

No. : OM-E2206-3E

# FURUNO

# OPERATOR'S MANUAL

NAVIGATIONAL ECHOSOUNDER

MODEL F-851SD



**FURUNO ELECTRIC CO., LTD.**  
**NISHINOMIYA, JAPAN**

851210J(85D)

PRINTED IN JAPAN

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SPECIFICATIONS OF F-851SD  
NAVIGATIONAL ECHOSOUNDER

1. DEPTH RANGES, SOUNDING RATES & PAPER SPEED

Depth Ranges (meters)	Sounding Rates (/min.)	Paper Speed (mm/min.)	
		Fast	Slow
0- 40, 30- 70	310	12.8	6.4
0- 80, 60-140	155	6.4	3.2
0-200, 150-350	62	2.6	1.3
0-400, 300-700	31	1.3	0.7

2. MAX. SOUNDING (Under favorable conditions. Guidance only)

50kHz:700m, 200kHz:400m

3. RECORDING SYSTEM & RECORDING PAPER

Belt straight line recording system  
Dry electrosensitive paper PD-2020: 204mm x 20m  
Effective width 180 mm

4. TRANSMITTER CHARACTERISTICS

Frequency: 50KHz or 200kHz  
Pulse length: 0.3ms  
Output power: 100W

5. TRANSDUCER

Ceramic transducer  
Type 50B-9, 50B-6 (50kHz) or 200B-8 (200kHz)

6. POWER SUPPLY

- 1) AC110V/220V, 50/60Hz, 1 $\phi$   
(50/60Hz---Different gear used)
- 2) DC24V, external DC-AC inverter is needed.

7. RECOMMENDED COMPASS SAFE DISTANCE

	STANDARD	STEERING
NORMAL	1.10 m	0.85 m
REDUCED *	0.90 m	0.65 m

\*May be applied to coastal boats.

COMPLETE SET

Standard Supplies

No.	Name	Q'ty	Dimensions (mm)	Weight (Kg)	
1	Recorder *	1	Bulkhead Mount	410 x 530 x 202	35
			Flush Mount	518 x 640 x 218	43
2	Transducer with 15m Cable & Tank *	1			
			TTS-5000-2 (50B-9)		
			TTS-5600-2 (50B-6)		
			TTS-2000-2 (200B-8)		
3	Installation Materials	1 set			
4	Spare Parts	1 set			
5	Spare Parts Box, JIS F0902 (23-20)	1	355 x 220 x 205	3.6	

Optional Supplies

- Junction Box\*\*
- Matching Box\*\*
- Transducer Switch Box
- ED-202 Digital Depth Indicator
- DC-AC Static Inverter TR-110 (Input DC 24V)

- \* Specify necessary type.
- \*\* Junction Box is required for extension of transducer cable. Matching Box is required instead of Junction Box when transducer cable length exceeds 100m. Specify necessary quantity.

INSTALLATION MATERIALS

(Supplied only for bulkhead mount type recorder.)

Name	Type	Q'ty
Bracket with Bolt		3
Rubber Packing		6
Washer		3
Hex. Nut	M10	3

STANDARD SPARE PARTS & TOOLS

Name	Q'ty
Recording Belt	1 pc.
Recording Stylus Assy.	2 pcs.
Collector Stylus Assy.	2 pcs.
Stylus Nib	10 pcs.
Fuse 1A	2 pcs.
Lamp (Winker type, 6V, 1.5W)	6 pcs.
Recording Paper (PD-2020)	4 rolls One roll fitted in recorder.
Screwdriver (+head, large)	1 pc.
Screwdriver (+head, small)	1 pc.
Long Nose Pliers	1 pc.
Adjustable Spanner	1 pc.
Machine Oil	1 pot
Grease	1 tube

## CHAPTER 1. INSTALLTION

## 1-1. Recorder Unit

There are two types of recorder unit: bulkhead and flush mount type. This unit is generally mounted on the bulkhead in the steering bridge where is dry, well ventilated and waterprrof location considering easy access to the unit and effective observation of the recordings.

The bulkhead mount type unit is fixed with three installation brackets (bolt welded) and nuts as in Dwg.No.C2206-035-A (page 1-5). As for the flush mount type, cut out the panel as in Dwg.No.C2206-036-A (page 1-6), and then settle the unit with screws or bolts and nuts.

## 1-2. Cabling

Cabling is very simple, requiring connection of the power and transducer cables on the terminal board. Refer to Dwg.No.C2206-052-C on page 1-4. For combination with the ED-202 Digital Depth Indicator, refer to the separate Operator's Manual for ED-202.

## 1-3. Transducer Tank

The transducer tank including the transducer is fixed to the flange with bolts and nuts so that the transducer face is flush with the hull bottom (hull bottom interior installation).

The installation of the transducer and the tank should be accomplished by a dockyard referring to the installation drawings. See pages 1-10, 1-11 and 1-12.

NOTE: Discussions should take place and agreement reached with the dockyard for sufficient reinforcement and watertightness of the hull to comply with the regulations concerned.

To decide the location of the transducer, the following points should be taken into account.

1. The most important point is the selection of the transducer position. There should be free from aeration possibly occurring beneath the transducer and also not effected so much by engine and propeller noise.
2. This is not always true, but gives one point to be consid-

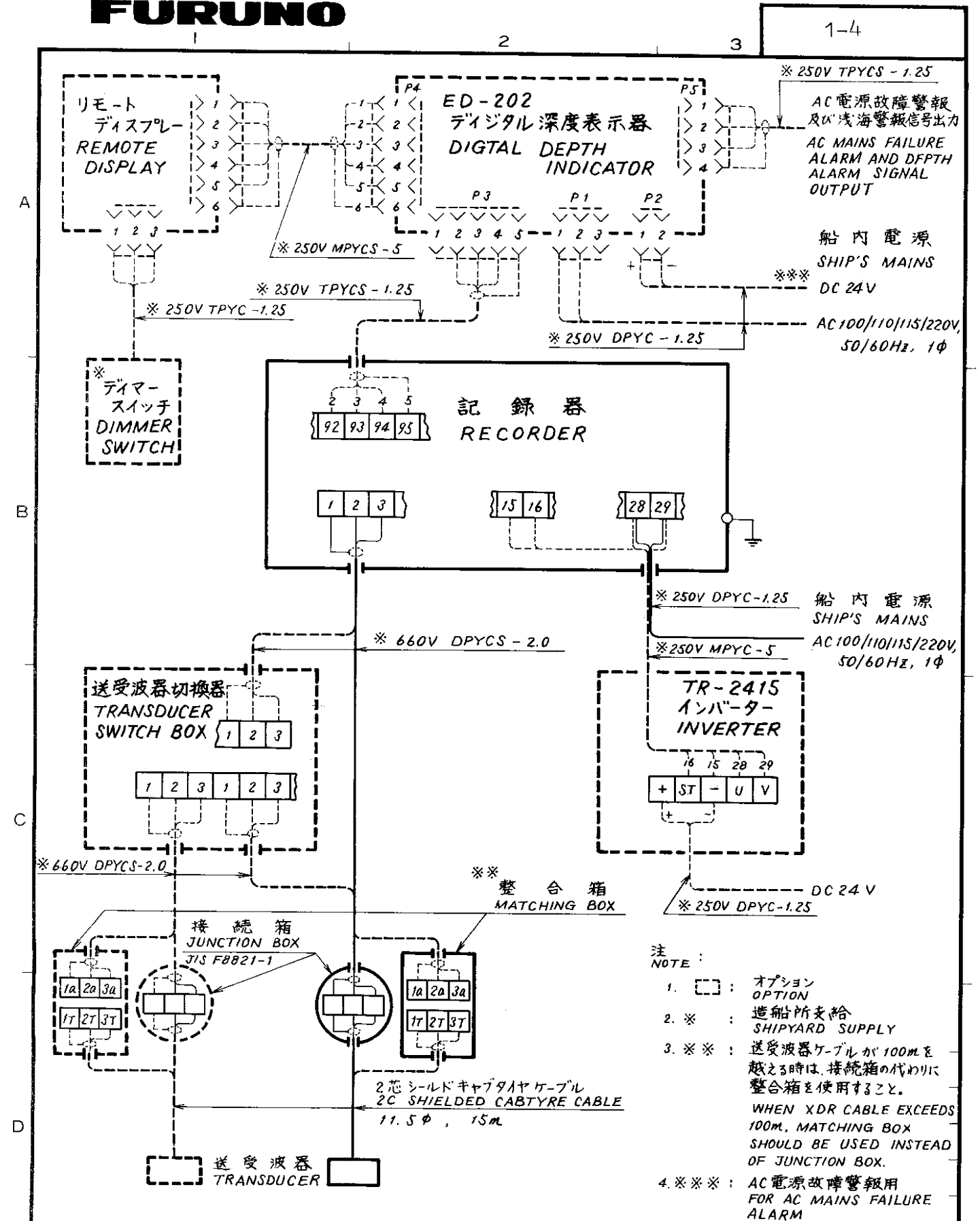
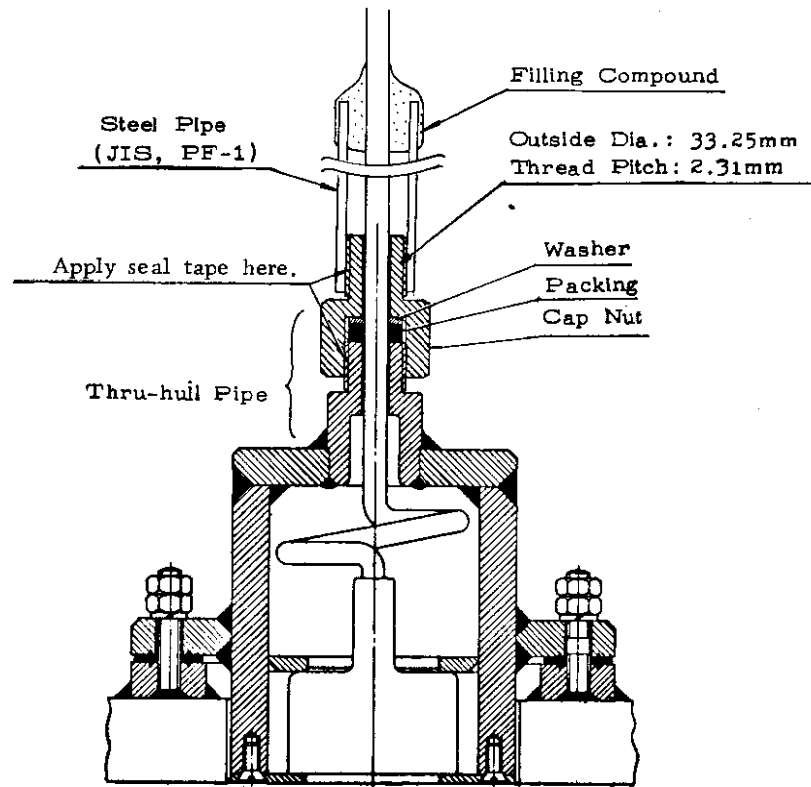
ered. Air bubble stream starts about a quarter length from the stem, and drives about three quarters.

Air bubble stream varies in form and intensity according to ship's speed, draught, trim, shape of bow and hull, as well as a sea state.

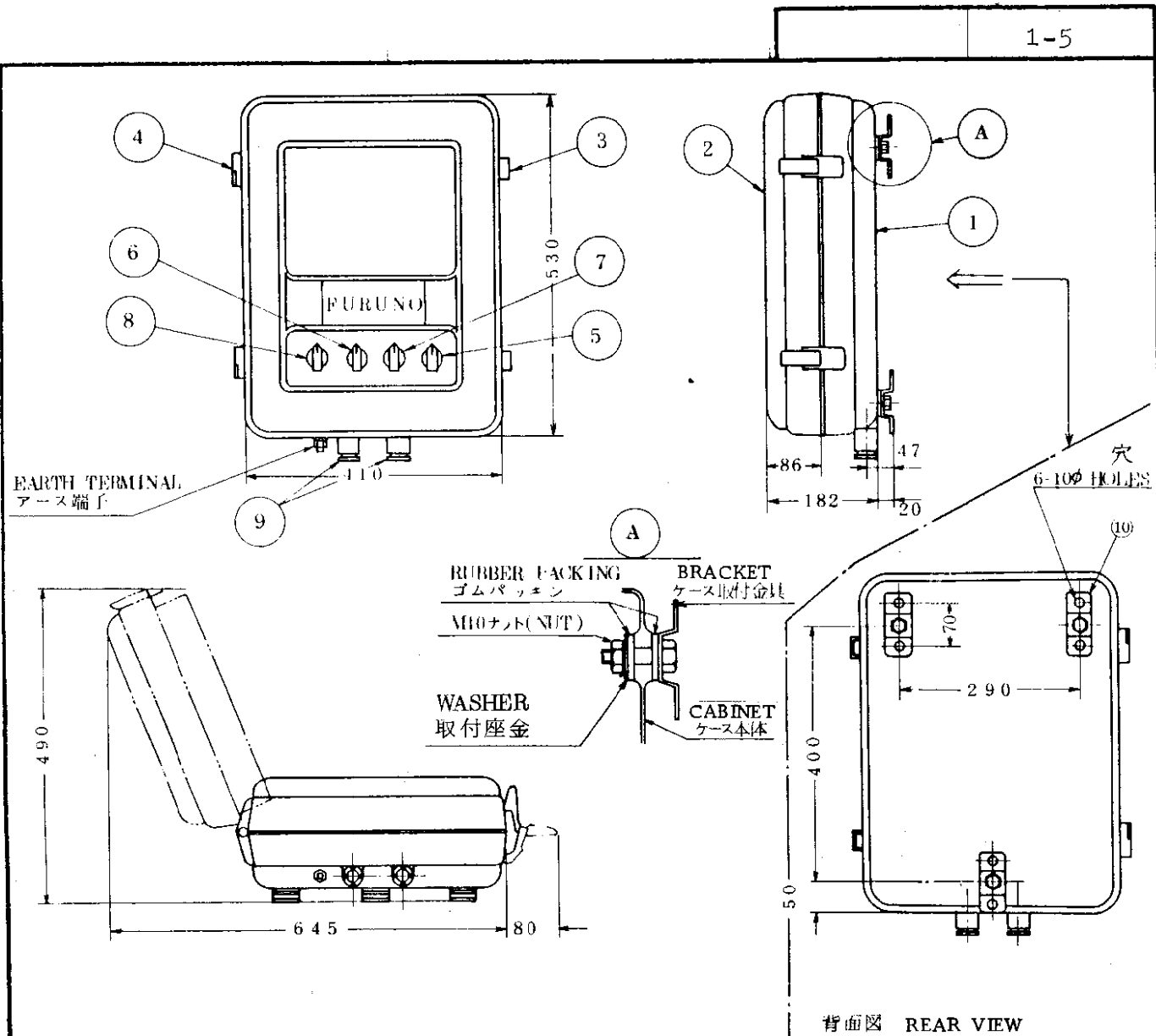
In a certain laden ship, a position somewhere near a quarter of the ship's length from the stem is found to give satisfactory results.

With ships making long voyages in ballast, however, such as oil tankers, because of the light draught forward an after position about three quarters of the ship's length from the stem is often most suitable.

3. It is recommended to install the transducer on or off the keel line; between 600mm and 900mm from the keel to minimize the effect of aerated water.
4. Siting near obstructions such as the forward propeller, bow thruster, water intake pipes and speed log sensor should be avoided.
5. Select a place giving a minimum mechanical vibration.
6. Do not lay the transducer cable near or in parallel with other electric cables.
7. To extend the transducer cable, junction box and an optional shielded 3C Cable (ex. 660V DPYCS-2.0) are required.
8. When the transducer cable length exceeds 100m, a matching box is required instead of junction box. It should be installed as near the transducer as possible.
9. It is recommended to enclose the transducer cable in conduit or pipe for waterproof purpose and electrical shield. The conduit should be secured on the upper section of the thru-hull pipe. The pipe should run above the water level when the ship is fully loaded. The top end should be finished with filling compound.
10. Apply seal tape to the threads of pipe for watertightness. Also apply filling compound to the end of the steel pipe of the thru-hull pipe.
11. Never tighten the cap nut too much. Excessive tightening may cause the cable to be damaged. Normally the cap nut should be screwed up by hand and then tightened about two turns with a spanner.



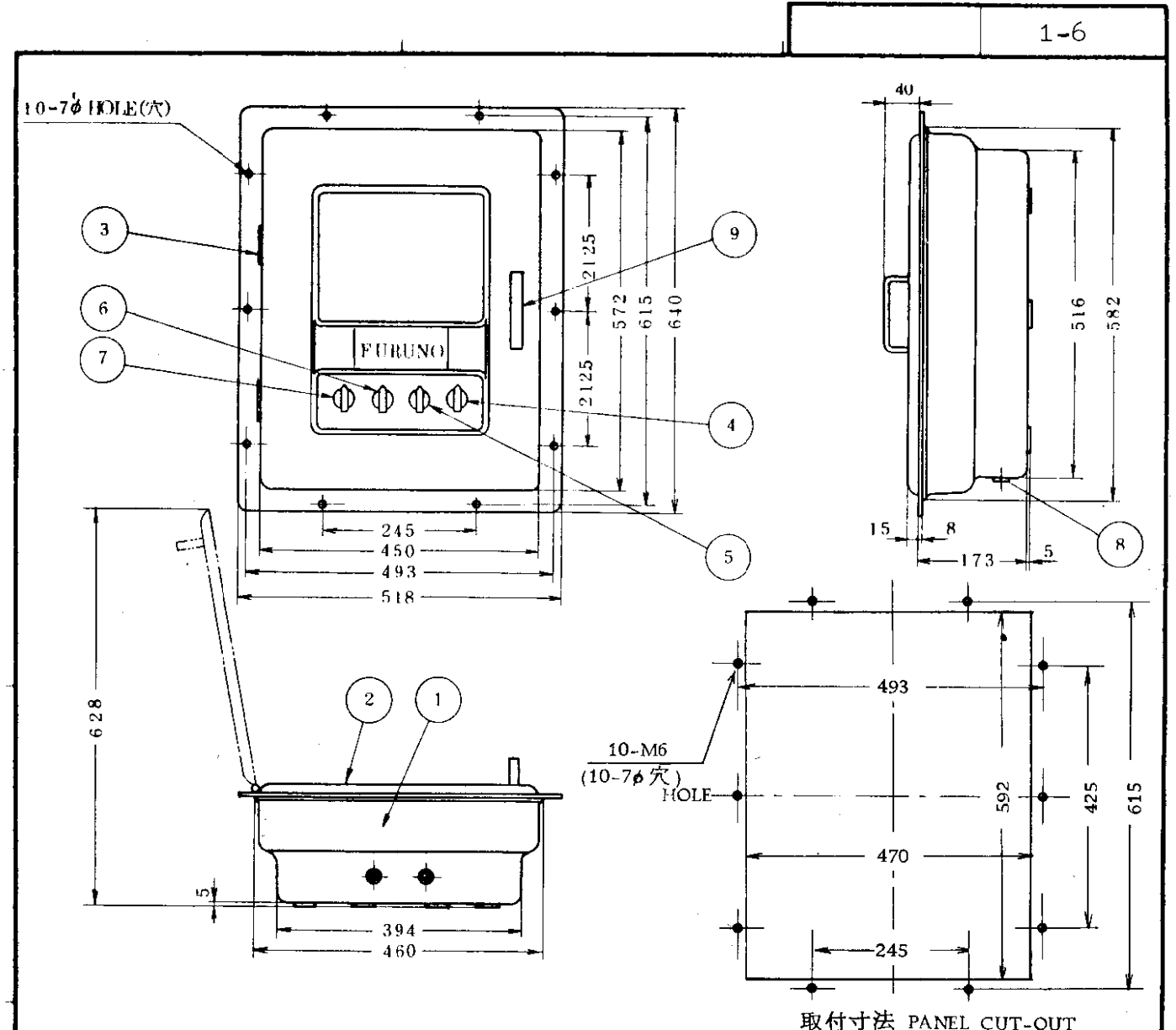
品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS
承認 APPROVED	Nov. 17 '80	三角法 THIRD ANGLE PROJECTION			名称 TITLE
検図 CHECKED	Nov. 17 '80	尺度 SCALE			F-851SD 相互結線図 CABLING DIAGRAM
製図 DRAWN	Nov. 17 '80	重量 WEIGHT	kg	図番 DWG.NO.	C2206-052-C



背面図 REAR VIEW

10	ケース取付金具 BRACKET WITH BOLT	SUS304	3		
9	電線貫通金物 CABLE GLAND		2		JIS F8801-A20b
8	感度調整 GAIN CONTROL	フェノール樹脂 SYNTH. RESIN	1		
7	電源及び深度切換 SOURCE & RANGE SWITCH	フェノール樹脂 SYNTH. RESIN	1		
6	判別調整 WHITE-LINE CONTROL	フェノール樹脂 SYNTH. RESIN	1		
5	照度調整 ILLUMINATION CONTROL	フェノール樹脂 SYNTH. RESIN	1		
4	蝶番 HINGE	SUS304	2		
3	鍵 LOCK	SUS304	2		
2	ケース蓋 CABINET DOOR	AC7A-F	1		
1	ケース本体 CABINET	AC7A-F	1		

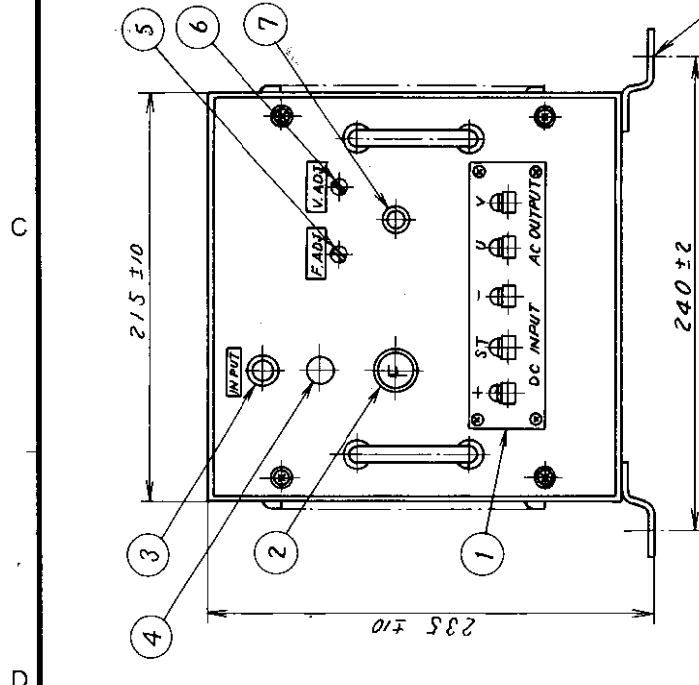
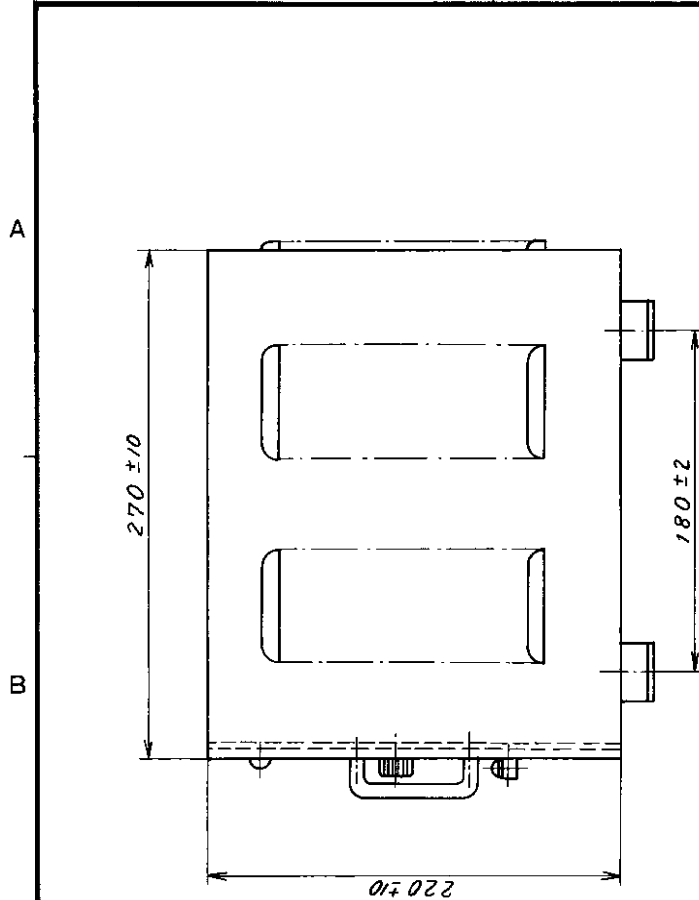
品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	備用 REMARK
課長 APPROVED		尺度 SCALE	1/10	名称 F-851SD 記録器外觀図 (壁掛型)	
検図 CHECKED		図法 DRAWING	三角法 TRIGON	RECORDER OUTLINE DRAWING (BULKHEAD MOUNT)	
製図 DRAWN		重量 WEIGHT	35 kg	図番 DWG. NO.	C2206-035-A



取付寸法 PANEL CUT-OUT

9	把柄 HANDLE	手 ZD1	1		
8	ゴムブッシュ RUBBER BUSH	合成ゴム RUBBER	2		内径 INN. DIA. 15φ
7	感度調整 GAIN CONTROL	フェノール樹脂 SYNTH. RESIN	1		
6	判別調整 WHITE-LINE CONTROL	フェノール樹脂 SYNTH. RESIN	1		
5	電源及び深度切換スイッチ SOURCE & RANGE SWITCH	フェノール樹脂 SYNTH. RESIN	1		
4	照度調整 ILLUMINATION CONTROL	フェノール樹脂 SYNTH. RESIN	1		
3	蝶番 HINGE	SUS304	2		
2	ケース蓋 CABINET DOOR	AC7A-F	1		
1	ケース本体 CABINET	AC7A-F	1		

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	備用 REMARK
課長 APPROVED		尺度 SCALE	1/10	名称 F-851SD 記録器外觀図 (埋込型)	
検図 CHECKED		図法 DRAWING	三角法 TRIGON	RECORDER OUTLINE DRAWING (FLUSH MOUNT)	
製図 DRAWN		重量 WEIGHT	4.3 kg	図番 DWG. NO.	C2206-036-A



取付穴 4-6.5φ  
FIXING HOLE

インバーター型式及びヒューズリスト

LIST OF INVERTER TYPES AND FUSES.

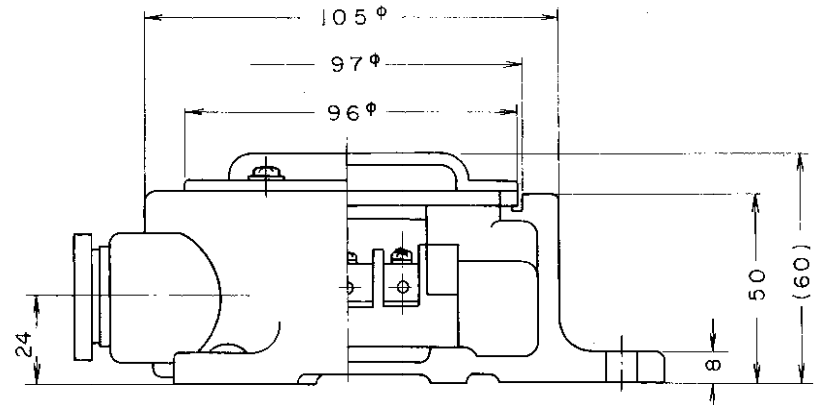
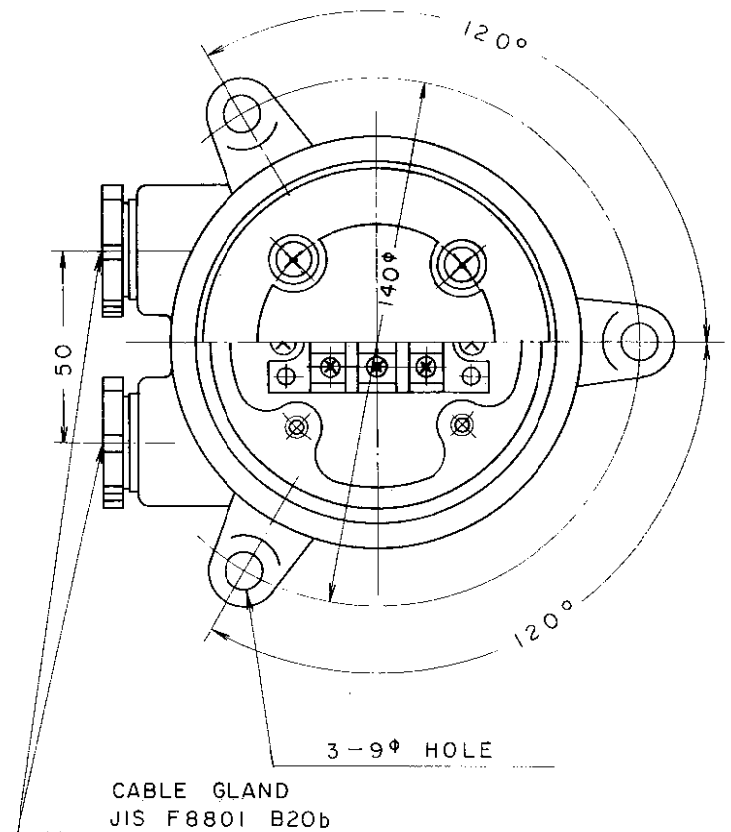
型式 TYPE	入力電圧 INPUT VOLTAGE	出力電圧 OUTPUT VOLTAGE	ヒューズ FUSE	
			F1	F2
TR1215	DC12V	AC100V	20A	3A
TR2415	DC24V	AC100V	10A	3A
TR3215	DC32V	AC100V	10A	3A
TR1015	DC100V	AC100V	3A	3A

番号 No.	品名 NAME
①	入出力端子板 (5 端子) TERMINAL BOARD (5.P)
②	ヒューズ F1 (入力用) FUSE (FOR INPUT)
③	入力指示ランプ PILOT LAMP
④	過電圧保護回路リセットスイッチ RESET SWITCH FOR OVERVOLT PROTECTOR
⑤	周波数調整ポット FREQUENCY ADJUSTOR POT.
⑥	出力電圧調整ポット OUTPUT VOLTAGE ADJUSTOR POT.
⑦	ヒューズ F2 (出力用) FUSE (FOR OUTPUT)

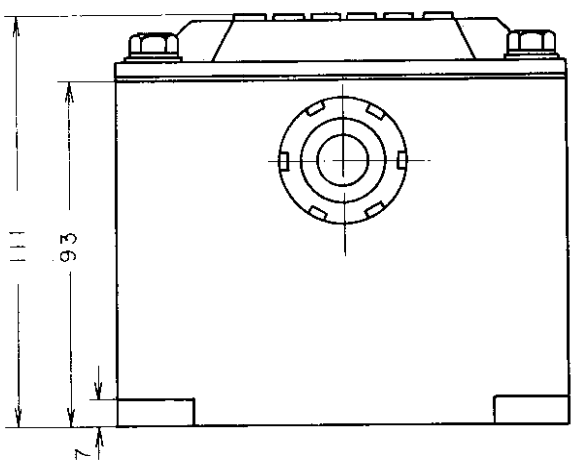
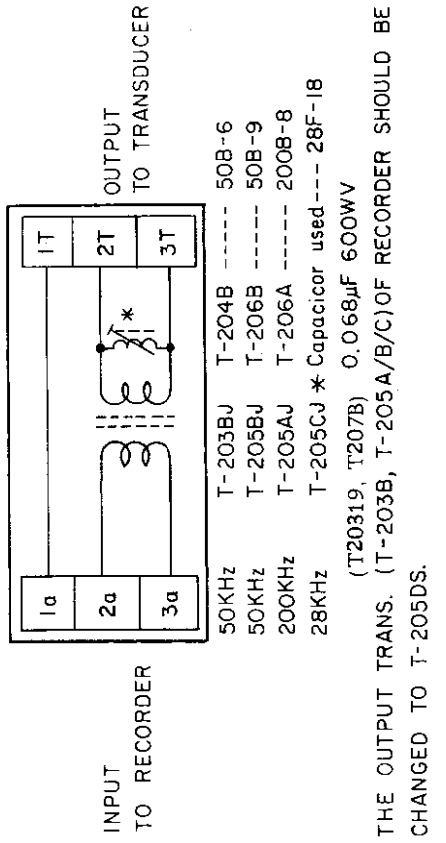
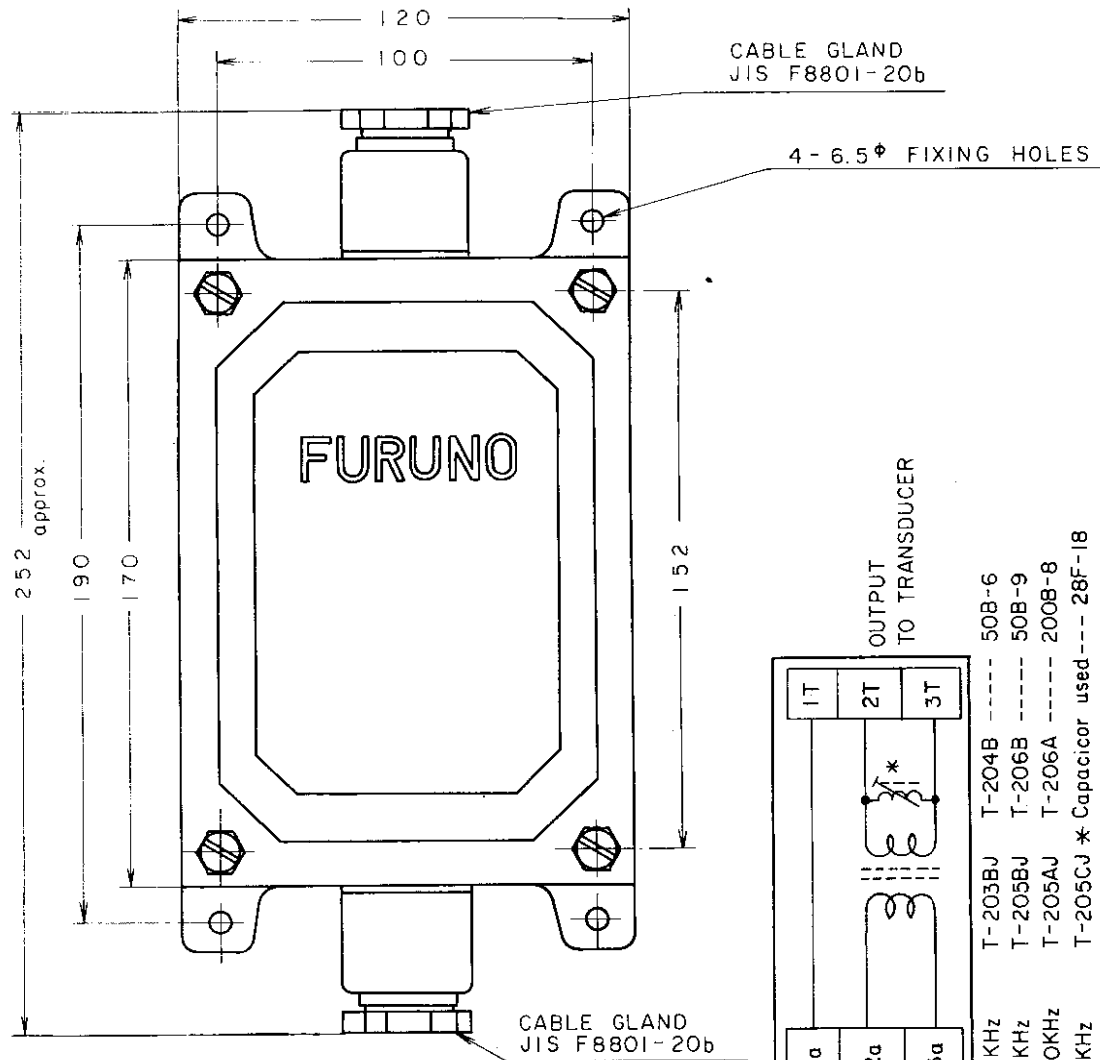
単位: mm  
UNIT

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS
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承認 APPROVED	JULY 11 '78 	三角法 THIRD ANGLE PROJECTION		名称 TITLE トランジスタインバーター 150VA TRANSISTORIZED INVERTER	
検 CHECKED	July 8 '78 	尺 SCALE	1/4	重量 WEIGHT 11 kg	
製 DRAWN	July 5 '78 	重量 WEIGHT		図番 DWG.NO. C2007-001-A	



Date	1975-12	Scale	1/2	TITLE	WATERTIGHT TYPE JUNCTION BOX JISF8821-1
Checked		DWG. No. E0002-001-A (DFE-2308)			
Ref.					



UNIT: mm  
WEIGHT: 2.6 kg

Date	1976-9	Scale	1/10
Checked			
Ref.			

TITLE	OUTLINE DRAWING OF MATCHING BOX
DWG. No.	E2006-001-B

変更通知書番号 訂正年月日 訂正記号 訂正内容 担当者

REVISED NO. SYM. DATE DESCRIPTION REVISER

1. 記号 "L" は造船所指定の寸法によること。  
MARKING "L" IS THE THICKNESS OF THE SHIPS HULL.  
2. 空母の固着は4mm以下とし、かつ外側に融れがみれに注意して接合のこと。  
MARKING "\*" IS THE CLEARANCE OUT SIDE THE TRANSDUCER TANK. THIS CLEARANCE SHOULD BE LESS THAN 4mm.

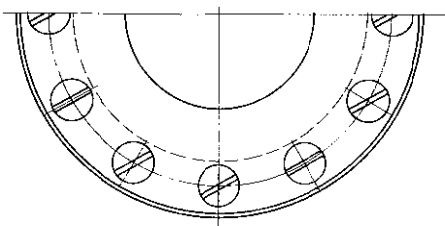
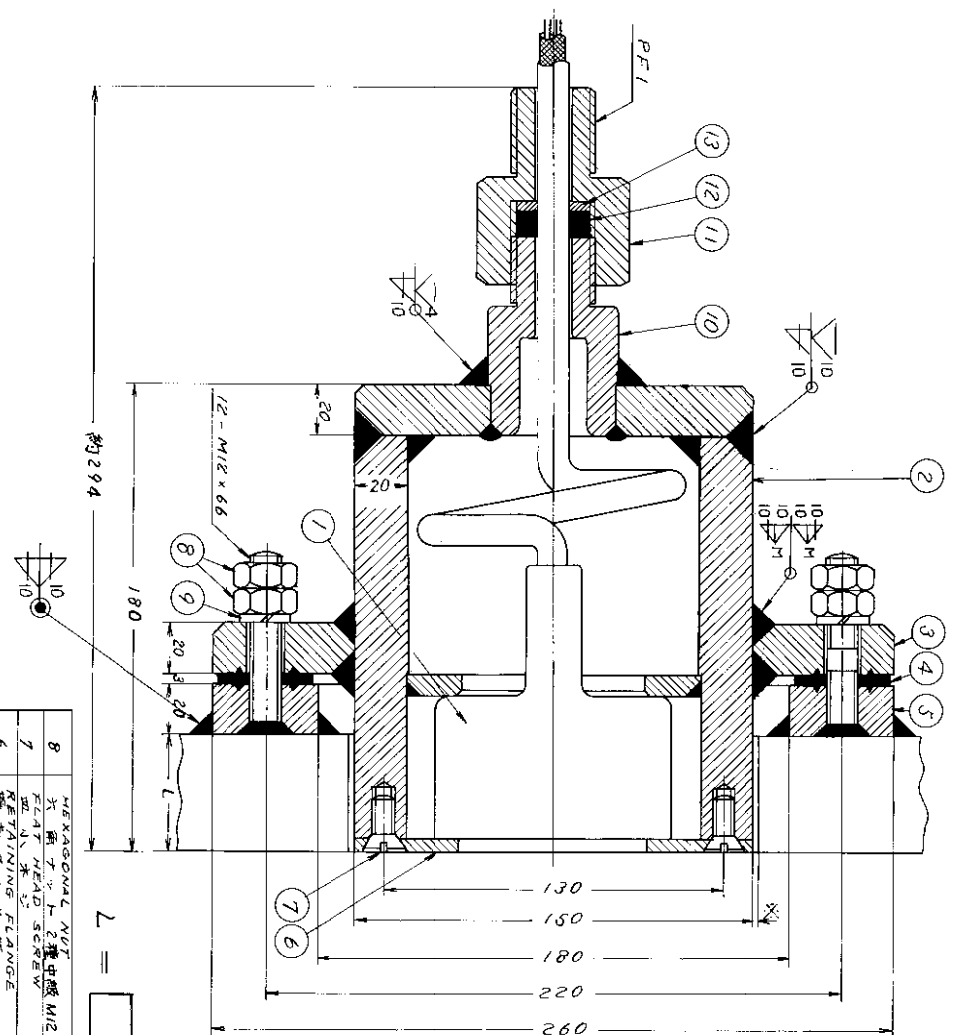
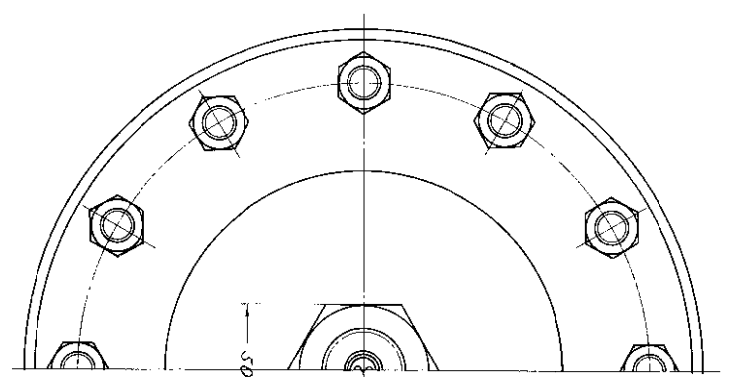
約294  
180  
95 $\phi$   
110 $\phi$   
111 $\phi$   
150 $\phi$   
180 $\phi$   
220 $\phi$   
130 $\phi$

品番	品名	数量	図番	備用	REMARK
1	200KHz 船内77式 発振器	1			200B-8
2	200KHz 発振器	1			
3	200KHz 発振器	1			
4	Supporting Flange	1			
5	Flange	1			
6	Flange with Bolt	1			
7	Stud Bolt	12			M12x188
8	Flange	1			
9	Gland	1			
10	Washer	1			
11	Flange	1			
12	Retaining Flange	1			
13	Hexagonal Nut	24			M12
14	Flat Head Screw	12			M8 x 18.8
15	Hexagonal Nut	12			

FURUNO ELECTRIC CO., LTD.

TTS-2000-2  
1-10

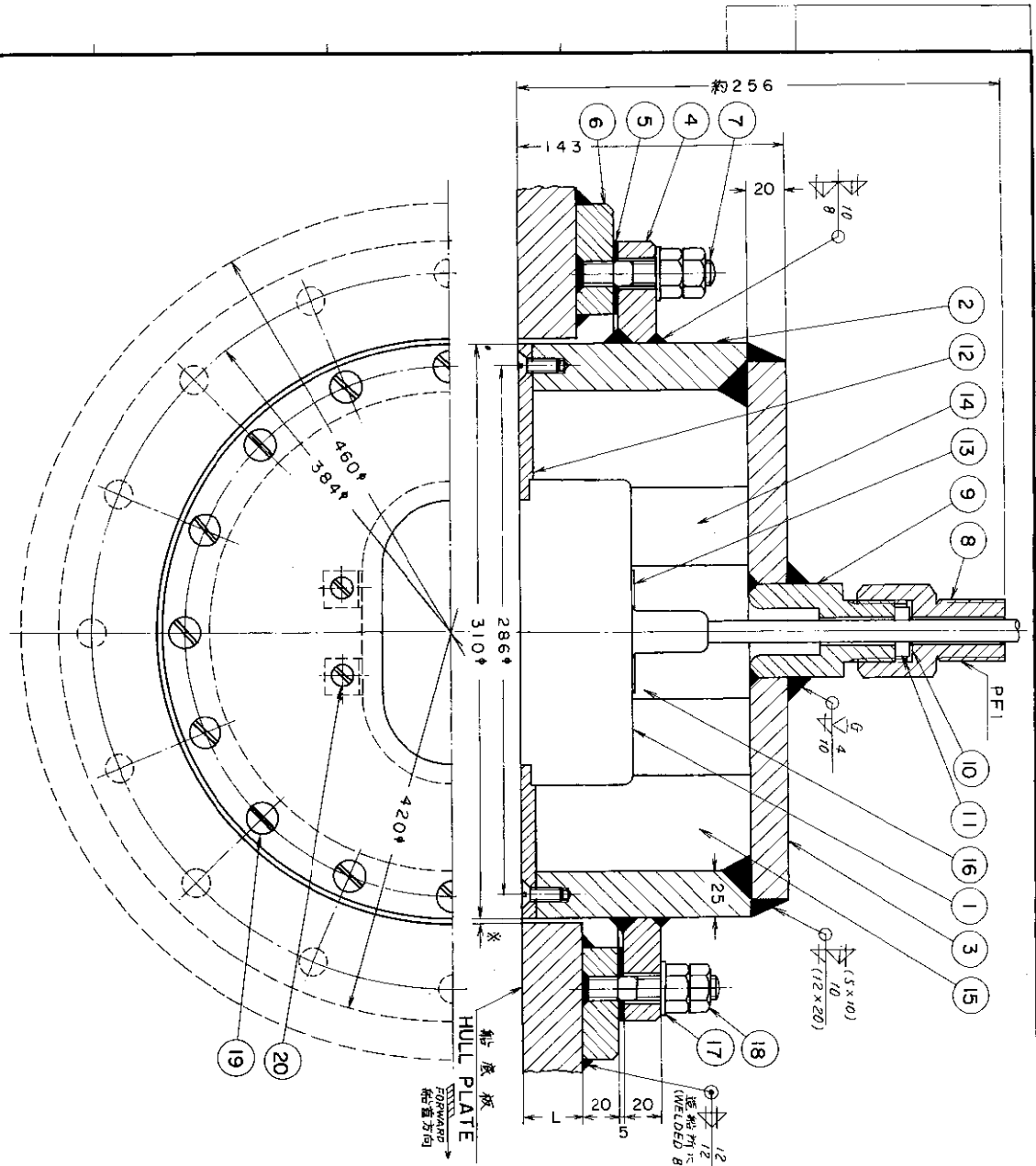




13	WASHER	SUS304	1
12	PACKING	合成ゴム	1
11	FLANGE	SM41	1
10	FLANGE	SM41	1
9	SPRING WASHER	SWR11-24	12

8	HEXAGONAL NUT	S20C	24
7	FLAT HEAD SCREW	SUS304	12
6	RETAINING FLANGE	SUS304	1
5	FLAT HEAD SCREW	KAS	1
4	PACKING	CR	1
3	FLANGE	KAS	1
2	TRANSDUCER TANK	KAS	1
1	SONAR TRANSDUCER	KAS	1

REVISED NO.	SYMBOL	DATE	DESCRIPTION	REVISER
1) LENGTH "L" TO BE DECIDED BY INSTRUCTION OF SHIPYARD. 2) * CLEARANCE OF HULL PLATE AROUND TRANSDUCER SHOULD BE LESS THAN 4mm. *印の間隔は4mm以下としタンク外周に船体板に注意して準備のこと。				
CHIEF SECT.	TITLE			
SUB CHIEF	音響測深機送受波器 装置図			
CHECKED	INSTALLATION DRAWING OF SONAR TRANSDUCER			
DRAWN	SCALE	WEIGHT	REMARK	
DATE	DRAWING NO.	C2001-103-B	508-6	



L =  m

20	皿小ネジ	SUS304	4	M4x15L
19	皿小ネジ	SUS304	16	M8x16L
18	六角ナット	SS41	32	
17	平垫	SS41	16	
16	平垫	スポンジ	1	
15	充填剤	スポンジ	1	
14	ゴムの垫	CR	2	
13	振動子	SUS304	2	
12	振動子	SUS304	1	
11	パッキング	CR	1	
10	ワッシャー	SUS304	1	
9	ゴランド	SS41	1	
8	ゴランド	SS41	1	
7	スチッドボルト	S25C	16	
6	スチッドボルト	KAS	1	
5	フランジ	CR	1	
4	パッキング	KAS	1	
3	振動子	KAS	1	
2	振動子	KAS	1	
1	50kHz 振動子	KAS	1	508-9

変更通知書番号	符号	訂正年月日	訂正 記事	担当
REVISED NO.	SYM.	DATE	DESCRIPTION	REVISER
製 図	重 量	52 kg	図 番	C2001-102-C
CHECKED	DRAWING	三角法	TITLE	50kHz 船内 3.7 式 装置 図
DRAWN	重 量	52 kg	DWG. NO.	SONAR TRANSDUCER INSTALLATION
				ECHO SOUNDER

NOTE,

1. 記号 L は造船所指定の寸法に注意すること。  
 MARKING "L" IS THE THICKNESS OF THE SHIP'S HULL.

2. 船の側面は 4mm 以下としタンク外周に船体板に注意して準備のこと。  
 MARKING "L" IS THE CLEARANCE OUT SIDE THE TRANSDUCER TANK. THIS CLEARANCE SHOULD BE LESS THAN 4mm.

装置図番号  
 INSTALLATION METHOD  
 TTS-5000-2

CHAPTER 2. OPERATION

Adjustment and function for the respective operating controls will be discussed in this chapter. The user should familiarize himself with all the operating controls in order to make the best possible use of the echosounder.

2-1. Description of the Controls

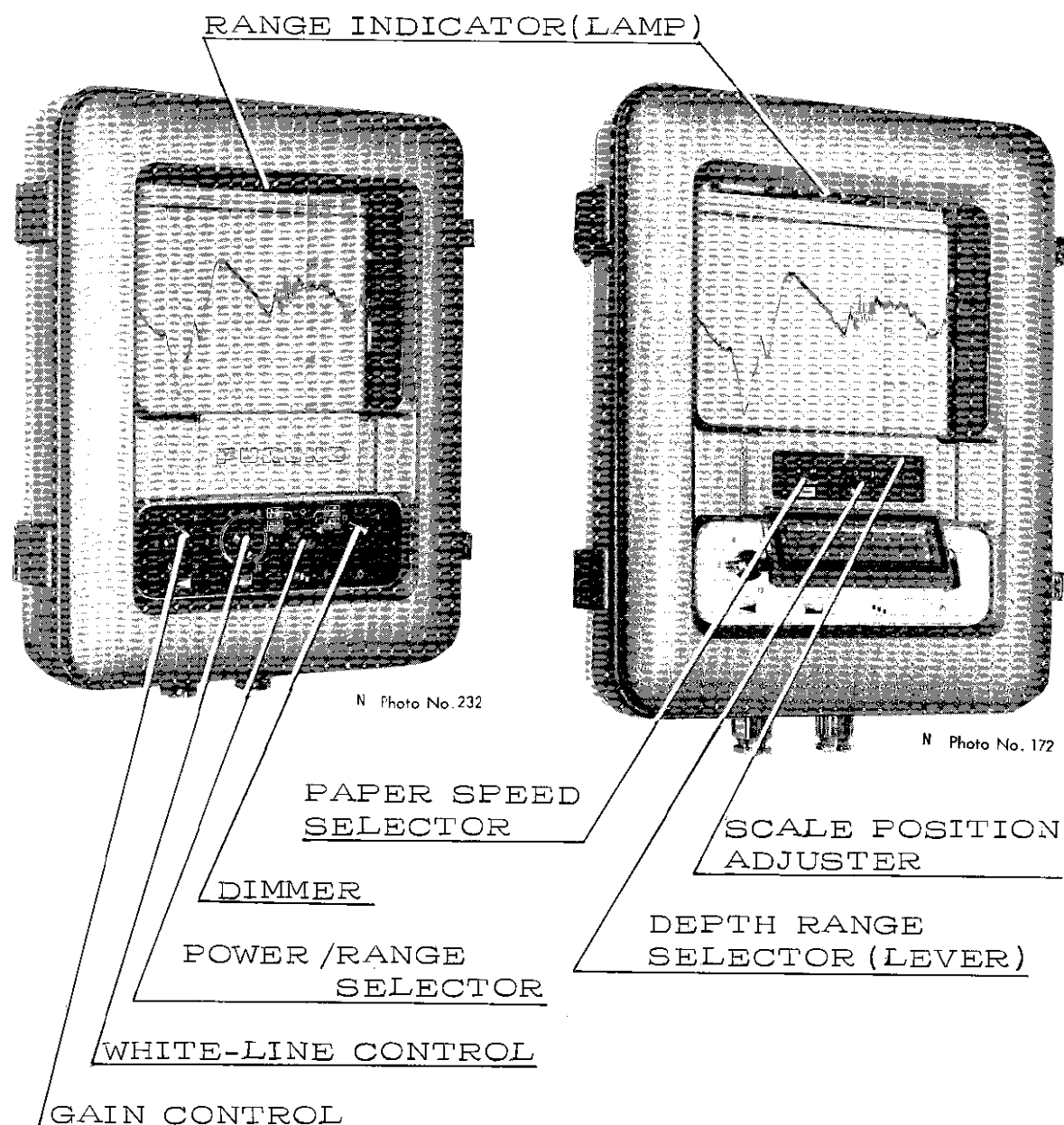




Fig.2-1 Recorder Unit (Bulkhead Mount Type)

POWER/RANGE SELECTOR   
 DEPTH RANGE SELECTOR  (INSIDE LEVER)



"On-off" of the power to the system can be made by the POWER/RANGE SELECTOR . Turn this switch from the position O (off) to one of other positions, and in approximately two seconds the recording belt will start to rotate.

Desired sounding range can be selected by both the POWER/RANGE SELECTOR switch and the DEPTH RANGE selector  (inside lever). Refer to Table 2-1 below. The shallow range group (0-40m/0-80m range group) is selected by placing the DEPTH RANGE selector in the position "X1". The selection of the deep range group (0-200m/0-400m range group) is done by placing it in the position "X5". Setting the POWER/RANGE SELECTOR switch at a proper position will select 0-40m/0-200m range group or 0-80m/0-400m range group.

For example, when the DEPTH RANGE selector is turned to "X1" and the POWER/RANGE SELECTOR switch is positioned in "0-40", the selected depth range is 0-40m.

CAUTION: Change the setting of the DEPTH RANGE selector with the belt rotating, otherwise the gearing may not be engaged smoothly.

Table 2-1  
 DEPTH RANGES  
 (in meters)

		SETTING OF POWER/RANGE SELECTOR 			
		0- 40 0-200	30- 70 150-350	0- 80 0-400	60-140 300-700
SETTING OF DEPTH RANGE SELECTOR (INSIDE LEVER) 	x 1 (SHALLOW)	0- 40	30- 70	0- 80	60-140
	RANGE INDICATOR	RED		YELLOW	
	x 5 (DEEP)	0-200	150-350	0-400	(300-700)
	RANGE INDICATOR	GREEN		BLUE	

RANGE INDICATOR (LAMP)

To eliminate a misreading of the depth, this indicator is arranged near the upper side of the recording paper. It is colored in red, yellow, green and blue from the right to the left in order and color-illuminated as shown in Table 2-1 depending on the range setting. Each depth scale is also printed in the color corresponding to the range indicator.

GAIN CONTROL



The GAIN control varies the sensitivity (gain) of the receiver amplifier. The gain is successively increased by turning the knob clockwise.

This control should be set so that only dense seabed echotrace is marked. Note that excessive increment of the gain does not give distinct seabed echogram but presents unnecessary echoes from fishes, sea surface noise, wake, etc.

DIMMER



This control adjusts the illumination on the recording paper and the control panel, and has four setting positions; 0 (off), 1 (dim), 2 (medium) and 3 (bright).

WHITE-LINE CONTROL



The white-line circuit enables to facilitate the discrimination between seabed and other objects such as mud, seaweed wreckage, etc. on or close to seabed. When the white-line is effective, the contour of the true seabed is given as a thin line having a white belt below.

This control is normally turned off. Turn it on only when the identification of the true seabed is required to know the exact depth or contour. Clockwise rotation of the control will increase the white-line effect. The adjustment should be made properly together with the GAIN control depending on the depth range setting.

NOTE: Turn off the White Line Control when using the ED-202 digital depth indicator.

SCALE POSITION ADJUSTER (INSIDE)

Move the depth scale with this adjuster so that the "0m" is placed at the upper edge of the zero line.

PAPER SPEED SELECTOR (INSIDE LEVER)

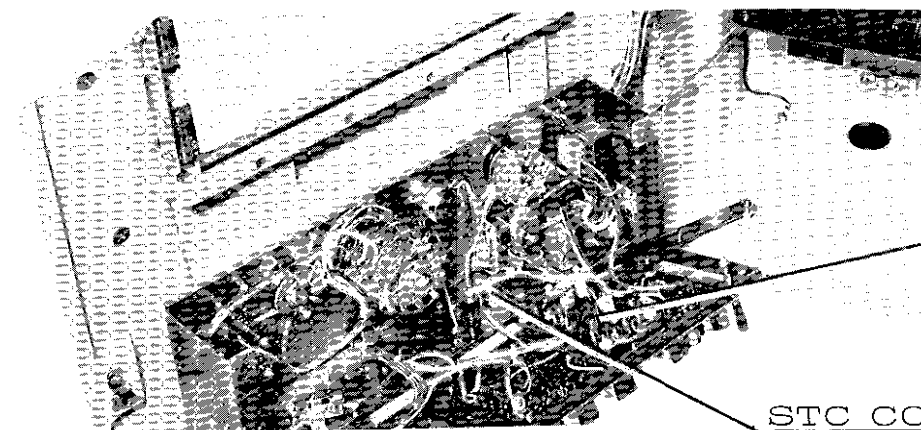


The paper speed can be changed by using this selector. The position "◀" is for slow speed and "◀◀" for fast speed.

STC (Preset Control)

This control is located in the amplifier box on the back of the front door as shown below. It reduces amplifier gain and increases the definition at close range. Turning the control clockwise will reduce darkening just below the zero line (surface noise). The preferable adjustment is to obtain such an echogram that the sea surface noise is slightly present at normal ship speed.

NOTE: Too high a setting of the STC control may result in the loss of shallow seabed signals.



Additional board for connection with ED-202 digital depth indicator

STC CONTROL

2-2. Operating Procedure

1. Turn the POWER/RANGE SELECTOR from the position 0 (off) to one of the other positions, and in a moment the recording belt will start to rotate.
2. Select a suitable range with both the POWER/RANGE SELECTOR and DEPTH RANGE SELECTOR and also select a suitable paper speed either ◀ (slow) or ◀◀ (fast).
3. Adjust the illumination of the paper and readout scale with the DIMMER control.
4. Move the scale with the SCALE POSITION adjuster so that the "0m" reading is placed at the upper edge of the zero line. Now, the depths can be read with reference to the position of the transducer on the ship's hull.
5. Adjust the GAIN control for a distinct echogram.
6. If necessary, adjust the WHITE LINE control to obtain a sharper contour presentation.

NOTE: Turn off the WHITE LINE when using the ED-202 digital depth indicator unit.

2-3. Replacement of Recording Paper

When the recording paper approaches its end, an end mark is seen on the paper, indicating that the remaining length is about 1 meter. Then it is necessary to prepare new roll of the recording paper. How to replace the recording paper is explained below.

The outline of the paper winding system is illustrated below.

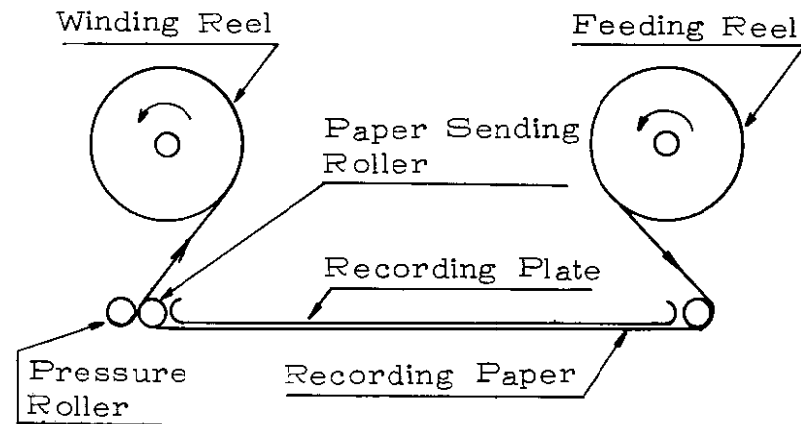


Fig.2-2 Sketch of Paper Winding System

1. Turn the POWER/RANGE SELECTOR to  $\bigcirc$  (off).
2. Turn the recording belt in the normal direction by hand so that the recording stylus may be off the recording paper.
3. Remove the scale plate. See Fig.2-3.
4. Release the pressure roller by pulling it up. See Fig.2-3.
5. Loosen the recorder assembly fixing screw and swing down the recorder assembly by holding the fixing screw. See Fig.2-4.
6. Take out the paper winding reel with used paper at the same time pulling the paper winding reel knob to the outside (ref. Fig.2-4 and 2-5), and wind out the remaining part of the paper, also remove the empty paper feeding reel in the same manner(ref. Fig.2-6).
7. Place the new paper between the recording belt and the recording plate as shown in Fig.2-7. Then, fix the new paper roll to the recorder assembly with the reel knob pulled outside. Confirm that the paper roll is secured.

8. Place the paper between the stylus guide piece and the recording plate (ref. Fig.2-3), also between the paper sending roller and the pressure roller.
9. Put an end of the new paper roll into the slot of the paper winding reel, then wind one or two turns of the paper on the reel with care so that the paper may be set in the center of the reel. See Fig.2-8.
10. Reset the paper winding reel in the recorder assembly with the reel knob pulled outside. See Fig.2-8. Confirm that the reel is secured.
11. Adjust the tension of the paper by turning the paper winding reel knob. Reset the pressure roller.
12. Swing up the recorder assembly and tighten the recorder assembly fixing screw. Reset the scale plate.

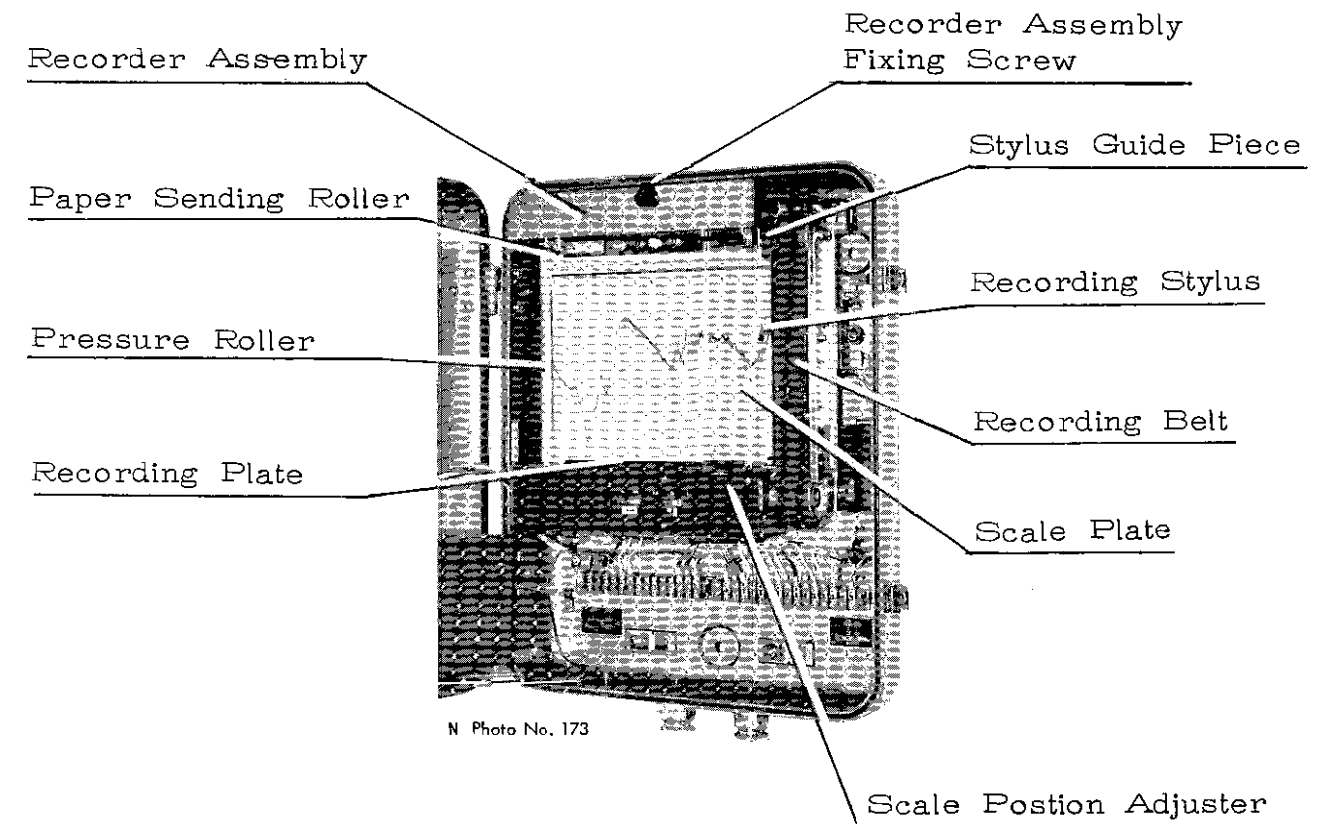


Fig.2-3 Recorder with Cabinet Door opened

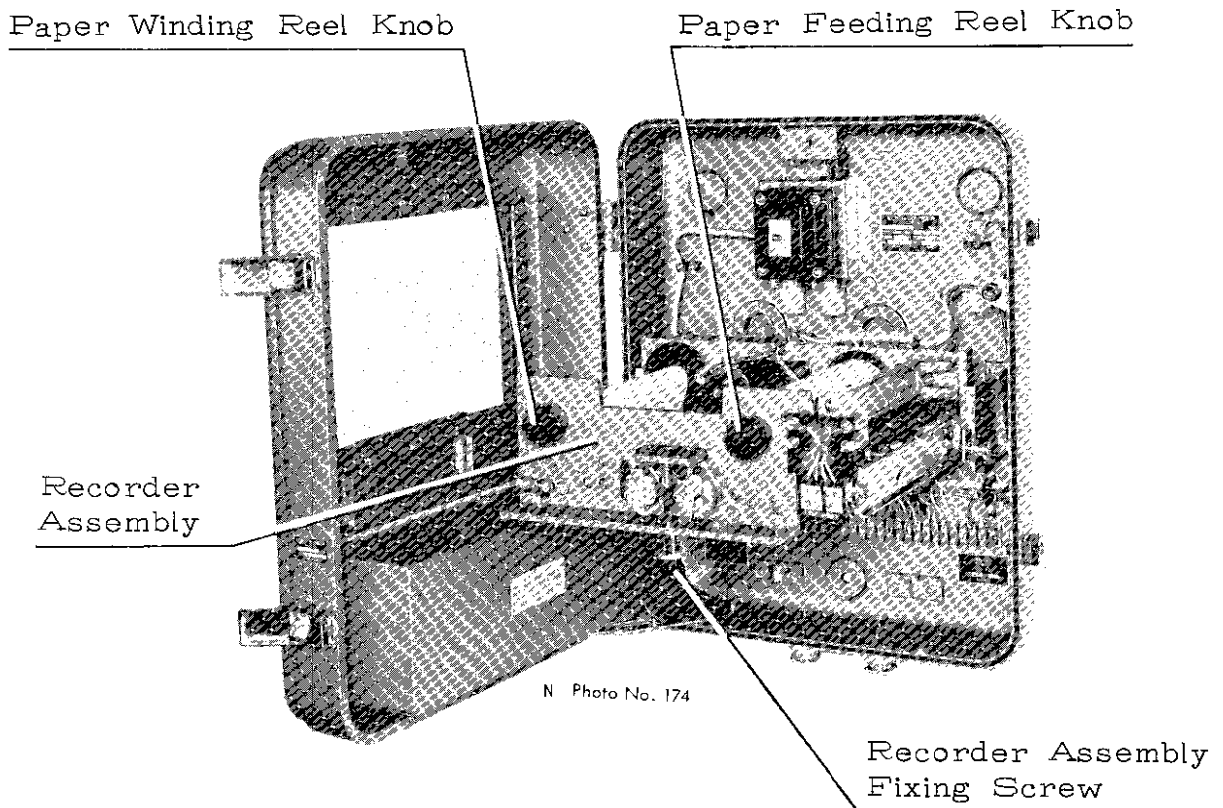


Fig.2-4 Recorder with Recorder Assembly swung down

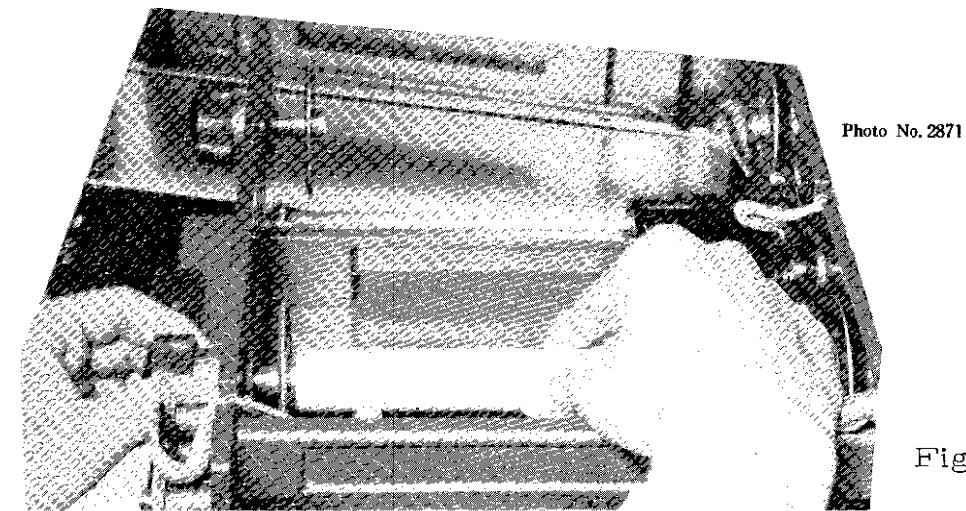


Fig.2-6

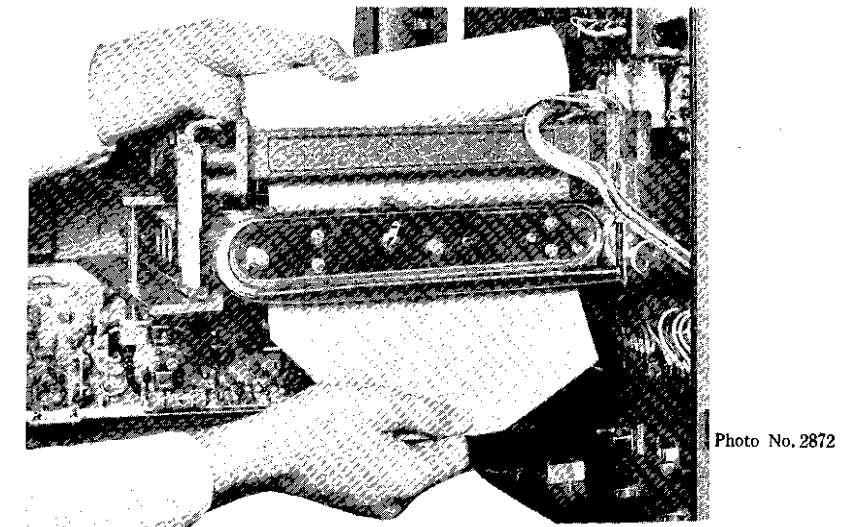


Fig.2-7

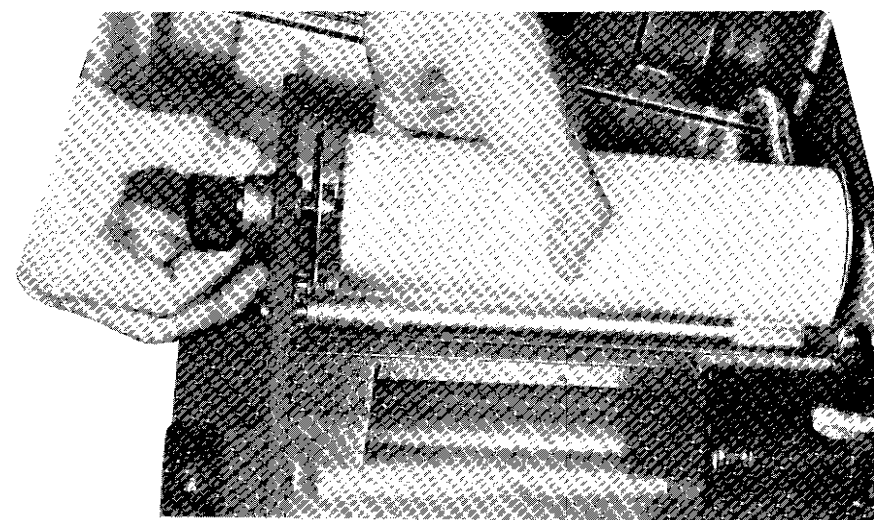


Fig.2-5

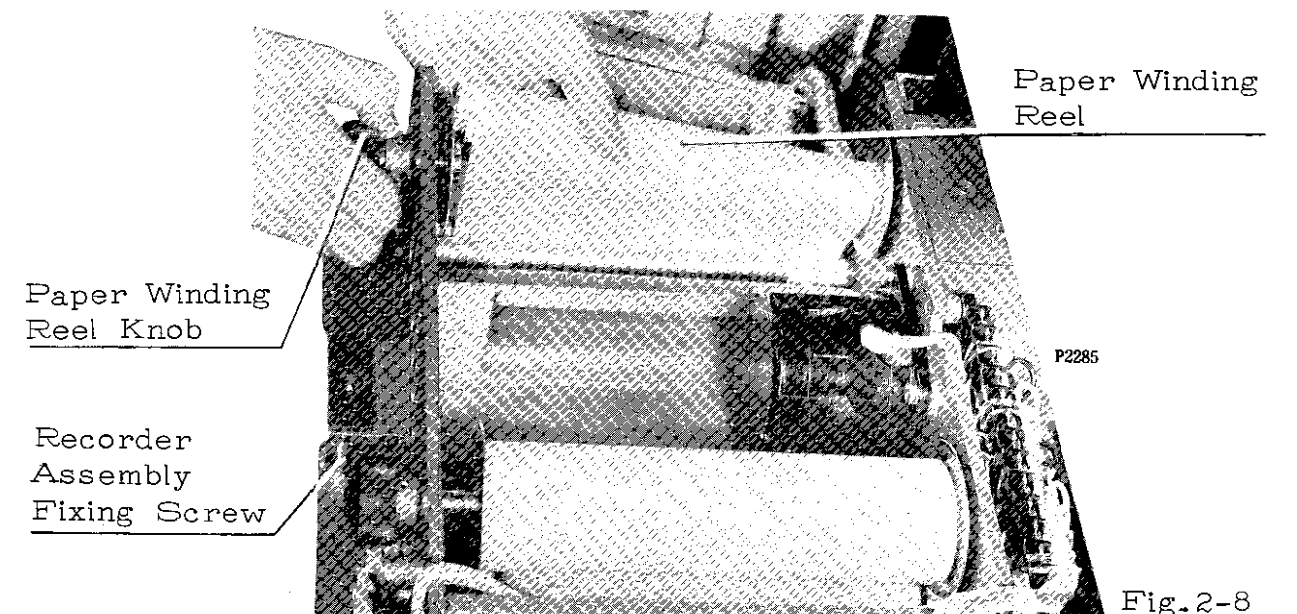


Fig.2-8

CHAPTER 3. OBSERVATION OF RECORDINGS

3-1. Echoes and Multiple Reflection

In a comparatively shallow depth sounding, too high a setting of the amplifier gain and a stiff seabed cause a second or sometimes third or fourth echoes with the same interval between them below the first echo trace. This is because the sounding pulse travels in the same path twice as long or more in the reasonably shallow depth.

Depth measurement should be made between the zero line and the first echo trace by using the scale plate attached.

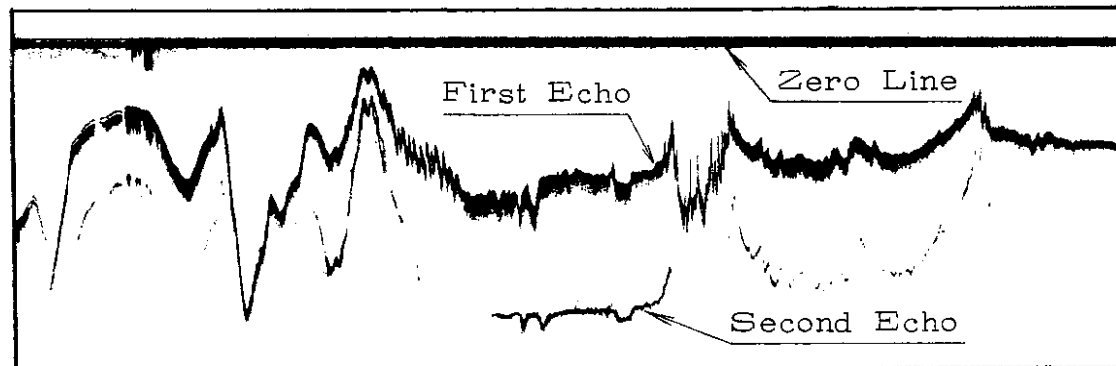


Fig.3-1

3-2. Shifted Echo Trace

It may sometimes occur that seabed you want to see is presented at the lower edge of the paper as shown in Fig.3-2. This will not allow the observer to understand the recording obtained. This situation can be improved by changing the depth range setting to a deeper one, e.g., 0-40m to 30-70m ranges. If the recording appears at an extreme upper position, change the range setting to a shallower one.

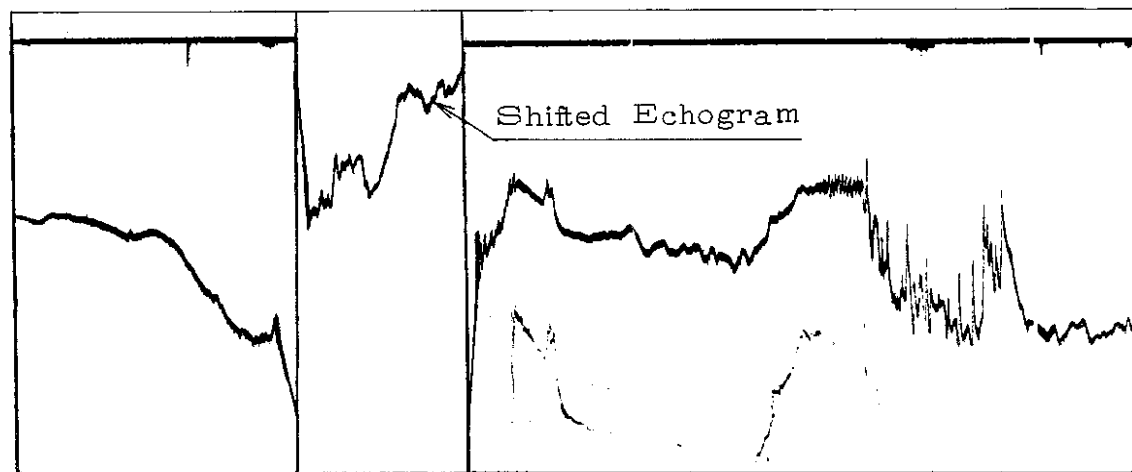


Fig.3-2

3-3. Sea Surface Noise

Sea surface noise is mainly caused by the air foam created by ship's cruising, rough sea conditions, rain, wake, etc. If this noise spoils the important area of recording, reduce the noise by adjusting the STC control.

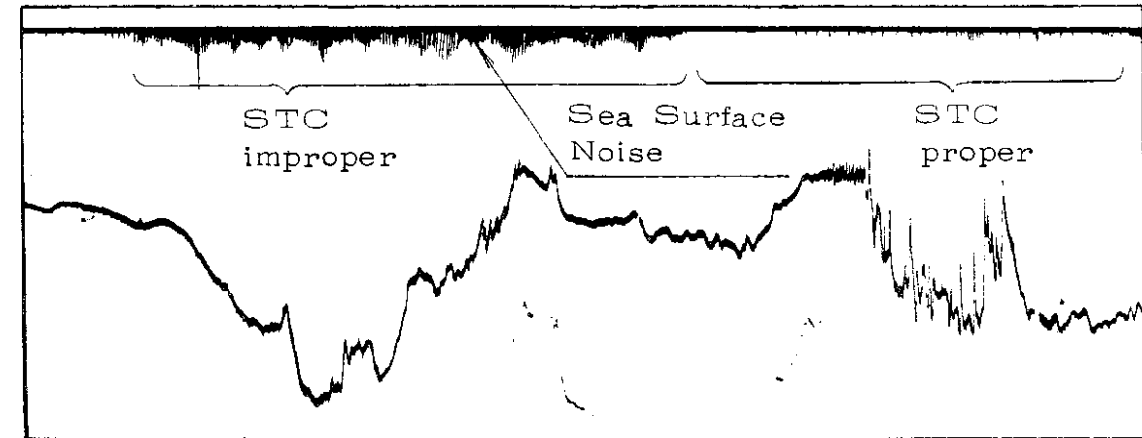
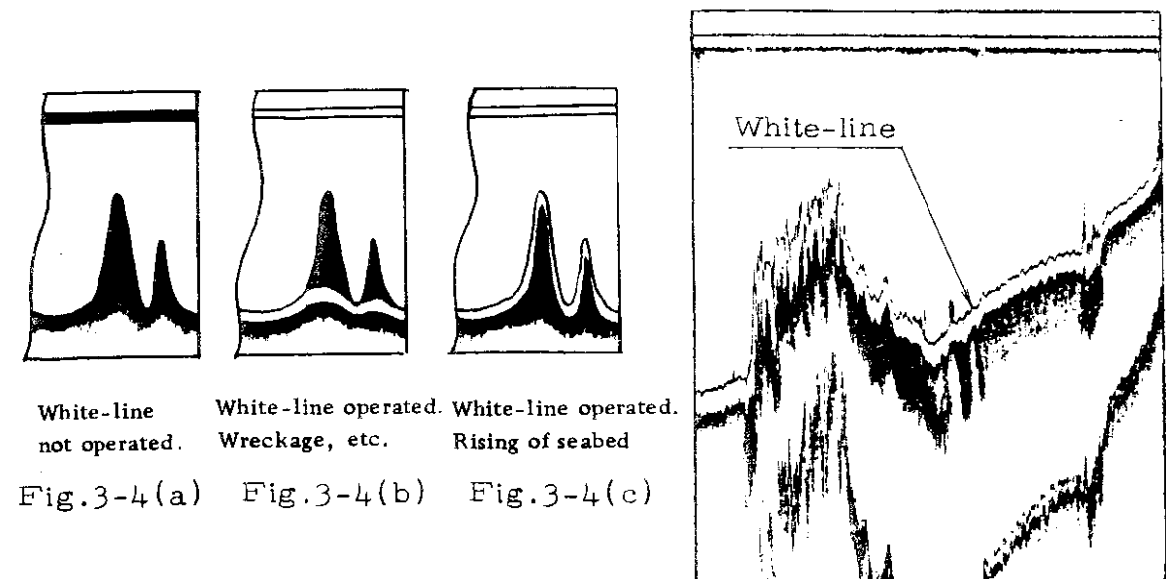


Fig.3-3

3-4. White Line Recording

If the seabed line is shaped as shown in Fig.3-4(a), it is difficult to judge what the rising (crest) portion is; rock, wreckage, bottom fish, seaweed, etc. The white-line function will then give a suggestion to make a correct judgement. If the rising portion is wreckage, bottom fish school, a group of seaweed or so, the seabed tracing will become like Fig. 3-4(b). If it is rock, protruding part of seabed or so, the seabed line will be as shown in Fig.3-4(c).



White-line not operated. White-line operated. Wreckage, etc. White-line operated. Rising of seabed  
 Fig.3-4(a) Fig.3-4(b) Fig.3-4(c)

White-line effect in actual echogram  
 Fig.3-4(d)



3-5. Noise caused by Interference and Induction

Fig.3-5 shows the noise caused by induction of other electric wirings, acoustic effect by swing of the ship and interference from other echosounders. Reduction of the amplifier gain will moderate the appearance of these noises and the observation of the actual echo will become easier.

The interference noise from other echosounders is shown in form of parallel broken lines inclined a little across the paper sending direction. Noise caused by electric induction, such as the one from a motor or generator, is plotted in irregular dots of blackening over the recording paper.

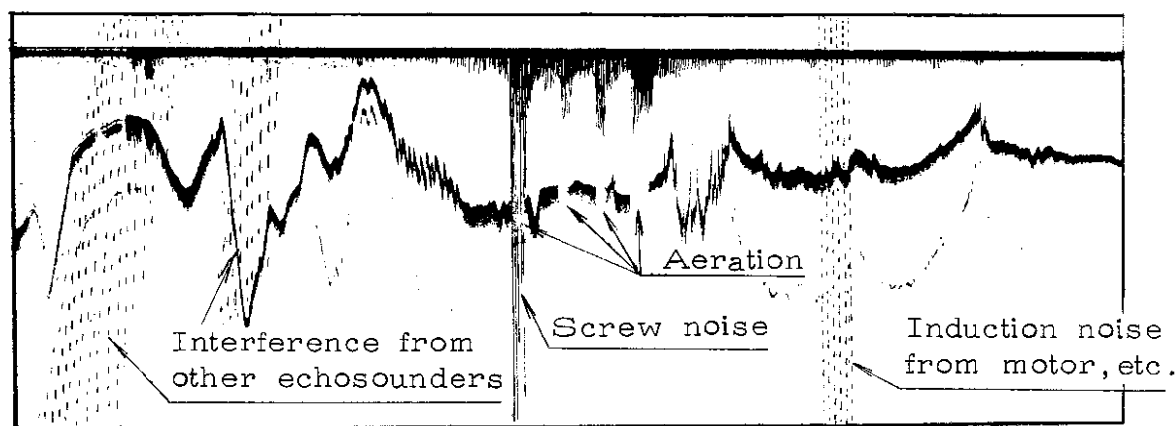


Fig.3-5

In rough sea, the effect of aerated water becomes extremely great. Such being the case, the sound beam energy is attenuated by a lot of air bubbles and the plotting of the seabed is sometimes suspended as shown in Fig.3-5.

CHAPTER 4. MAINTENANCE

Reliable operation of the echosounder largely depends on maintenance of the equipment. The maintenance should be made periodically with care.

4-1. General Maintenance of Recorder Unit

1. Since this model is provided with a dry paper recording system, a lot of carbon powder is produced during the actual operation. The carbon powder will pile up on the inner mechanism, particularly the electrical wiring and circuit boards. This may cause troubles in mechanical and electrical performance. The powder accumulations should be cleaned out with a brush at least once a week.

**CAUTION:** Be sure to turn the POWER/RANGE SELECTOR to "0" before opening the cabinet door.

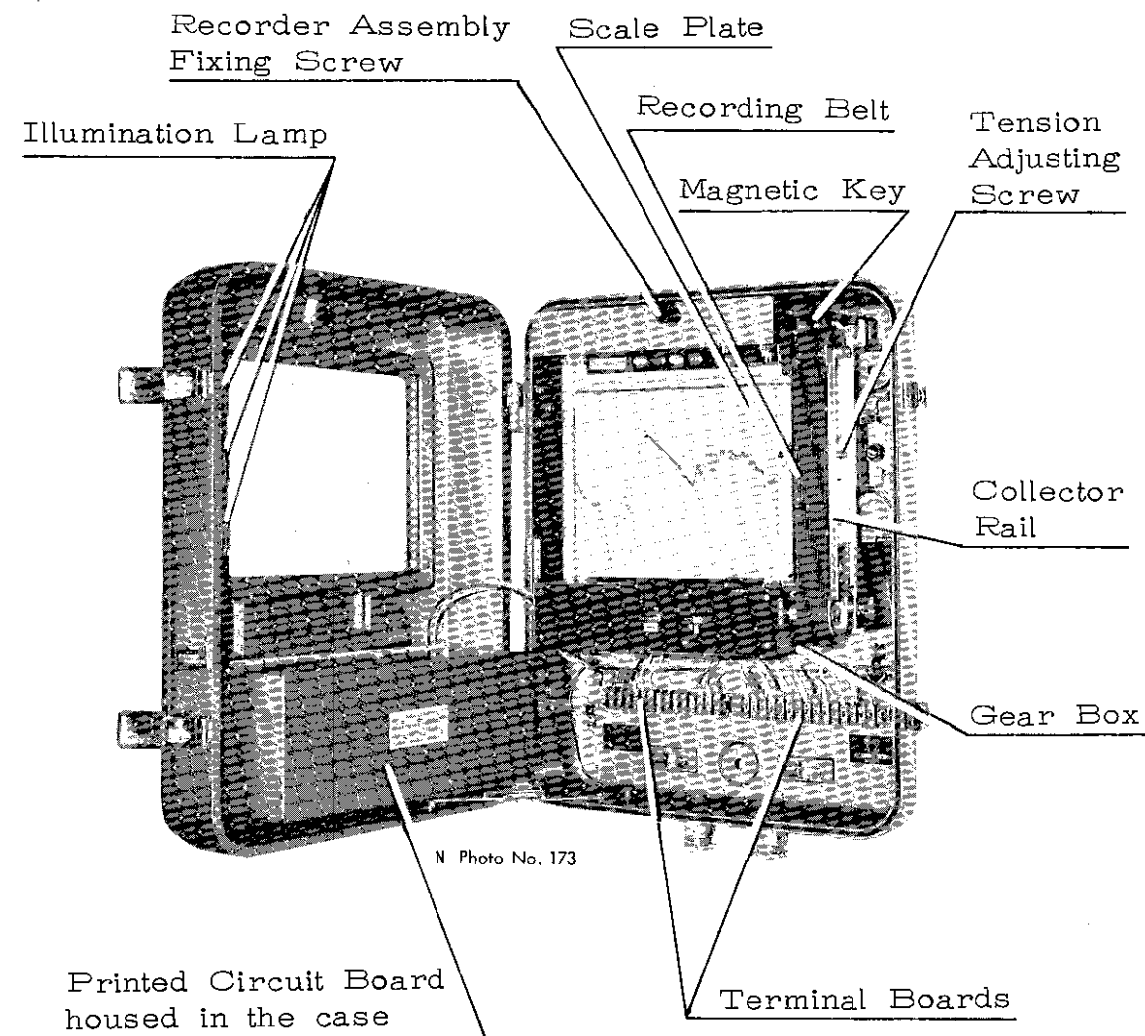


Fig.4-1 Recorder with Cabinet Door opened

2. Frequently wipe off the carbon powder, dust or stain on the collector rail with a soft cloth.
3. The recorder cabinet should always be kept clean and free from corrosion. Frequently wipe traces of salt water from the cabinet with a cloth damped in fresh water. It is particularly important to clean around fittings, operating controls and projections since corrosion tends to start in such places.
4. Illumination lamps and scale plate should be cleaned from time to time.
5. Cable connection at terminal boards should be kept clean and tight for a good contact.

4-2. Tension of Recording Belt

The recording belt is held with three pulleys. The tension should be adjusted to the optimum setting. Insufficient belt tension will cause bad recordings while excessive tension will place an overload on the driving motor. The tension pulley can be fixed at any required location with the tension adjusting screw as shown in Fig.4-2.

Rule to adjust the tension is as follows. Loosen the tension adjusting screw and the fulcrum screw, relocate the tension pulley so that the belt may just begin to tighten, move a bit more the tension pulley to the outside, then tighten both the tension adjusting screw and the fulcrum screw.

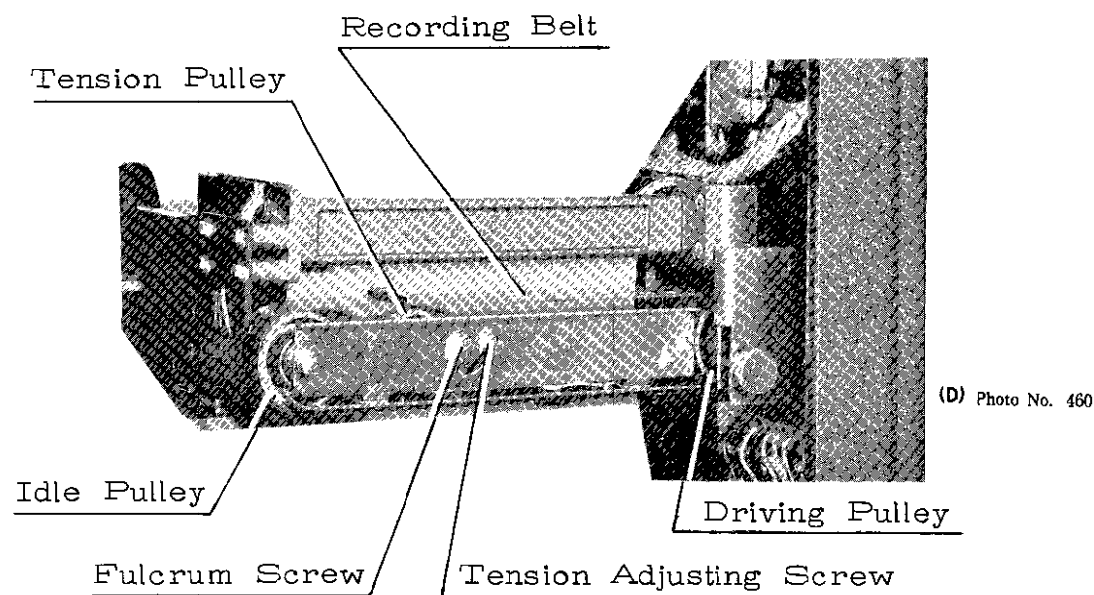


Fig.4-2 Adjusting of Belt Tension

4-3. Replacement of Recording & Collector Styli

The recording and collector styli are fixed on the same stylus stand which is mounted on the recording belt as shown in Fig. 4-3. These styli are removed by pushing the end of each stylus holder in the direction of the arrow.

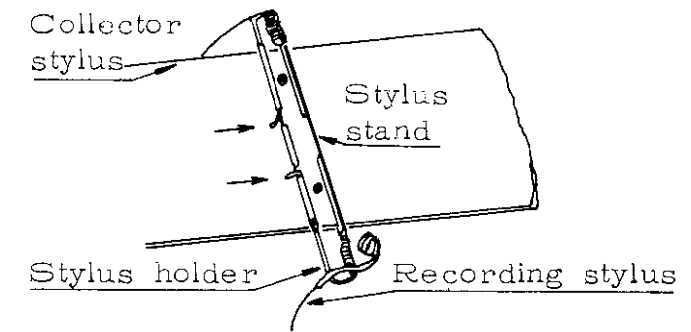


Fig.4-3

Prolonged use wears away the recording stylus wire. The stylus should be made to protrude about 10mm by pulling its end with the long nose plier supplied as a maintenance tool. See Fig.4-4. When the stylus wire comes to an end after lengthy use, replace the stylus wire or the whole piece (stylus with holder) with a new one.

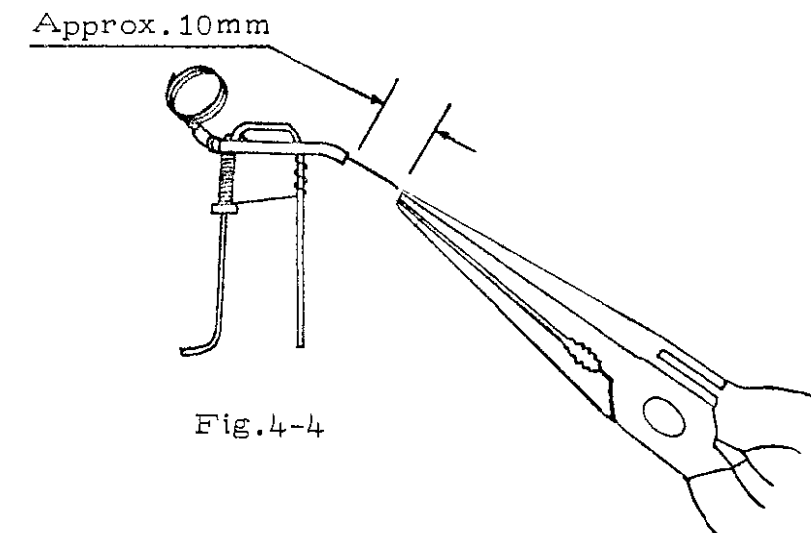


Fig.4-4

The collector stylus is made of different material from the recording stylus, so it does not need replacing as often as the recording stylus. When its replacement is required, replace the whole piece (stylus with holder).



4-4. Lubrication

The gears in the gear box of the recorder assembly (ref. Fig. 4-1) should be checked for good operation. The gears are lubricated with grease or machine oil when the equipment leaves the factory, but it is required to relubricate at regular intervals or when the old grease and oil seem to have deteriorated. See Fig.4-5.

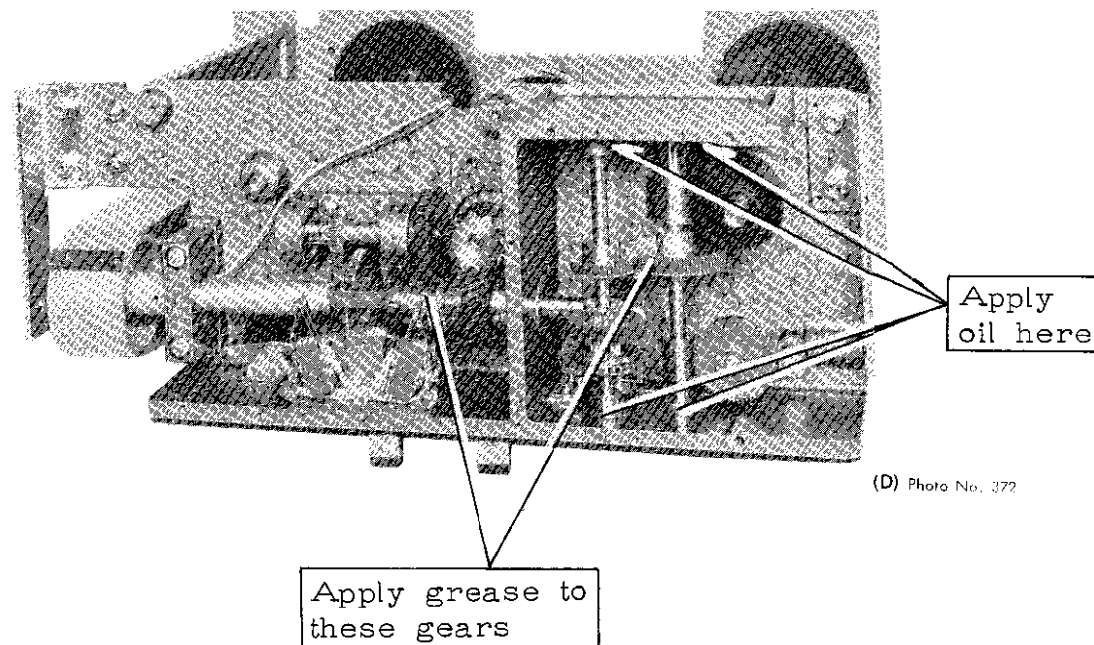


Fig.4-5 Recorder Assembly Gear Box with Cover removed

CHAPTER 5. TROUBLESHOOTING

Trouble 1. Recorder unit not operating with source switch turned on

- Cause:
- a) Low source voltage
  - b) Fuse blown off
  - c) Bad contact or disconnection of power cable

- Remedy:
- a) Check supply voltage across terminals #28 and #29 with the circuit tester when the POWER RANGE selector is turned to the specific range.
  - b) Replace the fuse with new one. If fuse blown off again, check followings.
    - (i) Shortcircuit of Tr208D or Tr209D.
    - (ii) Shortcircuit in other portions.
  - c) Check the power cable for good continuity with the circuit tester.

Trouble 2. Motor rotating but no recording

- Cause:
- a) Bad contact of recording or collector stylus
  - b) Bad amplifier circuit
  - c) Bad power supply circuit

- Remedy:
- a) Check the contact condition of the recording or collector stylus. If the stylus is worn out, renew it.
  - b) If the amplifier circuit board is faulty, replace it with new one. Check if the transistor Tr109D is short-circuited or inner-opened.
  - c) Check if more than +20V is applied between the terminals #4 and #5 and if less than -20V is applied between terminals #4 and #6 by using a circuit tester.

If each line voltage is abnormal, check the rectifier circuit.

Trouble 3. Illumination lamp lit but motor(belt) not rotating

Cause: a) Low supply voltage  
b) Inoperative motor circuit or faulty motor

Remedy: a) Check if the rated voltage is applied between terminals #28 and #29 with circuit tester.

b) In this case, the following troubles are considered.

- (i) Faulty capacitor C315D
- (ii) Faulty motor --- Faulty bearing, disconnection of wirings etc.

Should the above matters be in good order, the following points must be checked.

- (i) Check if the recording belt slips out of the pulley and if a lot of carbon powder piles up between the pulley and recording belt.  
Polish the pulley after removing the belt.
- (ii) Check the tension of the recording belt.
- (iii) Check if a lot of carbon powder and rubbish pile up in the gear mechanism.
- (iv) Check the bearing in the pulley bracket.

Trouble 4. Motor rotating but illumination lamp not lit

Cause: a) Illumination lamp blown off  
b) Disconnection of the wiring concerning the illumination lamp

Remedy: a) Replace the illumination lamp blown off with new one.  
b) Check the wiring by using a circuit tester.

Trouble 5. No zero line (NOTE: No zero line appears on shift ranges)

Cause: a) Faulty magnetic key  
b) Faulty magnet on the recording belt  
c) Faulty pulse driver

Remedy: a) Replace the faulty magnetic keying board 6702.  
b) Replace the recording belt with new one.  
c) Check if the pulse is applied to the point S on the PCB 6704 from the magnetic key. Faulty pulse driver PCB should also be renewed. Check if Tr208D and Tr209D are short-circuited.

## Trouble 6. Heavy noise

Cause: a) Bad cable connection  
b) Improper location of transducer  
c) Induction from other electrical or mechanical equipment on board  
d) Defective transducer

Remedy: a) Refer to the followings.

- (i) Connect the transducer cable to terminals #1, #2 and #3. Among them, #1 is for shield wire and #2 and #3 for inner conductors. Excessively long conductor not shielded induces a lot of noise, which lowers detection capability.
  - (ii) The wiring of the power source should be as apart from the transducer cable as possible and should not be laid in parallel with the transducer cable.
  - (iii) The earth terminal located at the lower end of recorder cabinet should be grounded to the hull or grounding plate.
- b) Relocate the transducer where are free from air foams and bubbles.
- c) Most of induced noise may be caused by generator or motor.
- (i) Insert a capacitor with adequate capacitance between the input terminals of generator or motor.
  - (ii) In case of noise induced from the mechanical vibration of the engine, insert the rubber plate under the base plate of the equipment.
- d) This trouble is caused from the breakout of the mold or disconnection of the cable of the transducer. If necessary, replace the faulty transducer with new one.

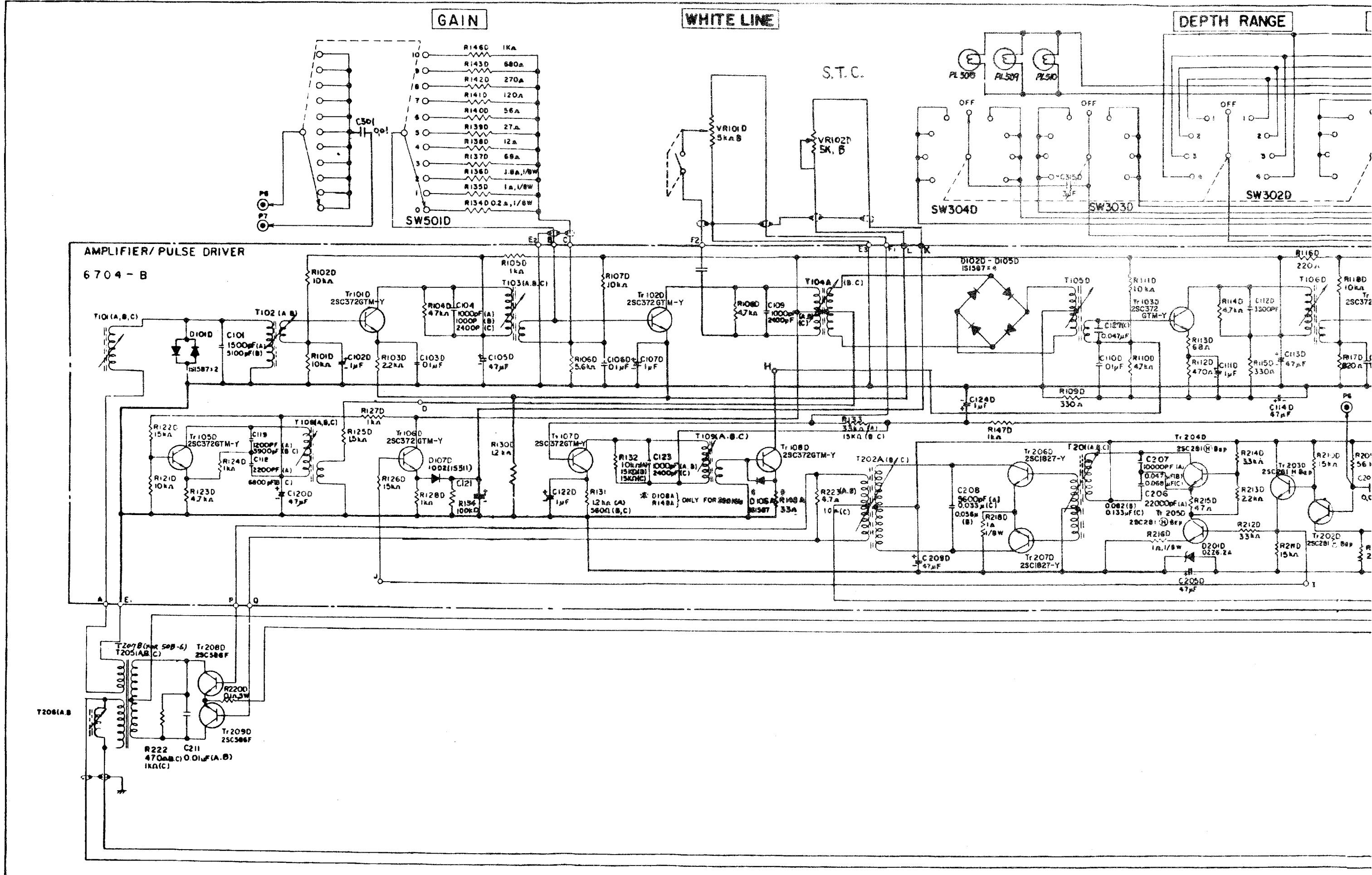
## Trouble 7. Poor sensitivity

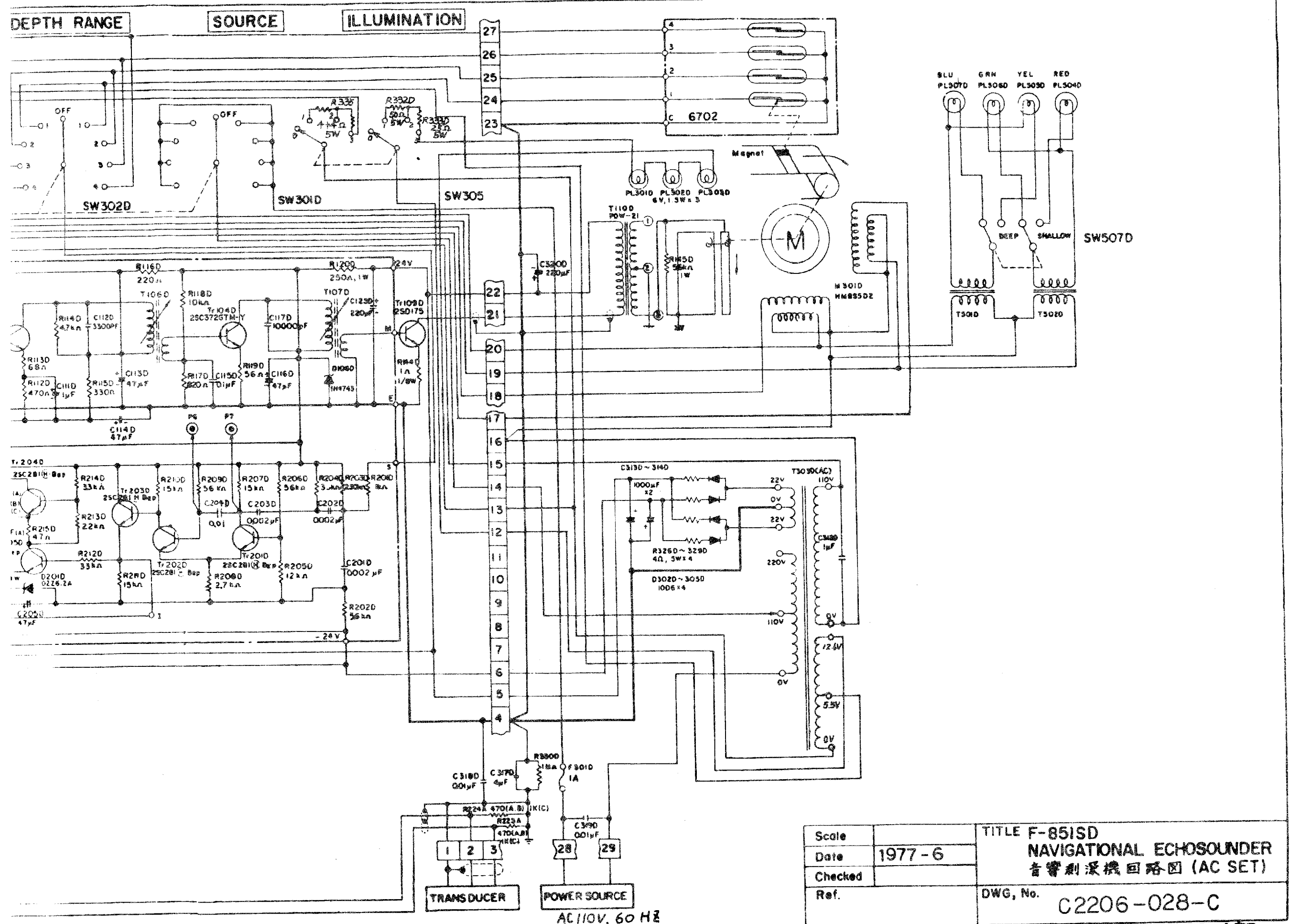
Cause: a) Frequency deviation in the amplifier or oscillator, or poor quality of them  
b) Lowered supply voltage  
c) Defective transducer

Remedy: a) Readjust the frequency of RF amplifier, IF amplifier and local oscillator, and check the amplifier gain.

Connect the terminals #2 and #3 to the vertical input and the standard signal generator to the horizontal input on a oscilloscope. Then readjust the transmission frequency by turning the core of T201(A,B,C) and T202(A,B,C) observing a "Lissajous Figure" appearing on the scope.

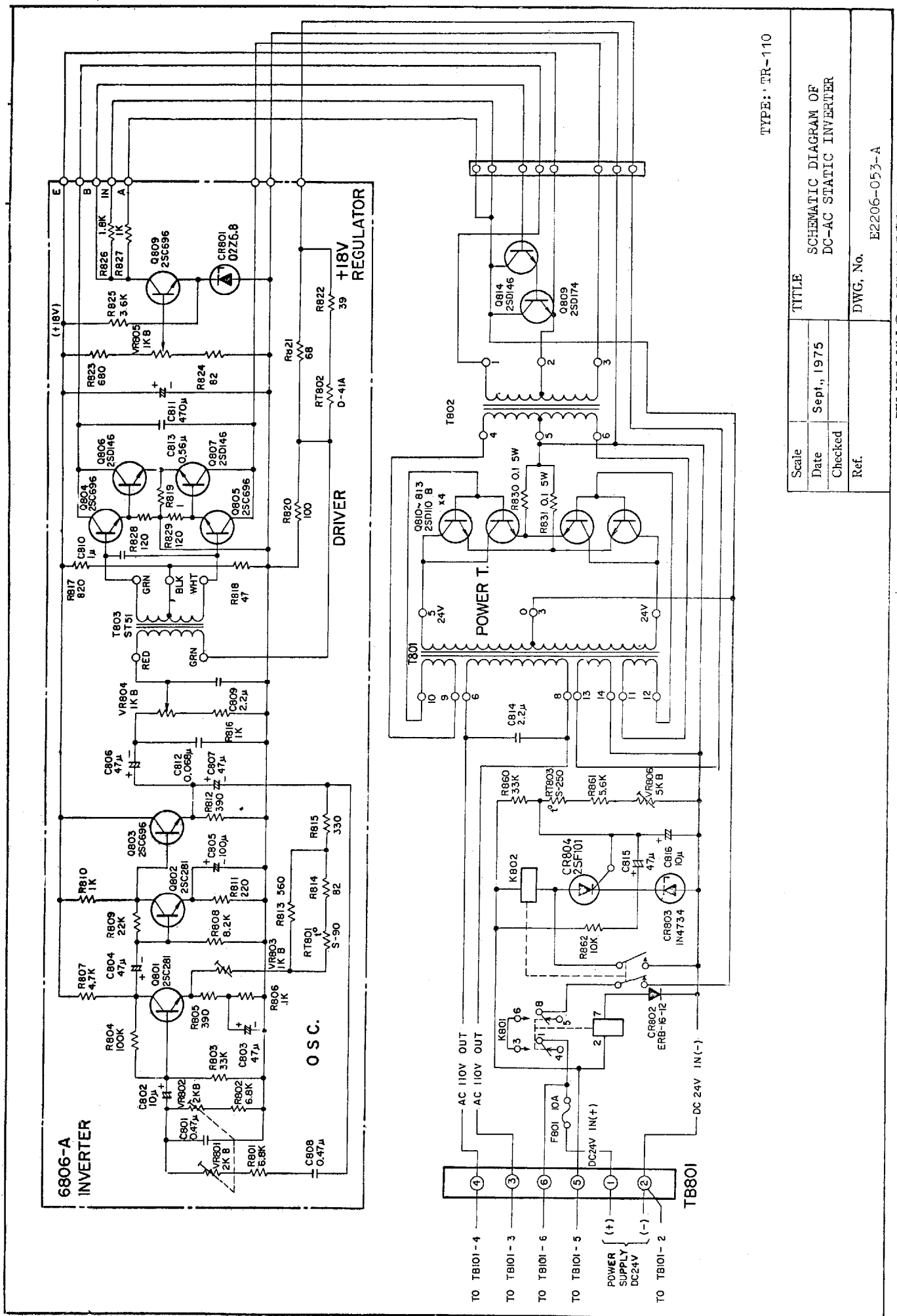
- b) Even reasonably low supply voltage allows the recorder operating but sufficient recording will not be obtained. Check the source voltage on the terminals #28 and #29.
- c) Check if the transducer cable is broken down or if the mold is broken off.





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Checked		
Ref.		DWG. No. C2206-028-C

FURUNO ELECTRIC CO., LTD.



TYPE: TR-110

Scale	TITLE		
Date	Sept., 1975	SCHEMATIC DIAGRAM OF DC-AC STATIC INVERTER	
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