NS/vk

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

11 February 1946

RESTRICTED

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

Subject: Target Report - Japanese Fire Control.

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

1. Subject report, covering Target O-29 of Fascicle O-1 of reference (a), is submitted herewith.

2. The investigation of the target and the target report were accomplished by Lt. Comdr. E. Delmar-Morgan, RNVR, and Lt.(jg) D. H. Jackson, USNR.

C. G. GRIMES
Captain, USN

JAPANESE FIRE CONTROL

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

FASCICLE O-1, TARGET O-29

FEBRUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

ORDNANCE TARGETS

JAPANESE FIRE CONTROL

This report contains miscellaneous data on Japanese fire control and should be considered in connection with three other NavTechJap reports on fire control.* The data presented here are important in the fields covered by those reports.

In general, it can be said that nothing of great originality has been discovered in the items discussed in this report. To a large extent, the equipment was really simple and sometimes backward (for example, synchros). A remarkable fact is that, despite the backwardness of synchro technique, the equipment and systems in general appeared to work well.

---

*NavTechJap Reports, "Japanese Anti-Aircraft Fire Control," Index No. O-30; "Japanese Surface and General Fire Control," Index No, O-31 and "Japanese Torpedo Fire Control," Index No. O-32.

TABLE OF CONTENTS

LIST OF ENCLOSURES

LIST OF ILLUSTRATIONS

REFERENCES

Location of Target:

Yokosuka Naval Arsenal, YOKOSUKA

Kure Naval Arsenal, KURE

Fuji Electrical Company, KAWASAKI

Japanese Personnel Interviewed:

Jiro ICHINOI, former Commander, IJN
Fire Control Design Department, Kure Naval Arsenal and First Technical Arsenal, YOKOSUKA

K. ISOBE, assistant designer, Fuji Electric Company

Koji MUTO, former Commander, IJN, Officer in Charge, Gunnery Shop, Yokosuka Arsenal

INTRODUCTION

Some difficulty has been encountered in presenting the information in this report due to the diverse nature of the items discussed. In some cases, where the information is of an entirely negative character, there is little or nothing to describe; in other case much more could have been written, but it would have duplicated data in other target reports. An example of the latter is the Ward Leonard System which is closely associated with gun mounts. It is believed that the description of the Japanese Ward Leonard System in this report is adequate to indicate its differences from the American Ward Leonard System.

A few brief paragraphs have been included with regard to the target designation system and it is hoped that these, along with the diagrams in Enclosure (A), will provide sufficient information, for those familiar with the problem, without further detailed description.

THE REPORT

A. SWITCHBOARDS

The Japanese fire control switchboard is usually a fusing and supply control panel only. No evidence was discovered of an installation intended to accomplish anything like the U.S. Navy action cutout switchboard.

On larger ships, fire control circuits were fed through an appropriate main distribution board and quite often had no separate panel of their own. Aboard the battleship NAGATO, these fire control circuits were located irregularly over the entire length of the panel shown in Figure 1. Without an index chart or familiarity with the installation, it would require much searching to locate a given circuit.

However, on capital ships having a main director forward, with an auxiliary director aft, provision is made at the distribution panel for switching from the one director to the other. Since the majority of the fire control systems use single selsyn circuits, switching from one director to another is a difficult procedure. Both directors are trained to either 90° or 270° as are the guns; the directors and guns are set at an elevation of 10°; all range dials (including the computer) are set to 10,000 meters, and deflection dials, at zero. When directors, guns and computer are all adjusted to these values, the circuits are switched by multiple pole switches in the distribution room. It requires at least a full minute, under the best conditions, to accomplish this change over.

On destroyers such switching in not needed, since they have but one director. Also, a separate fusing panel is often located in the computing room as shown in Figure 2.

The topside telephone communications and fire control distribution panel aboard NAGATO are shown in Figure 3 and the supply panel for the forward distribution room is shown in Figure 4.

Further information on switchboards may be found in NavTechJap Report, "Characteristics of Japanese Naval Vessels, Article 5 - Shipboard Electrical Equipment," Index No. S-01-5.

B. TARGET DESIGNATION SYSTEMS

1. General

Japanese target designation equipment was not as well developed as British and American equipment. It was admitted by Japanese authorities that their equipment and organizations were backward and that their H.A. fire, particularly, suffered as a result.

2. Target Bearing and Elevation Transmitters

Target bearing transmitters were the basis of their target designating equipment and these were usually placed one to port and one starboard. They were invariably situated on either side of the bridge structure and transmitted to the main and secondary gunnery officers in the case of L.A. fire. For H.A. fire, the transmitters were situated adjacent to the H.A. directors or the machine gun directors. A buzzer system, in addition, was associated in the latter case with a simple code to denote the general area from which an attack could be expected.

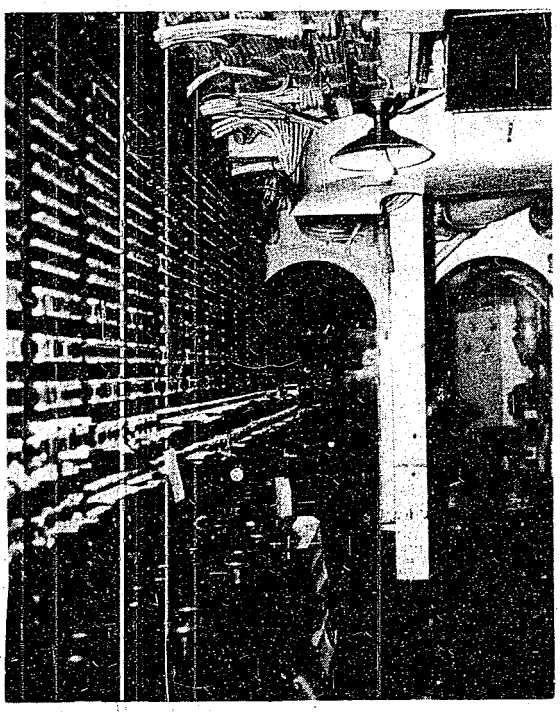


Figure 1
MAIN FORWARD DISTRIBUTION PANEL (NAGATO)

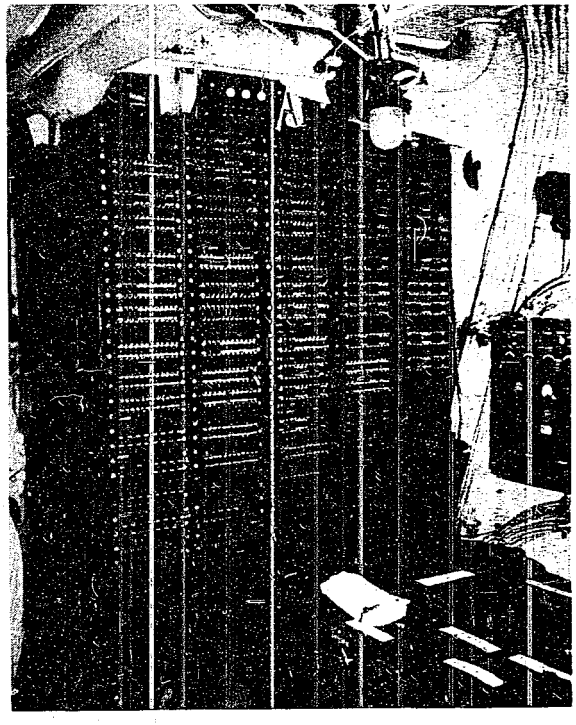


Figure 2
FUZING PANEL (HANAZUKI)

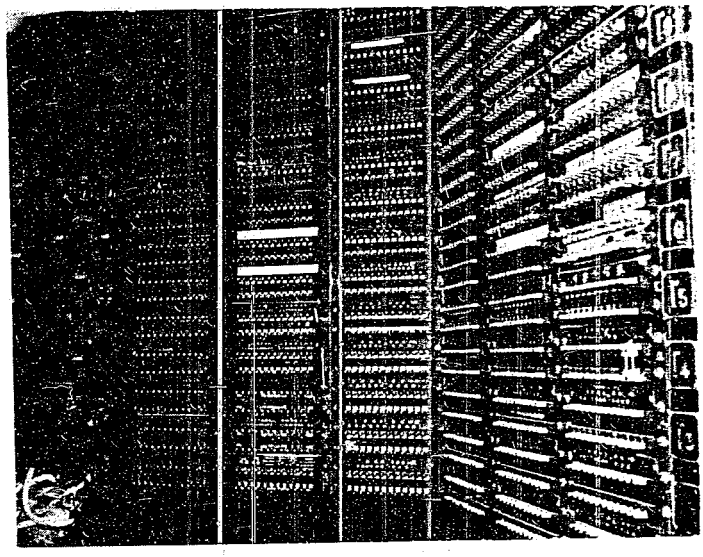


Figure 3

TOPSIDE TELEPHONE COMMUNICATIONS AND FIRE CONTROL DISTRIBUTION PANEL (NAGATO)

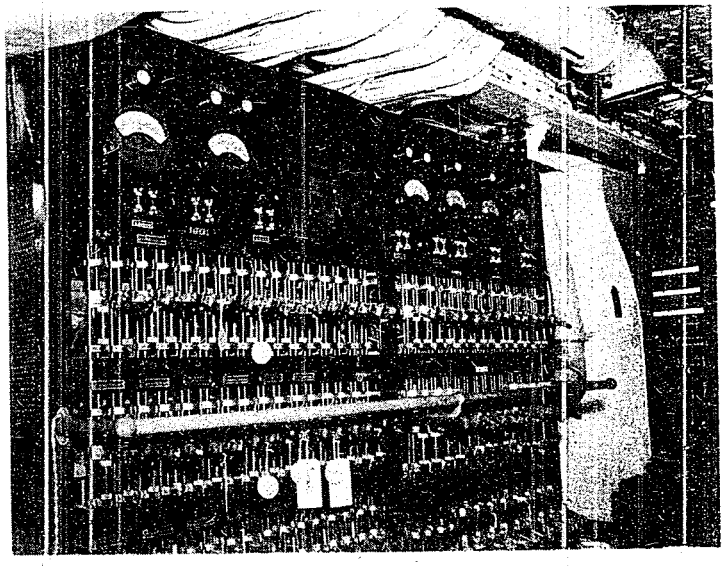


Figure 4

SUPPLY PANEL FOR DISTRIBUTION PANEL (NAGATO)

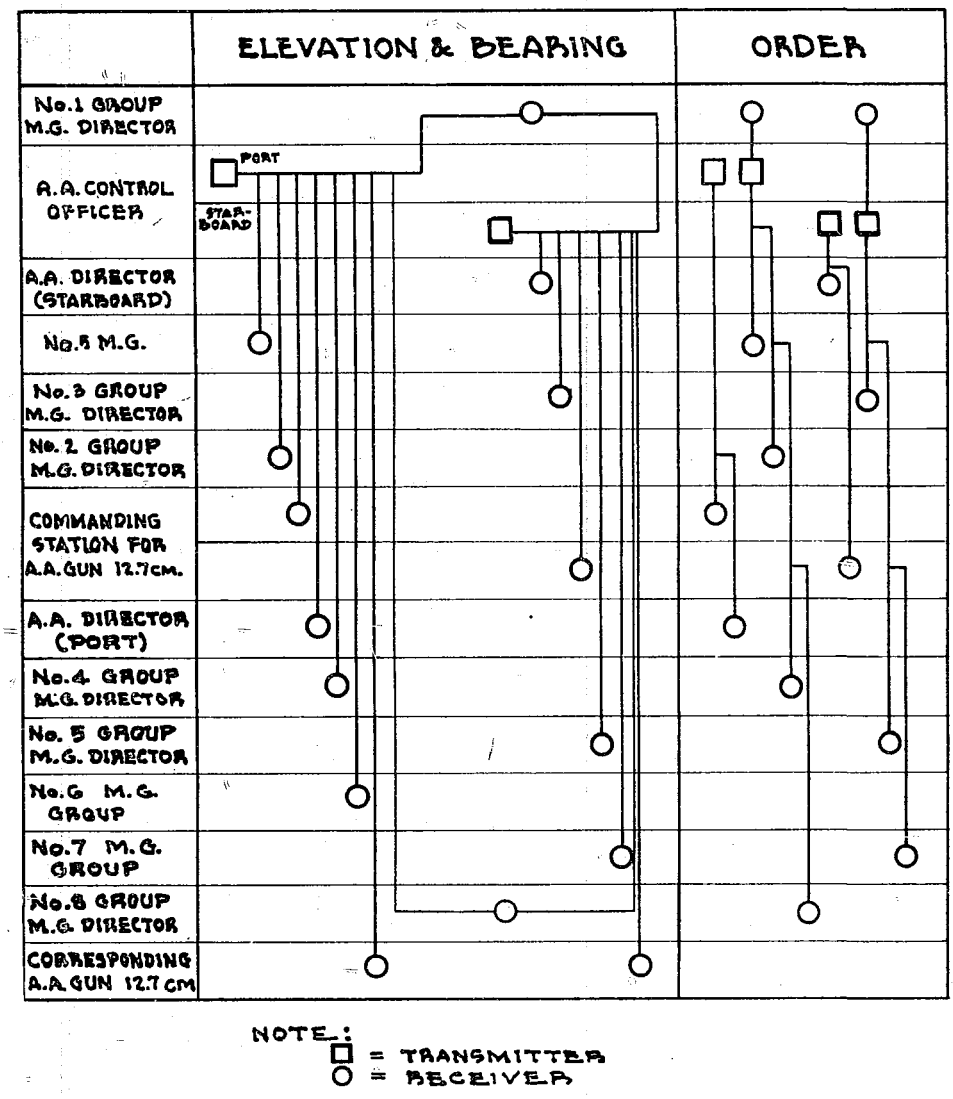


Figure 5

TARGET DESIGNATION EQUIPMENT (UNRYU)

The target designation equipment in the carrier UNRYU is illustrated in Figure 5. It was admitted by the Japanese that correct interpretation of the signals by the director crews was far from certain. The fact that there was doubt about this is a further indication of the difficulties which were encountered in this connection.

3. Type 94 H.A. Director (KOSHA SOCHI)

There was one device for use in association with the Type 94 H.A. system which had been devised to direct the layer and trainer of the director onto the correct target. This device was a small illuminated scale sealed into the side of the sights of the layer and trainer's telescopes; against this scale was a pointer driven by a selsyn motor which received signals from the control officer. When these scales were illuminated, the operators were forced, as a result, to follow the pointers until the control officer released his control. It is believed that this system was fairly successful, but it still did not completely solve the more difficult problem which was to correlate the different directors when there was more than one target.

C. CLOSE-IN ARMAMENT SIGNALS

J. ICHINOI, former Commander, IJN, stated that the only system known to him as being of any value in silencing close-in armament is a "large mallet weighted with lead wherewith to hit the gunners on the head".

The Japanese considered that this problem was an extremely difficult one and, in fact, they had no solution to it other than for the control officer to hit or kick the operators, since in the heat of battle a man will not easily be dissuaded from his set purpose either by buzzers, lights or any other device of such a nature.

D. FIRING AND CEASE FIRING RELAYS

1. General

Information on firing relays is somewhat meager but the following data may adequately describe the systems.

2. Firing Circuit

The firing circuit of the 12.7cm twin-mount Type 98, in which both gun barrels elevate together, is represented by Figure 6; the system in which the guns in the main turrets of destroyers (12.7cm twin) can elevate independently is illustrated in Figure 7. The emergency switch shown in the diagrams is used by the control officer for operation in the turret.

The change over switch is for use in case of quarters or local control of the gun. The intercepter has no unusual features.

In order to acquaint the layer and trainer with the situation at any time, there are small lights behind the dials of their receivers, one which is lighted when the trigger is pressed and the other which lights when the gun is actually fired. The operators match their pointers with extra special care during the intervening period of time and this may, in fact, contribute to some extent to the minimizing of dispersion discussed in more detail in NavTechJap Report, "Japanese Surface and General Fire Control", Index No. O-31.

In addition, there is a buzzer which sounds when the trigger is pressed, which once more makes the operators aware of the necessity of matching their pointers correctly.

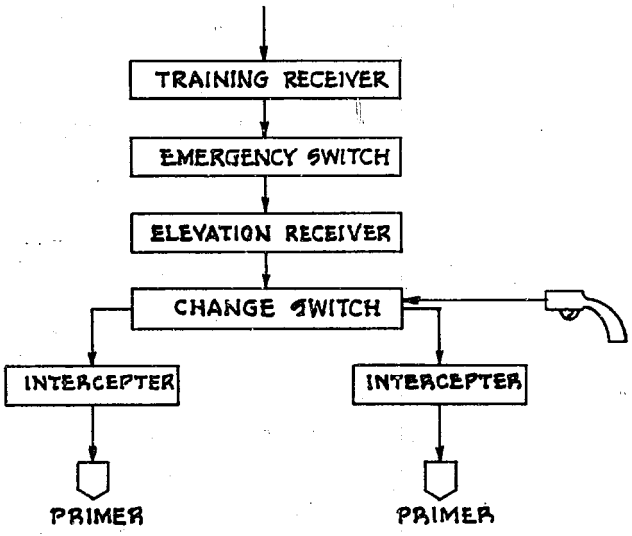


Figure 6

FIRING CIRCUIT DIAGRAM

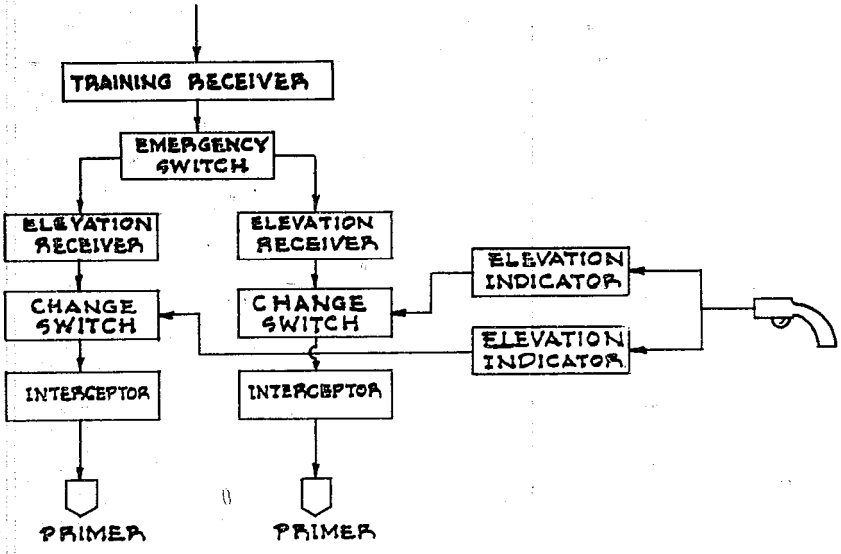


Figure 7

FIRING CIRCUIT DIAGRAM

E. GUN MOUNT INTERFERENCE

1. General

There are two kinds of devices for preventing interference of one mount with another. One is an electrical device. With this, in case of danger from interference, an electrical circuit is broken and an alarm bell rung. The other is a mechanical device by means of which the mount is actually stopped. These are described below.

2. Electrical Device

In each mount there is a type of panel which has two arms moving over contacts: one arm is for own mount, the other arm, driven by a selsyn, is for the other mount. Figure 8 shows such a circuit in which the left

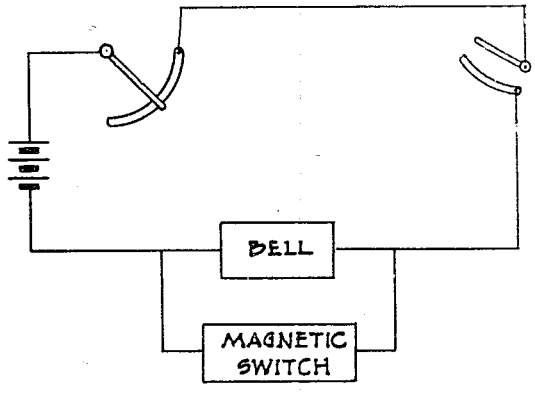


Figure 8

GUN MOUNT INTERFERENCE DIAGRAM

hand contact might represent own mount and the right hand contact the other mount. It will be seen, therefore, that the circuit will be completed by own mount if it is making contact while the other mount is in the "danger arc" represented by the length of the contact of other mount.

An exactly similar arrangement is used for elevation so that all conditions can satisfied.

3. Mechanical Device

With manually operated guns, simple mechanical stops are used since manpower is not great enough to do damage to the gearing; but with hydraulically operated mounts, cams and contact rollers are used. The results is that the roller gradually cuts off the power to the mount by controlling the valve of the operating mechanism. This valve is not restored to its operating position again until the layer and/or trainer has moved his hand-wheel back from the danger position.

F. COMMUNICATIONS

This subject is fully covered in NavTechJap Report, "Characteristics of Japanese Naval Vessels, Article 5 - Shipboard Electrical Equipment", Index No. S-01-5.

G. SYNCHRO OVERLOAD DEVICES

Extensive search of ships and interrogation of various Japanese personnel revealed that the Japanese Navy did not use any sort of synchro overload device.

With the exception of a few experimental types of selsyns (see NavTechJap Document No. ND21-3431 and ND21-3432) and the Ward Leonard selsyns, Japanese installations used approximately 50 volts for the single-phase supply. The only electrical protection in this circuit consists of a 16 ohm resistance placed in series with a three ampere fuse. There were no blown-fuse indicators.

It was not deemed necessary to provide any special overload devices as the selsyns were claimed to be designed to withstand a 60° C temperature rise. Performance of selsyns can be examined by research upon the various samples shipped to the United States (see Enclosure (B)).

H. TORPEDO CONTROL PANELS

This subject has been covered in NavTechJap Report, "Japanese Torpedo Fire Control", Index No, O-32.

I. LAYOUTS OF FIRE CONTROL SYSTEMS

1. General Installations

Enclosure (A) consists of four typical layouts of general fire control installations and one typical wiring diagram. These layout diagrams are self-explanatory. The wiring diagram shows the Type 92 L.A. Table (SHAGEKIBAN) and Type 94 Director (HOIBAN) similar to the system in NAGATO described in NavTechJap Report, "Japanese Surface and General Fire Control", Index No. O-31.

2. Torpedo Control is dealt with in NavTechJap Report, Japanese Torpedo Fire Control", Index No, O-32.

3. Firing Circuits for Rocket Projectors. Firing circuits for rocket projectors for 12cm 28-rocket A.A. fire are dealt with in NavTechJap Report, "Japanese Shipboard Rocket Launchers", Index No. O-50(N).

4. Special Fire Control Devices. The few special devices found have been described in detail in NavTechJap Reports, "Japanese Anti-Aircraft Fire Control", Index No. O-30 and "Japanese Surface and General Fire Control", Index No. O-31. The sine-wave mechanism described in the former report may be the most interesting, but the power rate integrator described in the latter report is also worthy of study.

J. WARD LEONARD SYSTEM

1. General

The Ward Leonard control system was examined carefully. It appeared to lack features of outstanding interest and indicated that the Japanese were lagging in this technique, both as to perfecting the device and in its application. It was applied only to the 25mm machine gun mounts and no plan seemed to exist for an extension of its application to medium caliber weapons.

2. Description

The "scooter" control in the directors has already been referred to in NavTechJap Report, "Japanese Anti-Aircraft Fire Control", Index No. O-30, but the following description provides information regarding the remainder of the system.

One man in the director operates the scooter control both in elevation and training and the movements result in the vibrating contacts being held longer on one side than another. This alters the field strength of

the generator. Figure 9 shows an elementary wiring diagram of the system. Figure 10, which is a wiring diagram, gives other salient features about which no comment is necessayy. Figure 11 gives the remaining information on the power supply and control which may be of interest.

In Figure 11, at approximately the center, can be seen the overload relays. These relays protect the DC circuits only and are set for five amperes. The AC supply for selsyns is protected by fuses shown in the diagram below the relays, and again, 5 amperes is the limiting value.

The two multiple-position switches are for facilitating an examination of current and voltage conditions at various parts of the circuit.

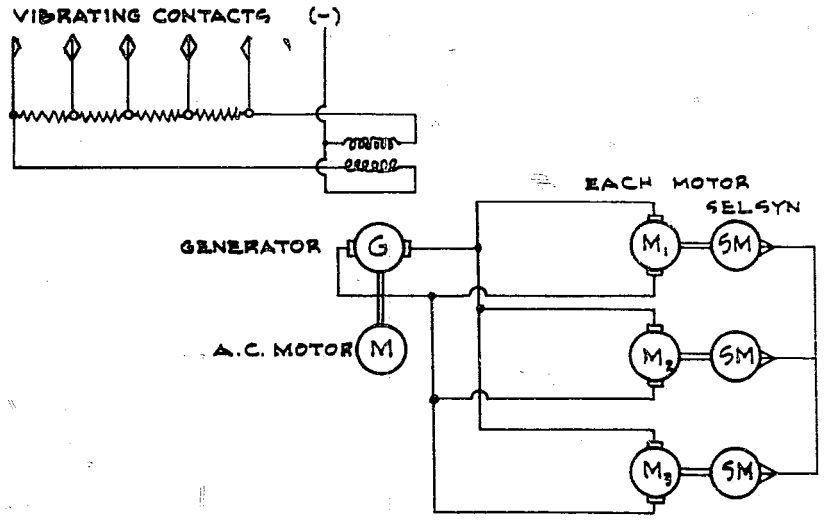


Figure 9

SCOOTER CONTROL, WARD LEONARD SYSTEM

3. Limit Switch Arrangements (Ward Leonard System)

The limit switch arrangements of the Ward Leonard System are worthy of comment as they show some successful ideas in the solution of the limit switch problem.

Figure 12 shows the limits of -10° and $+90^{\circ}$ in depression and elevation respectively and -270° and $+270^{\circ}$ in training (left and right). Also shown are two danger areas represented by the two rectangles.

For training left, for example, the gun must not proceed further than BC (on the scale, say 130°) unless the elevation is higher than the length of the line BC (on the same scale, say about 40° elevation). In order to accomplish such a maneuver, a series of cams and rollers is arranged for the training side of the Ward Leonard motor controls and a similar set for the elevating controls. Figure 13 shows the switches which are operated by the cams and Figure 14 shows how these cams are arranged. The action of the cams is somewhat complex, particularly at the corners of the danger zones. The principle of the system is indicated in the following table.

LIMIT SWITCH TABLE Left Side

	Switch In	Switch Off
on AB	1, 2, 3, 6	a, b, c, 4, 5
on BC	1, 2, 4, 5, 6, c	3, a, b
on B	1, 2, 4, 5(2°), 6	C, 3 a, b
on A	6, b	C, 3, a, 4, 5
on C	3, 1, 2, a, b	C, 6, 4, 5

In order to trace the series of operations by means of the table, let it be assumed that the gun is elevated and then trained left to about -200°. Then if the gun is depressed to the line AB, the switches which will be closed will be Nos. 1, 2, 3, and 6. In other words, with 1 and 2 closed the training motor can run according to the ultimate limits of the system and with 3 and 6 closed, the danger area is not trespassed.

Again, with a, b, c, 4, and 5 open under these same conditions, the elevation motor cannot be operated in the negative direction (i.e. depression) but can operate in the positive direction (i.e. elevation) since the main elevation limit switch is still closed.

Proceeding with the example as above, let it now be supposed that the gun is trained right along the line AB (in a positive direction) until the corner B is reached. Then switches 1, 2, 4, 5, and 6 are closed and C. 3, a, and b remain open to allow the corner to be negotiated.

In order to prevent the occurrence of a "dead" position at the corners, there is one further feature, a tolerance of 1.3° on the cam (shown at "a" in Figure 14) which is of importance. This 1.3° forms, in effect, a cushion corner between the two sides AB and BC (the same occuring at A and C).

It has been stated that the adjustment and initial installation of this gear was difficult, but that once set and working properly the equipment gave no trouble at sea and required little maintenance.

K. MISCELLANEOUS

The following are brief notes on various miscellaneous questions.

1. Method of Amplification of Error Signal - The Japanese had no such method.

2. Types of Selsyn

A list of selsyns being shipped to the United States is given in Encl (B).

A table setting out the different types of selsyns is given below.

TYPES OF SELSYNS

Name		Remarks
Selsyn Type 98	Mod 1	Very small capacity, obsolete.
	Mod 2	Small.
	Mod 3	Ordinary selsyn, most widely used in data transmission, especially as a receiver.
	Mod 4	Obsolete.

MOTORS & GENERATORS				
DESIGNATION	OUTPUT	VOLTAGE	RPM	TYPE
M_1	12 HP	100V	3450 r/m	DC
M_2	12 HP	100 V	3450 r/m	DC
LG_1	4 KW.	0±330V 472V	3450 r/m	DC
LG_2	4 KW	0±330V	3450 r/m	DC
ACG	12 KVA	250 V	3450 r/m	AC 115~
DCG	3.5 KVA	220V.	3450 r/m	DC

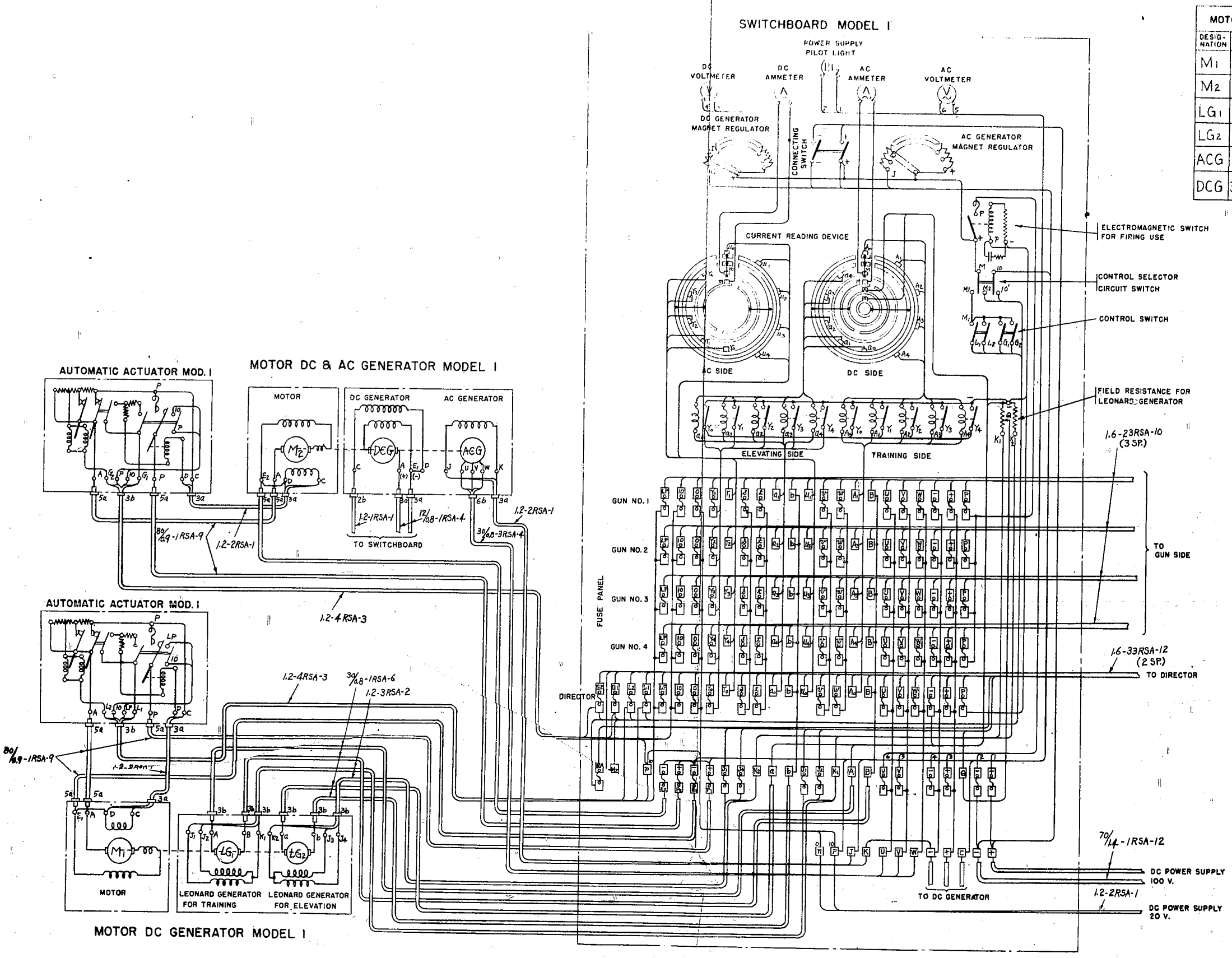
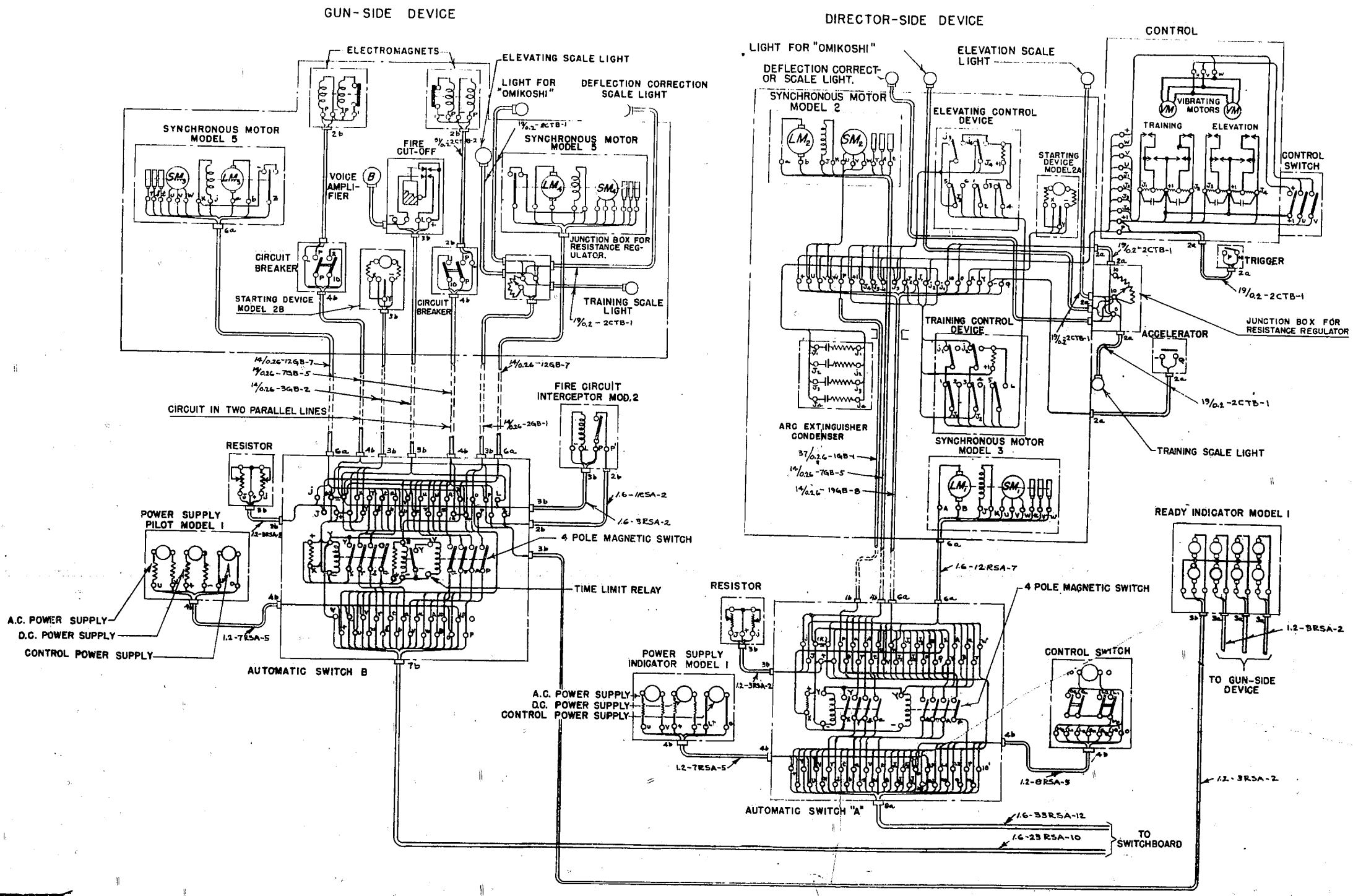


Figure 11

DIAGRAM FOR POWER SUPPLY OF WARD LEONARD CONTROL FOR 25mm MACHINE GUN



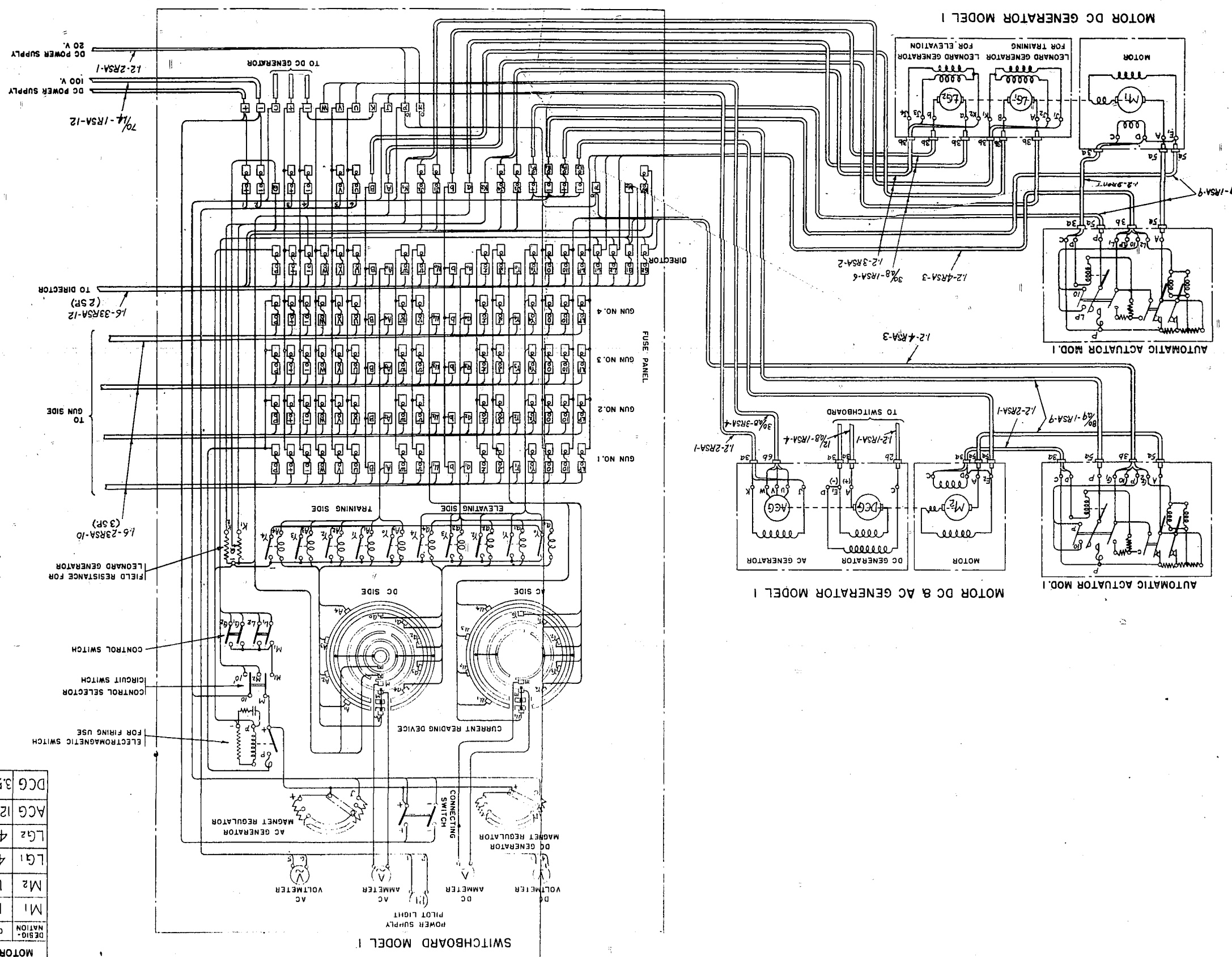
MOTORS & GENERATORS				
DESIGNATION	OUTPUT	VOLTAGE	R.P.M.	TYPE
LM_1	0.25 HP	0 ± 330 v / 495 v	0 ± 2500 R/M / 3750	D.C.
LM_2	0.15 HP	0 ± 330 v.	0 ± 2500 R/M	D.C.
LM_3	0.5 HP	0 ± 330 v.	0 ± 2500 R/M	D.C.
LM_4	0.5 HP	0 ± 330 v / 495 v	0 ± 2500 R/M / 3750	D.C.
SM_1	3.6 KG.CM.	250 v.	0 ± 2500 R/M / 3750	A.C. 115 v
SM_2	2.15 KG.CM.	250 v.	0 ± 2500 R/M	A.C. 115 v
SM_3	7.2 KG.CM.	250 v.	0 ± 2500 R/M	A.C. 115 v
SM_4	7.2 KG.CM.	250 v.	0 ± 2500 R/M / 3750	A.C. 115 v
VM	1.5 W	250 v.	2000 R/M	A.C. 115 v

Figure 10

WIRING DIAGRAM, WARD LEONARD SYSTEM

Figure 11

DIAGRAM FOR POWER SUPPLY OF WARD LEONARD CONTROL FOR 25mm MACHINE GUN



MOTORS & GENERATORS				
DESIGNATION	OUTPUT	VOLTAGE	RPM	TYPE
M1	12 HP	100V	3450/m	DC
M2	12 HP	100 V	3450/m	DC
LG1	4 KW.	0 1330V	3450/m	DC
LG2	4 KW	0 1330V	3450/m	DC
ACG	12 KVA	250 V	3450/m	AC 1/3 ~
DCG	3.5 KVA	220V	3450/m	DC

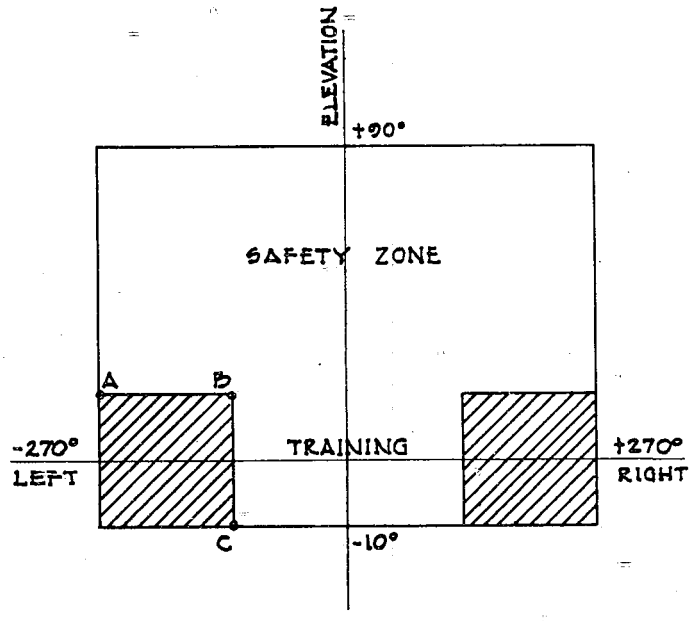


Figure 12

LIMIT SWITCH (WARD LEONARD)

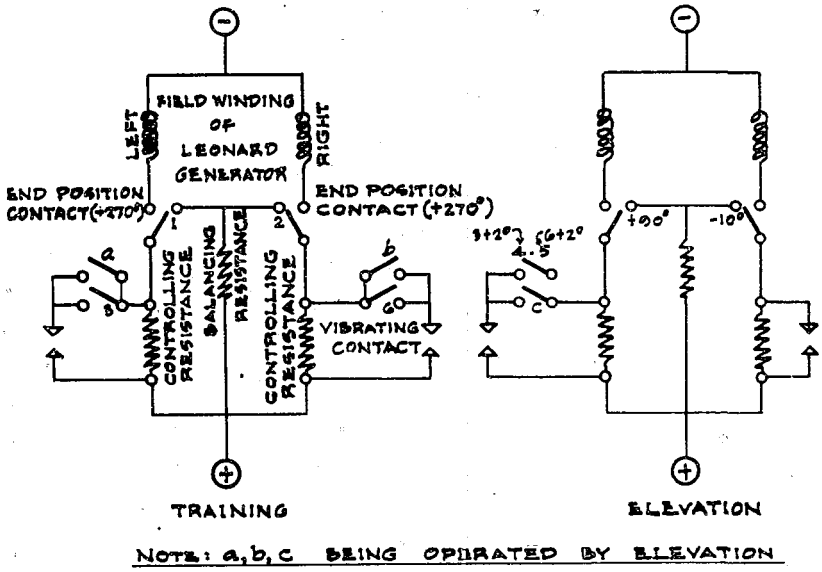


Figure 13

LIMIT SWITCH DIAGRAM

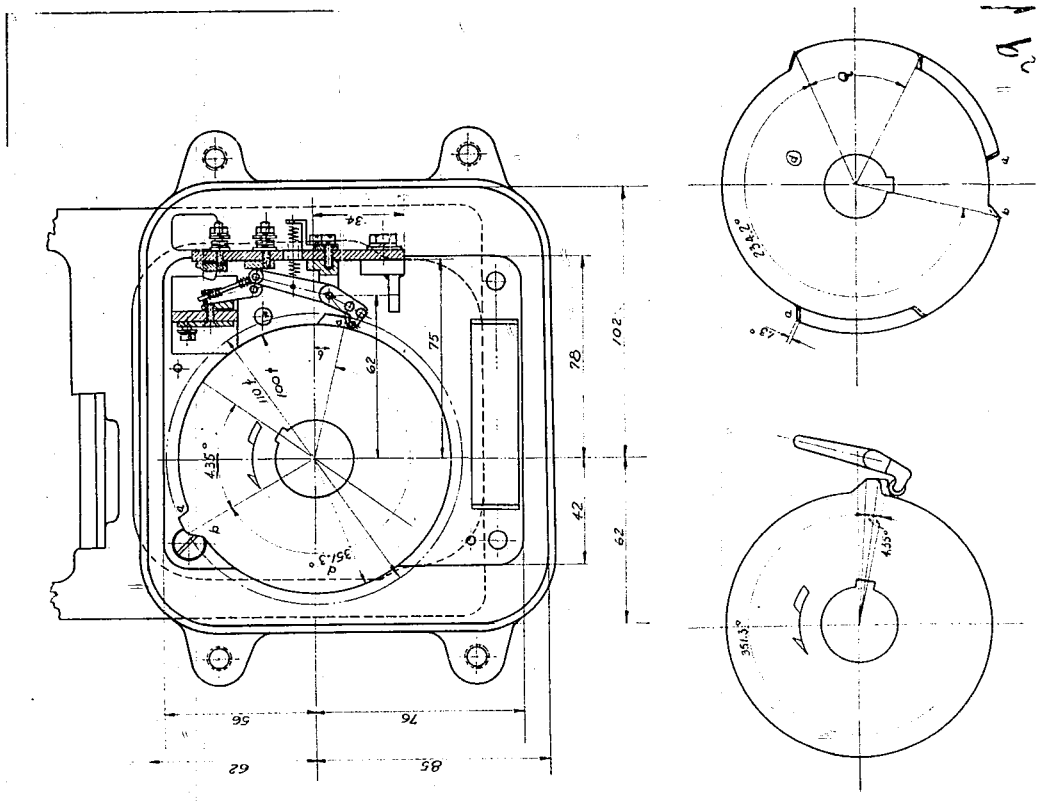
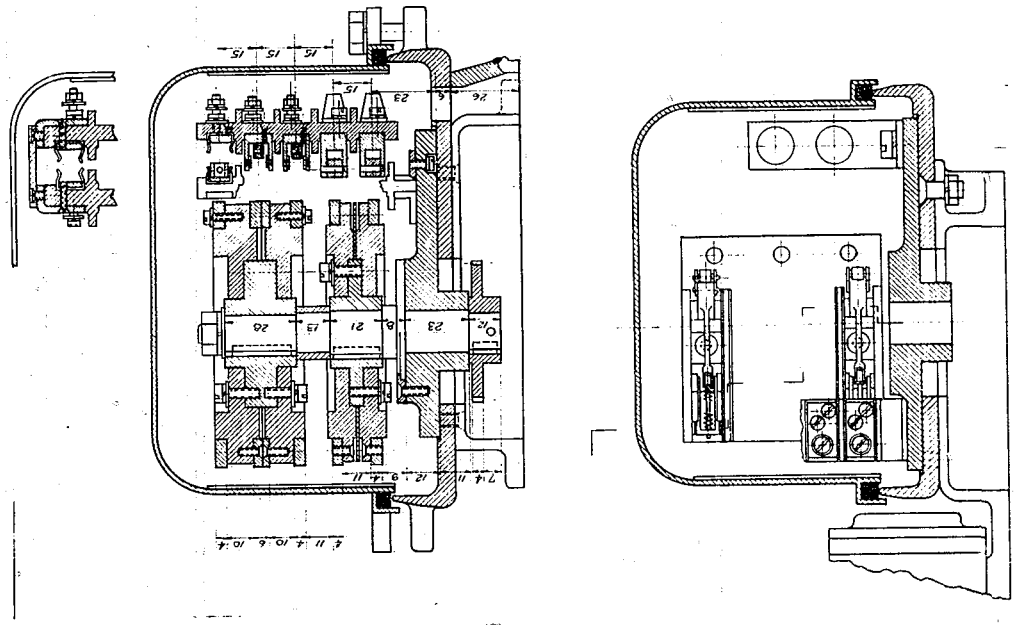


Figure 14
LIMIT SWITCH DIAGRAM



Name	Remarks
Mod 5	Known as "power selsyn", most widely used, especially as a transmitter in case of data transmission.
Mod 6	Known as "power selsyn", often used in case of direct automatic follow-up.
Mod 7	Power selsyn, not often used.
Selsyn Transmitter Type 2 Mod 1	Most widely used as transmitter and corresponds to Type 98 Mod 5, which latter was gradually replacing Type 2 Mod 1.
Selsyn Receiver Type 2 Mod 2	Most widely used as receiver and corresponds to Type 98 Mod 3. Again, the latter was gradually replacing Type 2 Mod 2.
Deflection and Range Transmitters to Gun Side	Especially used as deflection and range transmitter to gun mount (being included in computer) (SHAGEKIBAN); bigger size, designed and manufactured by the Aichi Clock Company.

3. Position of Resetters

Resetters were taken from a point as close as possible to the work which was being done. This ideal was not always realized, but Japanese designers were well aware of the benefits resulting therefrom. However, most of their systems were very simple and the Ward Leonard was the only complete remote power control system which required a resetter.

4. Sector Values

Transmission systems in the Japanese Navy were of a much simpler nature than in Allied Navies. Remarks on the applications of Japanese selsyns are given below:

Gun Training	Single, 3°/rev; Double, 360°/rev and 20°/rev	
Gun Elevating	Single, 3°/rev; Double, 90°/rev and 10°/rev	
Fuse Time	Single, 1 sec/rev; Double, 50 sec/rev and 5 sec/rev	
Deflection and Range	Speeds were selected to suit the range and deflection values, the rotation of the selsyn through 360° providing the complete scope of the values to be transmitted.	
Elevation and Bearing Angles	For transmitting these quantities to the computer or L.A. Table	1°/rev to 3°/rev, depending upon the values to be transmitted.
Target angle Target speed Present range Own speed Range rate etc.	Direct indication	
Gun Training Gun Elevating	Ward Leonard R.P.C.	20'/rev (special selsyn)

5. Relative Velocity Component

There were no equivalents of this device in Japanese Fire Control equipment.

6. Local Control Arrangements Using Remote Power Control

The local control arrangements of the machine gun mounts normally operated by the Ward Leonard System were manual only and no attempt was made to use the remote power control gear by introducing local control.

7. Limit Switch Arrangements

There were no limit switch arrangements other than those covered by the description of the Ward Leonard System.

8. Stabilization of Telescopes

There were no arrangements for stabilizing the telescopes in either H.A. or L.A. fire directly from gyros; they were stabilized only by the matching of pointers. Further mention of this had been made in NavTechJap Report, "Japanese Surface and General Fire Control", Index No. O-31.

9. Cross Levelling or Tri-Axial Mounting

There were no tri-axial mountings and only one tri-axial director, the Type 94 (KOSHAKI) fully described in NavTechJap Report, "Japanese Anti-Aircraft Fire Control", Index No. O-30.

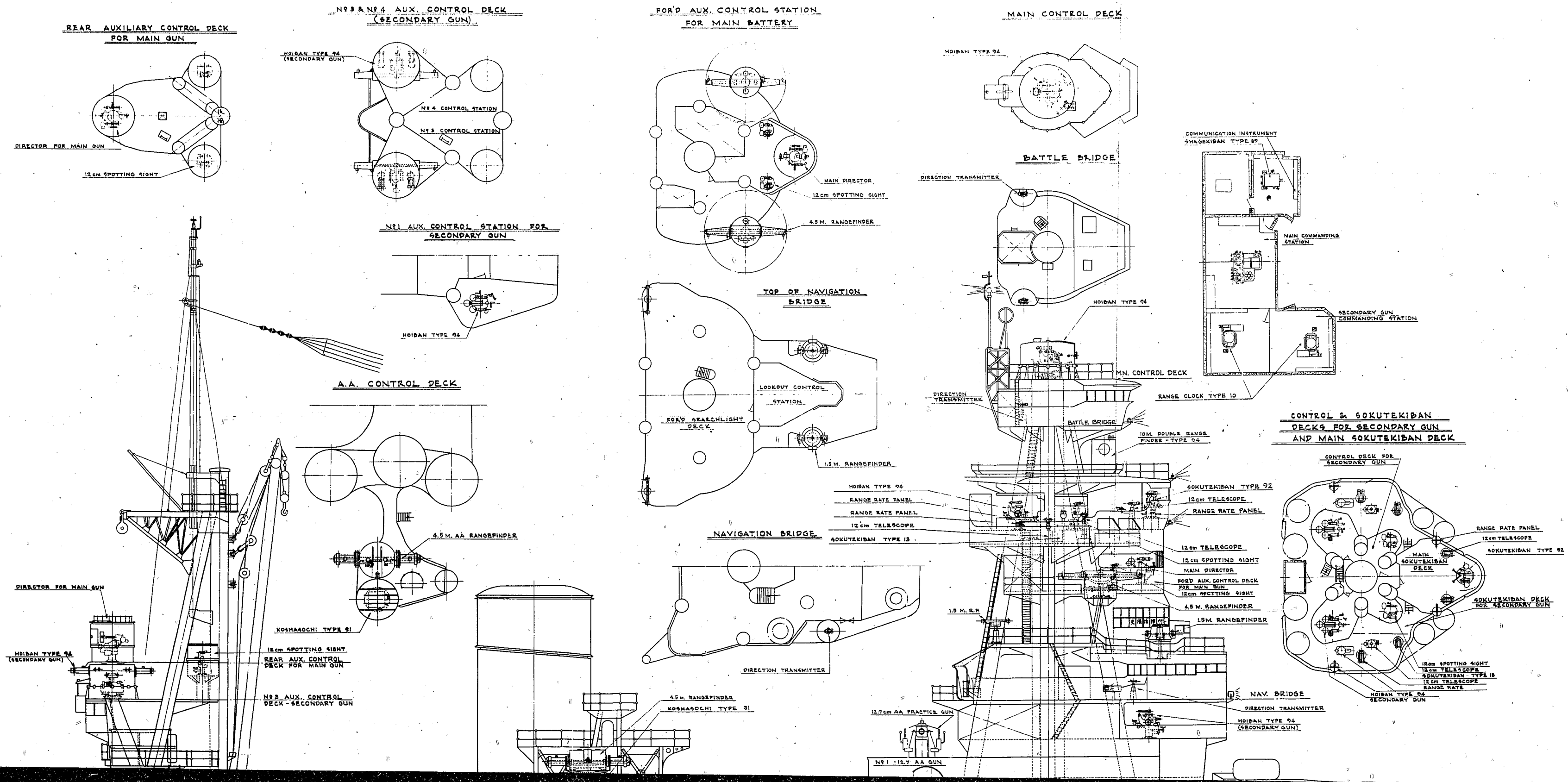
10. Time Interval Compensating Gear

There was no such gear since the principle of all Japanese gunnery, whether H.A. or L.A., depended upon following the target all the time. This applied to the smallest machine guns as well as the largest caliber guns. There was, therefore, no "selected level" or "selected cross level" firing as in the U.S. Navy and no T.I.C. or "forecasting" as in the British Navy. This was a remarkable state of affairs, particularly when it was discovered that the maximum rate of training of large gun turrets was not better than two or three degrees per second. (A battleship firing over the bow in a cross roll of 10° each side of the vertical, with a 15 second amplitude and guns elevated to 45° requires a mean training rate for its guns of $\frac{40^{\circ}}{15}$/sec or $\frac{40}{15} \times \frac{\pi}{2}^{\circ}$ /sec maximum training rate. This is about 4°/sec so that under these conditions, the guns could not fire during the conditions of maximum velocity of roll. The guns could fire, therefore, only about 2/3 of the time).

It is probably for this reason that the firing circuit contacts in the gun elevation and gun training receivers were necessary in association with the minimizing of dispersion gear described in NavTechJap Report, "Japanese Surface and General Fire Control", Index No. O-31.

It is also probable that some errors in dispersion were thereby avoided, since T.I.C. gear and selected-level firing introduce errors even under the best conditions.

ENCLOSURE (A)


REAR AUXILIARY CONTROL DECK FOR MAIN GUN
DIRECTOR FOR MAIN GUN
12cm SPOTTING SIGHT
No 3 & No 4 AUX. CONTROL DECK (SECONDARY GUN)
HOIBAN TYPE 94 (SECONDARY GUN)
No 4 CONTROL STATION
No 3 CONTROL STATION
No 1 AUX. CONTROL STATION FOR SECONDARY GUN
HOIBAN TYPE 94
A.A. CONTROL DECK
4.5 M. AA RANGEFINDER
KOSHASOCHI TYPE 91
DIRECTOR FOR MAIN GUN
HOIBAN TYPE 94 (SECONDARY GUN)
12cm SPOTTING SIGHT
REAR AUX. CONTROL DECK FOR MAIN GUN
No 3 AUX. CONTROL DECK - SECONDARY GUN
FOR'D AUX. CONTROL STATION FOR MAIN BATTERY
MAIN DIRECTOR
12cm SPOTTING SIGHT
4.5 M. RANGEFINDER
TOP OF NAVIGATION BRIDGE
LOOKOUT CONTROL STATION
FOR'D SEARCHLIGHT DECK
1.5 M. RANGEFINDER
NAVIGATION BRIDGE
DIRECTION TRANSMITTER
4.5 M. RANGEFINDER
KOSHASOCHI TYPE 91
MAIN CONTROL DECK
HOIBAN TYPE 94
BATTLE BRIDGE
DIRECTION TRANSMITTER
HOIBAN TYPE 94
COMMUNICATION INSTRUMENT SHAGEKIBAN TYPE 89
MAIN COMMANDING STATION
SECONDARY GUN COMMANDING STATION
RANGE CLOCK TYPE 10
MN. CONTROL DECK
DIRECTION TRANSMITTER
BATTLE BRIDGE
10M. DOUBLE RANGE FINDER - TYPE 94
HOIBAN TYPE 94
RANGE RATE PANEL
RANGE RATE PANEL
12cm TELESCOPE
40KUTEKIBAN TYPE 13
40KUTEKIBAN TYPE 92
12cm TELESCOPE
RANGE RATE PANEL
12cm TELESCOPE
12cm SPOTTING SIGHT
MAIN DIRECTOR
FOR'D AUX. CONTROL DECK FOR MAIN GUN
12cm SPOTTING SIGHT
4.5 M. RANGEFINDER
1.5M. RANGEFINDER
1.5 M. R.F.
NAV. BRIDGE
DIRECTION TRANSMITTER
HOIBAN TYPE 94 (SECONDARY GUN)
12.7cm AA PRACTICE GUN
No 1 - 12.7 AA GUN
CONTROL & 40KUTEKIBAN DECKS FOR SECONDARY GUN AND MAIN 40KUTEKIBAN DECK
CONTROL DECK FOR SECONDARY GUN
RANGE RATE PANEL
12cm TELESCOPE
40KUTEKIBAN TYPE 92
MAIN 40KUTEKIBAN DECK
40KUTEKIBAN DECK FOR SECONDARY GUN
12cm SPOTTING SIGHT
12cm TELESCOPE
40KUTEKIBAN TYPE 13
12cm TELESCOPE
RANGE RATE
HOIBAN TYPE 94 SECONDARY GUN

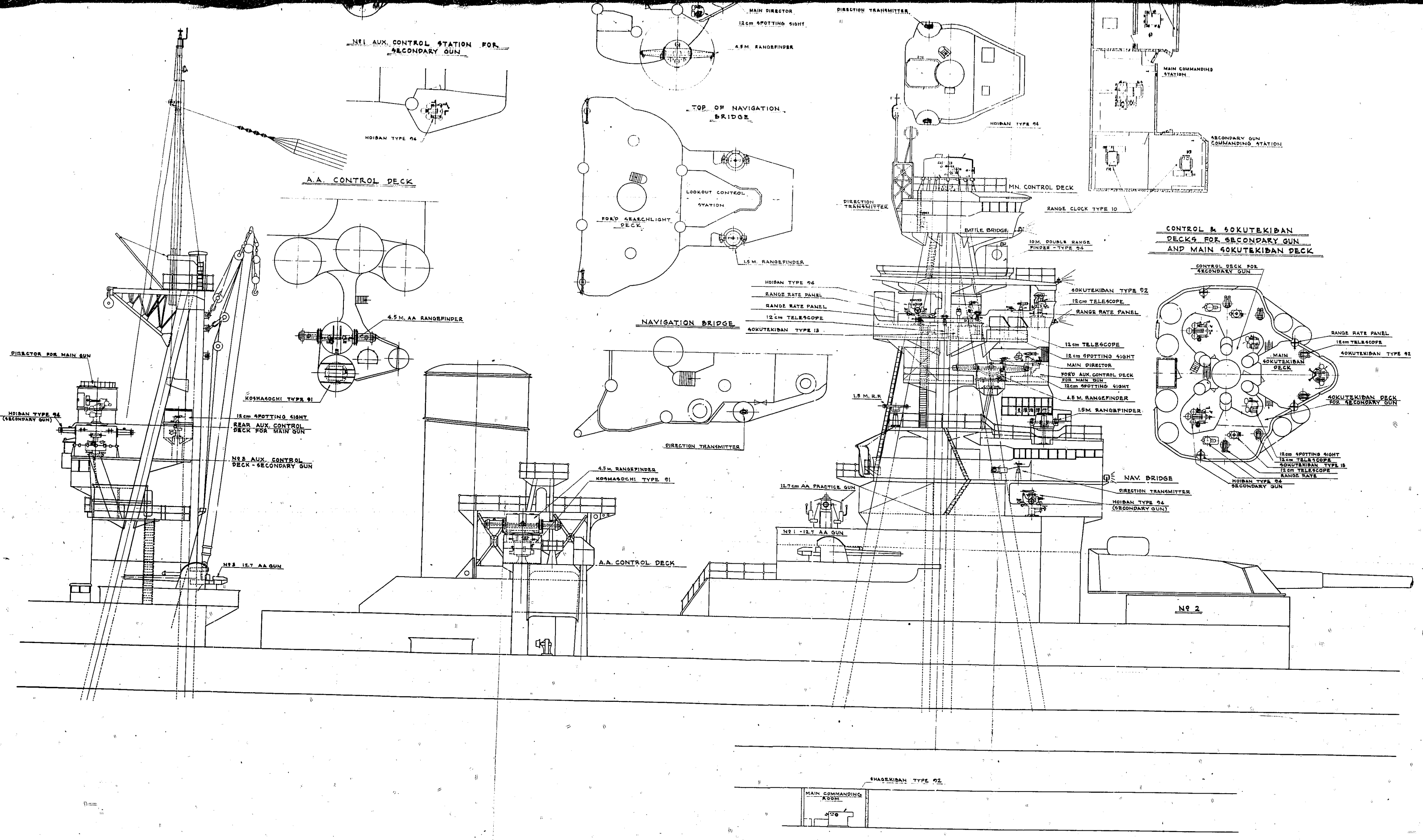
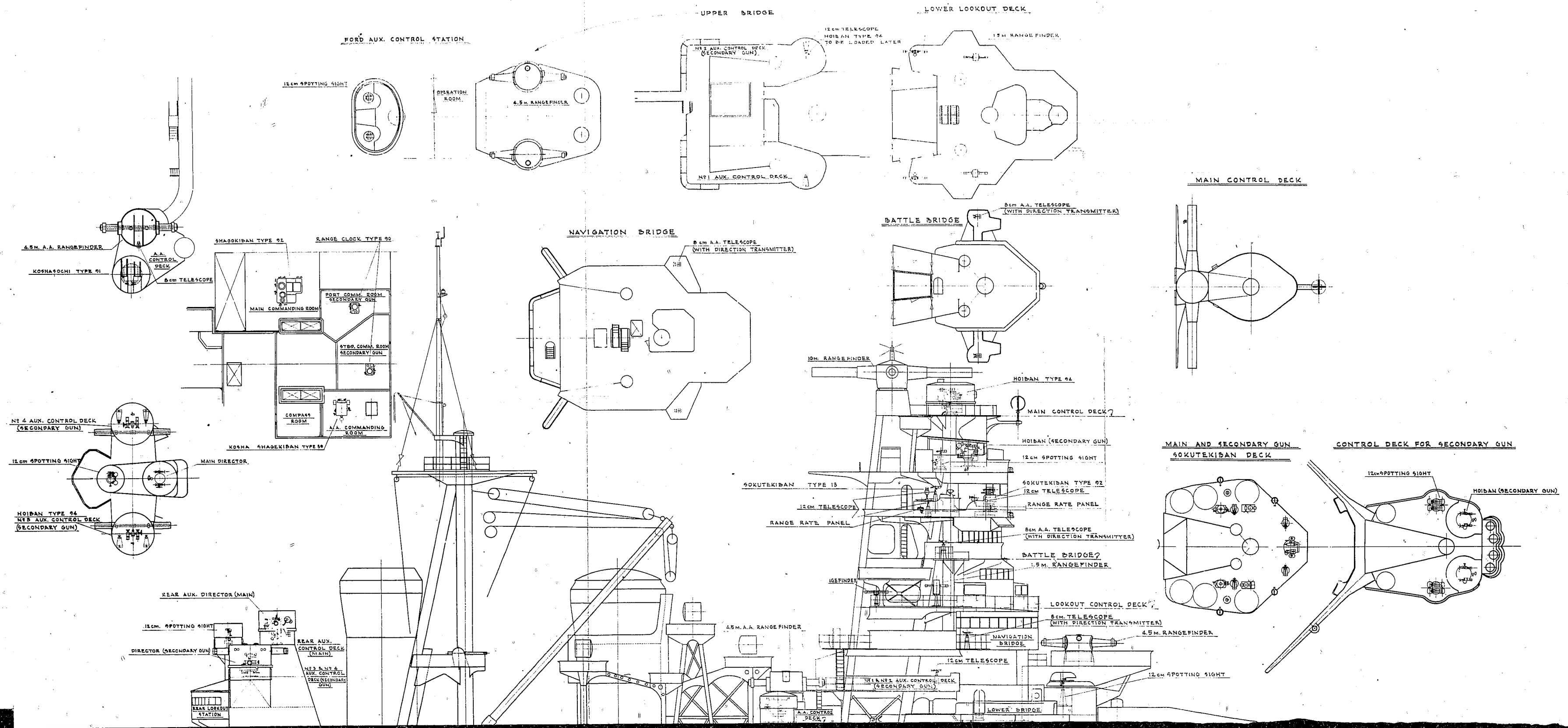


Figure 1(A)

BRIDGE AND GUNNERY ARRANGEMENT, BB MUTSU

ENCLOSURE (A), continued



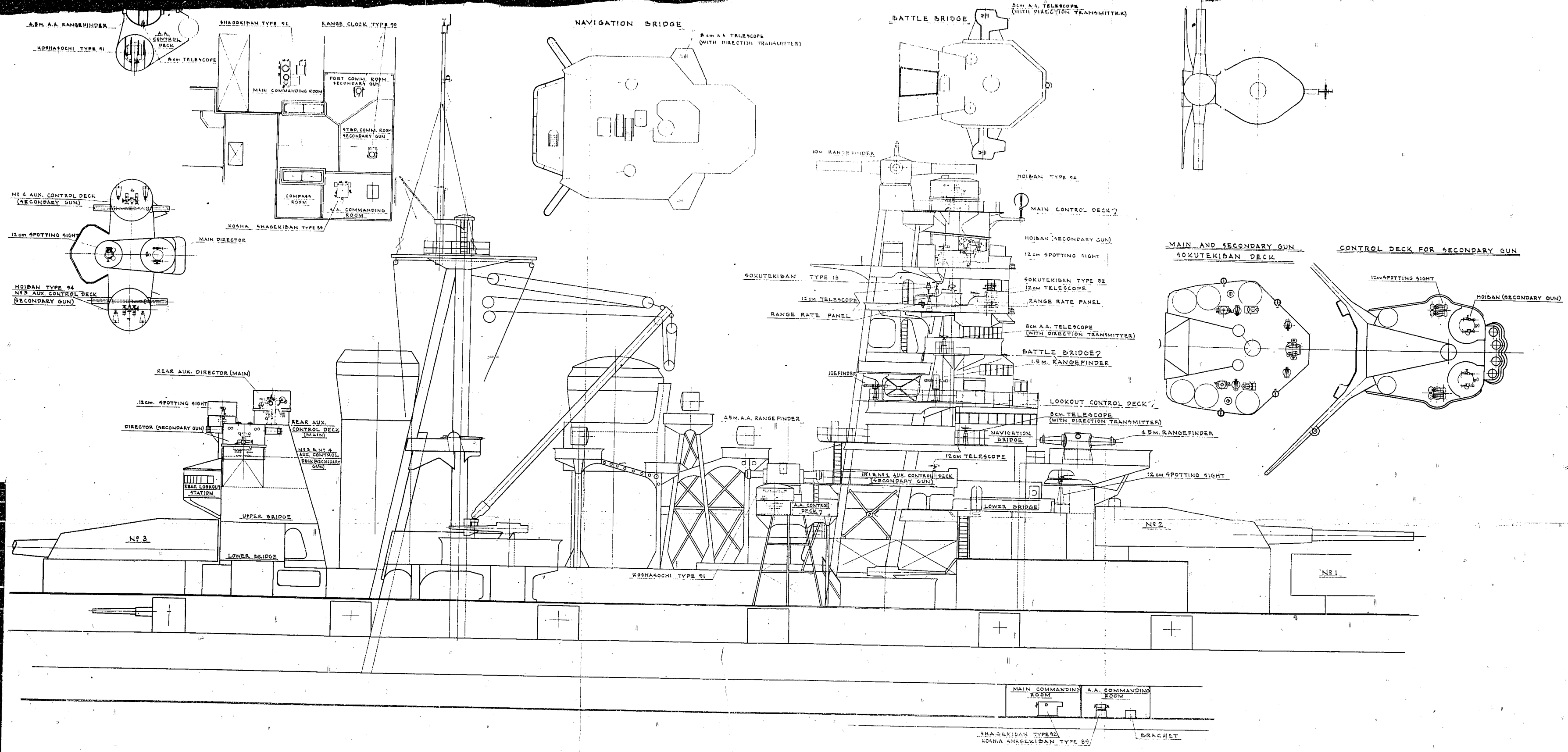


Figure 2(A)

BRIDGE AND CHIMNEY ARRANGEMENT, B.B. KONGO

COMMANDING STATION

REAR LOOKOUT DECK

GUN SUPPORT FOR 12.7 A.A.

REAR MAST

LOOKOUT DIRECTION PANEL

Nº2-12.7 cm TWIN A.A. GUN

AMMUNITION HOIST

12 cm. SPOTTING SIGHT FOR MAIN GUN

Nº1 12.7cm TWIN A.A. GUN

Nº1 & Nº2 AUX. CONTROL STATION

DIRECTOR FOR SECONDARY GUN

12cm SPOTTING SIGHT

3.5m. RANGE FINDER

13mm QUAD. M. G. TYPE 93

12cm TELESCOPE

FOR'D SEARCHLIGHT PLATFORM

MACHINE GUN DECK

SMOKE STACK

Nº2-13mm QUAD. M. G.

A.A. CONTROL DECK & LOWER LOOKOUT DECK

40mm TWIN M.G. TYPE VICKERS

REAR AUX. CONTROL DECK FOR MAIN GUN AND Nº3 & Nº4 AUX. CONTROL DECK FOR SECONDARY GUN

DIRECTOR FOR SECONDARY GUN

12cm SPOTTING SIGHT

DIRECTOR FOR MAIN GUN

12cm SPOTTING SIGHT

REAR A.A. GUN DECK

Nº3 & Nº4 AUX. CONTROL DECK FOR SECONDARY GUN

DIRECTOR FOR SECONDARY GUN

DIRECTOR FOR MAIN GUN 12cm SPOTTING SIGHT

REAR AUX. CONTROL STATION FOR MN. GUN

12.7cm TWIN A.A. GUN TYPE 89

REAR A.A. GUN DECK

LOOKOUT DIRECTION PANEL

Nº4-12.7cm TWIN A.A. GUN

3.5m RANGEFINDER

12.7 A.A. MUNITION HOIST

Nº3-12.7cm TWIN A.A. GUN

Nº5

Nº4

LOOKOUT DI

15cm TELES

LOOKOUT DIRE

7.7mm M.G. TYP

1.5m RANGEFINE

KOMAMOCHI TYPE 9

VERTICAL DEFLECTION MEA

6cm TELESCOPE

4.5 m A.A. RANGEFINDER

SOKUTE

SEARCH

12 cm

SOKUTEI

40mm TWIN

TYPE VIC

COMMANDING STATION

REAR LOOKOUT DECK

GUN SUPPORT FOR 12.7 A.A.

REAR MAST

LOOKOUT DIRECTION PANEL

No 2 - 12.7 cm TWIN A.A. GUN.

AMMUNITION HOIST

12 cm. SPOTTING SIGHT FOR MAIN GUN

No 1 12.7cm TWIN A.A. GUN

No 1 & No 2 AUX. CONTROL STATION

DIRECTOR FOR SECONDARY GUN

12 cm SPOTTING SIGHT

3.5 m. RANGE FINDER

13mm QUAD. M.G. TYPE 93

BATTLE BRIDGE

12cm TELESCOPE

FOR'D SEARCHLIGHT PLATFORM

MACHINE GUN DECK

SMOKE STACK

No 2 - 13 mm QUAD. M.G.

A.A. LOOKOUT DIRECTION PANEL

A.A. CONTROL DECK & LOWER LOOKOUT DECK

40mm TWIN M.G. TYPE VICKERS

REAR AUX. CONTROL DECK FOR MAIN GUN AND No 3 & No 4 AUX. CONTROL DECK FOR SECONDARY GUN

DIRECTOR FOR SECONDARY GUN

12cm SPOTTING SIGHT

DIRECTOR FOR MAIN GUN

12cm SPOTTING SIGHT

LOOKOUT DIRECTION PANEL

12cm TELESCOPE

LOOKOUT DIRECTION PANEL

7.7mm M.G. TYPE LEWIS

1.5m. RANGEFINDER

KOSHASOCHI TYPE 91

VERTICAL DEFLECTION MEASURING PANEL

8cm TELESCOPE

4.5 m. AA RANGEFINDER

LOOKOUT DIRECTION PANEL

12cm SPOTTING SIGHT

No 3 & No 4 AUX. CONTROL DECK FOR SECONDARY GUN

DIRECTOR FOR SECONDARY GUN

DIRECTOR FOR MAIN GUN

12cm SPOTTING SIGHT

REAR AUX. CONTROL STATION FOR MN. GUN

3.5m RANGEFINDER

12.7cm TWIN A.A. GUN TYPE 89

REAR A.A. GUN DECK

LOOKOUT DIRECTION PANEL

REAR A.A. GUN DECK

No 4 - 12.7cm TWIN A.A. GUN

3.5 m. RANGEFINDER

12.7 A.A. MUNITION HOIST

No 5 - 12.7cm TWIN A.A. GUN

SOKUTEKIBAN DECK AND SEARCHLIGHT CONTROL DECK

SOKUTEKIBAN TYPE 92

RANGE RATE PANEL

12 cm TELESCOPE

RANGE RATE PANEL

12cm TELESCOPE

12cm TELESCOPE

SOKUTEKIBAN TYPE 13

40mm TWIN M.G. TYPE VICKERS

No 4

No 5

MAIN SPOT

UPPER PART

DECK FOR

3.5m RANGEFINDER

140 136 132

BRITISH DELIVERY ARRANGEMENT, AS PAVAC

BRIDGE

MAIN SPOTTING DECK

MAIN DIRECTOR DECK

SOKUTEKIBAN DECK

15cm SPOTTING SIGHT

MAIN DIRECTOR

8m. DOUBLE RANGEFINDER

UPPER PART OF CONTROL DECK FOR SECONDARY GUN

3.5m. RANGEFINDER

9m DOUBLE RANGE FINDER

DIRECTION ANTENNA

MAIN DIRECTOR

MAIN RANGEFINDER DECK?

MAIN DIRECTOR DECK?

MAIN SPOTTING DECK?

DIRECTOR FOR SECONDARY GUN

LOOKOUT DIRECTION PANEL

UPPER LOOKOUT DECK & CONTROL?

DECK FOR SECONDARY GUN

SOKUTEKIBAN TYPE 92

RANGE RATE PANEL, TYPE B

12 cm. TELESCOPE

SOKUTEKIBAN DECK & ?

SEARCHLIGHT CONTROL DECK

BATTLE BRIDGE?

FOR'D SEARCHLIGHT PLATFORM?

12cm TELESCOPE

LOOKOUT DIRECTION PANEL

7.7 m M.M

A.A. CONTROL DECK?

DIRECTOR FOR SECONDARY GUN

3.5m RANGEFINDER TYPE 93

NAVIGATION BRIDGE?

13 mm QUADRUPLE M.G TYPE 93

No 1 & 2 AUX. CONTROL STN.

12 cm SPOTTING SIGHT FOR MAIN GUN

COMMANDING STATION?

No 2

No 3

UPPER LOOKOUT DECK & CONTROL DECK FOR SECONDARY GUN

3.5 m. RANGE FINDER RANGE RATE PANEL

12 cm TELESCOPE LOOKOUT DIRECTION PANEL

SOKUTEKIBAN TYPE 13

12 cm TELESCOPE

RANGE RATE PANEL

12 cm TELESCOPE

P.A. LOOKOUT DIRECTION PANEL

LOOKOUT DIRECTION PANEL

12cm SPOTTING SIGHT

SOKUTEKIBAN DECK AND SEARCHLIGHT CONTROL DECK

SOKUTEKIBAN TYPE 92

RANGE RATE PANEL

12 cm TELESCOPE

RANGE RATE PANEL

12cm TELESCOPE

TELESCOPE

SOKUTEKIBAN TYPE 13

mm QUADRUPLE M.G.

.5 m A.A RANGE FINDER

8 cm TELESCOPE

MEASURING PANEL

KOSHIKEIKI TYPE 91

7.5 m RANGE FINDER

12 cm TELESCOPE

12.7 cm A.A GUN TYPE 89

L.W.L

140 136 132 128 124 120 116 112 108 104 100 96 92 88 84 80 76 72

ARRANGEMENT, BB YAMASHIRO

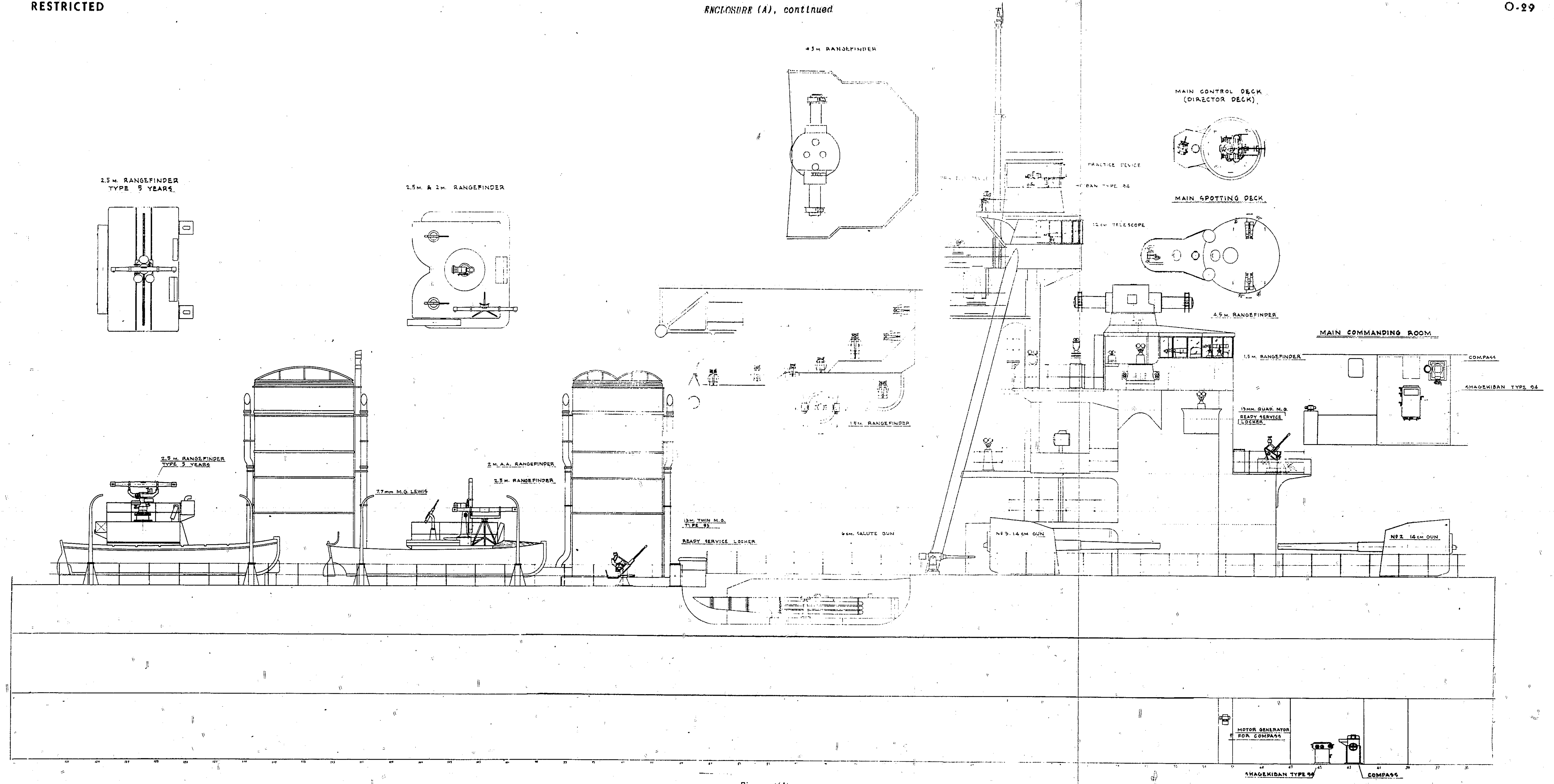
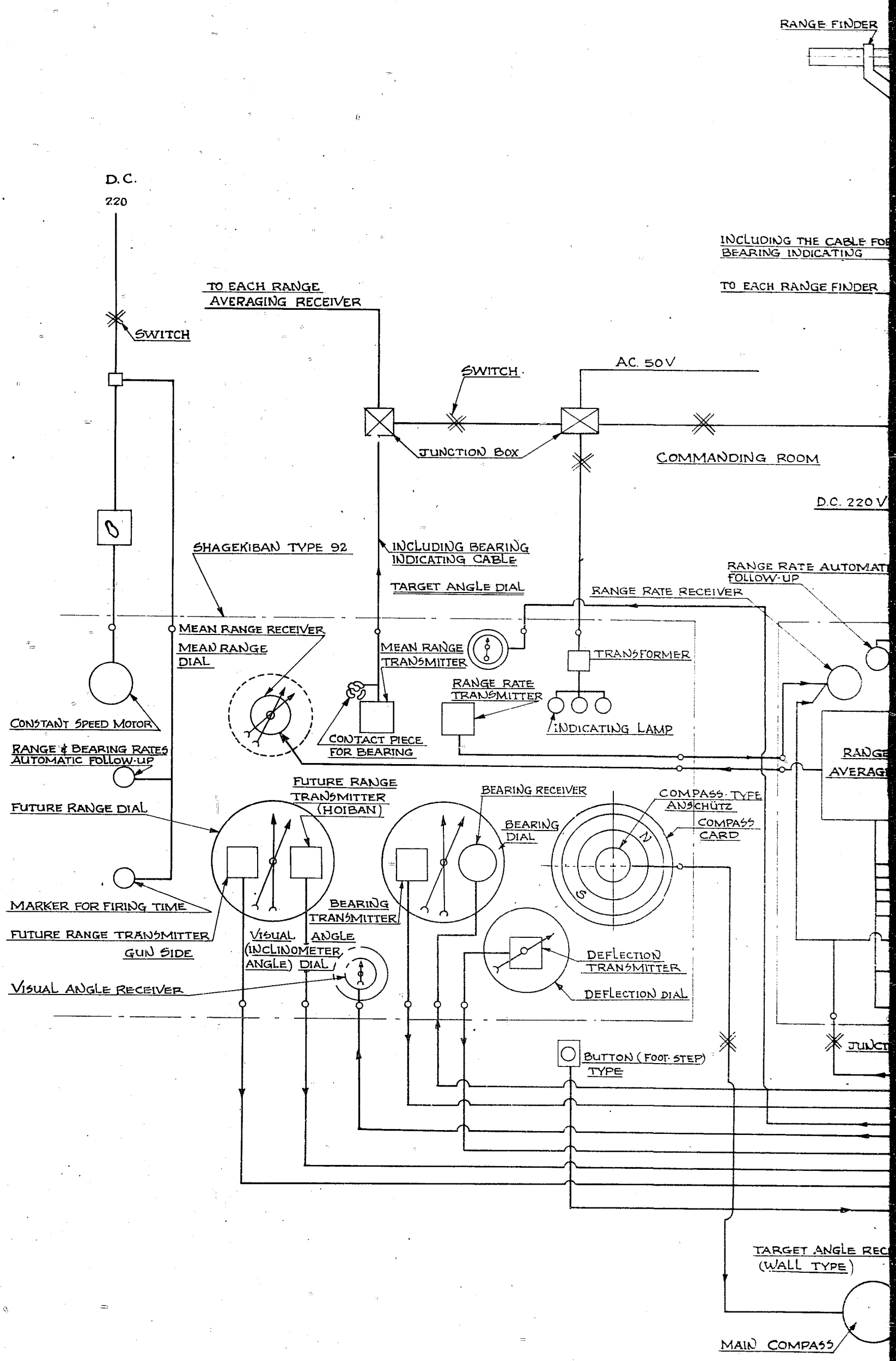


Figure 4(A)

BRIDGE AND GUNNERY ARRANGEMENT, CL ABUKUMA

RESTRICTED

ENCLOS



ELECTRICAL WIRING

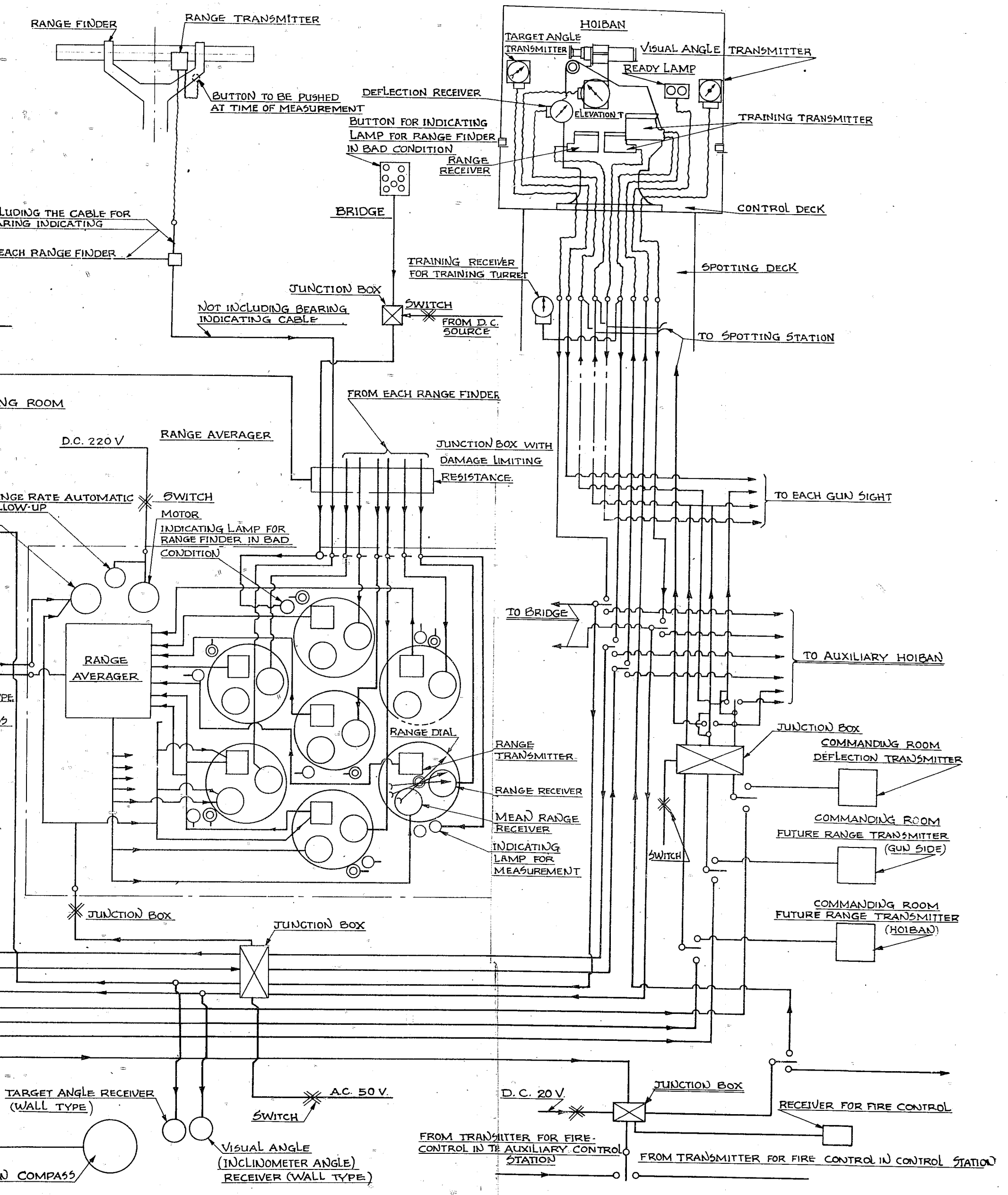


Figure 5(A)

ELECTRICAL WIRING DIAGRAM OF TYPE 92 SHAGEKIBAN

ENCLOSURE (B)

LIST OF EQUIPMENT SHIPPED TO ORDNANCE INVESTIGATION LABORATORY, INDIAN HEAD. Md.

NavTechJap Equipment No.	Item
JE21-3401	Azimuth Transmitter, Right, Type 92 Mod 2.
JE21-3402	Azimuth Transmitter, Left, Type 92 Mod 2.
JE21-3403	Selsyn Kit, Type 98 Mod 5.
JE21-3404	Wing Velocity Meter Indicator, Type 91 Mod 1.
JE21-3406	Deflection Slide Rule (With 8cm Using Type 89 Pointed AA Fuze).
JE21-3410-1 Thru - 4	Selsyn, Mod 3.
JE21-3411-1 Thru - 5	Selsyn, Type 2 Mod 1. (Deflection Transmitter for Gun Sight).
JE21-3412-1 Thru - 5	Selsyn, Type 98 Mod 5.
JE21-3413	Differential Selsyn, "Big" size.
JE21-3414	Differential Selsyn, "Small" size.

ENCLOSURE (C)

LIST OF JAPANESE DOCUMENTS FORWARDED TO THE WASHINGTON DOCUMENT CENTER

NavTechJap No.	Title	ATIS No.
ND21-3408	Mark Ro500 Submarine 10.5cm Trunnion Tilt Indicator	3943
ND21-3431	Experimental Long Range Bearing Repeater	3947
ND21-3432	Experimental Long Range Bearing Repeater	3948
ND21-3433	Dead-Time Computer	3949
ND21-3450	Experimental Manufacturing and Design of Range Averager (1932)	3957
ND21-3451	Abstract on Type 98 Gyro Compass (1940)	3958
ND21-3453-1	Type 96 Mod 1 90cm Searchlight	3960
ND21-3453-2	Type 96 Mod 1 110 Searchlight	3960
ND21-3453-3	Type 96 Mod 1 Searchlight Director	3960
ND21-3453-4	Type 96 Mod 2 Searchlight Director	3960
ND21-3454-1	3.5-meter Type 93 Rangefinder, Book A	3962
ND21-3454-2	3.5-meter Type 93 Rangefinder, Book B	3962
ND21-3455-1	4.5-meter Type 93 Rangefinder (1938)	3963
ND21-3455-2	4.5-meter Type 93 Rangefinder (1936)	3963
ND21-3456	Method of Seeing Halving Line in Rangefinder at Night	3964
ND21-3457	3-meter Type 90 Mod 2 Rangefinder	3965
ND21-3458	Model of Comparing Tests of Anti-Thermal Device for Rangefinder	3966
ND21-3459	10-meter Type 94 Mod 2 Rangefinder	3967
ND21-3460	Report on Anti-Vibration Test for Rangefinder (Using Red Rubber)	3968
ND21-3461	3-meter Type 89 Rangefinder	3969
ND21-3462	10-meter Type 3 Rangefinder	3970
ND21-3463-1	Automatic Regulator to Avoid Heat Effect on Rangefinder	3971
ND21-3463-2	Investigation of Heat Effect on Rangefinder	3971
ND21-3464	Experimental Design 2-meter Type 89 Rangefinder	3972
ND21-3465	Notes on 8-meter Rangefinder and Tower (BB Design)	3973
ND21-3467-1	General Description of 25mm Gun Sight (LPR)	3975

ENCLOSURE (C), continued

NavTechJap No.	Title	ATIS No.
ND21-3467-2	Construction and Design of 25mm Gun Sight (LPR)	3975
ND21-3468	Device to Convert Spotting Data of Spotting Ship to Correct Values for Firing Ship	3976
ND21-3469	Fine Measurement for Fall of Projectile	3977
ND21-3470-1	Investigation of Lateral Spotting Photography	3978
ND21-3470-2	Photographic Investigation of Lateral Accuracy of Fall of Projectile	3978
ND21-3470-3	Experiment on Automatic Shutter for Lateral Spotting Camera	3978
ND21-3471-1	10cm Gun Sight Mod 1 (April 1936)	3979
ND21-3471-2	10cm Gun Sight Mod 1 (February 1936)	3979
ND21-3472	6cm Inclinometer	3980
ND21-3473	Experiment of Improved Halving Glass for Range Rate Calculator Inclinometer Type II	3981
ND21-3474	Experimental Design of Gun Turret Sight	3982
ND21-3475-1	Anti-Vibration Device for 12cm Binocular Sight (1936)	3983
ND21-3475-2	Experiment on Reducing Vibration Effect on 12cm Spotting Glass (May 1931)	3983
ND21-3475-3	Effect of Rigidity and Weight on 12cm Spotting Sight to Reduce Vibration (December 1931)	3983
ND21-3476	Experimental Results of Luminous Paint on Submarine Gun Sights	3984
ND21-3477	Automatic Steering Recorder	3985
ND21-3478	Investigation on Night Spotting	3986
ND21-3484	Accuracy and Efficiency of Simplified Differential Gear in Directors	3992
ND21-3485	Range Clocks Report (Type 90, Type 11, & Type 10, (1921))	3993
ND21-3486	Data on Mechanical Play and Torque of TAKAO (CA)	3994
ND21-3487	Effect of Play and Torque on Accuracy of Directors	3995
ND21-3488	Notes on Effects of Mechanical Play on Roll Corrector of Destroyer Director	3996
ND50-3000	Automatic Follow-Up, AICHI Clock Company	3901
ND50-3001	Range Averager Device Type 92	3902

ENCLOSURE (C), continued

NavTechJap No.	Title	ATIS No.
ND50-3002	F.A. Torque Amplifier	3903
ND50-3003-1	German Co-Ordinate Transformer	3904
ND50-3003-2	German Co-Ordinate Transformer	3904
ND50-3004	Type 94 Air Follow-Up	3905
ND50-3005	Type 95 SHAGEKI SOCHI (Gear Train)	3906
ND50-3013	Gyro Compass Material	3914
	KOSHA SOCHI Type 94	
ND50-3015-1	Magnetic Clutch Type F.U.	3916
ND50-3015-2	Daily Corrections	3916
ND50-3015-3	Co-Ordinate Coverter	3916
ND50-3015-4	Range Difference Device	3916
ND50-3015-5	Notations for Equations	3916
ND50-3015-6	Range Ratio F.U.	3916
ND50-3015-7	Range Ratio (Ind)	3916
ND50-3015-8	Co-Ordinate Converter	3916
ND50-3015-9	Parallax Mechanism	3916
ND50-3015-10	Vertical Deflection	3916
ND50-3015-11	Lateral Deflection	3916
ND50-3015-12	Future Range and Rate Mechanism	3916
ND50-3015-13	Schematic Diagram	3916
	KOSHA SHAGEKIBAN Type 94	
ND50-3015-14	Schematic Diagram	3916
ND50-3015-15	Schematic Diagram (Gear Train)	3916
	KOSHAKI Type 94	
ND50-3015-16	Schematic Diagram	3916
	KOSHA SOCHI Type 94	
ND50-3015-17	Notes upon Construction	3916
ND50-3027	Gyro Horizon Type 4	3900