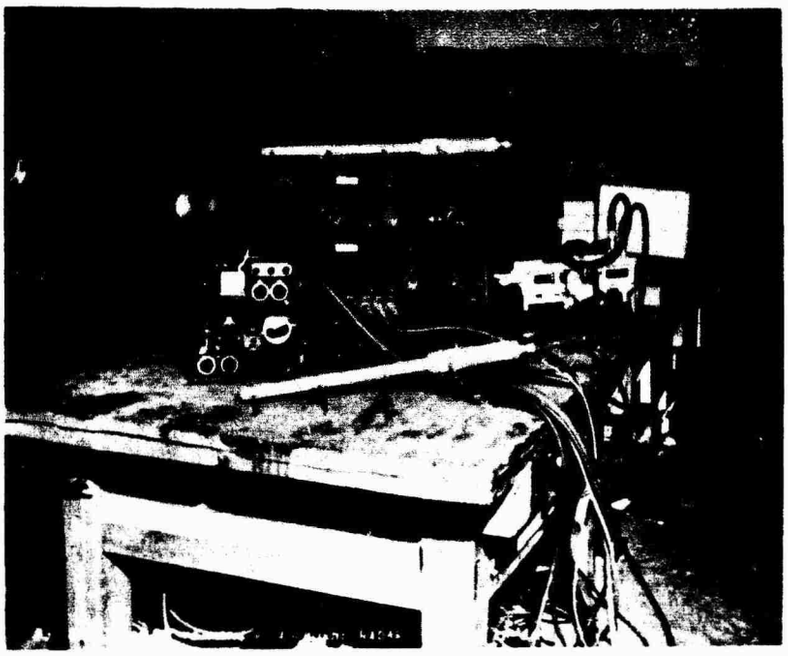
FD-2 was developed from FD-1 a 150 MC/S patrol set which upon test in 1943 by the navy was found to have inadequate range, and was therefore not accepted for use. Although FD-2 gave ranges of 3 km against other planes, and 10 km against ships it too was found not to have sufficient range.

This set uses a set of 4 forward looking Yagi antennas, one pair for sending and one pair for receiving. Horizontal lobe switching is done within each pair and synchronized between pairs by means of a motor operated mechanical switch. A CRT display showing range of the target and the degree of azimuthal homing on it is used; this is very similar to the display used in the American SCR-521.

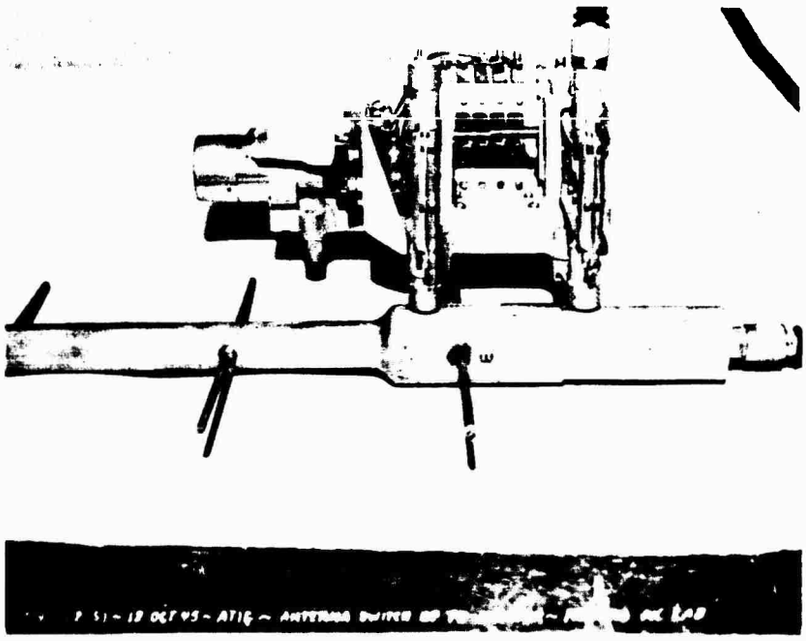
The notation FD-2 is a local designation given by the 2d Naval Technical Institute during its development. The "F" comes from the German word "flutzeig" or to fly, and "D" comes from its decimeter wavelength.

The Meguro Park Laboratory model of the FD-2 is being returned to the United States by the Air Technical Intelligence Group, Far East Air Forces.


FD2 RADAR
BLOCK DIAGRAM
Power Output 2.5kW
Frequency 500M.C
Pulse Length 3 u.s
Range (Med. Aircraft) 3 km
Accuracy ΔR ± 5%
Δθ ± 3°
Transmitter & Receiver Box
Receiving Antenna
Sending Antenna
Antenna Switching Box
Dehdor
75Ω Coaxial Cable
60c~ Osc.
T32l Anode
Indicator Box
Transmitter
Receiver
Rectifier
AC12V
Time axis
Voltage for extinguishing the return line
Phase adjust of impulse
Voltage control for Time axis
plate supply of rec. tube
Power Fan



FD-2 Night Fighter Radar; Bench Installation at Navy Laboratory, Meguro Park, Tokyo.



Antenna Switch for FD-2 with One of the 4 Antennas Showing.

GYOKU 3

NIGHT FIGHTER

Corresponding Allied Designation: ----

Technical Characteristics:

f = 150 MC/S. 3 KW. Range 4.5 Km against a medium-sized plane.
Accuracy: Range, ± 5%; Azimuth, ± 5°.

Number Built = 10. Number Installed = A few.

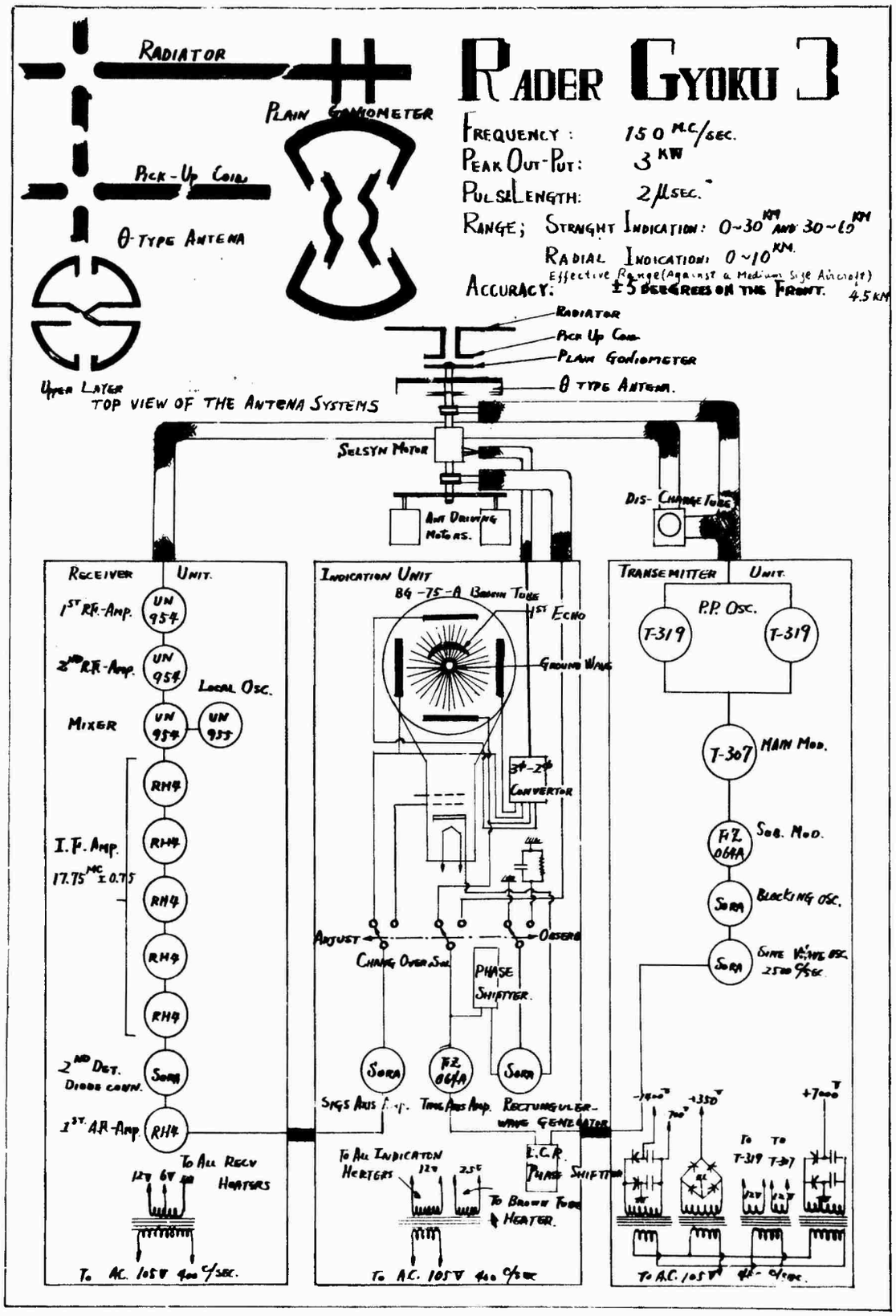
Description:

Gyoku-3 is a newly completed Japanese navy night fighter set operating at 150 MC/S. A specially constructed antenna making use of direction finder technique produces a conical scan in a forward direction. The radiating elements which are mounted, axis coincident with that of the plane, do not move. The pick up coil leading to the 2 pairs of dipoles is fed in such a manner by a rotating coil that the pair of lobes they generate rotates about the axis of the plane much as the propeller does. This pattern is shown in the sketch below in the "Front" view, as one faces the plane. Superimposed on this rotating field is a fixed doughnut shaped field created by the so-called θ antenna. The addition of the two fields produces a rotating cardioid. The corresponding side view of the patterns are shown in each case.

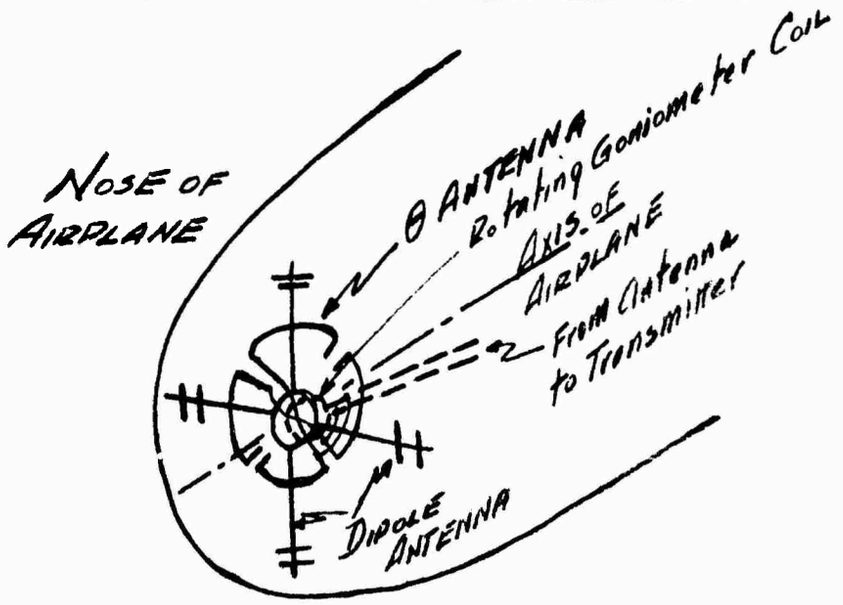
The lobe created in this fashion is very broad as indicated by the low antenna gain of 2.5 to 3.0 db. It is rotated at 900 rpm by a motor driving the feeding goniometer coil. A coverage of about 140° in front of the plane is obtained. The image on the selsyn synchronized PPI screen of course is very broad, giving a discrimination at best of about 5°. The designers were very insistent that such a broad beam was necessary in order to be sure of picking up any plane ahead of the night fighter.

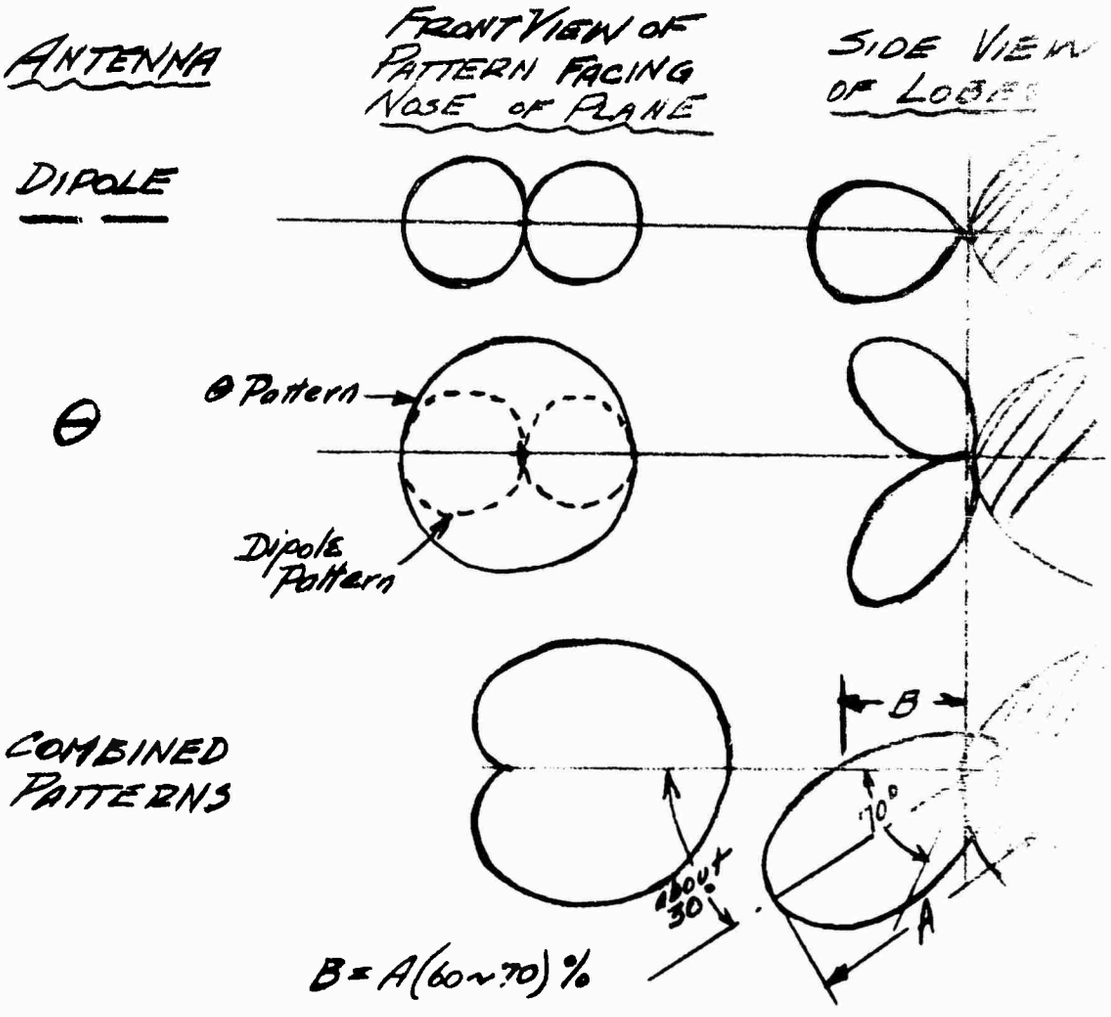
Daytime flight tests at Yokasuka Naval Base showed a range of 4.5 km on a medium type plane as target. No night or blind interceptions were attempted.

The name Gyoku is a naval laboratory name derived from Gyoku-sai, meaning "all suicide."


RADER GYOKU 3
FREQUENCY : 150 M.C/SEC.
PEAK OUT-PUT: 3 KW
PULSE LENGTH: 2 μSEC.
RANGE; STRAIGHT INDICATION: 0~30 KM AND 30~60 KM
RADIAL INDICATION: 0~10 KM.
ACCURACY: ±5 DEGREES ON THE FRONT. 4.5 KM
Effective Range (Against a Medium Size Aircraft)
RADIATOR
PLAIN GONIOMETER
PICK-UP COIL
θ-TYPE ANTENA
UPPER LAYER
TOP VIEW OF THE ANTENA SYSTEMS
RADIATOR
PICK UP COIL
PLAIN GONIOMETER
θ TYPE ANTENA.
SELSYN MOTOR
ANT DRIVING MOTORS.
DIS-CHARGE TUBE
RECEIVER UNIT.
1ST RF-AMP. UN 954
2ND R.F-AMP. UN 954
LOCAL OSC.
MIXER UN 954
UN 955
RH4
RH4
RH4
RH4
RH4
I.F. AMP. 17.75 MC ± 0.75
2ND DET. Diode conn. Sora
1ST A.F-AMP. RH4
To All Recv Heaters
12V 6V
To AC. 105V 400 C/SEC.
INDICATION UNIT
BG-75-A Brown Tube
1ST ECHO
GROUND WAVE
3F-2F CONVERTOR
ADJUST
OBSERV
CHANG OVER SW.
PHASE SHIFTTER.
Sora
FZ 66FA
Sora
SIGS AMP.
TRIG AMP.
RECTANGULER-WAVE GENERATOR
L.C.R. PHASE SHIFTTER
To All Indication Heaters
12V
25V
To Brown Tube Heater.
To AC. 105V 400 C/SEC
TRANSEMITTER UNIT.
P.P. OSC.
T-319
T-319
T-307
MAIN MOD.
FZ 66FA
SUB. MOD.
Sora
BLOCKING OSC.
Sora
SINE WAVE OSC. 2500 C/SEC.
-1000V
+350V
+700V
To T-319
To T-307
To A.C. 105V

GYOKU-3 ANTENNA





HAMA 62

FRIENDLY AIRCRAFT LOCATOR - LAND BASED

Corresponding Allied Designation: ----

Technical Characteristics:

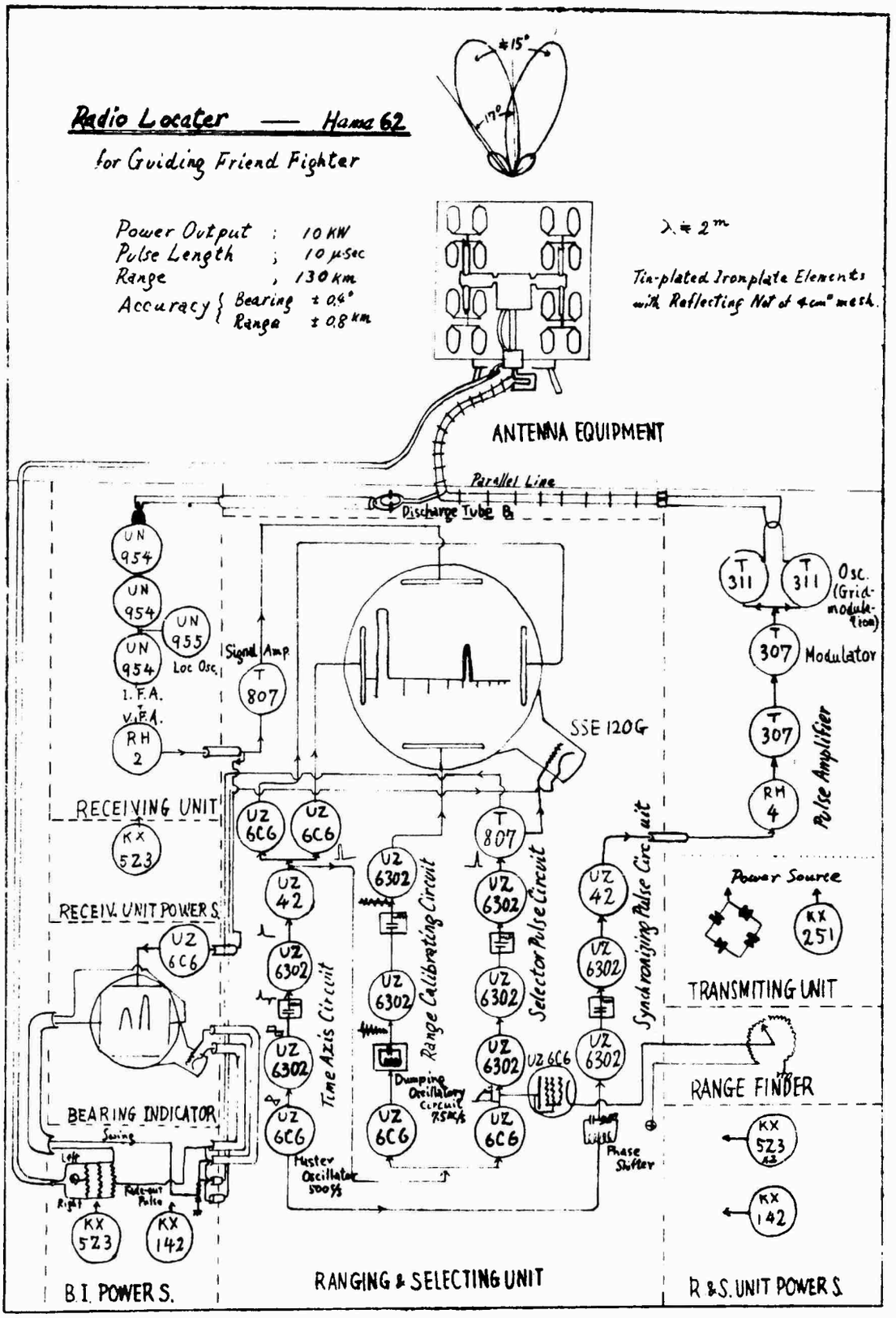
Wavelength 2 M. 10 KW. Range 150 Km.
Accuracy: Range, ± 0.8 Km; Azimuth, ± 0.4°.

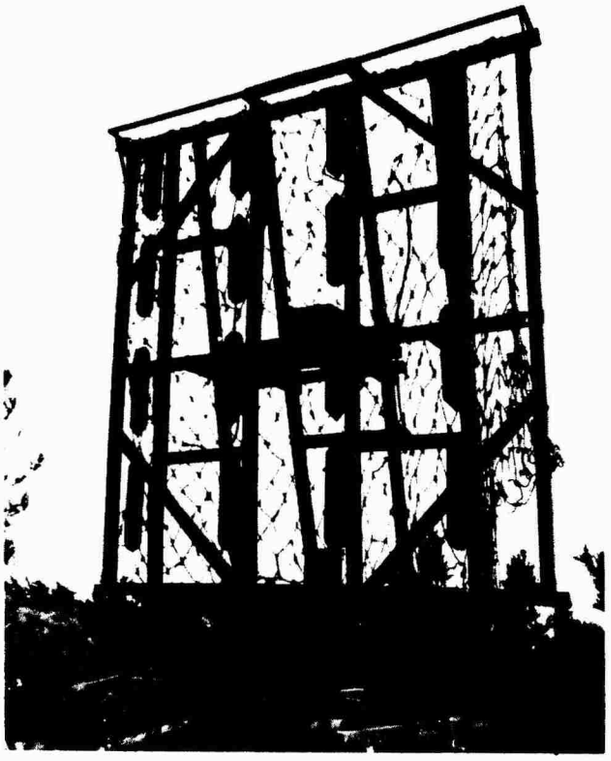
Number Built = *FEW* **Number Installed** = *NOT YET USED*

Description:

Radar No. 62 is a ground GCI set for installation near fighter airfields; its function is to accurately determine the location of the friendly fighter plane. The friendly fighter is equipped with an M-13 navy IFF set with its controls set to respond to one frequency and retransmit at a slightly different one. The No. 62 transmitter can send at any spot frequency in the range 150 mc ± 5 MC/S to correspond with the IFF setting. The ground receiver is then tuned to the retransmit frequency (slightly off its own transmitter frequency). This eliminates ground echo returns and brings in only the desired fighter plane. Flat plates are used for the No. 62 antenna dipoles to permit efficient radiation over the required frequency band.

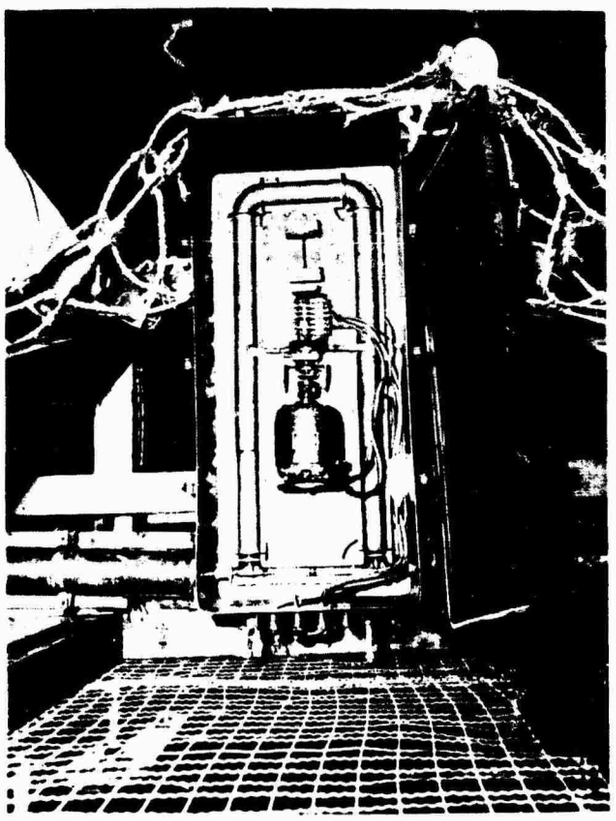
A range scope and an azimuth pip matching scope comprise the display. A motor driven lobe switch is located just behind the screen reflector on the antenna.


Radio Locater — Hama 62
for Guiding Friend Fighter
Power Output ; 10 KW
Pulse Length ; 10 μsec
Range ; 130 Km
Accuracy { Bearing ± 0.4°
Range ± 0.8 Km
λ ≒ 2 m
Tin-plated Ironplate Elements with Reflecting Net of 4cm² mesh.
ANTENNA EQUIPMENT
Parallel Line
Discharge Tube B
SSE 120G
RECEIVING UNIT
RECEIV. UNIT POWER S.
BEARING INDICATOR
B.I. POWER S.
Signal Amp
Loc Osc.
I.F.A.
V.F.A.
Time Axis Circuit
Range Calibrating Circuit
Selector Pulse Circuit
Synchronizing Pulse Circuit
Master Oscillator 500 ~
Dumping Oscillatory Circuit 7.5 M/s
Phase Shifter
RANGING & SELECTING UNIT
Power Source
TRANSMITING UNIT
RANGE FINDER
R & S. UNIT POWER S.
Osc. (Grid-modulation)
Modulator
Pulse Amplifier



Radar No. 62's
Broad Band
Antenna for
Interrogating
Friendly Fighter
GCI Operation
(150 MC ± 5 MC)

Chigasaki



Detail of Lobe Switch Mounted
Behind Antenna Screen.

M-13

IFF - FRIENDLY AIRCRAFT LOCATING

Corresponding Allied Designation: ----

Technical Characteristics:

f = 150 ± 5 MC/S. 50 W. M-13 on sweep frequencies answers to Type 13 radar within 120 Km range when its altitude is 2000 M; also works on fixed frequency with No. 62 radar.

Number Built = 100. Number Installed = FEW

Description:

This IFF transpondor is designed to operate in either of two ways: (a) Its tuned frequency can be swept continuously through the 150 ± 5 MC/S band (similar to the American SCR-695). In this case it responds with the same frequency as it received. In this mode of operation any radar station (such as the type No. 13) in the 150 MC/S range can obtain identification signals from the plane which appear as regular or coded increases in the signal return seen on the ground radar's scope. (b) The sweep may be stopped and the M-13 receiver set to respond to some selected spot frequency; it will be set to retransmit at a different frequency as far away as 3 MC/S. With this arrangement it is especially suitable for GCI work in connection with the No. 62 ground set.

The response can be given any one of 5 different codes for added identification precaution. The operator in the plane can hear his own set if it is responding.

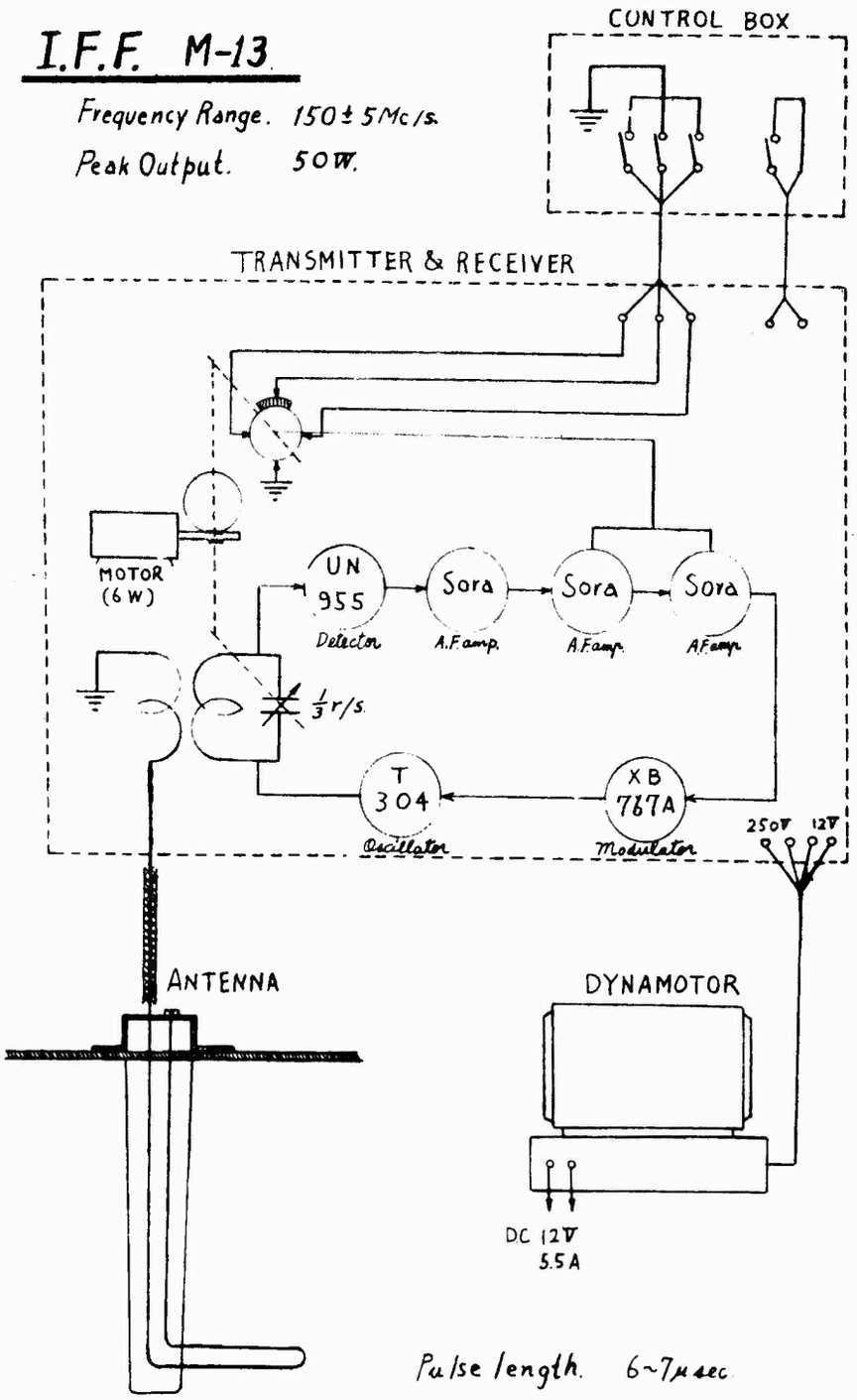
This set is quite different from the army IFF set which operates only in the (b) fashion but at higher frequencies. Hence the IFF's are only useful for the navy to identify navy planes, and for the army to identify army planes.

Five months were spent on the development of this equipment--and 4 months more were needed to get it into production. It was just coming into use by the navy as the war ended.

I.F.F. M-13

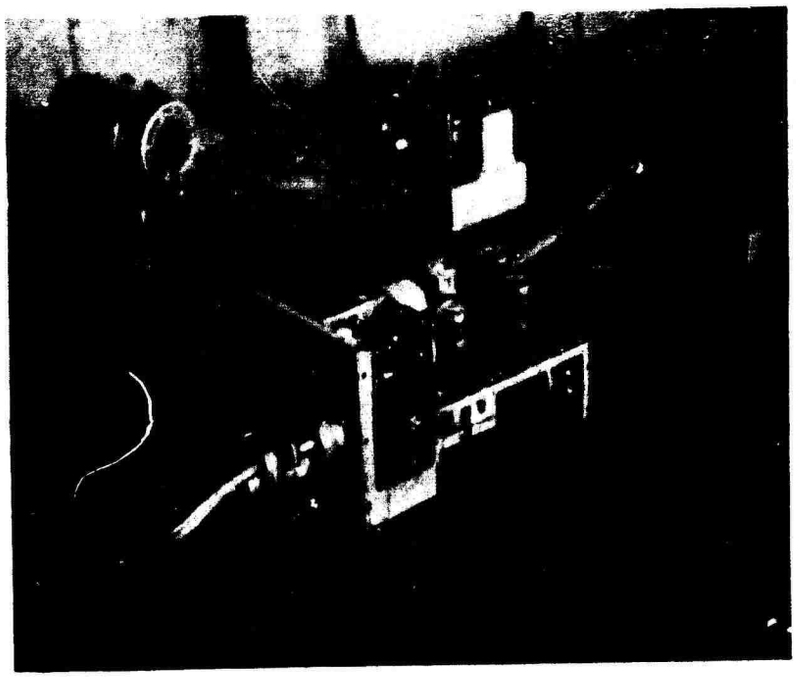
Frequency Range. 150 ± 5 Mc/s.

Peak Output. 50 W.



Pulse length. 6~7 μ sec.

M-13 answers to type-3 radar within 120 km. range, when its altitude is 2000 m.



M-13 Navy IFF Equipment - 2d Naval Technical Institute - Kanazawa.

HAMA 63

FOE AIRCRAFT LOCATOR

Corresponding Allied Designation: ----

Technical Characteristics:

f = 100 MC/S. 40 KW. Range 200 Km.
Accuracy: Range, ± 500 M estimated; Azimuth, unknown.

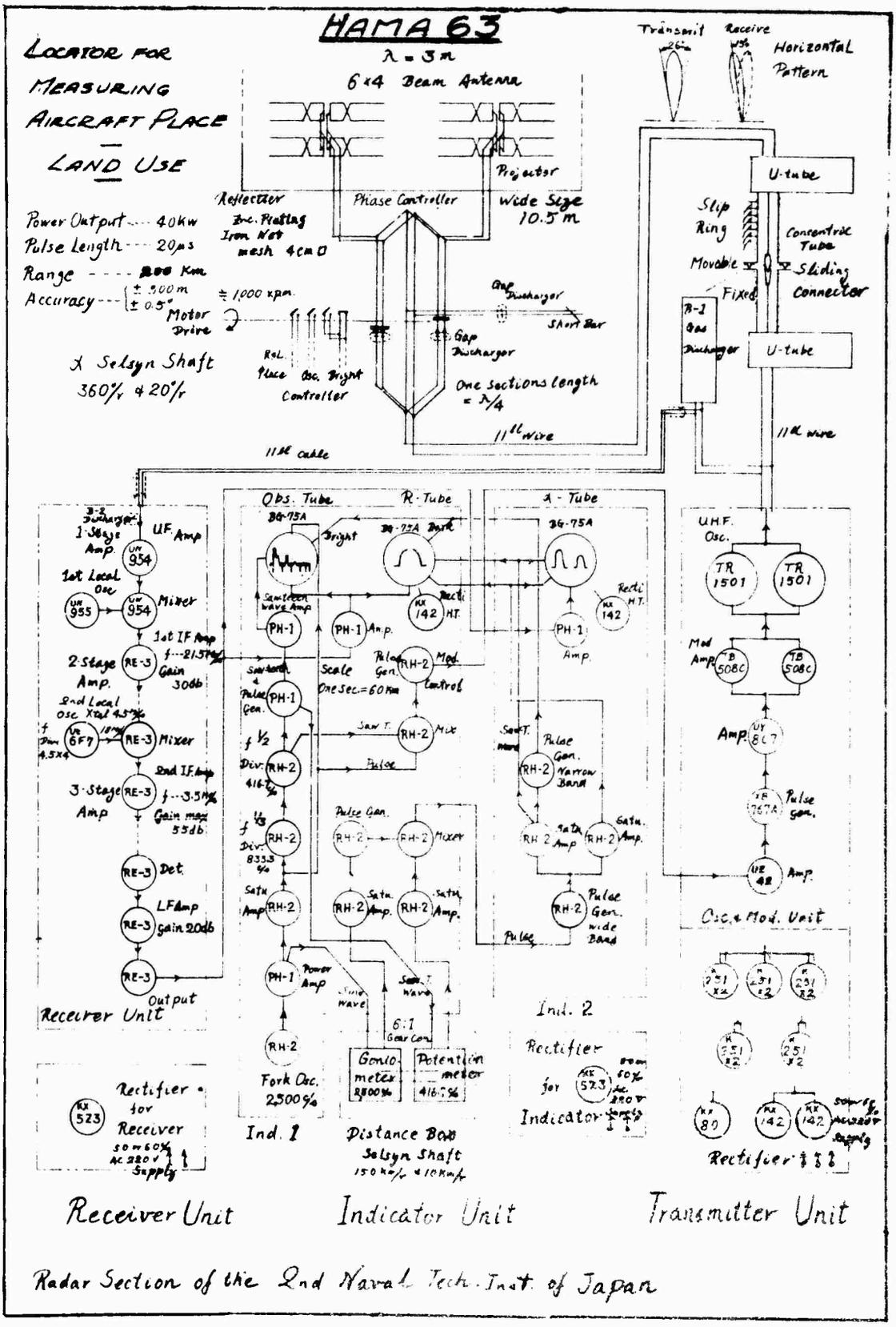
Number Built = Set in development. Number Installed = 0.

Description:

This radar was planned to be installed near an airfield where GCI operations could suitably be carried out. Its purpose would be to detect and then accurately locate an enemy plane and supply data on it until the fine tracking No. 62 radar could pick up the enemy plane and lock on it. Lobe switching at 1000 per minute provides the means for good azimuth accuracy.

An observation cathode ray tube is provided to view all returning echoes. A range tube gives range and gates the proper signal for the bearing tube.

This Set (No. 63) was still in its experimental stage when the war ended.

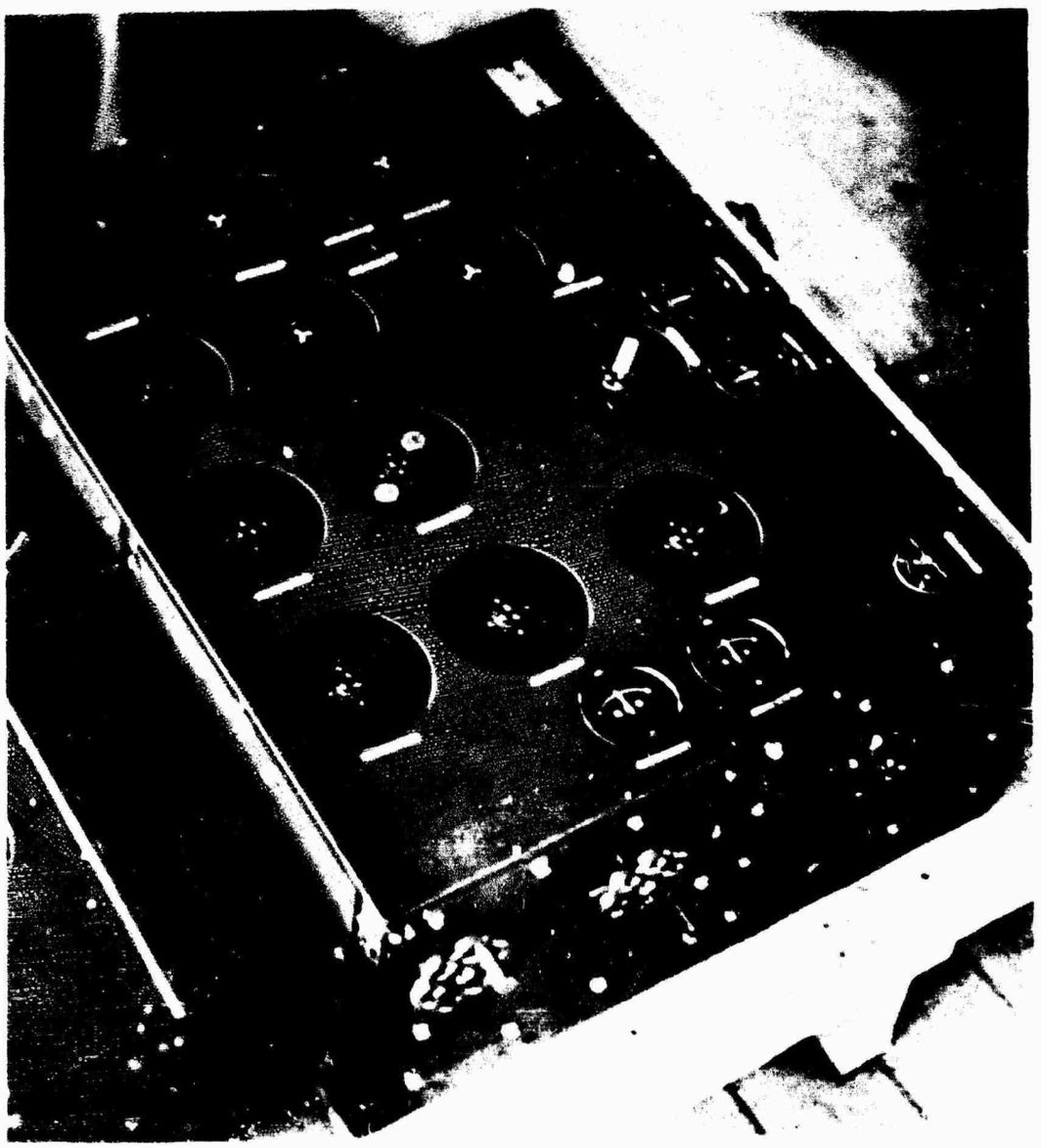


Radar Section of the 2nd Naval Tech. Inst. of Japan

INTERCEPTION COMPUTER

The Japanese navy had developed an interception computer by means of which a control officer sitting in the ship's information center could quickly determine the proper instructions to the friendly fighter to make an accurate interception. Present positions, directions and speeds of both the friendly and enemy planes are set in on the dials. The computer shows the direction (azimuth) the interceptor should fly and how long it will be before he makes the interception.

This computer is similar to the Japanese army's Tachi-36.



FH-1

HEIGHT MEASURE

Corresponding Allied Designation: ----

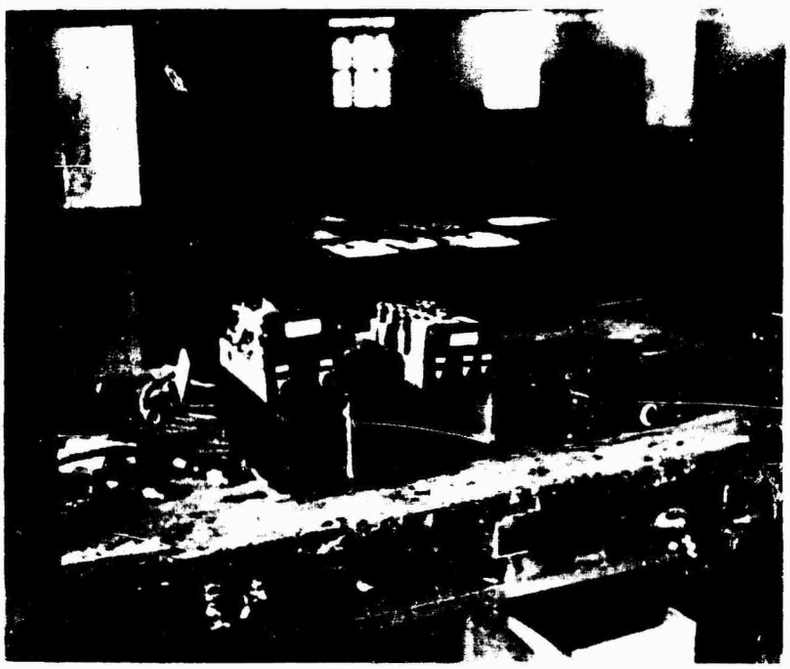
Technical Characteristics:

f = 340 ± 15 MC/S - frequency modulation. 0.1 W. Range 10-150 M. Accuracy of range, ± 5%.

Number Built = 100. **Number Installed** = NUMEROUS

Description:

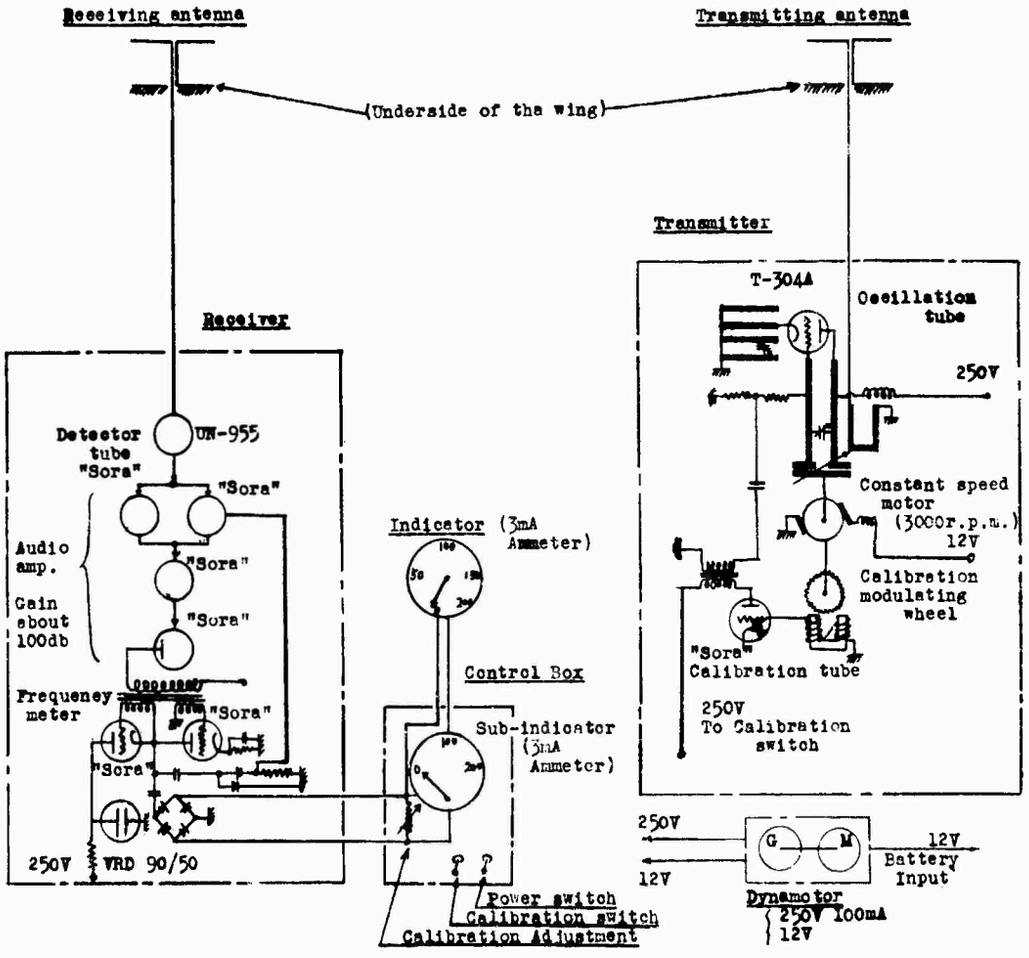
FH-1 is an FM absolute altimeter very similar to the army's Taki-13 and our own AN/APN-1. A motor driven tone wheel provides the modulating swing of ± 15 mc/s from the average of 340 mc/s. The return from ground signal is compared in phase with the direct signal, and the difference made to actuate an indicator reading the altitude from 10 to 150 meters. The Sora tube is used here as the "universal pentode." The navy radar people say this altimeter was widely and successfully used for torpedo attacks.

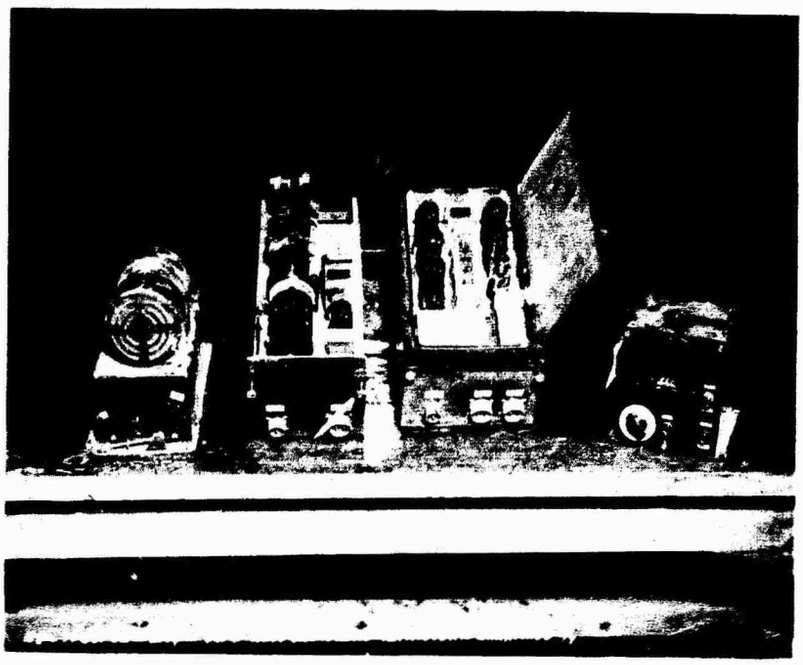


Bench Installation of FH-1 Altimeter -
2d Naval Technical Institute - Kanazawa.

Aireraft Radio Altimeter "FH-1"

Out put power:	about 0.1W.
Frequency:	340±15 Mc (Frequency modulation)
Range:	From 10m to 150m
Accuracy:	about ±5%





FH-1 Altimeter Showing Interior
of Components.

FTB

RADAR COUNTER MEASURE RECEIVER

Corresponding Allied Designation: ----

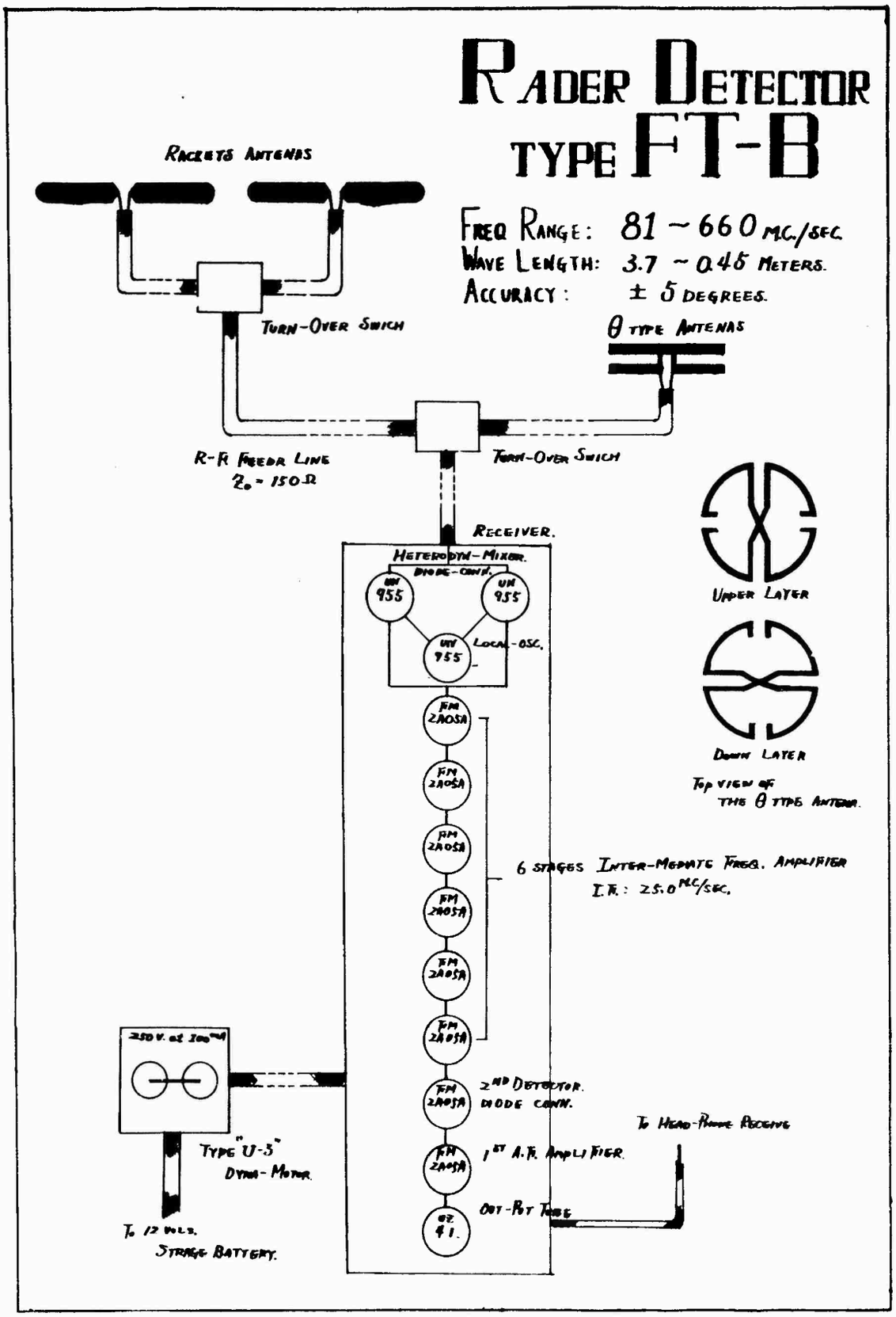
Technical Characteristics:

f = 81-660 MC/S. Azimuth Accuracy, ± 5°.

Number Built = 300. Number Installed = Not Yet Used

Description:

This is a simple high frequency radio receiver using a broad band omnidirectional search antenna, which can be replaced by a highly directive array when a signal is picked up. Signals are picked up through the ear phones provided, the radar's p.r.f. being heard as a tone.


RADER DETECTOR
TYPE FT-B
FREQ RANGE: 81 ~ 660 MC./SEC.
WAVE LENGTH: 3.7 ~ 0.45 METERS.
ACCURACY: ± 5 DEGREES.
RACKETS ANTENAS
TURN-OVER SWICH
θ TYPE ANTENAS
R-F FEEDR LINE
Z₀ = 150Ω
TURN-OVER SWICH
RECEIVER.
HETERODYN-MIXER.
DIODE-CONN.
6BK 955
6H 955
6H 955
LOCAL-OSC.
FM 2A0SA
FM 2A0SA
FM 2A0SA
FM 2A0SA
FM 2A0SA
FM 2A0SA
6 STAGES INTER-MEDIATE FREQ. AMPLIFIER
I.F.: 25.0 MC/SEC.
FM 2A0SA
2ND DETECTOR.
DIODE CONN.
FM 2A0SA
1ST A.F. AMPLIFIER.
6Z 41.
OUT-PUT TUBE
250 V. at 100 MA
TYPE "U-5"
DYNA-MOTOR.
TO 12 VOLS.
STORAGE BATTERY.
TO HEAD-PHONE RECEIVE
UPPER LAYER
DOWN LAYER
TOP VIEW OF
THE θ TYPE ANTENA.

FTC

RADAR COUNTER MEASURE RECEIVER

Corresponding Allied Designation: ----

Technical Characteristics:

f = 81-660 MC/S. Azimuth Accuracy = ± 5°.

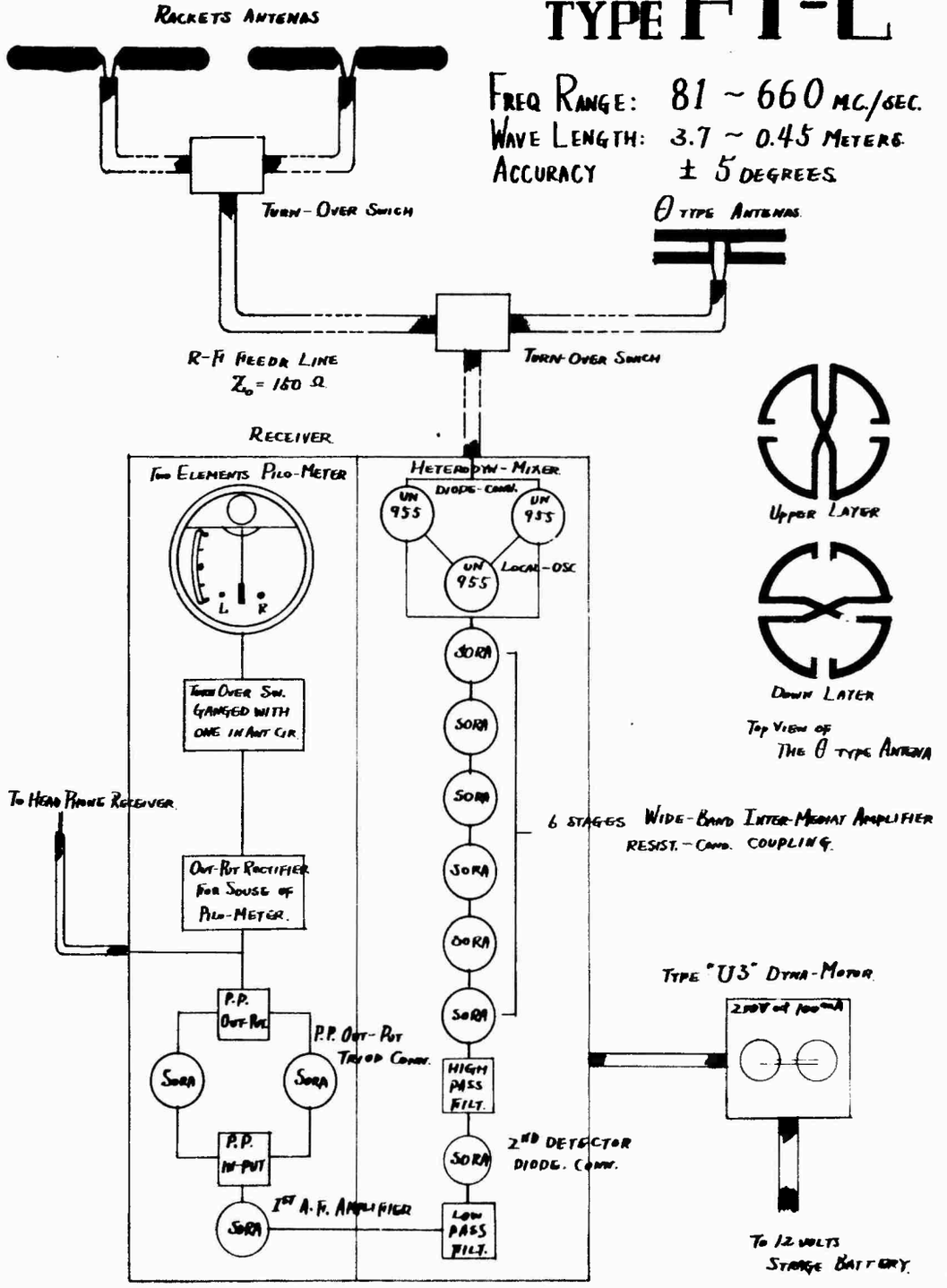
Number Built = 100 unfinished. Number Installed = 0.

Description:

FTC is similar to FTB except that in addition to the aural indication a visual indication is given the pilot to turn either right or left to home on the intercepted signal.

RADER DETECTOR TYPE FT-C

FREQ RANGE: 81 ~ 660 MC./SEC.
WAVE LENGTH: 3.7 ~ 0.45 METERS
ACCURACY ± 5 DEGREES



LAND BASED AND SHIPBORNE RCM SEARCH RECEIVERS

A number of search receivers for land and ship use are shown in the D-section of the large table preceeding the block diagrams of navy radar sets, whose diagrams are not included. For land use the range from 3 cm to 4 meters is covered by two equipments. The same receiver, E27 for 0.75 m to 4 m is used by the navy with a variety of antennas, some directional and some all-around, depending on the installation. Two more receivers going down to 3 cm coverage are available for shipborne use.

SUPPLEMENTARY

INFORMATION

DEPARTMENT OF THE AIR FORCE
AIR INTELLIGENCE AGENCY

AD-895 893

MEMORANDUM FOR DTIC-BCR

ERRATA

17 January 1994

FROM: NAIC/MSIR
4115 Hebble Creek Rd Ste 14
Wright Patterson AFB OH 45433-5618

SUBJECT: Freedom of Information Act (FOIA) Request, Case I-FASTC 93-37

1. Reference your letter 22 December 1993 and 18 October 1993 NAIC letter, same subject.

2. NAIC OPR has reviewed documents **AD 895891** Volume I, **AD 895892** Volume II and **AD 895893** Volume III and determined that the records are fully releasable.

3. The documents identified above may be released to future Freedom of Information Act requesters.

Marlyene A. Harrison

MARLYENE A. HARRISON, GS-11, USAF
Chief, Freedom of Information
Information Management Operations

ERRATA AD 895 893

Attachment:
1. OPR Comments
2. Releasable Documents

DEPARTMENT OF THE AIR FORCE
AIR INTELLIGENCE AGENCY

[redacted]

AD-895893

MEMORANDUM FOR DTIC-BCR

ERRATA

17 January 1994

FROM: NAIC/MSIR
4115 Hebble Creek Rd Ste 14
Wright Patterson AFB OH 45433-5618

SUBJECT: Freedom of Information Act (FOIA) Request, Case I-FASTC 93-37

1. Reference your letter 22 December 1993 and 18 October 1993 NAIC letter, same subject.

2. NAIC OPR has reviewed documents [redacted] Volume I, [redacted] Volume II and AD 895893 Volume III and determined that the records are fully releasable.

3. The documents identified above may be released to future Freedom of Information Act requesters.

Marlyene A. Harrison

MARLYENE A. HARRISON, GS-11, USAF
Chief, Freedom of Information
Information Management Operations

ERRATA AD-895893

Attachment:
1. OPR Comments
2. Releasable Documents

DEPARTMENT OF THE AIR FORCE
AIR INTELLIGENCE AGENCY

MEMORANDUM FOR NAIC/DXL 6 January 1994

FROM: NAIC/MSIR

ERRATA

SUBJECT: Freedom of Information Act (FOIA) Request R-FASTC-93-37

1. The attached FOIA request is forwarded for your review and releasability.

2. It is regards to a previous request from Mr. Edward Kettler for paper copies of documents AD 895891 Volume 1, AD 895892 Volume 2 and AD 895893 Volume III entitled "A Short Survey of Japanese Radar." No documents were located in NAIC per telecon with DTIC, the request was forwarded to them. DTIC located the requested documents and has forwarded them to NAIC for review and release determination.

3. Please ensure the branch chief signs the 1st Ind and records the time expended on DD Form 2086. After completing the required actions on this request, please call extension 77236 for pickup.

ERRATA

JOHN A. MCGUIRE, MSgt, USAF
Asst Chief, Freedom of Information
Information Management Operations

3 Attachments
1. AD 895891 Volume 1
2. AD 895892 Volume 2
3. AD 895893 Volume 3

1st Ind, NAIC/DXLA DATE: 6 Jan 94

TO: NAIC/MSIR

1. The following apply:

__x__ Records are fully releasable.

Records should be:

____ Fully denied under: ____ Partially denied under:

Exemption: 1 2 3 4 5 6 7 8 9

2. Individual who worked this request/point of contact:

Name: Sherry Jennings
Office Symbol: DXLA
Phone number (black): 72435

3. Remarks:

ANITA L. MILLER, CHIEF
DOCUMENT REQUIREMENTS & ACQUISITION BRANCH