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U. S. NAVAL TECHNICAL MISSION TO JAPAN
CARE OF FLEET POST OFFICE
SAN FRANCISCO, CALIFORNIA

TMJ
ET
E-09

-14 February 1946

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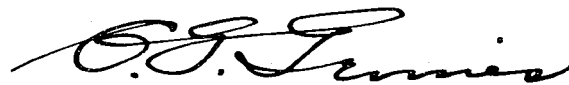
From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Japanese Navigational Aids.

Reference: (a) "Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, dealing with Target E-09 of Fascicle E-1 of reference (a), is submitted herewith.

2. The investigation of the target and the target report were accomplished by Lt. Comdr. M.C. Mains, USN(Ret).



C. G. GRIMES
Captain, USN

30609

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E-09

JAPANESE NAVIGATIONAL AIDS

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE E-1, TARGET E-09

FEBRUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

ELECTRONICS TARGETS
JAPANESE NAVIGATIONAL AIDS

Only one type of navigational aid developed by the Japanese appears to merit detailed study. This is the hyperbolic system, Tachi 39 - Taki 39, developed by the Army, but not put into use.

The Navy had one type of radio altimeter; the Army had two, one of which was unsatisfactory.

The new types of radio beacons for the Navy, still in the developmental stage, are of some interest, and a brief description is given.

Although both airborne and shipborne radar was used to some extent in navigation, no special radar navigational aids were developed, and no use was made of corner reflectors, beacon buoys, or other similar devices.

Radio direction finders are described in NavTechJap report "Japanese Radio and Radar Direction Finders", Index No. E-05, and radar direction-finding, such as it was, in NavTechJap report "Japanese Radar Countermeasures and Visual Signal Display Equipment," Index No. E-07. Underwater devices are described in NavTechJap report "Japanese Sonar and Asdic", Index No. E-10.

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REFERENCES

REPORTS OF OTHER AGENCIES:

Reports of Air Technical Intelligence Group, Far Eastern Air Forces
(Sent to the Bureau of Aeronautics and Wright Field).

ATIG #115 - A Short Survey of Japanese Radar.

ATIG #276 - Catalog of Japanese Radio, Radar, and Special
Electronic Devices of Interest to AAF.

ATIG #253 - A Survey of Japanese Airborne Radio Research and
Development.

ATIG #277 - Miscellaneous Electronic Documents (List of
documents sent to Air Documents Division, T-2,
Wright Field).

Reports of Technical Liason and Investigation Department, Office
of the Chief Signal Officer, Supreme Commander Allied Powers.
(TLID). (Available through G-2, War Department, Washington, D.C.).

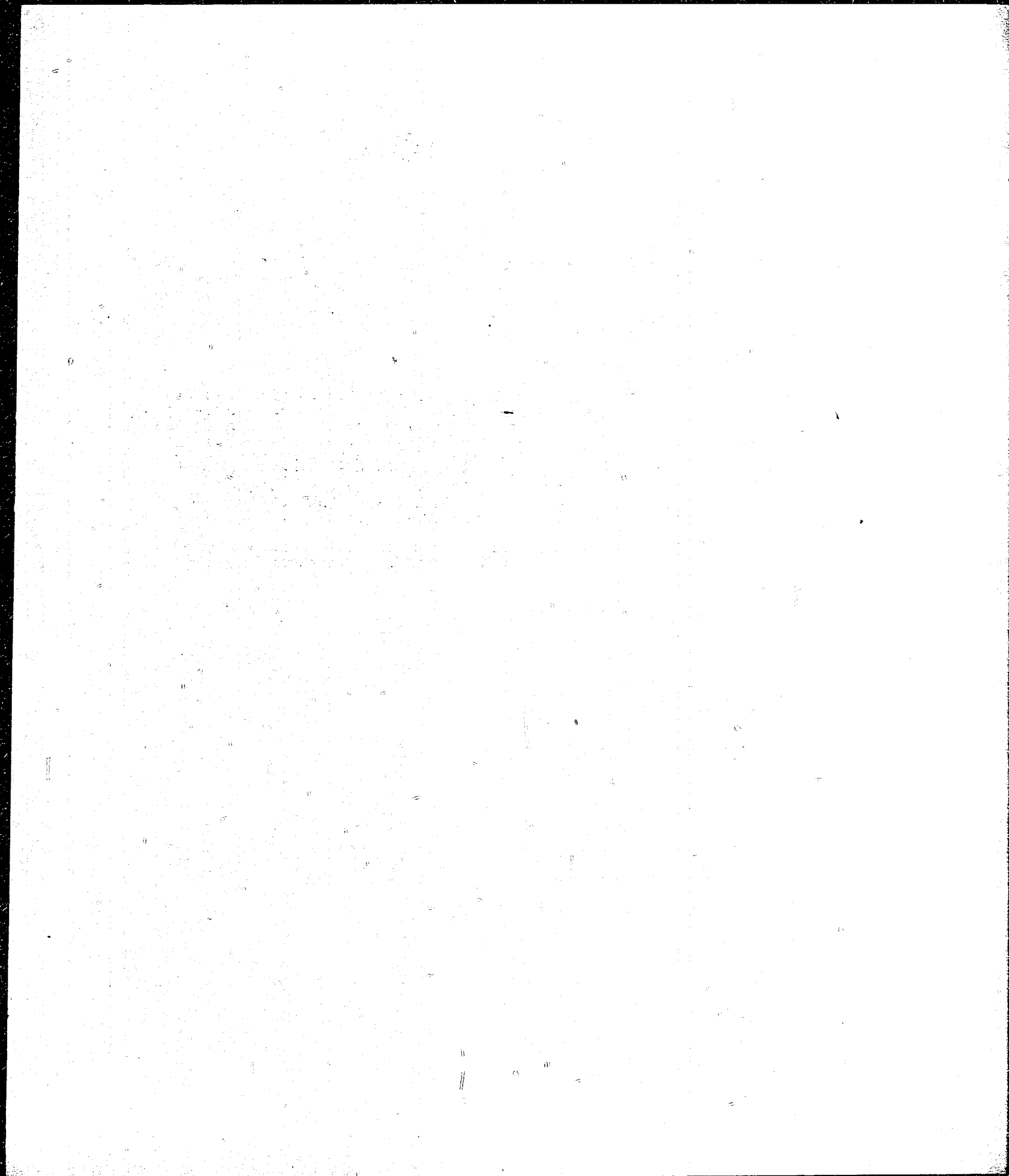
LIST OF ENCLOSURES

- (A) List of Documents forwarded to WDC through ATIS
- (B) MRB Radio Beacon - Block diagram
- (C) MKR Radio Beacon - Block diagram
- (D) URB Radio Beacon - Block diagram
- (E) FH-1 Radio Altimeter

INTRODUCTION

Intelligence reports prior to the end of hostilities indicated that the Japanese used altimeters and that some system similar to Loran was being developed. All available sources of information were investigated for further information on these and other possible types of navigational aids. During the investigation, close liaison was maintained with the Electronics Section, Air Technical Intelligence Group, Far Eastern Air Forces, and with the Technical Liaison and Investigation Department, Office of the Chief Signal Officer, Supreme Commander Allied Powers. It is believed that all sources of information were exploited without duplication of effort.

Inasmuch as direction finders and underwater devices have been dealt with in other reports, it was decided to omit any treatment of them here.



THE REPORT

A. SHIPBORNE NAVIGATIONAL AIDS

Radio direction finders are described in NavTechJap report "Japanese Radio and Radar Direction Finders", Index No. E-05, and sonar devices are described in NavTechJap report "Japanese Sonar and Asdic", Index No. E-10. The Mark 2, Model 2, 10cm radar was used to some extent for navigational purposes, but no special radar navigational devices were developed for shipboard use.

B. AIRBORNE NAVIGATIONAL AIDS

Airborne radio direction finders are covered in NavTechJap report, "Japanese Radio and Radar Direction Finders", Index No. E-05.

The H-7 and FM-1 radars were used for air navigation, but no special fittings or techniques for radars were developed for navigational uses.

The Japanese Navy had a frequency-modulated radio altimeter, the FH-1, which operated on a frequency of 340 megacycles plus or minus 15 megacycles. The power output was about 1/10 watt, the range 10 to 150 meters, accuracy within 5%, total weight 25 kg. The antenna consisted of two half-wave dipoles, one for transmitter and one for receiver. A schematic and block diagram will be found in Enclosure (E).

The Army had two altimeters, the Taki 11 for high altitudes and the Taki 13 for low altitude. A description of these, as well as further details on the FH-1, will be found in ATIG Report No. 115, "A Short Survey of Japanese Radar".

The aircraft part of the hyperbolic navigation apparatus mentioned in Part C was a simple super-heterodyne receiver (Taki 39) With a locally generated sweep for the cathode ray tube. The sweep was adjusted until the received pulses were stationary, then a drift pulse was timed with a stop-watch as it moved between the stationary pulses. This time was used to determine a line of position.

A visual-indicating receiver for use with the MKR radio beacon is described in Part C.

C. LANDBASED NAVIGATIONAL AIDS

The Japanese had in development a hyperbolic navigational system, which was in effect a simple version of LORAN. Original plans were to erect transmitting stations at ONMAEZAKE, (SHIZUOKA Ken), at SHIRAHAMA (CHIBA Ken) and a master station at HAKONE (KANAGAWA Ken), with radio telephone communications. A brief description of the transmitting equipment follows. Additional information will be found in ATIG Report No. 115.

| | |
|-----------------------|------------------------------|
| Frequency | 1500 and 1750 kc |
| Pulse frequency | 250 cycles sec |
| Pulse width | 40 microseconds |
| Output | 150 kw |
| Effective range | night, 3000 km; day, 1500 km |
| Accuracy | within 1% |

The Navy had three types of radio beacons under development, They were as follows:

1. MRB. A variable 4-course radio beacon, on 3 mc, power 20 watts, range 60 km. Indication was aural A-N or A-I, or course indicator meter. A block diagram is shown in Enclosure (B).
2. MKR. This type (see block diagram, Enclosure C) operated on 6 mc. The principle of operation was described as follows: The 6 mc carrier was modulated with a very narrow pulse at 80 cycles/sec. Two crossed figure eight patterns were radiated by the crossed loops. The receiver used had a visual indicator on which the signals from two adjacent lobes of the transmitting antenna appeared as two vertical lines, perpendicular to the base line, the height of the vertical lines being proportional to the signal strength. "On-course" was indicated when the two lines were of the same length.
3. URB. This was a variable single-course A-N or A-I system on a frequency in the range 60 to 75 mc, power output, 30 watts, range, 40 km, accuracy within plus or minus 1° at 20 km. A doublet in a corner reflector was used as the antenna. See block diagram, Enclosure (D).

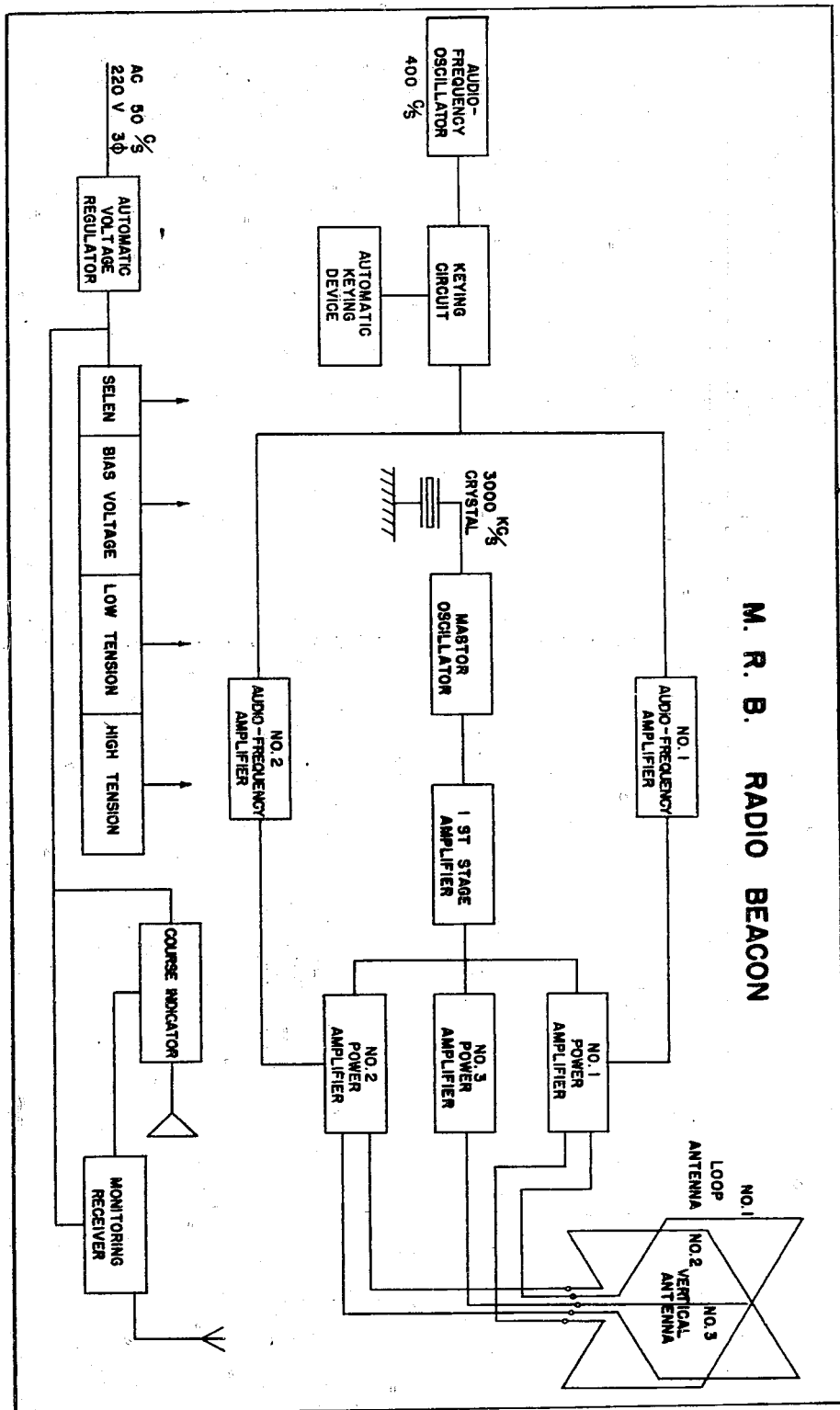
The Japanese Army had developed a modified Lorenz blind-landing system which was unsuccessful because its resolution at low angles was so poor that the pilots refused to use it.

ENCLOSURE (A)

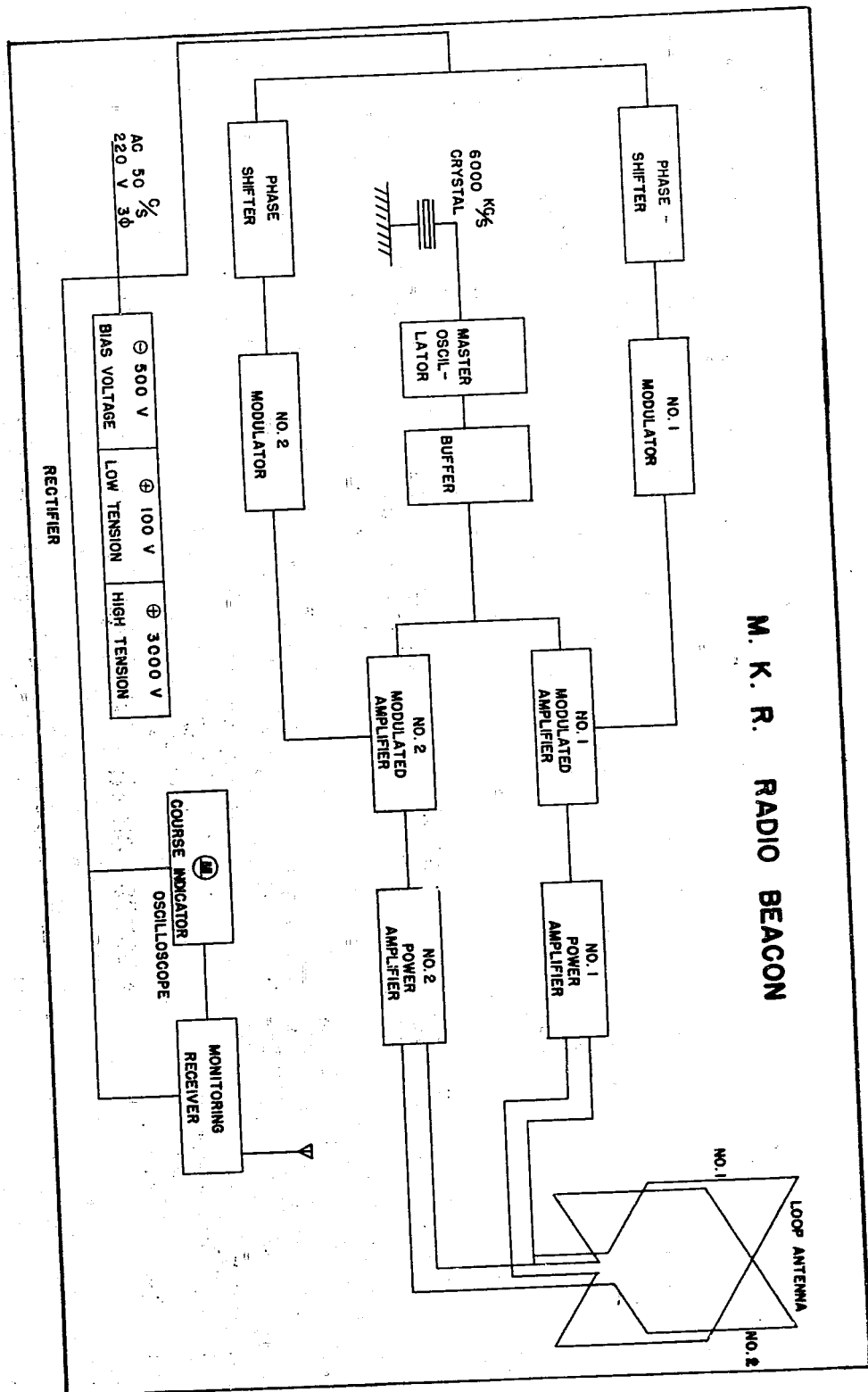
LISTS OF DOCUMENTS FORWARDED TO THE WASHINGTON DOCUMENT CENTER THROUGH ATIS

| <u>NavTechJap No.</u> | <u>Title</u> | <u>ATIS No.</u> |
|-----------------------|--|-----------------|
| ND21-6017 | Experimental research on the small type medium wave radio navigation beacon | 3302 |
| ND21-6020 | Experimental results on the ultra-short wave navigation beacon | 3303 |
| ND21-6127 | Installation of Model 2, Mark 1 transmitter used with Type 96 Mark 1 radio beacon | 3709 |
| ND21-6128 | Test report on ultra-short-wave radio beacon | 3308 |
| ND21-6130 | Radio blind landing equipment | 3310 |
| ND21-6131 | Tests of aircraft radio beacon | 3311 |
| ND21-6132 | Tests of aircraft radio beacon | 3312 |
| ND21-6162 | Experimental radio altimeter | 3420 |
| ND21-6226 | Ultra-short wave aircraft navigation beacon | 3319 |
| ND22-3010 | List of radio and radar equipment used by the Japanese Navy, including specification and operating characteristics | 4342 |

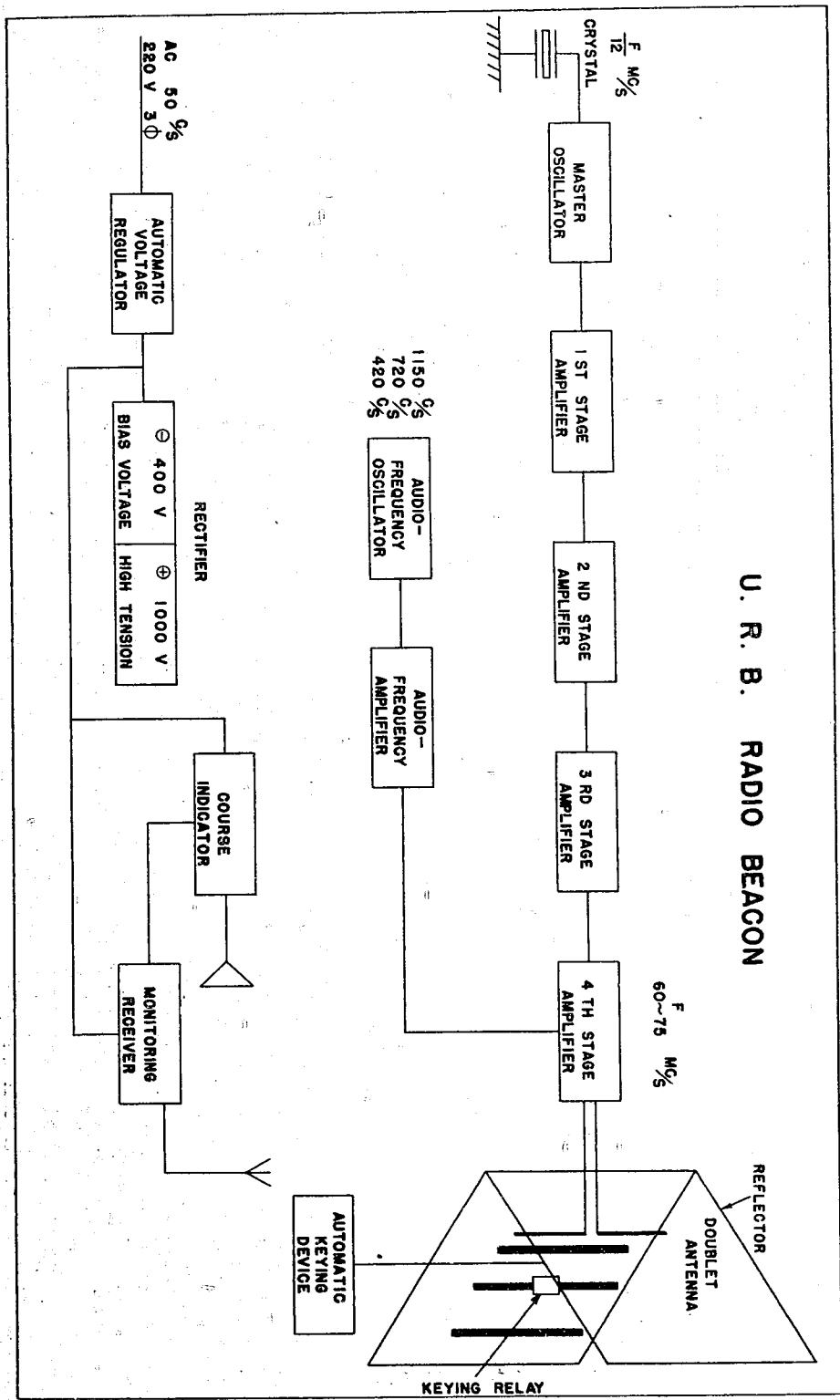
ENCLOSURE (B)



ENCLOSURE (C)



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ENCLOSURE (D)

ENCLOSURE (E)

FH-1 AIRCRAFT RADIO ALTIMETER**Transmitter**

Tube
 Modulating method
 Frequency
 Calibration modulator tube

"T-304A x1
 Frequency modulation
 340 15 mc
 "SORA" x1

Receiver

Detector tube
 Audio amplifier
 Frequency counter
 Total audio gain

"UN-955" x1
 "SORA" x4
 "SORA" x2, "VRD-90/50" x1
 about 100 db

Control Box

Power Switch
 Calibration Switch
 Calibration Adjustment
 Sub-indicator

Dynamotor

250v 100ma

Antennas (Transmitter and Receiver Antennas)

Half-wave doublet

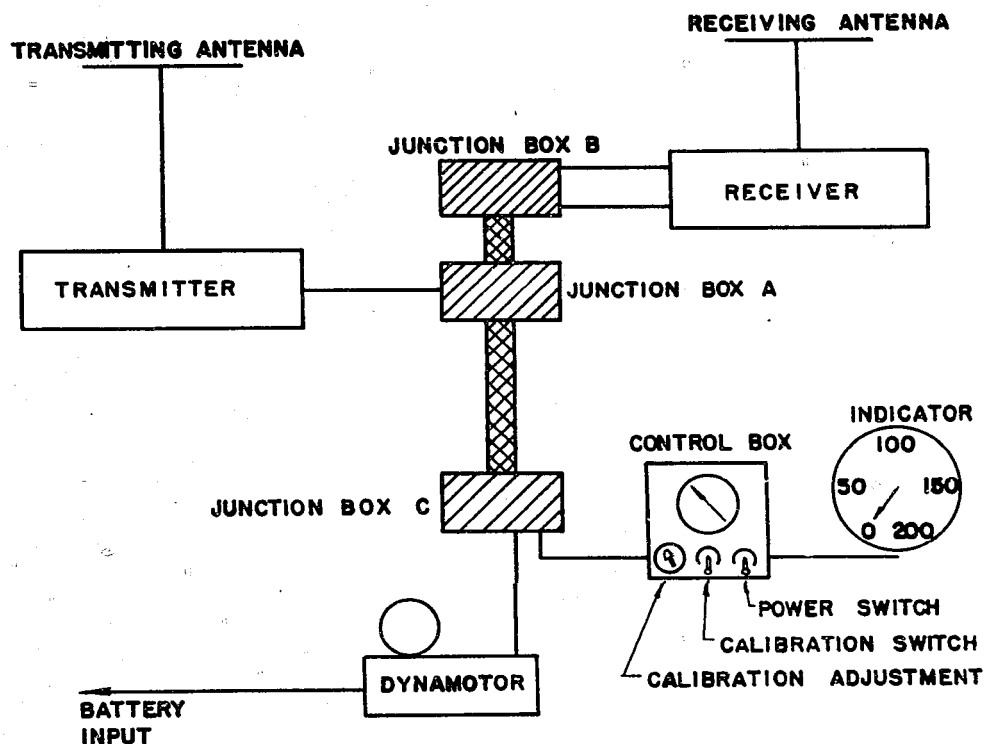
Range

From 10 to 150 m

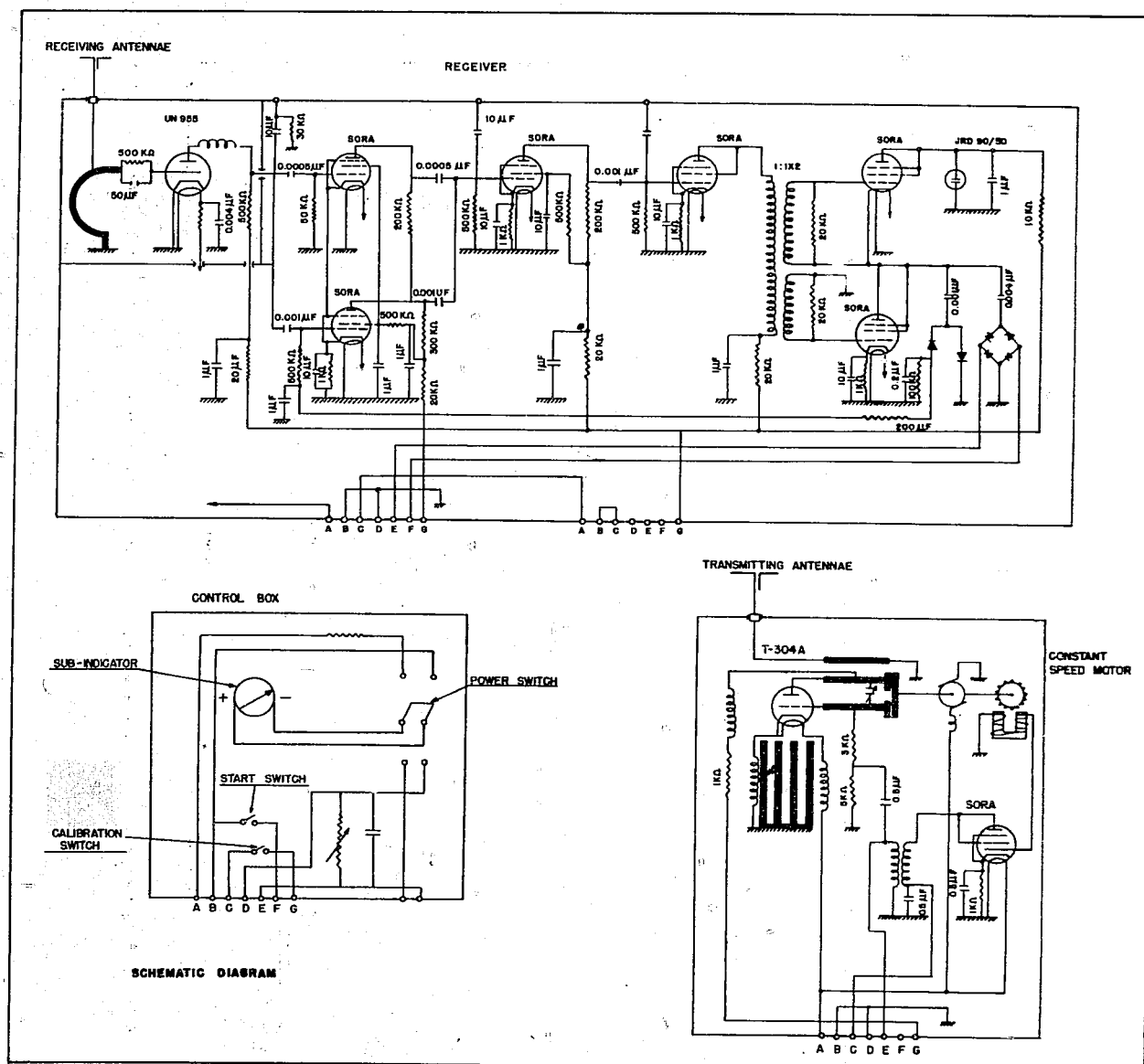
Error

Within 5%

CONNECTION DIAGRAM



ENCLOSURE (E), continued



ENCLOSURE (E), continued

