SEMINAR TEXT

FOR

NATURAL CONDITION SURVEY

FOR

THE STUDY ON MAINTENANCE DREDGING

IN

ACCESS CHANNEL OF BANJARMASIN PORT

IN

THE REPUBLIC OF INDONESIA

NOVEMBER 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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I. FIELD SURVEY FOR SILTATION STUDY

Field Survey for Siltation Study

1. Introduction

The deposition of soil materials into navigation channels by siltation is caused by the process of transportation and deposition of fine cohesive sediments, which are suspended in rivers or eroded from the bottom surface through some action. Therefore, it is important to investigate the mechanism that causes the erosion, transport and deposition of fine particles and to observe the tides, waves and current conditions as external forces that determine the behavior of bottom sediment and its properties.

2. Acquisition of field survey data

The structure of siltation at a river's estuary is as follows.

As soil materials are carried downstream by rain water from mountainous areas, sand particles of a large grain size settle on the river bed quickly. However, silt or clay of a small grain diameter do not settle easily and are carried downstream. The color of rivers in Southeast Asian countries and China is yellowish due to the large amount of fine soil particles that are contained in the river water. The soil materials which are carried downstream by river water gradually settle on the river bottom as its flow velocity slows down in its lower reaches. In the rainy season, when there is a large amount of water flow discharge, the flow velocity of the river increases, and soil materials deposited on the river's bottom are eroded and transported downstream. They then flow out to the estuary or into the sea.

Due to their fine grain size, the suspended soil materials that are carried downstream in this way settle very slowly and for the most part they do not settle at all. However, when the river water comes into contact with sea water in the estuary, the suspended materials act changes slightly different. In fresh river water, fine particles of soil materials are suspended independently due to the force (Van der Waals force) that acts on them. In the sea, however, these particles form flocs as a result of the attractive force among particles caused by positively charged ions contained in sea water. Though these flocs are very soft, their total diameter increases as they stick to each other and their settling velocity increases. As a result of the above-mentioned behavior, fine suspended particles settle on the bottom in the estuarine area. Sediments thus settled on navigation channels and mooring basins in harbors are consolidated and hardened with the passage of time. Such deposited sediment can obstruct ship navigation and the function of the port. This phenomenon is called "siltation". The phenomenon of large quantities of soil materials being carried downstream and settling in estuarine areas cannot be avoided unless the supply source of the soil materials is removed. Ingenious devices that prevent soil materials from obstructing ship navigation and the functions of ports are important in fighting siltation.

When considering the problem of siltation and measures to be taken to solve it, it is very important to obtain accurate knowledge of the mechanisms that are involved in the erosion, transportation and deposition of sediment materials. In order to clarify the mechanism of siltation, it is necessary to obtain data on natural conditions, topographical conditions, soil properties and the local sedimentation. By simultaneously measuring natural conditions and the siltation volume during representative periods, it is possible to discover the mechanism of siltation in detail and to estimate the annual siltation volume by using the relevant statistics concerning natural conditions throughout the year. Furthermore, an understanding of the mechanism of siltation is important for the selection of measures to be taken to prevent deposition and for estimating the siltation volume that will develop when planning ports and harbors.

Fig. 1.1-1 shows an outline of the above-mentioned siltation mechanism. This paper describes the necessity of measuring relevant factors and the proper measurement methods for a siltation field survey.

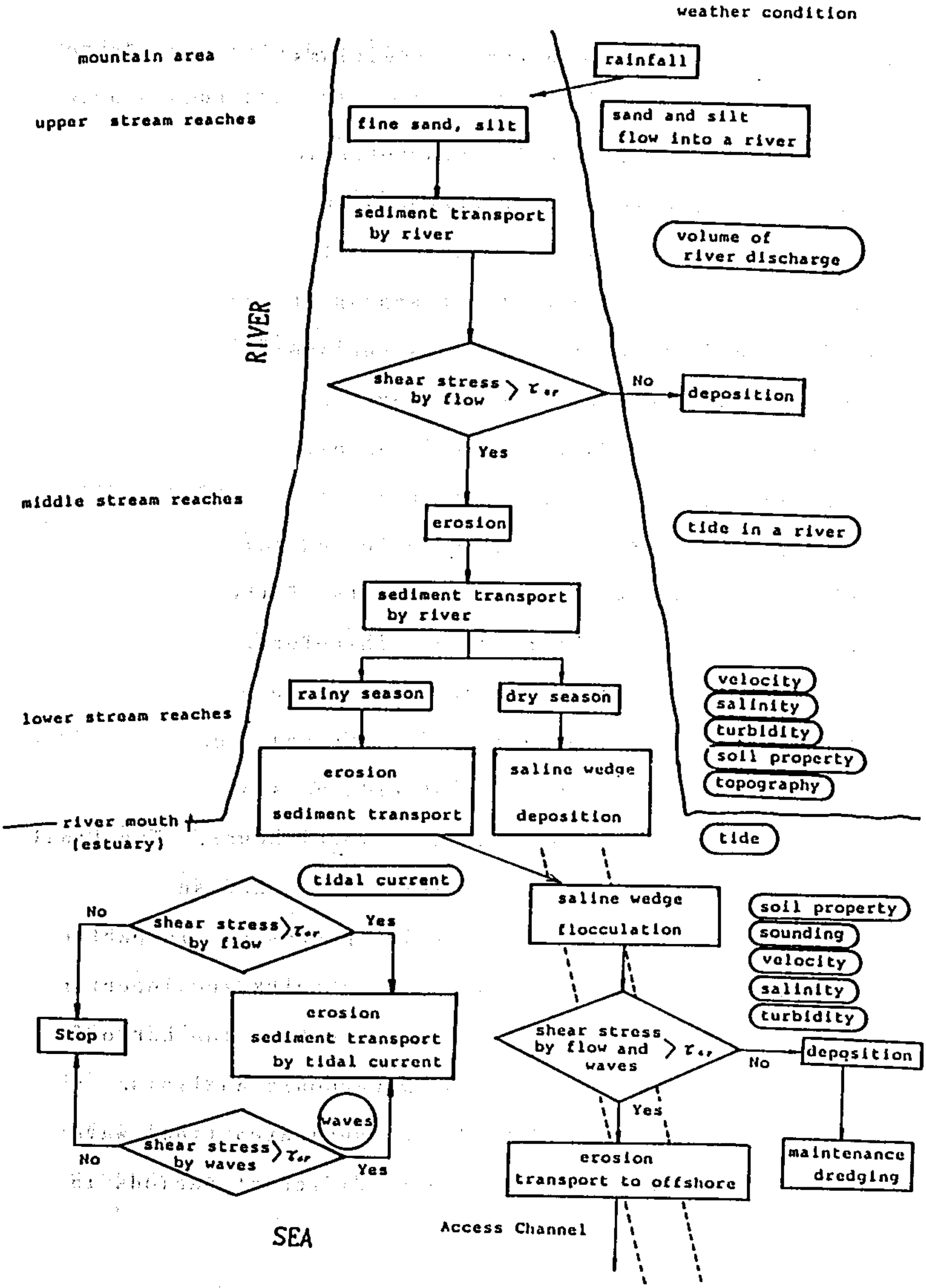

Fig. 1-1 The outline of mechanism of siltation

2.1 Acquisition of data on natural conditions

(a) Tide

Tide is a basic factor when determining the behavior of changes in water levels and currents in sea areas concerned. In order to understand the characteristics of the tide in the sea area concerned, meant the grasping it is necessary to measure the distance from the sea surface to the bottom, which varies momentarily (water depth). Furthermore, tide is the most important factor that is an external force generating currents in the sea area.

Tide can be defined as the rise and fall of the water surface level accompanied by movements of the moon and the sun. Tidal behavior is regular. Therefore, it is possible to know the characteristics of tide and to predict the level of the water surface by using its harmonic constants.

The harmonic components of tide consist of many periods ranging from one year to several hours. The tidal harmonic components shown in Table 1-1 [1] are sufficient for performing analyses for engineering purposes. In particular, the four components marked with an asterisk are important and are called the four main tidal components. The harmonic constants of tide are obtained by harmonic analysis. Harmonic analysis is a method that separates tidal waves into several tidal wave components with different periods in order to obtain the amplitudes and phase lags of each tidal wave component. The number of tidal components separated by such analysis is limited by the duration of the observation period. Data on tidal levels is a basic factor in studying about the natural conditions or the sea area of interest. Therefore, it is desirable that the observation period be as long as possible. A fairly accurate harmonic analysis can be made if data for at least one year is provided. The harmonic constant, once calculated, does not change so much even if there is some change in the conditions.

Generally speaking, tidal levels are measured by continuously observing the rise and fall of the water surface in a tide gauge well over a long period. Therefore, it is desirable that tidal levels be observed for a long period, such as several years, with a facility based on strong foundations. However, if data is required urgently or if a short observation period is enough to provide adequate data, a throw-in type tidal gauge can be used to observe the tide level.

If the observation area is not large and if the currents are not very complex, one observation station is enough to measure tide levels. The boundary conditions of tidal levels in the sea area of interest are considered with reference to tidal level records of other neighbouring sea areas. However, if the sea area of interest is large, or if the currents are complex and there is a long tidal river, two or more observation stations are required.

Using the above-mentioned type of tidal data, the harmonic constants of a tide shown in Table 1-2 and a diagram of the height of its tidal levels as shown in Fig. 1-2 can be obtained.

Table 1-1 Main Components of tide and Its phase Velocity

Component	Phase Velocity
S_a	0.041067
S_{sa}	0.082137
Q_1	13.398661
O_1*	13.943036
P_1	14.958931
K_1*	15.041069
μ_2	27.968208
N_2	28.439730
ν_2	28.512583
M_2*	28.984104
L_2	29.528479
S_2*	30.000000
K_2	30.082137
M_4	57.968208
MS_4	58.984104

*The four main tidal components

Table 1-2 Harmonic Constants of Tide in Kumamoto Port

Component	Amplitude (cm)	Lag (degree)
S_a	17.64	140.64
S_{sa}	4.47	20.70
Q_1	4.19	189.60
O_1*	21.17	197.30
P_1	8.78	217.10
K_1*	28.06	217.48
μ_2	9.48	308.77
N_2	25.36	252.30
ν_2	3.95	229.51
M_2*	134.68	255.08
L_2	7.13	224.67
S_2*	57.90	290.68
K_2	15.33	282.85
M_4	0.73	321.14
MS_4	0.69	326.24

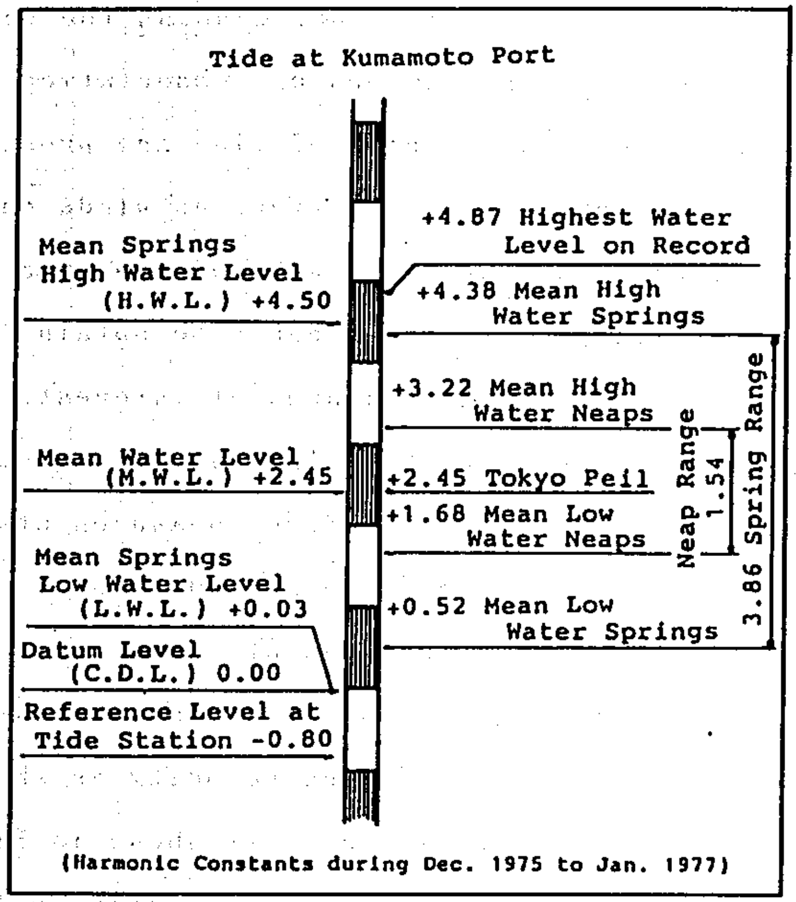

Fig. 1-2 Tidal Levels in Kumamoto Port.

(b) Wind

Wind is an external force that generates waves. It is also an external force that generates currents. Therefore, wind is an important factor in understanding the natural conditions of the sea area concerned. Observation data on winds measured over a long period of time are preserved at meteorological observatories. However, as winds on land are apt to be influenced by the topography of the area such as mountains or buildings, it is desirable to obtain measurements of winds on the sea area of interest. Data on winds is generally used for the values at 10 meters above the ground or the sea surface. Therefore, measurements of wind should be made 10 meters above the sea surface.

Wind data is analyzed in terms of annual or seasonal the distributions of frequency of of winds as classified according to wind direction or wind velocity as shown in Table 1-3, and in terms of wind rose as shown in Fig.1-3. Wind directions are utilized in some cases to estimate the wave directions in the observational sea area where data on wave directions is not available.

Table 1-3 Frequencies Distribution Wind Direction and Wind Velocity (1980.1-1984.12)

(unit:frequency, ( ) shows %)

		CALM	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
Through a year	Calm (less than 0.5m/s)	1,532 (4.0)																	
	0.5- 4.9		1,778 (4.7)	752 (2.0)	412 (1.1)	580 (1.5)	2,460 (6.5)	3,811 (10.1)	1,580 (4.2)	590 (1.6)	578 (1.5)	683 (1.8)	1,048 (2.8)	855 (2.3)	853 (2.3)	1,248 (3.3)	1,551 (4.1)	1,261 (3.3)	21,571 (57.0)
	5.0- 9.9		2,435 (6.4)	832 (2.2)	265 (0.7)	377 (1.0)	1,081 (2.9)	1,362 (3.6)	182 (0.5)	68 (0.2)	584 (1.5)	1,095 (2.9)	1,360 (3.6)	420 (1.1)	197 (0.5)	1,068 (2.8)	1,880 (5.0)	1,395 (3.7)	14,602 (38.6)
	10.0-14.9		232 (0.6)	50 (0.1)	23 (0.1)	64 (0.2)	85 (0.2)	4 (0.0)		25 (0.1)	64 (0.2)	62 (0.2)	155 (0.4)	48 (0.1)	46 (0.1)	201 (0.5)	255 (0.7)	284 (0.7)	1,516 (4.2)
	15.0-19.9		8 (0.0)	2 (0.0)	8 (0.0)					2 (0.0)	2 (0.0)	2 (0.0)	6 (0.0)	4 (0.0)	6 (0.0)	27 (0.1)	14 (0.0)	8 (0.0)	91 (0.2)
	20.0-										6 (0.0)								6 (0.0)
	TOTAL	1,532 (4.0)	4,453 (11.8)	1,636 (4.3)	708 (1.9)	1,021 (2.7)	3,626 (9.6)	5,177 (13.7)	1,762 (4.7)	685 (1.8)	1,234 (3.3)	1,842 (4.9)	2,569 (6.8)	1,327 (3.5)	1,102 (2.9)	2,544 (6.7)	3,700 (9.8)	2,944 (7.8)	37,866 (100.)
																Ratio of Data obtained			86.4%
Winter Season	Calm (less than 0.5m/s)	412 (4.0)																	
	0.5- 4.9		705 (6.9)	331 (3.2)	156 (1.5)	158 (1.6)	625 (6.1)	1,152 (11.3)	560 (5.5)	220 (2.2)	107 (1.0)	46 (0.4)	59 (0.6)	73 (0.7)	79 (0.8)	188 (1.8)	42 (3.4)	362 (3.5)	5,576 (54.6)
	5.0- 9.9		1,184 (11.6)	374 (3.7)	75 (0.7)	44 (0.4)	243 (2.4)	536 (5.3)	59 (0.6)	16 (0.2)	40 (0.4)	30 (0.3)	30 (0.3)	55 (0.5)	69 (0.7)	226 (2.2)	511 (5.0)	594 (5.8)	4,085 (40.0)
	10.0-14.9		95 (0.9)	12 (0.1)		6 (0.1)					2 (0.0)	6 (0.1)	8 (0.1)	2 (0.0)	10 (0.1)	85 (0.5)	139 (1.4)	174 (1.7)	532 (5.3)
	15.0-19.9														2 (0.0)	4 (0.0)	2 (0.0)	4 (0.0)	12 (0.1)
	20.0-																		
	TOTAL	412 (4.0)	1,984 (11.4)	717 (7.0)	231 (2.3)	208 (2.0)	868 (8.5)	1,682 (16.5)	619 (6.1)	236 (2.3)	149 (1.5)	82 (0.8)	97 (0.9)	130 (1.3)	160 (1.6)	503 (4.9)	994 (9.7)	1,134 (11.1)	10,211 (100.)
																Ratio of Data obtained			94.1%
Summer Season	Calm (less than 0.5m/s)	401 (4.4)																	
	0.5- 4.9		91 (1.0)	41 (0.4)	56 (0.6)	83 (0.9)	529 (5.8)	828 (9.0)	347 (3.8)	104 (1.1)	228 (2.5)	274 (3.0)	450 (4.9)	309 (3.4)	342 (3.7)	432 (4.7)	338 (3.7)	261 (2.8)	5,113 (55.7)
	5.0- 9.9		81 (0.9)	39 (0.4)	73 (0.8)	174 (1.9)	332 (3.6)	201 (2.2)	48 (0.5)	12 (0.1)	309 (3.4)	664 (7.2)	782 (8.5)	181 (2.0)	27 (0.3)	226 (2.5)	301 (3.3)	228 (2.5)	3,677 (40.1)
	10.0-14.9		6 (0.1)	6 (0.1)	21 (0.2)	54 (0.6)	79 (0.9)	4 (0.0)		10 (0.1)	37 (0.4)	25 (0.3)	56 (0.6)	17 (0.2)	2 (0.0)	4 (0.0)	6 (0.1)	21 (0.2)	347 (3.8)
	15.0-19.9		6 (0.1)	2 (0.0)	8 (0.1)						2 (0.0)	2 (0.0)	6 (0.1)	4 (0.0)			4 (0.0)		33 (0.4)
	20.0-										6 (0.1)								
	TOTAL	401 (4.4)	184 (2.0)	88 (0.9)	158 (1.7)	311 (3.4)	940 (10.2)	1,033 (11.3)	395 (4.3)	126 (1.4)	582 (6.3)	965 (10.5)	1,294 (14.1)	511 (5.6)	371 (4.0)	662 (7.2)	649 (7.1)	510 (5.6)	9,176 (100.)
																Ratio of Data obtained			83.1%

Data : From "Wind Observation Result at Kumamoto Port" by 4th District Port Construction Bureau, Ministry of Transport and Yatsushiro Port Construction Office

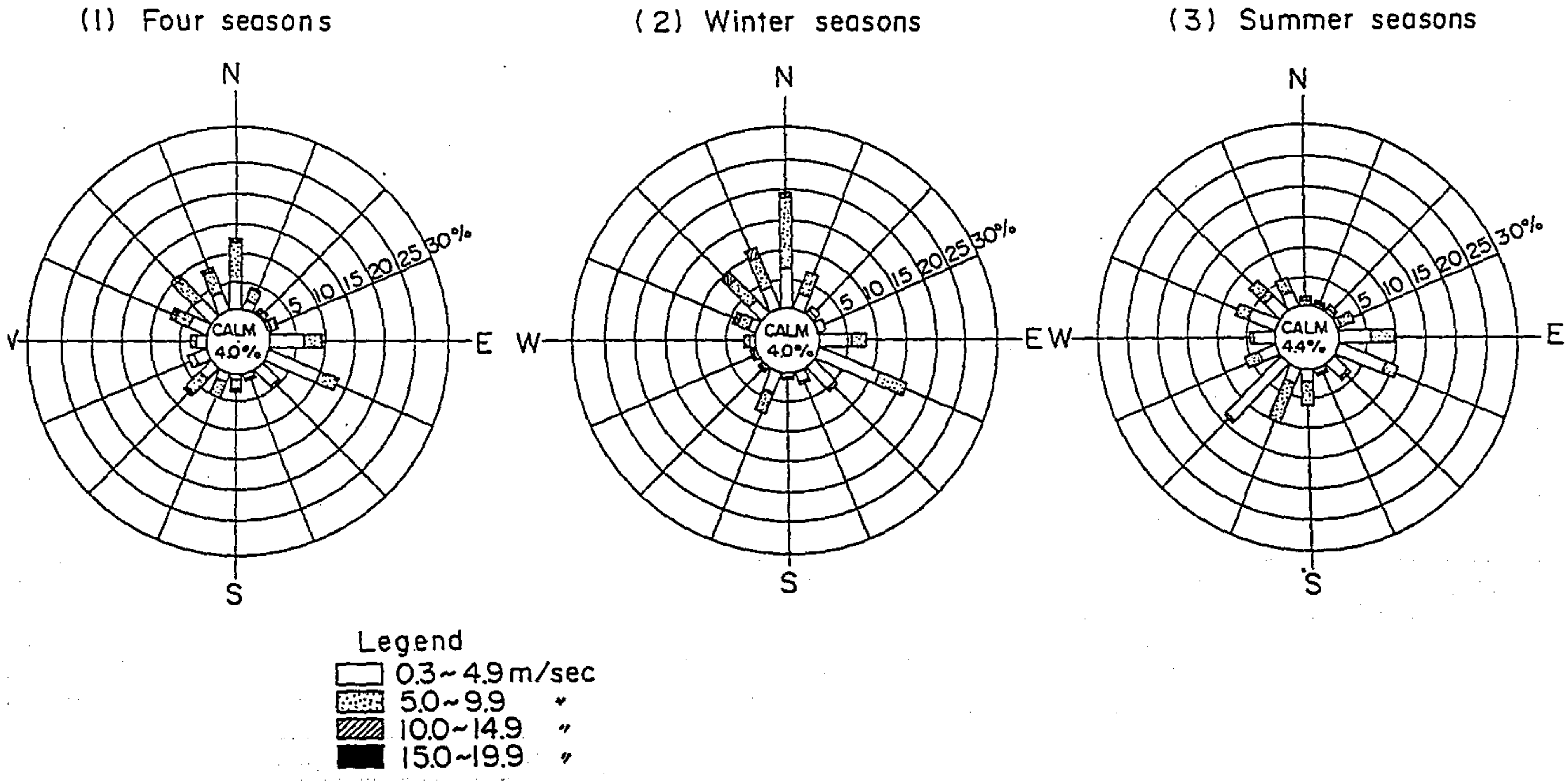

Fig. 1-3 Frequencies Distribution of Wind Directions by Wind Velocity

(c) Wave

The wave action is the strongest external force responsible for the suspension of bottom sediment in the coastal area. Furthermore, waves contribute to the transportation of bottom sediment by generating longshore currents due to radiation stress. Therefore, when studying the problem of siltation, it is most important to observe the characteristics of waves in the sea area concerned.

Waves are generated, developed and propagated by the tangential stress of winds that blow over the sea surface. Therefore, wind velocities, wind directions and the influence of winds in the surrounding sea area are the most important factors for characterizing waves. Therefore, it is necessary to obtain data on winds at the same time when the waves are measured.

Waves are measured by a wave gauge. Waves are specified by wave height, wave period and wave direction. Waves are transformed by configuration, topography and water depth. Therefore, in order to obtain the characteristics of waves in the entire area of interest, it is desirable to measure the deep water waves, which are not affected by bottom configurations. However, so far as the problem of siltation is concerned, the shearing stress of waves on the bottom surface is considered to be an important external force acting on bottom sediment in the sea area. Thus, it is necessary to measure waves in the shallow sea area of interest. Furthermore, if bottom sediments with a high water content are deposited on the sea bottom, the bottom sediments move in a wave motion together with the movement of water waves. There is also the phenomenon of wave heights damping together with the dissipation of wave energy. In order to calculate the distributions of wave heights in the entire area of interest, it is necessary to obtain not only data on the transformation of waves, but also this damping coefficient. The damping rate of wave heights can be calculated by obtaining wave heights at two points in the wave's propagation direction.

Various types of wave gauges are available. A shooting type ultrasonic wave gauge was used for wave height observation in the Banjarmasin study. Wave heights and periods are measured with a wave gauge. At present, various kinds of wave direction meters have been developed.

At present, the directions of waves with a long period are estimated from off-shore data and those of waves with a short period are estimated by observing wind directions.

Data processing of the measured values of waves is classified into annual statistical data and specialized data for stormy weather wave characteristics and other conditions.

Table 1-4 shows the frequency distributions of waves classified by wave direction and wave height Fig.1-4 is a diagram of the frequency distributions of waves, respectively, in Kumamoto Port in 1979-1982 and in 1985. Table 1-5 shows the frequency distributions of waves classified by wave height and wave period in the same observation period. Here, wave directions are estimated from records on wind directions. Although it is not treated here, the problem of statistical data on wave height is an important issue in the processing of records of wave data.

Next, there is the problem of wave characteristics in stormy weather. In cases where the behavior of bottom sediment is affected largely by waves as in Kumamoto Port, simultaneously recorded data on wave heights, tidal levels, currents, water particle velocity (current), turbidity (SS) and deposition height in stormy weather are important data for analyzing the mechanism of siltation. Fig.1-5 shows results of the observation data as an example. It is clear from this figure that the oscillating flow velocity on the bottom surface (or the shearing stress on the bottom surface) increases when wave heights are large and the tidal level is low, and as a result of that, SS concentration is increased and the sedimentation thickness is increased.

Table 1-4 Appeared Frequency of Wave Direction and Wave Height (1979-82, 1985)

Upper layer : Appeared times

Middle layer: % (Appeared times / Total times)

Lower layer : % (Appeared times / Rank total)

Wave direction / Wave height	CALM	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL
CALM	14370 76.1 100.								14370 76.1 100.
0.0<H<0.2	7 0.0 29.1	3 0.0 12.5	3 0.0 12.5			4 0.0 16.7	6 0.0 25.0	1 0.0 4.2	24 0.1 100.
0.2≦H<0.4	743 3.9 47.4	143 0.8 9.1	131 0.7 8.3	68 0.4 4.3	29 0.2 1.8	86 0.5 5.5	193 1.0 12.3	178 0.9 11.3	1571 8.3 100.
0.4≦H<0.6	715 3.8 38.3	127 0.7 6.8	155 0.8 8.3	70 0.4 3.7	33 0.2 1.8	176 0.9 9.4	304 1.6 16.3	288 1.5 15.4	1868 9.9 100.
0.6≦H<0.8	214 1.1 33.3	19 0.1 2.9	48 0.3 7.4	25 0.1 3.9	18 0.1 2.8	78 0.4 12.1	97 0.5 15.0	146 0.8 22.6	645 3.4 100.
0.8≦H<1.0	59 0.2 22.7	2 0.0 0.8	11 0.1 4.2	13 0.1 5.0	10 0.1 3.8	42 0.2 16.2	72 0.4 27.7	51 0.3 19.6	260 1.4 100.
1.0≦H<1.2	16 0.1 17.8	1 0.0 1.1	1 0.0 1.1	2 0.0 2.2	5 0.0 5.6	19 0.1 21.1	17 0.1 18.9	29 0.2 32.2	90 0.5 100.
1.2≦H<1.4	6 0.0 16.3	1 0.0 2.7		2 0.0 5.4	1 0.0 2.7	6 0.0 16.2	11 0.1 29.7	10 0.1 27.0	37 0.2 100.
1.4≦H<1.6					1 0.0 12.5		1 0.0 12.5	6 0.0 75.0	8 0.0 100.
1.6≦H<1.8								2 0.0 100.	2 0.0 100.
1.8≦H									
TOTAL	16,130 85.4 85.4	296 1.6 1.6	349 1.8 1.8	180 1.0 1.0	97 0.5 0.5	411 2.2 2.2	701 3.7 3.7	711 3.8 3.8	18875 100. 100.

(Remark) In case of no data for wind direction, data were excluded.

Table 1-5 Table of Frequencies by Wave Height and by Period (1979-1982 and 1985)

Period(SEC) \ Wave height (m)		CALM	0.0<H <0.2	0.2≦H <0.4	0.4≦H <0.6	0.6≦H <0.8	0.8≦H <1.0	1.0≦H <1.2	1.2≦H <1.4	1.4≦H <1.6	1.6≦H <1.8	1.8≦	TOTAL
CALM	Times %	14370 74.2											14370 74.2
T<1.0	Times %												
1.0≦T<2.0	Times %		4 0.0	33 0.2									34 0.2
2.0≦T<3.0	Times %		24 0.1	1320 6.8	1063 5.5	149 0.8	8 0.0						2564 13.2
3.0≦T<4.0	Times %		3 0.0	371 1.9	905 4.7	519 2.7	225 1.2	52 0.3	15 0.1				2090 10.8
4.0≦T<5.0	Times %			39 0.2	72 0.4	57 0.3	40 0.2	33 0.2	22 0.1	8 0.0	2 0.0		273 1.4
5.0≦T<6.0	Times %		2 0.0	8 0.0	11 0.1	7 0.0	3 0.0	2 0.0	1 0.0		1 0.0		35 0.2
6.0≦T	Times %				2 0.0	2 0.0	1 0.0	3 0.0					8 0.0
TOTAL	Times %	14370 74.2	33 0.2	1768 9.1	2053 10.6	734 3.8	277 1.4	90 0.5	38 0.2	8 0.0	3 0.0		19374 100.0

(note) Data included at the time of no data for wind direction.

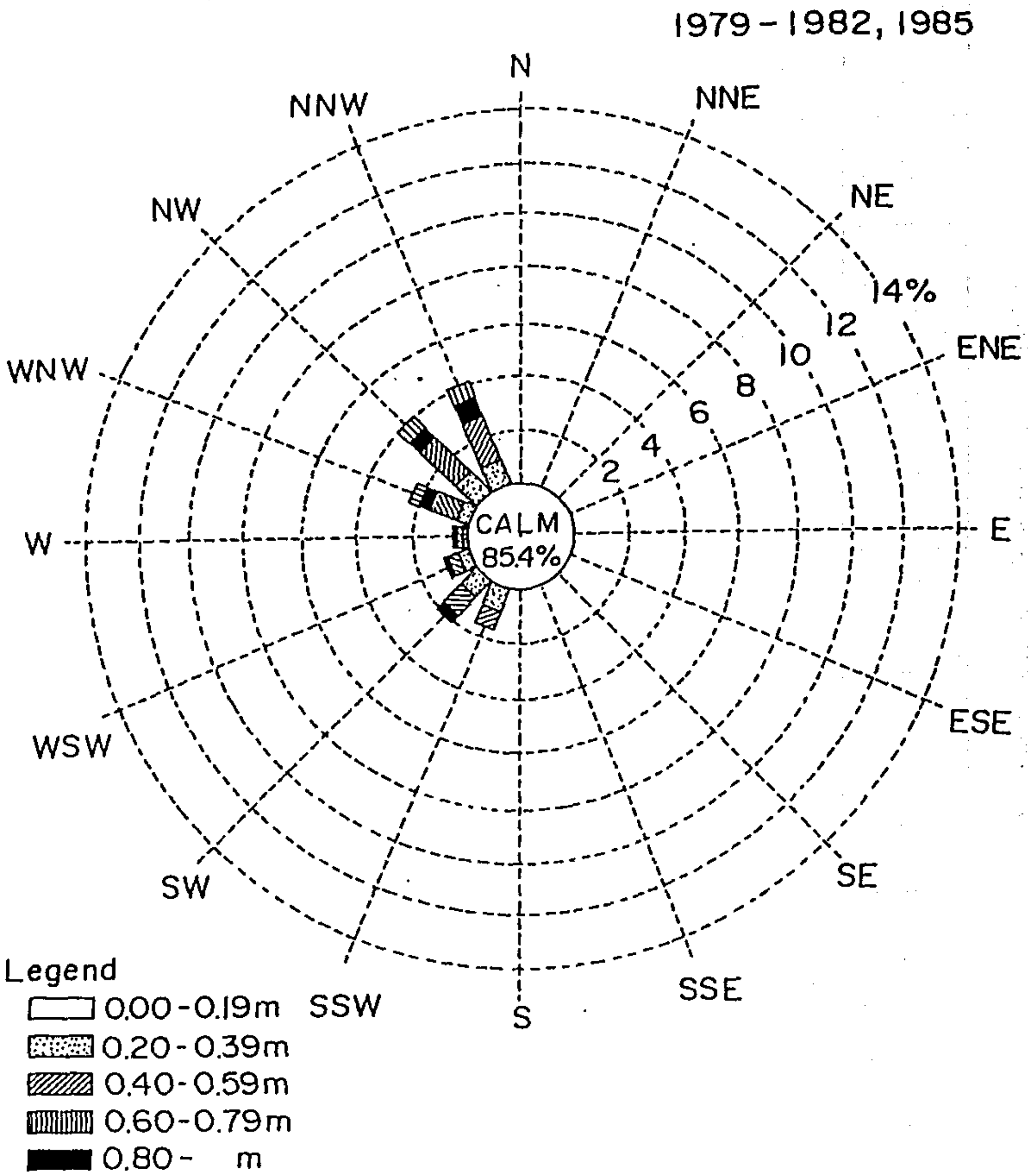

Fig. I-4 Frequencies Distribution of Wave Directions by Wave Height

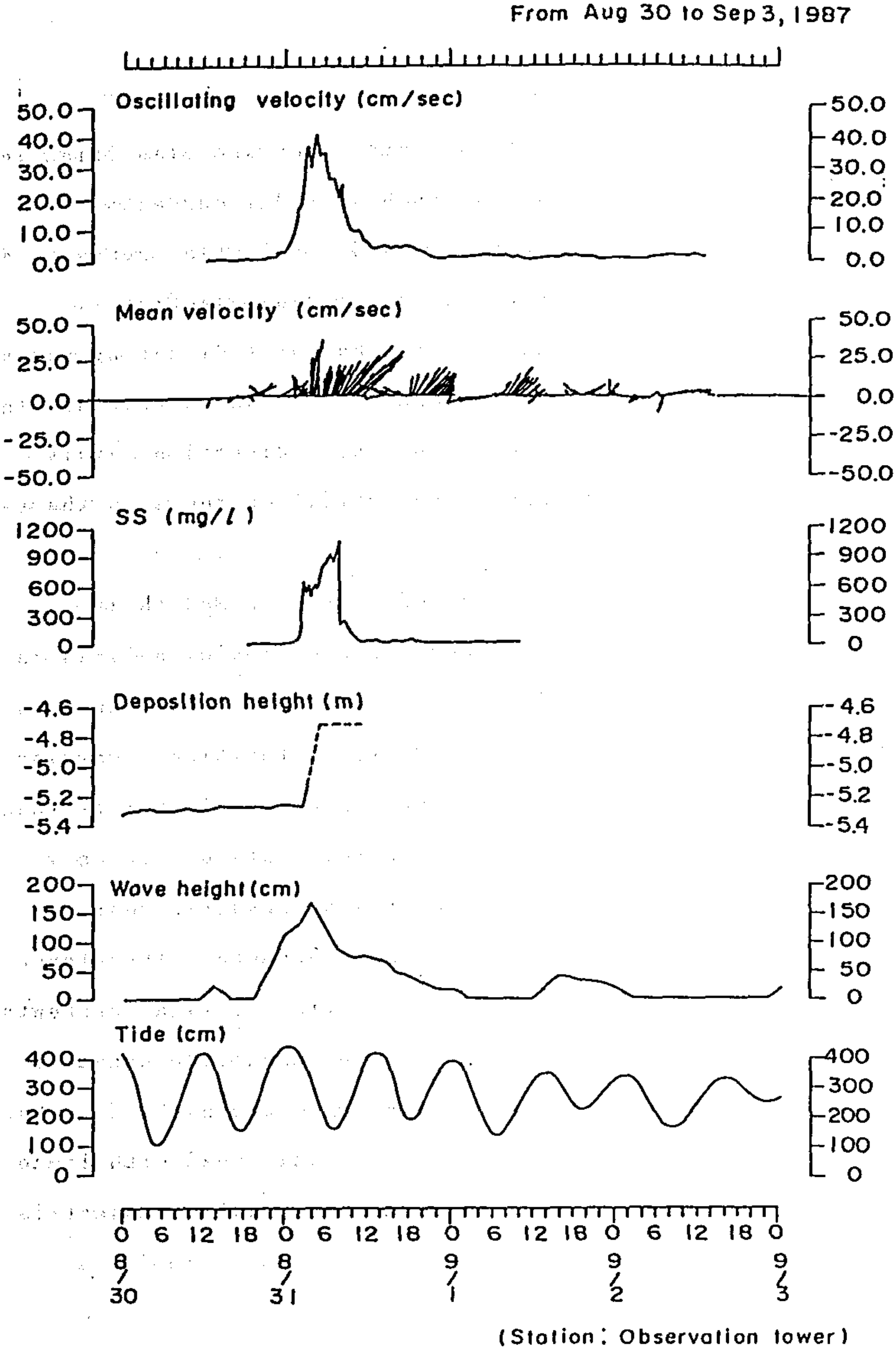

Fig. 1-5 Simultaneously Recorded Data on Oscillatry Flow Velocity, Average Flow Velocity, Turbidity, Deposition Height, Wave Height and Tide (Kumamoto)

(d) Current

In the observation of currents, they are classified into relatively large-scale waves, such as tidal currents, longshore currents due to waves, and oscillating currents due to the movement of water particles from wave action. Suspended material eroded from the bottom sediment by waves or currents is thought to be carried by tidal currents. In order to obtain the sediment deposition direction, it is necessary to study the behavior of tidal currents in the sea area of interest.

Tidal currents are generated by tides, and their movement is very regular. Therefore, harmonic analysis is effective for understanding the behavior of tidal currents in the sea area of interest, just as it is for tide. However, tidal currents are influenced more by external factors than tides, which are influenced by the movements of heavenly bodies. Some examples are wind-driven currents, density currents, longshore currents and sea currents. Therefore, it is not as simple to discover the behavior of tidal currents as it is for tides. However, in a sea area like Kumamoto Port, where the tidal range is large and where there is only a narrow mouth open to the sea, or in sea areas with large tidal rivers like Banjarmasin Port, the tidal component is the most important.

Tidal currents are measured generally by an Ono-type current meter or a Bergen type current meter. As in the case of tide, it is desirable to measure currents for as long as possible. However, it is extremely difficult to do so because of such various problems as the difficulty of mooring a current meter. It is necessary to carry out continuous measurements for at least 15 days - one month in order to obtain a harmonic constant of tidal currents. The measurement point of tidal currents should be chosen in order to make it possible to obtain a general pattern of tidal currents in the sea area concerned. This point should be suitable for use as a boundary in future studies to help verify data for future tidal current simulations. Measurement taken at position which is liable to be affected by eddy currents due to configurations should be avoided, except in cases where data obtained at such a point is of special significance.

Currents in stormy weather should be measured by a different method from that mentioned above. In order to observe the phenomenon of bottom sediment being eroded by the oscillatory current component of waves, or to discover the behavior of fine particles on the sea bottom, it is necessary to measure short period currents, such as the oscillating flow velocity due to wave action near the sea bottom.

together with averaged currents, such as tidal currents. An electromagnetic current meter which can measure in time intervals of 0.5 - 1.0 second is suitable for the purpose of this kind of measurement. Fig.1-6 shows an electromagnetic current meter installed with its framework on the sea bottom. This measurement method makes it possible to see whether the erosion of bottom sediment is due to waves or tidal currents. Fig.1-7 shows the relationships between average flow velocity and turbidity (SS), and oscillatory flow velocity and turbidity measured on the sea bottom in Osaka Bay[3].

Tracking floats on the sea surface is a simple way of investigating the pattern of currents in the observational area. A float is liable to be strongly affected by winds. To control cope for the wind effect, the float has a submerged resisting plate, as shown in Fig.1-8. This allows it to follow the current at the depth of the resisting plate. This method is very simple and makes it possible to observe the flow pattern over a wide sea area. But it is very difficult to carry out continuous, long-term observations under these conditions.

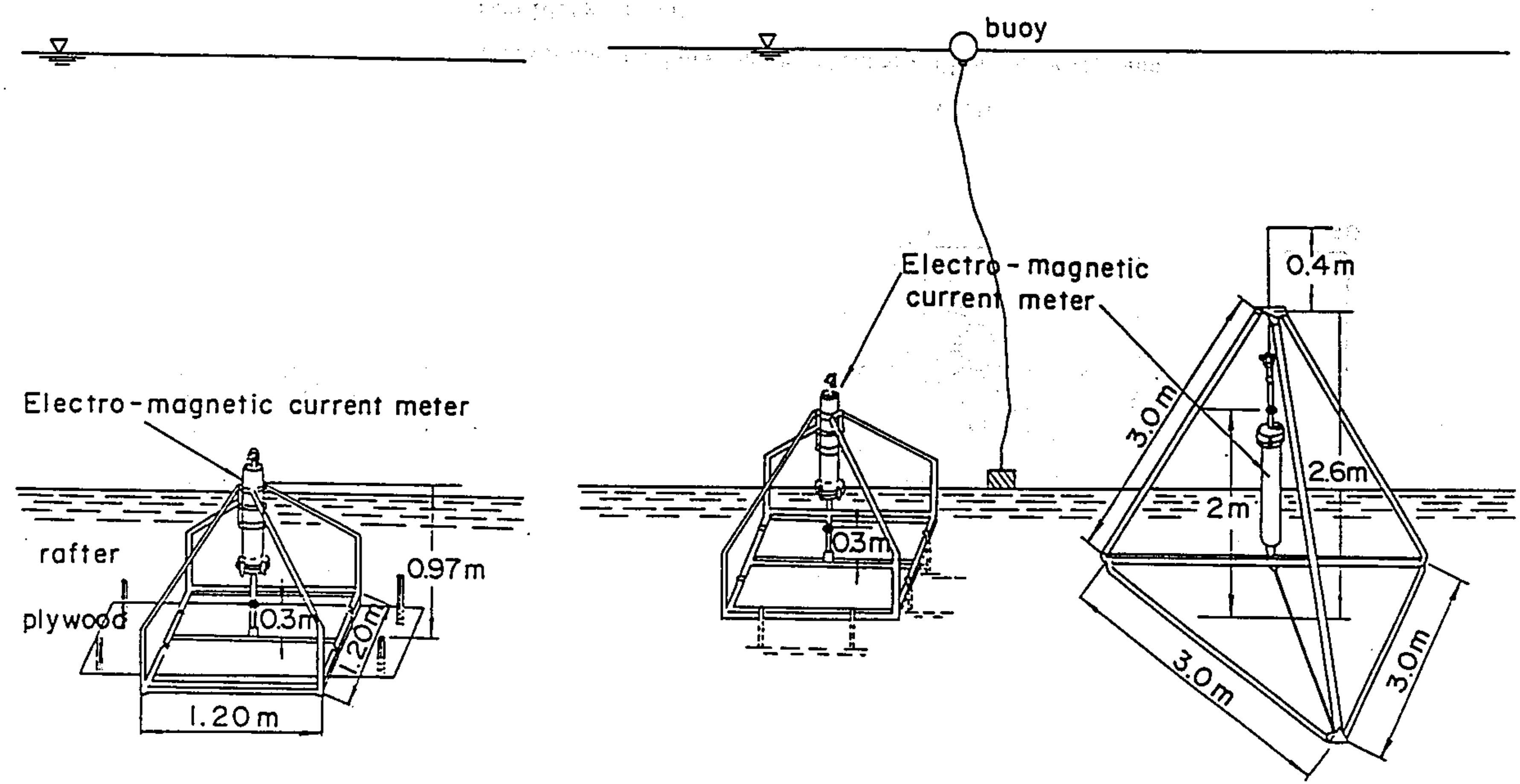

Fig. 1-6   Installation of an Electromagnetic Current Meter

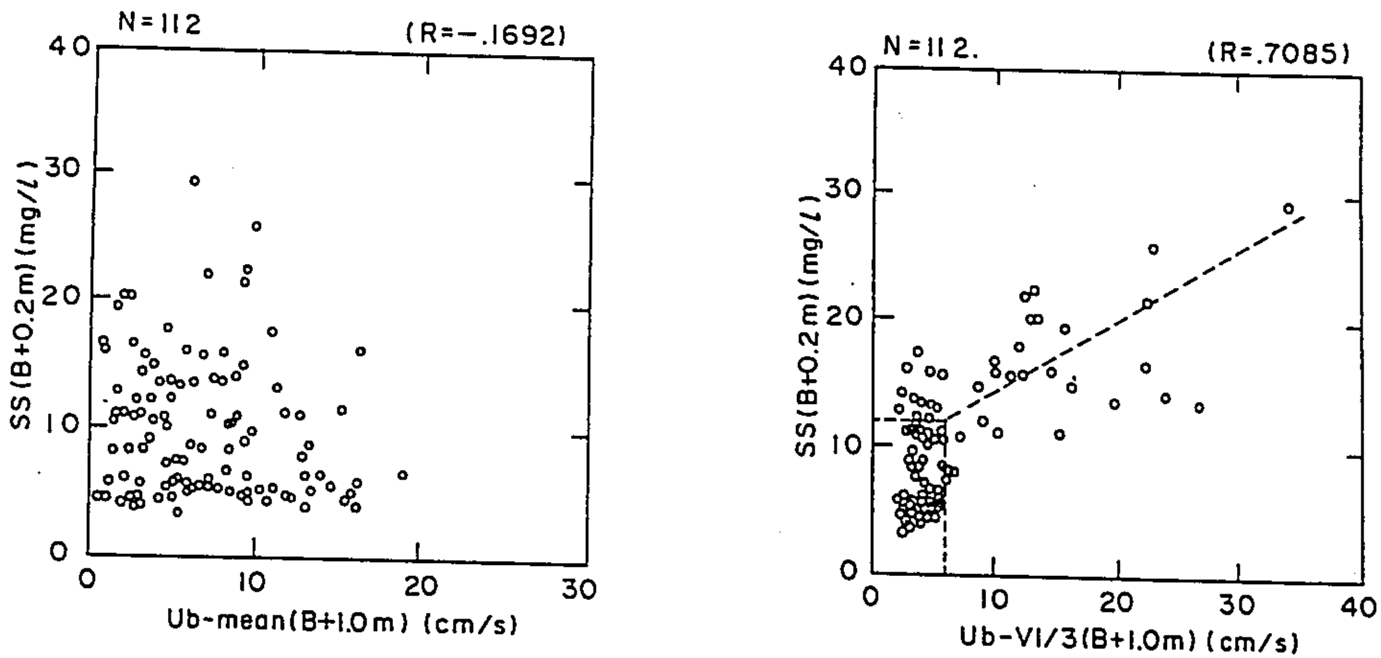

Fig. 1-7 Average Flow Velocity and Turbidity (left) and the Relationships between Oscillatory Flow Velocity and Turbidity (right)

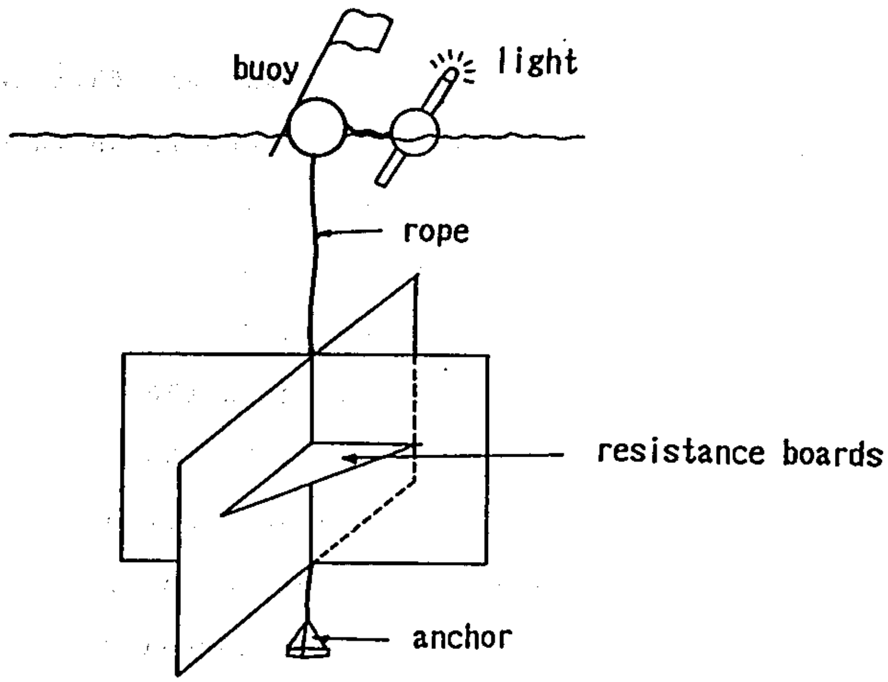

Fig. 1-8 Sketch of Float

(e) Saline wedge

When clay particles suspended in river water (fresh water) come into contact with sea water, they form flocs and settle down to the bottom because of the existence of positive charged ions in the sea water. This mechanism is outlined in Fig.1-9. The place where fresh water comes into contact with saline water determines where suspended materials settle and deposit.

If there is a tidal rise and fall in the estuary or the river, a tidal prism is generated in the tidal river. Saline water intrudes upstream the river by the tidal prism. This phenomenon is classified into a well-mixed, partially-mixed or weakly-mixed estuary depending on the flow discharge from the river and the tidal range in the sea. Furthermore, whether the river water meets the sea water in the river or in the sea, is determined by the amount of river discharge. Generally, fresh water with a light density flows in the upper layer and sea water with a heavy density flows in the lower layer. Therefore, when this phenomenon is called the saline wedge.

Conducting a field survey of a saline wedge, simultaneous measurements of flow velocity and salinity are carried out for each cross-section. Measurements are needed from surface to bottom layers at each measuring point. The saline water moves upstream during flood tide and recedes downstream during ebb tide. Thus, it is necessary to measure the current velocity and salinity during a complete tidal cycle continuously at regular intervals. There is a difference in a place where a saline wedge occurs in the rainy season, which has a large amount of river discharge, and in the dry season, which has only a small amount of river discharge. Therefore, it is necessary to understand the behavior of seasonal changes of the saline wedge. From the results of measurements taken in different seasons with different river discharge levels, a diagrams of the saline wedge can be shown as in Fig.1-10 [4].

At Banjarmasin Port, it is thought that sediment deposition occurs in the river in the dry season since the saline wedge moves upstream of the Barito River, and that sediment deposition occurs outside of the river in the rainy season, since the saline wedge is pushed from the river to the sea.

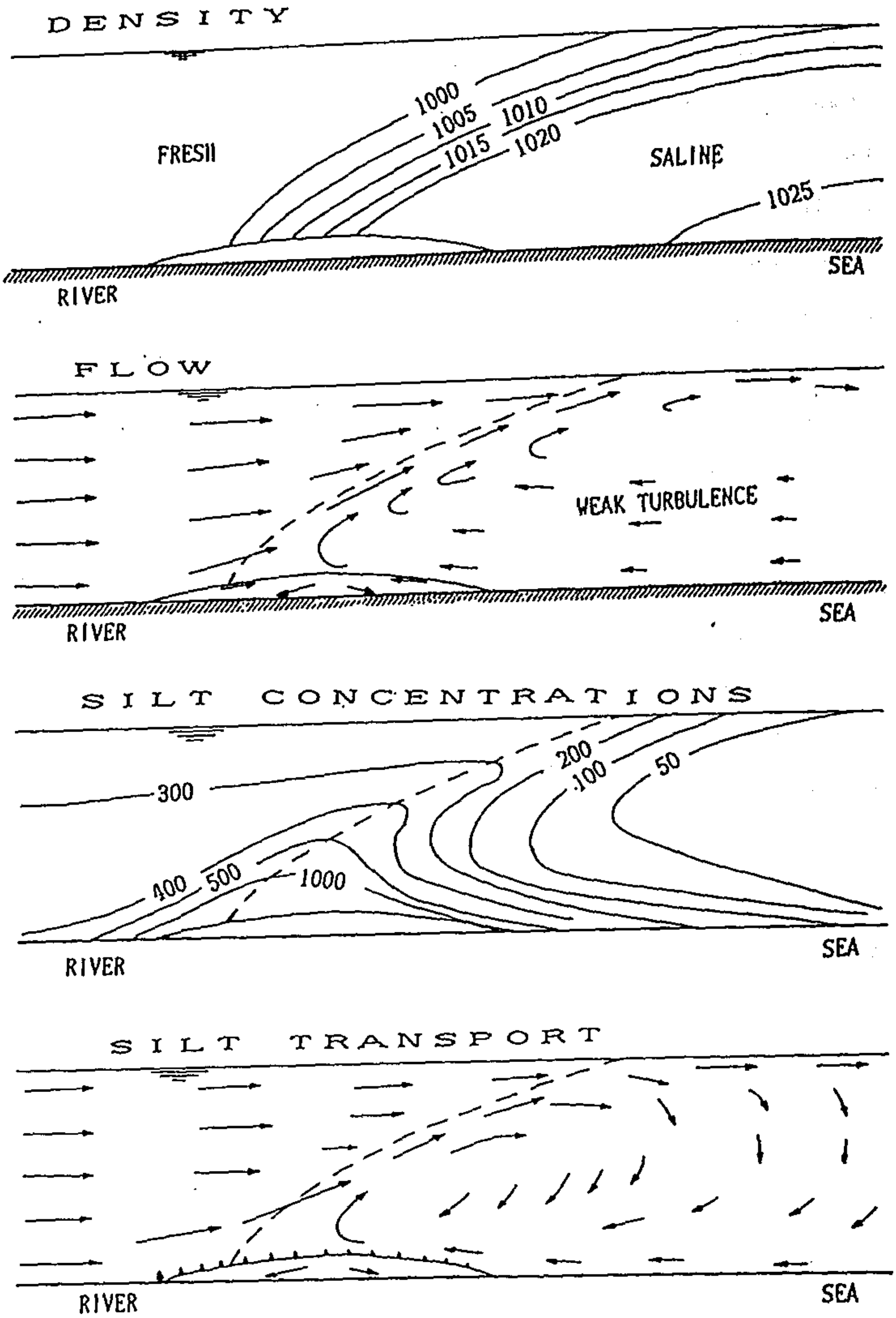

Fig. 1-9 Mechanisms of Saline Wedge and Siltation

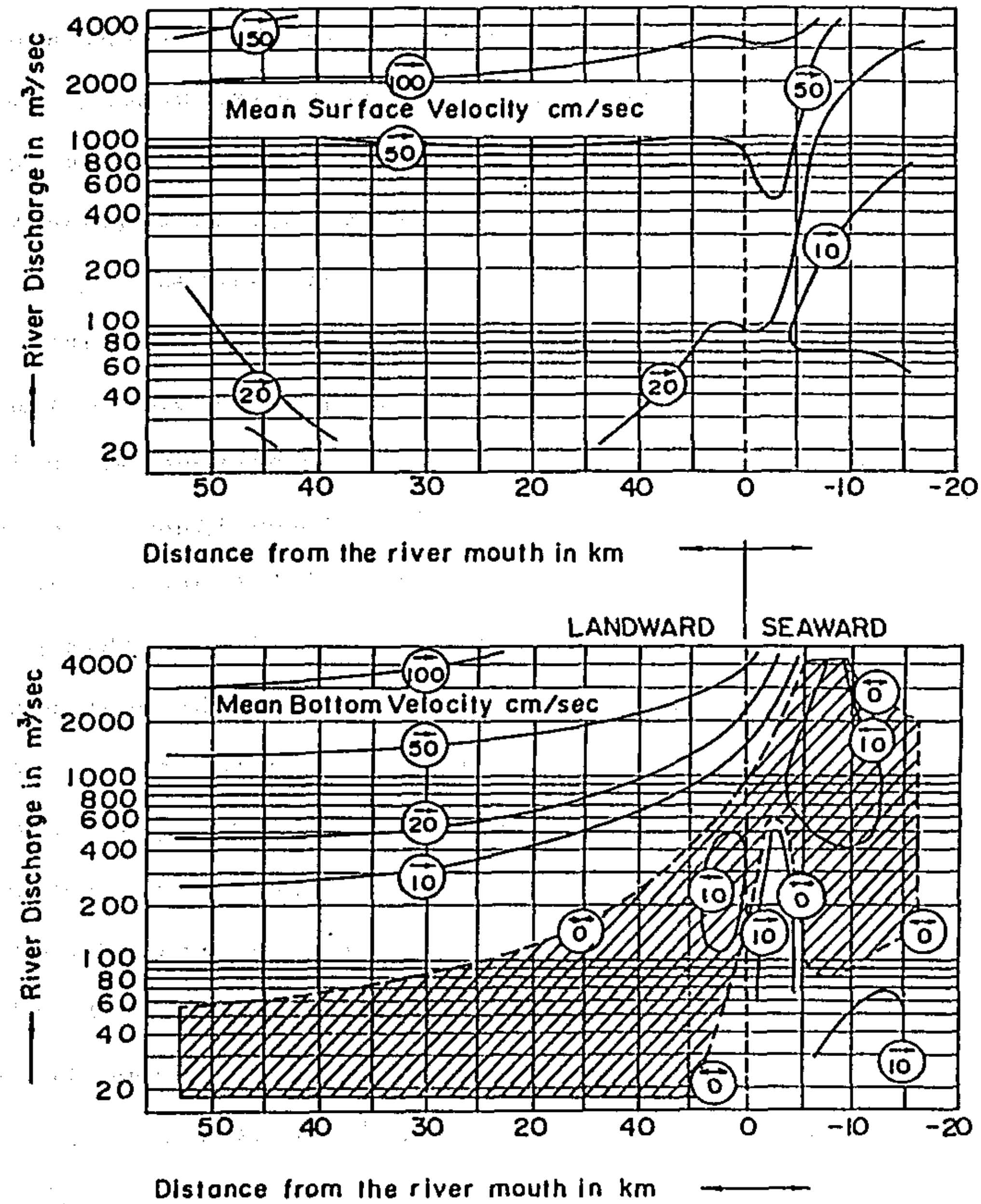

Fig. 1-10 Relationship between the Flow Directions of the Upper and the Lower Layer of the Chao Phraya River and Its River Discharge

(f) River discharge

The phenomena of tidal current, saline wedge, and the transportation of suspended material in the estuary are affected largely by the amount of river discharge. Therefore, in order to understand the phenomena of natural conditions in the sea area of interest, it is necessary to correctly obtain the amount of river discharge.

Measurements of river discharge are usually carried out at a location further upstream than the area of the tidal river and by obtaining the relationship between water levels and the amount of river discharge. If the tidal river is very long, as for the Barito River, or if there are many tributaries, this method cannot be adopted. In this case, therefore, the river discharge is estimated by measuring the current velocity at the cross-section for the river for a complete tidal cycle, and the average volume of discharge during one tidal cycle is regarded as the river discharge. In order to estimate the river discharge accurately, it is necessary to measure the current velocity for one tidal cycle with a current meter used continuously over the entire cross-section in vertical and horizontal directions.

2.2 Acquisition of data on soil properties

(a) Concentration of suspended materials

Until now we have examined various factors in the research of natural conditions as external forces on siltation. It is important to understand the property of suspension of bottom sediments under various natural conditions. Particularly, it is important to know the vertical distribution of the concentrations of suspended material, in order to understand the mechanisms of the behavior of sediment erosion from the sea bottom and the factors related to the transportation of suspended materials, as well as those involved in the deposition of the material on the sea bottom. This is also useful when carrying out numerical simulations. Therefore, it is necessary to investigate the suspended characteristics of bottom sediment, as well as performing a field survey on various natural conditions.

To begin with, as field measurements for studying the suspended characteristics of bottom sediments, concentration distributions of suspended materials under various natural conditions are measured in the observational area. Turbidity and/or suspended solids are generally measured in order to learn the distributions of suspended materials.

First of all we shall examine the measurements of concentration distributions of suspended material with the use of a turbiditymeter. The turbiditymeter uses an optical system of the backward scattering infrared ray method.

Water is sampled to measure the concentration of suspended solids. Turbidity is strongly related to suspended solids. However, even if the concentration of suspended solids is the same, the turbidity varies due to the distribution characteristics of grain size. While turbidity is obtained by measuring the concentration of suspended solids indirectly with the use of an optical measuring instrument, the measurement of suspended solids by water sampling is a direct method in which the weight of suspended materials in water is measured. This can be used for the verification of the measurement values by a turbiditymeter. Water sampling is done by a water sampler. Water sampling is usually conducted by a water sampler thrown into the sea from a boat. However, this method cannot be performed in stormy weather. In view of the importance of learning the concentration of suspended material in stormy weather for siltation research, an automatic water sampler with a remote timer was used for water sampling in Kumamoto Port. Fig. 11 shows the outline of data acquired by a turbiditymeter and a water sampler installed on the observation tower. These are designed for automatic observation and automatic water sampling in stormy weather and are activated by remote-control.

Fig.1-12 shows the results of time-series values of measurements of the vertical distribution of turbidity obtained by this facility[2].

Measurements of grain size distribution and ignition loss of the suspended material obtained by water sampling are useful data for discovering the behaviors of erosion and deposition of bottom sediments.

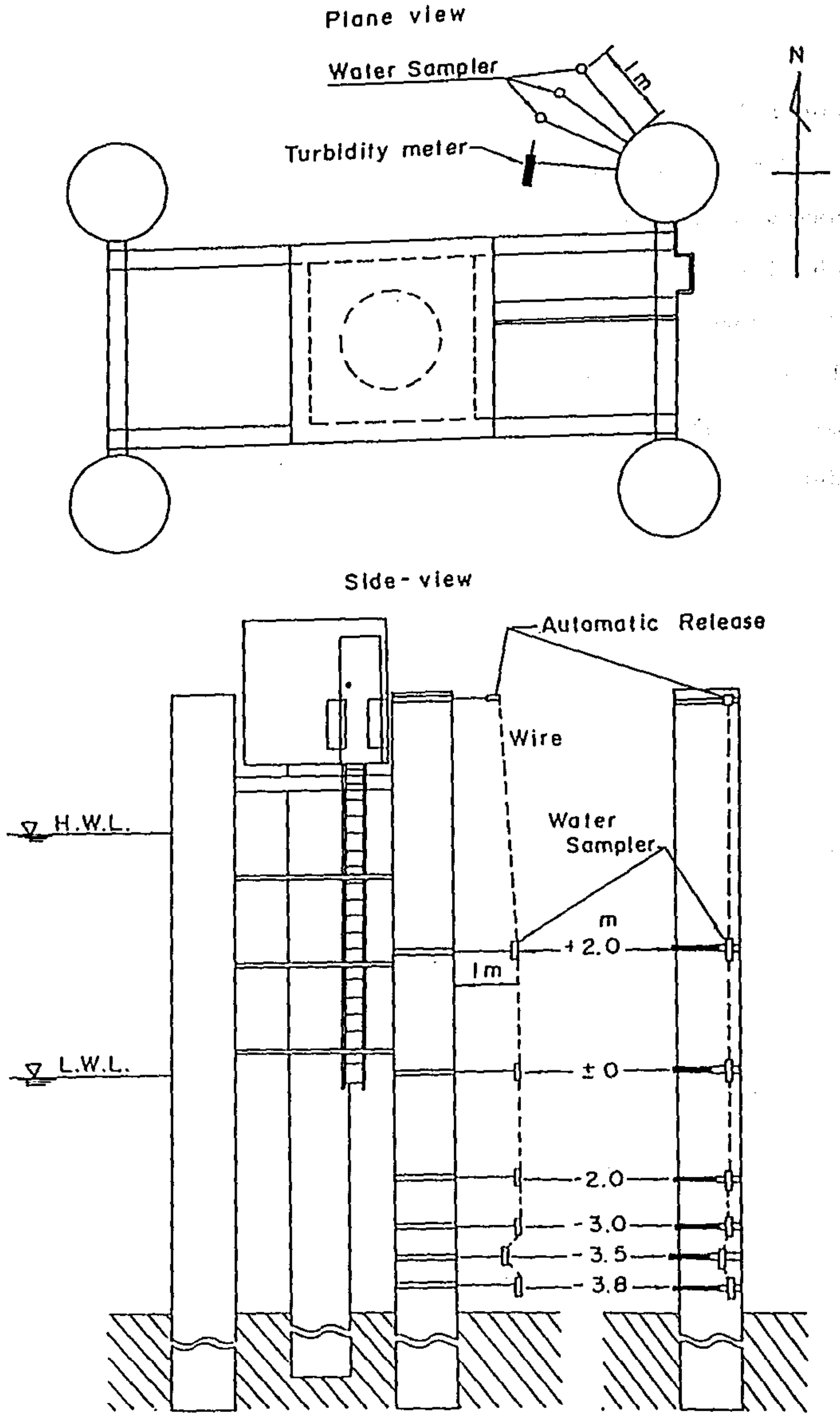

Fig. 1-11 Water Sampler and Turbiditymeter Installed on the Observation Tower (Kumamoto)

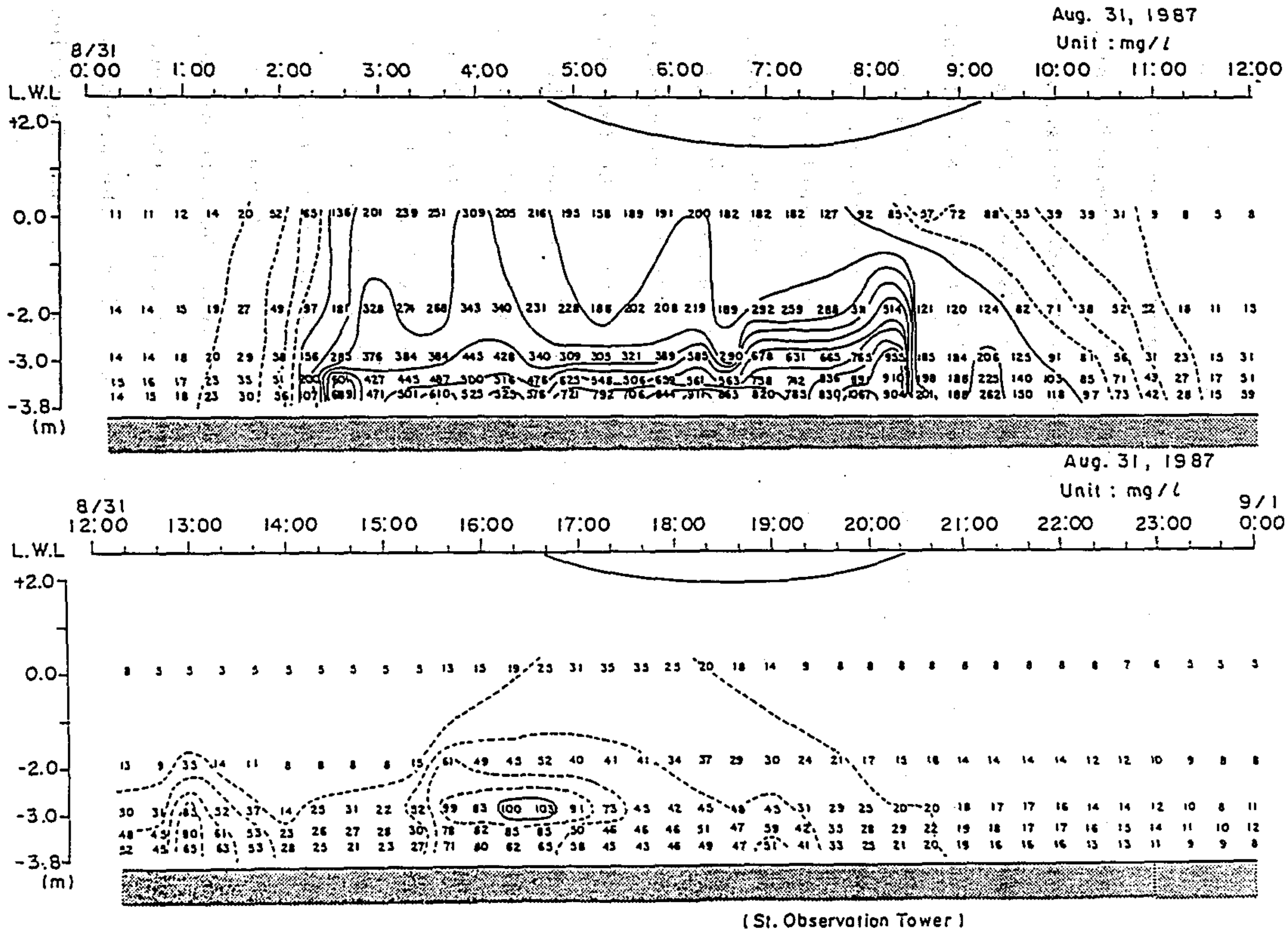

Fig. 1-12 The observed value of Vertical Distribution of Turbidity

(b) Settling characteristics

Settling characteristics of fine particles are considerably complex. Generally, the settling velocity of a single particle is expressed by the relationship between grain size and settling velocity, as expressed by Stokes' equation. However, cohesive fine particles such as clay and silt do not settle singly or independently, but in the form of flocs. It is well known that the settling velocity of flocs is considerably high when compared to a single particle. Fig.1-13 shows the relationship between settling velocity and the concentration of suspended solids[5]. If there is a low concentration, the settling velocity increases as the concentration increases. This is due to the fact that as the concentration of suspended material increases, the probability of collision of particles increases and there is an increase in the number of large flocs. However, if the concentration is increased further, the settling velocity is reduced due to interference between particles (hindered settling). For the above reasons, flocculation is a very important factor in the settling velocity of suspended sediments. In the process of flocculation, the size of the flocs is determined by the turbulent intensity of the flow, as well as the above-mentioned concentration. The strength of the turbulent intensity of the flow promotes the formation of flocs as it increases the likelihood of collision of particles. However, it also destroys the large flocs with its shear stress. As explained above, this phenomenon is quite complex.

The problem of settling velocity of sediment particles in siltation is very complex. Attempts at insitu measurement have been made to measure the settling velocity of sediment particles directly. One example is a method called the Owen Tube[6]. The Owen tube combines a water sampler with a sedimentation cylinder, and makes it possible to take water samples and conduct the settling velocity test on a boat immediately afterwards. This means that the measurement size of the flocs is equal to that in the field. Fig. 1-14 shows a Bray Stoke, an insitu type settling velocity equipment of the same type as the Owen tube. In a settling velocity test on a boat, the test tube is stood up as shown in Fig. 1-15. An amount of water equal to one-eighth of the volume of the tube is withdrawn from the bottom of the tube at the designated time, and the settling velocity insitu is estimated from the values of the concentration of suspended solids in the water samples. We should note that this method has the defect that there is a possibility of residual mud particles remaining on the bottom of the tube (in the test conducted in Kumamoto mud particles remained on the bottom surface of the tube). The concentration of mud particles is measured by withdrawing water from the bottom of the tube. To remove this defect, an insitu type settling velocity device has recently been developed. It is designed to allow water to be withdrawn from the side of the tube[7].

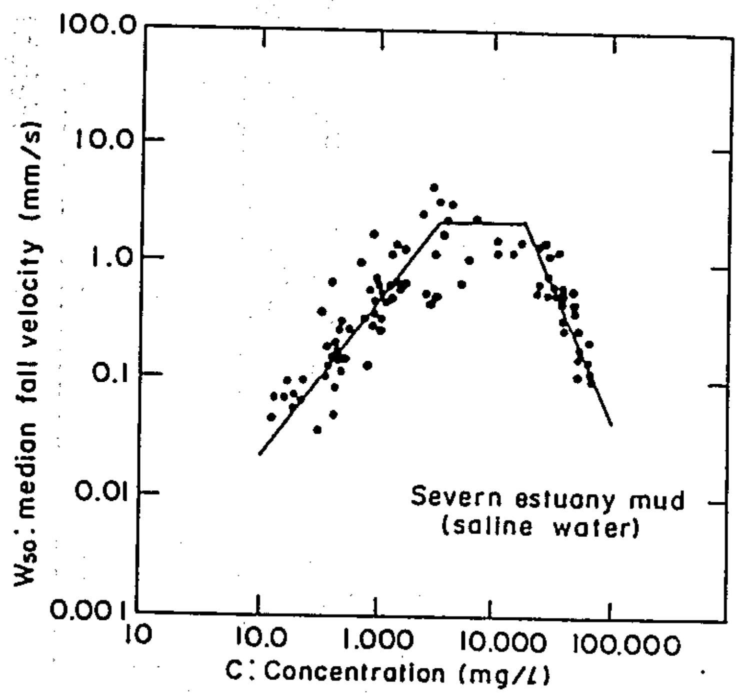

Fig. 1-13 The Relationship between Concentration of Suspended Materials and Settling Velocity

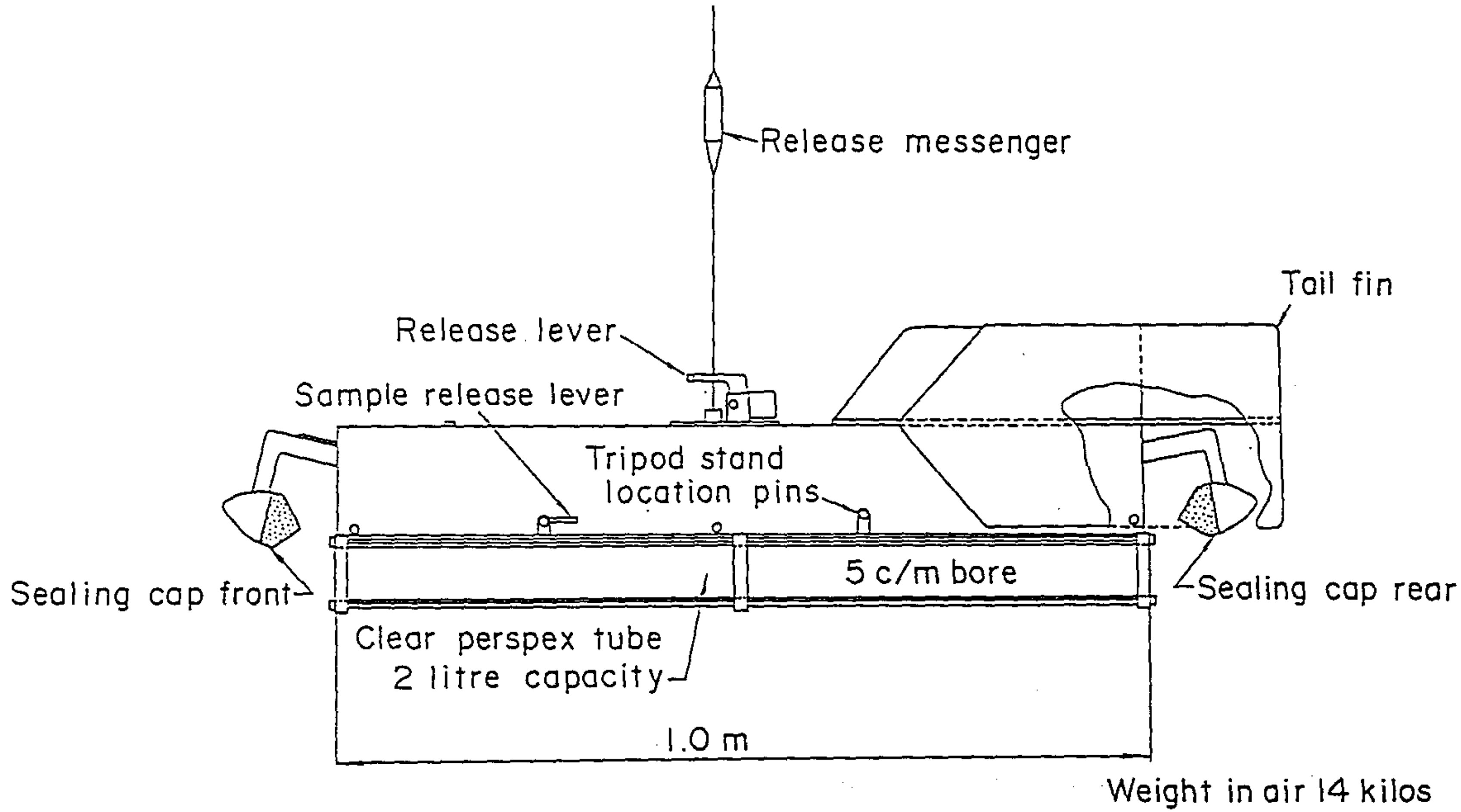

Fig.1-14 Owen Tube Type In-Situ Settling Velocity Equipment (in water)

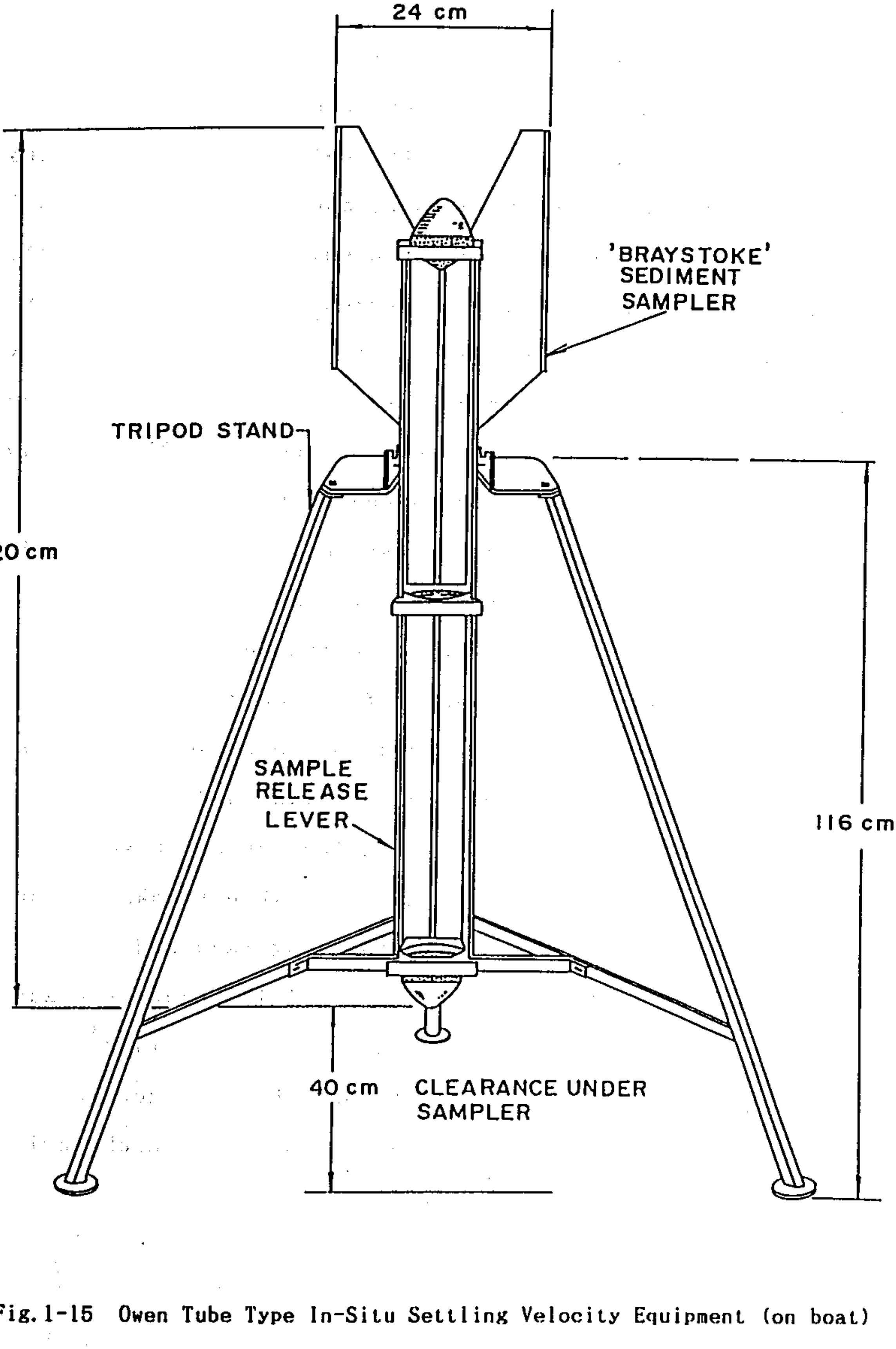

Fig. 1-15 Owen Tube Type In-Situ Settling Velocity Equipment (on boat)

2.3 Topographical data

The most fundamental problem related to siltation is to discover from where sand and silt are carried and deposited in navigation channels or in ports and harbor areas. As long as this original source is not removed, it is impossible to change topographical tendencies which have continued over a long period of time. Therefore, it is important to observe topographical changes over a long period of time in the order of several decades or even several centuries. This data will be very useful when planning future ports or harbors.

It can also be concluded that there are some cases in which no adequate measures can be taken to prevent siltation if the surrounding area is experiencing depositions.

Fig. 1-16 shows the advance of the coastline in Kumamoto over a long period from the 1500s to the present[6]. This record shows the advance of the coastline under positive efforts to reclaim the surrounding land area. However, reclamation projects are only made possible thanks to the advance of the coastline due to the long-term sedimentation of sand and/or silt from rivers. Fig. 1-17 shows the advance of the estuary of the Chao Phraya River in Thailand[4]. By predicting long-term trends in topographic change, more economical projects for ports and for navigation channel maintenance can be formulated.

Long-term trends in topographic changes can be predicted on the basis of information obtained by aerial photographs or remote-sensing technology that utilizes artificial satellites. Detailed information on topographic features over a wide area can be obtained by photographic data taken from a high altitude. By comparing a photograph taken at a certain time with another taken at a different time, data on topographic changes that have occurred in the interval can be obtained two-dimensionally. Furthermore, it may prove possible to understand topographic changes over a fairly long period by analyzing data on geological distributions or a distribution of vegetation obtained from aerial photographs or satellite images taken at the present.

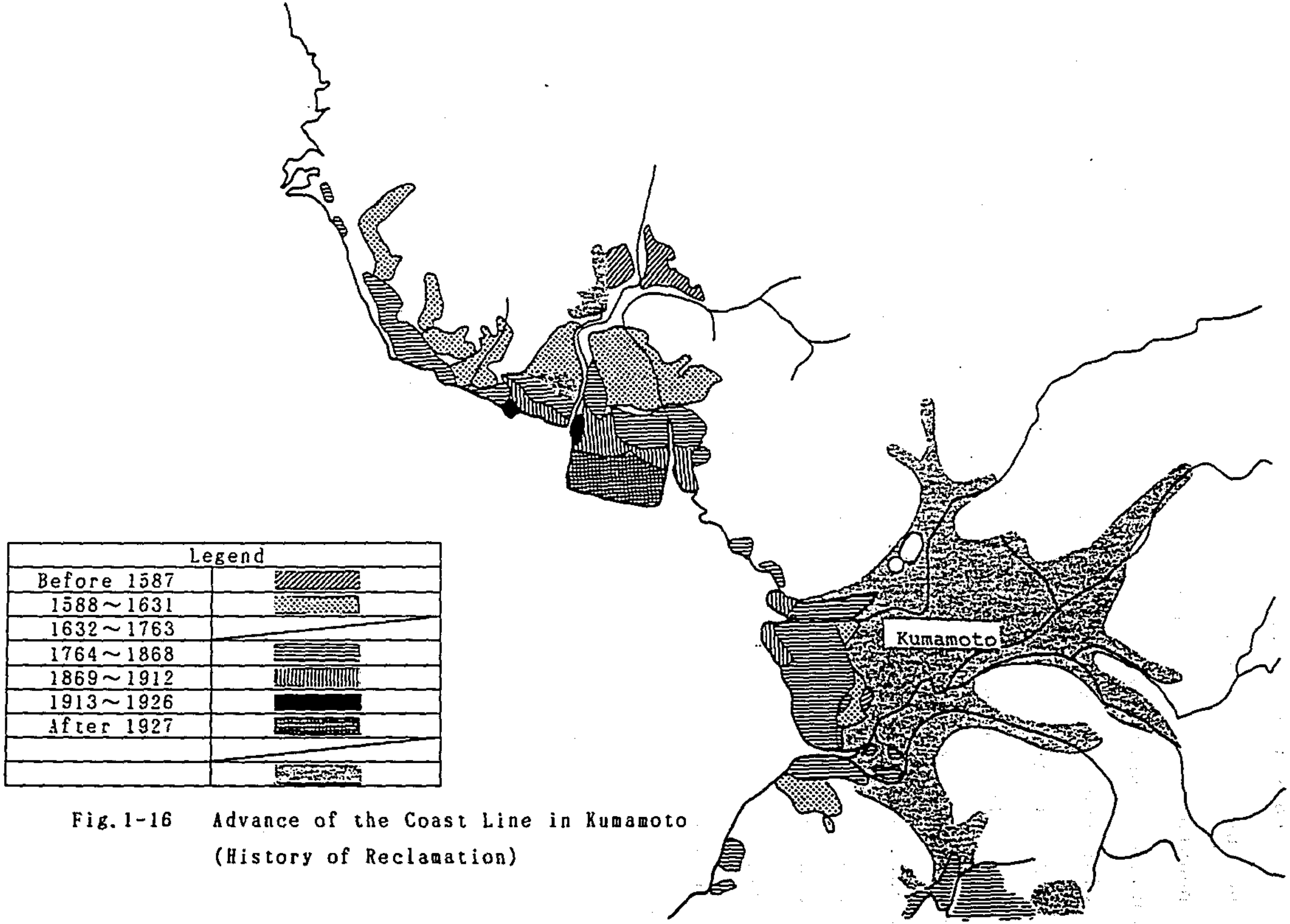

Fig. 1-16 Advance of the Coast Line in Kumamoto
(History of Reclamation)

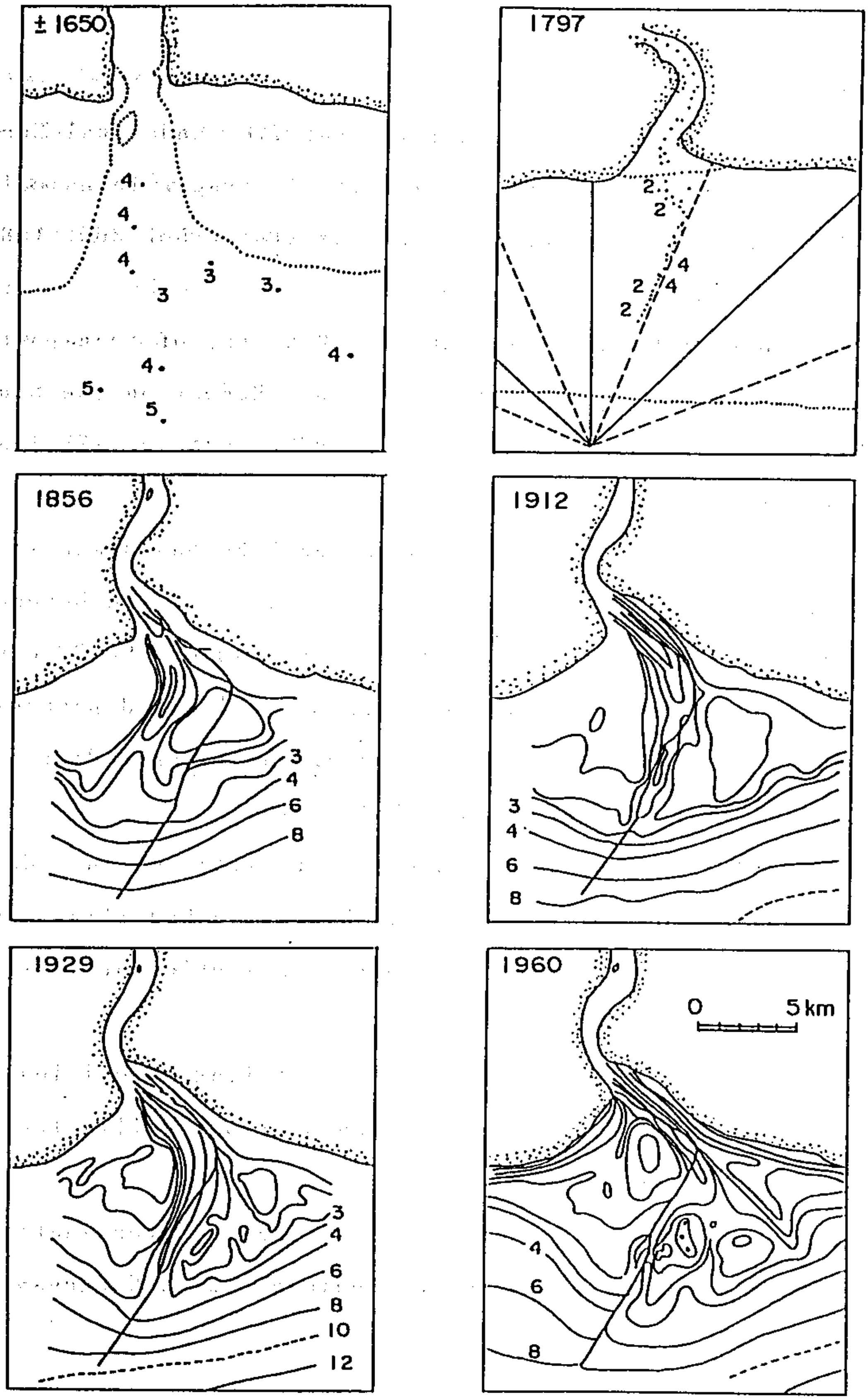

Fig. 1-17 Advance of the Estuary of the Chao Phraya River

References:

1) Kazuo Murakami: Harmonic Analysis of Tide and Tidal Currents by the Lowest Square Method and Its Accuracy, Technical Note of the Port and Harbor Research Institute, No. 369. 1981, p. 38 (in Japanese)

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4) NEDECO: A Study on the Siltation of the Bangkok Port Channel, Vol. 1, Vol. 2, and Vol.3, 1965

5) Thorn, M.F.C.: Physical Processes of Siltation in Tidal Channels, Proc. of the Conf. on Hydraulic Modelling Applied to Maritime Engineering Problems, Institution of Civil Eng.,1981, pp. 47-55

6) Owen, M.W.: Determination of the Settling Velocities of Cohesive Muds, Hydraulic Research Station, Wallingford, Report No. IT161, 1976

7) Rijn, L.C. and L. E. A. Nienhuis: InSitu Determination of Fall Velocity of Suspended Sediment, 21st Congress of

IAHR, Melbourne, 1985, pp. 144-148

8) The 4th Port Construction Bureau of the Ministry of Transport, Yatsushiro Port Construction Office: Challenging the Large Thick Layer of Soft Foundation in Ariake Bay, 32rd Annual Meeting of the Report on Constructions Within the Jurisdiction of the Bureau, 1986, p. 143 (in Japanese)

II. METHOD OF NATURAL CONDITION SURVEY IN BANJARMASIN PORT AND APPLICATION OF THE SURVEY RESULTS

II. Method of Natural Condition Survey in Banjarmasin Port and Application of the Survey Results

1. Field Survey Schedule of Natural Condition

A field survey of natural condition, the Study on Maintenance Dredging in the Access Channel of Banjarmasin Port, was carried out from 10th September, 1988 to 10th September, 1989 in Banjarmasin, South Kalimantan in the Republic of Indonesia.
(Refer to Fig 2.1-1 and Fig. 2.1-2)
The process of the field survey of natural condition shows Table 2.1-1 and Table 2.1-2.

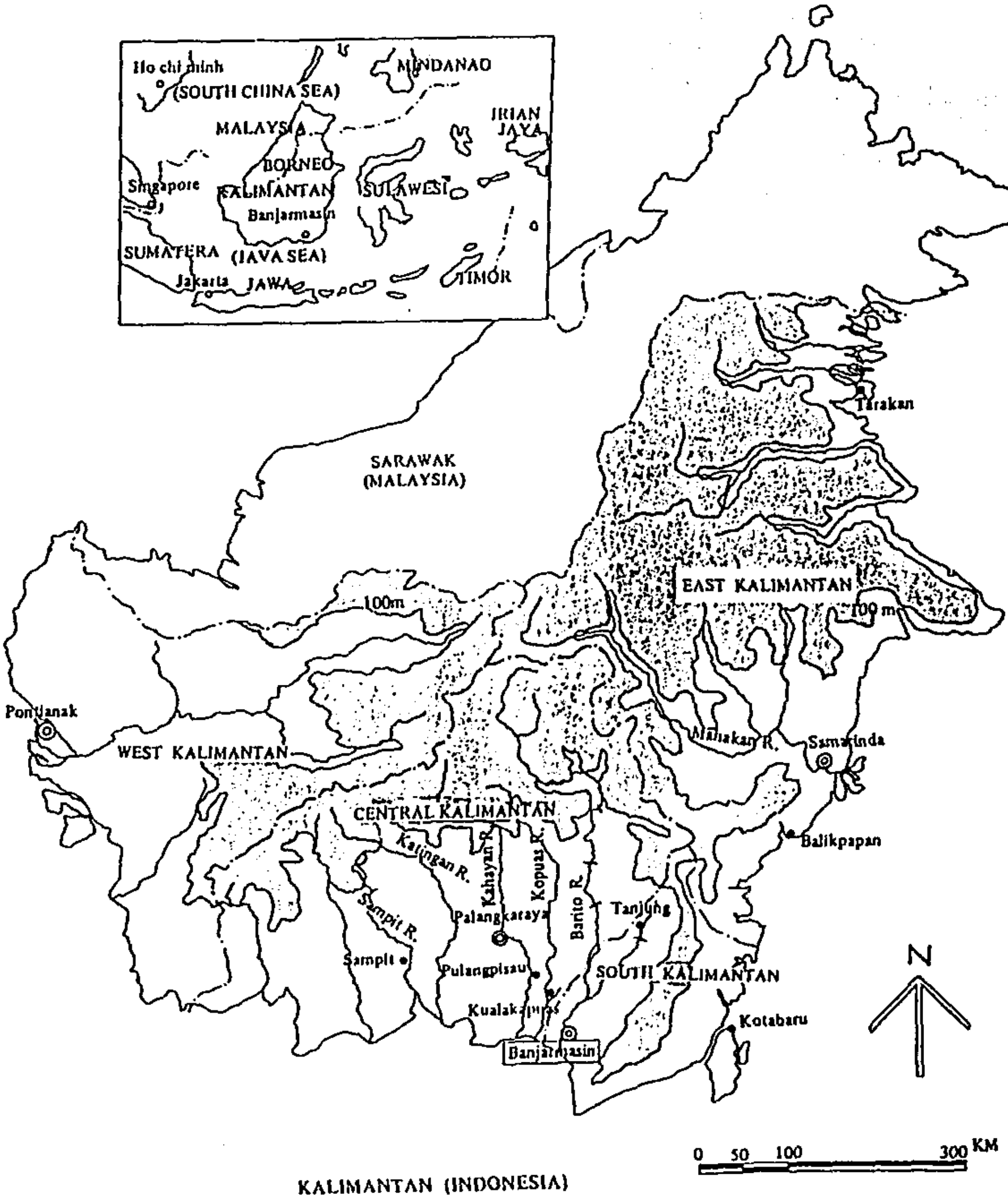


Fig. 2.1-1 Map of Indonesia and Location of Banjarmasin

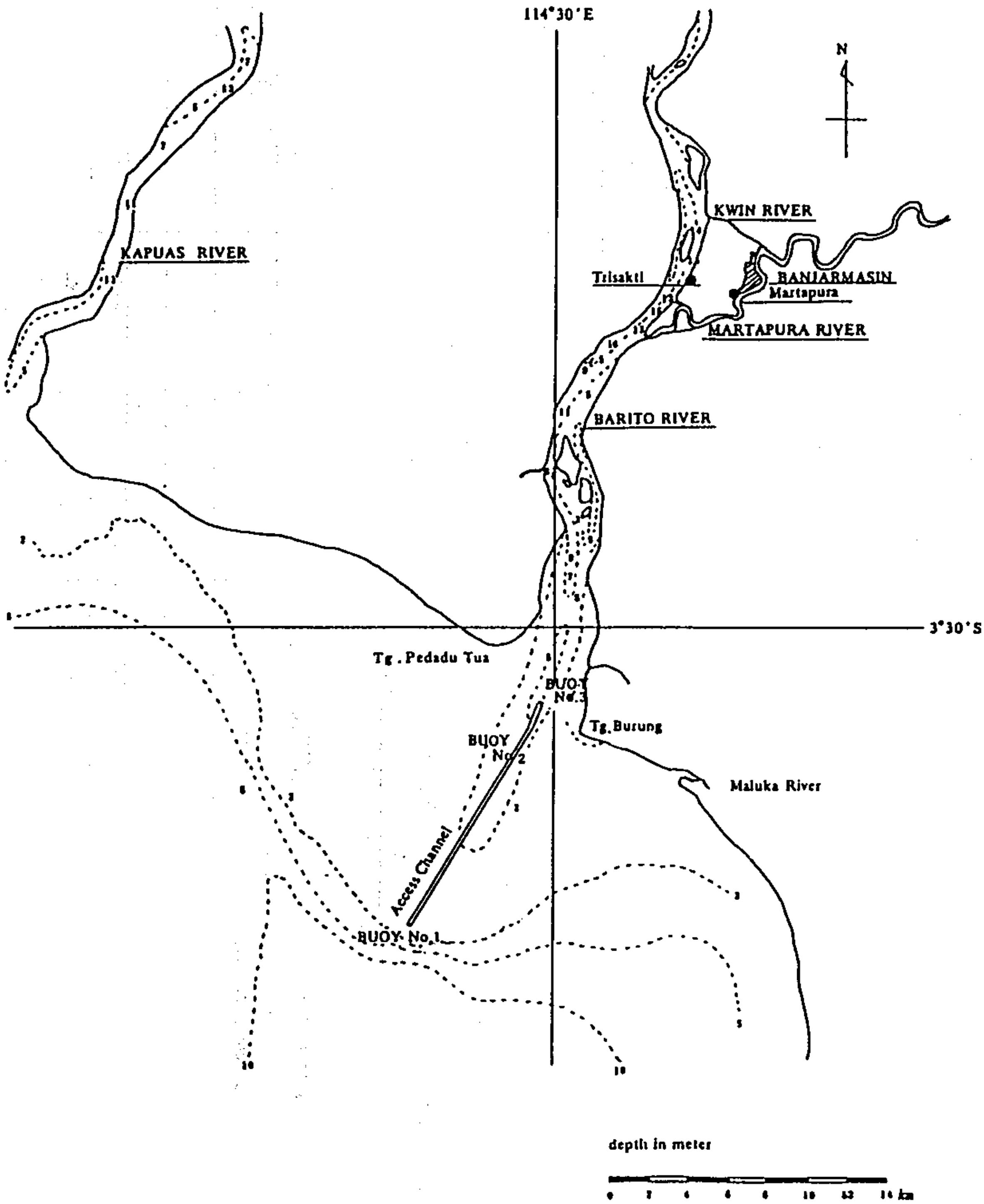


Fig. 2.1-2 Banjarmasin Port and Access Channel

Table 2.1-1 Schedule of Field Survey Executed for Natural Conditions (No. 1)

Item	Month, Year / Day	September, 1988 (1, 10, 20)	October, 1988 (1, 10, 20)	November, 1988 (1, 10, 20)	December, 1988 (1, 10, 20)	January, 1989 (1, 10, 20)	February, 1989 (1, 10, 20)
Yearlong Survey	1.Tide						
	2.Wind						
	3.Wave						
Monthly Survey	1.Saline Wedge		11-,15- ①	11-,16- ②	10-,13- ③; 29-,3- ④	31-,6- ⑤	
	2.Discharge	24- ①		19- ②	6- ③	7- ④	9- ⑤
	3.Echo-sounding in Narrow Area		8 (1st stage)	22	(2nd stage)	14 (3rd stage); 30	17; 20 (4th stage); 21 (5th stage)
General Survey	1.Tidal Current	21 (1st stage)	7			24 (2nd stage)	11
	2.Current 1	3 (1st stage)	7			17 (2nd stage)	19
	3.Current 2(Buoy tracking)	30 (1st stage)	2				14-16 (2nd stage)
	4.Current Velocity and Turbidity						
	5.Bottom Material, Salinity and Suspended Soilds	9 13 (1st stage)					21-23 (2nd stage)
Others Survey	1.Seabed level						
	2.Echo-sounding in Wide Area				19	(1st stage)	
	3.Soil Boring						
Remarks	Dredging Works						

Table 2.1-2 Schedule of Field Survey Executed for Natural Conditions (No. 2)

Item	Month, Year / Day	March, 1989 (1, 10, 20)	April, 1989 (1, 10, 20)	May, 1989 (1, 10, 20)	June, 1989 (1, 10, 20)	July, 1989 (1, 10, 20)	August, 1989 (1, 10, 20)	Sep. (1, 10)
Yearlong Survey	1.Tide							
	2.Wind							
	3.Wave							
Monthly Survey	1.Saline Wedge	16-,20- (6)	30- (7)	13- (7)	7-,11- (8); 24-,28- (9)	7-,10- (10); 22-,26- (11)	6-,10- (12)	
	2.Discharge	23- (6)	26- (7)	25- (8)	20- (9)	14- (10); 30- (11)	13- (12)	
	3.Echo-sounding in Narrow Area	8 (5th); (6th stage)	13; 26 (7th stage)	4; 25 (8th stage)	3; 16 23 (9th)	6 18 (10th); 21 (11th)	1; 7 14 (12th stage)	
General Survey	1.Tidal Current		13 30 (3rd stage)					
	2.Current 1		10 (3rd stage)	14				
	3.Current 2(Buoy tracking)			10-12 (3rd stage)				
	4.Current Velocity and Turbidity							
	5.Bottom Material,Salinity and Suspended Soilds		17-20 (3rd stage)					
Others Survey	1.Seabed Level			13-14 (1st stage)	1-2 (2nd stage)		8 (3rd stage)	
	2.Echo-sounding in Wide Area	1	(1st stage)		15; 18	(2nd stage)		
	3.Soil Boring				20	20		
Remarks	Dredging Works	1	Dredging Work Stop	29				

2. Observation Method of Field Survey for Natural Condition

Natural condition survey consists of Yearlong Survey, Monthly Survey, General Survey and Others Survey as follows;

a. Yearlong Survey

These observations were continuously conducted through a year. Tide level and wind direction, wind velocity at pilot station where located in the mouth of Barito River were observed. And wave height and wave direction were also observed at most offshore of the access channel.

Survey object are shown as follws;

- Tide
- Wind
- Wave

b. Monthly Survey

Monthly surveys were conducted periodically once time per a month for the purpose of grasping discharge water of the river, condition of saline wedge in the river area and changing nature of seabed topography in the access channel.

Survey object are shown as follows ;

- Saline Wedge
- Discharge
- Bottom Material
- Echo-sounding in Narrow Area

c. General Survey

General surveys were conducted to grasp the character of current movement, distribution conditions of bottom materials, salinity and turbidities.
General surveys were carried out in the vast area in the dry, rainy and intermidiate season between the dry and rainy as typical season for the survey.

Survey object are shown as follows ;

- Tidal Current
- Current 1
- Current 2(Buoy tracking)
- Current Velocity and Turbidity
- Bottom Material, Salinity and Suspended Solids

d. Others Survey

Other survey consists of seabed level, echo-sounding in wide area and soil boring.
Seabed level survey was conducted to grasp the behaivior of the fluid mud accumlating in the access channel.
Echo-sounding in wide area was conducted to grasp the condition of the seabed topography over the whole survey area. Soil boring was conducted to grasp the geological structure under seabed.

2.1 Yearlong Survey

1) Tide

a. Method

Tide observation was carried out continuously for one(1) year at the pilot station where located in the mouth of Barito River by using a self-recording type tide gauge (LFT-III).

The method of installation for the tide gauge is shown Fig. 2.2-1. The tide gauge consists of the well of a float senser and a pipe made of vinyl chloride.

A bench mark was established by leveling based on the nearest existing bench mark.

The condition of the operation was checked every day and the replacement of recording chart was carried out with about a month interval.

b. Position

The position of observation is shown Fig. 2.2-2.

c. Equipment/Goods

Equipment and Goods are listed in Table 2.2-1.

Table 2.2-1 List of Equipment and Goods for Tide Gauge

Equipment Name	Type	Manufacturer	Number
Fuess Type Tide Gauge	LFT-III	Kyowa Shoko	1
Accessories & Consumable	-	-	-
Set-up Goods	-	-	-

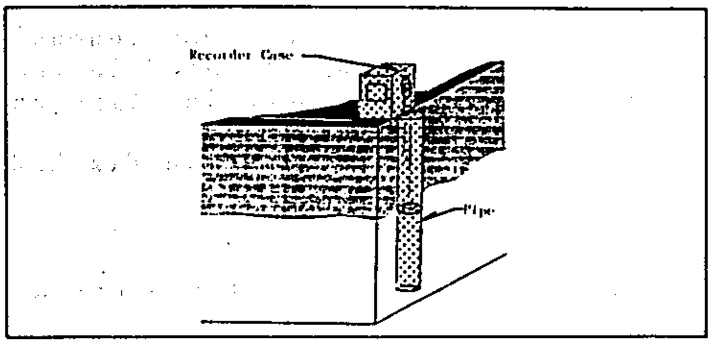


Fig. 2.2-1 Tide Observation (Yearlong) Method

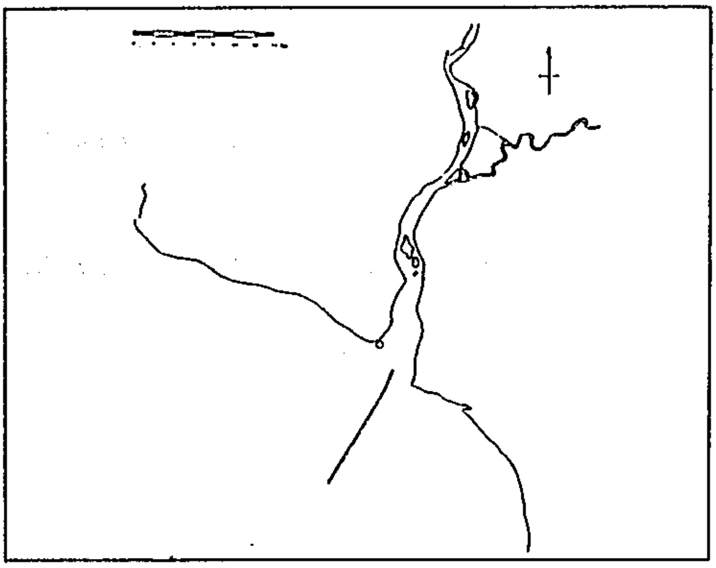


Fig. 2.2-2 Tide Observation (Yearlong) Position

2) Wind

a. Method

Wind observation was carried out continuously for one(1) year at the pilot station where located in the mouth of the Barito River by using a self-recording type anemometer.

The method of installation is shown in Fig. 2. 2-3.

The observational items were as follows :

- Instantaneous wind velocity for every a hour

- Mean wind velocity 10 minutes duration in one hour interval

- Instantaneous wind direction for every a hour

The replacement of recording chart for anemometer was carried out with a month interval.

b. Position

The position of observation is shown in Fig. 2. 2-4.

c. Equipment/Gooods

Equipment and Goods are listed in Table 2. 2-2.

Table 2. 2-2 List of Equipment and Goods for Wind Observation

Equipment Name	Type	Manufacturer	Number
Wind Direction and Wind Speed Anemometer	KDD-300	Koshin Denki	1
Accessories & Consumable	KDD-300	Kosin Denki	1
Set-up Goods	-	-	1

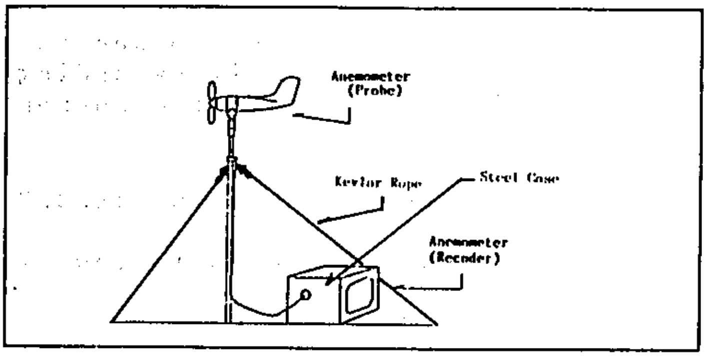


Fig.2.2-3 Wind Observation (Yearlong) Method

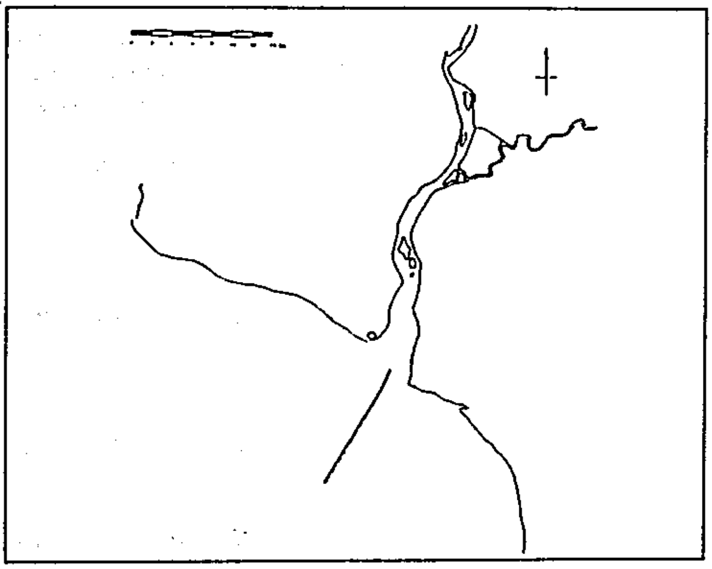


Fig.2.2-4 Wind Observation (Yearlong) Position

3) Wave

a. Method

Wave height and wave direction were observed continuously through one(1) year by using a self-recording wave height recorder(SSW-II) and a electromagnetic current meter (EMC-108).

The method of installation is shown in Fig. 2. 2-5.

The conditions of observation are as follows :

* Wave height
  - Measurement interval : 2 hours
  - Measurement duration : 10 minutes

* Wave direction
  - Measurement interval : 2 hours
  - Measurement duration : 4.2 minutes

The replacement of magnetic tape for the record was Conducted at an interval of 14 days for both equipment. When both equipments were withdrawn from underwater, divers were employed.

The installed condition of both equipments were checked at an interval of 7 days by divers.

b. Position

The position of observation is shown in Fig. 2. 2-6.

c. Equipment/Goods

Equipment and Goods are listed in Table 2. 2-3.

Table 2. 2-3 List of Equipment and Goods for Wave Observation

Equipment Name	Type	Manufacturer	Number
Supersonic Magnetic Reading Type Wave Height Recorder	SSW-II	Kyowa Shoko	2
Accessories & Consumable	SSW-II	Kyowa Shoko	2
Electromagnetic Current Meter	EMC-108	Yokogawa	1
Accessories & Consumable	EMC-108	Yokogawa	1
Mooring Goods	-	-	1

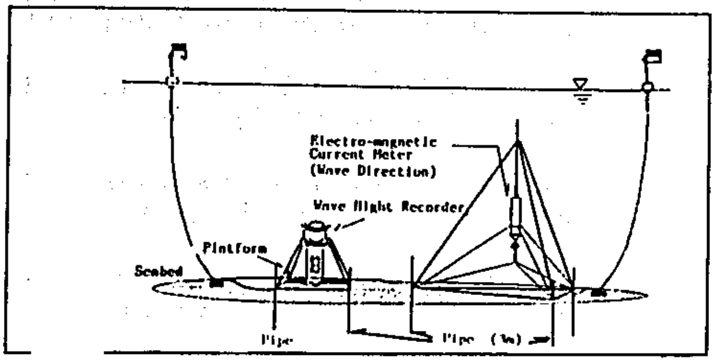


Fig. 2. 2-5 Wave Observation (Yearlong) Method

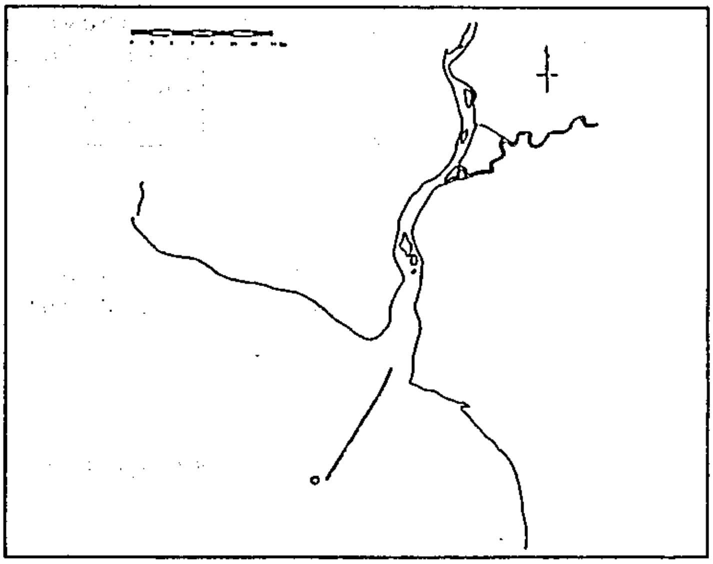


Fig. 2. 2-6 Wave Observation (Yearlong) Point

2.2 Monthly Survey

1) Saline Wedge

a. Method

A vertical profile of current was obsertved by using a direct-reading type current meter(DCM-PRT-III).

A vertical profile of salinity was measured by using a direct-reading type salinometer(5005).

A vertical profile of turbidity was measured by using a direct-reading type turbidimeter(PT-I).

A vertical profile of density of S.S was measured by water sampling which was taken by a water sampler.

The conditions of observation are shown in the following table.

Number of Points	Period	Interval	Observational layer
8(dry season) 8(rainy season)	24 hours	1 hour	every 0.5m pitch upto 2m above seabed and every 1m pitch between surface and 2m above seabed

A survey boat was fixed by anchor at each point and the observations mentioned above were carried out as shown in Fig.2.2-7.

a. Position

The positions of observation are shown in Fig.2.2-8.

b. Equipment/Goods

Equipments and Goods are listed in Table 2.2-4.

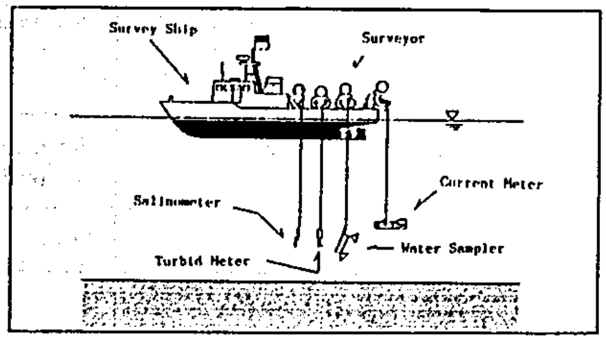


Fig. 2. 2-7 Saline Wedge Survey Method

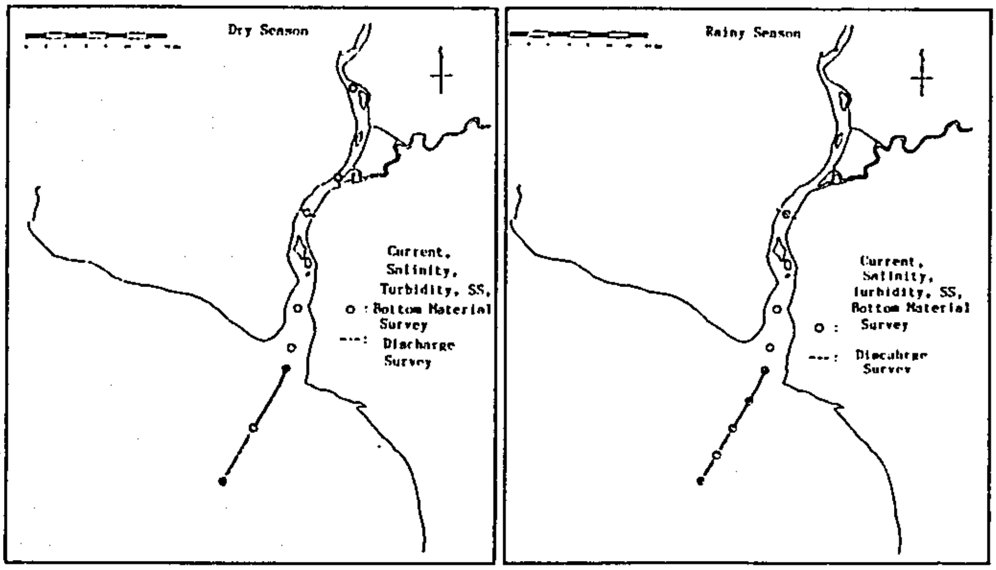


Fig. 2. 2-8 Saline Wedge Survey Points

Table 2.2-4 List of Equipment and Goods for Saline Wedge

Equipment Name	Type	Manufacturer	Number
Direct Reading Flow Direction Current Meter Printer	DCM-PRT-III	Kyowa Shoko	5
Salinometer	5005	Kawamura Tsusho	5
Turbidimeter	PT-1	Alec Denshi	5
Water Sample	Van-Dorn		5

2) Discharge

a. Method

This observation was carried out on a line of a transverse section of the Barito River. Prior to start the observation, depth was measured along the line by a Echo-sounding, and five(5) observational points were established.

A vertical profile of current was observed by using a direct-reading type current meter(DCM-PRT-III).

A vertical profile of salinity was observed by using a direct-reading type salinometer(5005).

A vertical profile of turbidity was observed by using a direct-reading type turbidimeter(PT-1).

A vertical profile of concentration of S.S. was measured by water sampling which was taken by a water sampler.

The conditions of observation are shown in the following table.

Number of Points	Period	Interval	Observational Layer
5	24 hours	1 hour	every 1m below sureface and 0.5m above seabed

A survey boat was fixed by anchor at each point, and the observations mentioned above was carried out as shown in Fig. 2.2-9.

This observation was carried out before or after a Saline Wedge observation.

b. Position

The positions of observation are shown in Fig. 2.2-10.

c. Equipment/Goods

Equipment and Goods are listed in Table 2.2-5.

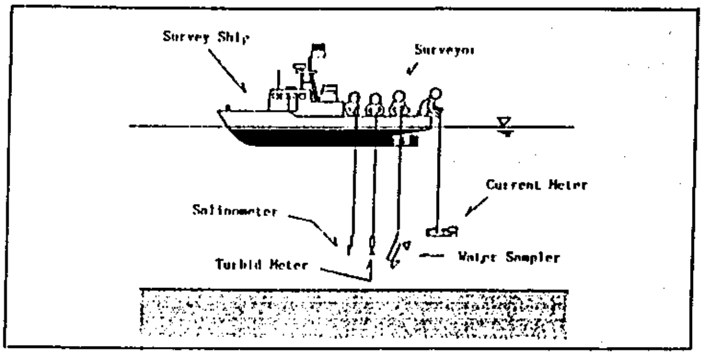


Fig. 2. 2-9 Discharge Survey Method

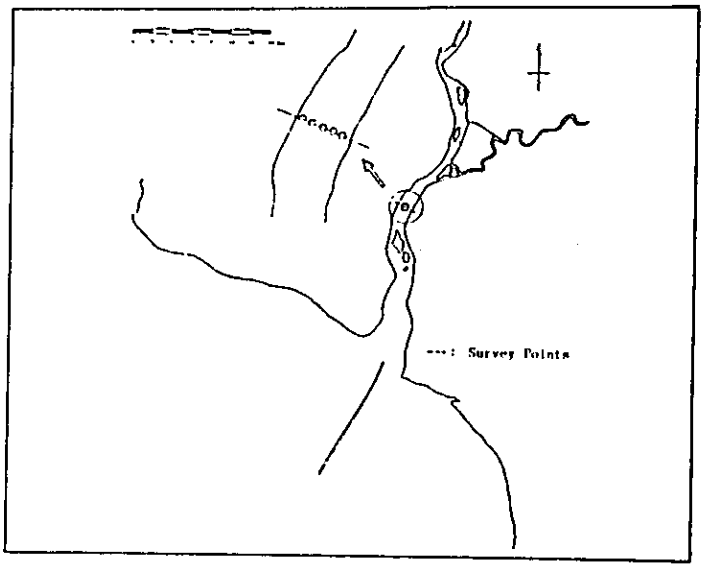


Fig. 2. 2-10 Discharge Survey Points

Table 2.2-5 List of Equipment and Goods for Saline Wedge

Equipment Name	Type	Manufacturer	Number
Direct Reading Flow Direction Current Meter Printer	DCM-PRT-III	Kyowa Shoko	5
Salinometer	5005	Kawamura Tsusho	5
Turbidimeter	PT-1	Alec Denshi	5
Water Sampler	Van-Dorn		5

3) Bottom material

a. Method

Bottom material was taken at each point by using a grab type bottom sampler as shown in Fig. 2.2-11.

Vane test was carried out onboard by using a handy type vane test equipment.

Depth was measured by using a lead line.

b. Position

The positions of bottom sampling are similer in Saline Wedge and Discharge observation as shown in Fig. 2.2-12.

c. Equipment/Goods

Equipment and Goods are listed in Table 2.2-6.

Table 2.2-6 List of Equipment and Goods for Bottom Material

Equipment Name	Type	Manufacturer	Number
Bottom Sampler	Grab Type	—	1
Handy Vane Test Equipment	—	—	5
Sample Bottle for Bottom Material	1 l	—	160
Lead line	2.7 Kg	—	5

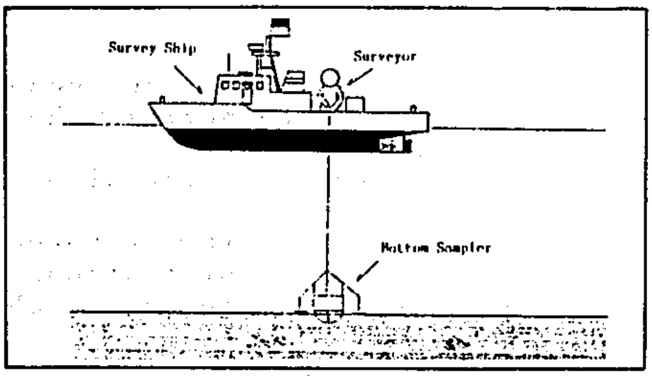


Fig. 2. 2-11 Bottom Material Sampling Method

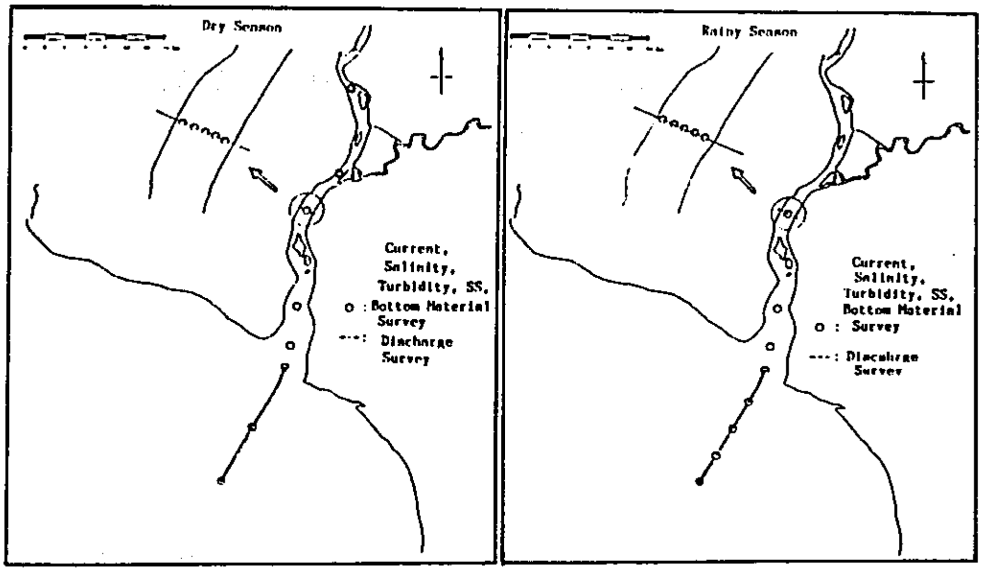


Fig. 2. 2-12 Bottom Material Sampling Points

4) Echo-sounding in Narrow Area

a. Method

Echo-sounding was carried out using an echo-sounder(ATLUS DESO 10, Frequency: 210KHz and 33 KHz) in the area of access channel as shown in Fig. 2. 2-13.
Sounding lines were set every an interval of 25m transverse to the access channel.
Tide corrections was made on the obtained depths, using observational tide data at the pilot station.
Sound velocity corrections was made on the obtained depths by the bar-check method.

b. Area

The sounding area (300m x 15km) is shown in Fig. 2. 2-14.

c. Equipment/Goods

Equipment and Goods are listed in Table 2. 2-7.

Table 2. 2-7 List of Equipment and Goods for Echo-sounding

Equipment Name	Type	Manufacturer	Number
Echo-sounder	ATLUS DESO 10		1
Check Bar	-	-	1
Accessories & Consumable	-	-	1

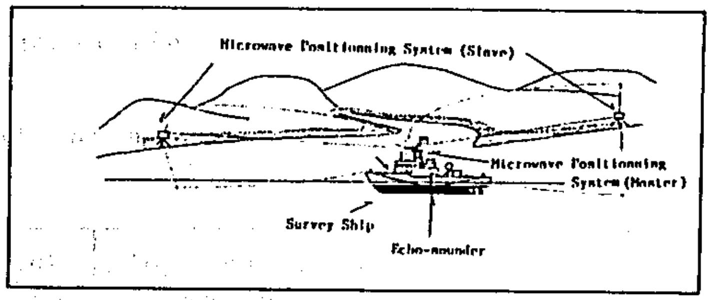


Fig. 2. 2-13　Echo-sounding (Narrow Area) Method

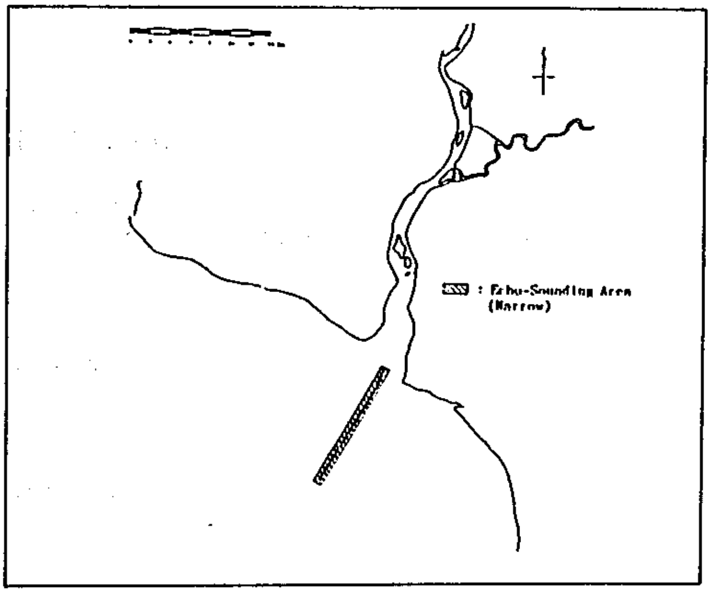


Fig. 2. 2-14　Echo-sounding (Narrow Area) Area

2.3 General Survey

1) Tidal Current

a. Method

Tidal current was observed by using self-recording current meters(MTC-III).

The conditions of measurement are shown in the followimg table.

Number of Points	Period	Interval of Measurement	Observational Layer
2	15-day and night	every 10 minutes	3m above seabed

The current meters were installed as shown in Fig. 2. 2-15.

The installed condition of the current meter was checked in every day during the observational period.

a. Position

The positions of observation are shown in Fig. 2. 2-16.

b. Equipment/Goods

Equipments and Goods are listed in table 2. 2-8.

Table 2. 2-8 List of Equipment and Goods for Tidal Current

Equipment Name	Type	Manufacturer	Number
Self Recording Current Meter	MTC-III	Kyowa Shoko	2
Accessories & Consumable	MTC-III	Kyowa Shoko	2
Mooring Goods	-	-	2

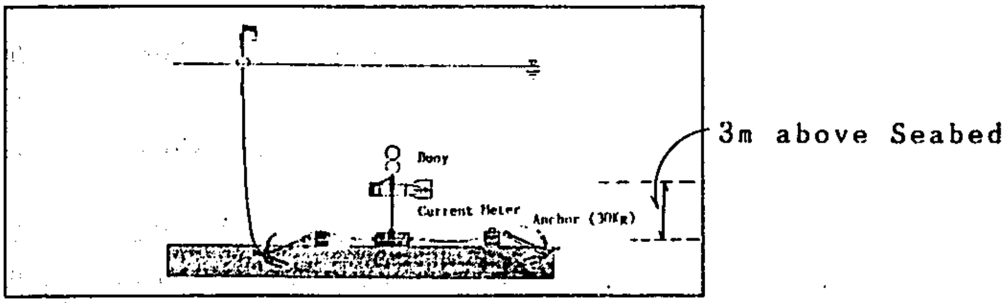


Fig. 2. 2-15 Tidal Current Survey Method

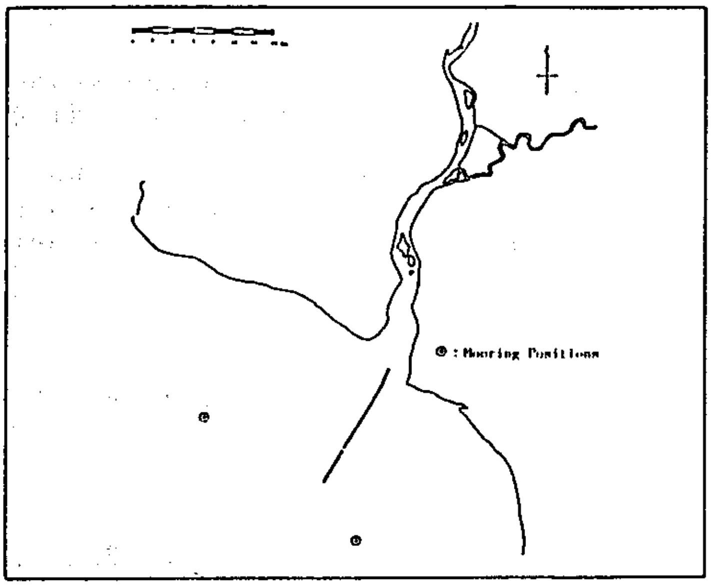


Fig. 2. 2-16 Tidal Current Survey Points

2) Current 1

a. Method

Current was observed by using a electromagnetic current meter(EMC-108).

The conditions of measurement are shown in the following table.

Number of Points	Period	Interval of Measurement	Duration of Measurement	Observational Layer
11	30 day and night(•) 15 day and night(○)	every 60 minutes	2.1 minutes	0.5m above seabed

The current meters were installed on the seabed as shown in Fig.2.2-17 by divers and withdrawn by divers after the completion of observation.
The replacement of magnetic tape for the record was carried out with an interval of 15 day and night.
The installed condition of the current meter was checked every day by divers.

b. Position

The observational positions and period are shown in Fig.2.2-18.

c. Equipment/Goods

Equipment and Goods are listed in table 2.2-9.

Table 2.2-9 List of Equipment and Goods for Current 1

Equipment Name	Type	Manufacturer	Number
Electromagnetic Current Meter	EMC-108	Yokogawa	9
Accessorioes and Consumable	EMC-108	Yokogawa	9
Mooring Goods	-	-	9

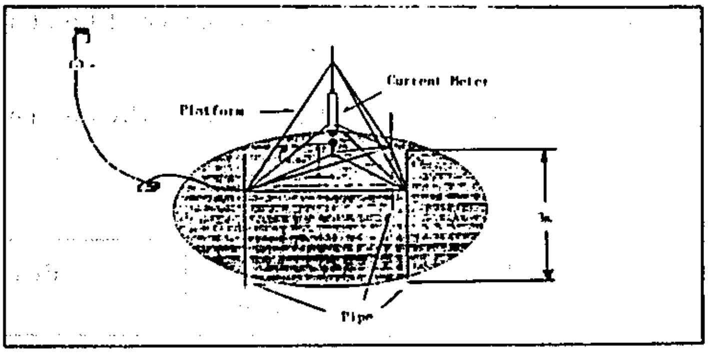


Fig. 2. 2-17 Current 1 Survey Method

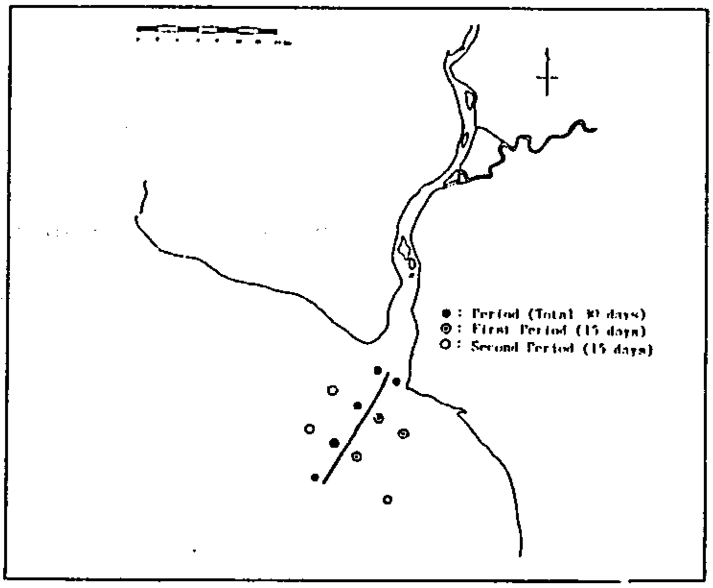


Fig. 2. 2-18 Current 1 Survey Points

3) Current 2

a. Method

Current observation in current 2 survey at the mouth of the Barito River was observed by tracking floats as shown in Fig. 2. 2-19.

The condition of this observation are shown in the following table.

Number of Boats	Number of Floats	Interval of Positioning	Period
4	12	every 30 minutes	3 days(8 hour/day)

b. Start point

The start points of this observation are shown in Fig. 2. 2-20.

c. Equipment/Goods

Floats are shown in Fig. 2. 2-19.

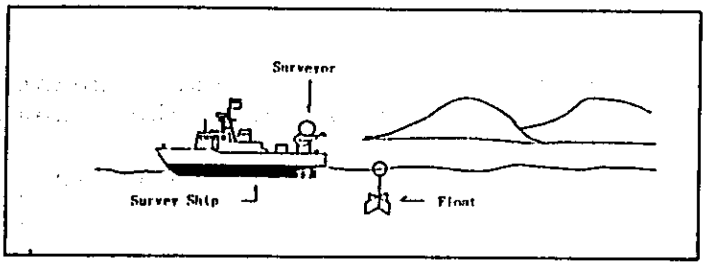


Fig. 2. 2-19 Current 2 Survey Method

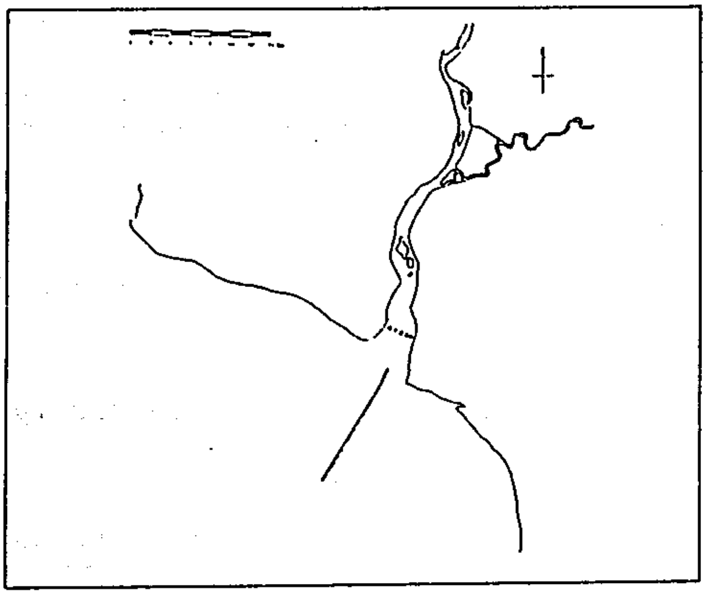


Fig. 2. 2-20 Current 2 Survey Area

4) Current Velocity and Turbidity

a. Method

A vertical profile of current was observed by using a direct-reading type current meter(DCM-PRT-III).

A vertical profile of concentration of suspended solids(S.S.) were measured by water sampling which was taken by a water pump.

The sedimentation velocity of S.S. were measured by using Owen Tube(Observation layer was 0.5m above seabed).

The conditions of measurement are shown in the following table.

Number of Points	Number of Times	Observational Layer
30	1	every 0.5m from seabed

A survey boat was fixed by anchor at each point and the observation mentioned above was carried out as shown in Fig.2.2-21.

b. Position

The positions of observation are shown in Fig.2.2-22.

c. Equipment/Goods

Equipment and Goods are listed in Table 2.2-10.

Table 2.2-10 List of Equipment and Goods for Current and Turbidity

Equipment Name	Type	Manufacturer	Number
Water Sampler	Pump Type		2
Sample Bottle for Water	1 l 0.5 l	-	400/time 550/time
Owen Tube	-	Kyowa Shoko	1
Direct Reading Flow Direction Current Meter Printer	DCM-PRT-III	Kyowa Shoko	1

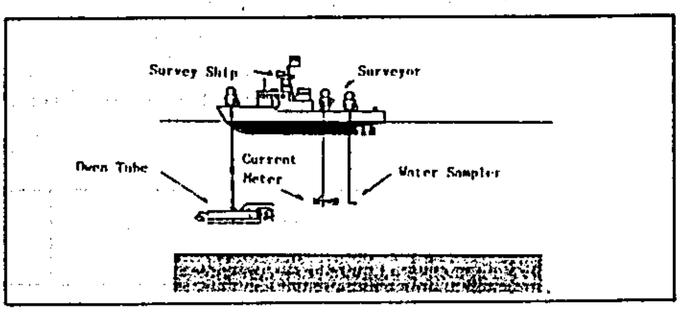


Fig. 2. 2-21 Current Velocity and Turbidity Survey Method

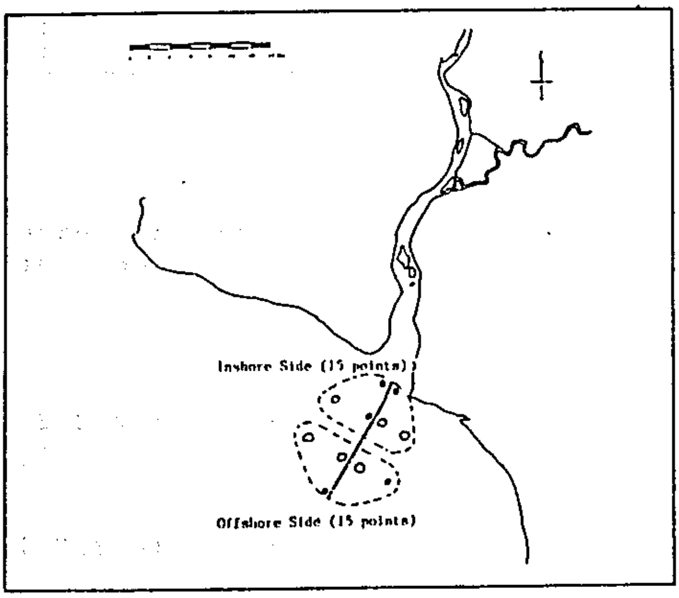


Fig. 2. 2-22 Current Velocity and Turbidity Survey Points

5) Bottom Material, Salinity and Suspended Solids

a. Method

Bottom sampling was carried out by a grab type bottom sampler.

A vertical profile of salinity was measured by using a direct-reading type salinometer(5005).

A vertical profile of density of S.S. was measured by water sampling which was taken by a water sampler.

A depth was measured by a lead line.

The conditions of survey are shown in the following table.

Survey Item	Number of Points	Observational Layer	Note
Bottom Sampling	26	-	Vane test was done onboard
Salinity	26	Sureface and 0.5m above seabed	
S.S.	26	Sureface and 0.5m above seabed	
Depth	26	-	

A survey boat was fixed by anchor at each point and the surveys mentioned above were carried out as shown in Fig.2.2-23.

b. Position

The positions of survey are shown in Fig.2.2-24.

c. Equipment/Goods

Equipment and Goods are listed in table 2.2-11.

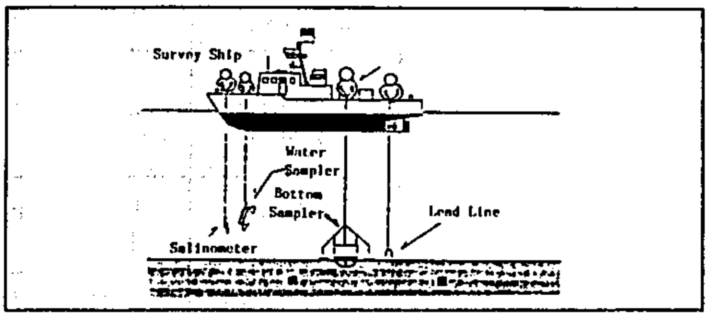


Fig. 2. 2-23 Bottom Material, Salinity, and Suspended Solids Survey Method

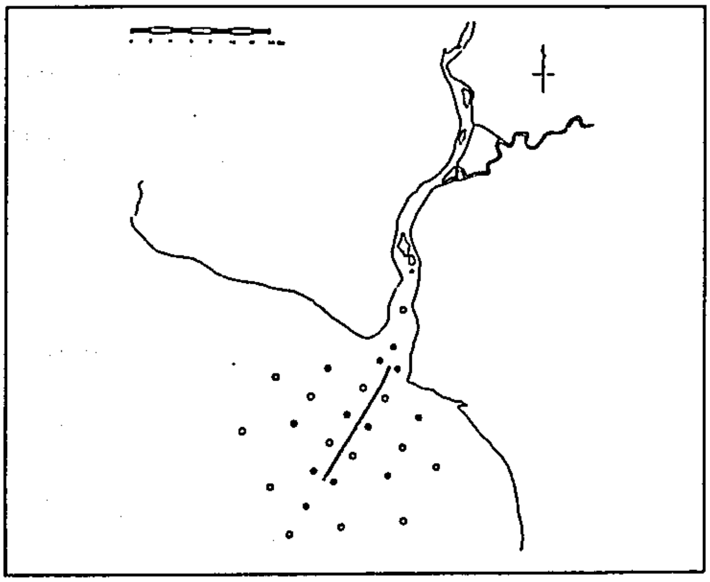


Fig. 2. 2-24 Bottom Material, Salinity, and Suspended Solids Survey Points

Table 2.2-11 List of Equipment and Goods for Bottom Material, Salinity and Suspended Solids

Equipment Name	Type	Manufacturer	Number
Bottom Sampler	Grab Type		1
Handy Vane Test Equipment	-		1
Lead line	2.7 Kg		1
Salinometer	5005	Kawamura Tsusho	1
Water Sampler	Van-dorn Type	-	1
Sample Bottle for Bottom Material	1 l	-	120
Sample Bottle for Water	1 l	-	70/time

2.4 Others Survey

1) Seabed Level

a. Method

It was a purpose of this survey that seabed level was confirmed by means of various methods as shown in Fig. 2.2-25.

The seabed level was measured by a lead line, a direct-reading type electromagnetic current meter(EMC-107), an echo-sounder with multi-frequency transducer(ATLAS DESO 10) and a bottom core sampler.

In case of measuring by a lead line, when a lead touches on the seabed, the touched location is indentified as a seabed.

In case of measuring by a electromagnetic current meter, the surface layer of a surmised fluid mud was identified at 0 m/sec of current velocity.

In case of measuring by an echo-sounder, a reflected surface which is sounded by 210KHz is indentified as a surface layer of a surmised fluid mud and a reflected surface which is sounded by 33KHz is indetified as a seabed.

A bottom core sampler is used for confirming a condition of sedimemtation on the seabed. Then a core sampler was frozen and devided into 5 pcs for soil tests at 5 layers.
These devided core samples were transported to laboratory and soil test was carried out about each sample.

b. Position

The positions of survey are shown in Fig. 2.2-26.

c. Equipment/Goods

Equipment and Goods are listed in table 2.2-12.

Table 2.2-12 List of Equipment and Goods for Seabed Level

Equipment Name	Type	Manufacturer	Number
Electromagnetic Current Meter	EMC-107	Yokogawa	1
Echo-sounder with multi-frequency transducer	ATLAS DESO 10		1
Lead Line	2.7 Kg		1
Bottom Sampler	Core Type		1

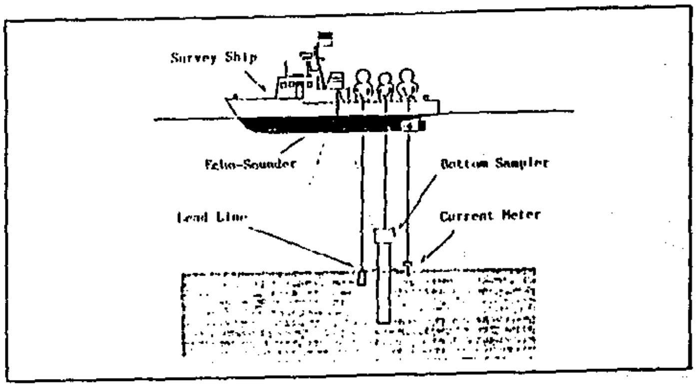


Fig. 2. 2-25 Seabed Level Survey Method

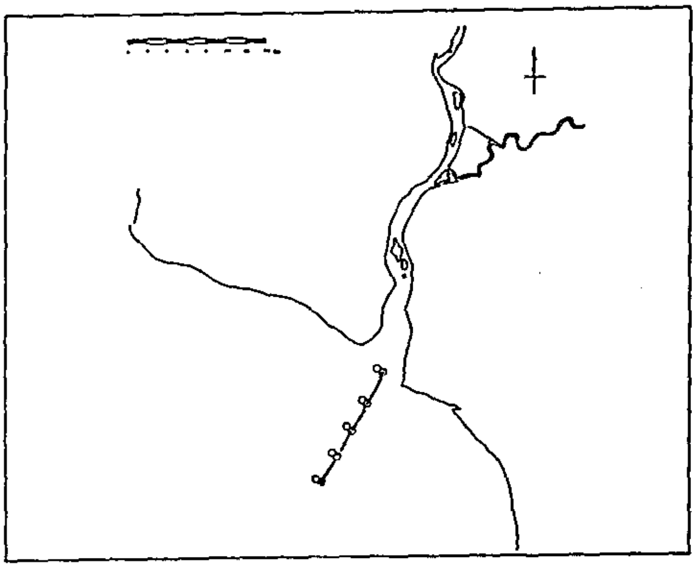


Fig. 2. 2-26 Seabed Level Survey Points

2) Echo-sounding in Wide Area

a. Method

Echo-sounding was carried out by an echo-sounder(Frequency: 210 KHz), as shown in Fig. 2.2-27.
Sounding line was set at an interval of 0.5Km, and the direction of lines was in N-S direction.
Tide corrections were made on the obtained depths using observational tide data.
Sound velocity corrections were made on obtained depth by the bar-check method.

b. Area

The sounding area(40 Km x 30 Km) was shown in Fig. 2.2-28.

c. Equipment/Goods

Equipment and Goods are listed in Table 2.2-13.

Table 2.2-13 List of Equipment and Goods for Echo-sounding

Equipment Name	Type	Manufacturer	Number
Echo-sounding(210 KHz)			1
Check Bar	-	-	1
Accessories & Consumable	-	-	1

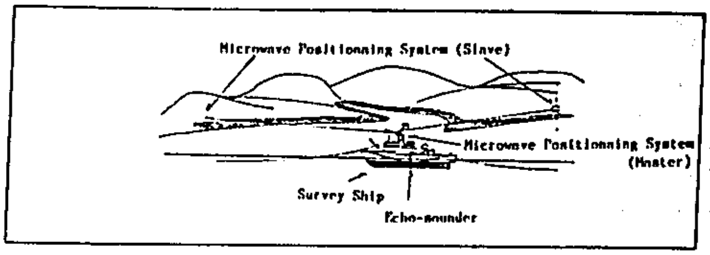


Fig. 2.2-27 Echo-sounding (Wide Area) Method

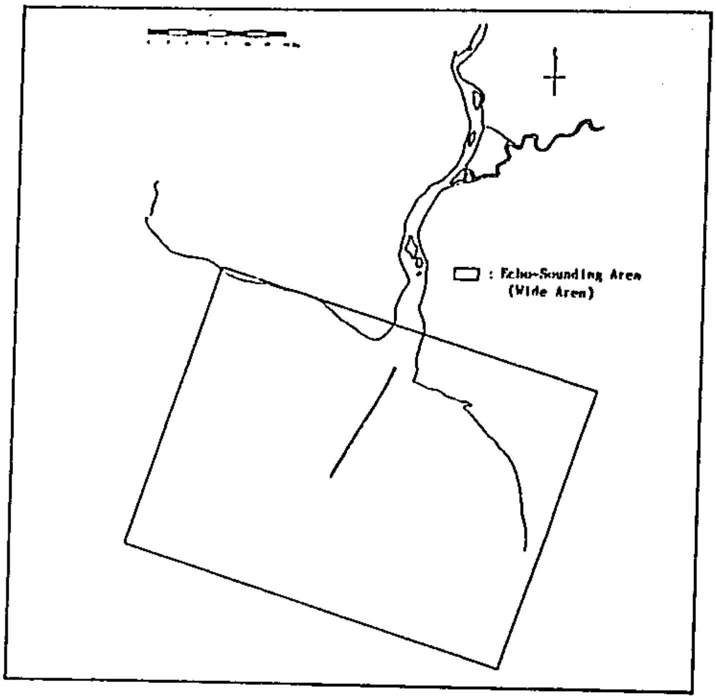


Fig. 2.2-28 Echo-sounding (Wide Area) Area

3) Soil Boring

a. Method

Soil borings were carried out at three(3) points using a drilling scaffold, as shown in Fig. 2.2-29.
The planned depth of soil boring was 20m below seabed.
A standard penetration test(N-value) were executed for sandy soil at an interval of 0.5m. Undisturbed soil sampling were carried out for cohesive at an interval of 2.0m.

b. Position

The position of soil boring are shown in Fig. 2.2-30.

c. Equipment/Goods

Equipment and Goods are listed in Table 2.2-14.

Table 2.2-14 List of Equipment and Goods for Soil Boring

Equipment Name	Type	Manufacturer	Number
Boring Machine	YSO-1	Yoshida Boring Machine Manufacturing Co., LTD.	1
Accessories & Consumable	-	-	1

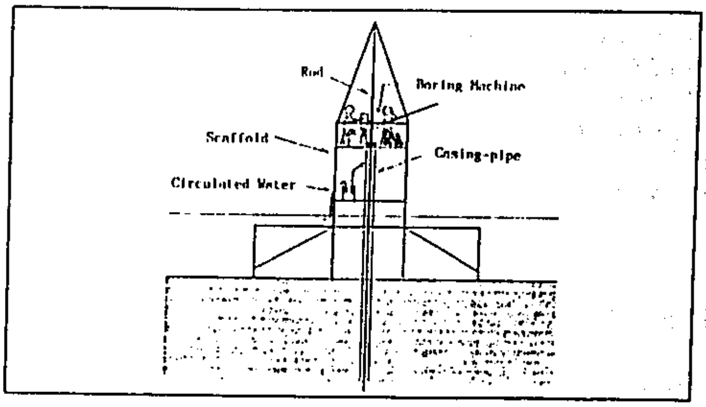


Fig. 2. 2-29 Soil Boring Method

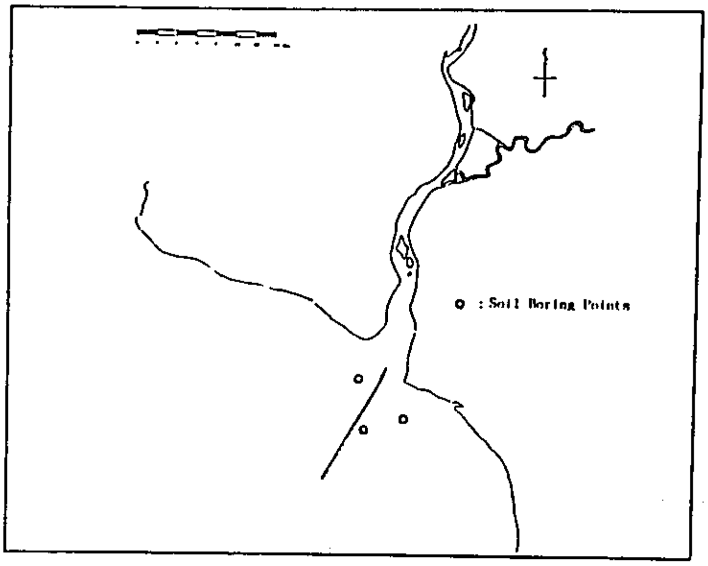


Fig. 2. 2-30 Soil Boring Point

3. Basic Data Processing Method of Natural Condition Survey

Various meteorological data and oceanographic data were observed by the natural condition survey.
These data were conversed , computed and drawn graph using two personal computers(PC-9801 VX) which were placed in Bajarmasin.
Data analysis methods by means of personal computer are generally separated in two types accordance with property of the observational equipment which is corresponded to purpose of suevey.

One is input and processing data obtained by the automatic recording type observational equipment.
Another one is by the other recording type observational equipment(e.g. analogue recording or direct recording type observational equipment)except automatic recording type observational equipment.

Each type of data processing method is as follows ;

(1) Processing data measured by automatic recording type observational equipment.

Automatic recording type equipment memories the obtained data in the cassette magnetic tape through the intermediary of logger.
In this type of data processing method, the data which were stored in the cassette tape are read and conversed then necessary computing and drawing graph are carried out by using an exclusive tape reader which is controlled by the computer.
Following main survey items such as kinds of observational equipment and results of computation are corresponded to this type of analysis for the natural condition survey.

-Yearlong Survey

Item	Measurement Item	Equipment Name	Tape Reader	Results
Wave	Wave Height	Supersonic Magnetic Reading Type Wave Height Recorder (SSW-II)	TEAC (MT-2GP)	·Wave height, water level curve ·Computed results for specified wave and swell
	Wave Direction	Electromagnetic Current Meter (EMC-108)	CMT Reader (EX010)	·Data conversion ·List of data

-General Survey

Item	Measurement Item	Equipment Name	Tape Reader	Results
Tidal Current	Current Speed and Current Direction	Self Recording Current Meter (MTC-III)	TEAC (MT-2GP)	•Current direction and current velocity curve List of data
Current 1	Current Speed and Current Direction	Electromagnetic Current Meter (EMC-108)	CMT Reader (EX010)	•Data conversion •List of data

(2) Processing data measured by other type of observational equipment except automatic recording type.

Data which were obtained by the equipment mainly analogue or direct reading type except automatic recording type are also processed by using personal computer.

Following tables are summerized about yearlong and monthly survey with survey items, measurement items, suitable equipment and results for every survey items.

-Yearlong Survey

Item	Measurement Item	Equipment Name	Results
Tide	Tidal Height	Fuess Type Tide Gauge (LFT-III)	•Tidal curve •List of data
Wind	Wind Direction and Wind Speed	Wind Direction and Wind Speed Anemometer (KDD-300)	•Wind direction and wind speed curve •List of data

-Monthly Survey

Item	Measurement Item	Equipment Name	Results
Saline Wedge and Discharge	•Current Speed and Current Direction •Salinity and Temperature •Turbidity •S.S.	•Direct Reading Flow Current Meter Printer (DCM-PRT-III) •Salinometer(5005) •Portable Turbidimeter (PT-1) •Water Sampler (Van-dorn Type)	•List of data for current velocity and current direction, water temperature, salinity, turbidity

As there were many survey items and many data on each items at the time of natural condition survey in Banjarmasin, we dealt with basic analysis work for the purpose of grasping the obtaining data condition in longterm observation such as data conversion in time serial and computation data input for various data.
On this seminar, method of data processing using personal computer will be explained in consideration of the abovementioned circumstances.

3.1 Data Conversion by Self Record Type Observational Equipment

Followings are the detailed operation method using personal computer about three types such as supersonic wave height recorder(SSW-II), electromagnetic current meter(EMC-108) and self recording current meter(MTC-III).

3.1.1 Data conversion procedure for Supersonic Magnetic Recording Type Wave Height Meter(SSW-II)

1) Preparation

1. Prepare an observation memorandum* sheet for SSW-II and a format floppy disk for data input.

   * The observational memorandum sheet is a paper which was noted necessary informations for data conversion, such as survey area, station No., observation layer, term of observation(from starting time to stopping time for instrument) and serial number of instrument etc.. Table 2.3-1 shows example of observation sheet for SSW-II.

2. Power switch "ON" for Tape Reader.

3. Set the recorded cassette tape into the tape reader.

4. Prepare the program soft floppy disk of SSW-II for reading.

5. Switch "ON" for the computer.

6. Insert the program floppy disk into "DISKET 1".

7. Push "RESET" switch where locates left lower part on the computer. Then following display appears.

```
        <SSW-II  JOB  MENU>
 *** Please set Data-floppy to Drive-B ***
    (1) READ  CASSETTE
    (2) CALCULATION  DATA
    (3) DISPLAY  DATA
    (4) END  THIS  PROGRAM

    *Please  select↑↓←→*
    *     and  Return     *
```

Fig. 2.3-1 JOB MENU on Display

Table 2.3-1

THE OBSERVATION MEMORANDUM of SUPERSONIC WAVE HEIGHT RECORDER (SSW-I)

ITEM :YEARLONG SURGVEY (WAVE)

AREA :THE ACCESS CHANNEL OF BANJARMASIN PORT

OBSERVER:

SERIAL NUMBER OF SSW-II		S / N : 24046 , 24047	
POSITION	OBSERVATION AREA	BANJARMASIN (15Day and Night)	
	STATION	ST. 1	
	LAT. LONG.	3° 39′ 5.41″ S	114° 25′ 22.0″ E
	DEPTH (DATE, TIME)	. m (/ , :)	
	OBSERVATION LAYER	0.5 m ABOVE SEABED	
DURATION TIME	BURST INTERVAL	2.0 Hour (120 Min)	
	SAMPLE INTERVAL	0.5 Sec	
	SAMPLE DURATION	1022 Data (8 Min 31 Sec)	
PERIOD	FIRST RECORDING TIME	1989 / H M S	
	INSTALLATION TIME	1989 / H M S	
	WITHDRAWAL TIME	1989 / H M S	
	LAST RECORDING TIME	1989 / H M S *Normal End (, DATA NUMBER) *Abnormal End( )	
MEASUREMENT RANGE	MODE : 1250	RANGE : 3.2 m	COFFICIENT : 1.25
CONDITION OF INSTALLATION	WEATHER : WIND DIRECTION: WIND SPEED : WAVE HEIGHT : WAVE DIRECTION:		
DATA-PROCESSING	GOOD NO-GOOD		

2) Conversed program start operation

(1) Read Cassette

1. Select "READ CASSETTE" in MENU, then push "RETURN " key. Then following display appears.

```
IF MT-2 is ready then push [Return] key
  IF you want end then [N]+[Return] key
```

Fig. 2. 3-2 Message on Display

2. If Cassette tape of SSW-II is ready, then push "RETURN" key. Then following display appears.

```
IF Data-floppy is ready then push [Return] key
```

Fig. 2. 3- Message on Display

3. Insert the new floppy disk which format had been done into "DISKET 2".
When a floppy disk is used, the disk must be written only for each time observation. Data for other observation time are never overlapped on same disk.

4. Push "RETURN" key.

5. Input data of information, such as St. , etc. into the display in order with reffering the observation memorandum sheet. (The last information of input is a coefficient number. In case of observation at this time in the Banjarmasin site, coefficient was "1250")

6. After input finish for coefficient number, display asks whether neccesary correction or not.
In case of sellection for no neccesary correction, input "Y".

7. Tape reader commence to read(It takes 30-40 min.).

8. Sign message of finish for cassette tape reading and transfer to floppy disk appears on the display after completion of reading and transfer.

9. At this time , push "RETURN" key, MENU(Refer to Fig.2.3-1) appear.

(2)Calculation Data

1. Select "CALCULATION DATA" in MENU(Refer to Fig.2.3-1), then push "RETURN" key.

2. When confirmation message for setting floppy disk into "DRIVE 2" appears, push "RETURN" key.

3. Computer starts carring calculation for elements of wave and shows result of calculation. Mean while, computer transfers data to floppy disk and also the elements of wave data print out.

4. When main MENU(Refer to Fig.2.3-1) appears, data trasfer from computer to floppy disk is completed.

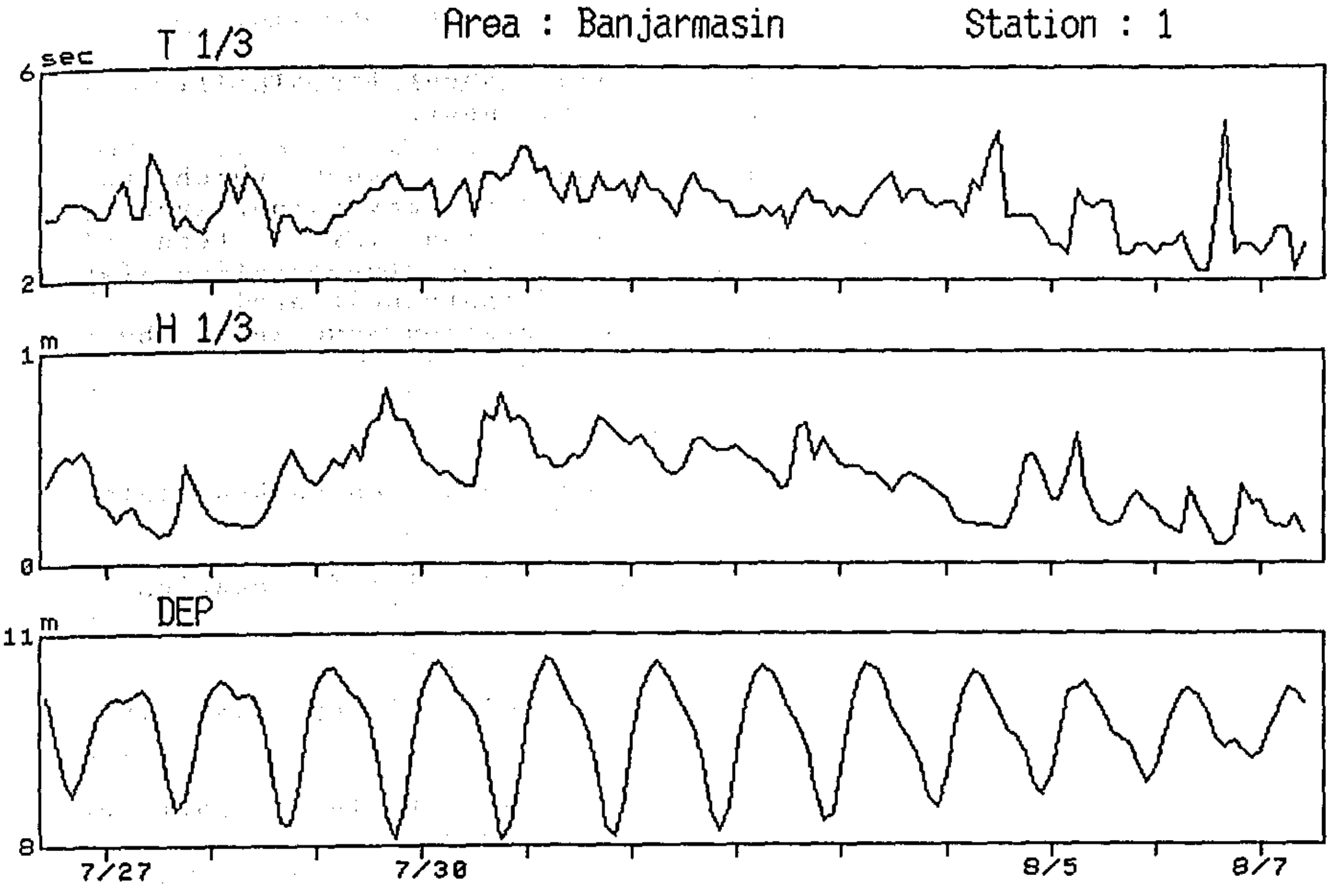
(3) Display Data

1. Select "DISPLAY DATA" in main MENU(Refer to Fig. 2.3-1) and push "RETURN" key.

2. Then drawing figure starts.

3. When drawing figure finish, display asks whether copy or not. When copy is required, push "C" and copy start. Fig. 2.3-4 shows display figure.

4. When main MENU(Refer to Fig. 2.3-1) appears, select "END" on display for completion of Job.



Note 1 : T1/3 shows period of significant wave
Note 2 : H1/3 shows waveheight of significant wave
Note 3 : DEP shows water depth

Fig. 2.3-4 Significant Wave Curve

3.1.2 Data Conversion for Self Recording Current Meter(MTC-III)

1) Preparation

1. Prepare an observastion memorandum* sheet for MTC-III and a format floppy disk for data input.

   *The observation memorandum sheet is a paper which was noted necessary informations for data conversion, such as survey area, station No., observation layer, term of observation (from starting time to stopping time for instrument) and searial number of instrument etc..
   Table 2.3-2 shows example of observation memorandum sheet for MTC-III.

2. Power swtich "ON" for Tape Reader.

3. Set the cassette tape which data had been packed into the tape reader.

4. Prepare program soft floppy disk of MTC-III for reading.

5. Switch "ON" for computer.

6. Insert immediately the program soft floppy disk into "DISKET 1".

7. Push "RESET" switch where locates left lower part of computer. Then following display appears.

```
***MTC2 CURRENT METER***

   JOB MENU
  (1) :READ CASSET
  (2) :PROCESS DATA
  (3) :END THIS PROGRAM


  PLEASE SELECT NUMBER
```

Fig. 2.3-5 JOB MENU on Display

Table 2.3-2

THE OBSERVATION MEMORANDUM of SELF-RECORDING CURRENT METER (MTC-III)

ITEM :GENERAL SURVEY (TIDAL CURRENT)

AREA :THE ACCESS CHANNEL OF BANJARMASIN PORT

OBSERVER: (CMT NO. -)

SERIAL NBER OF SSW-II		S / N :	
POSITION	OBSERVATION AREA	BANJARMASIN (15-Day and Night)	
	ST. 1	3° 35′ 36.93″ S	114° 20′ 46.9″ E
	LAT. LONG.	3° 42′ 24.43″ S	114° 32′ 12.9″ E
	DEPTH (DATE, TIME)	. m (/ , h m)	
	OBSERVATION LAYER	3.0 m ABOVE SEABED	
MODE	MEASURING INTERVAL	10.0Hour (120 Min)	
	MEASURING TIME	2.0 Sec	
OFFICIENT FOR IMPELLER	NUMBER OF IMPELLER	NO.32203-L V=0.275*N+0(RANGE:0.02～1.50m/s) NO.32204-L V=0.275*N+0(RANGE:0.02～1.50m/s) NO.32803-H V=0.504*N+0(RANGE:0.05～3.00m/s) NO.32804-H V=0.504*N+0(RANGE:0.05～3.00m/s) [DATE OF PROBATION: 23 FEB. 1988]	
PERIOD	FIRST RECORDING TIME	1989 / H M S	
	INSTALLATION TIME	[DATA NUMBER: , h m) 1989 / H M S	
	WITHDRAWAL TIME	1989 / H M S	
	LAST RECORDING TIME	1989 / H M S *Normal End (, DATA NUMBER) *Abnormal End( )	
MOORING METHOD OF MTC-III	METHOD OF INSTALLATION	SET UP ABOVE SEABED	
	DIRECTION	TRUE.N(DECLINATION ° From Mag.N)	
CONDITION OF INSTALLATION	DATE(/ h m) WEATHER : WIND SPEED : WIND DIRECTION: WAVE HEIGHT : WAVE DIRECTION:	DATE(/ h m) WEATHER : WIND SPEED : WIND DIRECTION: WAVE HEIGHT : WAVE DIRECTION:	

2) Program conversion start to operate

(1) Read Cassette Tape

1. Select "READ CASSETTE"(Refer Fig. 2.3-5) in MENU, then push "RETURN" key. Then following display appears.

```
MTC2  CASSET  has
          already  setted?

MT-READER  is  power  on?
Data-Floppy  has
          already  setted?

     (ESC/Cntl+B ··· Cancel)
       PUSH [←┘] KEY
```

Fig. 2.3-6 Message on Display

2. Insert the new floppy disk which format had been done into "DISKET 2", and push "RETURN" key.
   Following display appear.

```
       ***MTC2  Parameter***
Area  [Banjalmasin   ]             Station [A   ]
Layer : -1.0                       Ser. No: 32000
Interval: 10 (Min)                 Data No.     0
First Rec.    1988 / 7 / 1 / 0 / 0

Lat. 114° 35.0'     Lon. 3° 0.0'
Propeller Numbr : N27261
Propeller Coeficient  V=0.50000 * N + 0.00000 m/sec
 Please input paramaters
 IF paramater is right them push [Return] key
Area [BANJALMASIN] ?
```

Fig. 2.3-7 Parameter on Display

3. Input parameter of information, basing upon the observation memorandum sheet(Table 2.3-2), such as area, station No., layer etc. in order.

4. After coefficient number input, display asks whether necessary correction done or not.
In case of no neccesary correction, input "Y".

5. Tape reader commence to read. (It takes 30-40min.)

6. Sign message of finish for tape reading and transfer to floppy disk appears on the display after completion of reading and transfer.

7. At this time, "RETURN"key push, then MENU(Refer to Fig. 2.3-1) appears.

(3) Process Data

1. Select "PROCESS DATA" at Fig. 2.3-1 then following display appears.

```
              ***MTC2  Header***  file name
station name:1        model name :MTC2   F.R.T :1988/09/20 11:10:00
Lat.        :3° 0'    serial no. :32103  L.R.T :1988-10-06 21:40:00
Long.       :114° 35'                    interval:10(min)
layer (m)   :3        total record:2368
propellar no.:H32803  [V=0.50400*N+0.00000 m/sec]
lower limit  0.00000 m/sec

                         command mode
                   (1):dumping data on CRT or PRT
                   (2):ploting data on CRT
                   (3):end
                       input command mode:
```

Fig. 2.3-8 Command Mode on Display

2. If the dumping list is required for MTC-III data, select "dumping data on CRT or PRT" in command mode, and push "RETURN" key. Then following display appears.

```
          ***MTC2  Header***   file name:
station name:1          model name :MTC2   F.R.T :1988/09/20 11:10:00
Lat.         :3° 0'     serial no. :32103  L.R.T :1988-10-06 21:40:00
Long.        :114° 35'                     interval:10(min)
layer (m)    :3         total record:2368
propellar no.:H32803  [V=0.50400*N+0.00000 m/sec]
lower limit   0.00000 m/sec

       back:input(B)
             data start no.: 1      1988/09/20 11:10:00
             data end no.  : 2368   1988/10/06 21:40:00
             OUTPUT device         :     CRT

                          sure ?  (y/n)
```

Fig. 2.3-9 Parameter on Display

3. Select "CRT" or "PRT" in output device and push "RETURN" key. Dumping list of MTC-III show Table 2.3-3.

Table 2.3-3 Dumping List of MTC-III

*** MTC2 header ***

station name:1
Lat. :3° 0′
Long. :114° 35′
layer (m) :3
propellar no.: H32803
lower limit 0.00000 m/sec

model name :MTC2
serial no. :32103

total record:2368
[V=0.50400*N+0.00000 m/sec]

file name:
F.R.T. :1988/09/20 11:10:00
L.R.T. :1988/10/06 21:40:00
INTERVAL : 10 (min)

Rno.	day m d	time h m	WT Temp ℃	Dir. deg	Vel. cm/sec	N-Comp cm/sec	E-Comp cm/sec	forword turn	backword turn
1	09/20	11:10	28.70	*.**	2.94	1.33	2.62	1	17
2	09/20	11:20	28.80	*.**	0.00	0.00	0.00	0	0
3	09/20	11:30	29.00	*.**	0.00	0.00	0.00	0	0
4	09/20	11:40	29.10	*.**	0.00	0.00	0.00	0	0
5	09/20	11:50	29.20	*.**	0.00	0.00	0.00	0	0
6	09/20	12:00	29.40	*.**	0.00	0.00	0.00	0	0
7	09/20	11:10	29.50	*.**	0.00	0.00	0.00	0	0
8	09/20	12:20	29.70	*.**	0.00	0.00	0.00	0	0
9	09/20	12:30	29.90	*.**	0.00	0.00	0.00	0	0
10	09/20	12:40	30.00	*.**	0.00	0.00	0.00	0	0
11	09/20	12:50	30.20	*.**	0.00	0.00	0.00	0	0
12	09/20	13:00	30.20	*.**	0.00	0.00	0.00	0	0
13	09/20	13:10	30.30	*.**	0.00	0.00	0.00	0	0
14	09/20	13:20	30.40	*.**	0.00	0.00	0.00	0	0
15	09/20	13:30	30.40	*.**	0.00	0.00	0.00	0	0
16	09/20	13:40	30.50	*.**	0.00	0.00	0.00	0	0
17	09/20	13:50	30.60	*.**	0.00	0.00	0.00	0	0
18	09/20	14:00	30.70	*.**	0.00	0.00	0.00	0	0
19	09/20	14:10	30.80	*.**	0.00	0.00	0.00	0	0
20	09/20	14:20	30.80	*.**	0.00	0.00	0.00	0	0
21	09/20	14:30	31.00	*.**	0.00	0.00	0.00	0	0
22	09/20	14:40	31.00	*.**	0.00	0.00	0.00	0	0
23	09/20	14:50	31.00	*.**	0.00	0.00	0.00	0	0
24	09/20	15:00	31.10	*.**	0.00	0.00	0.00	0	0
25	09/20	15:10	31.20	*.**	0.00	0.00	0.00	0	0
26	09/20	15:20	31.30	*.**	0.00	0.00	0.00	0	0
27	09/20	15:30	31.30	*.**	0.00	0.00	0.00	0	0
28	09/20	15:40	31.30	*.**	0.00	0.00	0.00	0	0
29	09/20	15:50	31.30	*.**	0.00	0.00	0.00	0	0
30	09/20	16:00	31.30	*.**	0.00	0.00	0.00	0	0

4. If the drawing figure is required for each elements of observation item, select "ploting data on CRT" in MENU(Refer to Fig.2.3-8), then push "RETURN" key.
Then following display appears.

```
          ***MTC2  Header***   file name:
station name:1        model name :MTC2    F.R.T :1988/09/20 11:10:00
Lat.        :3° 0'    serial no. :32103   L.R.T :1988-10-06 21:40:00
Long.       :114° 35'                     interval:10(min)
layer (m)   :3        total record:2368
propellar no.:H32803  [V=0.50400*N+0.00000 m/sec]
lower limit  0.00000 m/sec

start no.   :1        end no.    :2368
      1988/09/20 11:10:00          1988/10/06 21:40:00
 *** plot item ***     flame start time:1988/09/20 00:00:00
(1):WT Temp            flame end time  :1988/10/07 00:00:00
(2):Direction          plot figs number:4
(3):Velocity
(4):N-comp.            plot form       :line
(5):E-comp.            fig 1: WT Temp     max:  34  min: 24
(6):forword            fig 2: Direction   max: 360  min:  0
(7):backword           fig 3: Velocity    max:  20  min:  0
                       fig 4: N-comp.     max:  20  min:-20
      back:input(B)
      sure ?  (y/n)
```

Fig. 2.3-10 Parameter on Display

5. Select "plot item number" and input necessary parameter from each item. Then drawing figure starts and display asks whether copy or not.
If copy is required, push "COPY" key. Drawing figure shows Fig. 2.3-11.

6. When main MENU (Fig. 2.3-1) appears, select "END" for completion of Job.

*** MTC2 header ***

station name:1
Lat. :3° 0'
Long. :114° 35'
layer (m) :3
propellar no.: H32803
lower limit 0.00000 m/sec

model name :MTC2
serial no. :32103

total record:2368
[V=0.50400*N+0.00000 m/sec]

file name:
F.R.T. :1988/09/20 11:10:00
L.R.T. :1988/10/06 21:40:00
INTERVAL : 10 (min)

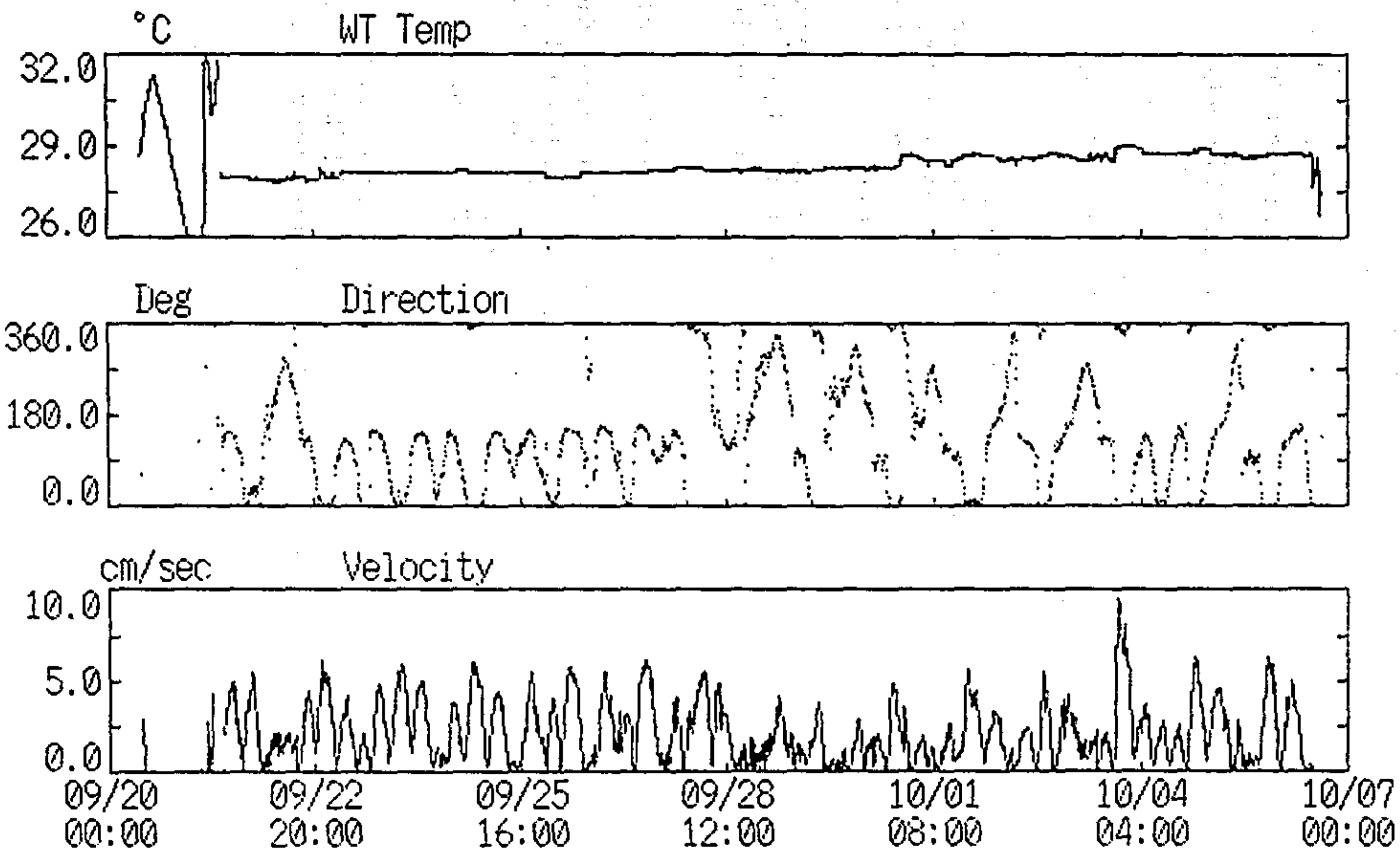


Fig.2.3-11 Current Direction and Current Velocity Curve

3.1.3 Data conversion for Electromagnetic Current Meter(EMC 108)

1) Operation order

1. Set cassset tape which data contained into Tape Reader (EX010) and push "REW" key for rewinding tape.
   (At this time, don't miss setting cassette case surface and opposite side.)

2. Power switch "ON" for PC-9801.
   At this time, no neccesary insert floppy disk and then display appears .

3. Push "RETURN" key, then JOB MENU appears on display.

4. And choose (7), then push "RETURN" key then "A>" appears left side on display.

5. Type "EMC", then push "RETURN" key.
   Type "File Name", for example "St.1-01" and "St.1-02".
   Then push "RETURN" key.

6. Push "START" for Tape Reader(EX010).
   At this time, "START LAMP" on and cassette tape moves.
   From this time, cassette tape reading starts.
   And after tape reads every 7 files then tape stops and data are transfered to PC9801 computer.

7. After data transfer finish, display shows data which computer recieved and data are sent to Hard Disk.
   Meanwhile, Tape Reader repeats the abovementioned actions up to final data.

8. "END" lamp in bright means completion of all data conversion.
   For example: When 15 days observation with Burst Interval : 60 min., Sampling Interval : 0.5 sec, Sampling Duration : 512, total number of file are about 2800.
   It takes about 3.8 hours for data conversion.

9. Push "STOP" on PC9801, then push "HOME CLEAR" key.
   Type "CLOSE" on display then push "RETURN" key.
   (At this time, all current data had been stored in the Hard Disk.)

10. How to make back up copy. (Data transfer to floppy disk)
The abovementioned opertation 1-3 are required.
Insert format floppy disk for data stowing into "DISK DRIVE 1".
Type "A>copy A:St.1-01(file name) B:St.1-01(file name)" on display.
Then push "RETURN" key.
After then data transfer starts from Hard Disk to floppy.

2) Data Processing

1. The data which were transfered from a cassette tape to a floopy disk were processed by a big frame computer.
In this processing, various informations were also supplied to the computer basing upon an observation memorandum sheet(Refer to Table 2.3-4 and Table 2.3-5) for EMC-108 and the computer computed current directions and velocities for necessary analysis.

Table 2.3-4

THE OBSERVATION MEMORANDUM of ERECTROMAGNETIC CURRENT METER (EMC-108)

ITEM :YEARLONG SURGVEY (WAVE)

AREA :THE ACCESS CHANNEL OF BANJARMASIN PORT

OBSERVER: (CMAT NO. 1-)

SERIAL NUMBER OF EMC-108		S / N : 1029 , 1030 , 1031	
POSITION	OBSERVATION AREA	BANJARMASIN (15-Day and Night)	
	STATION	ST. 1	
	LAT. LONG.	3° 39′ 5.41″ S	114° 25′ 22.0″ E
	DEPTH (DATE, TIME)	. m (/ , :)	
	OBSERVATION LAYER	0.5 m ABOVE SEABED	
DURATION TIME	BURST INTERVAL	2.0 Hour (120 Min)	
	SAMPLE INTERVAL	0.5 Sec	
	SAMPLE DURATION	512 Data (4 Min 16 Sec)	
PERIOD	FIRST RECORDING TIME	1989 / H M S	
	INSTALLATION TIME	1989 / H M	
	WITHDRAWAL TIME	1989 / H M	
	LAST RECORDING TIME	1989 / H M S	
MOORING METHOD OF EMC-108	POSITION OF COMPASS	NORMAL	
	DIRECTION OF Y AXIS	DIR.FROM MAG.N ° (DECLINATION °)	
	METHOD OF INSTALLATION	FIX WITH TRIPOD FRAME	
	MATERIAL OF TRIPOD	IRON	
CONDITION OF INSTALLATION	BATTERY POWER PRIOR TO SURVEY: V(DATE: / , h m)		
	BATTERY POWER AFTER SURVEY : V(DATE: / , h m)		

Table 2.3-5

THE OBSERVATION MEMORANDUM of ERECTROMAGNETIC CURRENT METER (EMC-108)

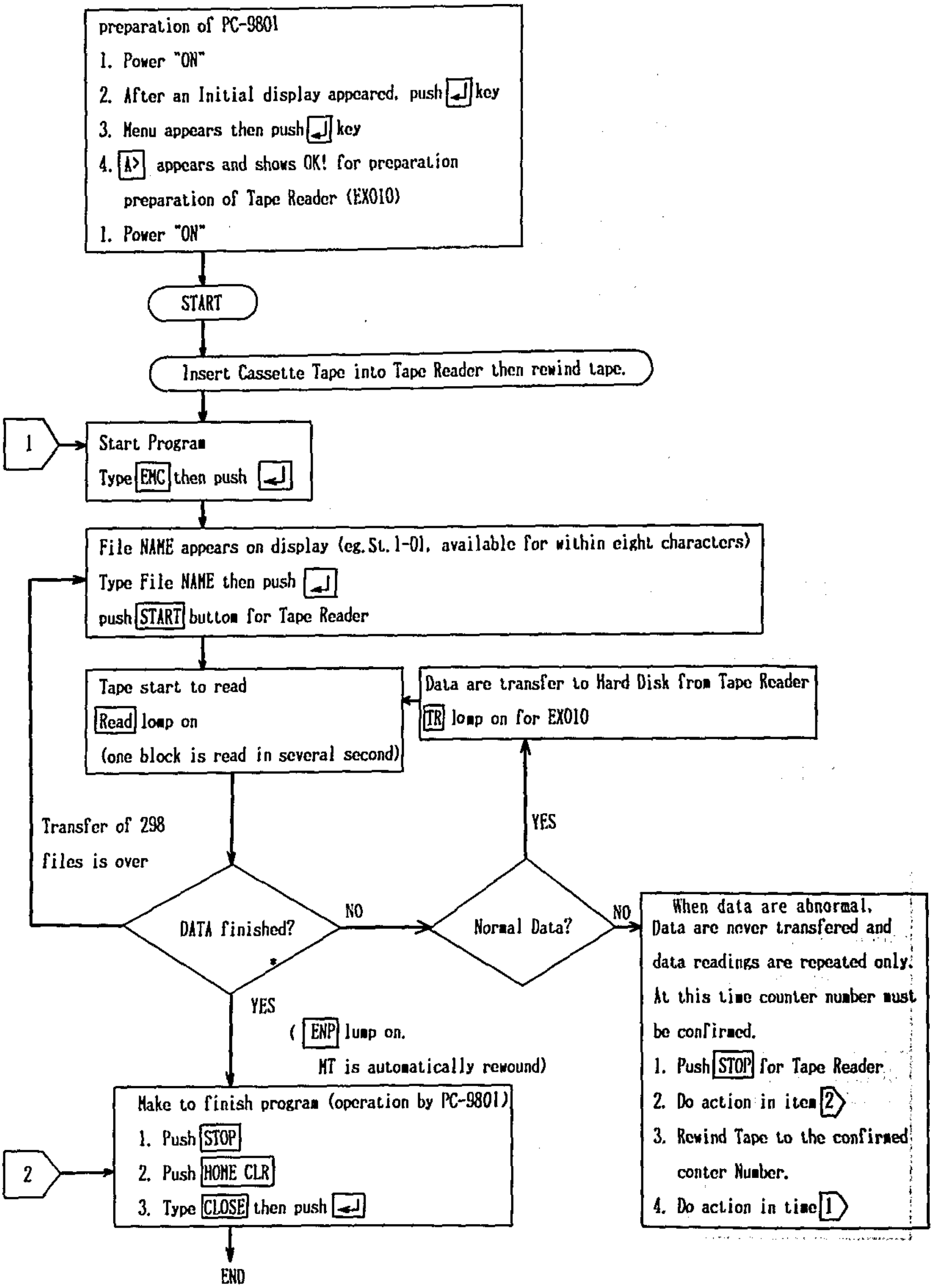
ITEM :GENERAL SURGVEY (CURRENT 1)

AREA :THE ACCESS CHANNEL OF BANJARMASIN PORT

OBSERVER: (CMAT NO. 1-)

SERIAL NUMBER OF EMC-108		S / N :	
POSITION	OBSERVATION AREA	BANJARMASIN	
	STATION	ST. (-Day And Night)	
	LAT. LONG.	3° ′ . ″ S	114° ′ . ″ E
	DEPTH (DATE, TIME)	. m(Month / Day , h : m)	
	OBSERVATION LAYER	0.5 m ABOVE SEABED	
DURATION TIME	BURST INTERVAL	1.0 Hour (60 Min)	
	SAMPLE INTERVAL	0.5 Sec	
	SAMPLE DURATION	256 Data (2 Min 8 Sec)	
PERIOD	FIRST RECORDING TIME	1989 Month / Day H M S	
	INSTALLATION TIME	1989 / H M	
	WITHDRAWAL TIME	1989 / H M	
	LAST RECORDING TIME	1989 / H M S	
MOORING METHOD OF EMC-108	POSITION OF COMPASS	NORMAL	
	DIRECTION OF Y AXIS	DIR.FROM MAG.N ° (DECLINATION °)	
	METHOD OF INSTALLATION	FIX WITH TRIPOD FRAME	
	MATERIAL OF TRIPOD	IRON	
CONDITION OF INSTALLATION	BATTERY POWER PRIOR TO SURVEY: V(DATE: / , h m) BATTERY POWER AFTER SURVEY : V(DATE: / , h m) Weather : (Date: / , h m) Wind direction: Wind speed : Wave height : Wave direction:		

Flow of Conversion of Cassette Tape of EMC108



* Tape Reader can judge automatically.

Fig. 2. 3-12 Flow Chart of Conversion of Cassette Tape (EMC108)

3.2 Processing Data Measured by the Observational Equipment except the Self Recording Type Equipment

Followings are operation methods of data input and drawing figure using a personal computer for data which were measured by analogue recording type observational equipment(Tide gauge and wind anemometer) and direct reading type observationl equipment.

3.2.1 Method of Data Processing for Tide

1) Data Input Procedure

The first, date, time and recording conditions on an analogue chart of the tide gauge must be checked. After normal records were confirmed, height of tide from the datum line are read. Then these data are input.

2) Input Data

1. Switch "ON" for the computer.

2. Insert the floppy disk for the program into "DISKET 1".

3. Push "RESET" switch, then the following message of "JOB MENU" apears on the display.

```
                 (JOB MENU)

            (1) TIDE
            (2) WIND
            (3) END THIS PROGRAM


        * Please select ↑ ↓ ← → *
        *        and Return      *
```

Fig. 2.4-1 JOB MENU on Display

4. Select "TIDE" from JOB MENU, then the following message apears on the display.

```
              〈 TIDE-FILE JOB MENU 〉
    *** Please set Data-floppy to Drive-B ***
              (1) DATA INPUT
              (2) DISPLAY DATA
              (3) END THIS PROGRAM


           * Please select ↑ ↓ ← → *
           *        and Return     *
```

Fig. 2.4-2 JOB MENU on Display

5. Insert a format floppy disk into "DISKET 2".

6. Then select "DATA INPUT" on the MENU and the following is displayed.

```



--------------------------------------------------------
ドライブ B: のディスクのボリュームラベルはありません。
ディレクトリは B: ¥

--------------------------------------------------------
File Name ( Useless ".WJ2" )  :

```

Fig. 2.4-3 Display asks File Name

On preserving the data, file name must be correctly separated among many files. Therefore, it is desirable that survey item and month are determined without confusion. For example, in case of tide data obtained in July, 1989, file name is "TIDE8907".

7. After file name is input, format of table is displayed. Then input the tide data for every one hour in the format of table.

8. After completion of inputting tide data, push the key for "CNTL P". The output table is displayed as Table 2.4-1.

9. Push the key "CNTL P" for saving the input data. Display returns to Fig. 2.4-2. Then input operation closed.

3) Output of Tidal Curve

1. Shift a carsol position to "DISPLAY DATA" on the display shown as Fig. 2.4-2 and push the "RETURN KEY". Then display shown as Fig. 2.4-3 appears. Input file name then tidal curve appears on the display.

2. When a copy in Fig. 2.4-4 is required , select a command of "COPY" to print out by a printer.

3. After completion of printing out, select a command of "END" display returns to Fig. 2.4-2 and operation of drawing curve closed.

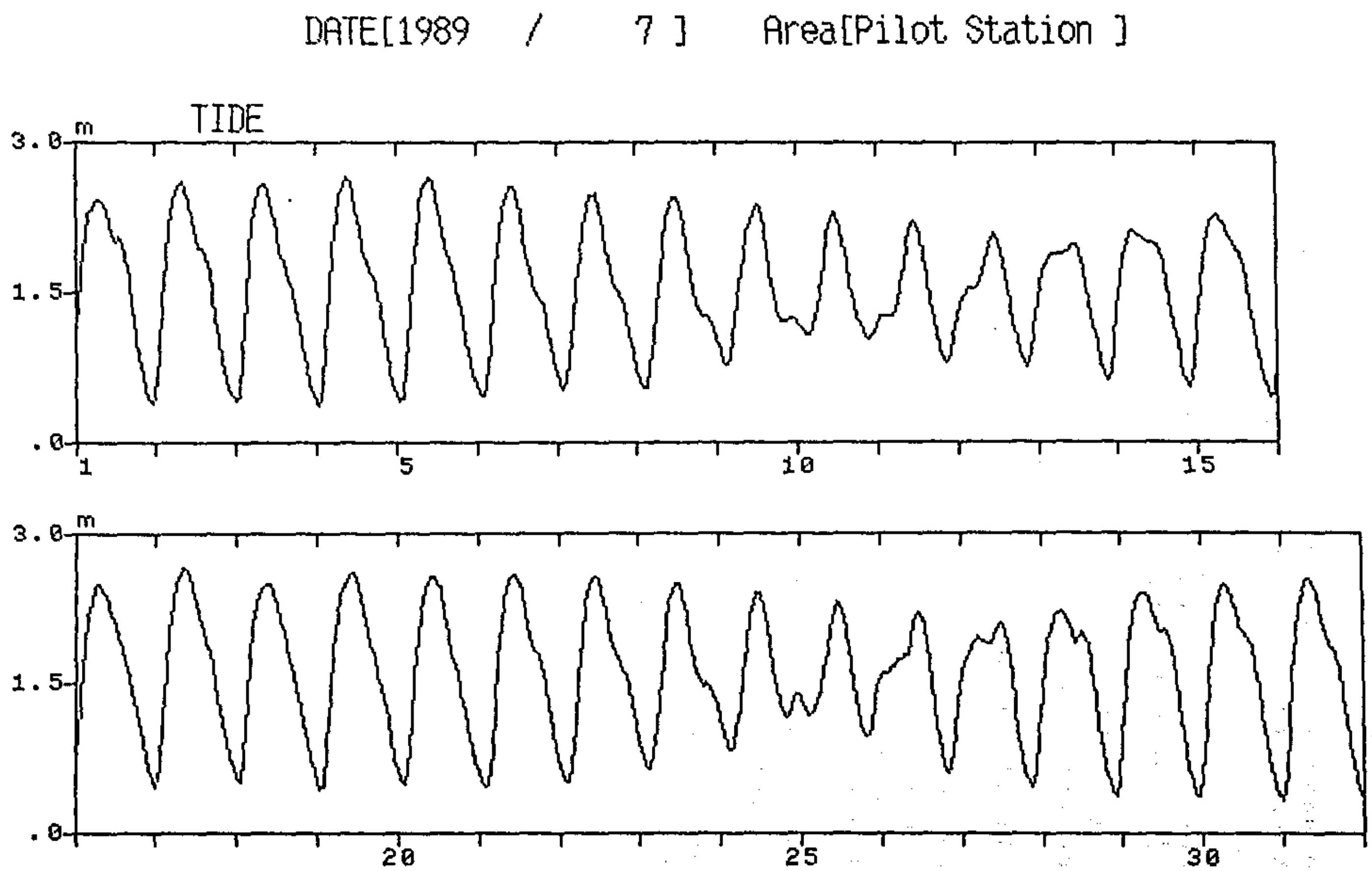


Fig. 2.4-4 Tidal Curve

Table 2.4-1 Tide

DATE(1989 / 7) Item:TIDE(cm) Area(Pilot Station))

	1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h	24h	AVG.	Low Water Time	Level	Time	Level	High Water Time	Level	Time	Level
1	131	174	209	229	235	242	244	242	232	221	208	203	206	199	186	166	136	108	86	69	56	45	40	47	163.1	2305	40			710	245		
2	89	142	184	219	241	253	260	262	253	240	222	206	196	194	185	173	149	123	104	83	66	55	47	42	166.2	2359	43			740	263		
3	48	91	147	188	222	242	254	259	259	243	231	210	190	181	172	163	154	135	117	98	77	61	49	41	159.7	023	41			825	259		
4	37	55	102	153	194	227	249	260	266	263	250	231	213	194	180	173	168	158	137	112	91	73	59	49	162.3	105	37			915	266		
5	43	44	79	129	171	207	239	254	262	266	263	246	223	212	189	184	169	153	145	123	101	82	68	58	162.9	130	42			1000	266		
6	49	47	59	99	141	176	208	234	249	258	258	248	229	208	188	174	160	148	144	139	121	101	84	70	158.0	200	47			1045	259		
7	61	54	60	87	123	159	189	216	236	247	249	251	234	214	193	177	161	153	148	138	124	111	91	76	156.3	217	53			1151	251		
8	63	56	57	79	104	137	170	200	226	239	246	246	236	218	196	170	150	136	130	128	129	124	116	103	152.5	226	55			1130	248		
9	93	83	80	88	107	144	160	185	213	223	232	238	236	216	191	171	150	133	124	123	123	126	125	120	153.5	300	80			1225	238		
10	116	114	110	109	119	135	154	181	210	225	231	228	215	199	182	159	139	126	120	111	106	107	109	118	151.0	2116	106			1109	232		
11	127	128	128	128	129	143	158	178	201	215	222	221	208	188	168	143	123	109	96	85	81	90	107	129	146.0	2102	81			1115	222		
12	141	148	153	156	156	156	166	175	193	203	210	208	192	180	158	136	122	107	92	82	77	91	115	144	148.4	2100	77			1130	211		
13	161	173	183	188	191	190	190	191	192	197	199	199	191	177	156	131	118	100	83	70	63	71	100	136	152.1	2120	63			1133	199		
14	165	187	201	210	213	212	209	207	204	203	203	200	191	182	157	132	118	102	84	69	59	56	78	121	156.8	2145	56			500	213		
15	159	186	212	223	228	229	226	222	213	207	200	193	187	176	162	137	118	99	81	66	54	47	49	92	156.9	2230	46			544	230		
16	141	188	218	233	247	250	244	238	229	218	208	196	185	172	158	142	124	112	94	77	64	54	48	68	162.8	2310	48			543	250		
17	115	163	205	233	252	261	267	267	260	245	233	219	205	192	181	167	148	124	109	93	48	66	56	51	174.6	2359	51			811	267		
18	78	134	174	211	230	241	247	251	250	242	230	214	202	189	174	161	145	126	110	92	76	63	63	46	164.1	2359	46			745	251		
19	47	88	139	184	217	238	250	256	262	263	255	239	221	204	188	178	136	149	133	114	93	76	64	55	169.5	033	44			950	263		
20	50	66	110	159	198	221	236	252	258	258	251	248	218	199	179	168	161	142	121	108	87	71	61	52	161.4	110	50			927	261		
21	48	30	82	128	174	209	236	255	257	259	253	243	220	206	190	184	178	168	149	128	105	84	68	60	163.9	124	49			934	259		
22	54	53	70	108	155	186	232	251	256	257	254	243	223	204	188	179	169	162	159	146	129	109	90	77	165.2	140	53			930	257		
23	69	66	82	105	136	173	210	235	244	251	251	236	220	195	172	160	150	146	152	147	140	129	115	100	161.8	145	66			1030	252		
24	86	85	89	107	126	159	187	217	231	241	240	225	208	186	165	144	130	119	117	126	138	140	135	124	155.2	130	84			1030	244		
25	119	119	124	134	145	165	183	205	225	232	230	216	201	170	148	124	110	89	97	107	134	148	158	161	156.4	1840	96			1015	233		
26	161	166	168	174	175	178	179	195	211	222	220	208	187	153	124	96	81	69	62	69	100	133	160	172	152.7	1930	83			955	222		
27	179	189	192	197	195	193	190	191	200	209	211	204	185	160	126	96	78	62	52	47	61	100	139	170	.151.2	2000	47			1030	212		
28	192	205	2172	220	222	218	211	201	190	198	201	197	191	168	136	107	84	66	51	42	38	55	96	145	152.1	2050	38			510	222		
29	185	216	32	239	240	241	235	224	213	204	203	204	194	184	156	127	103	83	66	51	41	38	59	106	160.2	2200	38			600	241		
30	157	198	227	242	248	250	245	233	224	207	201	198	190	187	166	146	118	94	74	58	46	37	34	60	160.0	2300	34			550	250		
31	108	159	200	227	242	252	256	252	240	222	207	197	188	185	177	164	138	114	90	71	57	46	38	39	161.2	2340	37			700	256		

3.2.2 Processing Data for Wind

1) Data Input Procedure

The first, date, time and recording conditions on an analogue chart of the wind meter must be checked.
After normal records were confirmed, instantaneous wind velocity, average wind velocity and wind directions which smoothing are carried out are read. Then these data are inputed.

2) Input Data

1. Switch "ON" for the computer.

2. Insert the floppy disk for the program into "DISKET 1".

3. Push "RESET" switch, then JOB MENU as Fig. 2.4-1 appears on the display.

4. Select "WIND" from "JOB MENU" and push "RETURN" key.

```
              〈 WIND-FILE JOB MENU 〉
     *** Please set Data-floppy to Drive-B ***
               (1) DATA INPUT
               (2) DISPLAY DATA
               (3) END THIS PROGRAM


           * Please select ↑ ↓ ← → *
           *        and Return       *
```

Fig. 2.4-5 JOB MENU on Display

5. Insert a format floppy disk into "DISKET 2".

6. Select "DATA INPUT" on the display shown as Fig. 2.4-5, then following is displayed and the display asks file name.
In case of wind data obtained in July, 1989, file name is "WIND8907".

```
ドライブ B: のディスクのボリュームラベルは BNJR00048
ディレクトリは B:

 WID8907 WJ2   TP890707 WJ2   TP890710 WJ2   TP890714 WJ2
        5 個のファイルがあります。
--------------------------------------------------------------
File Name ( Useless ".WJ2" )  : WIND8907
```

Fig. 2.4-6 File Name on Display

7. After file name was input, the format of table is displayed. Then input wind directions and wind velocities at every just hour.

8. After completion of input, push the key "CNTL P" then data are printed out by a printer in the table. Sample of the table is shown as table 2.4-2.

9. After completion of printing out, push the key "CNTL E" for saving data, the display returns to Fig. 2.4-5 and the data input operation is closed.

3) Wind Direction and Wind Velocity Curve

1. Shift carsol position to "DISPLAY DATA" on the display show as Fig. 2.4-6 and push the key "RETURN". Then the display shown as Fig. 2.4-6 appears.
When a file name is input, drawing curve shown as Fig. 2.4-7 is displayed.

2. Copy shown as Fig. 2.4-7 is required, select "Copy" in the commands. Then the curve is printed out by a printer.

3. After completion of printing out, select the "END" in the commands, the display returns to Fig. 2.4-5 and operation of drawing curve is closed.

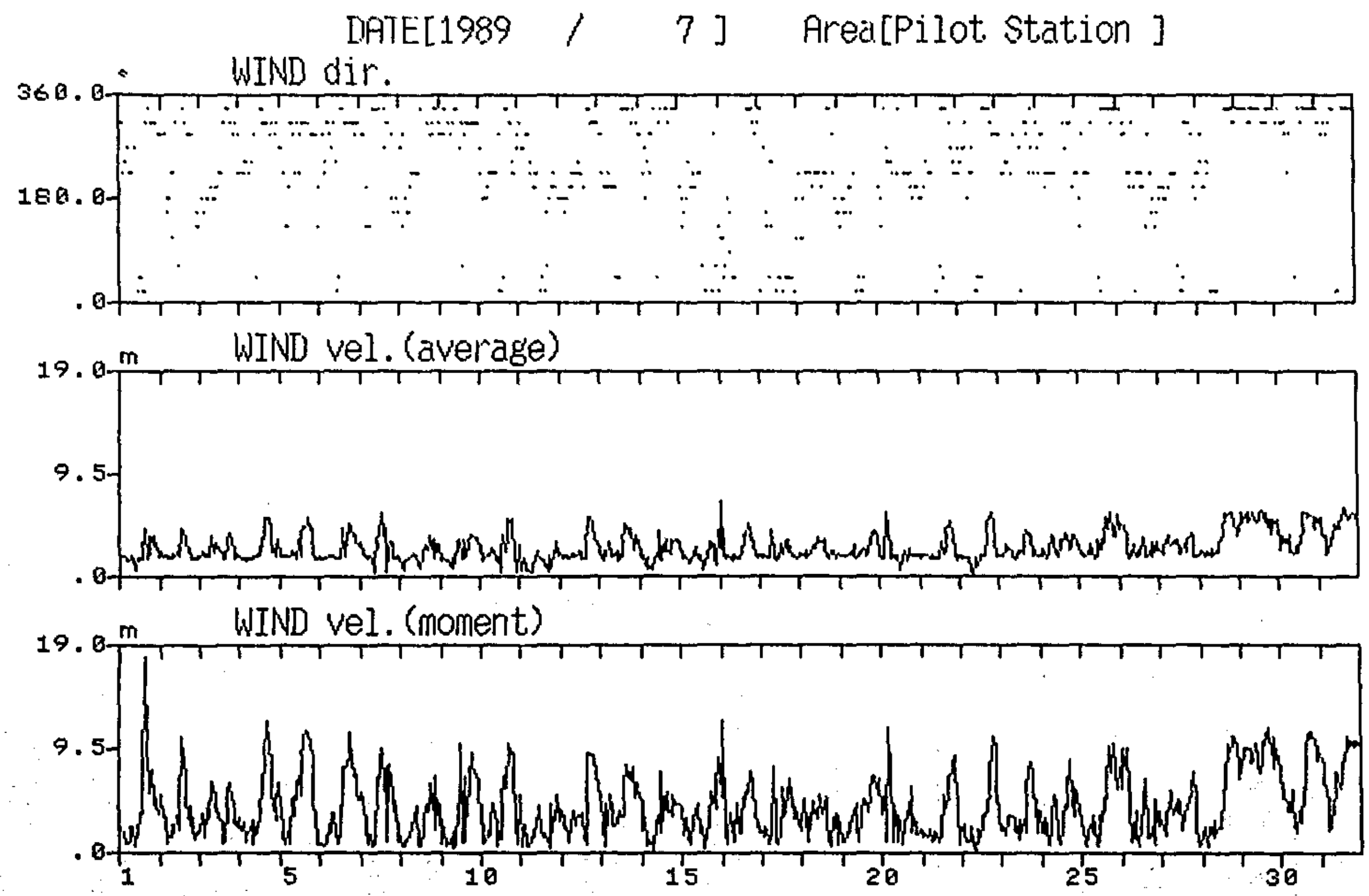


Fig. 2.4-7 Wind Direction and Wind Velocity Curve

Table 2.4-2 Wind Direction and Wind Velocity

DATE(1989 / 7) Item:WIND(vel.(m)) Area(Pilot Station)

		1h	2h	3h	4h	5h	6h	7h	8h	9h	10h	11h	12h	13h	14h	15h	16h	17h	18h	19h	20h	21h	22h	23h	24h
1	dir.	SSE	SE	SE	NE	ENE	E	NE	NE	NE	E	S	SSW	SW	SW	SSW	SSW	SE	SSE	SSE	SE	SE	SE	SE	ESE
	ave-v	2.2	2.0	2.0	2.0	1.6	1.5	1.8	2.0	1.8	0.8	1.3	1.8	1.9	1.8	2.4	4.5	1.9	2.4	4.0	3.6	3.0	3.8	2.9	2.0
	mom-v	2.8	2.5	1.7	0.9	1.0	1.0	1.3	2.4	2.4	0.8	1.0	2.0	3.7	3.8	5.0	18.0	9.3	5.6	7.2	7.7	4.7	6.3	4.4	3.8
2	dir.	SSE	ESE	ESE	ESE	NNW	N	N	WNW	NE	E	SE	WSW	WSW	S	SSE	SE	SE	ESE	ESE	ESE	ESE	S	NNW	NW
	ave-v	2.5	2.3	2.0	2.1	1.8	2.0	1.9	1.9	2.2	2.0	2.5	2.0	2.0	4.6	4.3	3.8	3.3	2.8	1.8	2.0	1.9	1.8	1.9	2.0
	mom-v	5.0	5.4	6.5	3.1	1.0	1.4	1.5	1.5	2.7	2.0	3.6	2.2	3.8	10.7	8.6	6.8	4.8	3.4	2.7	4.4	2.2	1.4	2.1	1.8
3	dir.	NW	N	NNW	NNW	N	N	N	NNE	N	NE	NNE	NNE	NE	NE	NE	SE	SSE	SSE	SSE	SE	ESE	ESE	SEE	ESE
	ave-v	2.1	2.4	2.0	2.0	2.0	2.7	2.1	4.1	2.4	3.2	3.0	2.8	2.6	2.3	1.9	1.8	3.5	3.8	4.2	3.3	2.8	1.9	2.2	2.0
	mom-v	2.0	3.8	2.8	1.5	4.2	4.2	3.2	6.7	6.1	5.4	4.4	3.3	3.0	2.8	1.0	1.2	4.4	5.8	6.4	5.1	4.6	2.9	2.7	3.2
4	dir.	NE	NE	NE	ENE	NE	ENE	NE	ENE	ENE	N	S	SW	S	SSE	SE	SSE	SE	SE	ESE	ESE	SE	ESE	ESE	SE
	ave-v	2.0	1.9	1.9	1.8	1.6	1.9	1.8	2.0	1.8	2.0	2.2	2.0	2.4	3.8	3.8	5.5	5.7	5.5	4.5	2.6	2.8	2.0	3.0	3.5
	mom-v	2.3	2.2	25.9	1.1	1.9	2.1	2.2	3.1	1.0	2.4	2.5	2.0	4.1	6.6	8.5	9.2	12.2	10.0	8.0	5.7	4.3	3.0	4.6	6.4
5	dir.	E	E	E	NE	NW	NNE	NW	SE	ESE	ESE	NE	SE	NE	ESE	SE	SE	SE	SE	SE	ESE	ESE	ESE	ESE	NNE
	ave-v	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.2	2.2	1.9	3.6	2.0	4.2	4.8	4.8	5.0	5.5	4.5	4.6	2.2	1.9	1.9	1.8
	mom-v	3.9	2.5	1.4	1.0	2.0	1.0	1.8	5.1	5.2	3.5	6.4	7.0	5.3	8.3	10.7	11.4	11.0	11.0	10.0	9.0	4.2	3.8	1.0	1.0
6	dir.	NW	S	ESE	ENE	NE	SE	SE	ESE	E	SE	ENE	SSW	SW	SSE	SSE	SSE	SE	SE	SE	SE	SE	SE	ESE	SE
	ave-v	2.0	1.8	1.8	1.9	1.7	2.0	2.0	2.1	2.0	1.9	1.9	1.9	1.9	4.1	4.6	2.0	4.2	4.2	5.0	4.5	3.9	4.0	3.2	3.0
	mom-v	1.0	1.0	0.9	1.2	1.0	2.7	2.1	3.8	3.8	1.5	1.5	1.0	2.1	6.9	8.0	8.0	8.1	9.4	11.0	8.4	7.1	7.3	5.6	5.0
7	dir.	SE	SE	ESE	ESE	NNE	NW	NW	NW	SSE	SSE	SSE	SSE	SSE	SSE	S	SSE	E	SE	SE	ESE	N	NNW	N	N
	ave-v	3.2	3.2	2.3	2.0	1.9	2.0	2.0	1.7	0.7	1.9	3.2	4.5	4.1	6.2	4.0	4.5	0.7	2.8	3.2	3.2	1.8	1.9	1.9	2.0
	mom-v	5.0	5.7	4.9	2.2	1.0	1.8	1.7	0.8	1.0	2.9	5.4	9.0	6.9	9.5	5.8	7.9	1.1	8.1	6.4	5.5	4.0	4.8	1.2	2.0
8	dir.	NNW	E	ESE	NW	N	NNW	NNW	NNE	NE	NE	NE	NE	NE	SSE	SSE	S	S	S	SE	ESE	SE	ESE	SSE	SSE
	ave-v	1.8	1.0	0.9	1.5	1.5	1.9	2.0	2.0	2.2	2.0	2.0	1.2	1.0	2.0	2.6	3.0	2.8	3.5	4.1	2.7	3.5	1.9	3.0	3.0
	mom-v	1.3	0.9	0.9	1.1	1.3	2.0	2.6	2.6	3.4	4.4	3.7	0.9	0.9	2.5	3.4	4.4	3.9	5.3	6.6	4.2	7.0	2.3	5.0	4.2
9	dir.	ESE	SE	ESE	ESE	SSE	SSE	SE	ESE	ESE	SE	SSE	S	SSE	E	WSW	SE	ESE	SE	SE	SE	SE	SE	SE	SE
	ave-v	1.5	2.1	1.8	1.5	1.5	1.5	1.3	1.9	1.0	1.6	3.2	3.2	3.5	1.9	1.8	3.4	2.0	3.2	4.0	4.1	3.9	3.7	3.8	3.4
	mom-v	1.0	3.1	2.0	0.9	0.9	1.0	1.0	2.1	0.5	1.0	4.2	5.3	10.0	1.1	1.3	7.1	3.5	7.0	9.2	8.2	7.5	7.3	6.5	5.4
10	dir.	SE	E	NE	N	N	N	NNE	NE	NE	NE	NE	NE	ESE	SSW	SSW	SW	SSE	SSE	SSE	SE	ENE	NE	NE	ESE
	ave-v	2.8	1.9	1.5	1.8	2.0	2.0	2.0	2.8	2.2	2.0	1.5	1.8	0.5	2.5	3.9	2.4	4.1	5.4	5.2	5.3	1.6	2.2	0.7	3:0
	mom-v	3.7	1.8	1.0	1.2	2.0	1.8	3.0	4.5	3.3	3.0	0.8	2.1	1.4	5.1	7.0	6.1	10.2	8.7	9.7	9.0	2.0	3.5	1.0	5.3
11	dir.	E	SE	E	E	E	ESE	ESE	ENE	NE	NNE	NNE	NE	NE	SSW	SW	S	SSW	WSW	NNW	N	NNE	NE	NNE	NNE
	ave-v	2.0	0.8	1.9	1.0	0.8	0.8	0.7	0.7	1.2	2.0	2.6	2.1	1.8	1.5	1.5	1.2	1.2	0.6	2.0	1.0	2.6	2.4	3.2	2.0
	mom-v	4.5	0.8	2.7	1.0	0.9	0.9	1.5	2.1	1.5	3.1	4.0	4.4	2.1	1.5	1.8	1.5	1.4	0.5	4.5	2.0	4.1	4.0	5.4	3.0
12	dir.	N	N	N	N	N	NNW	N	NNE	NE	NNE	NE	NE	NE	ENE	NE	NNE	S	S	SSE	SSE	SE	SE	SE	SE
	ave-v	2.3	1.9	1.9	2.0	2.0	1.9	1.9	2.2	2.0	2.2	2.1	2.5	2.4	1.9	1.8	1.8	2.8	5.6	5.5	5.0	4.5	3.8	3.0	2.9
	mom-v	4.1	3.1	2.5	2.5	1.5	1.3	2.7	4.0	2.7	3.3	3.4	3.5	3.7	3.4	1.6	1.0	9.1	9.2	9.0	9.0	8.5	7.3	6.3	5.1
13	dir.	SE	ESE	ESE	NE	NNE	NNE	NE	NNE	NNE	NNE	NNE	SW	SW	SW	S	SSE	SSE	SSE	SSE	SSE	SE	SSE	SSE	SE
	ave-v	2.5	1.7	1.5	2.4	2.0	3.3	2.2	2.1	2.1	2.2	2.4	1.6	2.0	2.0	3.2	5.0	4.7	4.2	4.5	4.7	2.8	3.9	3.9	3.0
	mom-v	41.9	2.5	0.9	4.5	2.7	3.4	3.7	2.8	2.8	3.0	3.9	3.7	3.5	3.5	6.5	8.1	7.2	6.8	7.3	8.0	5.2	6.4	5.6	5.6
14	dir.	ESE	ESE	ESE	NE	N	E	ENE	NE	ESE	ESE	SSE	SW	S	SE	SSE	S	S	SSE	SE	SSE	S	SSE	SSE	S
	ave-v	2.5	2.0	2.0	1.2	1.8	0.9	1.0	0.8	0.8	1.9	2.2	1.8	4.4	1.5	3.1	3.5	2.5	2.5	2.2	3.4	3.2	3.5	3.6	3.2
	mom-v	4.4	2.3	3.2	0.8	1.3	1.0	1.0	0.7	2.4	3.0	3.4	2.0	7.5	3.0	3.1	5.6	4.0	3.9	3.5	3.3	4.5	4.5	4.6	4.5
15	dir.	SSE	NNE	N	NW	NNW	N	N	ENE	NNE	NNE	NE	NNE	NE	NE	S	WSW	SSW	S	S	S	SSW	S	ESE	WSW
	ave-v	3.2	1.8	1.9	2.1	1.8	1.5	1.4	1.5	2.5	2.9	2.5	1.9	2.0	1.0	0.8	1.5	1.8	1.9	3.2	2.9	3.0	1.8	1.2	4.4
	mom-v	4.4	1.8	2.4	3.2	1.5	1.0	1.1	3.2	4.0	4.5	4.2	2.0	2.5	1.0	0.6	2.0	2.7	3.3	5.6	5.1	4.2	6.0	8.9	7.5
16	dir.	NW	SSW	WNW	SW	WNW	WSW	N	NNW	W	SW	SW	S	S	S	S	S	S	S	SSE	SSE	SSE	SSE	SE	ESE
	ave-v	2.8	7.0	2.0	1.9	2.1	2.0	1.7	2.1	1.6	2.0	1.9	1.9	2.1	2.2	3.8	3.9	4.0	5.1	4.4	4.0	2.9	2.1	2.2	1.9
	mom-v	5.2	12.2	1.7	1.0	2.15	3.7	2.0	3.0	1.1	4.5	2.1	2.1	3.2	5.2	5.2	5.7	5.7	7.6	6.4	5.7	4.0	2.5	3.0	2.0
17	dir.	SE	SSE	SSW	SSE	E	NW	NNW	SW	NW	ENE	ENE	SSW	SW	SW	SW	SSW	SW	SW	SW	SW	S	SW	SSW	WNW
	ave-v	2.0	2.1	1.8	2.0	1.7	2.0	1.9	4.4	1.8	2.0	1.6	2.0	2.9	3.0	2.2	3.2	2.6	3.5	2.6	2.0	2.3	2.0	1.9	2.2

3.2.3 Data Processing for Discharge

1. Prepare the field survey notes.
2. Switch "ON" for computer.
3. Insert the floppy disk for the program into "DISKET 1".
4. Push "RESET" switch, then the following JOB MENU appears.

```
              〈 MONTHLY SURVEY 〉

                 (1) DISCHARGE
                 (2) SALINE
                 (3) END


           * Please select ↑ ↓ ← → *
           *        and Return      *
```

Fig. 2.4-8 JOB MENU on Display

5. Select "DISCHARGE" then the following is displayed.

```
                 〈 DISCHARGE 〉
      *** Please set Data-floppy to Drive-B ***
                 (1) DATE INPUT
                 (2) END


           * Please select ↑ ↓ ← → *
           *        and Return      *
```

Fig. 2.4-9 JOB MENU on Display

6. Insert a format floppy disk into "DIKET 2".

7. Select "DATA INPUT" from the MENU on the display then format of table for five(5) stations is displayed as Fig. 2.4-10 on the display.

8. Input necessary informations such as date for each survey item, station No., depth, time, measured values and equipment No., etc. into the locations required.

9. After completion of input data, push the key "CNTL S" then data are saved.

10. Print out the input data by a printer in way of LOTUS 1-2-3 system.

11. Push the key "CNTL E" then operation closes.

File save => [CTRL]+[S]
End => [CTRL]+[E]

Table 2.4-3(1) Current Velocity and Current Direction List

DISCHARGE (9 23 ~ 24 1988)

ST: F Current Velocity(cm/s)

Current meter: S/N65177

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Depth																										
Start																										
End																										
1m																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
B+0.5																										

ST: F Current Direction(°)

Current meter: S/N65177

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Depth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Start	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1m																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
B+0.5																										

Table 2.4-3(2) Salinity and Temperature List

ST: F Salinity(°/..) Salino meter: F/12150/1/2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Depth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Start																										
End																										
1m																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
B+0.5																										

ST: F Temperature(°C) Salino meter: F/12150/1/2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Depth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Start	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1m																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
B+0.5																										

Table 2.4-4(3) Turbidity List

ST: F Turbidity(ppm) Turbidi meter: S/N23

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Depth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Start																										
End																										
1m																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
B+0.5																										

3.2.4 Processing Data for Saline Wedge

1. Prepare the field notes.

2. Swich "ON" for the computer.

3. Insert floppy disk for the program into "DISKET 1".

4. Push "RESET" switch then "JOB MENU" appears on display shown as Fig 2.4-8.

5. Select "Saline" then the follwing is displayed.

```
                    ( SALINE )
      *** Please set Data-floppy to Drive-B ***
                 (1) DATE INPUT 1
                 (2) DATE INPUT 2
                 (3) END


            * Please select ↑ ↓ ← → *
            *        and Return       *
```

Fig. 2.4-10 JOB MENU on Display

6. Insert a format floppy disk into "DISKET 2".

7. Select "DATA INPUT 1" from the MENU then format table for four(4) stations is displyed as Table 2.4-4.

8. Input necessary informations such as date for each survey items, station No., depth, time, measured value and equipment No., etc. into the location required.

9. After completion of input data, push the key "CNTL S" then data are saved.

10. Print out the input data by a printer in way of LOTUS 1-2-3 system.

11. Push the key "CNTL E" then operation closes.

File save => [CTRL]+[S]
End => [CTRL]+[E]

SALINE

Table 2.4-4(1) Current Velocity and Current Direction List

Table 2.4-4

(10 11 ~ 12 1988)

ST: Current Velocity(cm/s)

Current meter: S/N65177

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Depth																										
Start																										
End																										
1m																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
B+2.0																										
B+1.5																										
B+1.0																										
B+0.5																										

ST: 0 Current Direction(°)

Current meter: S/N65177

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Depth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Start	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1m																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
B+2.0																										
B+1.5																										
B+1.0																										
B+0.5																										

Table 2.4-4(2) Salinity and Temperature List

Table 2.6-4

ST: 0 Salinity(°/..)

Salino meter : F/12150/1/2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Depth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Start																										
End																										
1m																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
B+2.0																										
B+1.5																										
B+1.0																										
B+0.5																										

ST: 0 Temperature(°C)

Salino meter : F/12150/1/2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Depth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Start	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
End	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1m																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
B+2.0																										
B+1.5																										
B+1.0																										
B+0.5																										

Table 2.6-4

Table 2.4-4(3) Turbidity List

ST: 0 Turbidity(ppm)

Turbidi meter :S/N23

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Depth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Start																										
End																										
1m																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
B+2.0																										
B+1.5																										
B+1.0																										
B+0.5																										

4. Application of Results of Natural Condition Survey of Access Channel

On the study on maintenance dreging, the countermeasure of sedimentation is processed basing upon a flow chart shown in Fig. 2.5-1.
In the flow chart, natural condition survey occupies a important position to grasp the phenomenon of sedimentation in consideration of sedimentation.

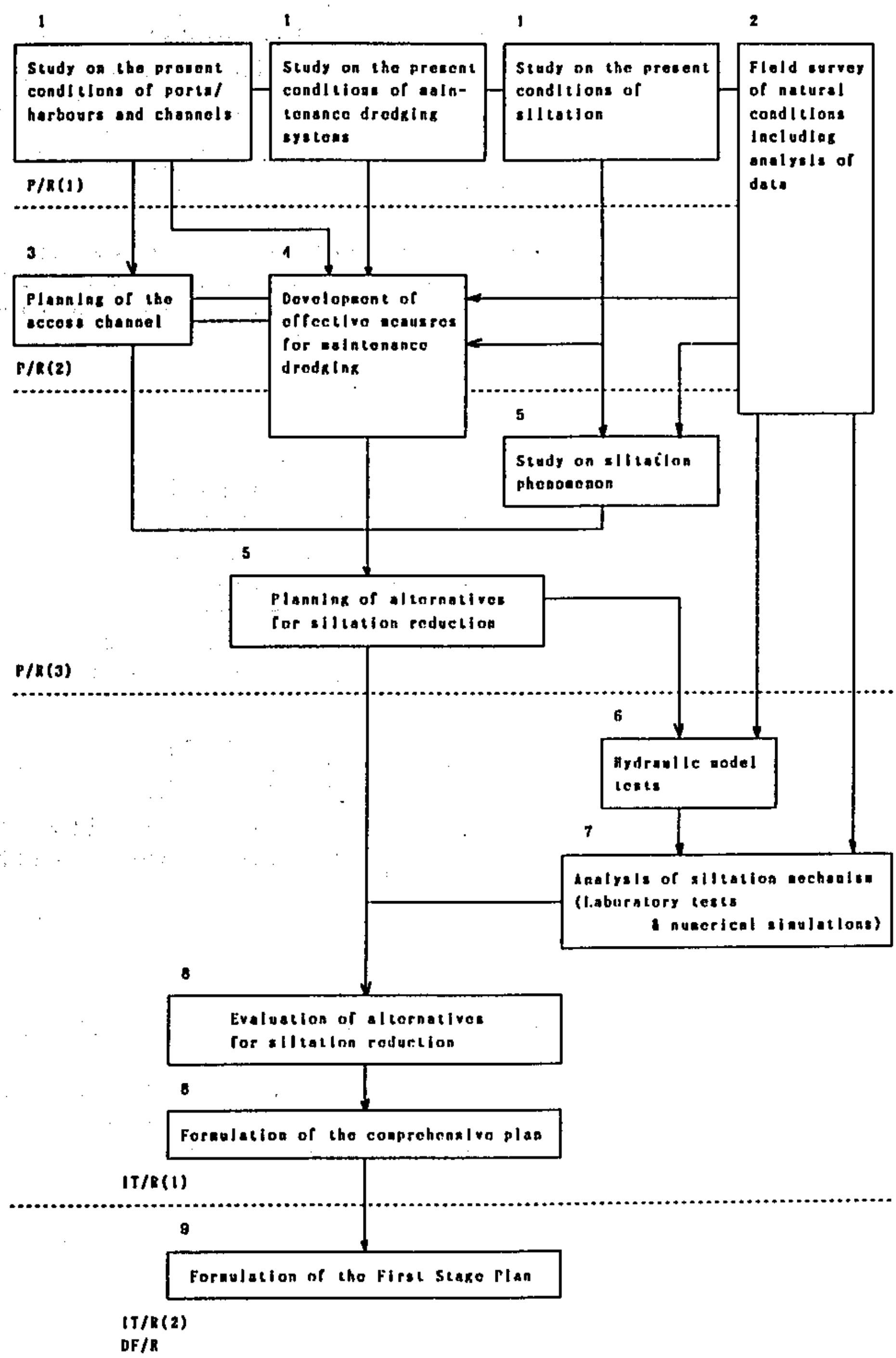


Fig. 2.5-1 Master Flow Chart of the Study

On this text, we describe briefly how does the results of natural condition survey reflect to the countermeasure.
First of all, the data obtained from the natural condition survey are processed and analized for every observation item. Then a condition of sedimentation in navigation channel is grasped by the results of natural condition survey and the phenomenon of sedimentation is examined.
The results of analysis are provided as basic data for the reproduction of exsisting condition by a hydraulic model test and a numerical simulation.

Following is a procedure of a hydraulic model test which were abstracted from the Progress Report(3) issued by JICA Study Team.

Following sentence is abstracted from Chapter 4 Test Procedures in the Progress Report(3).

"The hydraulic model test will consist of a series of tests reproducing the existing conditions and tests for planned countermeasures to reduce the quantity of the maintenance dredging volume.

The test procedure will be as follows.

$$\boxed{\text{Analysis of Field Observation Data}}$$
$$\downarrow$$
$$\boxed{\text{Determination of Test Conditions}}$$
$$\downarrow$$
$$\boxed{\text{Reproduction Tests of Existing Conditions}}$$
$$\downarrow$$
$$\boxed{\text{Tests for Planned Countermeasures}}$$

Conditions such as the tide, currents and salinity to be in the model will be determined in accordance with the results of the field observations."

And also, numerical simulation is conducted by a flow chart shown in Fig. 2.5-2.

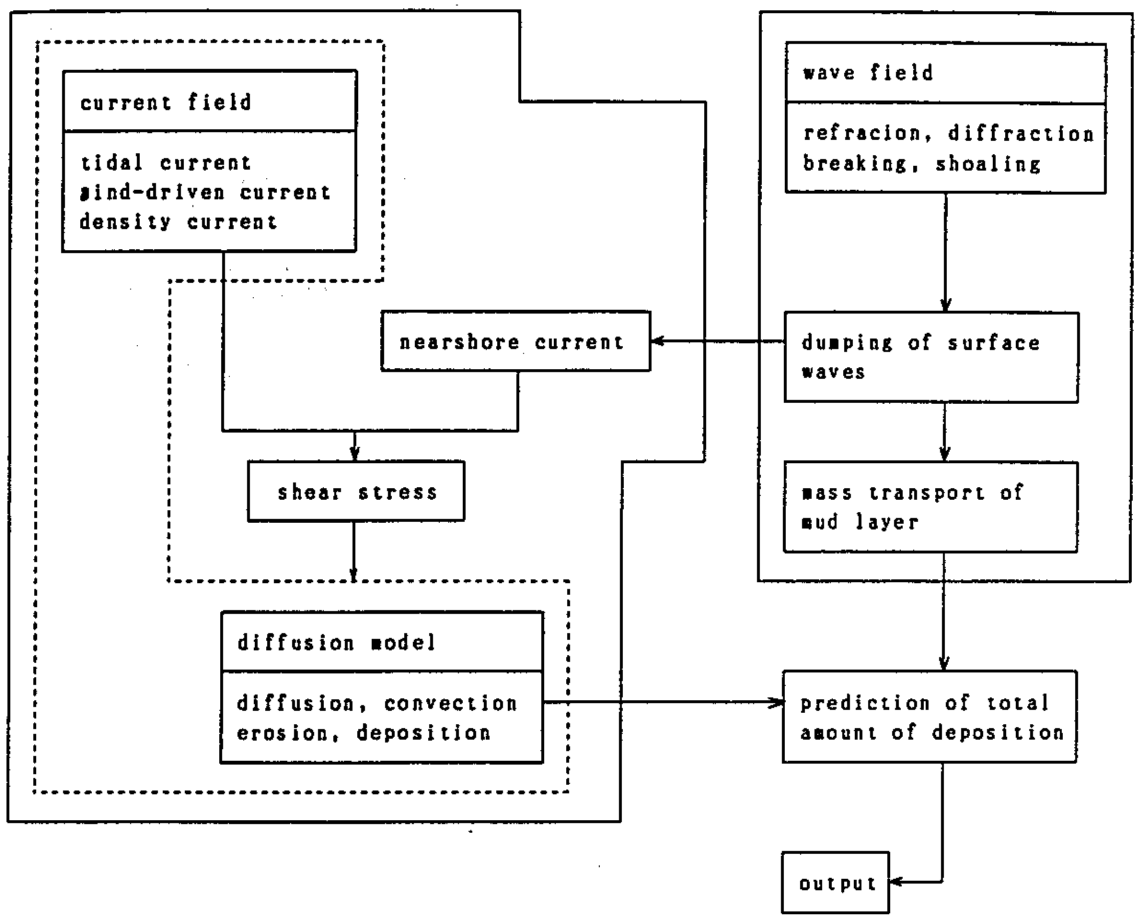


Fig. 2.5-2 Aggregate Flow Chart of Siltation Model

According to the chart, the program is mainly divided into three parts such as tidal current model , wave deformation and total amount of deposition.

III. OPERATION METHODS OF OBSERVATIONAL EQUIPMENT USED FOR NATURAL CONDITION SURVEY

Table 3.1-1 List of Observation Equipment for Each Survey Item

Suevey	Item	Object of Surevy	Kind of Equipment	Data Reading Method
Year-long Survey	1.Tide	Tide Height	*Puess Type Tide Gauge(LFT-III)	Drawing on chart
	2.Wind	Wind Direction & Wind Velocity	*Wind Direction and Wind Speed Anemometer(KDD-300)	Drawing on chart
	3.Wave	Wave Height	*Supersonic Magnetic Rercording Type Wave Height Meter(SSW-II)	Recording by cassette tape (self recording type)
		Wave Direction	*Electromagnetic Current Meter	-ditto-
Monthly Survey	1.Saline Wedge	Current Direction & Current Velocity	*Direct Reading Flow Direction Current Meter Printer(DCM-PRT-III)	Direct reading and printing out on rolled paper
		Temperature & Salinity	*Salinometer(5005)	Direct reading type
		Turbidity	*Portable Turbidimeter(PT-1)	-ditto-
		S.S.	*Water Sampler(Van-dorn)	-
	2.Discharge	Current Direction & Current Velocity	*Direct Reading Flow Direction Current Meter Printer(DCM-PRT-III)	Direct reading and printing out on rolled paper
		Temperature & Salinity	*Salinometer(5005)	Direct reading type
		Turbidity	*Portable Turbidimeter(PT-1)	-ditto-
		S.S.	*Water Sampler(Van-dorn)	-
	3.Bottom Material	Bottom Sampling	Grab sampler	-
	4.Echo-sounding in Narrow Area	Echo-sounding	ATLUS DESO 10(Multi-frequency type Echo-sounder)	-
General Survey	1.Tidal Current	Tidal Current Direction & Current Velocity	Self Recording Current Meter(MTC-III)	Recording by cassette tape (Self Recording Type)
	2.Current 1	Current Direction & Curerent Velocity	*Electromagnetic Current Meter(EMC-108)	-ditto-
	3.Current 2(Buoy tracking)	Current Direction & Current Velocity	*Float	-
	4.Current Velocity and Turbidity	Current Direction & Current Velocity	*Direct Recording Flow Direction Current Meter Printer(DCM-PRT-III)	Direct recording and printing out on rolled paper
		Suspended Solid	*Water Sampler(Pump) Owen Tube	-
	5.Bottom Material,Salinity and Suspended Solids	Salinity	*Salinometer(5005)	Direct reading type
		Bottom Sampling S.S.	Grab type Bottom Sampler *Water Sampler(Van-dorn)	-
Others Survey	1.Seabed Level	Echo-sounding Bottom Sampling	ATLUS DESO 10(Multi-frequency type Echo-sounder) Core Sampler	-
		Current Direction & Current Vel.	*Vector Electromagnetic Current Meter(EMC-107)	Direct reading type
		Salinity	*Salinometer(5005)	-ditto-
		Turbidity	*Portable Turbidimeter(PT-1)	-ditto-
	2.Echo-sounding in Wide Area	Echo-sounding	Echo-sounder	-
	3.Soil Boring	Soil Test	YOSHIDA Boring Machine(YSO-1)	-

Note : * shows JICA equipment

III Operation Methods of Observational Equipment used for Natural Condition Survey

1. Observational Equipment

Followings are JICA's equipment used for Natural Condition Survey in Banjarmasin.

a. Automatic Recording type Observational Equipment

- -Supersonic Magnetic Recording Type Wave Height Meter (SSW-II) and an exclusive Tape Reader
- -Self Recording Current Meter(MTC-III) and an exclusive Tape Reader
- -Electromagnetic Current Meter(EMC-108) and an exclusive Tape Reader(EX010)
- -Fuess Type Tide Gauge(LFT-III)
- -Anemometer(KDD-300)

b. Direct Reading Type Observational Equipment

- -Direct Reading Flow Direction Current Meter Printer (DCM-PRT-III)
- -Vector Electromagnetic Current Meter(EMC-107)
- -Salinometer(5005)
- -Portable Turbidimeter

c. Others

- -Personal computer(PC-9801 VX)
- -Water Sampler(Van-dorn)
- -Variable Speed Tubing Pump
- -EMC-108 Checker

Table 3.1-1 shows an arrengement of observational equipment which are classified for every survey item of natural condition survey.(Refer to the instruction manual for the operation of equipment in Apendices)

2. Installation Method of Automatic Observational Equipment

Among the JICA's equipment, automatic recording type observational equipment have to be installed into the seawater by some divers using the platform or the mooring facilities. Followings are necessary goods and the detailed methods for the installation of the equipment.

2.1 Supersonic Magnetic Recording Type Wave Height Recorder(SSW-II) and Electromagnetic Current Meter(EMC-108)

An installed condition of SSW-II and EMC-108 for the observation of wave height and wave direction in yearlong survey is shown in Fig. 3.1-1.

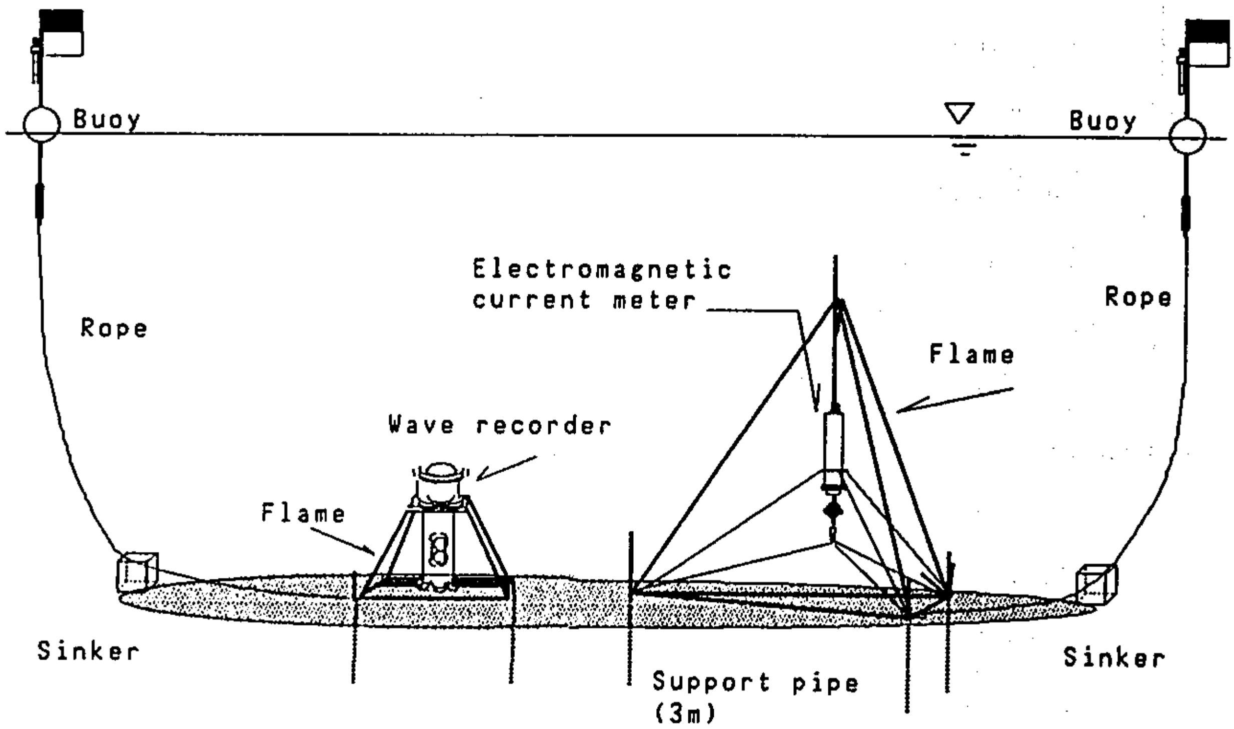


Fig. 3.1-1 Installation condition of SSW-II and EMC-108

1) Necessary Equipment and goods

Necessary equipment and goods for a station with an installation condition shown in Fig. 3.1-1 are as follows :

(1) SSW-II (weight : 35Kg)		: 1 set
(2) EMC-108 (weight : 29Kg)		: 1 set
(3) Frame of SSW-II(weight : 20Kg)		: 1 set
with support pipe(dia. : 4.6cm, length : 3m)		: 4 set
(4) Frame of EMC-108 (weight : 50Kg)		: 1 set
with support pipe (dia. : 4.6cm, length : 3 m)		: 3 sets
(5) A complete set of Jet-pump		
-Jet-pump(3HP)		: 1 set
-Fire hose(length : 30m)		: 1 set
-Nozzle of fire hose(Refer to Fig. 3.1-2)		: 1 set
(6) Consumables		
-Corrosion protective zinc		: 2 pcs
-Rope(dia. 16 mm)	20 m	: 5 pcs
	5 m	: 1 pcs
-Shackle		:10 pcs
-Sinker(weight : 25Kg)		: 2 pcs
-Floating flag pole		: 2 pcs
(7) Mooring goods for big boat		
-Anchor(weight : 40Kg)		: 2 pcs
-Chain	5 m	: 2 pcs
-Rope(length of anchor rope is required 4 times of depth)		: 2 pcs
(8)Working boat		
-Big boat		: 1 boat
-Motor boat		: 1 boat

For smooth carring the installation work, a selection of working boat is an inportant element. View point of this, it is desirable that a big boat with wide deck and boom is employed. A motor boat is necessary to support the big boat.

2) Working Process for SSW-II and EMC-108

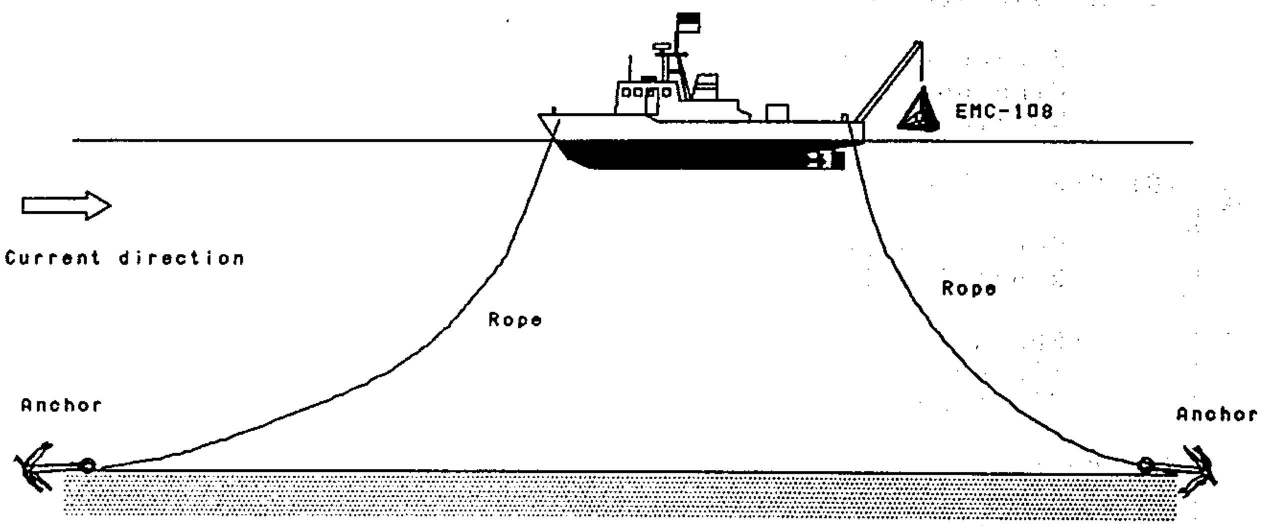
Followings are the process for SSW-II and EMC-108.

(1) Lead a big boat to a planned position using positioning system.

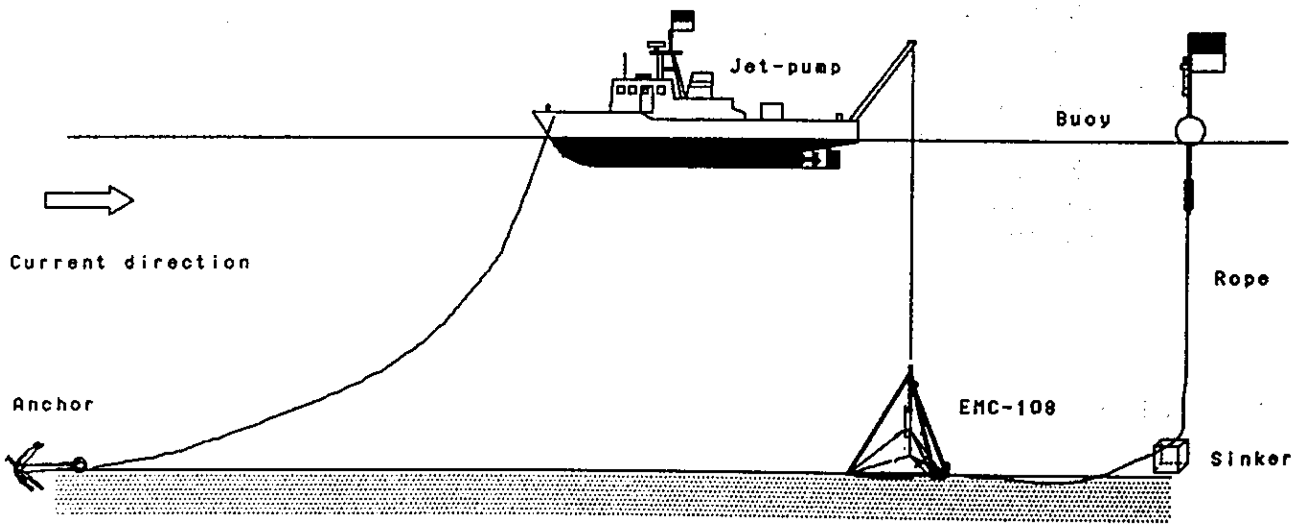
(2) Keep ahead of the boat upstream then let go anchor.

(3) Anchor is thrown downstream at stern of the boat.

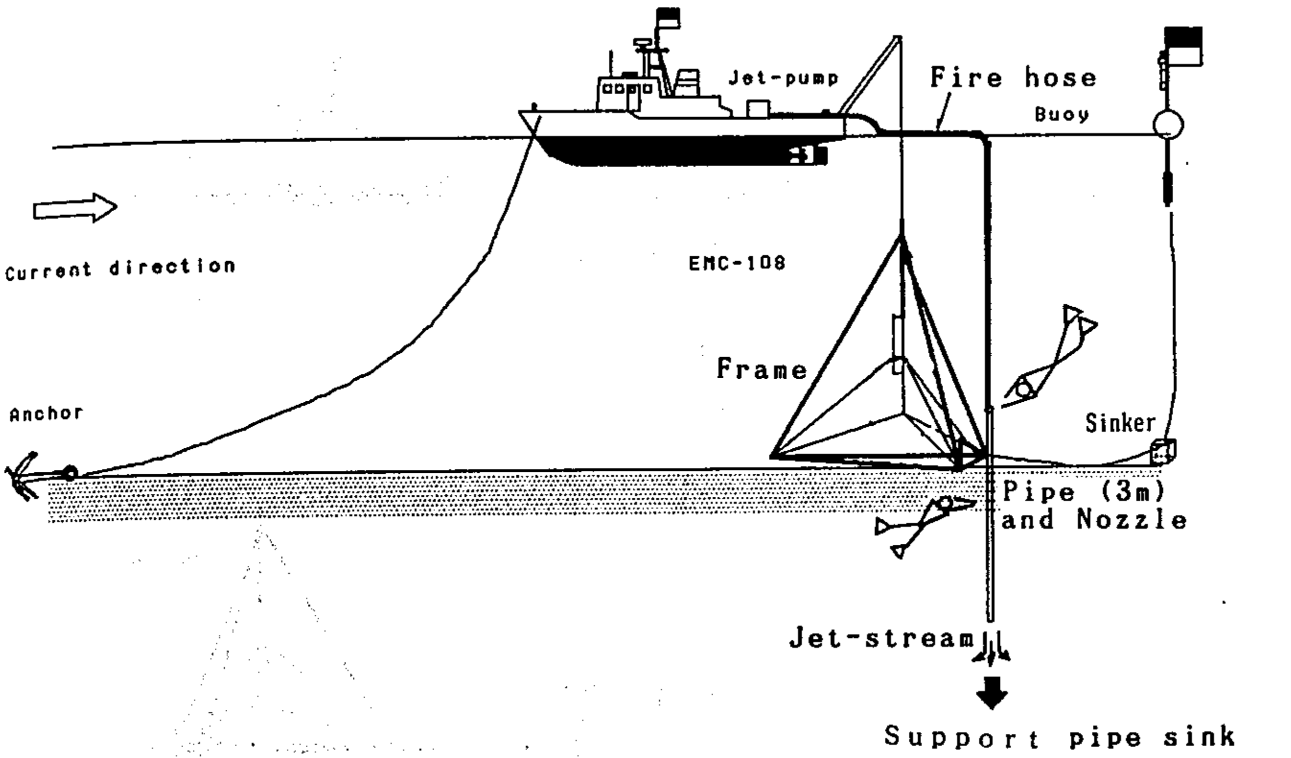
(4) Fix the boat at a position with 2 anchors.



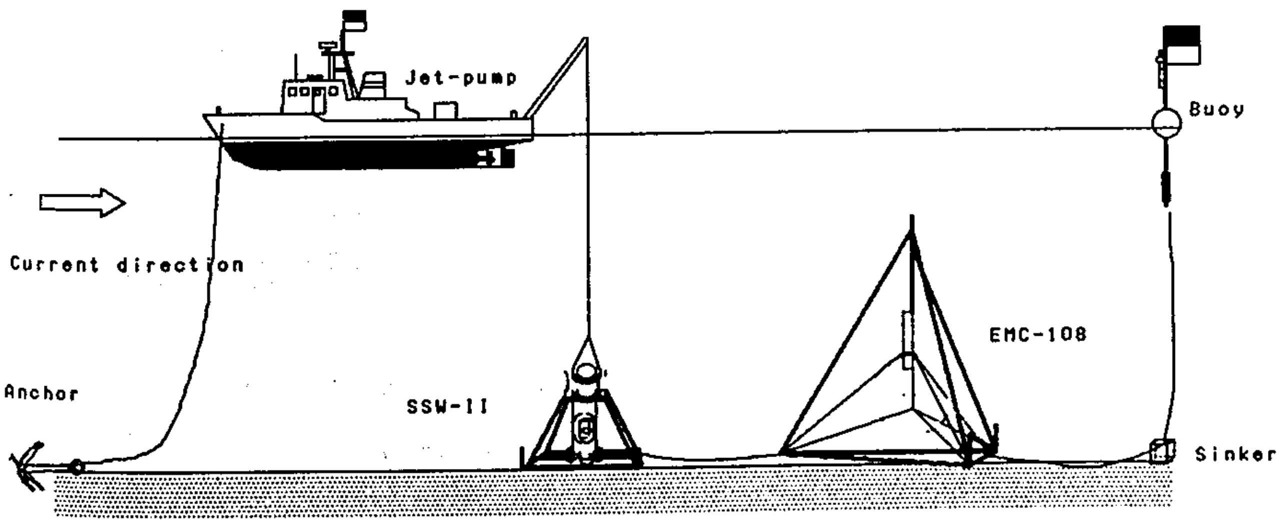
(5) Place EMC-108 with the frame on the planned point.



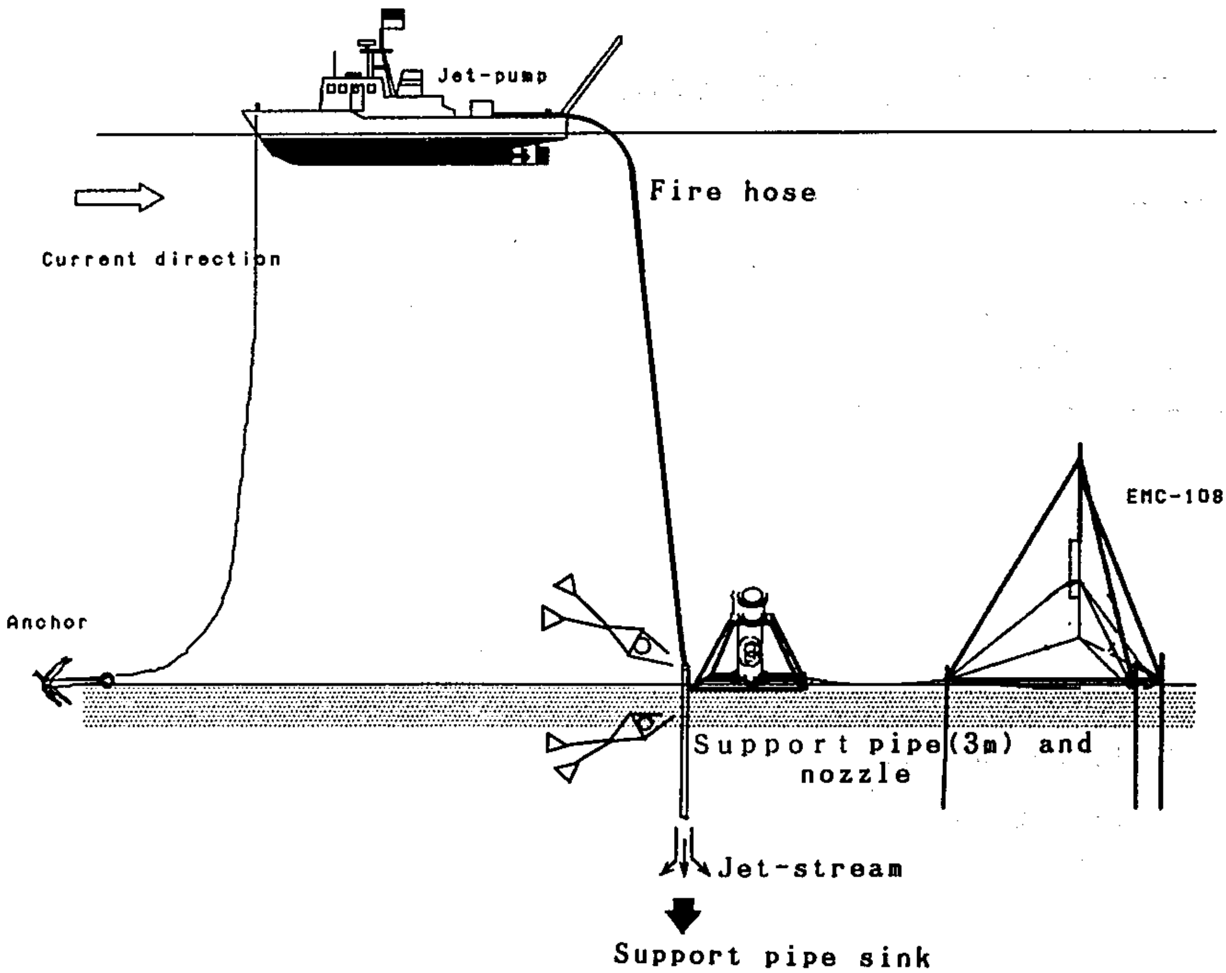
(6) Fix the frame of EMC-108 on the seabed by penetrating 3pcs of the support pipes(3m) through the seabed using divers and jet-pump.



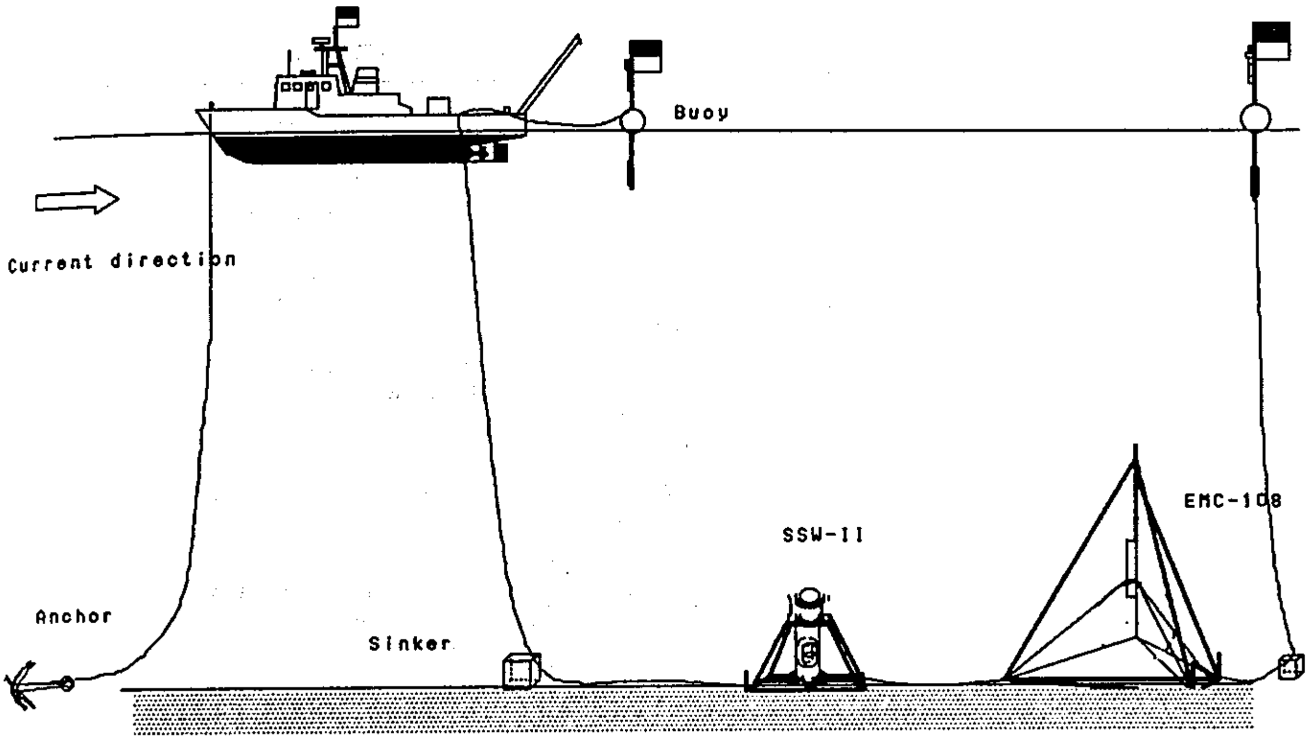
(7) Place SSW-II with the frame on a planned point after shifting about 20m upstreamward away from the point of EMC-108.



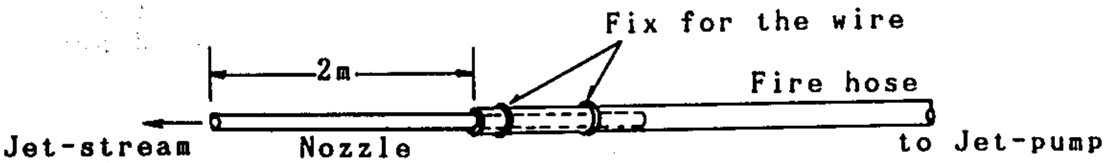
(8) Fix the frame for SSW-II on the seabed by penetrating 4 pcs of the support pipes(3m) through the seabed using divers and jet-pump.



(9) After an installation of the frame for SSW-II, sinkers are thrown in to the sea on upstream side and downstream side using a motor boat. Then marker buoys are installed on both side.



Condition of mooring point has to be confirmed by divers after completion of the installation work.



PVC (Polyvinyl Chloride 2cm)

Fig. 3.1-2 Nozzle of Fire Hose

2.2 Electromagnetic Current Meter(EMC-108)

An installation condition of EMC-108 used for current observstion in general survey is shown in Fig. 3.1-3.

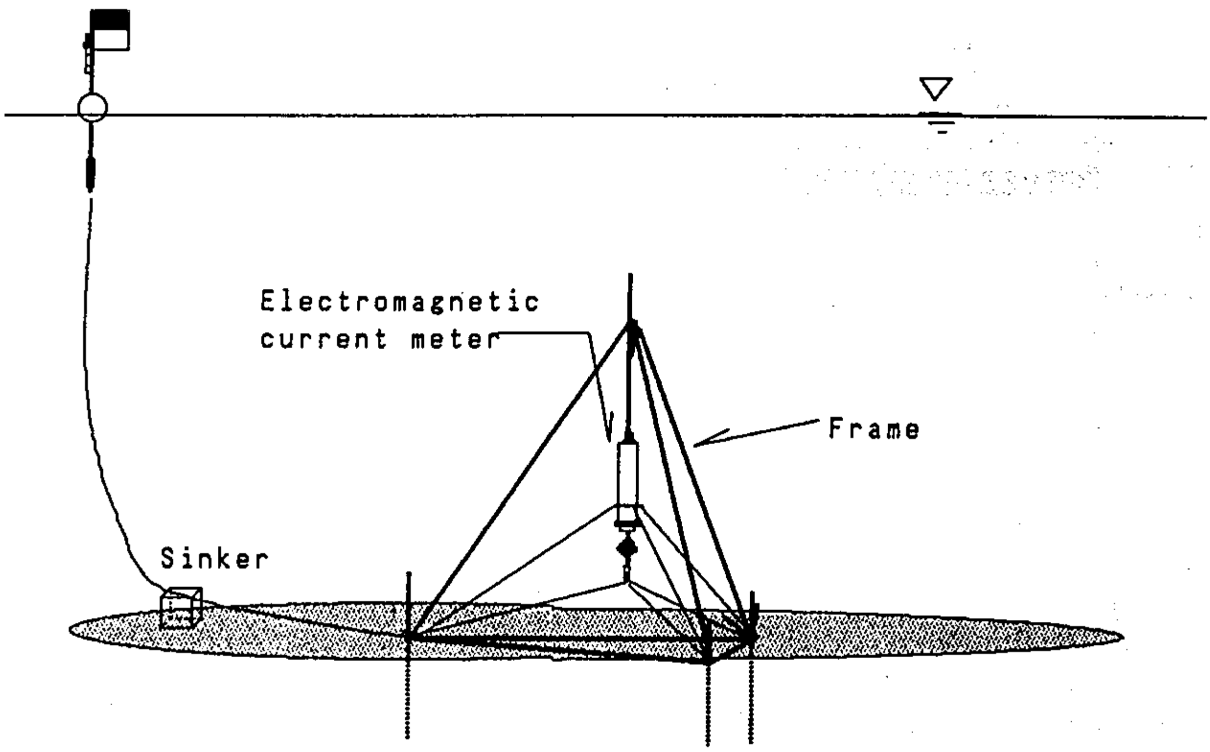


Fig. 3.1-3 Installation condition of EMC-108

1) Necessary Equipment and Goods

Necessary equipment and goods for a station with an installation condition in Fig. 3.1-3 are as follows ;

(1) EMC-108(weight : 35 Kg)		:	1 set
(2) Frame for EMC-108(weight : 29 Kg)		:	1 set
with support pipe(dia. : 4.6cm)		:	3 pcs

(3) Consumables

-Corrosion protective zinc		:	1 pc
-Chain	1 m	:	3 pcs
	0.5 m	:	3 pcs
-Shackle		:	10 pcs
-Sinker(weight : 20Kg)		:	1 pc
-Rope (dia. : 16mm)	10 m	:	2 pcs
-Small buoy		:	1 pc

(4) A complete set of Jet-pump

-Jet-pump (3HP)	:	1 set
-Fire hose(length : 20 m)	:	1 set
-Nozzle of fire hose(Refer to Fig. 3.2-2)	:	1 set

(4) Mooring goods for a boat

-Anchor(weight : 30Kg)	:	2 set
-Chain 5 m	:	1 pc
-Rope(length of anchor rope is required 3 times of depth)	:	2 sets

(5) Working boat

-Big boat	:	1 boat
-Motor boat	:	1 boat

2) Working process for EMC-108

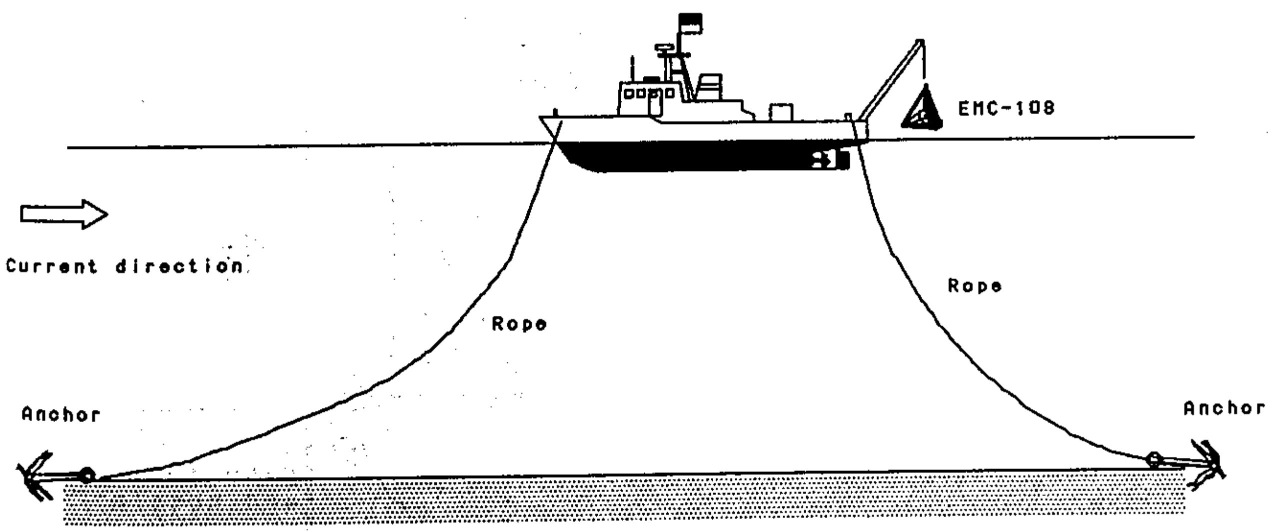
Followings are the process for EMC-108.

(1) Lead a working boat to a planned position using positioning system.

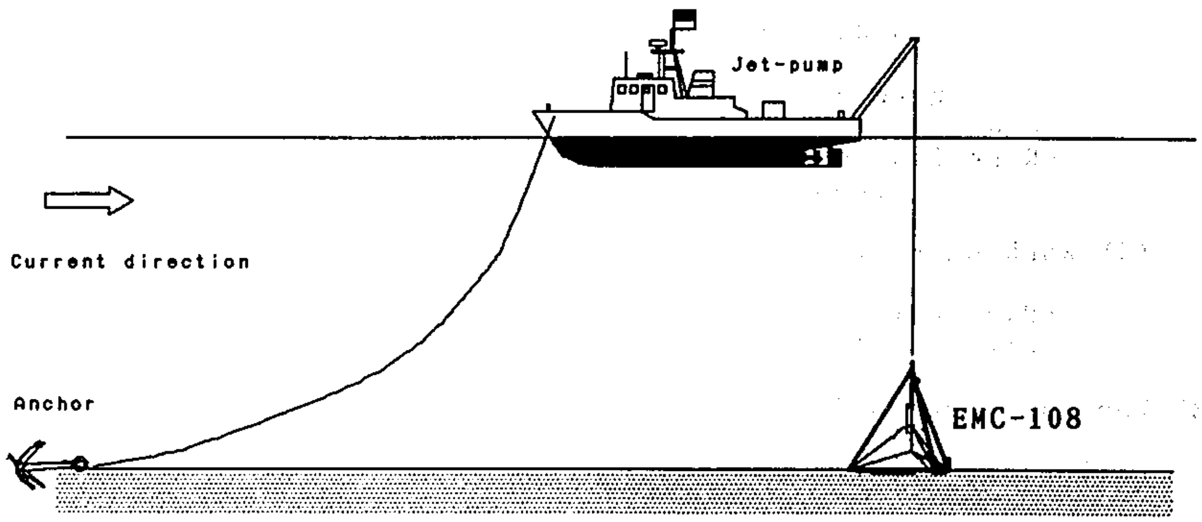
(2) Keep ahead of boat upstream then let go anchor.

(3) Anchor is thrown downstream side at stern of boat.

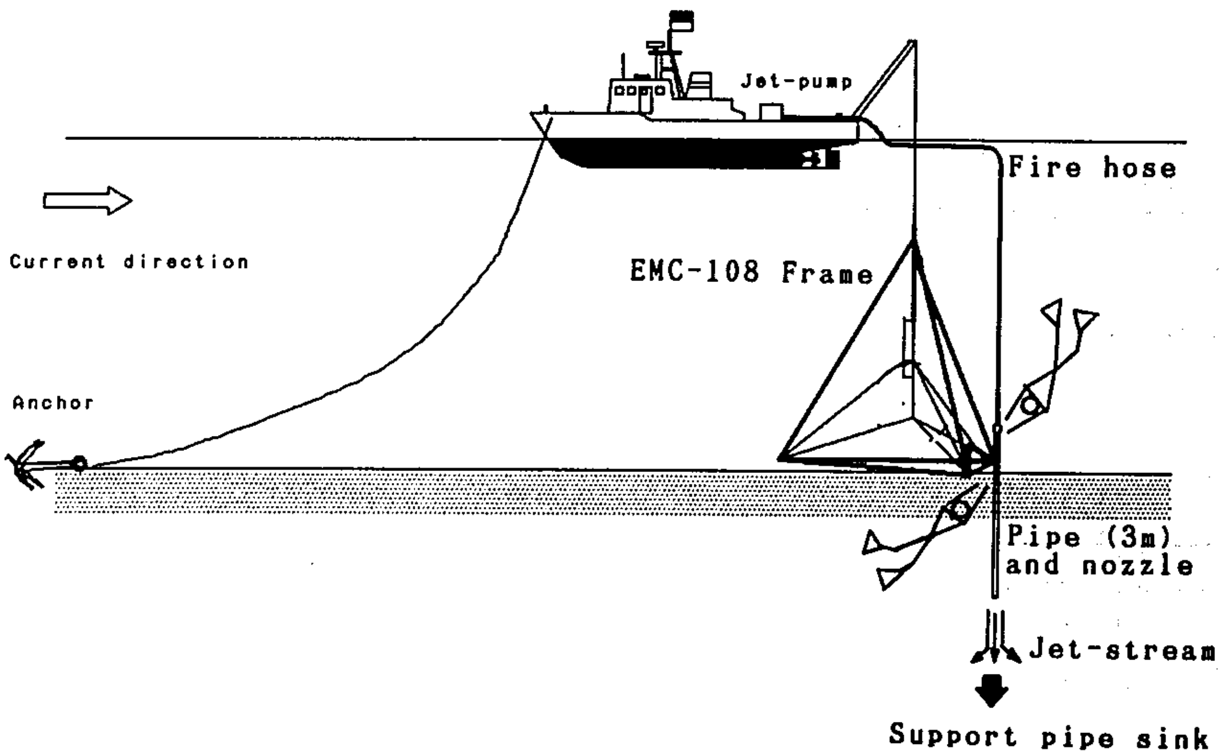
(4) Fix the boat at the position with 2 anchors.



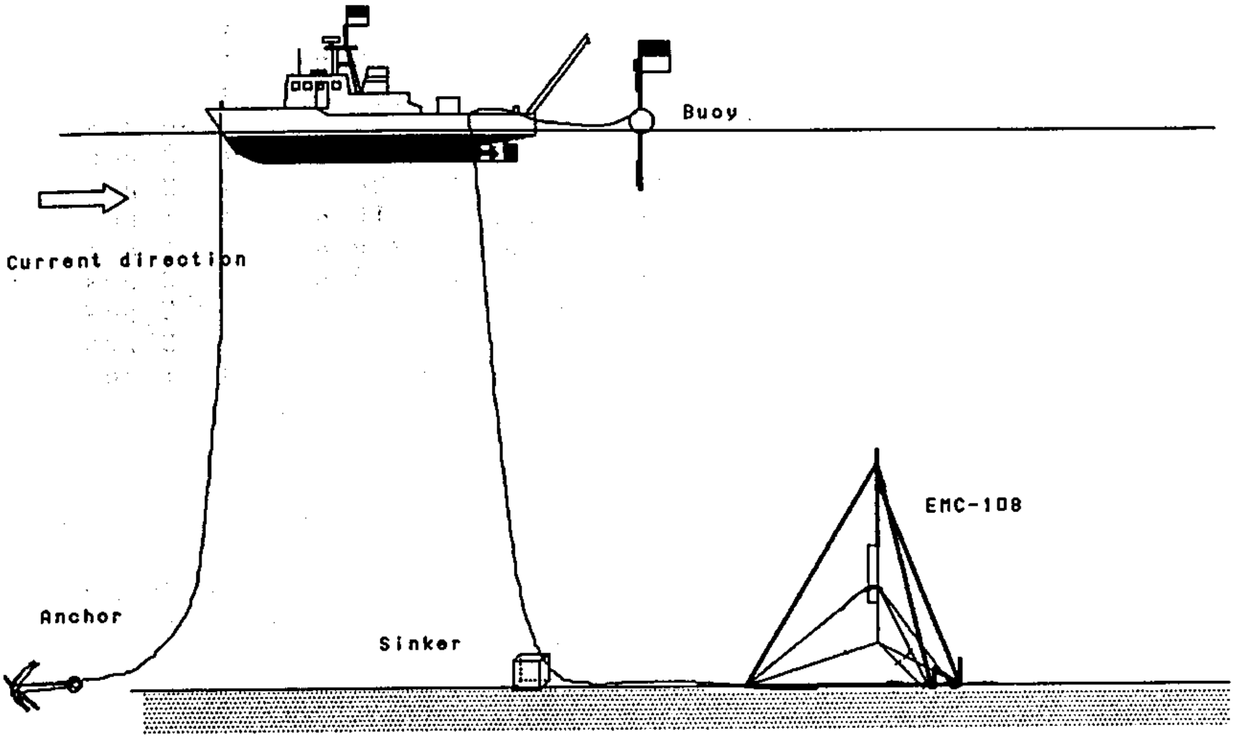
(5)Place EMC-108 with the frame on the seabed.



(6)Fix the frame for EMC-108 on the seabed by penetrating 3pcs of the support pipes(3m) through the seabed using divers and jet-pump.



(7) After an installation of frame for EMC-108, sinkers are thrown into the sea on downstream side using a motor boat. Then marker buoy are installed.



1) Necessary equipment and goods

Necessary equipment and goods for a station with an installation condition in Fig. 3.1-4 are as follows :

(1)MTC-III(weight : 37 Kg) : 1 pc

(2)Mooring goods of current meter

-Sinker(weight : 60 Kg)			: 3 pcs
-Chain		10 m	: 3 pcs
		3 m	: 2 pcs
-Schakle			: 30 pcs
-Rope	(dia. : 16mm)	30 m	: 2 pcs
	(dia. : 16mm)	20 m	: 2 pcs
	(dia. : 12mm)	10 m	: 1 pc
	(dia. : 6mm)	200 m	: 1 coil
-Steel wire	(dia. : 8mm)	3 m	: 2 pcs
-Iron buoy(Buoyancy 40 Kg)			: 2 pcs
-Floating flag pole			: 2 pcs
-Small buoy			: 1 pc

2.3 Self Recording Current Meter(MTC-III)

An installation condition of MTC-III used for tidal current observation in general survey is shown in Fig. 3.1-4.

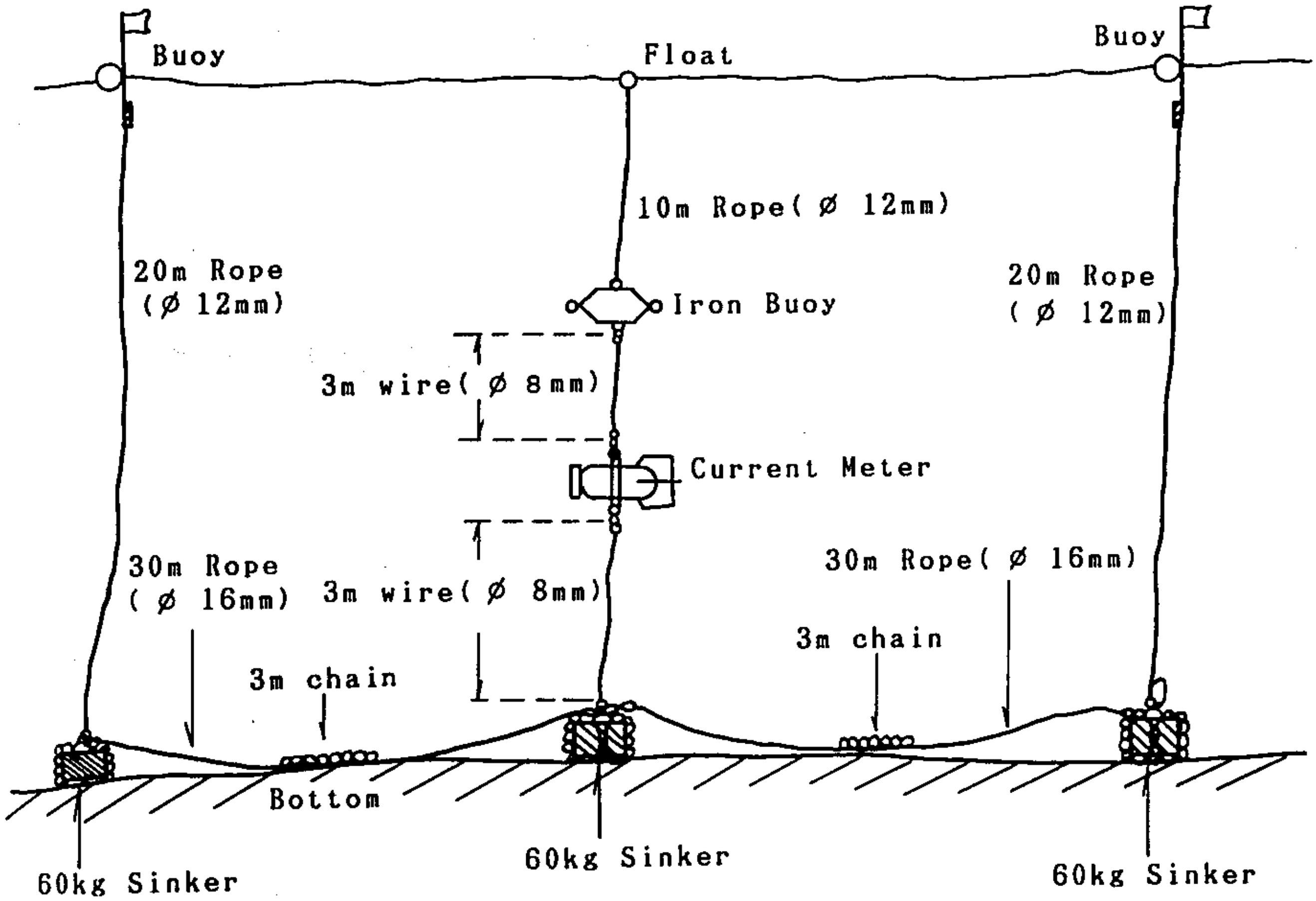


Fig. 3.1-4 Installation condition of MTC-III

APPENDICES

(INSTRUCTION MANUAL FOR OBSERVATION EQUIPMENT)

APPENDIX 1

INSTRUCTION MANUAL
OF
ANEMOMETER AND ANEMOSCOPE
(MODEL:KDD-300)

KOSHIN DENKI KOGYO CO., LTD

KDD-300

WIND DIRECTION AND WIND SPEED ANEMOMETER ON D.C. SUPPLY

FOR USE IN SOURCELESS DISTRICT

● GENERAL

It is quite essential to observe and know direction and speed of wind for the preliminary environmental investigation for the construction of highways, harbours, railways, bridges and numerous storeys buildings. In view of the fact that districts for which such preliminary investigation is required are in many cases those where acquisition of electrical source is of a considerable problem, a wind direction and wind speed anemometer suitable for use on D. C. power supply with less power consumption has been enthusiastically anticipated.
In this system, a wind direction and wind speed anemometer is combined with a power-saving unit, and, by supplying a D. C. power to the wind direction measuring part of this system at intervals of the pre-determined time, power consumption of the system is curtailed to a considerable extent. This system therefore enables an operator to effect a long-term measurement with the use of batteries of a small capacity. Recording of wind direction with this system, although intermittent, could be sufficiently applied to the analysis of general meteorological phenomena. On the other hand, the recording of wind speed is obtained in this system in the ordinary form of continuous recording as no power is required for its wind speed recording functions.
The recorder cabinet is of a self-standing and rainproof construction for the outdoor installation and contains in it a recorder, a power-saving unit and batteries.

● FEATURES

① As the wind direction and wind speed sensor/transmitter and the recorder can be separated each other by about 300 meters with the use of connecting cable of 0. 75 mm^2x 8-cond., these units could be freely installed at locations where the measurement of wind behaviour is made most conveniently(Note that it is preferable to install the wind direction and wind speed sensor/transmitter at the height of more than 10 meters above the ground).
② Long-term wind direction and wind speed recording can be effected with the use of batteries of small capacities.
③ No shelter for the recorder cabinet is necessary as the cabinet itself is self-standing and of rainproof construction.

● COMPOSITIONS

① Wind Direction and Wind Speed Sensor/Transmitter.
② Wind Direction and Wind Speed Recorder.
③ Power-Saving Unit.
④ Recorder Cabinet.

• SPECIFICATIONS AND RATINGS

① Wind Direction and Wind Speed Sensor/Transmitter (Model KL-111)

Type································Propeller Type.
Wind Direction Transmitter D. C. Synchro Motor.
Wind Speed Transmitter···· A. C. Generator.
Ranges for Measurement···Wind Direction: All azimuths, 360°
Wind Speed: 2 to 70 m/s.
Maximum Wind Speed········More than 90 m/s.

② Wind Direction and Wind Speed Recorder (Model KDD-300)

Type································3-pen, analogue recording.
Ranges for Measurement
Wind Direction···········All azimuths, with the 540°/360° shifting system.
Wind Speed················2 to 35 m/s and 2 to 70 m/s (Switchable).
Wind Speed averaged for 10 minutes: 2 to 50 m/s.
Chart Speed······················15 mm/h.
Chart Feeding Device········Self-winding clock by means of Pulse motor.
Recording Chart··········· Length 23 m. x width 277mm. (Corresponding to 2 month's recording at a speed of 15mm/hour).
Recording width for instantaneous wind speed: 120 mm.
Recording width for wind speed averaged for 10 minutes: 60 mm.
Recording width for instantaneous wind direction: 60 mm.
Roll winding type.
Power Supply··················12 V.D.C.
or 100V.A.C. ±10% 50 or 60 Hz.

③ Power-Saving Unit (Model KLS-10)

Operating System·············ON/OFF Switching System for the electrical supply to the Wind Direction Measuring Component, 0. 5 sec. /60 sec.
Input Power·····················10 to 15 V.D.C.
Alarm Circuit····················Red lamp lighting at the dropping of supply voltage.
Protection Circuit·············Supply mains OFF at the dropping of supply voltage.

④ Recorder Cabinet

Type································Self-standing, rain-proof type.
Components contained········Wind Direction and Wind Speed Recorder, Power-Saving Unit, and batteries.

1. Wind direction and wind speed transmitter.

1-1. Use.

The wind direction and wind speed transmitter is a unit to be combined with a Model KL-111 Wind direction and wind speed indicator and a Recorder in order to easily measure remotely on the land instantaneous wind direction and wind speed and to "indicate" and "record" them.

1-2. Performance characteristics.

Type : Propeller system, water-proof type.

Starting of wind direction axis: Less than 2 m/s in wind speed at 90°.

Wind direction transmitter: Synchro system (A resistance ring system in the D.C. unit ~~and an A.C. selsyn system in the A.C. unit)~~.

Wind speed transmitter : Magnet system A.C. generator, 30 V/2500 R.P.M.
Minimum wind speed for starting operation: Less than 2 m/s.

Maximum resistible instantaneous wind speed: 90 m/s.

This equipment is considered to be less influenced by atmospheric turbulences and its propeller rotation is linear with wind speed.

The propeller, being big in its rotational power and small in its inertia, is excellent in its follow-up characteristics to a breath of air and the vertical tailfin, being big in its restoration power and small in its inertia including that of the streamlined body, is excellent in its follow-up characteristics to wind direction and in braking characteristics.

1-3. Structure and Functions.

This equipment is of a structure as shown in Fig. 1-9. It is finished to be water-proof and a rotationable streamlined body with a tailfin is mounted on the stand made of marine aluminium. The wind direction transmitter is contained in the centre of the streamlined body and the wind speed generator is contained in the front part of the streamlined body.

The shaft of the wind speed generator is protruded externally and the propeller made of marine aluminium is mounted on the shaft. The propeller mounting part is of a special construction and the rotational part is finished to be water-proof.

The slip-ring positioned in the centre serves for electrical connections of the wind speed generator, the electro-contact device and the movable parts of the wind direction transmitter with the terminals in the stand.

Fig. 1-1 shows a magnet system A.C. generator which is a rotational field magnetic type 4-pole generator. Fig. 1-2 shows a wind direction transmitter for D.C. use (Standard). Fig. 1-3 shows a wind direction transmitter for A.C. use.

All mechanical constructions and electrical performances of the transmitter are arranged according to the established standard. In addition, propellers, generator covers, tailfins, generators, and so on, are also manufactured according to the established standard. Therefore, an entire interchangeability among all of them is ensured.

Fig. 1-1

Magnet System A.C. Generator

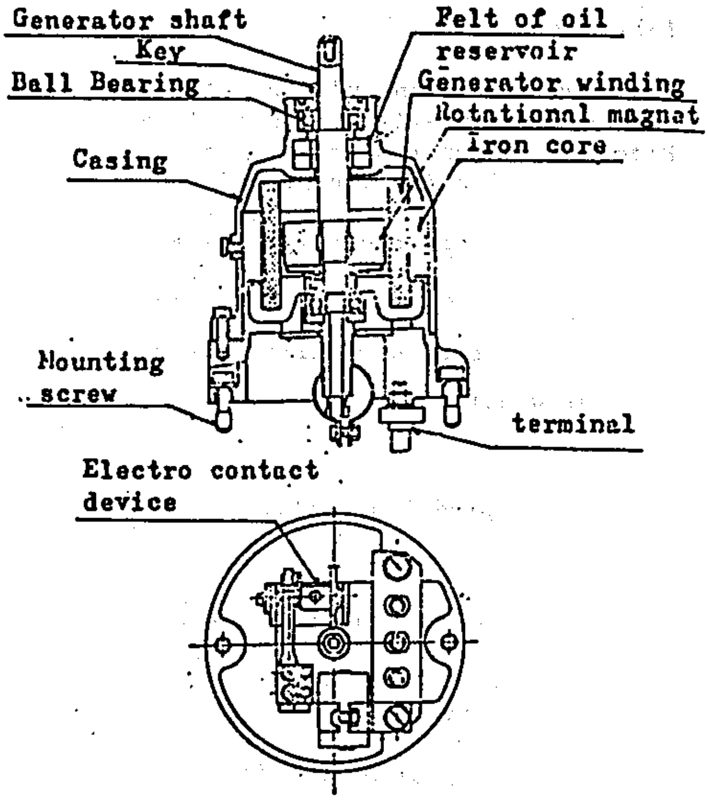
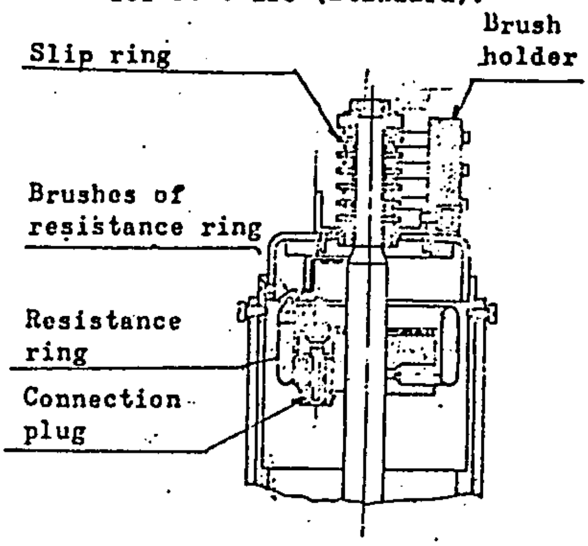


Fig. 1-2

A. Wind direction generator for D.C. use (Standard).



If the transmitter is put as it is in a wind, the direction of the streamlined body corresponds to a direction at which a wind pressure against the vertical tailfin comes down to the minimum; in other words, it corresponds to a wind direction. As the propeller rotates proportionally with a wind speed, a voltage proportional with wind speed is excited in the A.C. generator which is directly coupled to the propeller.

As stated above, in the wind direction measurement, an angle deviated from the reference angle is fed to the wind direction transmitter. Such angle is transmitted electrically to the selsyn receiver and wind direction is detected by its rotating angle. The electro-contact device is mounted on the shaft of the wind speed generator at the opposite side of the propeller. Pulse generated from this device is effected at a rate of 100 m. per every wind-run. With these pulses, a measurement of averaged wind speed is possible if the electro-contact device is coupled to a self-recording electro-contact counter or a recorder of averaged wind speed.

1-4. Installation.

On installation of the system, a location where the transmitter is to be installed should be selected and determined most seriously. If the location is an open ground, for example, a field or a beach, a tower or a pole may be erected and the transmitter may be mounted on the top of such a tower or a pole. On the other hand, if the transmitter is to be installed on the roof of a building, shape of that building and its environmental conditions should preliminarily be investigated sufficiently prior to installation of the transmitter, and the location of the transmitter and its height from the roof should be determined from the viewpoint of avoiding any effect from blowing up or whirling of wind.

Now that the location, height of the pole, and so on, were decided, the transmitter mounting hole is just prepared. On doing so, the correspondence between the hole and the N-S direction should be confirmed completely according to Fig. 1-9, prior to entering into actual holing. Do so without fail, particularly in case that an adjustment in later days is not possible.

As the wind direction is expressed by a rotating angle of the streamlined body in relation with the stationary part (stand) of the transmitter, care must be taken to ensure, on installing the transmitter, the correspondence of the line connecting N (North) and S(South) marks given on the mounting flange at the bottom of the stand, with the actual north and south line.

The earthing terminal is provided in the stand. Be sure to conduct earthing with it.

1-5. How to operate.

Any maintenances like oiling and so on are not necessary for the transmitter. However, how to disassemble the transmitter is given hereunder as this procedure is necessary when replacing brushes of the slip-ring or when conducting internal inspections.

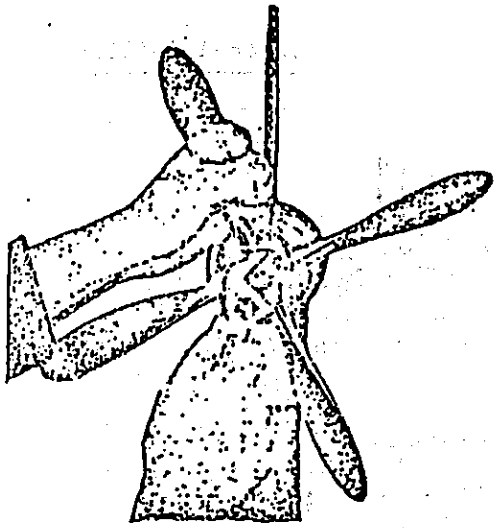
In order to insure more firmly that the propeller may not drop off from the shaft during operation, a socket screw (to fit a 3 mm. hexagonal bar) is now re-mounted on the propeller retaining screw. For disassembling the propeller from the shaft, a socket screw should firstly be unscrewed with an accessory hexagonal bar and the propeller retaining screw should then be loosened with a spanner or something like that. For mounting the propeller on the shaft; the propeller retaining screw should firstly be tightened and the socket screw should then be fastened with a hexagonal bar. (Fig 1-5)

~~In the first step,~~ the propeller should be disassembled. In doing so, hold the propeller tightly at its root as shown in Fig. 1-4 and remove the propeller by turning the propeller retaining bolt anticlockwise with the accessory monkey spanner applied to it. The propeller retaining bolt should be loosened very carefully as it usually gets considerably tightened.

If it is extremely tightened after a long term operation, a light knock may be applied, prior to loosening the bolt, to a vicinity of the propeller retaining bolt. In doing so, care should be taken not to damage the shaft.

After the propeller is removed, hold the generator cover, and turn it clockwise until the red mark on the cover reaches to the blue mark on the propeller. Then, the generator cover may be pulled out to this side (Fig. 1-5).

Reverse operations are conducted when mounting the generator and the propeller. In doing so, be sure to insert the key of the generator shaft into the key groove of the propeller. If not adequately inserted, such discrepancy may be discriminated from the fact that a gap between the propeller and the cover becomes bigger than usual. Tightening without proper insertion of the key into the key groove may result in breakage of a key or a key groove. To make the matter worse, the propeller retaining bolt with such careless and improper tightening may sometimes never be removed in future disassembling.

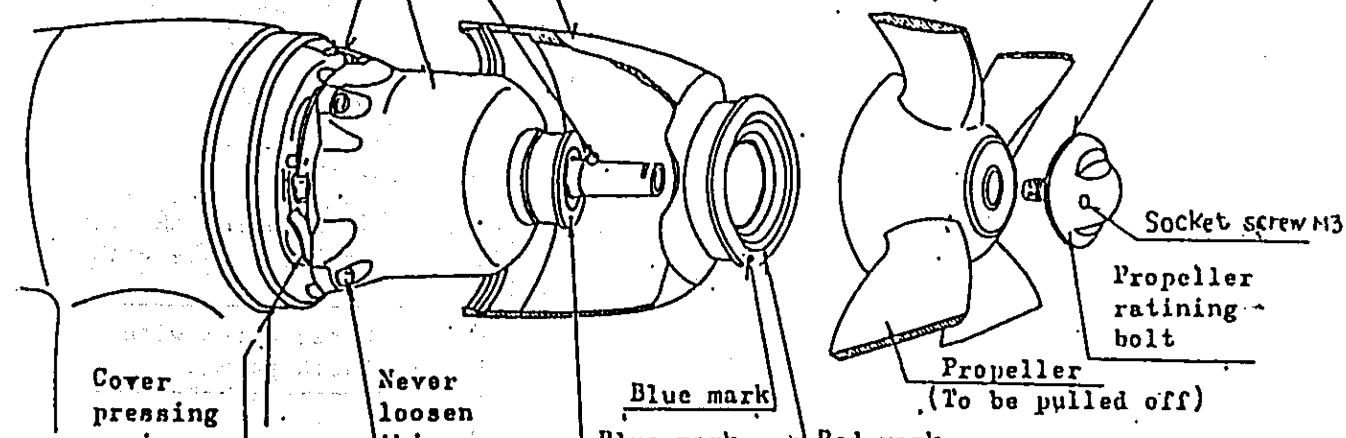


After removal of the cover, a generator may be disassembled if its 2 mounting screws are loosened. As the mounting screws are of a suspending type as shown in Fig. 1-6, they may not drop off away when loosened.

Fig. 1-7 shows a front view of the transmitter from which the generator was removed. The vertical tailfin can be removed if 2 tailfin retaining screws situated in the deepest on both sides are loosened (In doing so, be sure not drop the tailfin carelessly). After the disassembling to this stage, the slip-ring can be removed from the side of the tailfin.

A further disassembling exceeding this stage may usually not be recommended as such may cause a bad effect to adjustment of the selsyn transmitter.

Fig. 1-4



(in which an inside pen is inserted)

(For uncovering, turn the cover clockwise until its red mark corresponds to the blue mark of the generator and pull the cover out to this side)

Fig. 1-5

Fig. 1-6

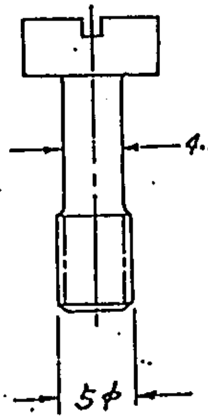
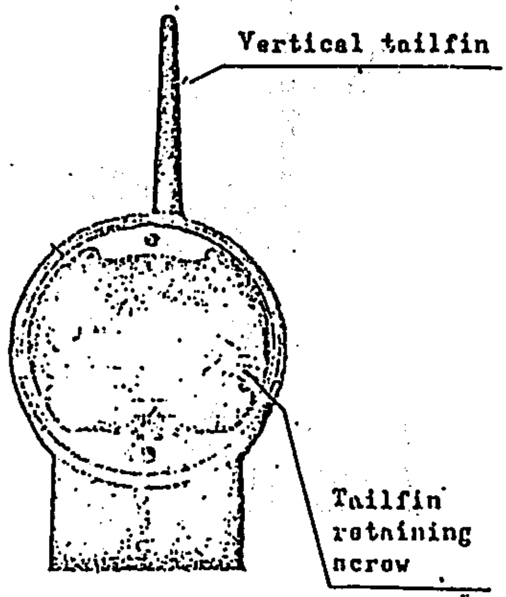


Fig. 1-7



1-6. Maintenance and Inspection.

Ball bearings are used in all rotational parts of the transmitter. These ball bearings are fully cleaned, applied with grease and their oil reservoir is filled with oil. Therefore, no maintenance nor inspection is necessary. Careless disassembling or inspection may cause a damage or failure. External painting, if damaged, should be cleaned and applied thereto with a new paint thinly. Painting should be conducted according to instructions given in Fig. 1-8.

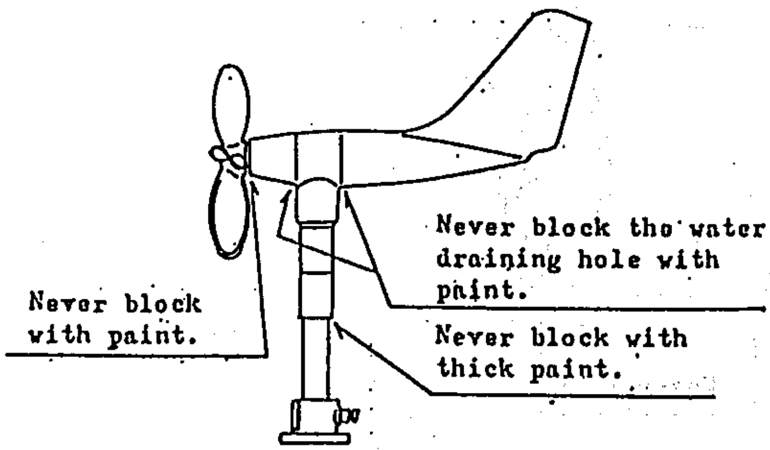


Fig. 1-8

1-7. Inspection of troubles and remedies.

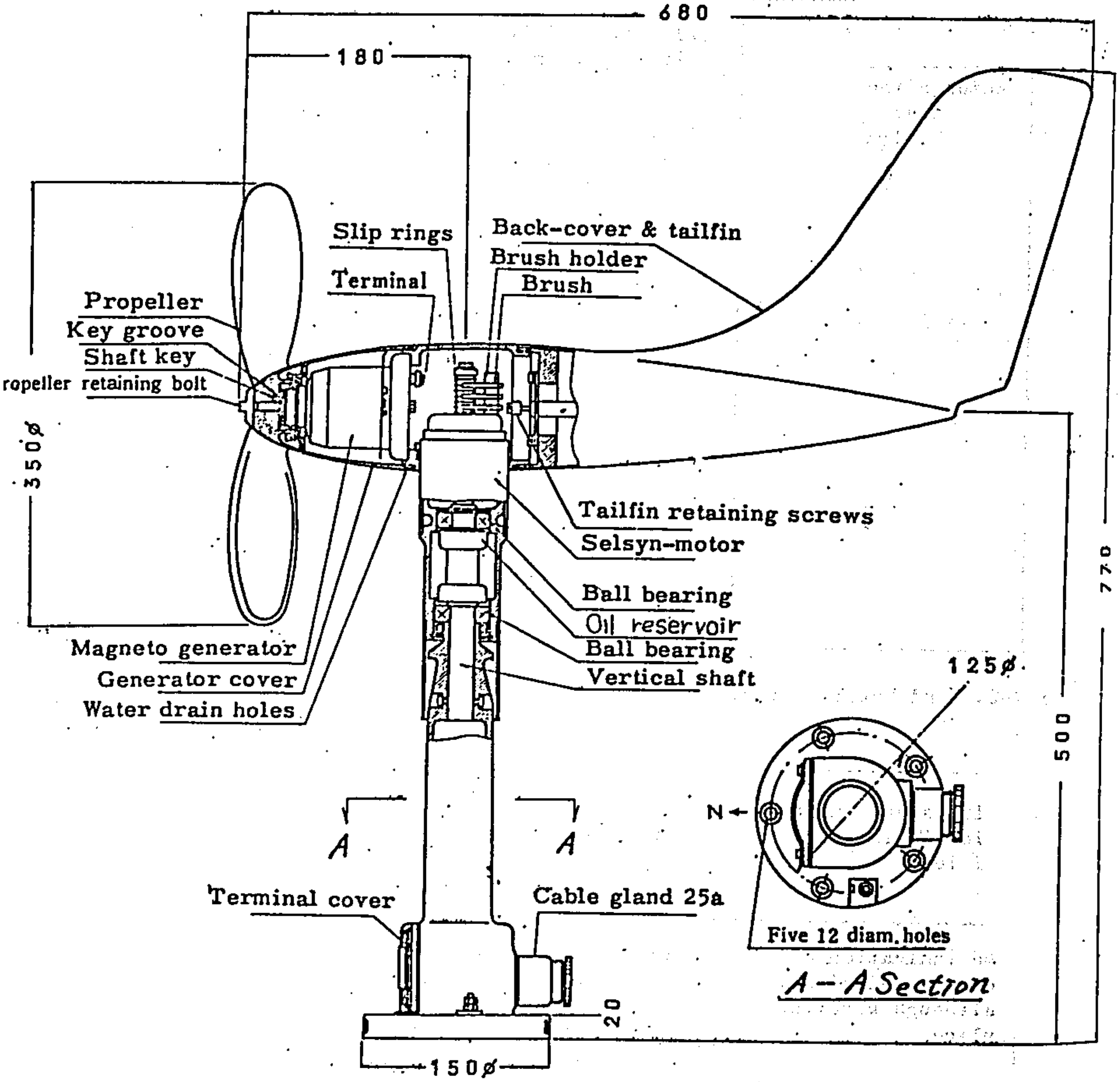
1-7-1. Wind Direction System.

Troubles	Causes	Remedies
No signals at recorder or indicator although wind takes place and the transmitter moves.	(1) Contact failure in slip ring. (2) Disconnection in Wind Direction Transmitter.	(1) Repair bad contact in slip ring by referring to Article 1-5 "How to Operate". (2) Measure resistance of windings if they conform to the following standards: About 36 ohm. between Nos. 4 & 5; About 32 ohm between Nos. 6 & 7, 7 & 8, 8 & 6, respectively. If any of the above are not met, consult Koshin Denki for repair as disconnection may have taken place in the transmitter.

1-7-2. Wind Speed System.

Wind speed indication is intermittent.	Contact failure in slip ring.	Repair bad contact in slip ring by referring to Article 1-5 "How to Operate".
No indication of wind speed at all although wind takes place.	(1) Contact failure in contact terminal of generator. (2) Disconnection in generator.	(1) Repair bad contact. (2) Check if resistance between Nos. 1 & 2 terminals is about 230 ohm. If so, generator is normal and if not, generator was disconnected and should be replaced.

Fig. 1 Wind direction and wind speed transmitter.



2. 3-Elements Recorder Model KDD-300

This recorder is designed for coupled use with Model KL-111 KOSHINVANE Anemometer for recording wind direction and wind speed data. Wind direction and wind speed signals electrically detected by the transmitter is supplied to the recorder for recording.

The wind direction component and wind speed component are contained in one and the same casing for recording both data on one and the same chart on which graduations for both wind direction and wind speed are printed. Therefore, no time lag is expected in the recording of both data. This system offers a convenient means for investigation and treatment of data obtained.

The wind speed instrument employs a voltmeter which is graduated for reading of wind speed, and wind direction data are recorded by an original device to which full descriptions will be given in a later paragraph. Recording is made by a syphon pen system.

2-1. Specifications and Ratings.

Type	: 3-pen, analogue system.
Casing	: Rectangular type; for both desk-top and panel mounting.
Wind direction recorder	: D.C. selsyn system for D.C. use
Average wind speed.	: Integrated by "C" (condencor) and "R" (Resistor) in order to transform
Wind speed recorder	: Rectifying type movable coil voltmeter. Sensitivity of current: 9 V. A.C., 6 mA/30 m/s.
Measuring ranges	: Wind direction: All azimuths of 540°/360° shifting system Wind speed : 0 to 35 m/s and 0 to 70 m/s (Switchable). Average wind speed : 0 to 50 m/s.
Error in wind direction indication:	Less than ± 5°.
Error in wind speed indication:	Within ± 0.5 m/s at a wind speed below 10 m/s, or within ± 5% of the indicated value at a wind speed exceeding 10 m/s.
Chart speed	: 15 mm/h.
Timing error	: Within ± 2 minutes per 24 hours.
Power supply	: 100 V. A.C., 50 or 60 Hz; or 12V D.C
Painting	: Munsell Mark 2.5 G 7/2. (Standard)
Spare Parts	: 8 rolls of Chart No. 3WA-L1-15. 1 bottle of red ink. 2 pieces each of Fuses, 1 A and 2 A.

2-2. Principles of measurements.

2-2-1. Wind Direction System (Recording range of 540° with a shift system at 360°).

The recording principle of customary recorders was that a shifting to the center is devised at every 180° between the total width of chart which is graduated to be 360° in total. This system is called 180° shift system. This system requires a considerable experience in the reading of data as the reading should be conducted after discrimination of either 'N' or 'S' was made with an N-S Discrimination Pen.

In the 360° shift system, the overall chart width is graduated to be 540° in order to accept a shifting at 360°.

The mechanisms and operational principles of the 360° shift system are given hereunder (Figs. 2-1 to 2-5 refer):

Referring to Fig. 2-3, the overall width of the chart corresponds to an azimuth angle of 540°, where two markings of N exist at the left extremity and near the centre, respectively. These two markings of N are discriminated calling N_1 and N_2, respectively. In the same way, 2 markings of S existing at the right extremity and near the centre are discriminated calling S_1 and S_2, respectively. (The above discriminations of N_1 and N_2, and S_1 and S_2, are merely for the sake of explanation and no such discriminations are made on an actual chart, where only marks N and S appear).

Fig. 2-1 shows a series of gears. The selsyn receiver is connected to the Wind Direction and Wind Speed Transmitter and one rotation of the selsyn receiver corresponds to an azimuth angle of 360°. When the coupling is made in the gear ratios as shown in Fig. 2-1, one rotation of the shaft B corresponds to an azimuth angle of 540° and rotating angle of the shaft A will be 40° (covering the range from the left to the right extremities of chart) at the azimuth angle of 540°.

Fig. 2-2 shows the shift device situated on the shaft B. The lever is consolidated with the shaft B in one block and its rotation with the shaft B actuates the lead-switches positioned at 3 equal distances and the extremity contacts N_1 and S_1.

<u>The shifting procedures at the 'N' side.</u>

(1) When the recording pen reaches the left extremity 'N' on the chart, the lever positioned on the shaft B as referred to in Fig. 2-2 touches the contact N_1, which is switched to ON. At this moment, charg current flow the capacity 'C_1' of 1000μF and actuate the relay 'R_4'.
The power of the shift circuit was 'ON' by the R_{4-1b} discontact and the R_{4-2a} contact. At this moment, the relay R_1 actuated by the transistor 'Q' disconnects the connection with the transmitter. Then a voltage is applied externally to the selsyn receiver at its differential angle of 120° and the selsyn shaft is accordingly rotated by 120° to a shifting direction. As the R_1 relay is self-retained by the R_{1-1a} contact, its function continues when the N_1 is disconnected.

(2) After the selsyn receiver was rotated by 120°, the lead-switch (N_2) switched to ON actuates the R_3 relay through the contact R_{1-1a}. At this moment, a voltage necessary for rotation to the same direction by 120° is applied to the selsyn receiver, which is accordingly rotated to the same direction by 120° from the present position.

(3) The lead-switch (NS) actuated at the time when the selsyn receiver was rotated by 240° from the original position, releases self-retention of the relay R_1 and reconnects the transmitter and follows the transmitter at its 'N' position. By this the 360° shifting procedure is completed and at this moment, the recording pen is shifted to the N_2 positioned on the centre-right of the chart.

The shifting procedures at the 'S' side.

The shifting at the 'S' side is same at the 'N' side, reverse rotation.

2-2-2. Wind Speed System.

In the wind speed measurement, a voltage proportional to a wind speed is generated at a magneto-generator directly coupled to a wind-mill (propeller) of the Wind Direction and Wind Speed Transmitter. Such voltage is measured by a voltmeter as an instantaneous wind speed and is recorded accordingly.

The adjustment resistors are contained in the wind speed recording circuit in order to maintain a constant load to the generator. The range switch provides 2 steps of measuring ranges of 0 to 35 m/s and 0 to 70 m/s.

The meter sensitivity is 9 V. A.C., 6 mA, at 30 m/s.

2-3. Additional Circuits.

2-3-1. Power Circuit.

The power circuit consists of a transformer and a rectifier for changing input from 100 V. A.C. to 12 V. D.C. and of a relay for intermittent recording of wind direction.

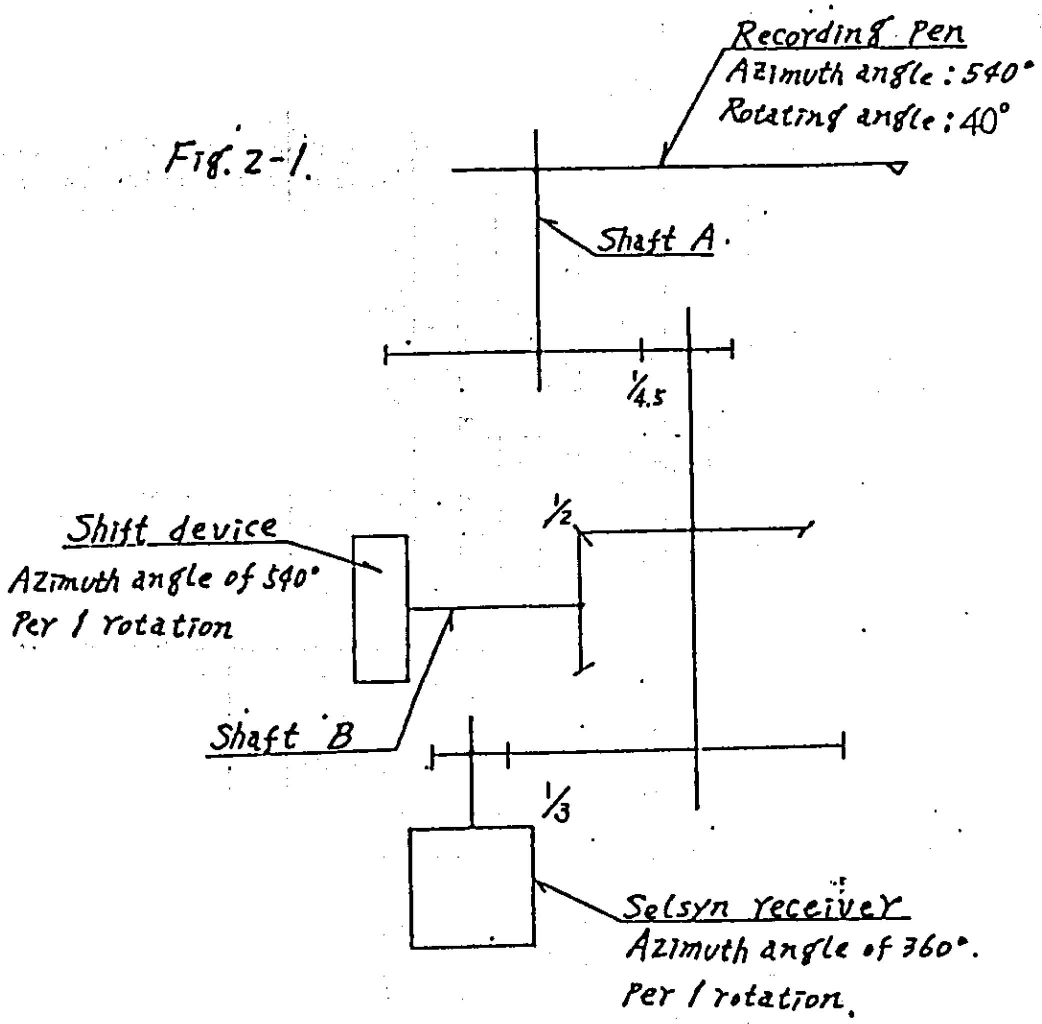
2-3-2. Shift Circuit.

The shift circuit consists of 4 relays for the shift of 360° and of transistor resistors for protecting contacts.

2-3-3 Average wind speed circuit.

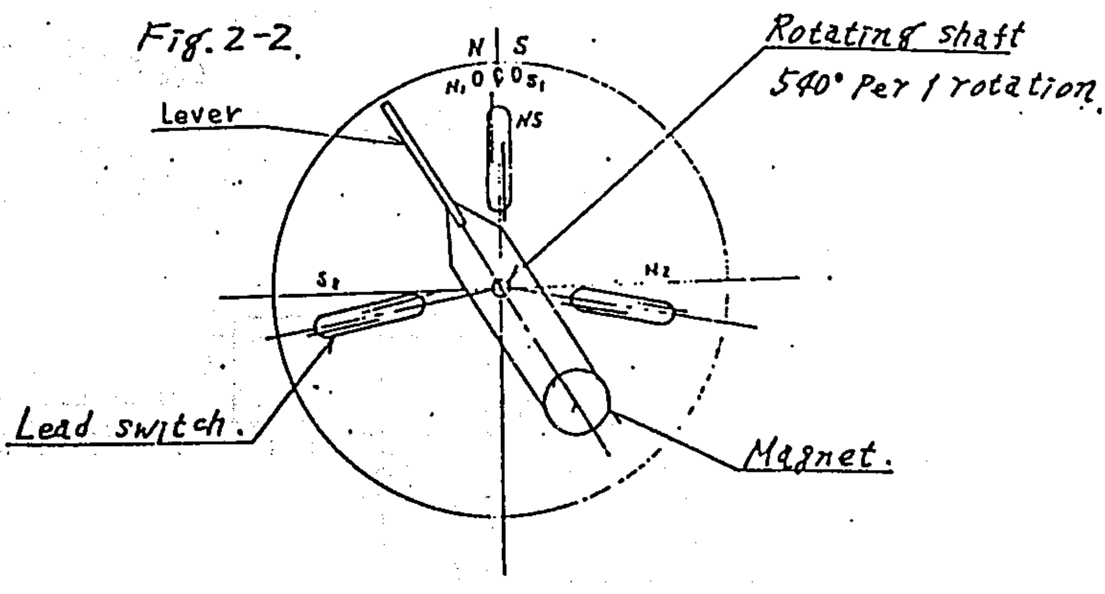
A.C Voltage generated in the transmitter is rectified and integrated by "C" (Condensor) and "R" (Resistor) in order to transform it to be a signal of wind speed averaged for 10 minutes. Such signal is amplified to a stage of being able to drive a recorder and the recording is thus affected.

Fig. 2-1.



Recording Pen
Azimuth angle : 540°
Rotating angle : 40°
Shaft A.
1/4.5
1/2
Shift device
Azimuth angle of 540°
Per 1 rotation
Shaft B
1/3
Selsyn receiver
Azimuth angle of 360°.
Per 1 rotation.

Fig. 2-2.



N | S
Rotating shaft
540° Per 1 rotation.
Lever
NS
Lead switch.
Magnet.

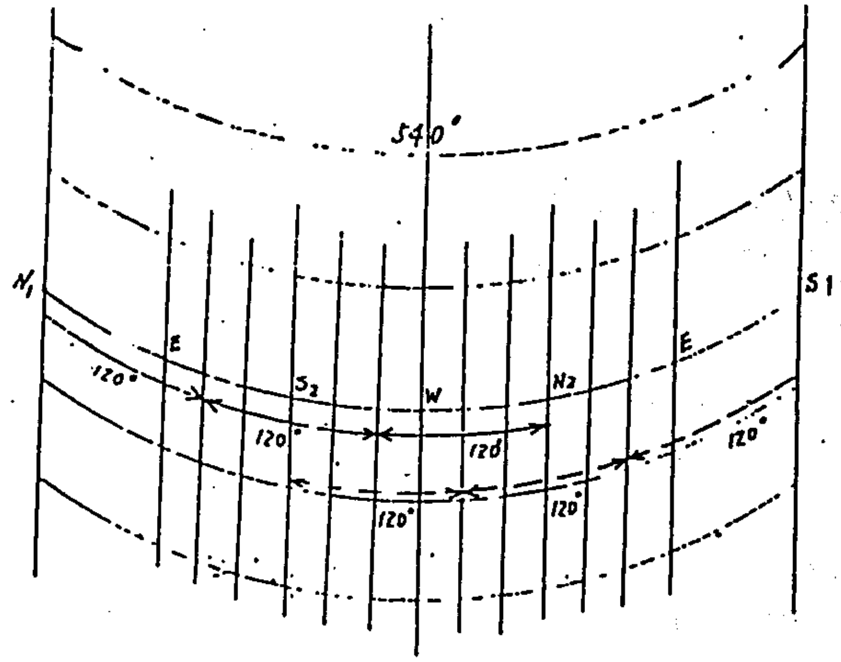
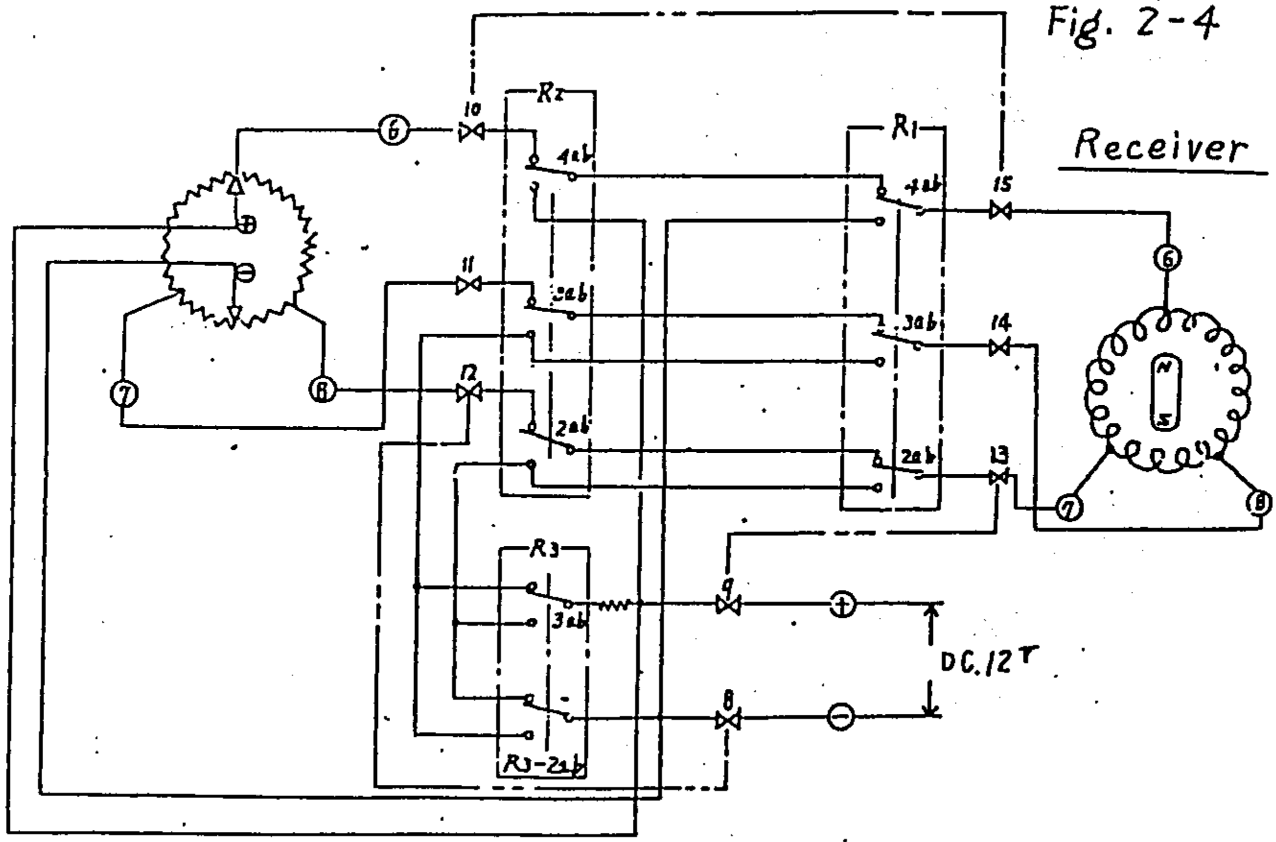


Fig. 2-3

Fig. 2-4



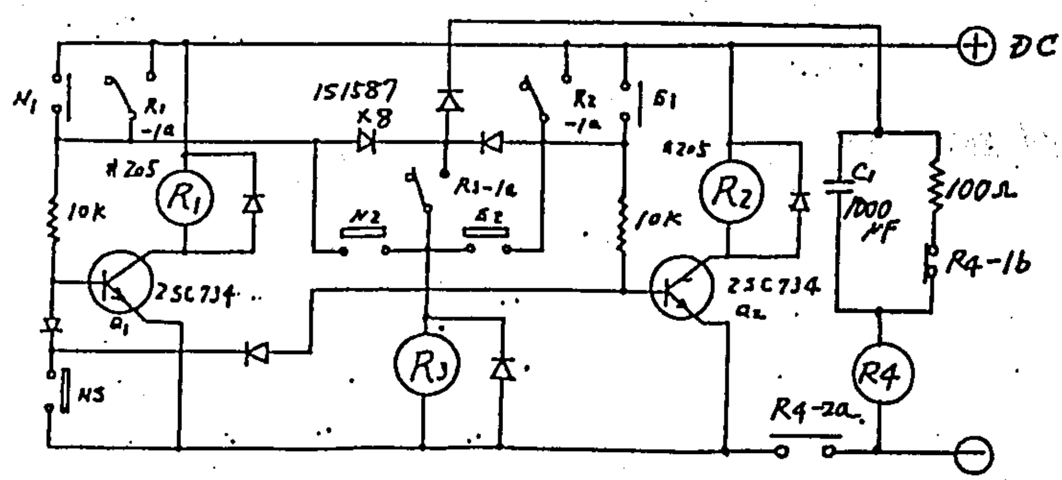


Fig. 2-5

2-4. Functions of Parts and Components and How to Operate Them.

2-4-1. Chart Feeding Device.

Chart fed by the sprocket drum and the chart receiving roller, both of which are rotated by the pulse motor driven by the pulse circuit on the principle of crystal oscillation, is wound gradually on the chart receiving spool.

As the chart receiving spool is pressed to the chart receiving roller by a spring force, the chart is wound on the chart receiving spool at a speed almost equal to a surface speed of the sprocket drum. It is also possible to advance the chart freely by turning the knob by hand. The recording pen is made of stainless steel.

All supplies will be interrupted when the power supply switch is switched to OFF. The power supply fuse can be replaced if the knob is loosened.

These inside components can be pulled out in the following procedure:

Referring to Photograph No. 4, open the external casing and pull the right hand handle to this side. Then, the internal device can be taken out around the axis of the flange while the device is operating.

2-4-2. Chart.

The overall length of the chart is about 23 m. Paper used in the chart is of a material which is least in its extension and contraction due to humidity. Perforations prepared on one side of chart (opposite to the standard side) are longitudinally oval in order to ensure stable feeding of the chart.

Graduations given on the chart are arc-shaped with the radius of 102 mm.

Timing graduations are arranged to be 15 mm. per hour.

The chart used is Type 3VA-L1-15.

2-4-3. Installation of Chart.

For installation of the chart, open the window and lift the chart presser and the pen-lifter up. (In the initial use after unpacking the shipment, strings fastening all spools and screws tightening the locker should be removed). Then, remove the chart storing spool and mount the chart after disassembling the flange and after that, tighten again the flange (Be careful not to tighten the flange excessively in order not to damage the chart).

The storing spool on which a chart was mounted in such a manner as stated above is inserted in the original grrove after pushing the pressing plate down to this side. In this practice, the oval perforations of the chart must be seen on the right hand if viewed from the front side. The pressing plate touches the chart stored in the spool and applies an adequate friction to it by a spring force.

Take a tip of the chart triangularly cut and pull it out (In case of the chart being in the course of use, it is also recommended to cut its tip also triangularly in order to carry out manipulations thereafter without any difficulty). Pull further the chart out and upwards along the guide plate and beneath the chart pressing rod as shown in Fig. 2-6 and take it out towards the sprocket drum by a length of about 60 cm.

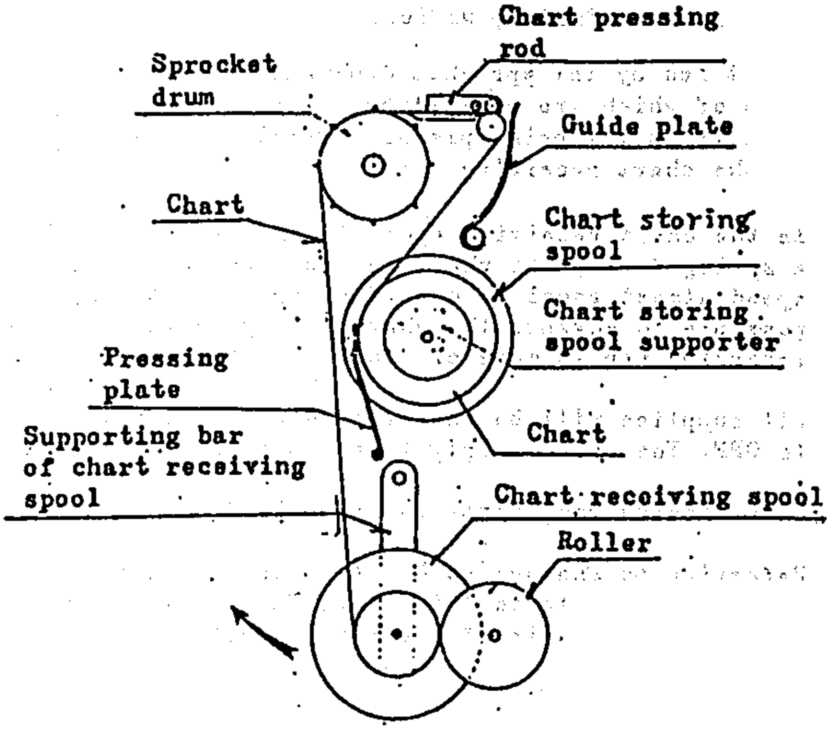


Fig. 2-6.

Then, lift the supporting bars positioned on both sides of the chart receiving spool up to this side (namely, to the arrow direction as illustrated in Fig. 2-6). Push the spring plate of the right-hand supporting bar slightly outside by a finger tip, and take the chart receiving spool off. As shown in Fig. 2-7, the chart tip is inserted in the chart tip holder and is wound as it is around the spool core two or three times. Then, insert the left-hand shaft tip of the chart receiving spool in the receiving hole on the left-hand supporting bar and press the right side of the chart receiving spool to the spring plate of the right-hand supporting bar and push the chart receiving spool into the groove in position. Then, arrange that the perforations of the chart correspond to the protrusions of the sprocket and extend the chart with a sufficient tension by turning the chart receiving spool. Push the supporting bars back to their original positions and make the spool core touch with the chart receiving roller. The supporting bars of the chart receiving spool are pulled by a spring force and the spool core is pressed to the chart receiving roller also by a spring force.

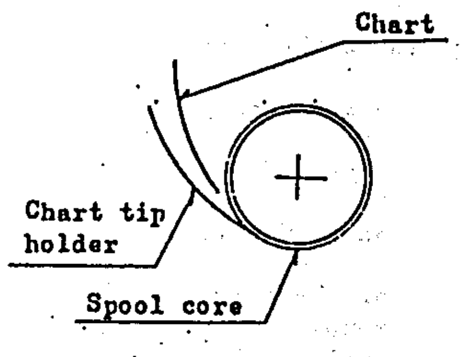


Fig. 2-7.

The chart mounting procedure is completed when the chart presser is again pushed down on the chart. When the chart installation is completed, place pens on their respective positions and suck ink therein. Arrange that pen tips correspond to timing indicated on the chart by turning manually the hand-wheel on the right side. As the shaft of the chart feeding device and the sprocket shaft are frictionally combined, the chart can be fed manually by a hand-wheel regardless of movement or stop of the chart feeding device. Chart between the sprocket drum and the chart receiving roller sometimes appears not to be sufficiently extended but be loosened slightly. However, no fear is necessary for such conditions.

2-4-4. Ink.

It is recommended that filling of ink in the ink tank and positioning of the pens would be made from the upper side after the internal device is pulled out from the housing (The internal device can be taken out if pulled by a handle provided on the internal device for this purpose).

Ink is poured into the ink tank by an accessory ink bottle.

Ink may be poured as the ink tank is mounted in position, but care must be taken not to spatter ink in the surroundings.

Removal of the ink tank should be conducted as follows: Secure the guiding adaptors of the tank tightly with fingers and pull the tank to this side slightly upwards. The tank should be restored to its original position gently after ink was filled.

The distance between the tank fastening springs on both sides are slightly narrower than the width of the ink tank and therefore, on restoring the ink tank in position, the spring on one side may be pressed by a side face of the tank in order to insert the tank smoothly and then, the ink tank is placed in the most stable position.

2-4-5. Handling of pens.

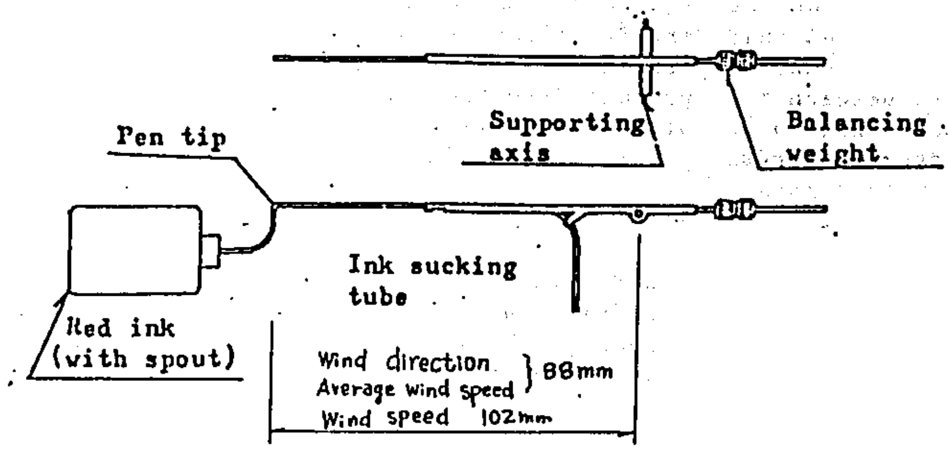
The recording pens are placed on their respective pen holders after the ink tank filled with ink was fixed in position.

At this moment, the ink sucking tip comes to a position being dipped in the ink tank.

The length of pens (from the supporting axis to the tip) for either wind direction recording or wind speed recording is equally 102 mm.

Then, the pen tip is dipped in the tip of the spout of an accessory ink bottle and suck ink sufficiently. Any air bubbles introduced in the course of this procedure may disturb a smooth ink flow during recording and therefore, be careful to suck ink quite sufficiently.

In this state, the balancing weight is to be adjusted so that the pen tip may be slightly heavier than the root of the pen.



Recording pen Fig. 2-8.

2-4-6. Self-Recording Clock.

This is a drive circuit for chart feed and it consists of a pulse circuit and a pulse motor. This device is so designed to be low in its power consumption that this can be satisfactorily used with any power-saving units or on supply mains of 12 V. D.C. In view of the fact that a secondary rechargeable battery is inserted in this circuit, no adjustment of chart is necessary for an electrical line interruption of a short period, while the device is being operated on the A.C. power supplies.

2-5. Mounting and Wirings.

2-5-1. Mounting.

1) Location of installation of the system shall be a site where no mechanical vibration may take place and less corrosive gases or dusts may exist.

2) On mounting the system on a panel, angled holes as shown in the drawing must be prepared.

3) Then, clamp the panel with and between metal adaptors positioned on the top and side of the instrument case and secure both of them tightly with screw bolts.

4) A clearance in the depth of about 1 metre should be prepared behind the panel in view of the necessity for wirings.

2-5-2. Wirings.

The wirings should be made after the mains switch was switched OFF. The wirings should be made correctly to the terminal board on the rear side of the recorder in accordance with the terminal numbers designated on the connections diagram.

The two kinds of power terminals of 100 V. A.C. and 12 V. D.C. are available, but connections should be made to either of the above two power terminals.

2-6. Starting Operations.

When the mounting and wiring procedures were completed in accordance with the preceding Articles, switch the power switch to be ON~~, and push the START/STOP knob of the clock to be START for starting operation of the clock.~~ At this moment, measurements of both wind direction and wind speed will start.

Wind speed measurements are usually made at the range of 35 m/s, which should be switched to the range of 70 m/s when it blows strongly. Be careful to mention remarks on the chart when measurements are made at the range of 70 m/s.

2-7. Maintenance.

2-7-1. Handling of pens.

The pens are of the device to suck ink into the pen tip by the syphon and capillary actions. Be careful not to introduce in ink any foreign objects, such as string pieces or dusts, as these may prevent ink from flowing smoothly.

Ink may become thick gradually due to evaporation and ink flow becomes worse accordingly, and therefore, ink should be diluted by water or be replaced with a new ink after taking the old ink off and washing the ink tank sufficiently.

Alcohol should be added if drying of ink after recording is too slow. When the instrument is not used for a considerable time, the pens are washed completely to the extent where no red colour of ink can be seen externally by inserting or extracting water in or from it by a spout.

The pens which were left with ink filled in should be dipped in a warm water prior to entering the above-mentioned washing procedures.

2-7-2. Self-recording mechanism.

No oiling should be made to the sprocket shaft and the self-winding clock. Excessive oiling is not recommended as oil may be solidified with dusts introduced although it appears good for the time being.

Oiling should be made with a clock oil of an extremely small quantity.

* Switching with the S_3 Switch (the Wind Direction Continuous Recording/Discontinuous Recording Switch) should be conducted through the following procedures:

1) In case of a power-saving unit not being used: 152-222 1/1

The Switch should be switched to CONTINUOUS (Continuous recording of wind direction is effected).

2) In case of a power-saving unit being used:

The switch should be switched to DISCONTINUOUS. Discontinuous among systems or units should be made in accordance with Schematic Diagram 152-221 1/1.

2-8. Inspection of Troubles and Remedies.

2-8-1. Wind Direction System.

Troubles	Causes	Remedies
It blows and transmitter operates, but no indication at all in recorder.	(1) Power switch in recorder being OFF. (2) Fuses in recorder were disconnected. (3) Contact failure in the print connector. (4) Contact failure of the slip ring in transmitter. (5) Contact failure of Relays R1 and R2 in the shift circuit.	(1) Switch the power switch to be ON. (2) Take spare fuses and replace. (3) Check if the print connector is tightly inserted in position. (4) Remove dirts from the slip ring and brushes, and repair contact failure. (5) Wipe sufficiently the contacts in the relays with a dried cloth.
Abnormal indication or recording.	(1) Loosening of a pen. (2) Same with (5) above.	(1) Tighten the setting screw after adjustment was made according to transmitter azimuth. (2) Same with (5) above.
No shifts in wind direction system.	(1) Contact failure in N1 and S1 Contacts (or Stopper). (2) Breakage of Lead Switch. (3) A magnet slipped off. (4) A lead switch moved from its original position. (5) Trouble in the shift circuit.	(1) Wipe these contacts with a dried cloth lightly. (2) Replace Lead Switch. (3) Fix magnet with adhesive. (4) Adjust position of the lead switch. (5) Check all relays and replace faulty relays with new ones.

2-8-2. Wind Speed System.

Troubles	Causes	Remedies
Propeller rotates, but no indication at all in recorder.	(1) Trouble in the generator. (2) Disconnection in cables or series resistors.	(1) Check with a tester (for measurement of resistance ranging to about 1 kilo-ohm) resistance between (1) and (2) terminals of transmitter. If obtained value is excessively different from the normal value of 230 ohm, the generator was damaged and must be replaced. (2) Check if conductivity in the cable connecting the terminals (1) and (2) is sound.
Unstable recording or indication.	Contact failure of the slip ring in transmitter.	Wipe lightly with a dried cloth or a cloth slightly dipped in gasoline the contact surfaces of both slip ring and brushes.
Too large or too small recording or indication.	Zero point was incorrectly adjusted.	Either of the two wind speed inputs (1) or (2) is disconnected and checking is made if the zero in the instrument is correct.
Poor indication in recorder. Its operation is also intermittent.	(1) Improper balancing of the recording pen.	(1) If the pen tip is excessively heavy, reduce pressure towards pen tip by returning the balancing weight backwards. (2) Tighten setting screws of the pen support and fix it (Be sure to conduct zero adjustment preliminarily).

2-8-3. Chart Feeding Device.

Troubles	Causes	Remedies
No feed of chart is possible.	Voltage of 8-15V is not loaded between + and - external terminals, while voltage being loaded between + and - in Power-Saving Unit.	Contact failure or disconnection may take place between +/- external terminals and +/- in Power-Saving Unit. Repair should be made accordingly.
	Voltage of 8-15V is not loaded between relay terminals A and B.	Contact failure or disconnection may take place between +/- external terminals and relay connectors A/B. Repair should be made accordingly.
	No function at all despite voltage of 8-15V being loaded between relay terminals A and B.	Contact failure or disconnection may take place between relay terminals A/B and +/- in Clock Device. Repair should be made accordingly.
	No function at all despite voltage of 8-15V being loaded between + and - in Clock Device.	Clock Device is faulty. Consult manufacturers.
Perforations of chart and protrusions of the sprocket drum do not correspond to each other.	Incorrect mounting of chart.	Mounting of chart must be rectified. Arrange rectification in order that chart may not shift to either side of spool.
Complete stop of chart feeding device.	Bad rotation of the chart feeding device or trouble in the clock.	Disassemble couplings between chart feeding device and self-winding clock and rotate the chart feeding device manually. If it turns lightly, the clock is in trouble. If not, the chart feeding device is in trouble and should be overhauled for repair.

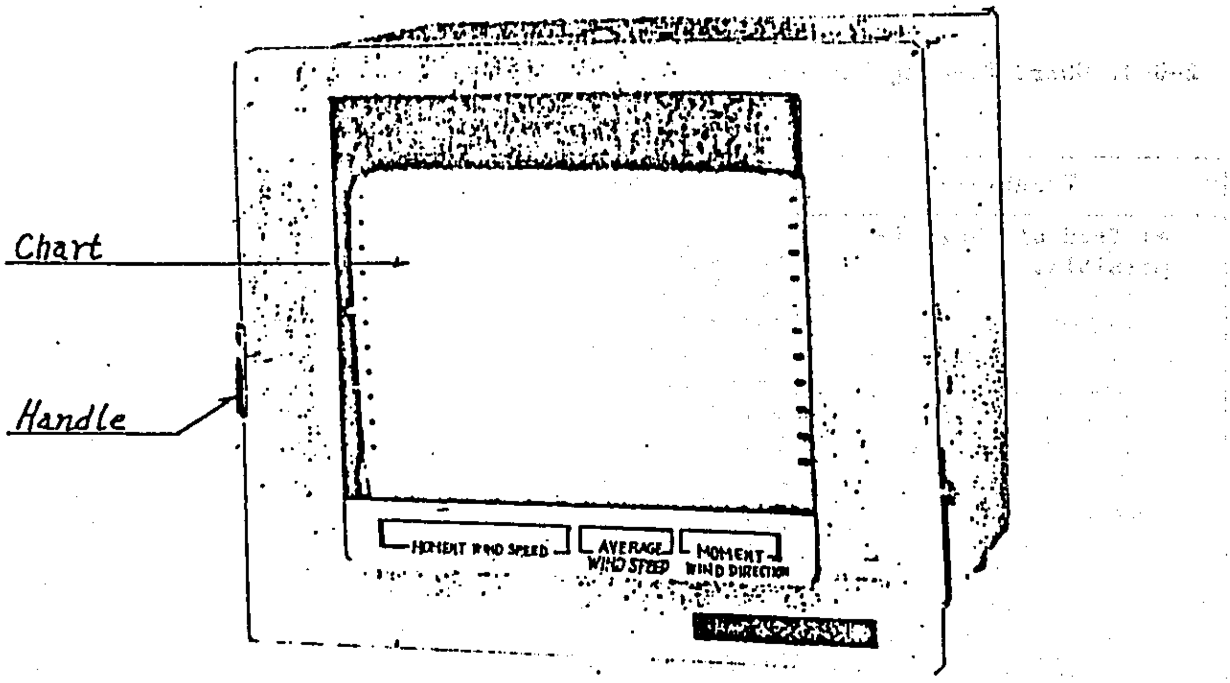
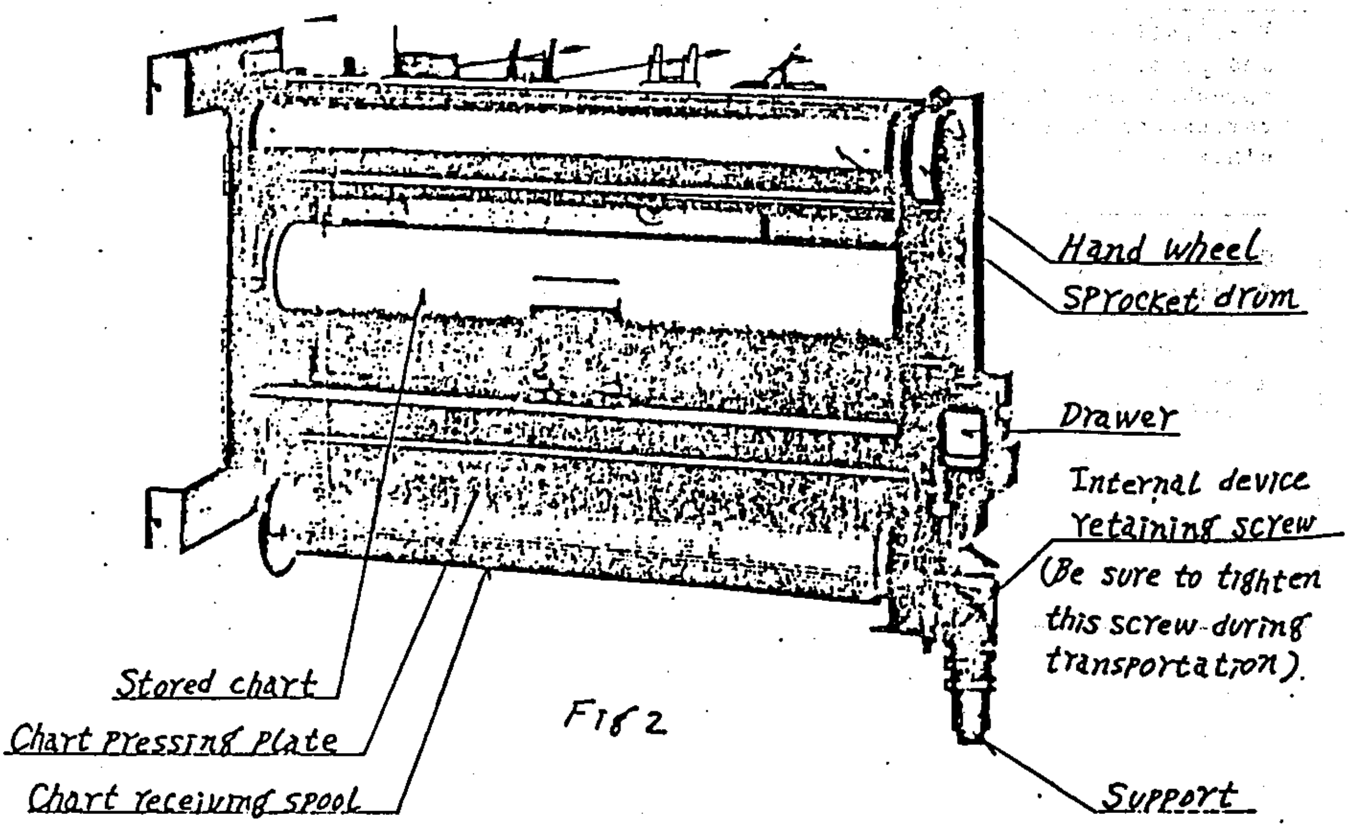


Chart
Handle
MOMENT WIND SPEED
AVERAGE WIND SPEED
MOMENT WIND DIRECTION

Fig 1



Hand wheel
Sprocket drum
Drawer
Internal device retaining screw (Be sure to tighten this screw during transportation).
Stored chart
Chart pressing plate
Chart receiving spool
Support

Fig 2

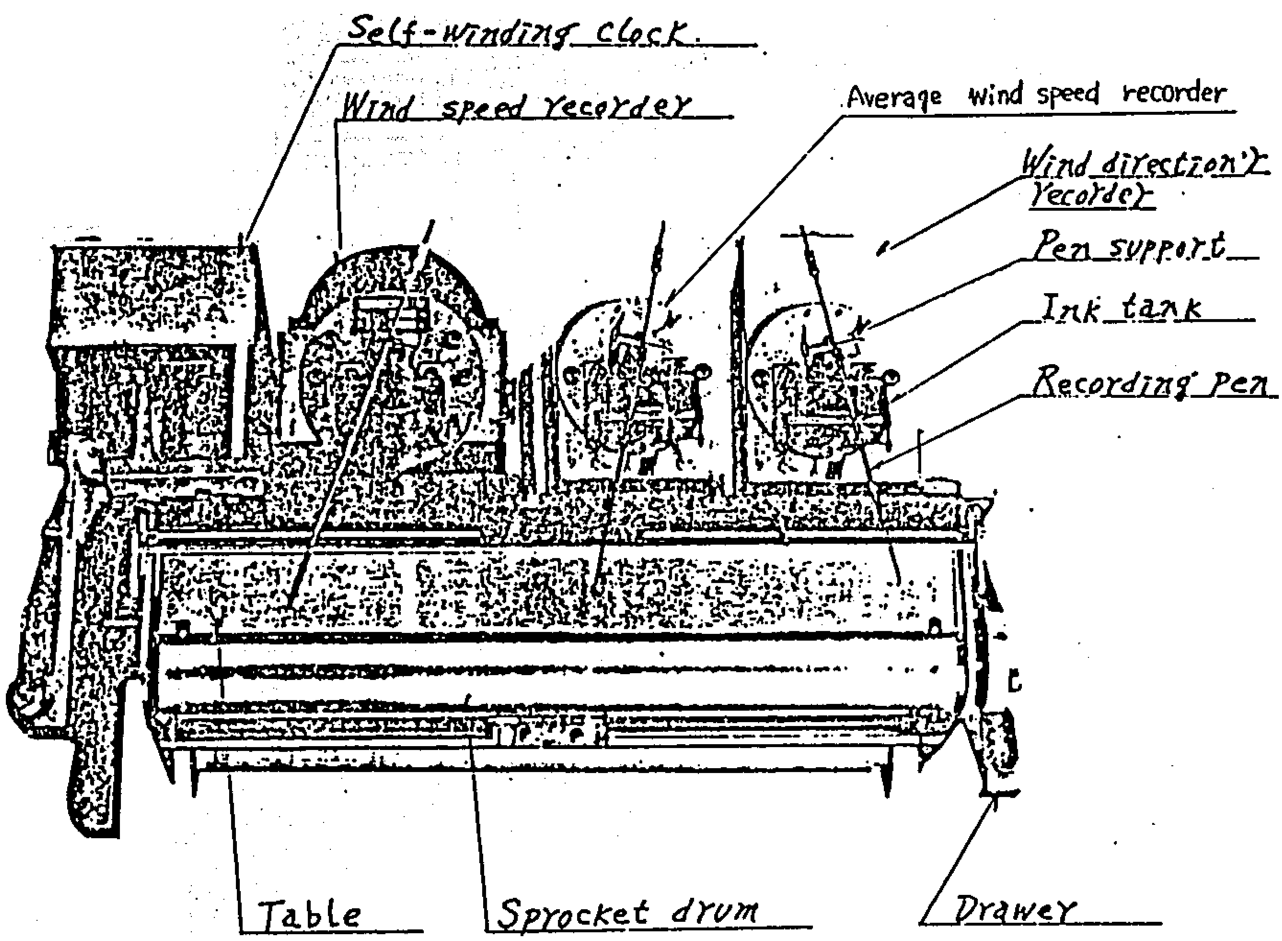

Self-winding clock.
Wind speed recorder
Average wind speed recorder
Wind direction recorder
Pen support
Ink tank
Recording pen
Table
Sprocket drum
Drawer

Fig. 3

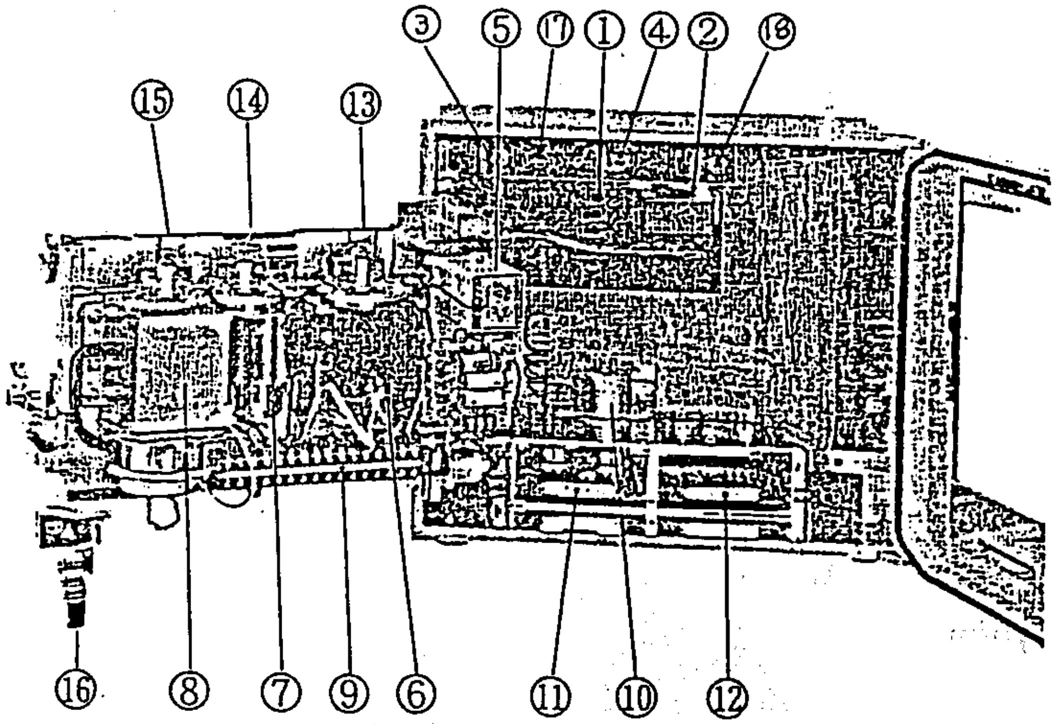
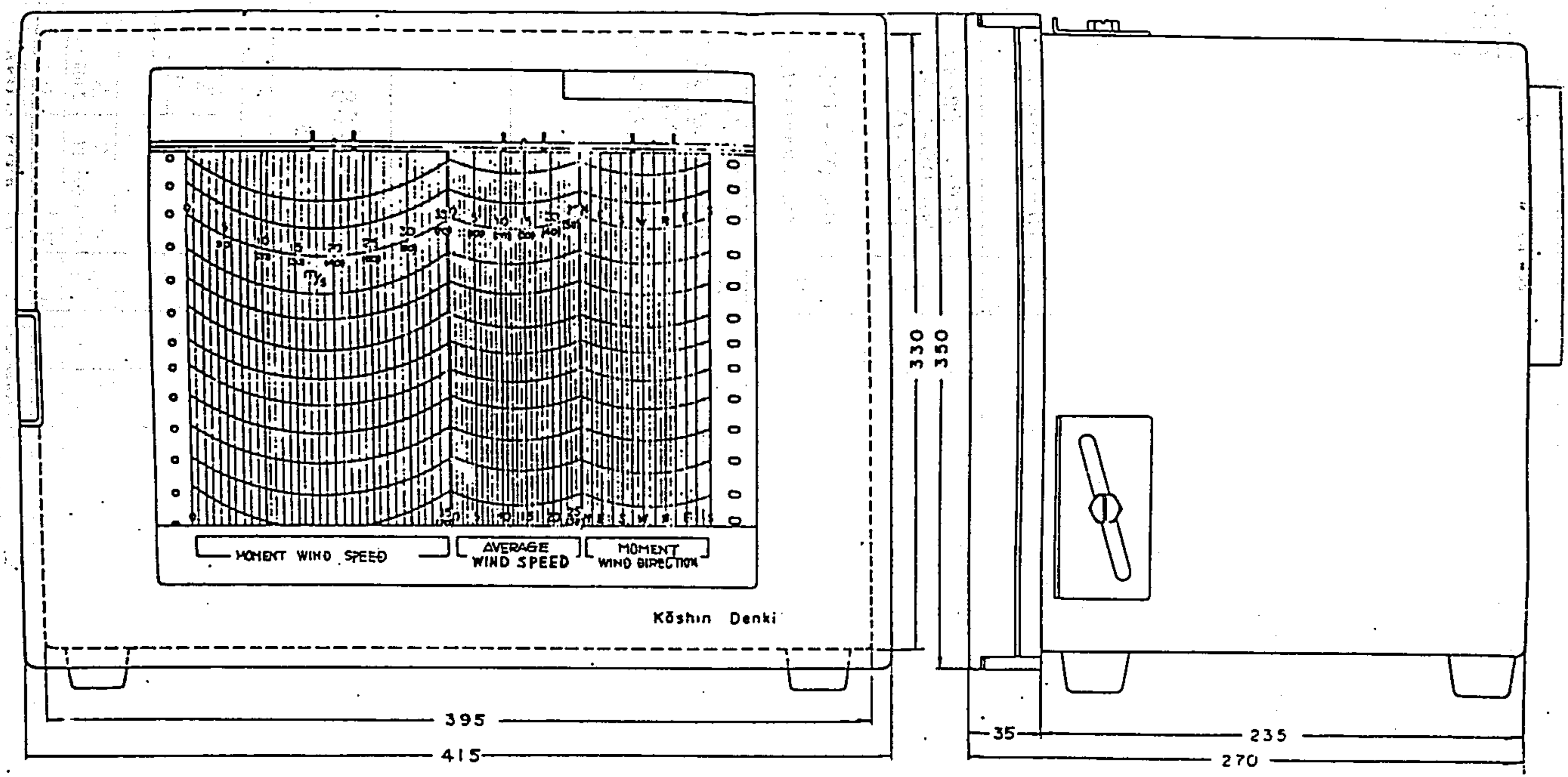
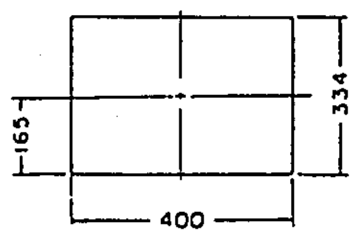


Fig 4

① External wiring terminals
② Power transformer
③ Power switch
④ Wind speed range switch
⑤ Self-winding clock
⑥ Wind speed recorder
⑦ Average wind speed recorder
⑧ Wind direction recorder
⑨ Relay terminal
⑩ Wind speed rectifier box
⑪ Shift circuit
⑫ Average wind speed circuit
⑬ Wind speed recording pen
⑭ Average wind speed recording pen
⑮ Wind direction recording pen
⑯ Drawer
⑰ Fuse
⑱ CONTINUOUS / DISCONTINUOUS SWITCH



Panel holing dimensions

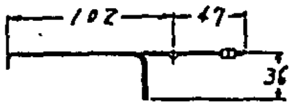
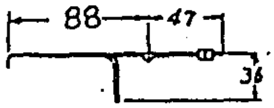
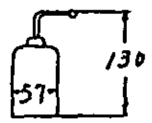
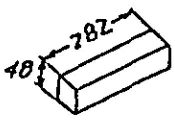
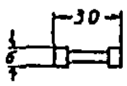
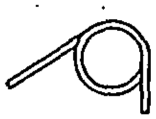


Moment Wind direction	N-E-S-W-N-E-S	(540°/360° Shift)
Moment Wind Speed	0~35 m/s. 0~70 m/s.	
Average Wind speed	0~50 m/s.	

3-Element Recorder

BOX NO ______ P ______

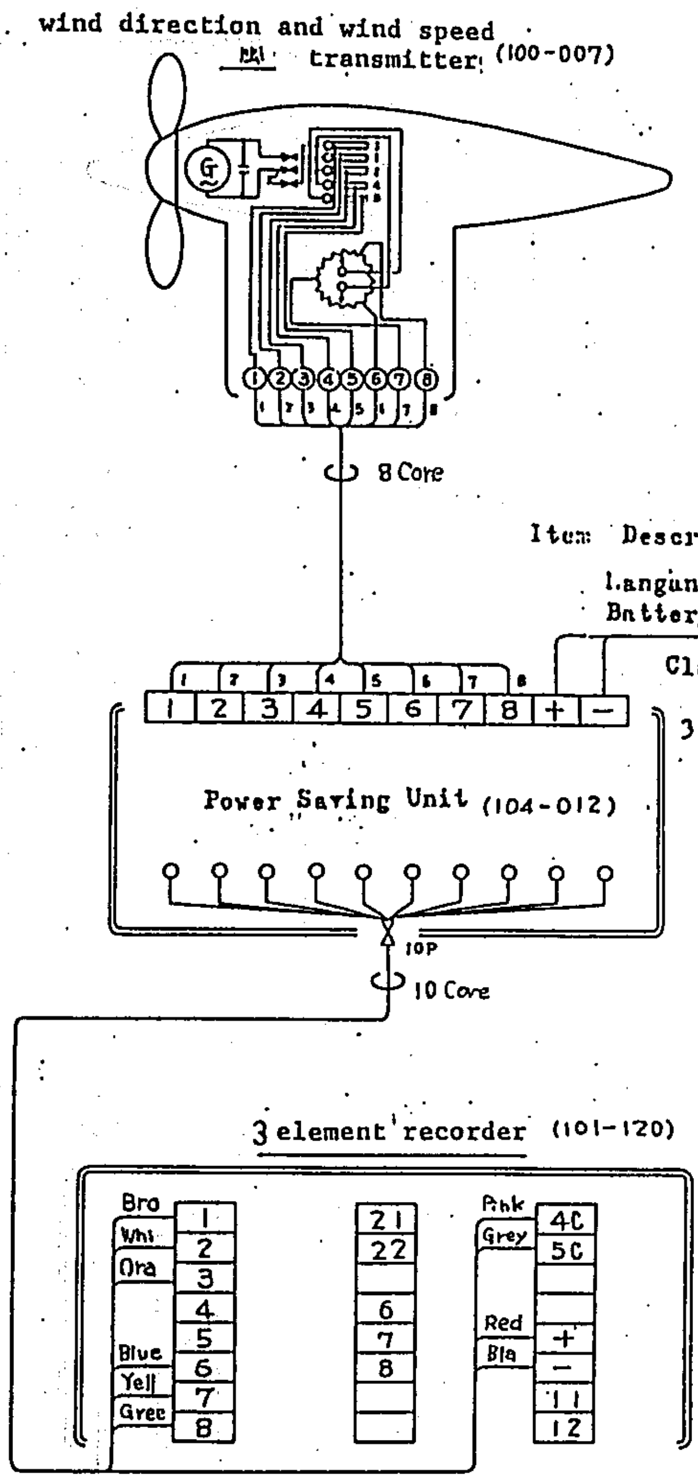
SHIP NO	SPARE PARTS LIST FOR	USE	SETS PER VESSEL
	KDD-300	Anemometer & Anemoscope for recorder 風向風速 記録器用	

ITEM NO	NAME OF PART	OUTLINE	QUANTITY WORKING PER SET	QUANTITY WORKING PER VESS.	SPARE	REMARKS
1	Recording pen 記録ペン(風向) (wind direction)		1			No. 06-156 (H-37-4E-5)
2	Recording pen 記録ペン(風速) (Wind speed / Average wind speed)		2			No. 06-157 (H-37-4E-6)
3	Recording ink 記録用インキ				1	150 cc. (Red) No. 05-282 (H-36-1)
4	Recording chart 記録紙(風向.風速)				8	No. 05-175 (No. 3WA-L1-15)
5A	Fuse		1		2	125V 1A コードNo. 03-551
5B	ヒューズ		1		2	125V 2A コードNo. 03-552
6	Wire 針金				1	
7	Polyvinyl pipe ビニルパイプ				1	l = 1m
8	六角棒スパナ Hexagon Wrench Key				1	05-268 M 3

MFR'S NAME	KOSHIN DENKI KOGYO CO., LTD.	DRW.NO	481-004

(K-3-15G-21)

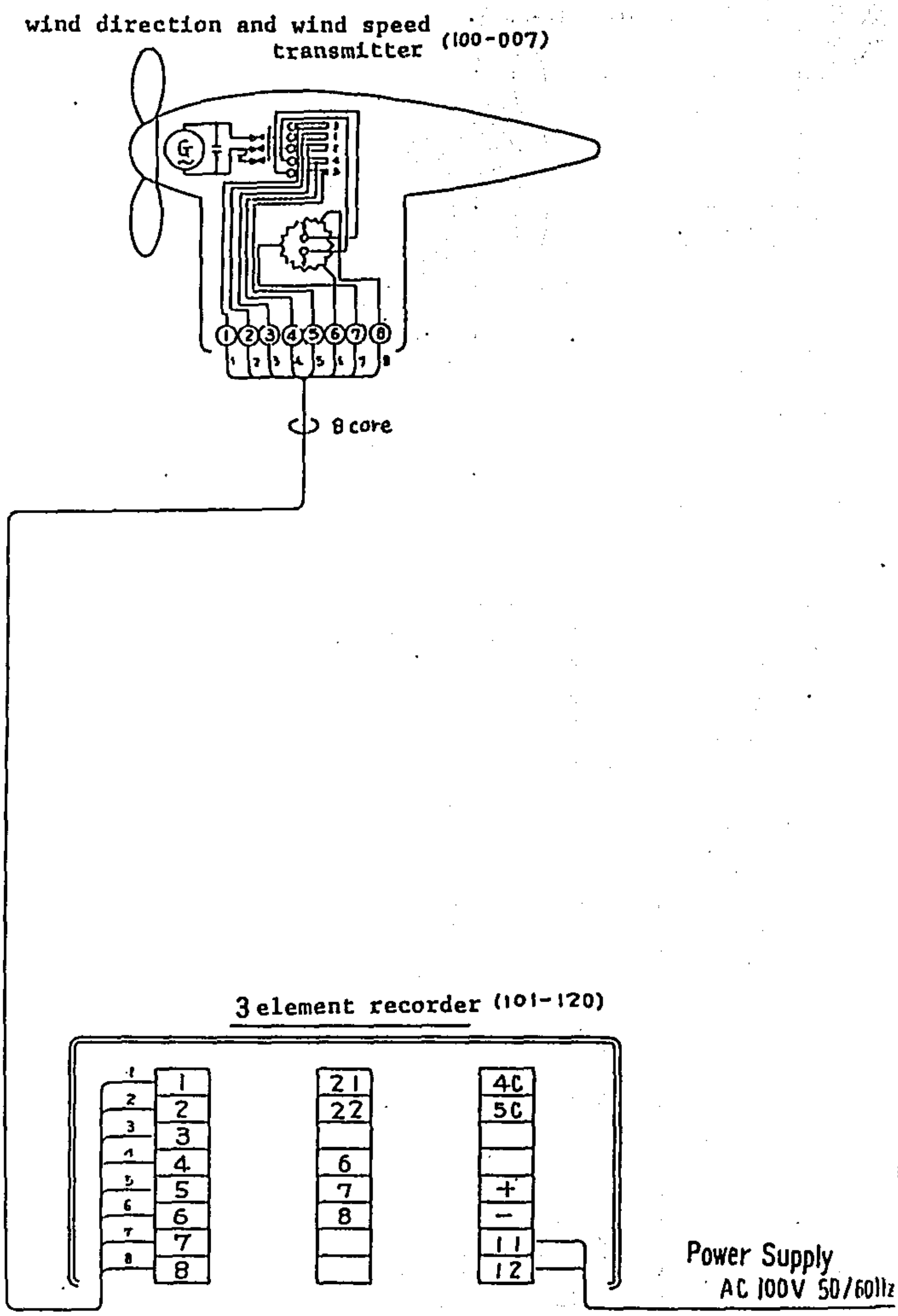
r2. 1. 6



Item Description		Model
Manganese Dry Battery		FM-5H, Hira No. 5.
Classification		No. of pcs. used
3 V, 5 A.		5
10 V. to 15 V. D.C.		

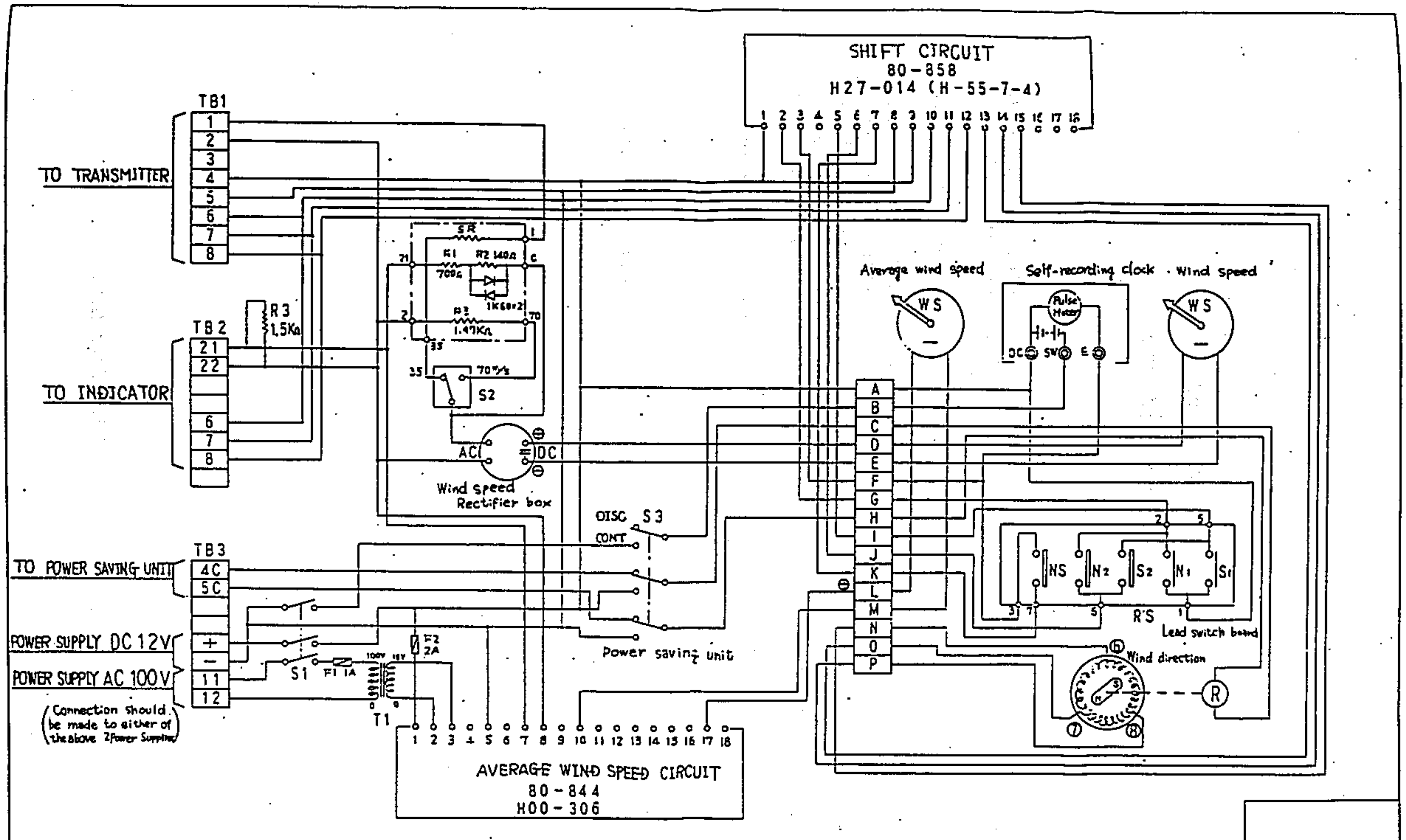
In case of a power-saving unit being used

重量 WEIGHT		塗装色 PAINTING		図面番号 DRAW.G.NO	152-221 1/1
				品名 DESCRIPT.N	Systematic diagram
画法 DRAW.RULE	第三角法 TRIGONOMETRY	尺度 SCALE	寸法単位 UNIT mm	区分 SECTION	MODEL KDD-300
部長 SEC.CHIEF	係長 CHECKED		設計 DESIGN 三浦	DATE	1986. 9. 11
課長	担当		製図		光進電気工業株式会社 KOSHIN.DENKI.KOGYO.CO.LTD



In case of a power-saving unit not being used

重量 WEIGHT		塗装色 PAINTING			図面番号 DRAW.G.NO	152-222	1/1
					品名 DESCRIPT.N	Systematic diagram	
画法 DRAW.RULE	第三角法 TRIGONOMETRY	尺度 SCALE		寸法単位 UNIT mm	区分 SECTION	MODEL KDD-300	
部長 SEC.CHIEF		係長 CHECKED	久保	設計 DESIGN 三浦	DATE	1986. 9. 11	
課長		担当		製図	光進電気工業株式会社 KOSHIN.DENKI.KOGYO.CO.LTD		



R3 { Indicator with 3KΩ
No Indicator 1.5KΩ

重量 WEIGHT		塗装色 PAINTING		図面番号 DRAW.G.NO	101-120 1/1
-E60256				品名 DESCRIPT.N	Connection Diagram
画法 DRAW.RULE	第三角法 TRIGONOMETRY	尺度 SCALE	寸法単位 mm UNIT	区分 SECTION	KDD-300 Recorder
部長 SEC.CHIEF		係長 CHECKED 担当	久,	設計 DESIGN 製図	三浦
				DATE	1986 . 7 . 4
					光進電気工業株式会社 KOSHIN.DENKI.KOGYO.CO.LTD

INSTRUCTIONS FOR USE OF

MODEL KLS-10 POWER SAVING UNIT

KOSHIN DENKI KOGYO CO., LTD.

INSTRUCTIONS FOR USE OF

MODEL KLS-10 POWER SAVING UNIT

This Unit is intended for coupled use with Model KL-111 KOSHINVANE Anemometer. A long-term observation can be expected with the use of this Unit even in case of operation on D.C. supply mains.

Model KL-111 KOSHINVANE Anemometer can operate for more than 1 year on a battery of 12 V. D.C., 60 AH, provided that Model KLS-10 is coupled therewith, whilst a standard Model KL-111 can operate for continuous recording only for about 6 days on the same battery.

METHOD OF RECORDING:

Wind Speed	: Continuous recording (The same recording with that of ordinary system).
Wind Direction	: Intermittent recording at a rate of 0.5 sec. per every 1 minute by means of a semiconductor circuit.

1. General Specifications.

Item	Description	Specifications
1	Power Supply	10 V. to 15 V. D.C.
2	Current Consumption when current circulates	About 100 μA.
3	Applicable Temperature Range	0° to 40°C.
4	Intermittent Operation	0.5 sec. per every 1 minute.
5	Protection Circuit	Power Supply being disconnected when a current of about 200 mA flows for more than 10 minutes (See Article 6 below for particulars).
6	External Dimensions	About 140 (W) x 77 (12) (L) x 170 (D)
7	Weight	About 900 g.
8		
9		
10		

2. Spare Parts and Accessories.

Item	Description	Remarks	Q'ty
1	Instructions for Use		1 Copy
2	Cable, 1 m. long, complete with Connector, 10 P.	(For connection between Recorder and Power Saving Unit)	1 pce.
3	Fuses	1 A.	3 pcs.
4			

3. Life of Batteries.

Manufacturers of Batteries: Matsushita Denki Sangyo Company Limited.

Item	Description	Model	Classification	No. of pcs. used	Life
1	Manganese Dry Battery	FM-5H, Hira No. 5.	3 V, 5 A.	5	About 2 months
2					
3					
4					
5					
6					

4. Method of Connection.

4-1. Inputs (1) to (8) to Sensor/Transmitter.

Disconnect the cabtyre cable at the 8 terminals of (1) to (8) on the external terminal board of the recorder and connect it to the 8 terminals of (1) to (8) on the Power Saving Unit (Note that this cabtyre cable is from the sensor/transmitter).

4-2. Output to Recorder.

Connect the 10 P connector to the recorder output provided on Model KLS-10 Power Saving Unit and connect another side of the cable to the terminals of the external terminal board of the recorder in accordance with colour codifications, numbers, and/or symbols given below:

1	Brown	7	Yellow	4C	Pink
2	White	8	Green	5C	Grey
3	Orange		Red		
6	Blue		Black	(14)	Pink (Former Type)

4-3. Batteries.

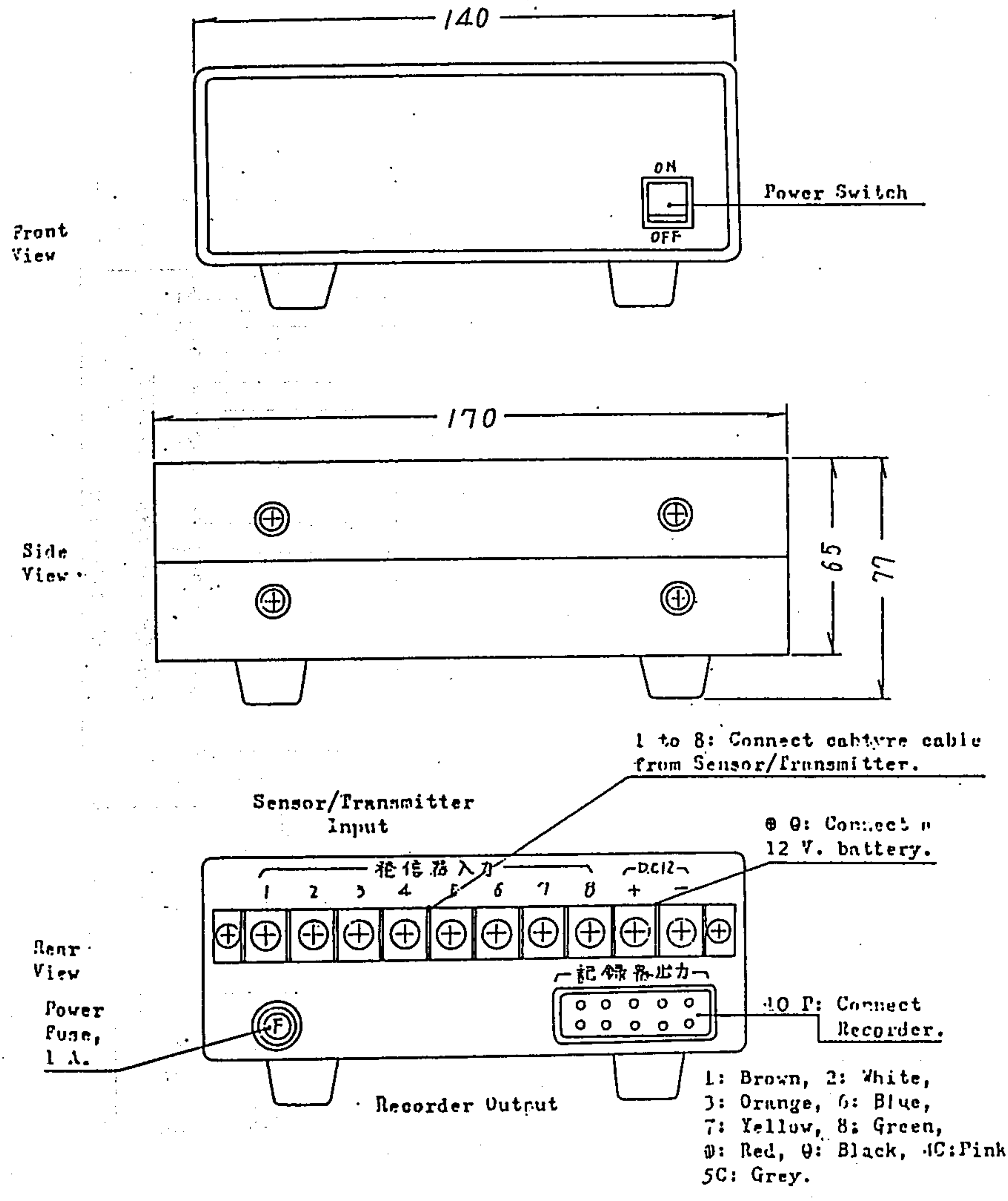
For example, 5 pieces of FM-5 Battery, 3 V. D.C., 5 A, are connected in series and are further connected to the external terminals ⊕ and ⊖ in the Power Saving Unit.

5. Intermittent Operation.

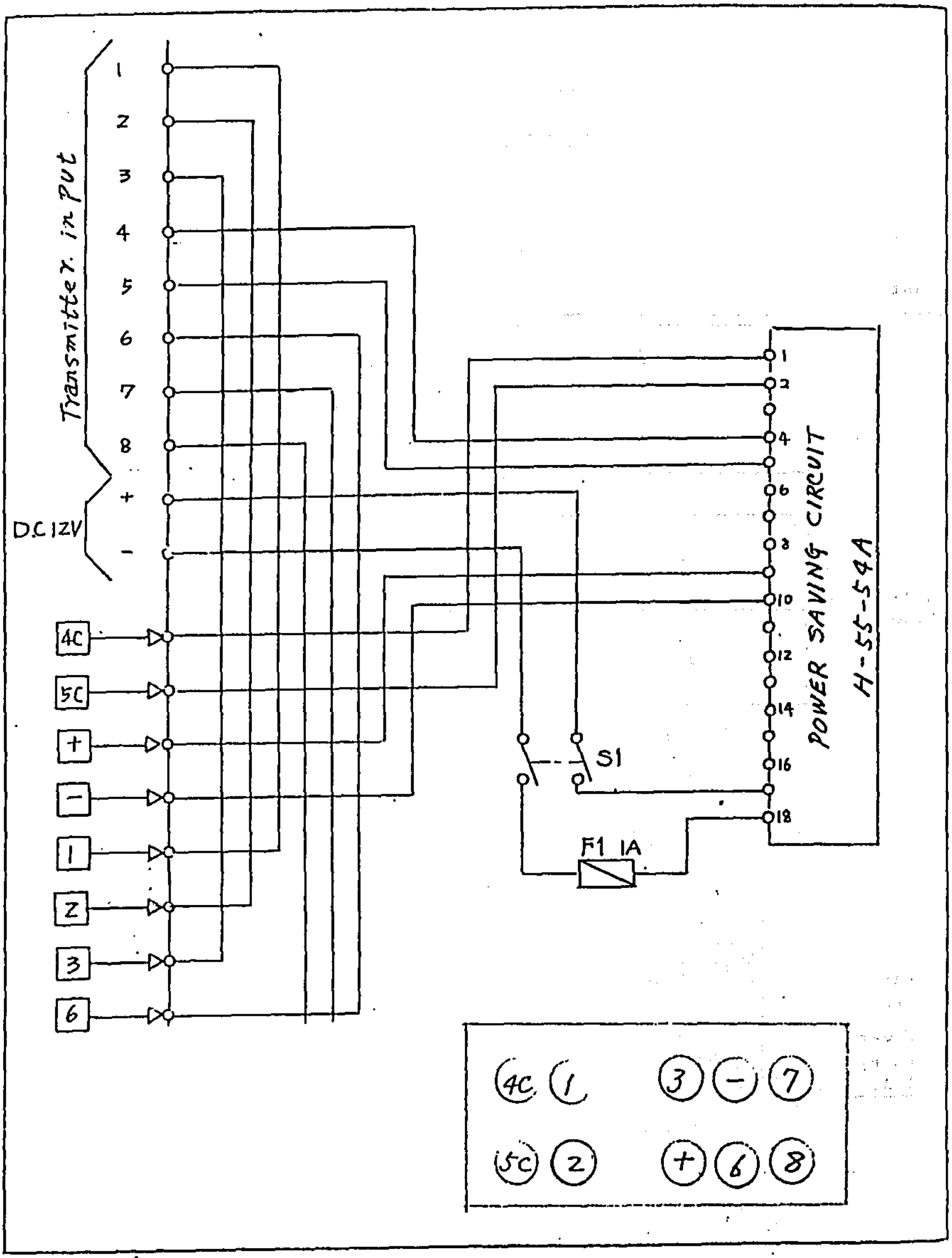
On switching ON the power switches in both Power Saving Unit and Recorder, a power is circulated through the sensor/transmitter for 0.3 sec. per every 1 minute and the recorder operatesonly during this period. A power is however circulated at all times through the shifting circuit and clock device in the recorder and therefore, the shifting device and clock winding motor are operating at all times as usual.

6. Protection Circuit.

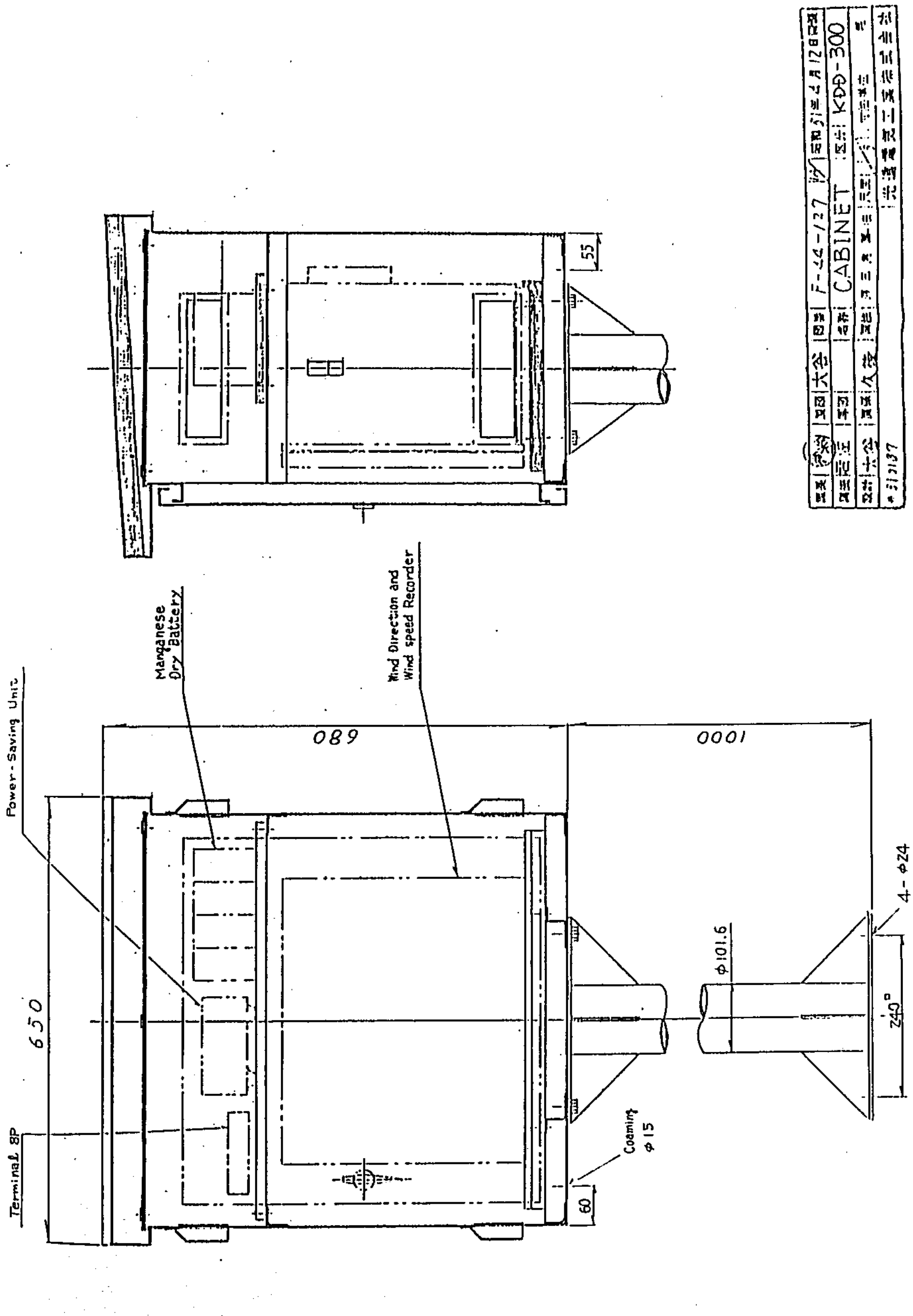
There is a risk of the clock winding motor rotating endlessly when voltage in the batteries has become abnormally deteriorated due to long-term use of the system. At such occasion, supply mains are automatically disconnected with the red lamp warning shortage of voltage lights up. Replacement of batteries should preferably be made prior to the protection circuit starting the above-mentioned operation.



Power Saving Unit



POWER SAVING UNIT CONNECTION DIAGRAM



Power-Saving Unit
Manganese Dry Battery
Wind Direction and Wind speed Recorder
680
1000
650
Terminal 8P
Coaming φ15
60
55
φ101.6
240□
4-φ24
F-44-127
CABINET
KDD-300

APPENDIX 2

INSTRUCTION MANUAL

OF

PORTABLE TURBIDIMETER

(MODEL：PT-1)

FEATURES:

Model :PT-1 is apotable Turbidimeter of direct-reading type, consist of a Sensor Unit with 100 meters cable and a Display Unit.

The measuring range is 0～ 2000 ppm of Kaoline density.

A Rubber Cap is attached to the Receiver(Photo-eye) of the Sensor Unit which is used for zero-adjustment of the Sensor by covering the Receiver. An Zinc-anode is attached to the Unit which prevent the Sensor-housing from corrosion.
This Zinc-anode should be replaced by new one when necessary.

The power of Display Unit is supplied from 8 pieces of A2 type dry-cell. The turbidity is displayed by digital values and also available in analogic output of 0～2V. Battery voltage is also displayed on LCD and the batteries should be replaced by new ones when the voltage drops down to 1.2V.
Approx. 20 hours successive operation is guaranteed.

CONSISTS:

Sensor Unit with 100mcables	1 ea.
Display Unit	1 ea.
driver	1 ea.
manual	1 ea.

SPECIFICATIONS:

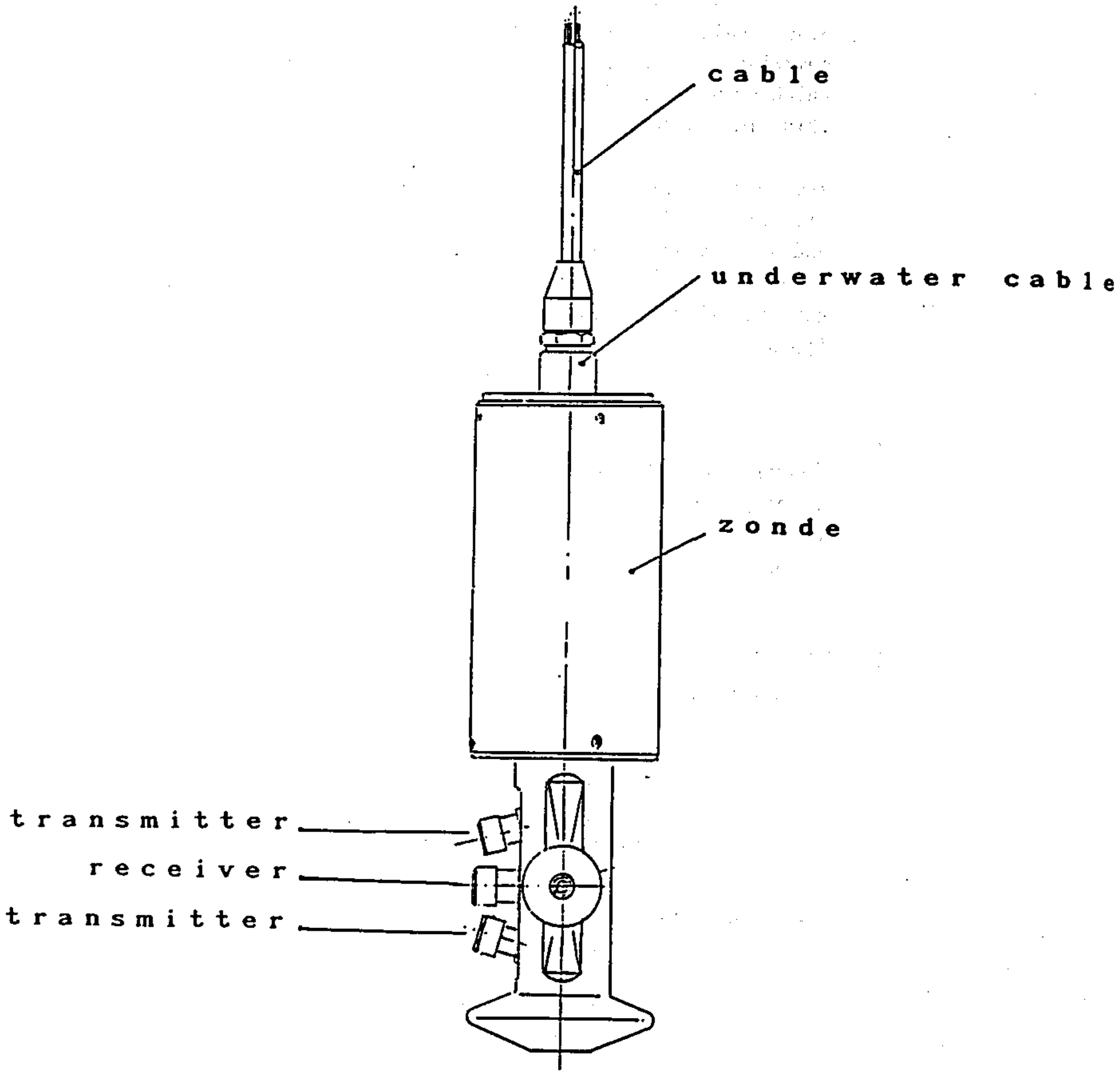
Sensor Unit

wavelength	940nm
range	0 ～2000ppm
accuracy	2%
dimension	dia.60mm L206mm
weigth	1.75Kg

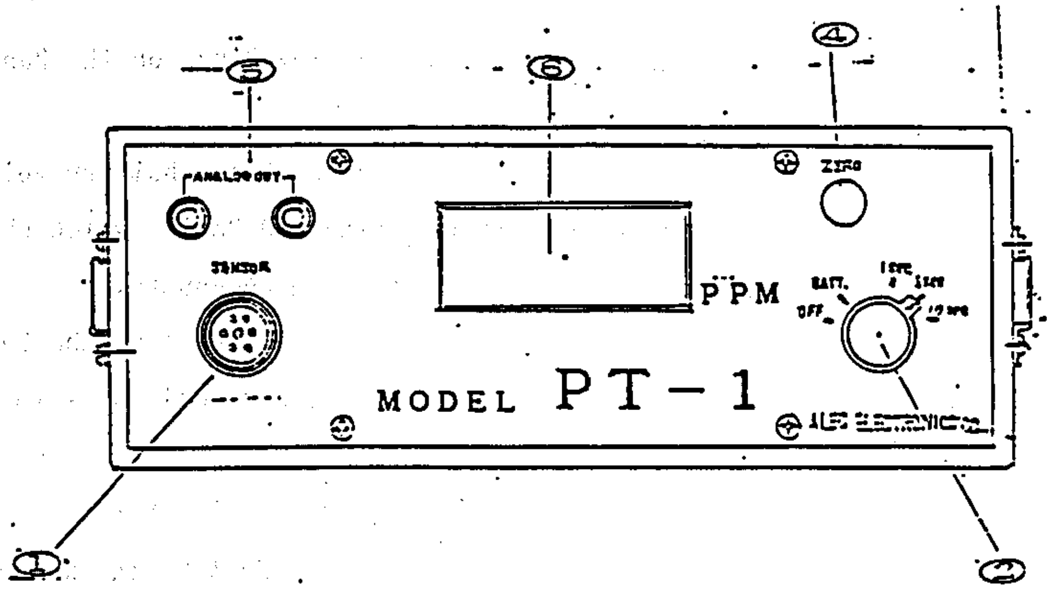
Display Unit

time-constant	1,5,10sec
battery	A2 type 8ea.
battery capacity	20 hours
analogue output	0 ～2V(0～2000ppm)
dimension	240mm 90mm 115mm
weight	2.5Kg

図－1　Sensor Unit



【表示部パネル面の名称】



<u>Names on the Panel of the Display Unit</u>

(1) Connecting Plug for Sensor Unit

(2) Main Switch

This Switch can work as:

1) ON/OFF Switch

2) Battery-check

3) Time-interval Selector

(4) Zero-adjust Trimmer

Zero point of the Sensor can be adjusted with the time-interval at 1 second.

(5) Analogue-output Terminal

The output is DC 0～2V for the measuring range.

(6) LCD Display Panel

The turbidity and the voltage at Battery-check are displayed on this Panel.

Operating Manual

〔1〕Pre-settings

(1) Connect the Sensor cable to ① the Connecting Plug on the Panel of the Display Unit.

(2) Set the Main Switch at BATT position and check the battery voltage. The battery voltage is displayed on ⑥ the LCD Panel which should be more than 1.2V. Replace the battery when necessary.

(3) A Rubber cap is attached to the Receiver (Photo-eye) of the Sensor Unit, which is used for zero-adjustment. Please don't miss this Cap.

〔2〕Zero-adjustment

(1) Cover the Receiver (Photo-eye) of the Sensor Unit by the Rubber cap.

(2) Select the time-interval at 1 second by ② the Main Switch.
Then, the numerical value is displayed on LCD to indicate the power in now ON.

(3) Turn ④ the Zero-adjust Trimmer to obtain zero on ⑥ the LCD Panel. Wait for more than 1 second after zero-adjustment is done until the data become stable, because the selected time-interval is 1 sec.

(4) Now the zero-adjustment is done. This process should be done every time when the power is turned ON.

〔3〕Measuring

(1) Take off the Rubber cap from the Receiver of the Sensor Unit and start measuring.
The time-interval can be selected at 1, 5 or 10 seconds.
Select the time-interval as follow:

Time-int. 1 sec.•••••••• When the water is fairly clear, the turbidity being less than 20 ppm.
The data become stable in 1 second.

Time-int. 5, 10 sec.••• When the turbidity seems high, the sizes and the density of the particles should be so irregular that the measured data are not constant. Select the Time -interval at 5 or 10 sec.

The data become stable in 5 or 10 seconds, therefore, wait for 5 or 10 seconds before starting to read the data. Select 10 secs. if 5 sec. interval is still not enough.

(2) When the analogic output is used, the output voltage is 0～2V against 0 ～2000 ppm, the calculating formula being as follow:

Turbidity (ppm) = 1000 x Output Voltage (mV)

〔4〕Ending of Measurements

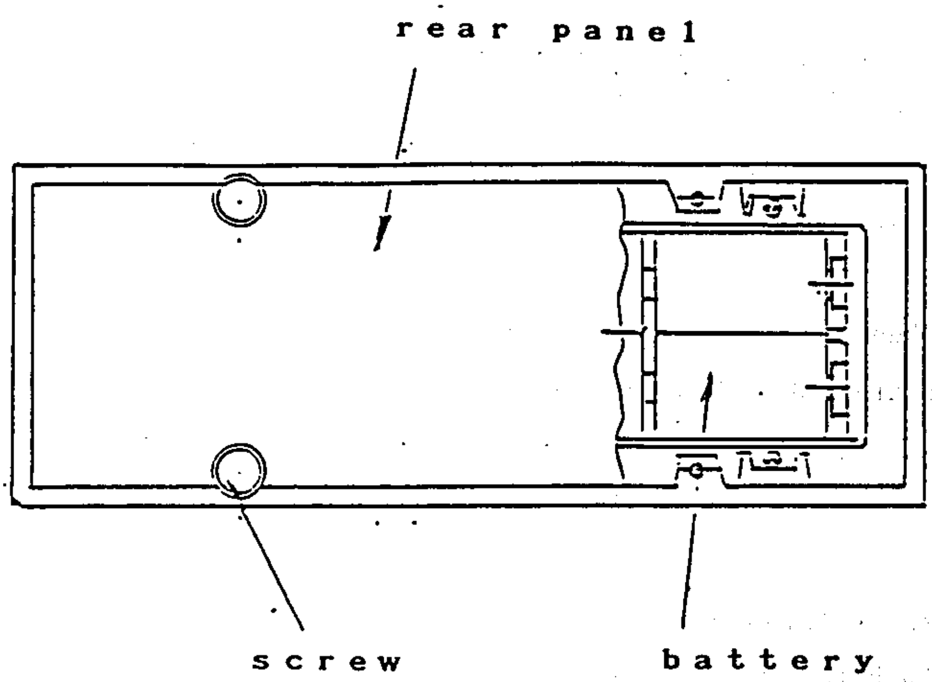
(1) Wash the Sensor Unit with fresh water.
Softly clean the glass faces of the Receiver and the Transmitter with clean cloth.

(2) Attach the Rubber cap to the Receiver.

(3) Turn the Main Switch OFF on the Display Unit.

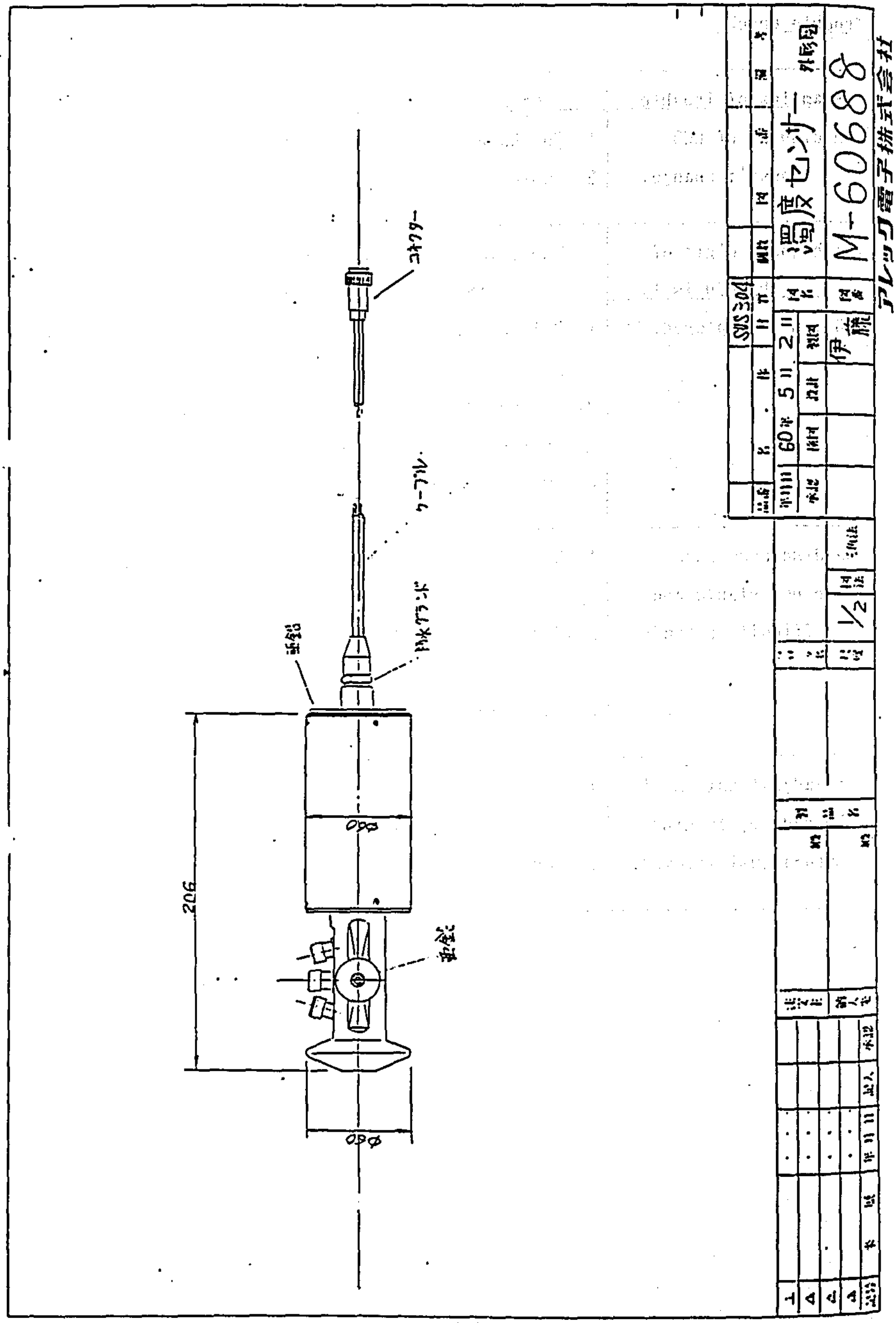
〔5〕Battery change

Take out the Display Unit from the case, unscrew 4 bottom screws and the Battery can be taken out. (see the drawing below)
The battery case has the indictaion of + and -. Make sure that the polarities are correct.

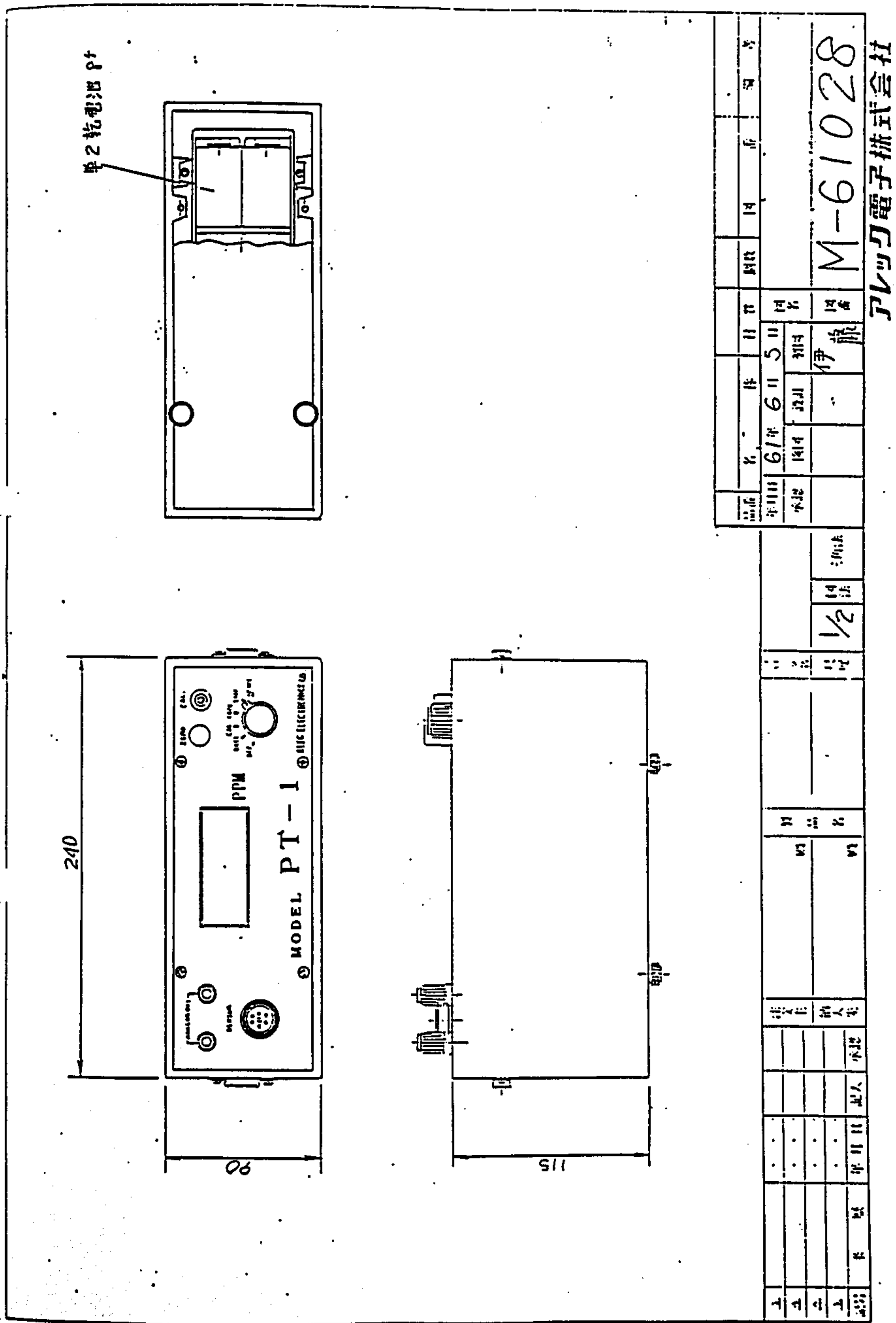

rear panel
screw
battery

Trouble Check

Examples of Trouble	Causes	How to cope with
The display of LCD doesn't change.	1. The Rubber cap is attached.	Remove the Rubber cap.
	2. Cable is disconnected.	Check the cable and repair.
The highest digit of the LCD is 1.	1. The values are exceeding the measuring range.	
LCD isn't displayed.	1. Battery voltage isn't enough.	Replace the batteries by new ones.
	2. The polarities of the Batteries are not correct.	Check the Batteries.
	3. The Display Unit is out of order.	Return the Unit to the Maker.
The displayed data are not stable and difficult to read.	1. Main Switch is set at 1 second.	Select Time-interval at 5 or 10 seconds.
	2. The Sensor Unit is out of order.	Return the Unit to the Maker.
	3. Cable is almost broken.	Check the cable and repair.
Zero-adjustment can't be made by turning Zero-adjust Trimmer.	1. The Rubber cap is not attached to the Receiver.	Attach the Rubber cap.
	2. Sensor is out of order.	Return the Sensor to the Maker.



コネクター
ケーブル
防水グランド
206
φ60
φ60
SUS304
60年 5月 2日
1/2
濁度センサー
外形図
M-60688
アレック電子株式会社



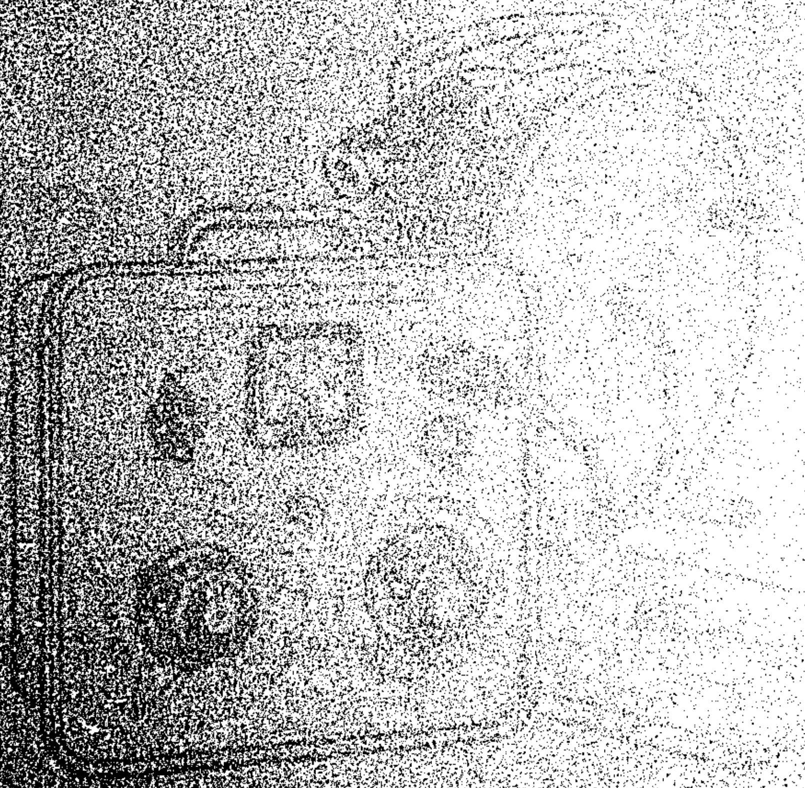
MODEL PT-1
PPM
240
90
115
1/2
M-61028
アレック電子株式会社

APPENDIX 3

INSTRUCTION MANUAL

OF

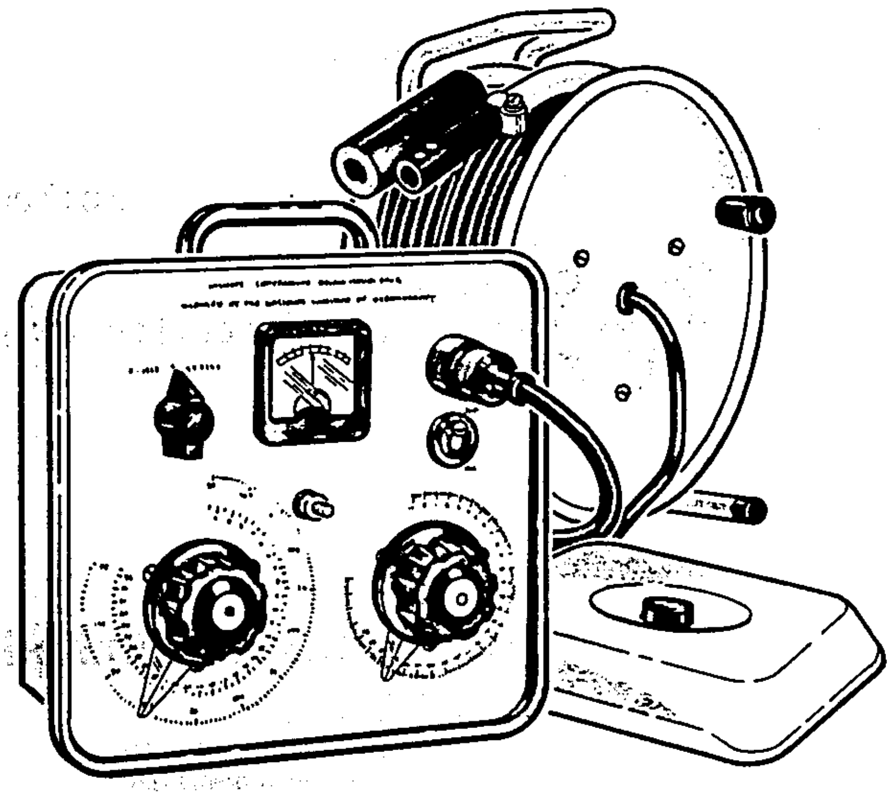
SALINOMETER



Kent Industrial Measurements

Analytical Instruments

Instruction Manual for Model 5005 Oceanographic Salinity and Temperature Measuring Bridge



BBC
BROWN BOVERI

MODEL 5005
OCEANOGRAPHIC SALINITY AND TEMPERATURE BRIDGE
OPERATING INSTRUCTIONS

August 1984

OI/5005/2
5005 040

Kent Industrial Measurements Limited

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St Neots Huntingdon
Cambridgeshire England PE19 3EU
Telephone Huntingdon (0480) 75321
Telex 32676 FOSCAM G
Telecopier Huntingdon (0480) 217948 (Group 2/3)

INTRODUCTION

This instruction manual describes the operation and routine maintenance of the Model 5005 Oceanographic Salinity and Temperature Measuring Bridge, a portable battery-operated instrument for rapid measurements of salinity and temperature in sea and tidal waters. The Model 5005 is also suitable for laboratory applications.

There are two distinct versions of the Model 5005, depending on the salinity range (measured in parts per thousand) required ie.

Model 5005-600 - 0.5-32.5°/oo and 32-38°/oo salinity
or
Model 5005-700 - 0.5-32.5°/oo and 32-39.5°/oo salinity

The design of the Model 5005 has been carried out in collaboration with the National Institute of Oceanography.

DESCRIPTION

Measuring bridge

The Model 5005 is enclosed in a grey nylon-coated alloy case which has a carrying handle and a watertight quick-release cover. The controls of the instrument are all located on an instrument panel underneath this cover, together with a centre-zero moving coil meter and a connecting socket for the measuring cell. The instrument can be operated in either a horizontal or vertical position.

The front panel controls comprise two large vernier screw dials which balance the bridge when making the salinity or temperature measurements, a three-position range selector switch, and a rubber-covered on/off toggle switch. The balance dials are calibrated in parts per thousand of sea water salinity and degrees Centigrade for direct reading.

Measuring Cell

The sensor used with the Model 5005 is a dip-type conductivity measuring cell specially adapted for salinity measurements, and is furnished with a cable 100 metres long wound onto a portable drum. This cable terminates in a waterproof plug fitted with a protective cover for direct connection to the matching socket on the front panel of the instrument.

Incorporated in the measuring cell is a thermistor which serves both to provide automatic temperature compensation for the salinity measurements, and as the sensing element for temperature measurements.

SPECIFICATION

Measurement ranges:	0.5-32.5°/oo and 32-38°/oo salinity -1 to +30°C (Model 5005-600) 0.5-32.5°/oo and 32-39.5°/oo salinity 0 to +40°C (Model 5005-700 - alternative version)
Accuracy:	±0.05°/oo on expanded ranges ±0.1°/oo on normal ranges ±0.1°C on temperature ranges
Temperature compensation:	Automatic, using integral thermistor in measuring cell
Power supply:	Ever-Ready PP3 9 volt battery, or equivalent type
Dimensions:	
Bridge:	263 x 251 x 140mm approx. (10 3/8 x 9 7/8 x 5 1/2in) - see Fig.1
Measuring cell:	254mm (10in) long, 76mm (3in) dia. approx. Supplied complete with 100m cable on cable drum
Weight:	
Bridge:	5kg (11 lb)
Measuring cell:	9kg (20 lb), including cable drum

PREPARATION FOR USE

Before reliable measurements can be made using the Model 5005, the measuring cell unit must first be thoroughly cleaned, and the instrument's calibration checked (using a sample of known salinity). These two procedures are described below.

Cleaning the measuring cell

1. Make up a 10% solution of liquid detergent (eg. 'Teepol' or household detergent) and immerse the measuring cell in it for a few minutes.
2. Scrub the tubular bore of the cell until all visible traces of contamination are removed. Rinse the brush and cell in several changes of distilled water, until the inside of the cell is evenly wetted (ie. there is no evidence of grease).
3. During periods between measurements, the measuring cell can be conveniently stored in a flask of distilled water or clean sea water. It is important that a dirty measuring cell is never allowed to dry out, but is cleaned immediately.
4. Do not use acid to clean the bore of the cell - the epoxy resin moulding may be attacked and permanently damaged.
5. Check that the cable is undamaged, and that the 3-pin connecting plug is clean and dry before attaching it to the Model 5005.

Checking the calibration

1. Connect the cable of the freshly-cleaned measuring cell to the 3-way socket on the Model 5005 and immerse the measuring head in a beaker of sea water of accurately known salinity (preferably within the anticipated measuring range). 280ml ampoules of 'standard' sea water may be ordered from KIM using the Part No. 0218 204, on which is stated the chlorinity value in parts per thousand. This value can be converted to salinity by the simple relation

$$S = 0.03 + 1.805C$$

where S = salinity and C = chlorinity (both expressed in parts per thousand).

2. Set the 3-position range switch to the salinity range in which the standard sample falls and turn the salinity dial pointer to the value of the standard sample.
3. Depress the toggle switch ON.
4. Agitate or stir the sample until the balance meter on the instrument panel settles down. When the calibration is correct, as it will be on despatch from the factory, the balance meter will settle at centre (zero) precisely. If it does not, reclean the measuring cell (as described above) and repeat the procedure.
   If the discrepancy still persists, remove the instrument from the case by undoing the central fixing screw (into which the case cover fixes) on the panel, and locate a small trimming potentiometer on the printed circuit board (circuit ref. VR2 (10k) on Fig.3) marked S, and adjust this with a screwdriver until balance is correctly indicated.
5. The temperature calibration of the instrument can also be checked if required by measuring the temperature of a sample of water with an accurate thermometer, and setting the range switch to the °C position. Adjust the temperature dial pointer to align with the temperature reading of the thermometer. The balance meter should be at centre (zero) precisely : if it is not, adjust the trimming potentiometer on the printed circuit board (circuit ref. VR1 (10k) on Fig.3) marked T until balance is correctly indicated.

OPERATION

Using the Model 5005

To carry out a measurement of salinity on a sample of sea-water, carry out the following steps:-

1. Connect the measuring cell cable to the Model 5005 and lower the cell gently into the sample.
2. Set the range switch to the anticipated salinity range and set the toggle switch to ON.
3. The balance meter now deflects to left or right : slowly rotate the salinity dial until the balance meter is at centre (zero deflection) and read off the salinity of the water directly from the appropriate scale in parts per thousand.
4. Turn the toggle switch to OFF, to conserve battery power, after completing the measurement.

To carry out a temperature measurement, carry out the following steps:-

1. Connect the measuring cell cable to the Model 5005 and immerse the cell into the sample.
2. Set the range switch to °C, the toggle switch to ON, and rotate the temperature dial until zero balance is obtained on the balance meter, and then read off the temperature directly from the temperature scale.

The following notes may be useful when making laboratory measurements:-

1. It is more convenient to immerse the measuring cell in a wide-necked bottle of sample and to agitate it by either shaking the cell or moving it up and down in the sample. Always allow sufficient time for the cell and sample to attain temperature equilibrium before attempting a measurement.
2. It is clearly essential that the water temperature inside the cell should be the same as that surrounding the thermistor (to obtain correct temperature compensation), and this is often difficult to achieve with samples (eg. deep sea water samples)

whose temperature is markedly different to the ambient temperature. When this problem arises, it is often advantageous to use a silvered vacuum flask as the sample container, to reduce errors in measurements due to temperature gradients.

The following notes may assist in obtaining reliable measurements in shipboard use:-

1. There will normally be enough movement to ensure that the measuring cell always moves relative to the water, and thus keep the bore of the measuring cell flushed with fresh sample. However, in very calm conditions, or when working from a height, it may be necessary to move the connecting cable up and down to keep the bore flushed.
2. When working at anchor in a considerable current a heavy sinker should first be lowered on a taut wire, and the measuring cell then tied to a smaller weight which can then slide down the wire.
3. When carrying out a long series of measurements, it is desirable to check the accuracy of the bridge from time to time using a sample whose salinity content is accurately known. For this purpose it is convenient to transport this 'standard' sample in a large thick-walled polythene bottle with a wide neck, into which the measuring cell can be lowered. (The error incurred by diluting this standard sample with water from the measuring cell is insignificant when the bottle contains (say) 2 litres of sample). For the most accurate measurements, ampoules of 'standard' seawater may be purchased from KIM (see the LIST OF SPARES).

The frequency with which this check is carried out depends largely on the cleanliness of the sea water and the degree of accuracy required. This is often best determined after experience in using the bridge over a period of time.

Pressure effects

The effect of hydrostatic pressure on the accuracy of deep water salinity measurements is insignificant for an instrument like the Model 5005.

The pressure coefficient was determined experimentally for sea water of chlorinity 19°/oo by B. Hamon (Journal of Marine Research, 16, 2, 1958, pages 83-89). If a similar coefficient is valid for lower chlorinity values, the error would be approximately 0.1°/oo per 100 metres of depth at a chlorinity of 10°/oo and a temperature of 10°C. Thus unless the water is unusually uniform in both temperature and chlorinity throughout its depth, the error is negligible.

Locating faults

The observable faults which may occur when operating the Model 5005 may be broadly classified into three groups:-

1) Failure to indicate - the balance meter does not deflect from centre zero,
2) Failure to balance - the balance meter remains at fullscale deflection in either direction
3) Indecisive or unstable results - the balance meter reading is not steady.

These three groups are briefly dealt with in the following paragraphs:-

Failure to indicate: If the balance meter does not deflect at all when the toggle switch is turned ON, check that the PP3 battery has not become disconnected by removing the front panel of the instrument and examining the battery connectors. Check the battery voltage with a voltmeter - it should not fall below 8 volts. If it has, replace with a new battery (Part No. 0231-143), as described under ROUTINE MAINTENANCE. Check the condition of the wiring and printed circuit board for disconnection or loose components.

Failure to balance: If the balance meter pointer deflects to hard right or left of the scale, and cannot be brought to zero, first check that the range switch is set to the correct salinity range for the anticipated value of the sample, and that the temperature of the sample also falls within the measuring range. Then check that the measuring cell cable is dry and clean and correctly plugged into the instrument panel.

As a further check on the measuring bridge only, unplug the measuring cell cable from the bridge, and connect a 130 ohm resistor between the socket pins A and B, and a 100 ohm resistor between pins A and C. Turn the toggle switch to ON, and a balance should be obtained at some value on the salinity range.

To check the disconnected measuring cell, immerse it in a sample of clean seawater which has a salinity within the measuring range, and check with a multimeter that the resistance between the plug pins A and B is of the order of 130 ohms (this value will increase rapidly due to polarisation on the measuring cell electrodes). The resistance between pins A and C should similarly be measured, and should be in the order of 100-140 ohms. If the measuring cell is at fault, it should be returned to KIM for repair or replacement, with the measuring bridge.

Indecisive or unstable results: these are generally attributable to a failing battery or dirty or contaminated electrodes in the measuring cell. This is especially likely to happen when the cell becomes contaminated with sewage, or when being used in areas of high plankton density. The electrodes will then become heavily coated with grease and must be thoroughly cleaned as previously described.

ROUTINE MAINTENANCE

Cleaning the measuring cell

Always clean the measuring cell thoroughly before use, as instructed in the PREPARATION FOR USE section. If the bore of the measuring cell is allowed to dry out without cleaning, the internal electrodes can become coated with grease deposits which will certainly affect subsequent readings and may produce erratic and unstable measurements. It is recommended to store the measuring cell immersed in a flask of distilled water or clean sea water between measurements.

Battery replacement

With a few hours intermittent use per day, the battery life extends to approximately 200 hours. It will become apparent towards the end of this time from sluggish balance meter movement that the battery requires replacement, and if a check of the battery condition with a multi-meter indicates a voltage at the battery terminals of less than 8 volts, it should be discarded.

Spare batteries may be ordered from KIM quoting the part no. 0231 143 : the new battery is inserted in a spring clip fixed to the rear of the instrument panel, and connected using polarising connectors. Access to the battery is by unscrewing the knurled central nut on the front panel, and removing the panel completely from the case. The spring clip is then located between the two large calibration potentiometers on the panel.

LIST OF SPARES

The following brief list of major components and assemblies of the Model 5005 may be useful for spares purposes : spares should be ordered from Kent Industrial Measurements Limited, Analytical Instruments, Hanworth Lane, Chertsey, Surrey, England KT16 9LF, quoting the appropriate part number listed below.

Description	Part No.
Measuring cell, complete with 100m of cable	2024 804
Battery 9V PP3 type, or equivalent	0231 143
Centre-zero meter (50-0-50 microamps)	0232 131
Toggle switch (ON/OFF)	0232 937
Potentiometer 250 ohms (TEMPERATURE/SALINITY)	0243 168
Wafer switch 3 way, 6 pole (range switch)	5005 270
Printed circuit board assembly, complete	5005 203
Standard sea-water (in sealed glass ampoule)	0218 204

GUARANTEE AND SERVICE

If within a period of twelve months (twenty-four months in the case of Kent Industrial Measurements, Industrial Instruments' "Clearspan" recorders, indicators and controllers) from the date of despatch of the goods any defects in materials or fault in manufacture of the goods shall be found to exist and be reported to the Company in writing the Company will repair or at its option replace the defective part free of charge providing it is returned carriage paid to the Company's works. Alternatively at the Company's entire discretion in exceptional circumstances a Service Engineer will repair/replace the defective parts at the Customer's works and the Customer will be charged for travelling time and expenses.

Instruments sent to the Company's works must be appropriately packed and the following information provided:

i) the name of the Company
ii) the department within that Company
iii) the name of the person involved, his telephone number and extension
iv) a brief description of the fault
v) for pH installations, the type of electrode system and electrode being used
Special arrangements will be made in individual cases for goods returned from overseas.

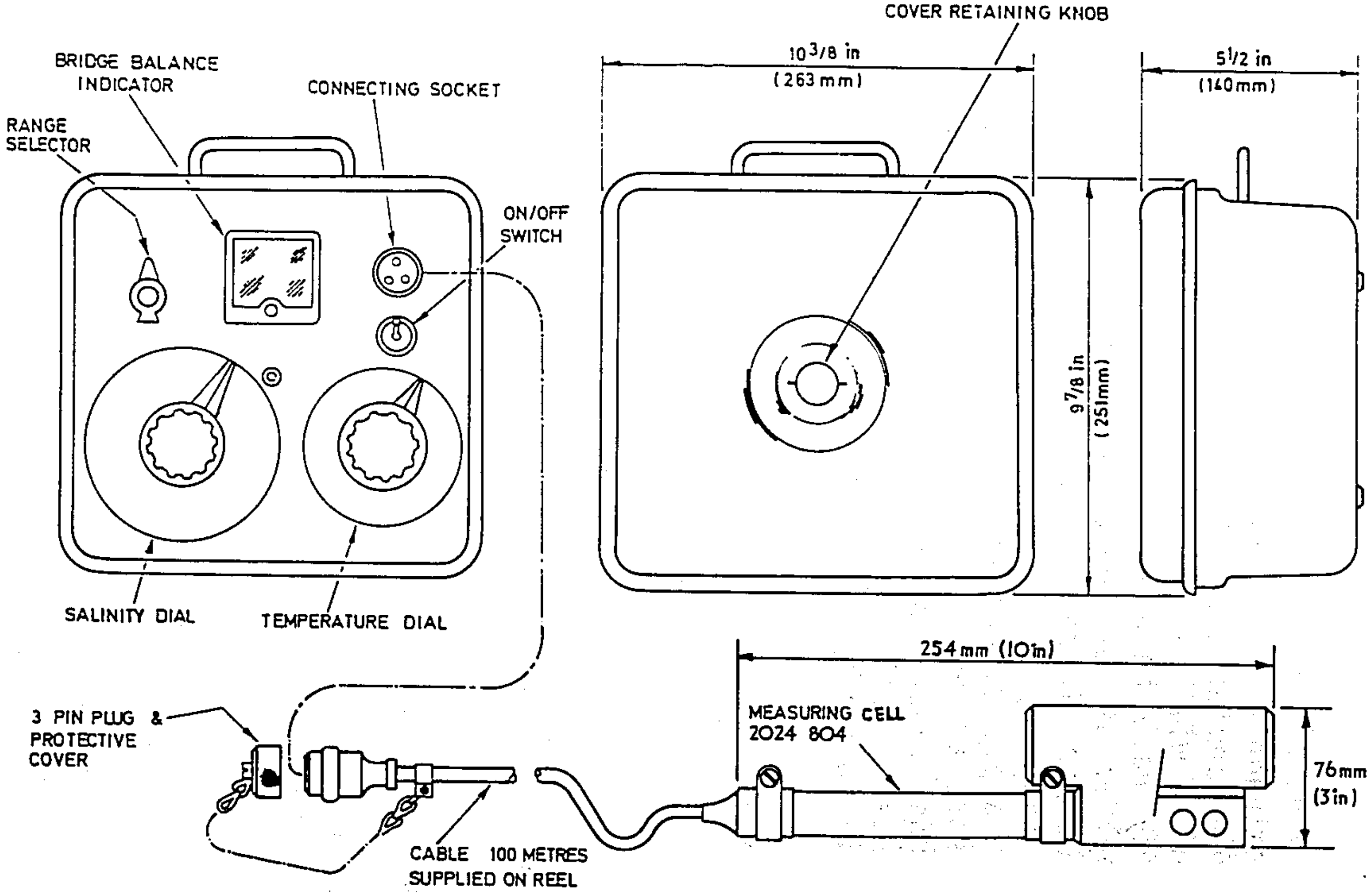
Providing that this guarantee:

i) does not apply to damage sustained in transit, and
ii) shall cease to have effect if the goods have been used for a purpose other than those for which they are intended or not in accordance with the Company's instructions, or if any seal has been removed, broken or tampered with, or if the Company's trade mark or serial number has been removed, defaced or altered.

iii) does not apply to goods which are not of the Company's manufacture but in respect of such goods a guarantee will be given limited to any guarantee which may have been received by the Company from the supplier of such goods but not so as to impose on the Company in respect of such goods a liability greater than any accepted herein.

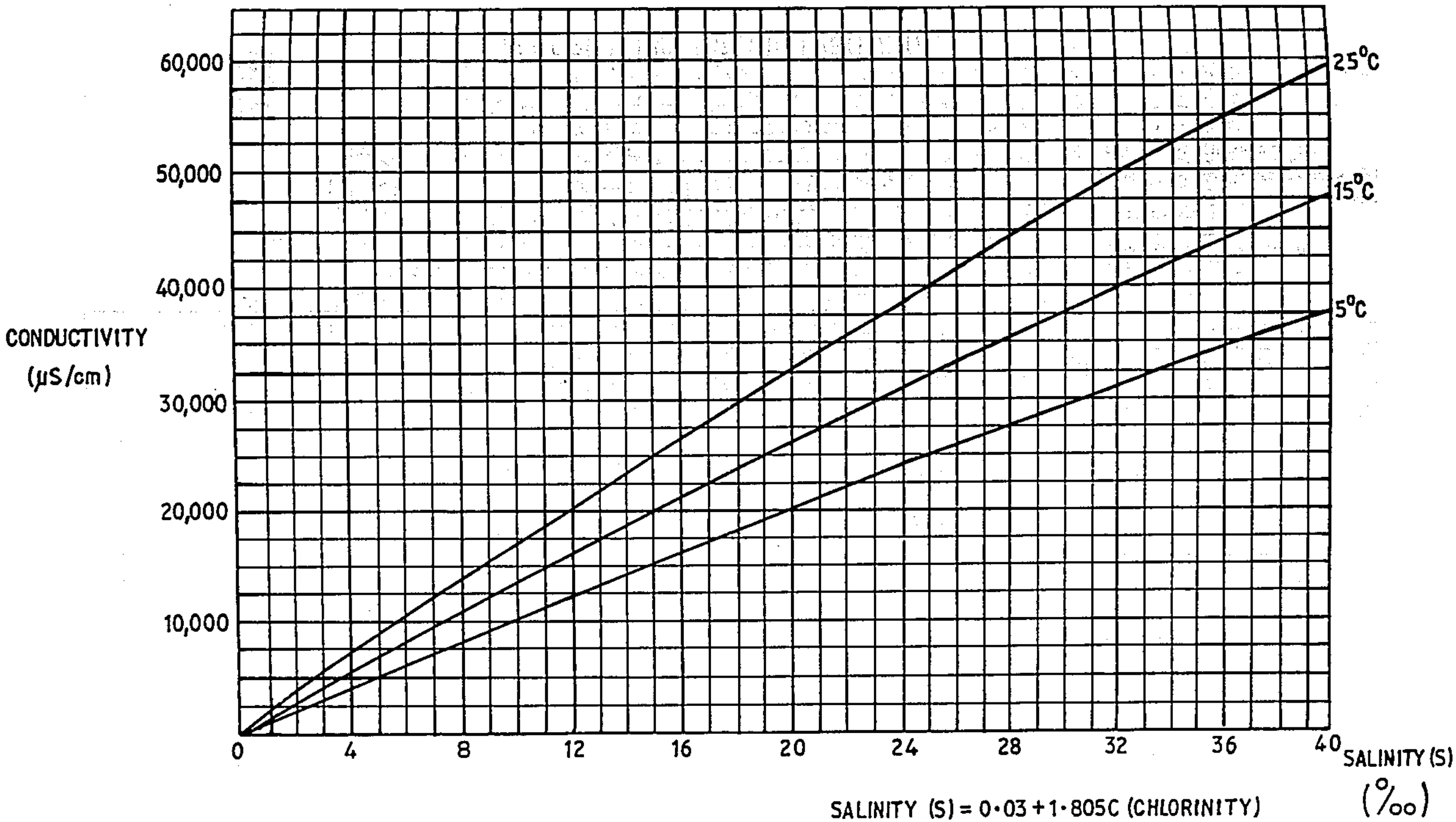
iv) does not apply to Analytical Instruments electrodes and sensors as the Company has no control over the conditions under which they are used, although complaints concerning their performance will be carefully investigated.

GS/7



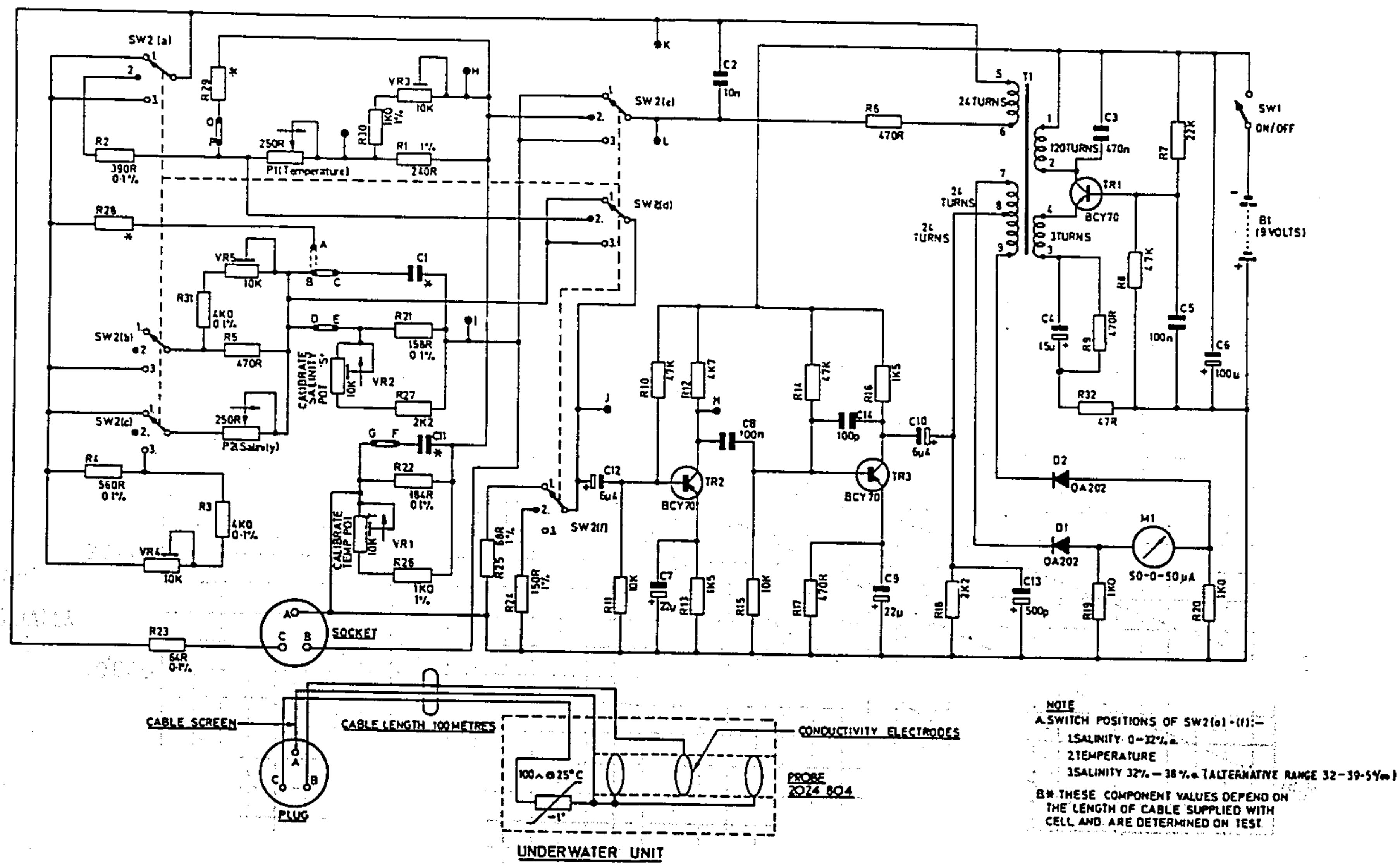
Model 5005 Overall Dimensions

Fig.1



Model 5005
Conversion Graph for Salinity to Conductivity

Fig. 2



Model 5005 Circuit Diagram

Fig. 3

Service Organisation

London Service Centre
Chaseside Works, Chelmsford Road
Southgate N14 4JW
Tel: 01-882 3737

Bristol Service Centre

IMPORTANT NOTE.

The Birmingham and Bristol service centre facilities have now been transferred to a new centre at the following address:

Kent Industrial Measurements Ltd, Oldends Lane, Stonehouse, Gloucestershire, England. GL10 3TA

Tel: (045 382) 8882 Tlx: 43127 KENTFP G Fax: (045 382) 6358

Tel: 021-643 4114 or 021-643 6783

Manchester Service Centre
Lord Street, Manchester M3 1HL
Tel: 061-832 5391

Newcastle Service Centre
10 Hannington Street, Newcastle-upon-Tyne NE6 1JT
Tel: 091-2656126

Falkirk Service Centre
Tamfourhill Industrial Estate
Tamfourhill, Falkirk FK1 4RT
Tel: (0324) 34110

Factory Repair of KIM Instruments:-

LONDON SERVICE CENTRE
at address shown above

BBC
BROWN BOVERI

Kent Industrial Measurements Limited

Howard Road Eaton Socon
St Neots Huntingdon
Cambridgeshire England PE19 3EU
Telephone Huntingdon (0480) 75321
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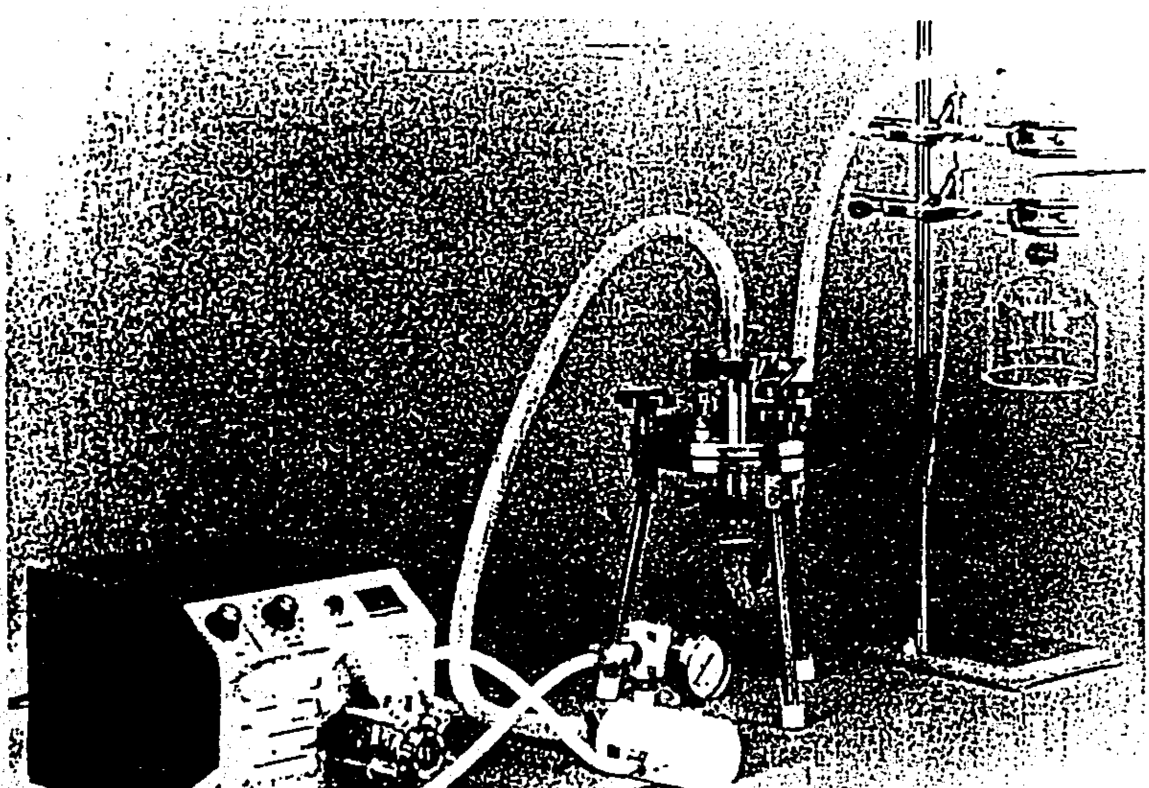
Telecopier Huntingdon (0480) 217948 (Group 2/3)

PRINTED IN ENGLAND

APPENDIX 4

INSTRUCTION MANUAL
OF
VARIABLE SPEED TUBING PUMP

Table of Contents



Typical filtration application using Millipore Variable Speed Tubing Pump, 1680ml/min Pump Head, 5-Way Manifold and Bypass Valve.

Cat No OM052 Printed in U.S.A.

Description

The Millipore Variable Speed Tubing Pump provides a pressure or vacuum driving force for liquids and gases. The fluid being pumped passes through the tubing only and is never exposed to any other parts of the mechanism.

The pump drive is completely self-priming and consists of an aluminum chassis and an epoxy-enameled steel casing. The drive is available in both a 115V AC, 50-60Hz and a 230V AC, 50-60 Hz configuration. A controller fuse in the rear of the unit prevents overload of the solid state electronic circuits.

The drive can be used with either the 480ml/min or the 1680ml/min polycarbonate pump head. When the 1680ml/min pump head is selected, a companion add-on head may be used to double the pumping capacity. The pumping speed is continuously variable from 30-600 RPM.

Operation and Maintenance

General Instructions

Install pump head(s) and tubing on the pump drive and connect the power cord to a grounded 3 conductor AC outlet. Adjust the speed control knob to the desired pumping speed.

NOTE: Control knob graduations are not calibrated but express relative speeds only.

Direction of flow may be changed with the rotation selector switch.

NOTE: Always stop the pump before reversing flow direction to avoid damaging pump drive control circuits.

Pump drive control circuits are protected against overload by a 1.5 ampere fuse found in the receptacle on the rear pump panel. If fuse blows, always replace with fuse of the same amperage. Use of a fuse with higher rating risks damage to control circuits.

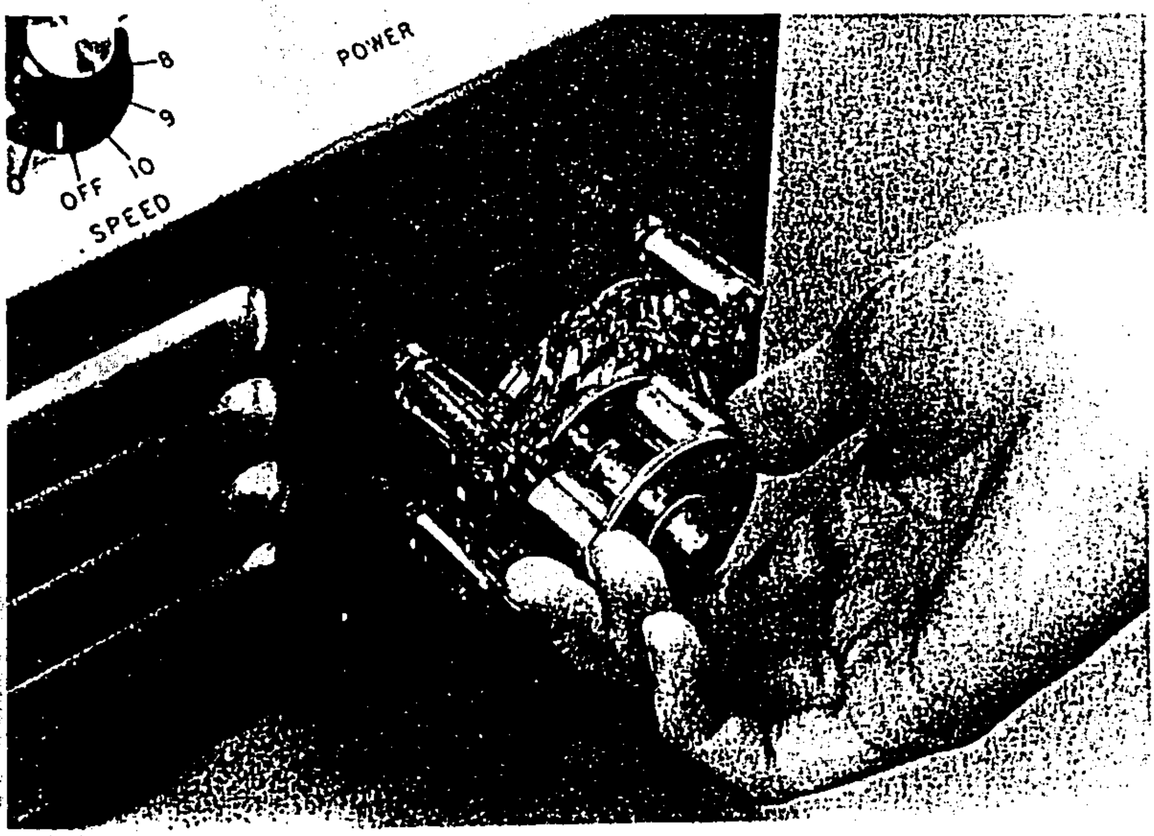


Fig. 1

Installation of Pump Head

1. Align either half of the plastic pump head with the two pins on the front pump drive panel. Secure in position with the two screws provided by placing screws in diagonally opposed recessed holes. Tighten screws snugly but do not over-tighten as this may damage pump head. Install the longer end of the rotor assembly shaft in the pump head bearing. Mate the shaft cross slot with the pump drive shear pin by rotating and gently exerting pressure (Fig. 1). Assembly is fully mated when it is firmly seated within the pump head bearing.

2. Rotate the assembly to position one of the rollers between the tubing recesses in the head. Partially unseat assembly, maintaining proper alignment by steadying with one hand. Position tubing around rollers and pull up to flatten (Fig. 2).

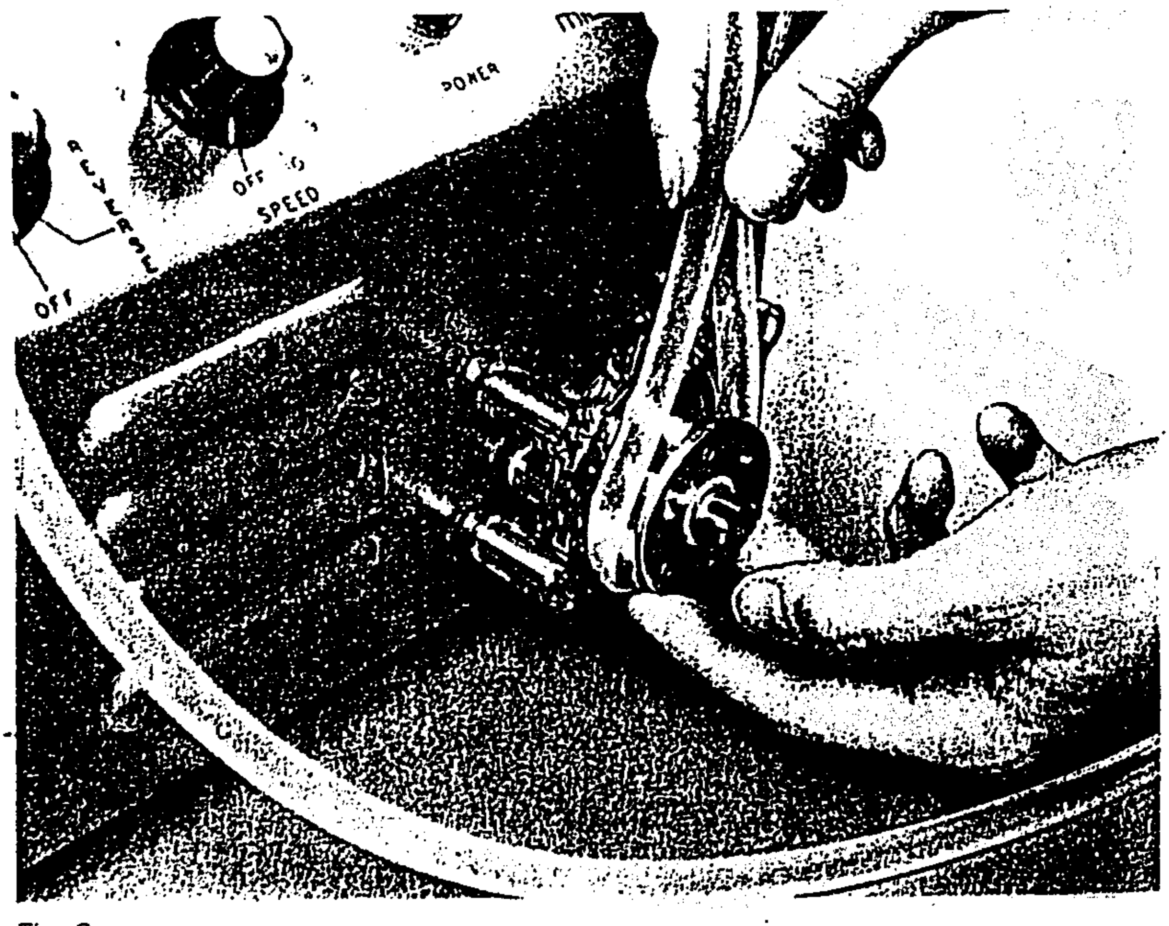


Fig. 2

Gently work tubing and rotor assembly into pump head bearing.

NOTE: Do not use hard or sharp objects such as screwdrivers to seat tubing.

3. Hold the free ends of tubing in the inlet and outlet recesses of the housing. While exerting tension on the tubing, attach the remaining half of the pump head (Fig. 3).

NOTE: Failure to maintain tension on tubing may result in improper seating of rotor assembly, and damage to the drive unit during operation.

4. To make certain that tubing and rotor assembly are secure within the pump head housing, rotate the assembly with a screwdriver while holding onto the housing (Fig. 4). No gap should remain between the housing halves and no binding between tubing and rollers should occur.

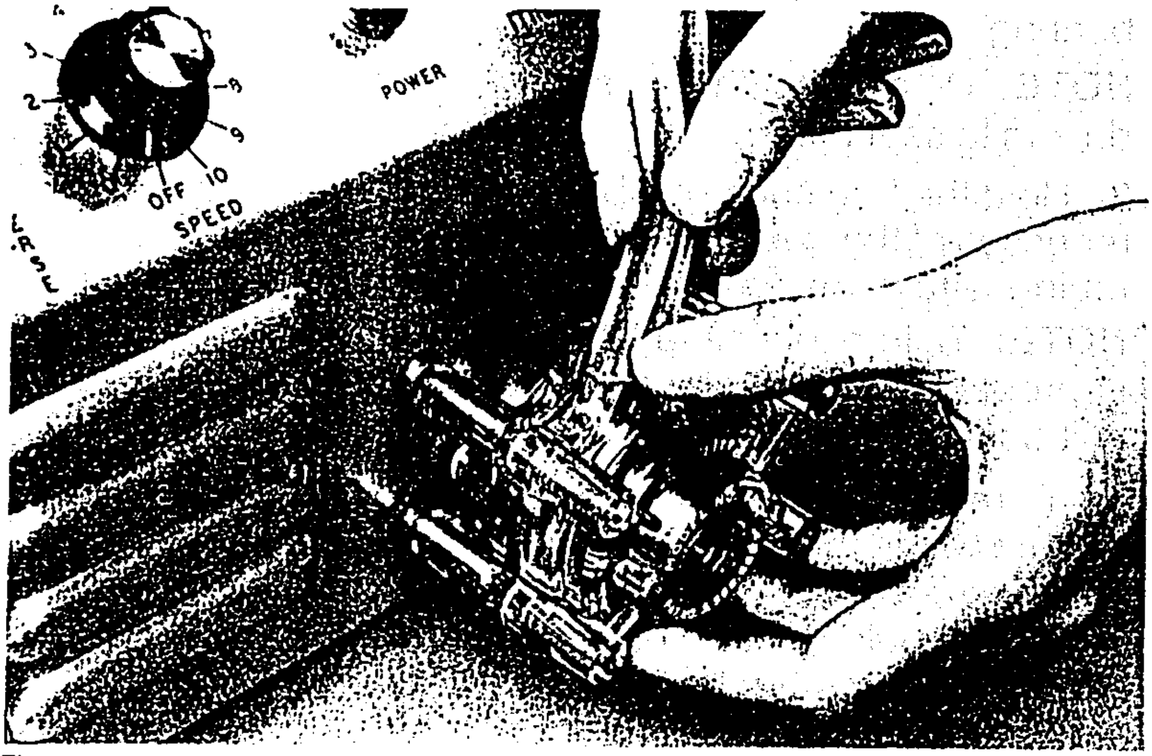


Fig. 3

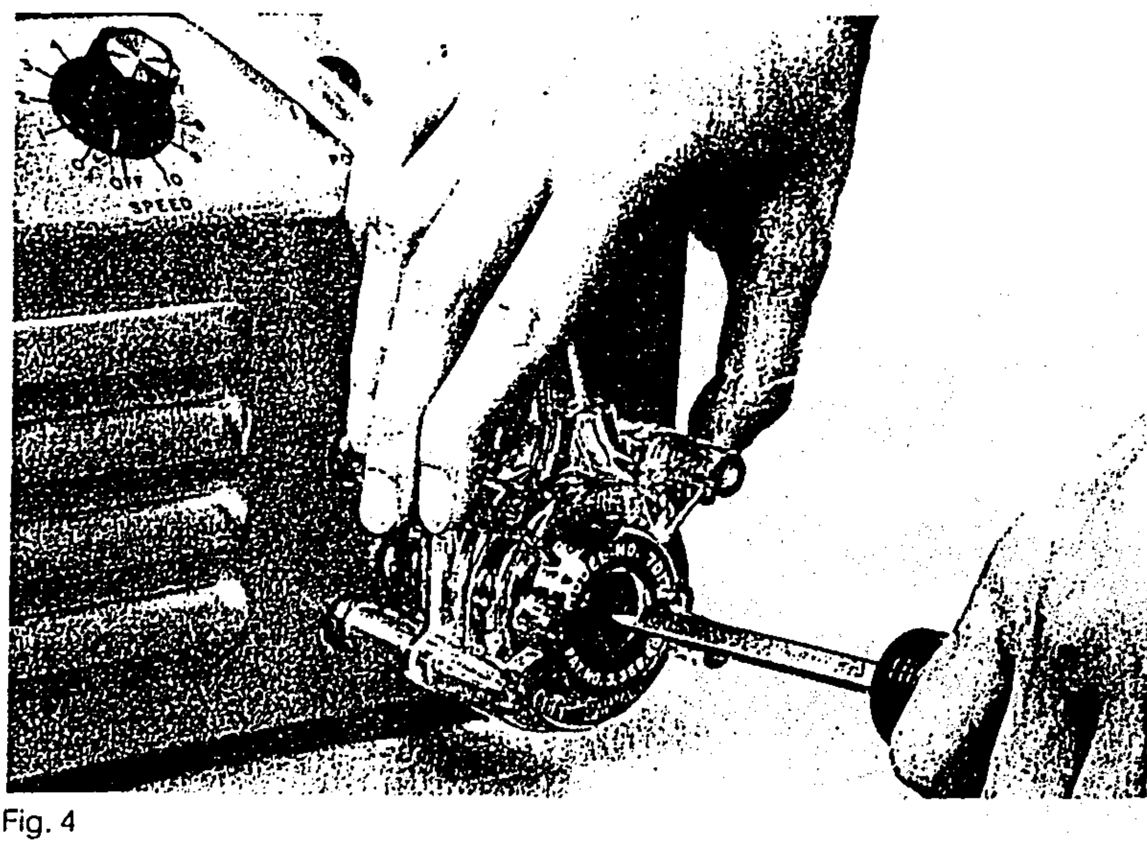


Fig. 4

5. Use the two thumbscrews and washers to attach the assembled pump head to the drive unit (Fig. 5). Screws should be threaded into mounting holes opposite from those used previously.

Installation of Add-On Pump Head

1. Thread four long studs into the mounting holes on the front panel of the pump drive. Slip half of the standard pump head housing onto the studs. Install the rotor assembly and tubing in the same manner as described in steps 1-4 of *Installation of Pump Head* instructions (Fig. 6).

2. Repeat installation procedures for add-on pump head and tubing. Make sure that no gaps exist between any housing sections and that rotor assemblies and tubing are properly sealed. Install four wing nuts on mounting studs and tighten with finger pressure only (Fig. 7).

NOTE: Excessive torque on wing nuts may cause distortion or cracking of heads.

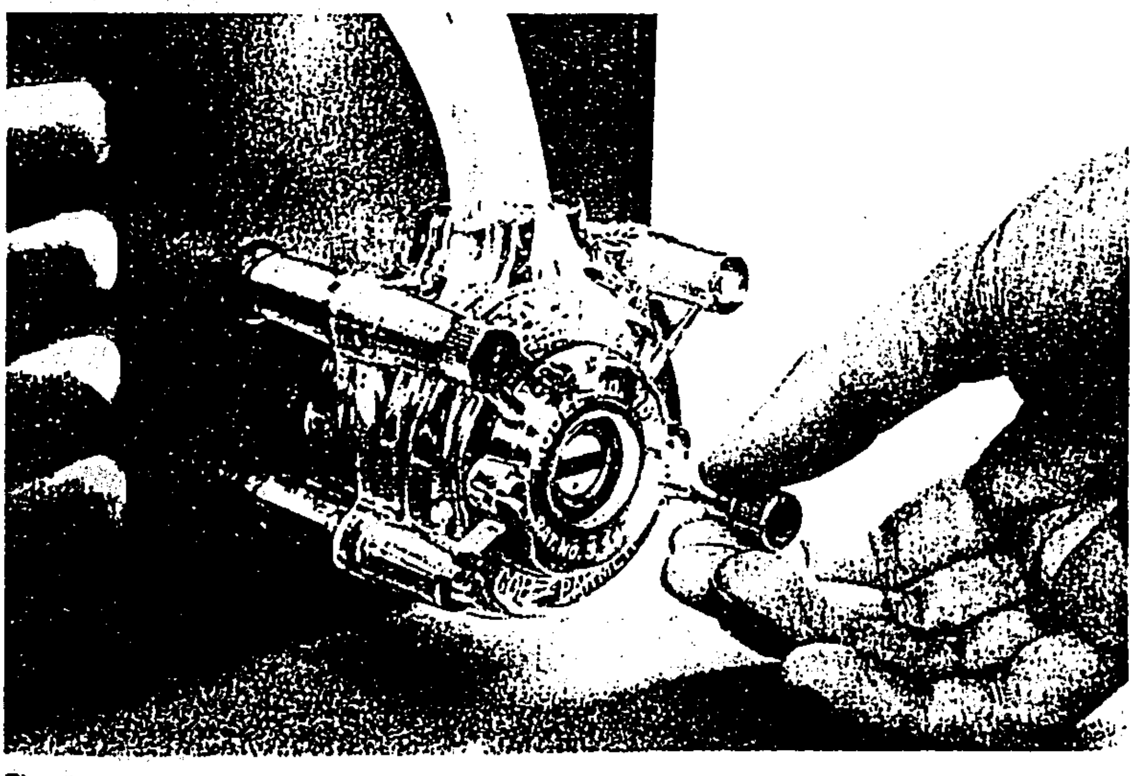


Fig. 5

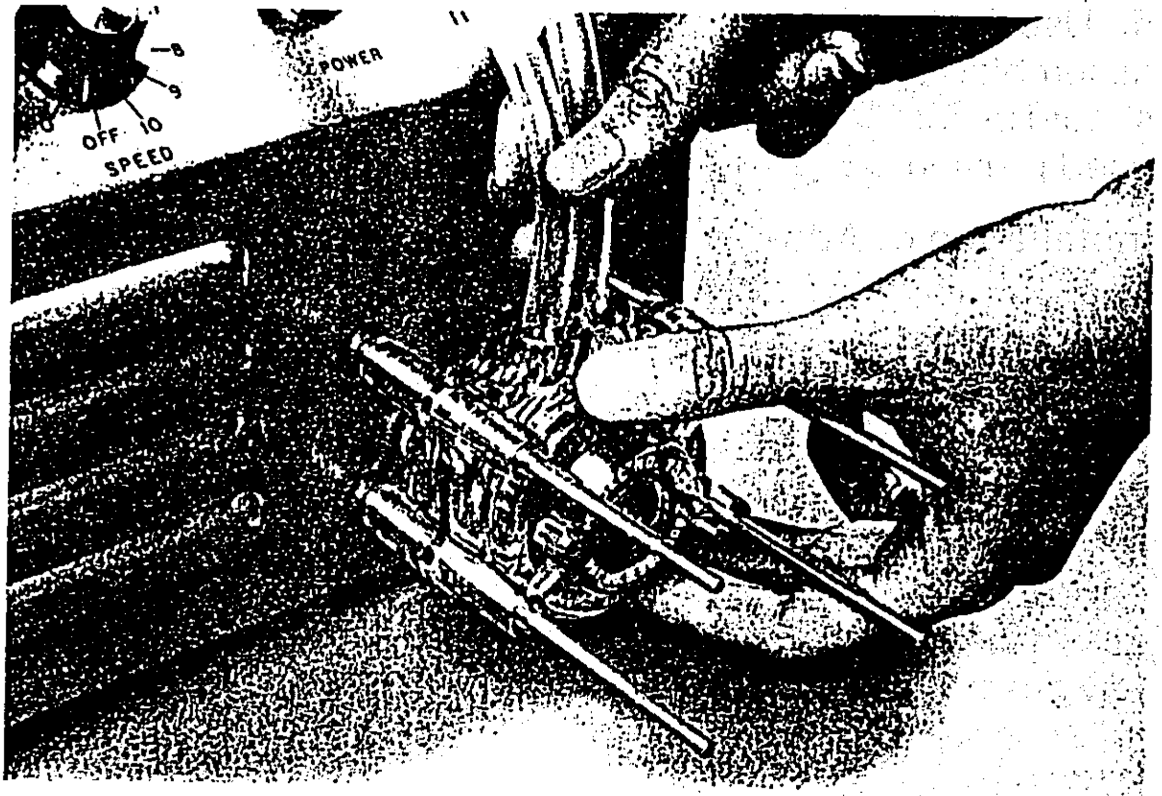


Fig. 6

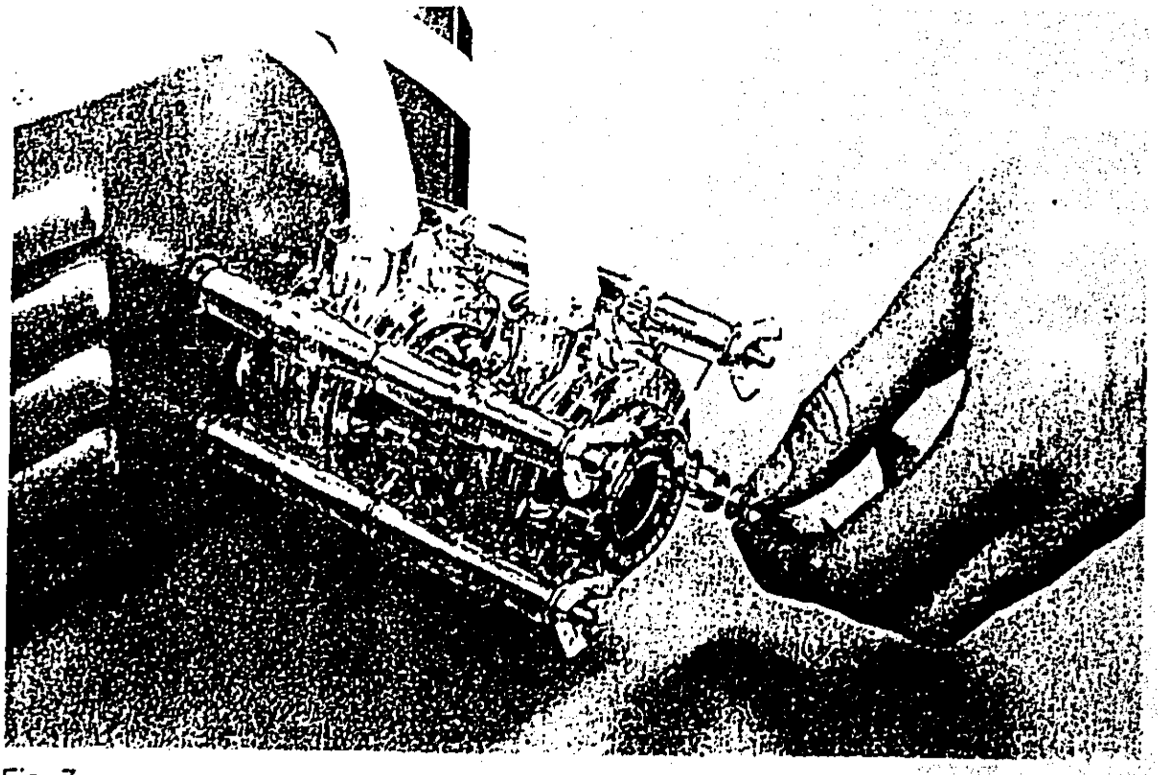


Fig. 7

Tubing Life

Tubing wear or fatigue is normal and should be anticipated to assure pumping efficiency and prevent tubing rupture. Tubing should frequently be repositioned to allow unused portions to come in contact with pump rollers.

The medical grade silicone tubing supplied with the Millipore pump is autoclavable. During normal operation, tubing life can be expected to be 150 hours or more at 550 RPM and 450 hours or greater at 200 RPM. To maximize tubing life and prevent damage to the pump drive, only precision grade tubing as specified on page 14 should be used.

Silicone tubing is recommended for use with aqueous solutions only and should not be exposed to strong acids or bases.

Use of 5-Way Manifold and Bypass Valve

The Millipore 5-Way Manifold and Bypass Valve are intended for use with the Millipore Variable Speed Tubing Pump in filtration applications where downstream fluid flow is intermittently restricted. The bypass valve prevents excessive pressure buildup that can damage pump and tubing or cause fluid surging when flow is resumed.

1. Install the pressure gauge, nipple, bypass valve, and threaded fittings in the polypropylene manifold (Fig. 8). Take care to wrap each threaded fitting with 2-3 turns of Teflon® thread tape to assure a proper seal. Avoid cross threading of parts as plastic may be damaged. If only a single pump head is used, seal one ¼" NPTF fitting with the ¼" NPTM plug provided.

2. Attach a length of tubing to the bypass valve outlet to direct unfiltered fluid back into reservoir.

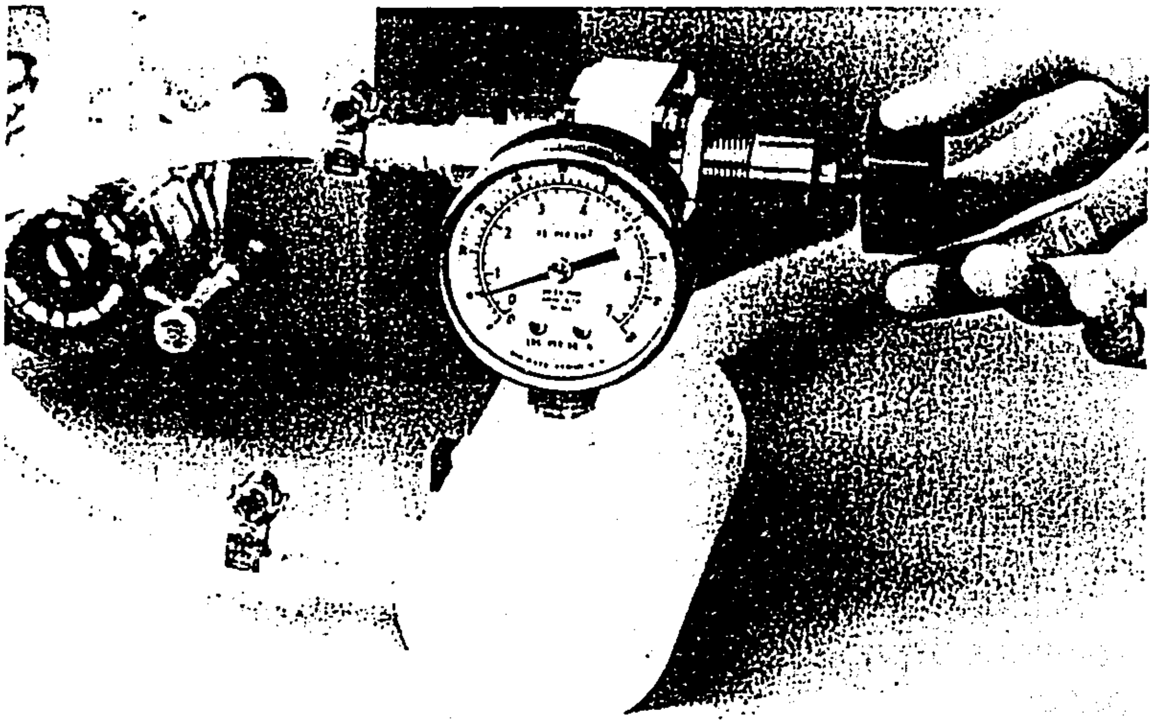


Fig. 8

3. Before starting the pump, turn the bypass valve adjustment knob counterclockwise until no resistance to rotation is detected. Start the pump. Clamp the outlet tubing between the manifold and filter holder and turn the adjustment knob clockwise until the gauge registers the desired filtration pressure (usually 5-10 psi).

4. Unclamp the outlet tubing and proceed with filtration. Flow will be directed through the filter holder as long as the filter back pressure does not exceed pressure setting of the bypass valve.

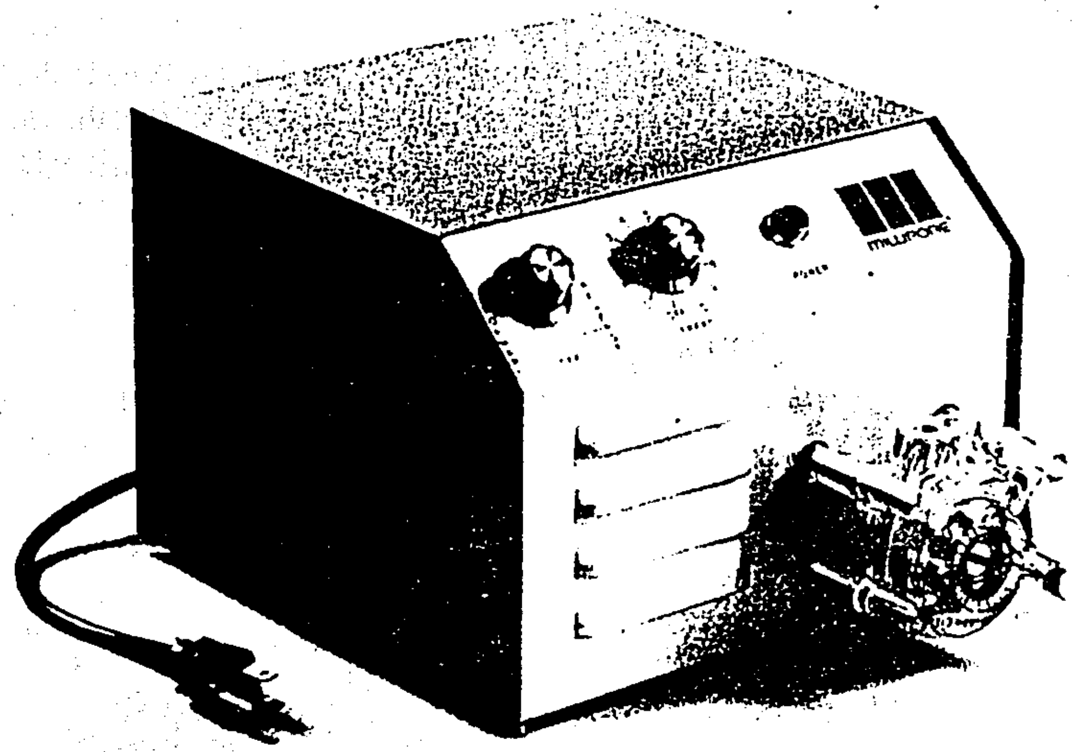
5. When flow is stopped, i.e., when downstream tubing is clamped or filter clogs, the bypass valve will open and flow will be directed back into reservoir.

Maintenance

When operated according to instructions, the Millipore Variable Speed Tubing Pump will provide long life and maintenance-free performance.

To assure efficient operation, make certain air vents on pump drive front and rear panels are never blocked. Adequate air flow prevents overheating of pump drive unit.

If tubing failure should occur, do not allow solution (especially saline) to remain in contact with rotor assembly or roller bearings. Remove assembly, clean with purified water, and dry thoroughly.



Catalogue Information

Variable Speed Tubing Pump 115V, 50-60 Hz
XX80 000 00
Variable Speed Tubing Pump 230V, 50-60 Hz
XX80 002 30

Function

AC powered Peristaltic pump for gases or liquids for pressure (to 20 psi) or vacuum applications. Requires, in addition, either 480ml/min or 1680ml/min pump head (see below). The drive has solid state electronic circuits. A constant speed fan provides efficient cooling of the drive housing at all pumping speeds.

Operation

Flow direction and power/speed are regulated by two control knobs on pump drive front panel. Pump speed is continuously variable from 30-600 RPM. Current flow is indicated by red pilot light on front panel.

Materials

Aluminum chassis and epoxy-coated steel casing.

Connections

Three conductor grounding power cord.

Dimensions

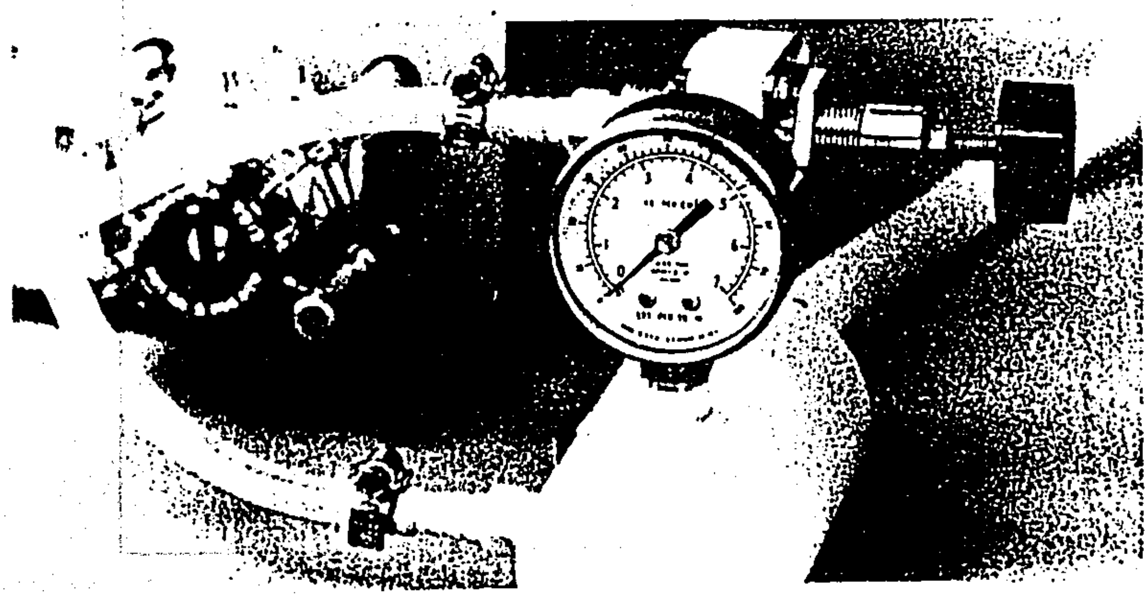
6¾″ x 9¼″ x 9¼″.

Weight

Approximately 15 lbs.

Pump Accessories	Cat. No.
Tubing Pump Head, 480ml/min polycarbonate	XX80 000 03
Tubing Pump Head, 1680ml/min polycarbonate	XX80 000 05
Add-on Pump Head, 1680ml/min polycarbonate	XX80 .000 15
Precision Grade Tubing, silicone ⅛" I.D., 25 ft., for 480ml/min head	XX80 000 23
Precision Grade Tubing, silicone ¼" I.D., 25 ft., for 1680ml/min head	XX80 000 25

Additional Accessories	Cat. No.
Manifold, polypropylene	XX67 001 30
Adjustable Bypass Valve, 5-20 psi	XX67 000 20
Pressure Gauge with Snubber, stainless steel, 0-100 psi	YY13 010 20
Hose Clamps, ½" (4/pk)	XX67 001 33
Teflon® Thread Tape, ½" x 260"	TP00 013 26
Filling Bell, 70mm diameter	XX67 001 32
Hemostat, stainless steel	XX67 001 31
Medical Grade Tubing, ¼" I.D. 10 ft.	XX67 000 37
Medical Grade Tubing, ½" I.D. 10 ft.	XX67· 000 37



To Place An Order or Obtain Technical Assistance

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In Massachusetts,
dial 617-275-9200

Wire — Telex 92-3457
TWX 710-326-1938

Write — Millipore Corporation
Bedford, Massachusetts
01730

In other countries, consult the back cover for the Millipore office nearest you.

APPENDIX 5

INSTRUCTION MANUAL
OF
FUESS TYPE TIDE GAUGE
(MODEL: LFT-Ⅲ AND V)

KYOWA SHOKO CO., LTD

TOKYO

C O N T E N T S

INSTRUCTION MANUAL OF FUESS TYPE TIDE GAUGE
(MODEL: LFT - V and LFT - 111)

1. General

This tide gauge records accurately the actual changes of tides in a reduced scale, through a gearing mechanism, by taking out the rise-and-fall movement of a float according to the tidal changes as a rotating movement of a pulley by means of a wire suspending the float. Since the recording mechanism is driven by quartz crystal clock with holding high accuracy for both time and paper feeding. A time mark can be drawn on the recording paper by using a quartz crystal timer for Model LFT-V only, which makes it possible to check accurately the recorder paper feeding speed.

2. Specifications

(1) Tide Gauge

Measuring range	....	3.5 meters or 7 meters
Scale	....	1/10 or 1/20
Paper speed	....	20 mm/hour
Recording paper	....	375 mm in width, 20 m in length
Driving clock	....	Electric winding type dc 6 v
Dry cells	....	UM - 1 or D, c
Diameter of float	....	300 mmø, 180 mm in height
Steel tape	....	10 meters (stainless)
Dimention	....	470 x 570 x 380 mm
Recording accuracy	....	3/1,000 of the full scale

(2) Quartz Crystal Timer for model LFT-V

Accuracy: Within ± seconds per month on the average (15 - 25°C)

Output signal: One time mark/every one to 99 hours (at every one hour selectable). Time mark will appear at the selected time on paper. For example, if set the time mark as one hour at the regular time intervals, time marker will draw a mark at every just time.

Ambient condition for operation: Temperature ..... -15°C to +50°C

Humidity ..... 20 % to 90 %

Power supply: dc 1.5 v for clock module, dc 6 v for time marker device

Vibration proof: 10 Hz to 30 Hz. No cessation at the vibration of 1.5 G

Others: Ceases its operation if electrical supply is suspended for more than one second.

3. Composition

The gauge consists of the following parts:

(1) Recorder part

Main body (recording unit)	....	1 set
Steel tape with surface checker	....	1 set
Float (300 mm ø)	....	1 pc.
Float wire (stainless 1.8 mmø x 9 meters)	....	1 roll
Counter weight (large)	....	1 pc.
Counter weight wire (stainless 1.8ø x 2 m)	....	1 roll
Backlash removal weight (small)	....	1 pc.
Backlash removal weight rope (eslon 1ø x 1 m)	....	1 roll

(2) Accessories

Recording ink (capacity 50 cc.)	....	1 bottle
Nylon tube (30 cm)	....	1 roll
Recording paper	....	1 roll
Tweezers	....	1 pair
Screw driver (large)	....	1 pc.
Winding rod	....	1 pc.

4. Names of Main Parts of L F T

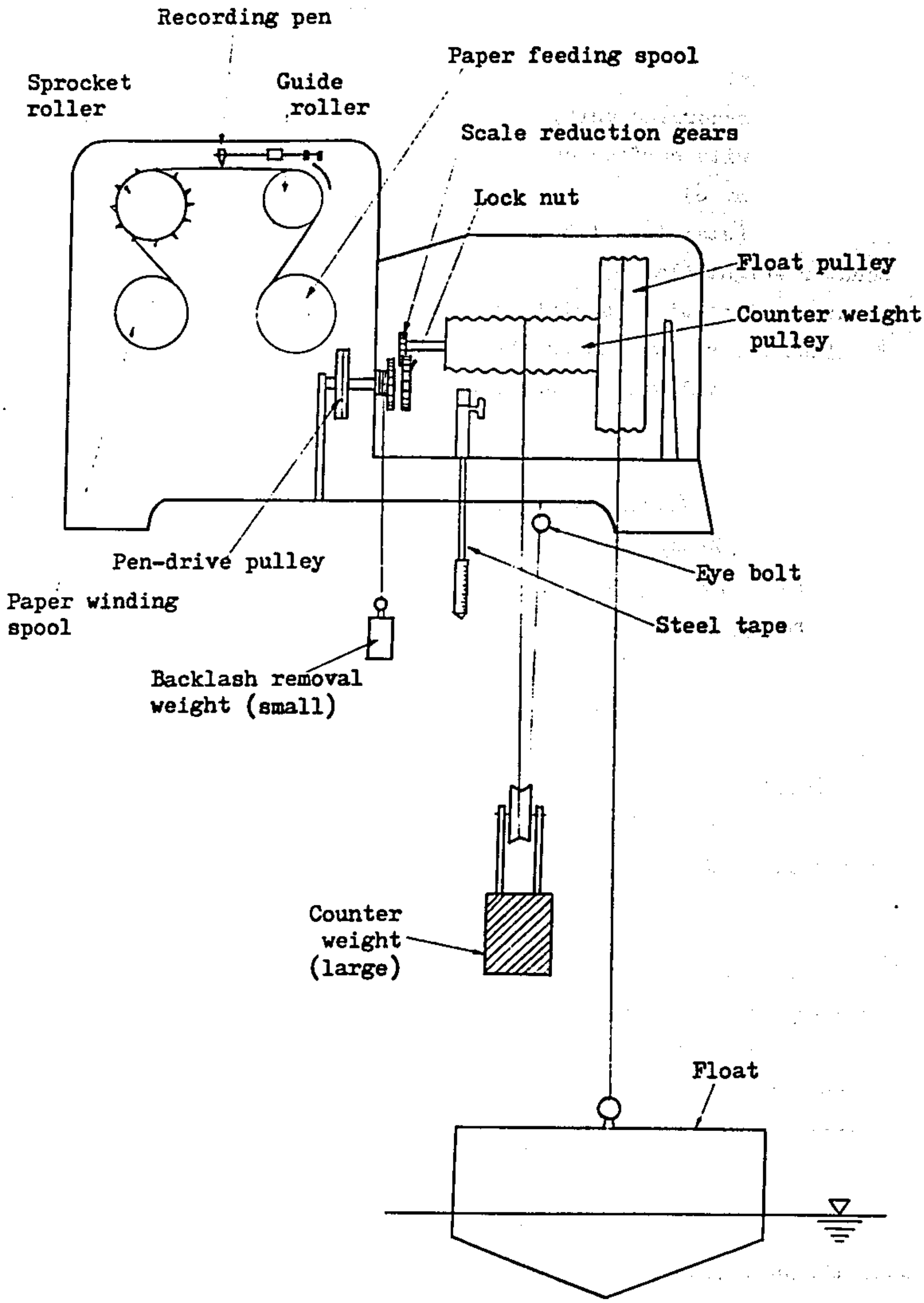
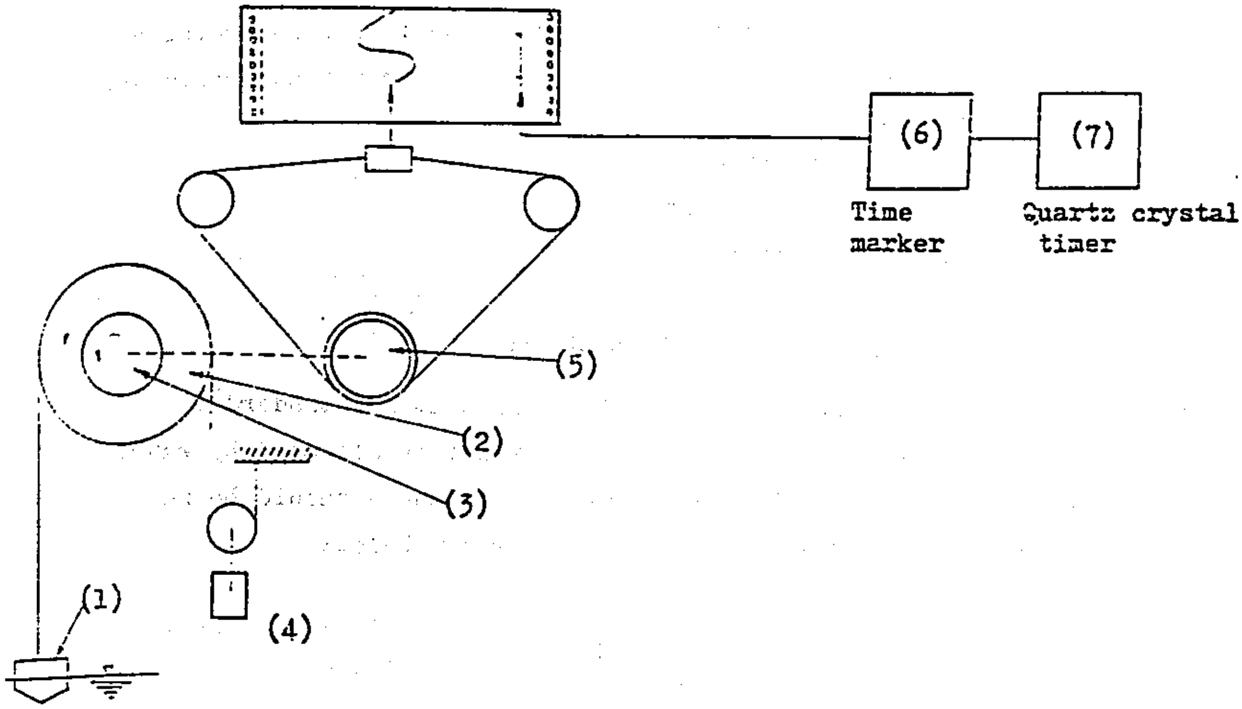


Fig. 1 Names of main parts of LFT (side view)

5. Outline of Operation



The float wire which leads from the float (1) on the surface of the water is wound around the float pulley (2) to which the end of the wire is secured. Another wire is wound around the counterweight pulley (3) which is on the same axle with the float pulley, and its end is secured to the bottom of the base via the counterweight pulley (4). Thus, the rise-and-fall movement of the float caused by the changes of the water level is transferred to the rotation movement of the principal axle without any slipping. The rotation movement is reduced to 1/10 or 1/20 by the reduction gears and transferred to the pen-drive pulley (5). The wire for operating the recording pen is wound around the pen-drive pulley (5) and tied to the pen-holder by way of small pulleys on the both sides of the recording paper feeding mechanism. It is possible to move the pen-holder to any desired position, since the gears to the pen-drive pulley can be made running idle by loosening the lock nut. A syphon pen is used for recording, and the recording ink bottle contains a sufficient quantity of ink which lasts for one month's recording.

The crystal quartz timer (7) lets the time marker (6) operate at the regulated hours to record the accurate time mark on the recording paper.

6. Installation

The order of construction and installation is as follows:

1. Installation of a tide well and a frame stand
2. Installation of the main unit
3. Setting of the reduction ratio
4. Separation of the float pulley axle and pen-drive pulley axle

5. Installation of wire to the counterweight pulley
6. Installation of wire to the float pulley
7. Installation of the counterweight
8. Installation of the float
9. Removal of backlash
10. Mounting of the recording paper
11. Determination of the pen position
12. Filling or supplementing of ink
13. Setting and adjusting of the time

6-1. Installation of the Tide Well and Frame Stand

The inner diameter of the tide well should be 1,000 mm ϕ (standard). Attention should be paid to the pipe so that it may not be affected by waves around the well. Caution should also be exercised that there should be no springing water in the site. The frame stand is as shown below:

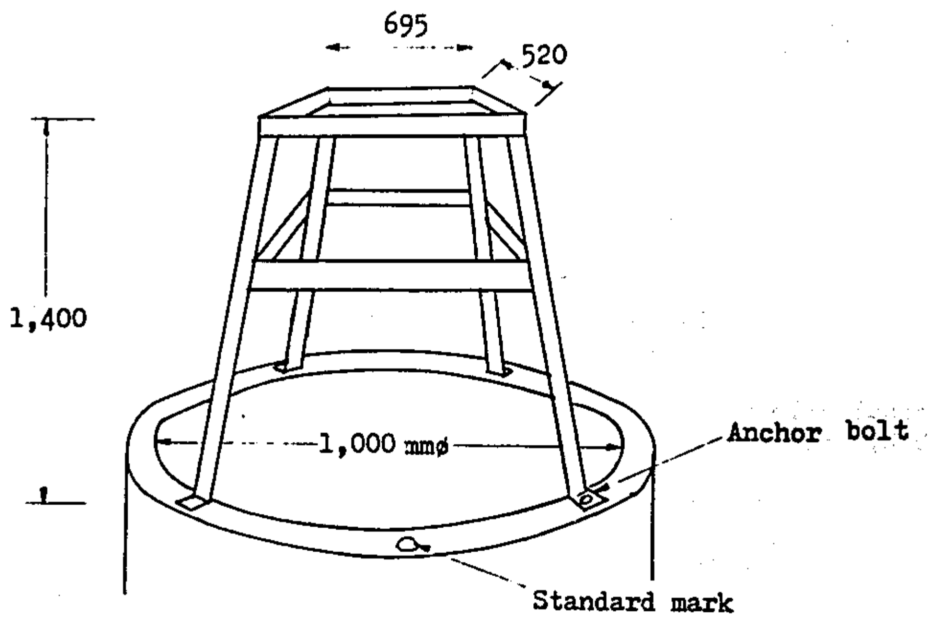


Fig. 2. Installation of frame stand

6-2. Installation of the Main Unit

The main unit of the tide gauge should be placed horizontally on the frame stand. In case if it is inclined, insert spacers such as wooden wedges or lead plates between the frame stand and the base of the unit to place it horizontally. Use a level to check it.

6-3. Setting of the Reduction Ratio

The reduction ratio can simply be set by loosening the lock nut on the common axle of float pulley and counter weight pulley, and by shifting the reduction pinion.

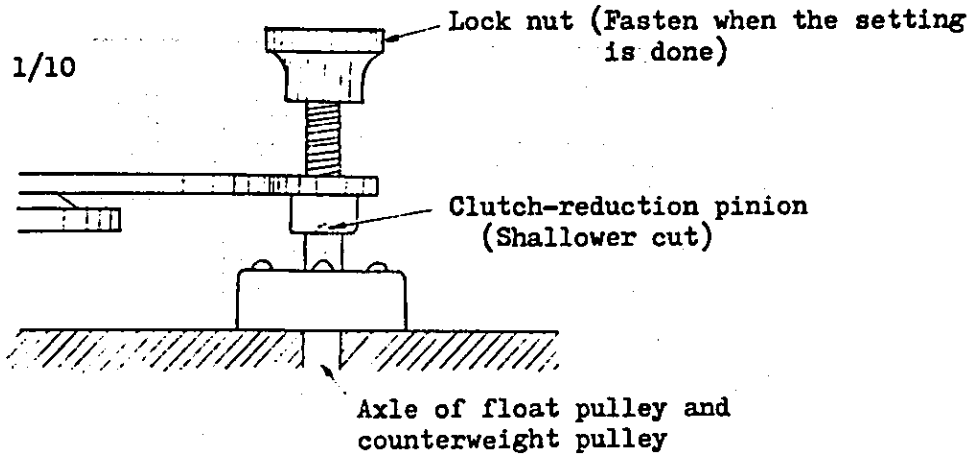


Fig. 3 How to set the reduction ratio - The case of 1/10, measuring range 0 to 3.5 meters.

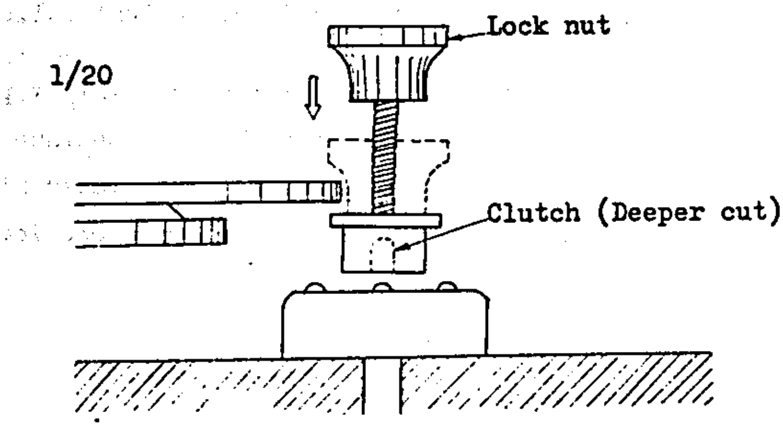


Fig. 4 How to set the reduction ratio - The case of 1/20, measuring range 0 to 7 meters.

6-4. Separation of the Float Pulley Axle and Pen-Drive Pulley Axle

Let the gear between the float pulley axle and the pen-drive pulley axle run idle so that the pen-drive wire may not be damaged by the pen during installation.

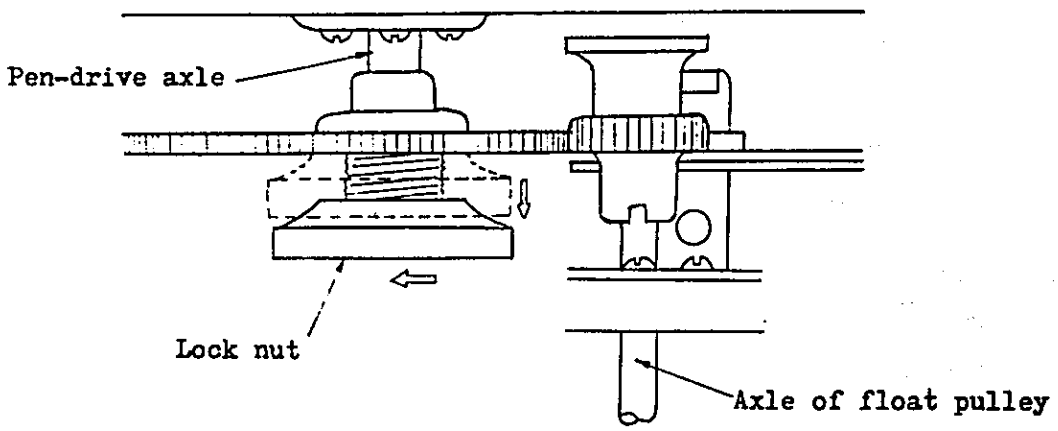


Fig. 5 Separation of float pulley axle and pen-drive pulley axle

6-5. Installation of Counterweight Wire to the Counterweight Pulley

Insert the wire through the small hole of the counterweight pulley, make a knot and pull the knot back into the large hole. (Continued to 6-7 below.)

In case of a new unit, the installation may be facilitated if the wire around the float pulley is temporarily fixed so as not to come loose during assembly.

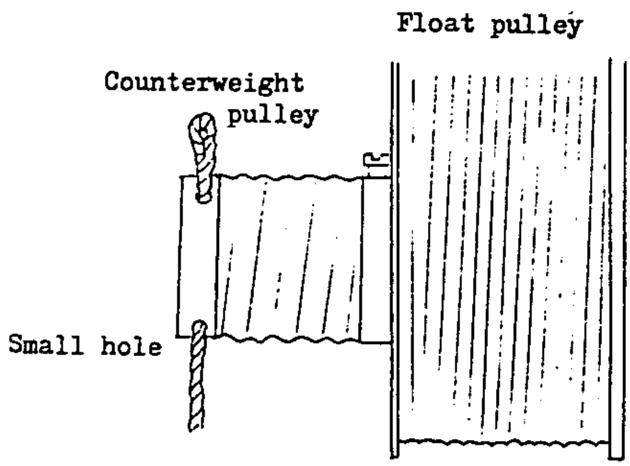


Fig. 6 Installation of wire

6-6. Installation of Wire to the Float Pulley

Insert the end of the wire into the hole from the thread side of the float pulley. Make a knot and pull it back, then wind the wire neatly along the thread.

In case of a new unit, the wire is already installed, so go on to futher operation.

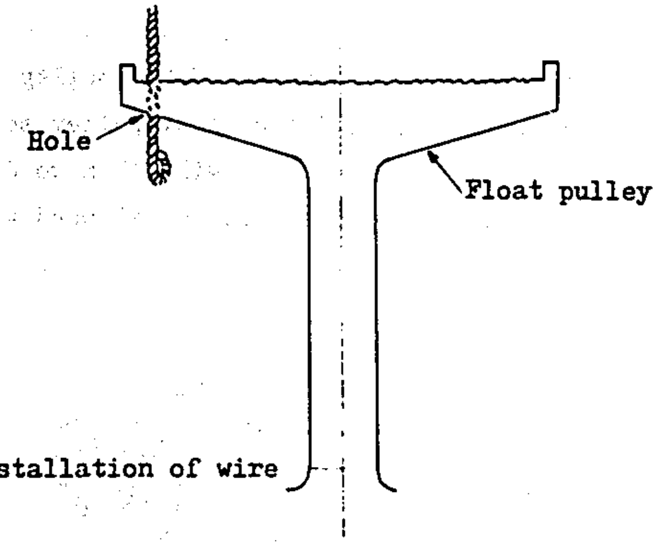


Fig. 7 Installation of wire

6-7. Installation of the Counterweight

The other end of the wire mentioned in 6-5 above is inserted into the counterweight pulley, and then fastened to the eye bolt of the back of the base. Let down the counterweight gently into the well.

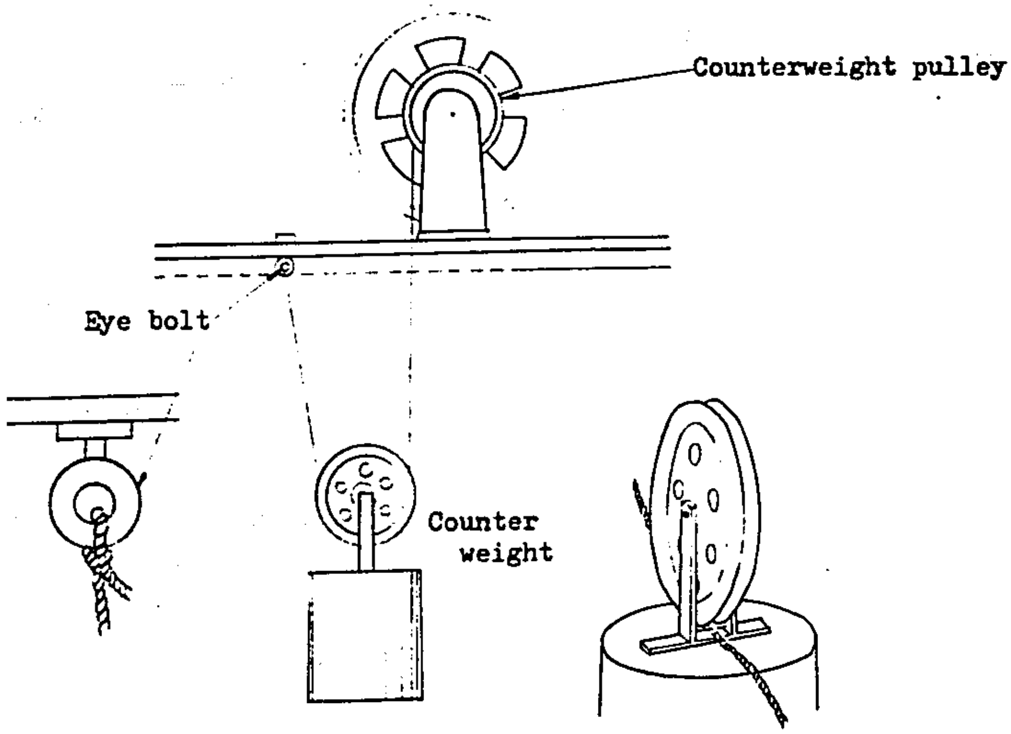


Fig. 8 Installation of counterweight

6-8. Installation of the Float

(1) The float should be filled with dried sand or heavy oil so that two-thirds of the body sinks into the water. Then the float cap should be sealed with packing. When sand is used, make the float well-balanced so that it may be horizontally afloat. Adjust the float cap so that the float may rotates freely.

(2) Lead the other end of the wire wound around the float pulley to the back of the base and tie it to the float cap. Hold the float pulley so that it may not rotate quickly, and loose the brake. The float will then go down to the surface of water and stop at the point where it is balanced with the counter-weight pulley is wound along the groove.

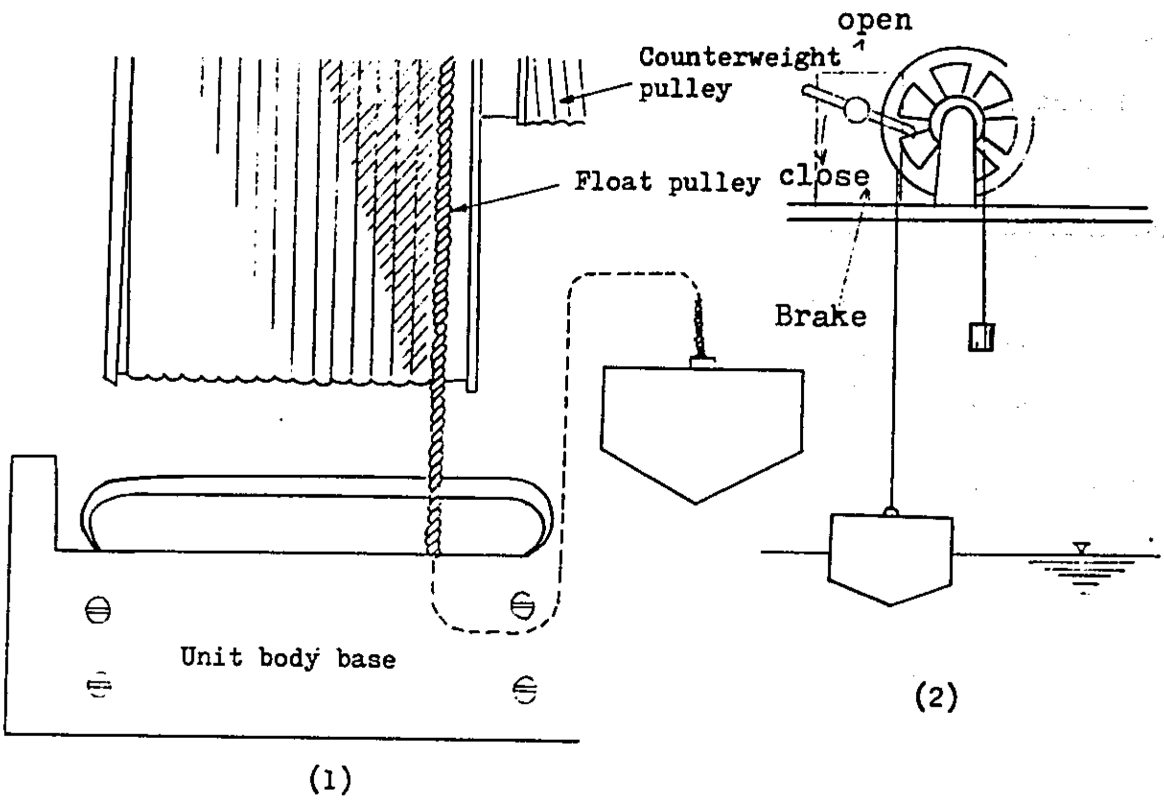


Fig. 9 Installation of float

6-9. Removal of Backlash

A pulley for removal of backlash is fixed to the pen-drive pulley axle in order to remove backlash produced by engaging gears when force is transmitted from the float pulley axle to the pen-drive pulley axle. Tie the wire as shown in Fig. 10. Attach a weight to the other end of the wire. Then adjust the Eslon rope so that it may be wound around the pulley with one turn when the recording pen is roughly centered on the recording paper.

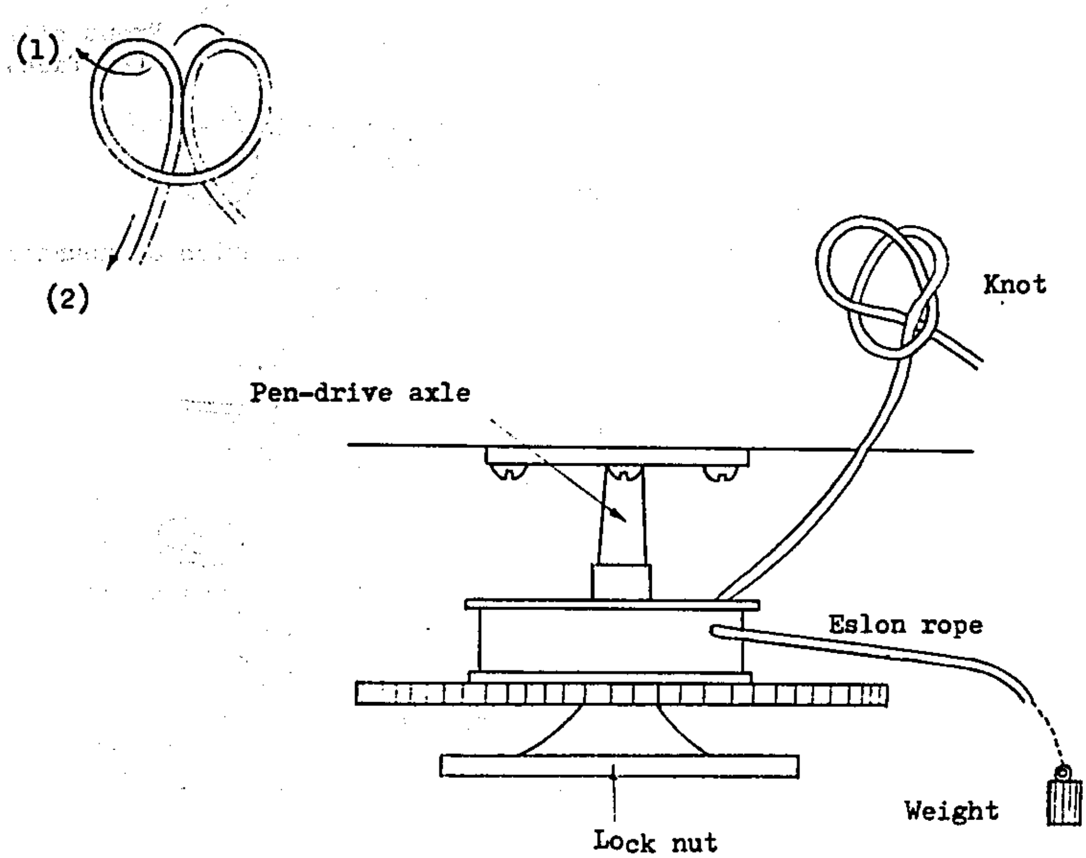


Fig. 10 Installation of weight for removal of backlash

6-10. Mounting of the Recording Paper

(1) Open the acryl plate at the front of the main unit, draw out the paper stock tray and take out the feeding spool (back side). Loosen the lock nut and insert the recording paper into the source bobbin.
Set the lock nut on the right side.

(2) Put the feeding spool mounted with the recording paper into the V-shaped grooves on the both sides of the paper stock tray (see Fig. 11).

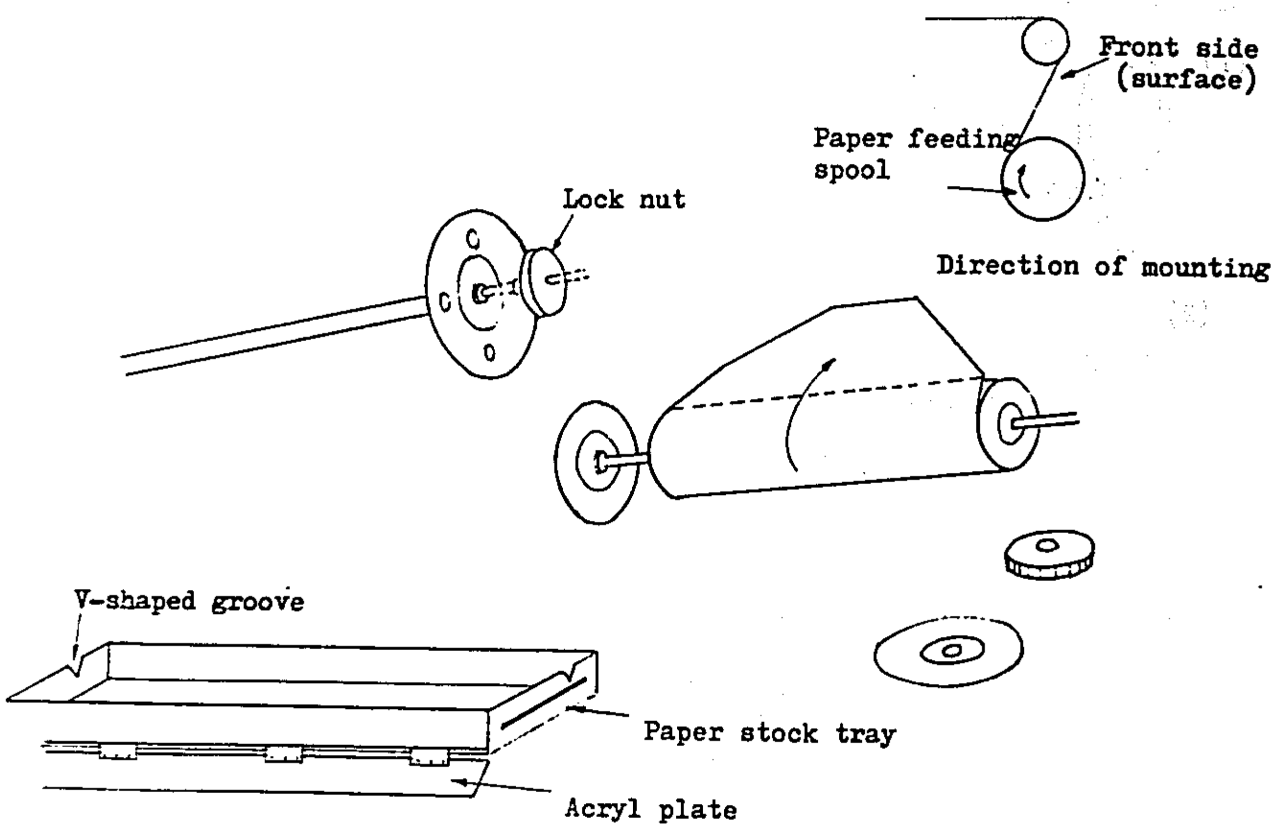


Fig. 11. Mounting of recording paper - 1.

(3) Push back the paper stock tray. Insert the tongue of the recording paper through between the guide plate and the guide roller and further between the pens and the mirror plate (which enables smooth running of the recording paper), and pull it out to the front side of the mirror plate.

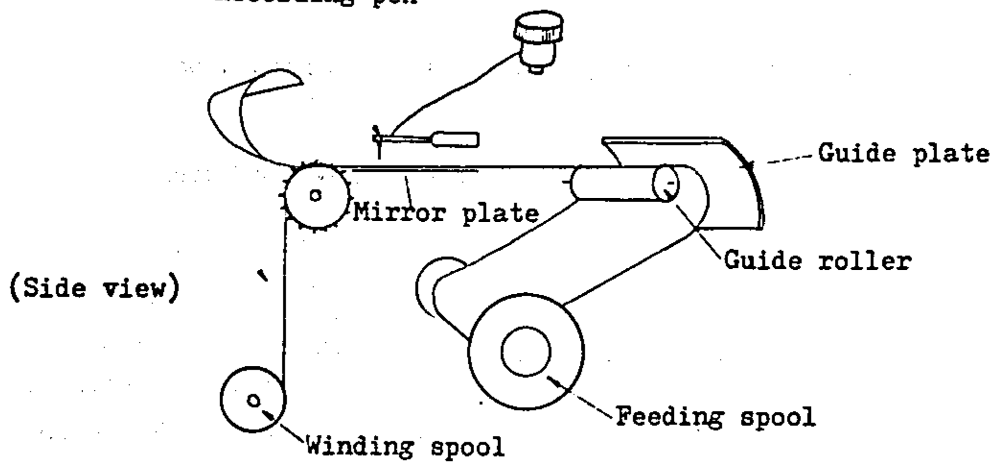


Fig. 12 Mounting of recording paper - 2

(4) Insert the rod into the winding spool and roll the tongue of the recording paper together with the holding sheet into the rod. The printed side of the paper should face inside.

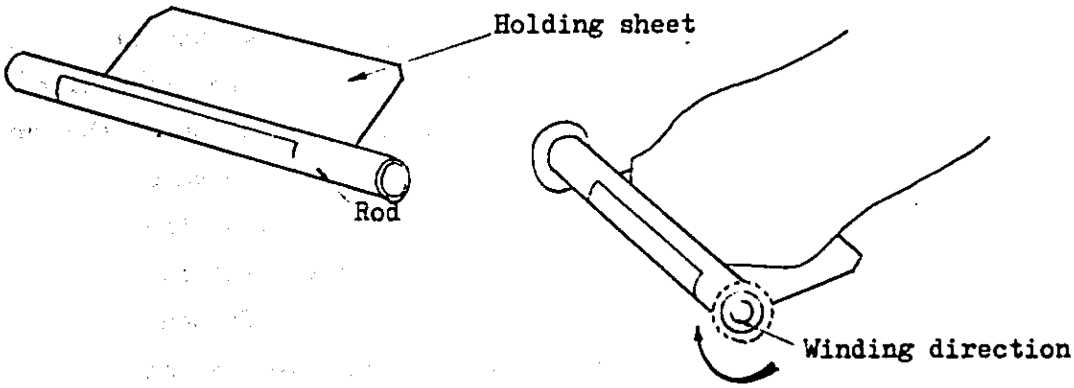


Fig. 13 Mounting of recording paper - 3

(5) Adjust the holes of the recording paper with the sprockets of the sprocket roller, roll the paper into the winding spool, take the paper out from the paper stock tray and fix it on the roller. Shut the acryl plate. (see Fig. 12, 13)

6-11. Determination of the Pen Position

(1) The present tidal level can be obtained by:

$WL = L_0 - L$

where $L_0 = H_0 + L_1$

L is the length measured by a steel tape. L should be the average of 3 to 4 measurements.

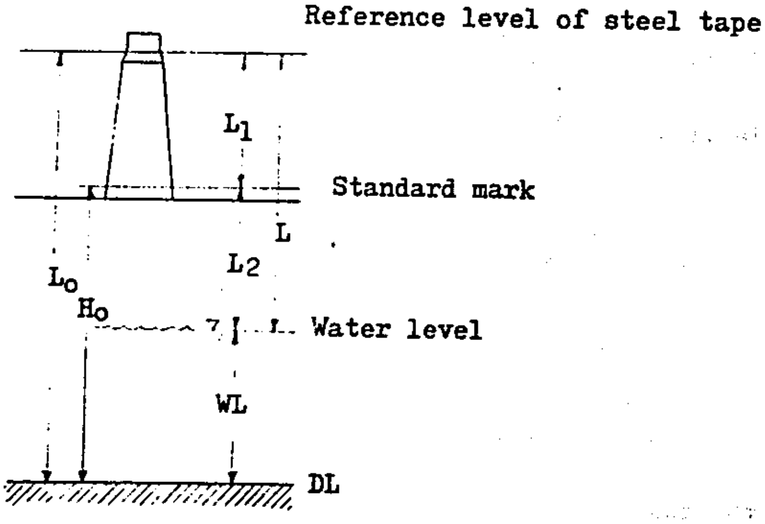


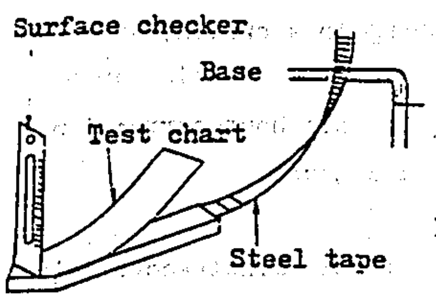
Fig. 14 Relationship of various levels

(2) Pull out the steel tape from the back of the base and fix a surface checker on it.

(3) Put the test chart into the surface checker, hang down the tape until the surface checker sinks into water half way, and read the graduation of the steel tape. Then take up the steel tape and read the graduation of the surface checker where the colour on the test chart is changed. Add the value to the graduation on the tape. Repeat the above measurement three to five times and take the mean.

(4) Once the present tidal level is obtained, set the position of the pen at the corresponding position on the recording paper. Then fasten the gears of the float pulley axle and pen operating axle which have been made running idle as described in 6-4 above.

(5) If further adjustment of the position of the pen is desired, loosen the screw on the pen holder and adjust it finely.



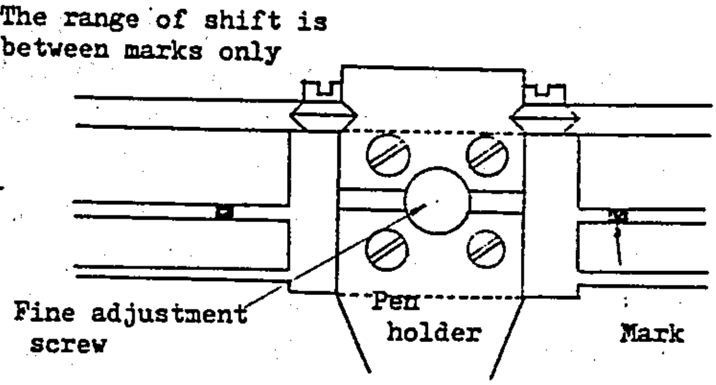


Fig. 15 Fixing of test paper   Fig. 16 Fine adjustment of pen position

6-12. Filling or Supplementing Ink

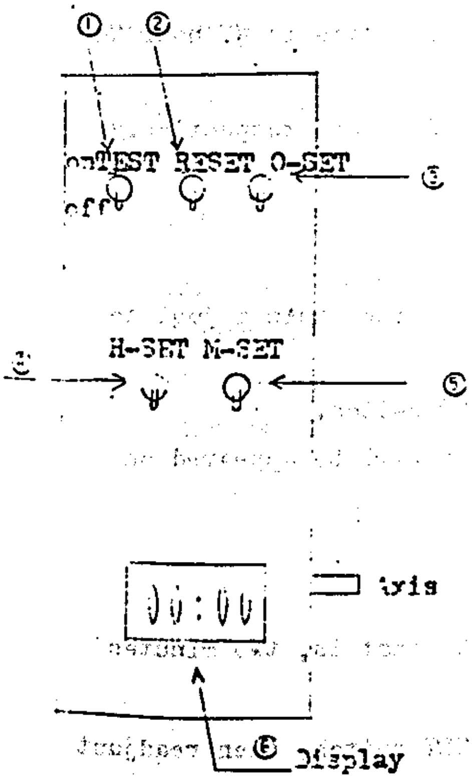
(1) Use the recording ink for recording purposes.

(2) Take off the top cap of the ink bottle and fill the bottle with the ink approximately 80 % by using a pippet. Press the lid with putting a finger on the small hole at the center of the cap, and the ink will flow into the pen by the action of pumping. Caution should exercised that, if bubbles are included within the nylon tube, it will cause a break in ink flowing.

(3) In case of supplementing ink, be sure to keep filling the ink until the bubbles in the nylon tube disappear. Those bubbles have been produced in the tube as the ink bottle became empty.

6-13. Adjustment time of quartz crystal clock

(4). Name of each part



(1). TEST swtich
After inserting the required numbers of dry cell, switching "ON" of this switch, then time control will count about 1,000 times faster with checking all functions. Then at the selected time comes, time mark will be appeared on paper. This motion will continue until switch "OFF". In case of one hour setting for time mark, output interval for time mark is about 3.6 seconds.

(2). RESET switch
All time values will be cleared at once by switching "ON" and time display will become the state 00:00.

(3). O-SET switch (Zero set switch for second)

This start-count switch is always started from the zero of second after switch "ON" of O-SET switch and the unit of "second" will be easy to modify as exactly zero time of second by pushing this switch.

(4). H-SET switch (Hour-correction switch)

Only one hour will be counted by one pushing of this hour-correction switch. If push two times, time will be past two hours.

(5). M-SET switch (Minute-correction switch)

Only one second will be count by one pushing of this minute-correction switch. that is, if push two times, two minutes past.

6-14. Change of dry cell for clock module

Release the key hook of clock cover, insert one piece of dry cell with negative electrode side down into the dry cell case.

After setting dry cell, clock will move at once. A life of dry cell for clock module is about one year.

6-15. Change of dry cell for time marker device

Insert four pieces of dry cell by paying attention to its electrode into the case. A life of dry cell for this device is about two months.

At every times for changing them, all values in the clock will be cleared that is why, reestablish the present time as following way.

6-16. Time setting

This clock will start at once when insert a dry cell for clock module into the dry cell case. The colon mark " : " on display board blinks at every one second.

6-16-1. Time adjustment

1. When the state of "ZERO" second, that is, present time is NN hour NN minute OO second, push O-SET switch "ON".
2. After the above adjustment, adjust the hour and minute respectively by pushing each switches.

6-17. Time correction

6-17-1. In case of delaid-time display

1. Set one minute past state than present correct time, then adjust to count by pushing H-SET and/or M-SET switch.
2. When the established time comes up, push O-SET switch.

Now, when the selected time comes, time marker will be appeared on paper at every regulated time.

6-17-2. In case of fast yime display

"EXAMPLE"

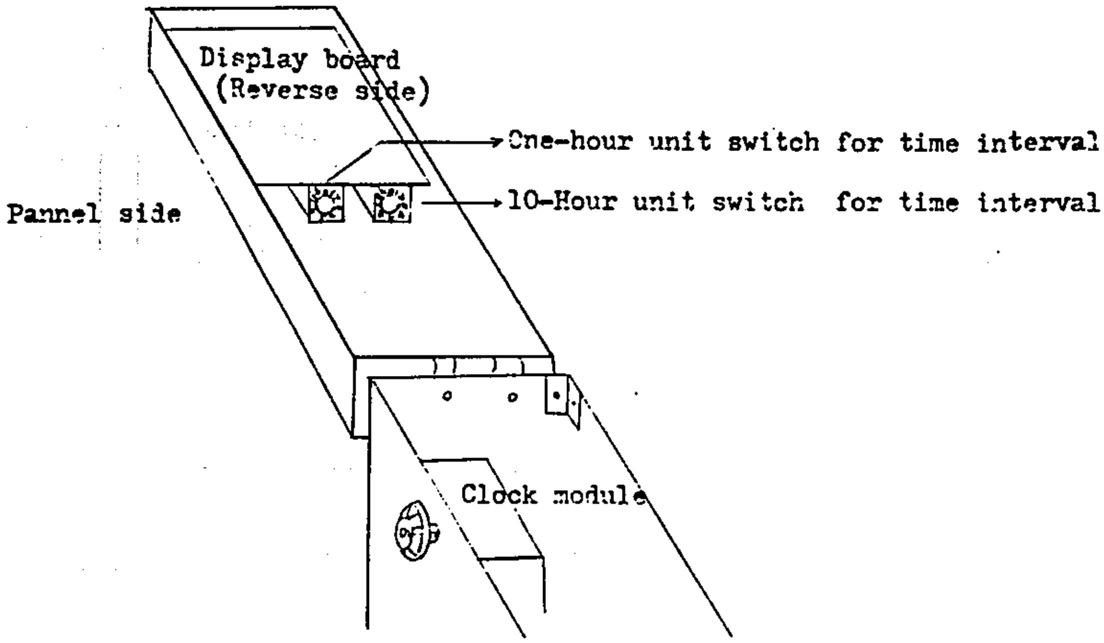
Displaid time is 13:02 but real time is 13:00, that is, two minutes faster than real time.

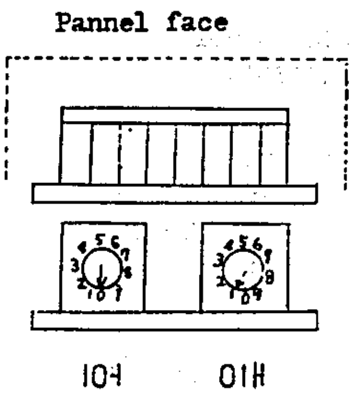
1. First, clear the displaid time by pushing RESET switch, then readjust the time as clause 6-16-1.

2. Finally, do it as the clause 6-17-1.

6-18. Establishment of interval for time marker

Interval for time mark is selectable from one to 99 hours at every one hour unit.





Note: This is an example figure of one hour time setting for time marking interval.

There are 2 digital switches on the back side of circuit board. When open the top cover of clock, the switch at right side is for one-hour-unit setting switch and left side is for 10-hour-unit setting switch.

When set the value "1" on one-hour-unit setting switch with "0" of 10-hour-unit setting switch, time mark will be out put at every one hour.

Decision of this state, however, when connecting the dry cell or the time for switch "ON" of 0-SET switch is an interval of output time.

Therefore, in case of change for time interval, make to clear the display time by pushing RESET switch or at the change of dry cell. Standard setting of time interval is already preset with 6 hour interval.

Turn the flange until the pen comes on the line three minutes ahead, and turn the flange of the paper winding spool toward the operator in order to remove slacking of the recording paper as well as to adjust the time.

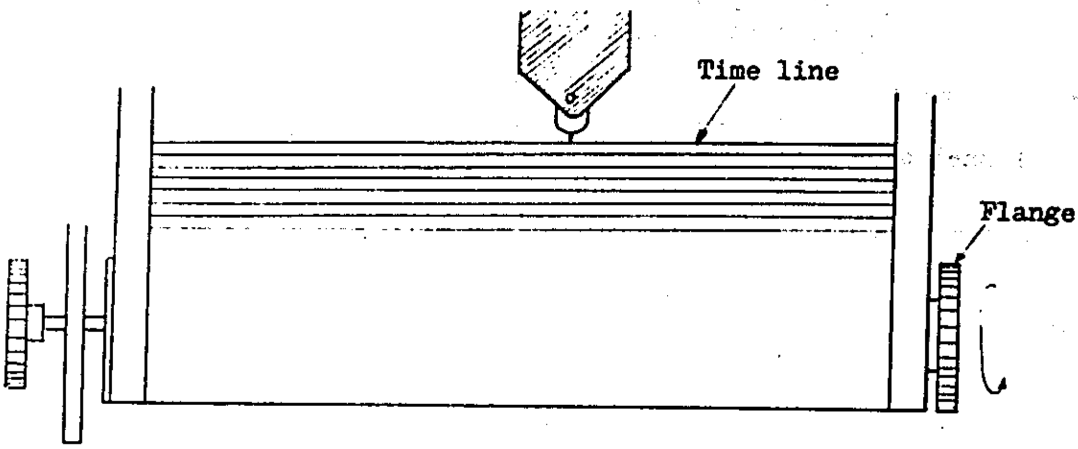


Fig. 17 Adjustment of time - 1

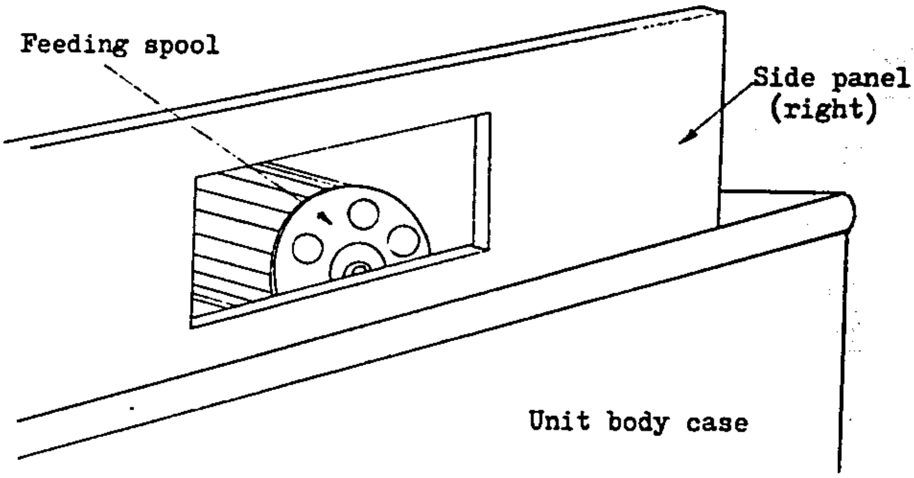
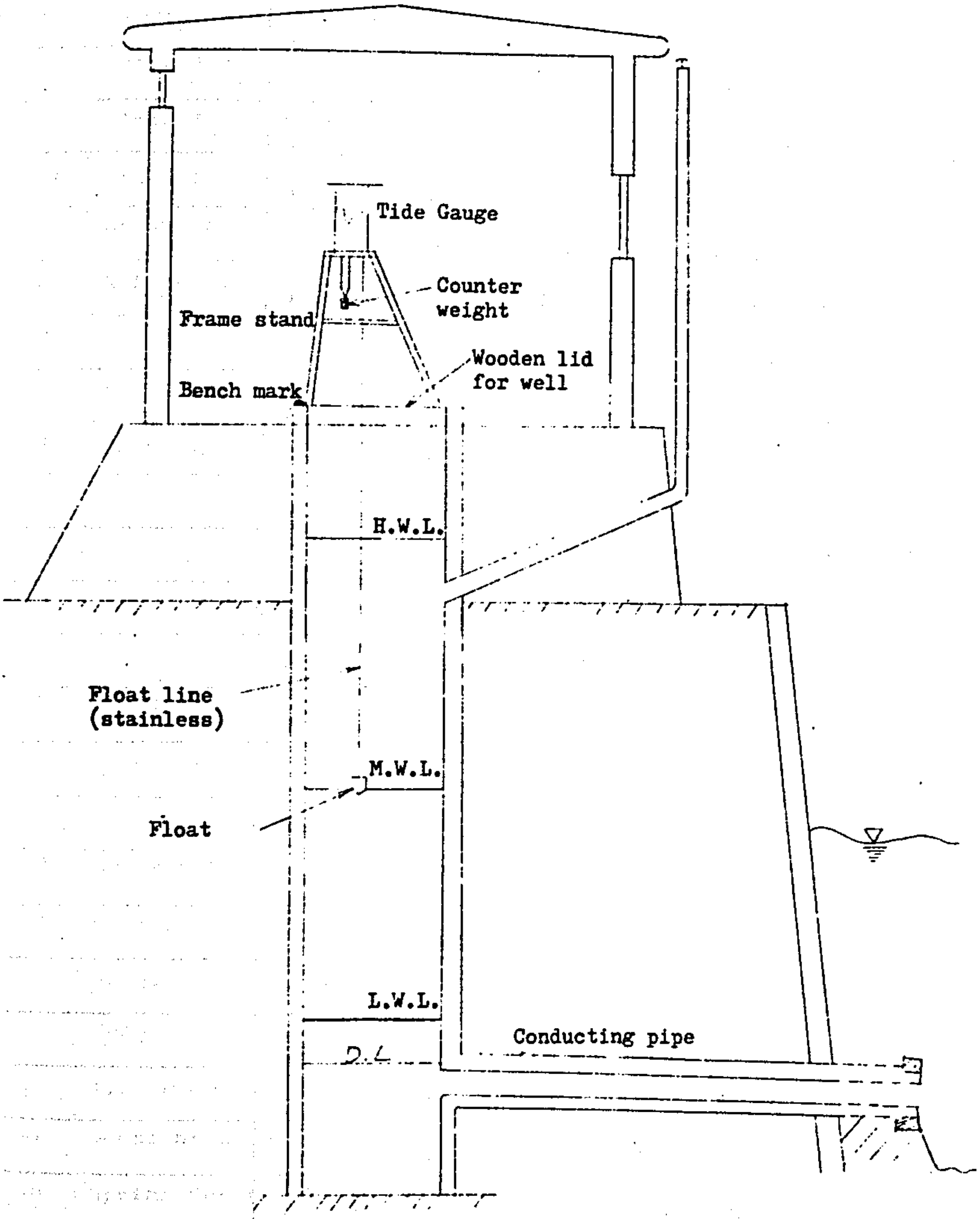


Fig. 18 Adjustment of time - 2

8. Side View of Tide Observation



DRAWING NUMBER 5 — 55 (1)	PARTS LIST FOR TIDE GAUGE MODEL: L F T - 5	Page 1

Parts No.	Name of Parts	Quality	Q'ty	Remarks
1	Base	AC	1	
2	Float pully	BC	1	
3	Shaft for pully	Drillrod	1	
4	Counter weight pully	BS	1	
5	Disk "A" for float pully	BC	1	
6	Disk "B" for float pully	"	1	
7	Lid "A" for bearing	BS	3	
8	Pinion gear	"	1	
9	Lock nut for pinion gear	"	1	
10	Reduction gear	"	1	
11	Reduction pinion	"	1	
12	Gear	"	1	
13	Axis for idle gear	"	2	
14	Nut for idle gear	"	2	
15	Flange for sub-pully gear	"	1	
16	Lock nut	"	1	
17	Axis for counter weight pully	S35C	1	
18	Sub-pully	BC	1	
19	Flange for sub-pully	"	1	
20	Counter weight for sub-pully	SS	1	
21	Counter weight for float pully	"		
22	Pully for counter weight	BS	1	
23	Axis for pully	"	1	
24	Bracket for float pully	BC	1	

Kyowa Shoko k.k.

DRAWING NUMBER 5 --55 (1)	PARTS LIST FOR TIDE GAUGE MODEL: L F T - 5		Page 2

25	Bearing case	BS	1	
26	Sliding base for pen	"	1	
27	Pen holder "A"	"	1	
28	Plate for indicater	PBZ	1	
29	Pen holder "B"	BS	1	
30	Recording pen	BS SUS	3	
31	Roller "A"	BS	1	
32	Roller "B"	"	2	
33	Axel for roller	SUS	3	
34	Fine adjustment screw	BS	1	
35	Plate for fine adjustment	PBZ	1	
36	Coil spring	SUP	1	
37	Hook for spring	BS	1	
38	Arm stand for ink bottle	"	1	
39	Guide rail "A"	"	1	
40	Guide rail "B"	"	1	
41	Bracket "A"	"	1	
42	Bracket "B"	"	1	
43	Mirror plate	"	1	
44	Holder for mirror plate	"	2	
45	Beam	"	3	
46	Idle gear	"	2	
47	Coupling base	"	each 1	
48	Spring for clock	PBZ	1	
49	Pinion gear	BS	1	

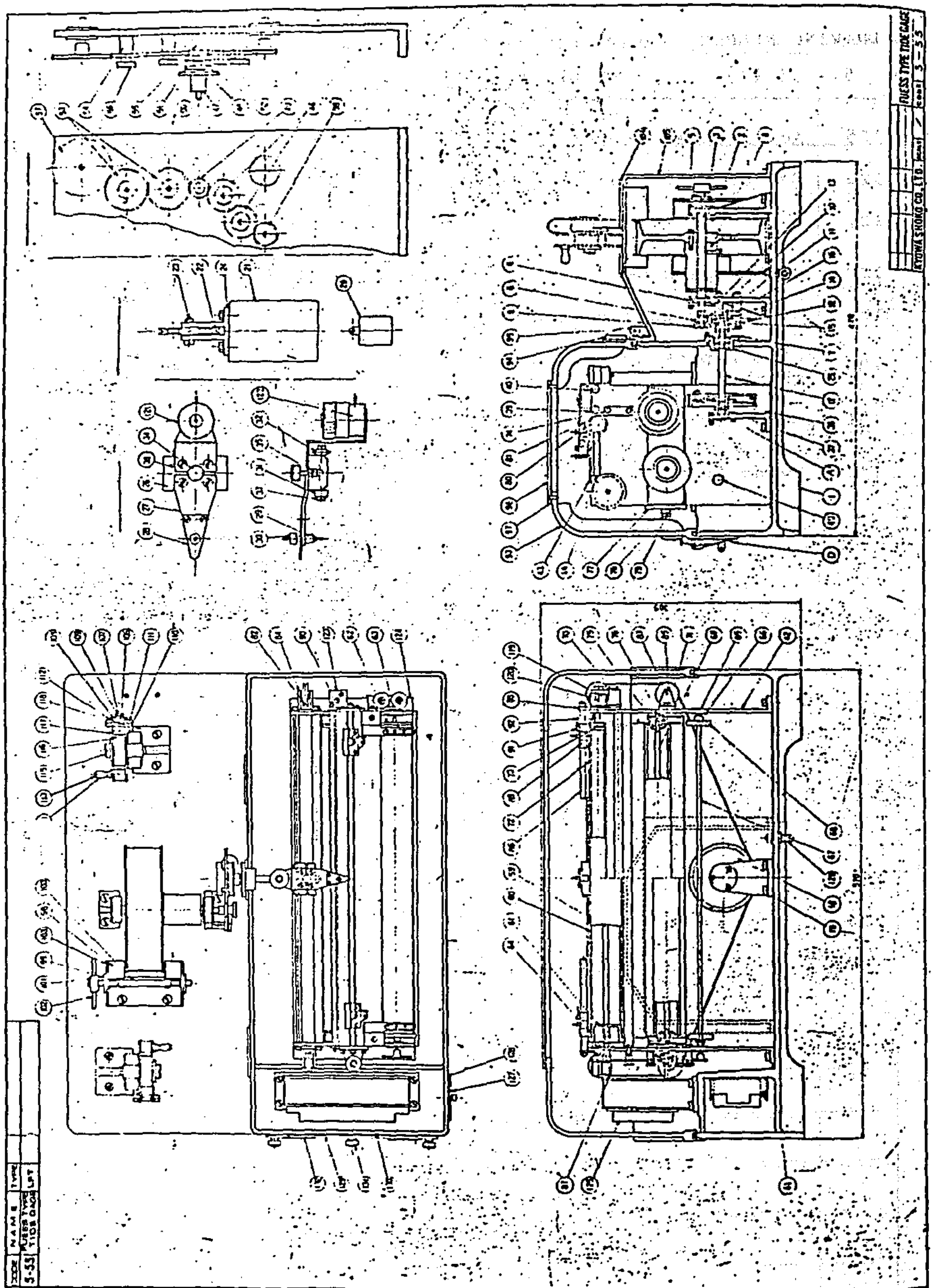
DRAWING NUMBER 5 - 55 (1)	PARTS LIST FOR TIDE GAUGE MODEL: L F T - 5		Page 3	
50	Driving boss	BS	1	
51	Pin	SUS	1	
52	Spring holder	BS	1	
53	Idle gear	"	2	
54	Axis for idler gear	S15C	4	
55	Axis for pinion gear	"	1	
56	Nut	BS	4	
57	Gear for sprocket roller	"	1	
58	Gear for winding roller	"	1	
59	Spindle for sprocket roller	S30C	1	
60	Roller for feeding roller	ALT	1	
61	Flange for feeding roller	AL	1	
62	Lid for sprocket roller	"	1	
63	Paper holder	PBZ	each 1	
64	Sprocket	BS	16	
65	Lid "B" for bearing	"	6	
66	Lid "C" for bearing	"	6	
67	Shaft for feeding spool	S30C	2	
68	Roller for feeding spool	BS	4	
69	Axis for paper spool	S30C	2	
70	Flange for paper spool	BS	4	
71	Lock nut for paper spool	"	2	
72	Guide roller	ALT	1	
73	Axis for guide roller	S30C	2	
74	Paper guide plate	BS	1	

DRAWING NUMBER 5 - 55 (1)	PARTS LIST FOR TIDE GAUGE MODEL: L F T - 5		Page 4	
75	V-shaped grooves bracket	BS	1	
76	Paper stock tray	SPC	1	
77	Acryl panel		1	
78	Clamp "A" for bobbin	PBZ	2	
79	Clamp "B" for bobbin	PBZ	2	
80	Tension roller	BS	1	
81	Bracket for tension roller	"	2	
82	Guide pully	AL	4	
83	Axis for guide pully	BS	4	
84	Bracket "A" for guide pully	BC	2	
85	Bracket "B" for guide pully	"	2	
86	Scal	BS	1	
87	Bracket "A" for scale	"	1	
88	Bracket "B" for scale	"	1	
89	Side pen holder	"	2	
90	Side pen guide	"	2	
91	Side pen stopper	SUS	2	
92	Handle for stopper	"	2	
93	Cover	AC	1	
94	Swing frame "A"	"	4	
95	Shaft for swing frame	S30C	2	
96	Acryl window		1	
97	Rubber packing	NEOPRENE	1	
98	Brake	WOOD	2	
99	Boss for brake	BS	each 1	

DRAWING NUMBER 5 - 55 (1)	PARTS LIST FOR TIDE GAUGE MODEL: L F T - 5		Page 5	
100	Handle for brake	S15C	1	
101	Boss for handle	"	1	
102	Handle	"	1	
103	Brake stand	SPC	1	
104	Acryl window		1	
105	Cover for pully	AC	1	
106	Plate for base point	BS	1	
107	Screw nut	"	1	
108	Standard mark plate	"	1	
109	Screw for scale stand	"	1	
110	Arm for index	"	1	
111	Index	"	1	
112	Screw for standard mark plate	"	2	
113	Axis for bobbin handle	"	1	
114	Handle for bobbin	BS	1	
115	Axis for scale bobbin	"	1	
116	Scale bobbin	"	1	
117	Flange for scale bobbin	"	2	
118	Scale stand	AC	1	
119	Ink bottle "A"	BS	3	
120	Cap of ink bottle "A"	"	3	
121	Ink bottle "B"	"	1	
122	Cap of ink bottle "B"	"	1	
123	Bracket for time marker	"	1	
124	Holder for ink bottle	"	1	

DRAWING NUMBER 5 - 55 (1)	PARTS LIST FOR TIDE GAUGE MODEL: L F T - 5	Page 6

125	Acryl cover for clock		1	
126	Eye bolt for counter weight	S15C	1	
127	Panel for volt meter	BS	1	
128	Rubber packing	NEOPRENE	1	
129	Cover for battery chamber	BS	1	
130	Rubber packing for battery chamber	NEOPRENE	1	
131	Lock for battery chamber	BS	3	
132	Swing frame "B"	"	2	


FUESS TYPE TIDE GAGE
KYOWA SHOKO CO., LTD.
CODE
NAME
TYPE
5-55

APPENDIX 6

INSTRUCTION MANUAL
OF
SUPERSONIC MAGNETIC RECORDING TYPE
WAVE HEIGHT METER
(SSW-II)

KYOWA SHOKO CO., LTD

TOKYO

SUPERSONIC MAGNETIC RECORDING YYPE

WAVE HEIGHT METER

(SSW-II)

INSTRUCTION MANUAL

CONTENTS

6-3 Measurng Mode Manipulation and Operation

6-3-1 Setting of Measuring mode and start waiting time

6-3-2 Measurement start

6-3-3 Observation end manipulation and operation

1. GENERAL

This wave-height meter is installed on the seabed. Supersonic pulses are emitted to the sea surface from the wave-height meter. The supersonic pulse reflected from the sea surface is received, its propagation is accuretely measured to find the distance from the sea surface. By continuously emitting supersonic pulses, variation of water level is detected and the surface wave height is measured.

Detected wave height signal is recorded by the magnetic recorder. The magnetic recorder can record wave data of 18day or more.

In addition, when several sets of this wave height meter are connected with the cable, sampling synchronizing signal is fed so as to be utilized in the observation of wave height distribution, wave direction, etc. (Option)

Though installation method, etc. of the handling method do not vary so much from the existing wave height meters, the magnetic recorder with built-in microcomputer has much more functions than the conventional recorder. In order to eliminate measurement error due to mishandling, be sure to understand its manupulation and operation according to this instruction manual thoroughly before use.

Fectronic circuits constituting the main portion of this wave height meter, cassette tape, etc. are sensitive to humidity.

For maintaining the reliablility of the instrument over a long period of time, give sufficient consideration to the storage method of the instrument.

2. SYSTEM COMPONENTS

2-1	Supersonic magnetic recoring type wave-height meter	1 set
	Pulse transmitter-receiver	1 set
	Wave height detector	1 set
	Magnetic recorder	1 set
	Pressure resistant tank	1 ea
	Special battery	1 ea
2-2	Stabilizing mounting base	1 ea
2-3	Accessories	
	Cassette tape	1 ea
	Charger	1 ea
	Synchronizing cable (50m)	1 ea
	(Option)	
	Driver	2 ea
	Adjustable wrench	1 ea
	Silion grease	1 ea
	Spare 0 ring (C-210)	1 set
	Cleaner	1 set

3. SPECIFICATIONS

3-1 General Specifications

Depth of water used	6.0 - 25.0m
Measurement range	3.2,6.4,9.6,12.8m (selecting system)

Resolution	1.25,2.50,3.75,5.00cm (selscting system)
Measurement accuracy	± 1% FS (water temperature 15°C)
Pressure resistance	5.0kg/cm^2
Observation days	Max. 18days (at 10min/2 hrs measurement)
Special battery	12V 6Ah Nicd battery
Outside dimensions	590 (H) X 270ømm
Weight	35kg
Installation levelness	within 15°
Sampling interval	0.5 sec
Number of data/measurement	1022 data (at 10 min measurement) 2045 data (at 20 min measurement)
Observation mode	0 - 10min/2hrs 1 - 10min/1hr 2 - continuous 3 - 20min/2hrs 4 - 20min/1hr
Synchronizing cable	Neoprene 4 core 50m steel wire contained (Option)
Synchronizing system	Measurement start signal synchronizing system
Cable connection system	Underwater connector

3-2 Pulse Transmitter/Receiver

Vibrator	Ti-Ba 100ø
Supersonic frequency	20kHz
Direction angle	Half reduction half angle 3°
Support mechanism	Gimbal mechanism

3-3 Wave Height Detector

Detection resolution	1.25cm
Detection interval	0.1 sec
Detection system	Waveform processing system with microcomputer
Output system	Parallel transfer system
Data format	16bit binary

3-4 Magnetic Recorder

(1) Magnetic recording secton

Compatible cassette tape information exchange

Casserre tape	Standard item CT-300 (TEAC product)
Recording format	ISO-3407 JIS-C 6281 based information recording fomat
Recording system	Phase modulation system (PE system)
Recording density	800bpi

(2) Control section

Control system	Microcomputer system

Clock accuracy	± 10ppm
Self check function	Battery voltage check, memory check, CMT check etc.

Measurement start timing adjusttement

0-9hrs 90min settable in 10min steps

(2) Data Processing Function

Wave height/period detection

Zero up cross method

Number of waves to be calculated

Within 100 waves from beginning of measurement

Calculation item Max. wave, 1/10 max. wave, significant wave, average wave

Data indication item

Signification wave height

(4) Printer output

Output system	20 MA current 100p system
Transfer speed	100 baud
Code used	ASCII
Output content	Data and calculation result

4. PARTS NAMES

4-1 Main Body Parts Names

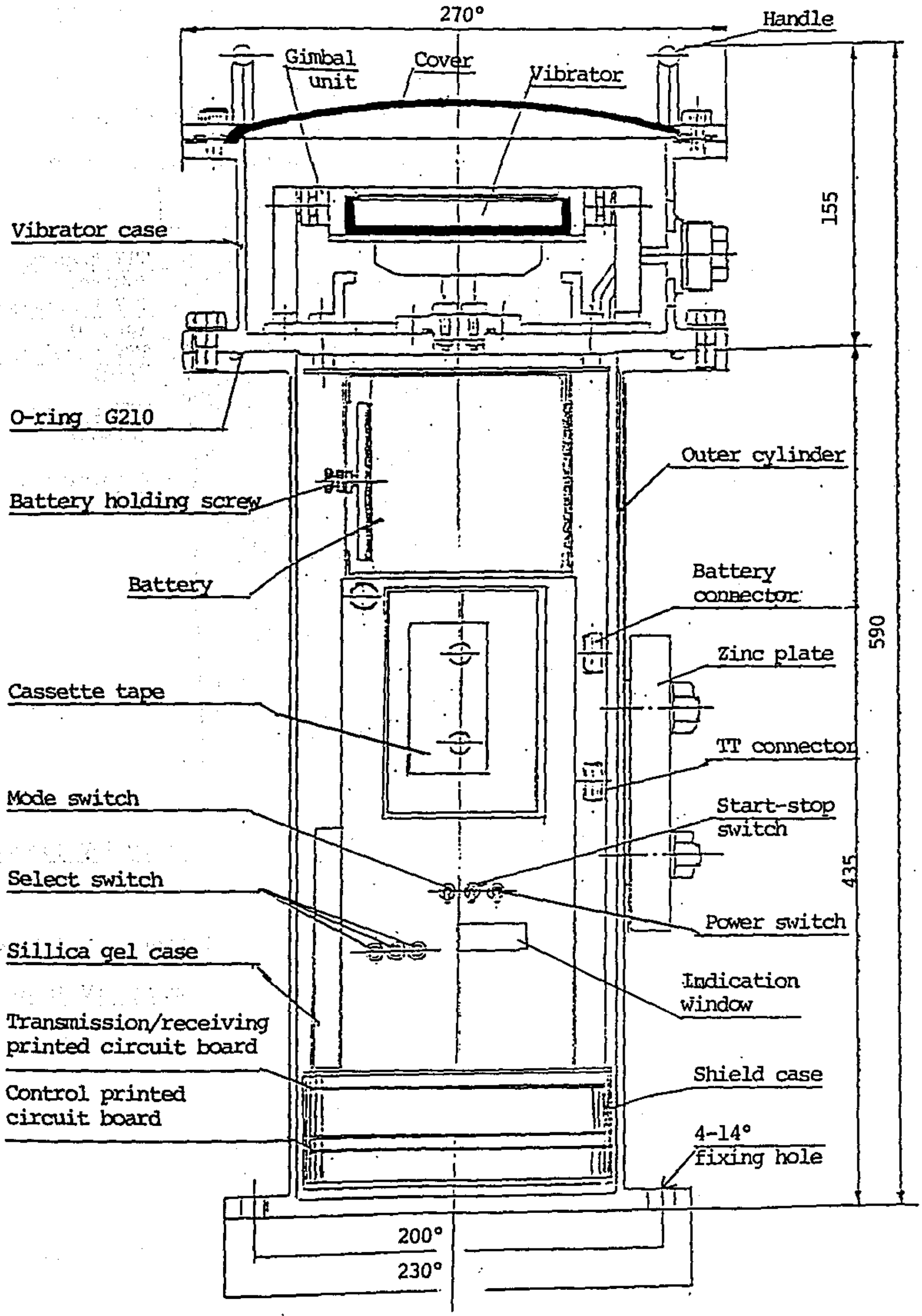


Fig. 4-1

4-2 Connection Diagram

Battery, sensor, etc. are connected on the terminal board on the rear side of the magnetic recorder ti be uncovered as shown in Fig. 4-2.

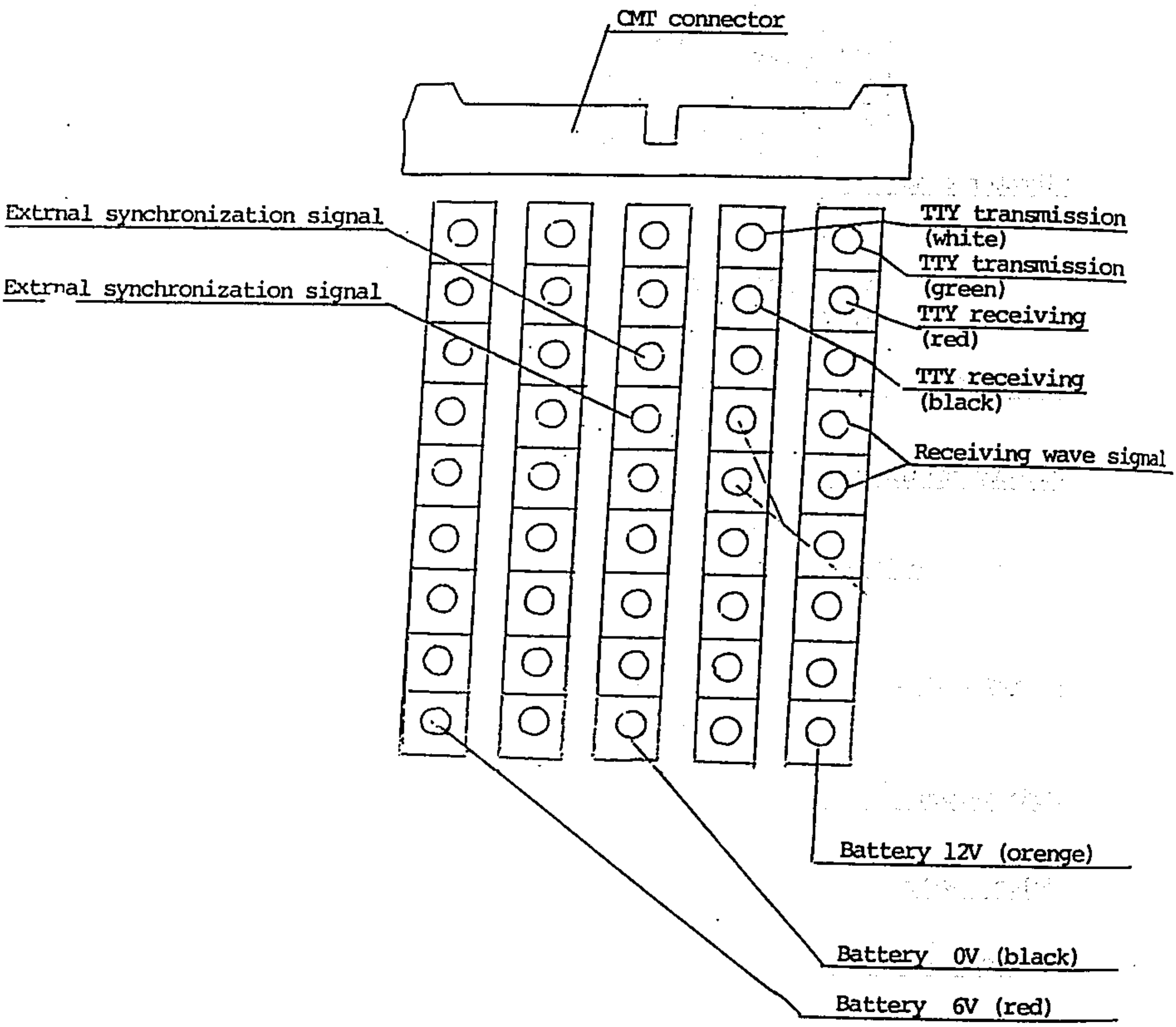


Fig. 4-2 Connection Diagram

5. ENCLOSURE AND REMOVAL OF RECORDER

Remove 6bolts shown in Fig. 5-7, hold the upper flange by both hands, and lift the recorder upward.

Befor enclosing the recorder, wipe the O ring surface with waste cloth to remove dust, and apply sufficient grease the O ring. When enclosing the recorder, insert it into the pressure resistant tank straight with caution to the connector portion, and tighten bolts firmly.

Note: When the O ring surface is damaged, water will enter. Be sure to handle with sufficient case.

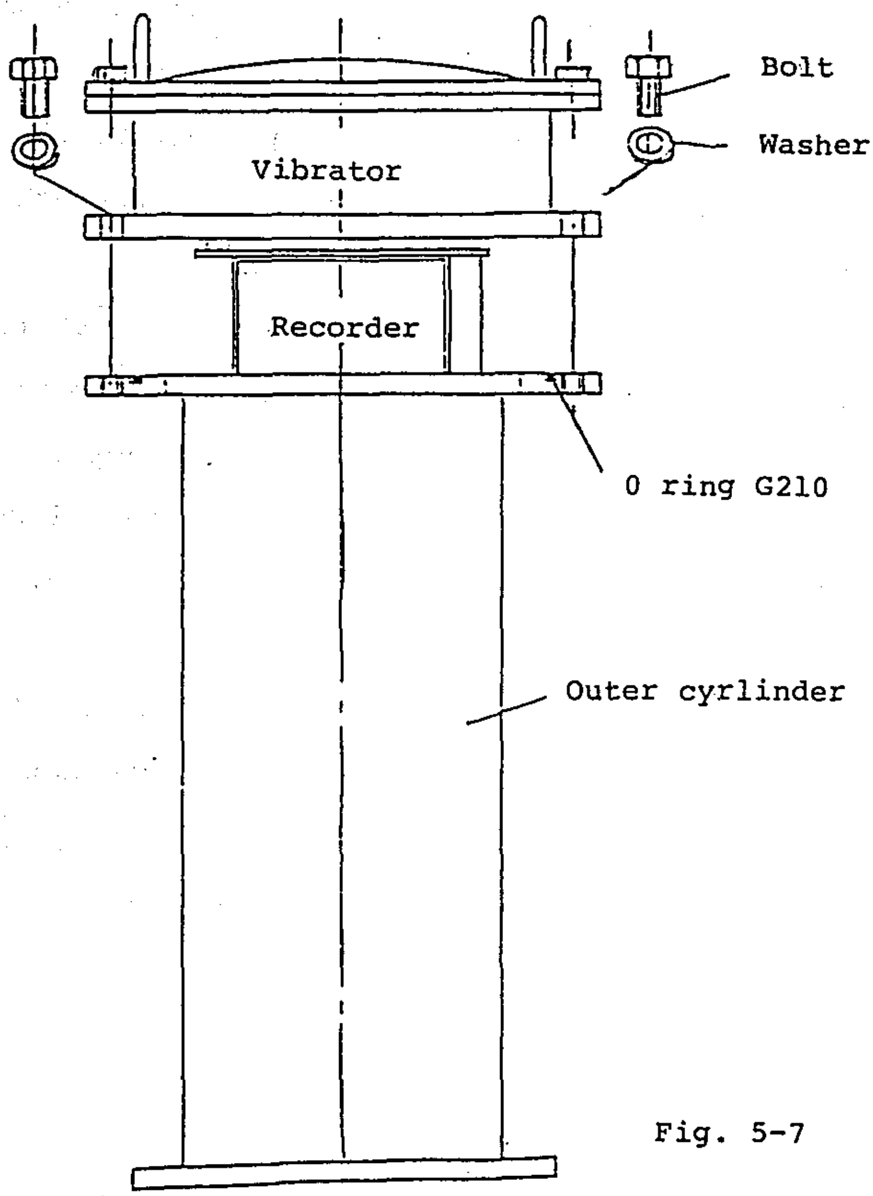


Fig. 5-7

6. MAGNETIC RECORDER HANDLING METHOD

6-1 Preparation

6-1-1 Battery replacement

Ture off power switch, and pull out power connector. Loosen screw holding battery and remove battery by pusing it out. Enter sufficiently charged battery into the enclosure unit, tighten the holding screw, and secure with the lock nut. Lastly, insert the power connector completely to the end.

6-1-2 Cassete tape loading

Use information exchange magnetic cassete tape conforming to the specification. (Musical tape cannot be used.)

Push the EJECT button of the magnetic recorder, and open the cassete insertion pocket. Insert the cassette tape straight to the end, and close the pocket. Be careful not to apply excessive force for the insertion. When the pocket dose not close normally, insert once again.

Used a new cassette tape or one in which records have completely been deleted. When a cassette tape with record is used without deleting, recorded data will not be read nomally. When using a recorded cassette tape. delete all records through the check mode operation, and then use the tape.

6-1-3 Silica gel replacement

Use NITTO GEL (20g). Shift the content of the bag to one side, and put it in the pocket with care not to breack the bag.

Be sure to change before observation.

6-1-4 Relation between measurement mode and observation days

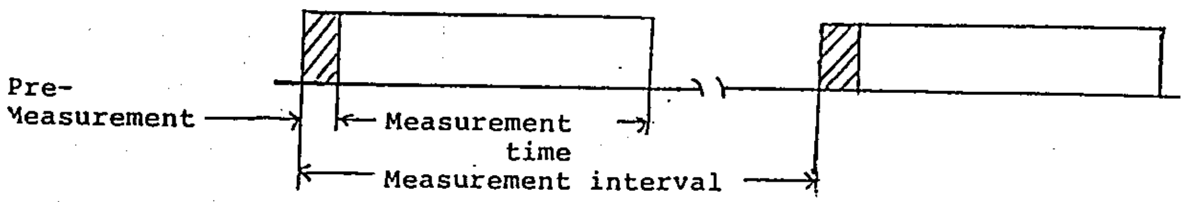
Measurement modes of SSW-II and observation days are shown in Table 7. Set the measurement mode with the select switch No.1.

Table 7

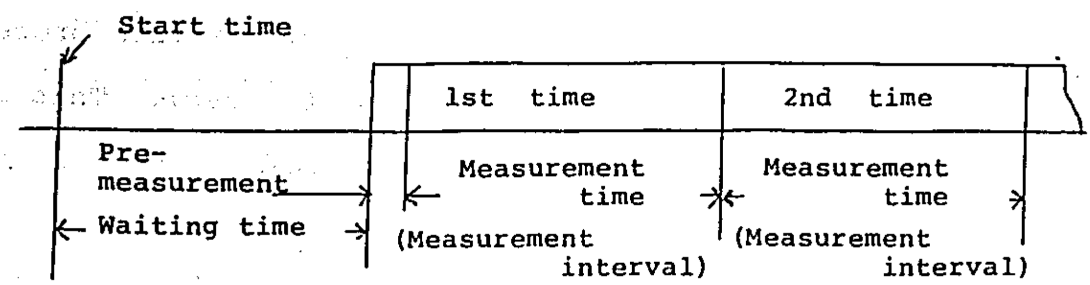
Measurement mode	Measurement time	Measurement interval	Pre-measurement	Sampling interval	Number of data	Max. observation days
0	8min 31sec	2 hours	1 min	0.5sec	1022	18days
1		1 hours			1022	9days
2	17 min 3sec	17min3sec	1min at interval measurement		2046	30hours
3		2 hours	1 min			9days
4		1 hours	1 min			4.5days

Measurement time chart

(a) Intermittent observation (measurement modes(0),(1),(3),(4))



(b) Continuous observation (measurement mode (2))

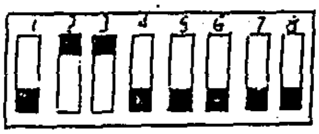


6-1-5 Measurement range setting

Measurement range and measurement resolytion can be know by performing the check operatiun described later. For changing measurement range, remove 6 screw at the bottom of the recorder main body, and open the bottom cover. There are the following switches in the internal circuit. Change according to the indication of the following table.

ON

OFF



Measurement range select switch

Switch bit 1	Switch bit 2	Measurement range	Resolution	
OFF	OFF	3.2 m	1.25 cm	
ON	OFF	6.4 m	2.50 cm	(Setting at shipping)
OFF	ON	9.6 m	3.75 cm	
ON	ON	12.8 m	5.00 cm	

Setting range is selected by bits 1 and 2 of the select switvh. Bit 3 is a switch for determining whether of not the value of water surface detected ta the time of waveform processing is calculated by moving average (4 samples, 0.4 sec). This switch is normally ON, and moving average is performed.

6-2 Check Mode Manipulation and Operation

6-2-1 Power ON

Turn on power switch. At this time, the display indicates nothing or an uncertain value. This is due to charge/discharge condition of internal capacitor, not a trouble. 88, 8888, 999, 00, etc. are displayed sometime.

6-2-2 Check mode operation start

Set mode switch to check, and start. Display 8000 indicates normal start. After about 2 seconds, CMT operates.

When any date is already recorded in the cassette tape, 8008 is displayed. In this case, perform either of the following two operations.

The first operation is to delet record of the cassette tape entirely. Start in as is condition. CMT performs write, rewind, and atarts record delection. After about 5 minutes, entire record is deleted, tape is rewound. and operation of 6-2-3 is started.

The second operation is for the case cassette tape record is not to be deleted. Upon stopping, CMT is rewound, and operation of 6-2-3 is started.

Display 8008 remains unchanged until start of operation 6-2-3. When a new tape or a tape with deginning. end record or entire record deleted is used, CMT displays 8000, and the tape is rewound for deleting recorded data by the write test, and deletion is started.

After deletion, the tape is rewound again, and operation 6-2-3 is perfoemed.

Note 1 : This check is not performed for the entire cassette tape. When used tape is used again for observation, be sure to delete all records before use.

Note 2 : Display of other than 8000 and 8008 during the operation 6-2-2 indicates device trouble.

Take action according to paragraph 10-1.

6-2-3 Sensor check

When power is turned on for transducer and waveform processing unit, sensityvity coefficient is read and displayed. The relation between displayed value and measurement range is as follows.

Display	Measurement range	Sensitivity coefficient
1250	3.2m	1.25
2500	6.4m	2.50
3750	9.6m	3.75
5000	12.8m	5.00

The value of sensitivity coefficient is counted up by the sampling signal (0.5 sec interval) from the waveform processing unit. at this time sound wave is projected at 0.1 sec intervals.

When the ear is brought into contact with the rubber the transducer, intermittent sound (chi, chi, ...) is heard. check.

6-2-4 Check mode operation end

When START/STOP switch is lowered,8888 is dispalyed, and check operation is terminated. When check mode operation is performed, be sure to stop it.

6-3 Measurement Mode Manipulation and Operation

6-3-1 Measurement mode and start waiting time setting

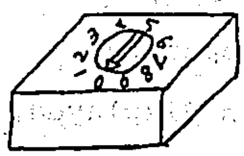


Fig. 6-2

Set the mode switch in the MEASURE position (middle). Select desired measurement mode and set in select No.1.

The construction of select switch is as shown in Fig. 6-2.

Check 0 position and set with the attached (-) driver so as not mistake the set value. Use select Nos. 2 and 3 for setting the observation waiting time.

When select switch is set as shown in Fig. 6-3, measurement mode is (3) (measurement time 20 min, measurement interval 2 hours) and waiting time is 2 hours 50 minutes. 2 hours 50 minutes after start, initial observation is started.

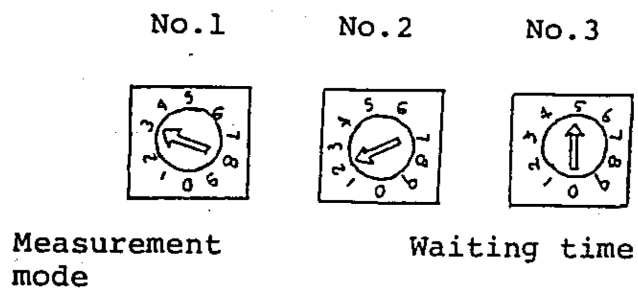


Fig. 6-3

6-3-2 Measurement start

When the above setting is completed, start measuremet by raising the START/STOP switch. 9000 will be displayed in case of normal start. After about 2 seconds, CMT operates, and label data is written. After AMT stop, 0000 is displayed, and after a lapse of ovservation start waiting time, first ovservation is started.

Thereafter during the pre-measurement, 0002 is displayed, and during the measurement sampling number is displayed. During the measurement waiting, number of completed measurements is displayed.

Note 1 : CMT operates once every two measurementsin measurement mode (0) and (1), every time in (2) to (4), and data are recorded.

Note 2 : Even when measurement mode is re-set after measurement start, value at the time of start is kept in the memory intact. For re-setting, turn off power switch once, perform check mode operation, delete recorded labal data and perform measurement mode operation again.

6-3-3 Observation end manipuration and operation

(a) Take out internal unit and check display. When the display is 9009, perform operation of (b), and in other cases perform the following operation.

Make sure that the state is in measurement waiting. Check number of finished measurements. Then, lower the START/STOP switch to stop. After about 2 seconds, CMT operates, data of remaining memory and end mark are written, and CMT is rewound. After CMT stop, 9999 is displayed and observation is terminated.

Be sure to perform stop operation after the end of observation. If this operation is neglected,not only remaining data in the memory are not write but also end mark is not record. Accordingly, data cannot be read narmally at the time data read.

(b) When 9009 is displayed, observation has been interruped due to either of the following two causes.

Cassette tape is used up.

Battery voltage has become lower than normal.

In the case, turn off power switch once, and perform other operation.

When 9009 is displayed, START/STOP switch is ineffective, and operation is not accepted.

Note 1 : Never attempt to operate in the check mode or measurement mode with recorded cassette tape set. To protect recorded data, bear in mind to pull out write inhibit plug of cassette tape.

6-4 Recorded Data Check

This is an operation to check data recorded on the cassette tape.

6-4-1 Print format selection

Set format to be printed on teletywriter (hereinafter referred to as TTY) on select No.

1. In normal cases, 0 is set.

   0 - wave height statistical processing result is printed.(Fig.11-2)

   1-9-Each wave heiht, period, and statistical processing result are printer. The value to be displayed is significant wave height alone. Display is mode repertedly as follows.

Note 1 : Since select No. 1 is set to 1-9 and caused to calculate all wave heights and period, processing one observation takes time. When checking data by display alone, be sure to set select No. 1 to 0.

6-4-2 Data display start and end

Set the mode switch to data out, and raise start/stop switch and cause to start. After about 2 seconds, CMT operates, and the labal data is read. For about 30 seconds after reading lable data CMT stops, 7000 is displayed and remains in that state. This is the time during which the content of label block is outputted to the teletypewriter (TTY). When TTY is not connected, it looks no operation is perfodrmed.

After 30 seconds, CMT operated again and reads measurement data. Read data is calculated by the built-in microcomputer, and the result is displayed. (At the same time with the displsy, the result is outputted to TTY) When the display is left being mode, CMT operates again and reads the next data, and keeps displaying that data.

This operation is repeated unitil the last data is displayed. When the last data is displayed, CMT is rewound automatically, 7777 is displayed, and operation comes to the end. At the same time, TTY interface is cut off thereby becoming break condition.

In the case of stop during data-out operation, the processing of that observation data is complated, CMT is rewound, data-out operation is stopped, 7777 is displayed and stopped.

7. INSTALLATION METHOD

Fig. 7-1 (installation drawing) illustrates installation at around 10m of water depth.

The main body is fixed by the following :

(1) Main body hanging rope (18mmø approx. 17-20m)

(2) Main body fixing rope (18mmø approx. 15-20m) and

(3) Marking rope (14mmø approx. 15-20m)

Main body is immovably fixed by anchor.

When the effect of floating sand or current is great, use a large anchor.

Installation levelness is within 15°. If it is more than 15°, data cannot be obtained normally.

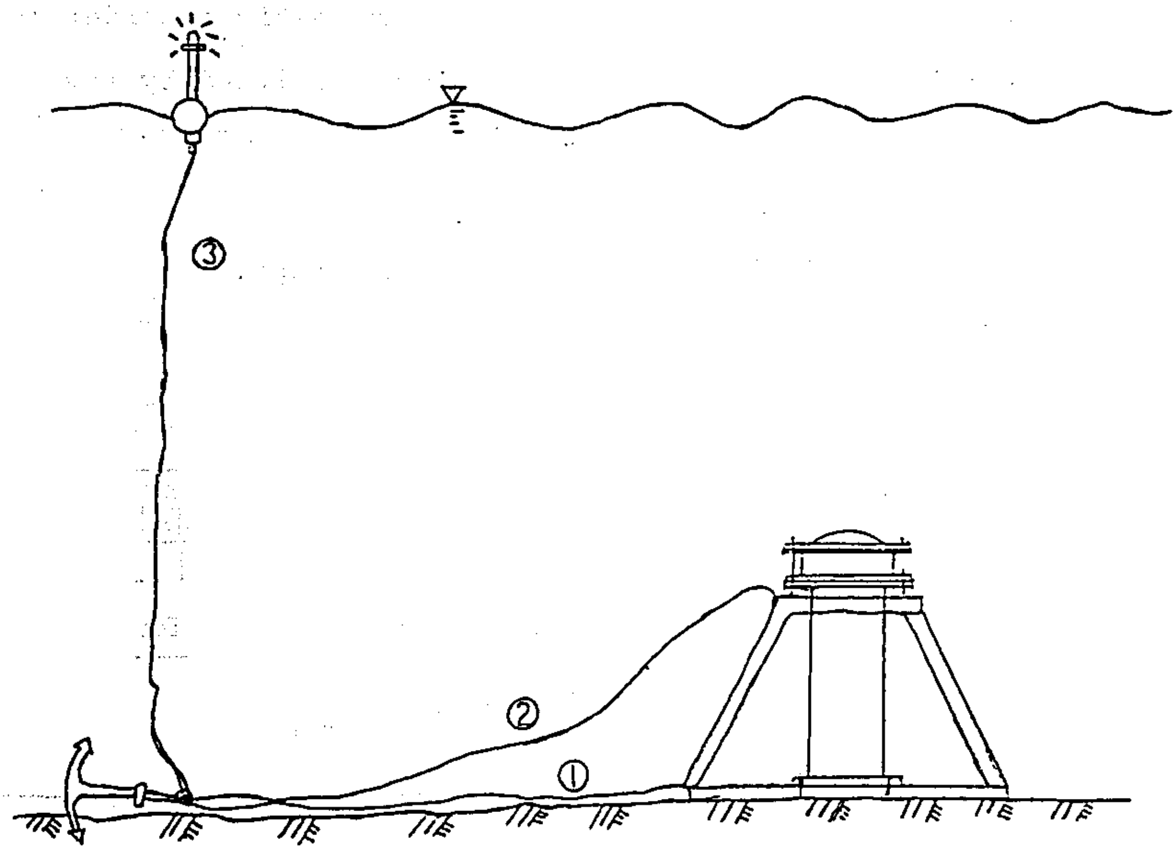


Fig. 7-1

8. CHAGING METHOD

Use attached special charger for charging. Insert battery connector into the charger. Turn on power switch of the charger, then the lamp lights, and charging is started. Since the amount of battery charge is not known accurately, charge for 15hours. Completely discharged battery becomes fully c harged condition after 15 hours of charging. When the amount discharge of a battery is smoall, 15 hours charging causes overcharging, however, it is not the matter. In the case of overcharging while a battery is being charged, the battery becomes slightly warm. According to this, judge that the battery is fully charged.

Be sure to use battery after 4-5 hour overcharging.

9. DATA RECORDING

9-1 Tape Format

Data of cassette tape recorded by this magnetic recorder is recorede in the information recording format specified by the standards such as ISO-3407 and JIS -C 6281.

9-1-1 Tapa format

Fig.9-1 shows format of cassette tape.

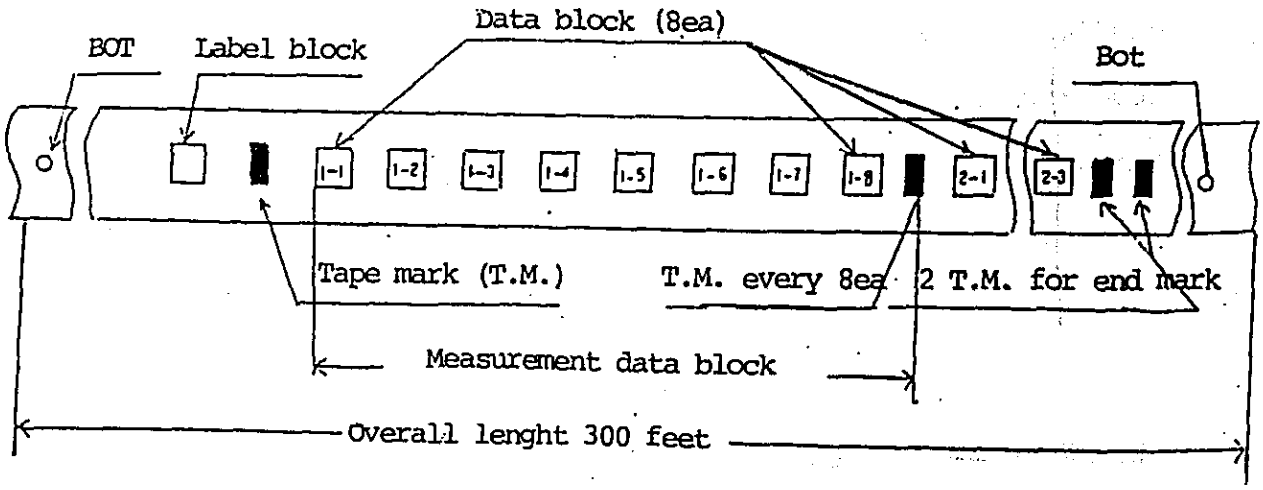


Fig. 9-1 Tape format 256bytes/block

(a) Label block

Information, such as product No., measurement time, and sensitivity coefficient, are recorded.

(b) Data block

In the case of 10min observation (Note 1).

Data for one observation requires 4blocks (1024bytes). That is, the first time observation data are recorded in data blocks 1-1 to 1-4 and second time observation data in data blocks 1-5 to 1-8.

In the case of 20min observation (Note 2).

Data for one observation requires 8blocks (2048bytes). That is, the first time observation data are recorded in data blocks 1-1 to 1-8 and cecond time observation data in blocks 2-1 to 2-8.

Note 1. In the case of measurement mode 0 and 1.

Note 2. In the case of measurement mode 2, 3, and 4.

9-1-2 Content of label block

256 bytes			
32 bytes	32 bytes	32 bytes	160 bytes
Observation condition (A)	Number of data (B)	Coefficient (C)	NULL (D)

(a) Content of observation condition

32 bytes

2 bytes

Machine No.	0	0	Measurement time	Measurement interval	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Machine No, - Manufacturing No. of wave height meter.

In the case of SSW-II ...24xxx

Measurement time - 10 (min) or 20 (min)

Measurement interval - 20 (min), 60 (min), or 120 (min)

(b) Content of number of data

32 bytes

2 bytes

CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	CH 9	CH 10	CH 11	CH 12	CH 13	CH 14	CH 15	CH 16

This portion shows number of recorded data in each channel (CH1 -CH6) and data structure. That is, when record data is 1 byte number of data is shown by a positive value, and in the case of 2 bytes structure, number of data is shown by a negative value.

2 bytes	32 bytes														
CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	CH 9	CH 10	CH 11	CH 12	CH 13	CH 14	CH 15	CH 16

CH1 is a value -1, that is, one (average value) 2 bytes data is stored.

CH2 is 1022 or 2046, that is, 1022 or 2046 1 byte data are recoeded (wave height data value).

CH - CH16 ...0. Nothing is recorded.

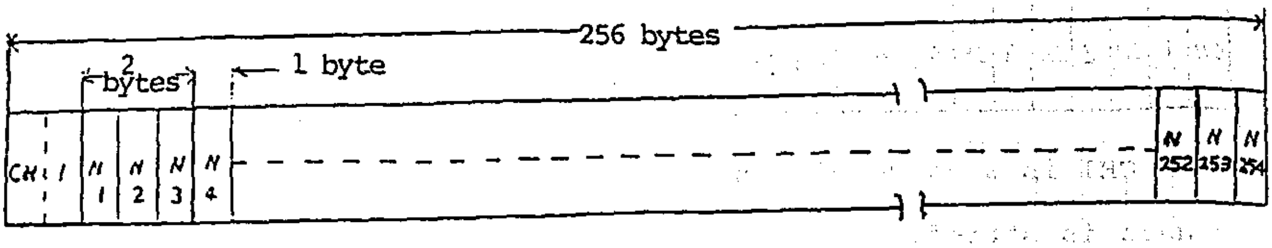
(c) Content of coefficient

32 bytes															
S	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

This portion records a coefficient for converting record data value to physical quantity. Each value is represented by an integer in the range of -32768 to 32767. In calculation, take numerals up to 999 as a number below decimal point. That is, if the coefficient is 2000, it is handled as 2.000 in the calculation for converting to physical quantity.

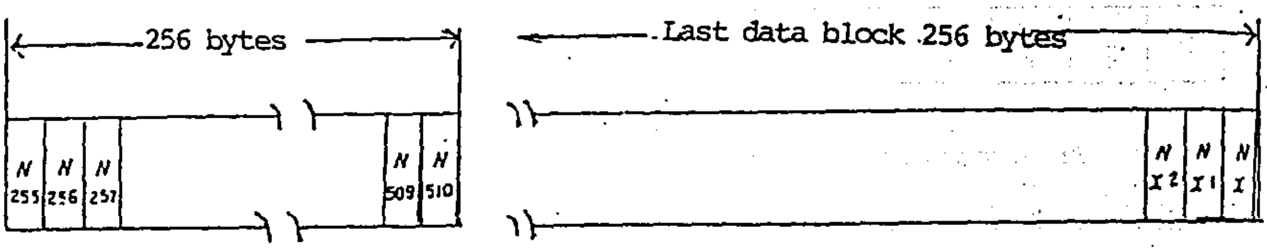
Note : Numeral values of labal block are all 2's complement values of 2 byte structure.

9-1-3 Content of data block



The first data block aming the data of each observation recods average value.

CH1 - average value. This value, when multiplied by the coefficient of label block, becomes water depth (cm). Wave height data N1, N2, N3 ... are differences from this average value.



In the data block after the second data block, wave height data enters from the first byte. Number of data blocks for one measurement varies according to the measurement maod.

Tape mark is recorded in every 8 data blocks regardless of the measurement mode.

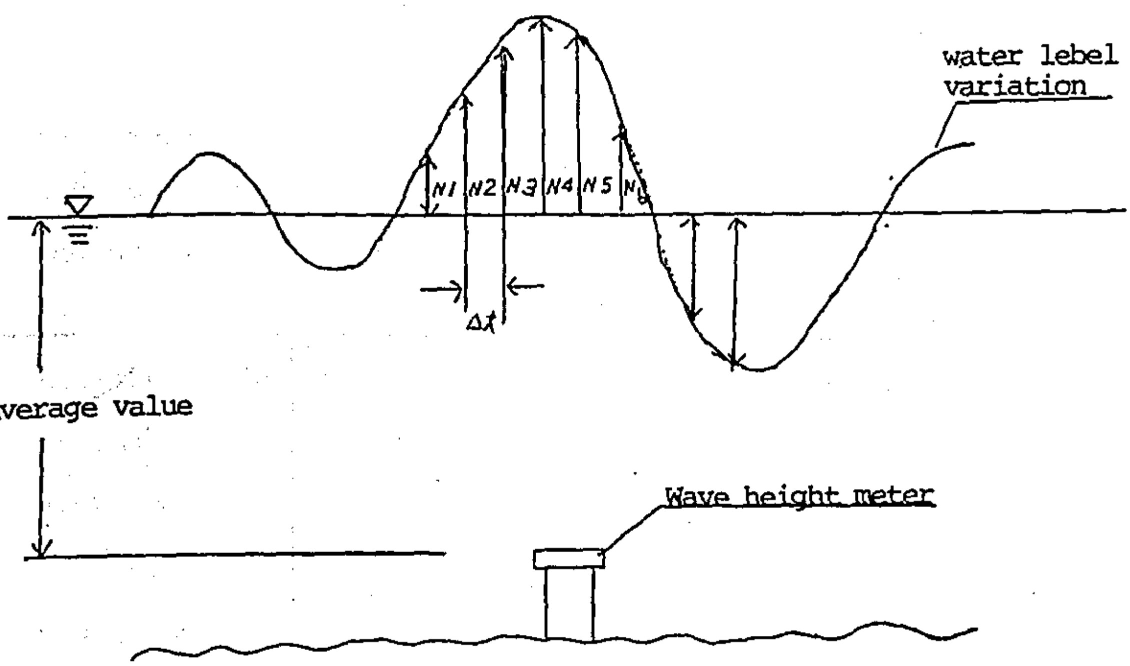
Measurement mode (0)-(1)

Number of data blocks : 4 Nx (number of data) : 1022

Measurement mode (2) - (4)

Number of data blocks : 8 Nx (number of data) : 2046

Relation between wave height and record data

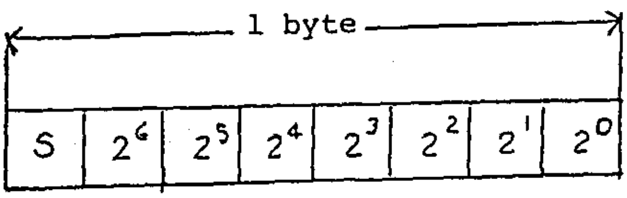


Δt : sampling interval 0.5 sec

N : record data 1127 = N = 127

(Handle N = -128 as error data.)

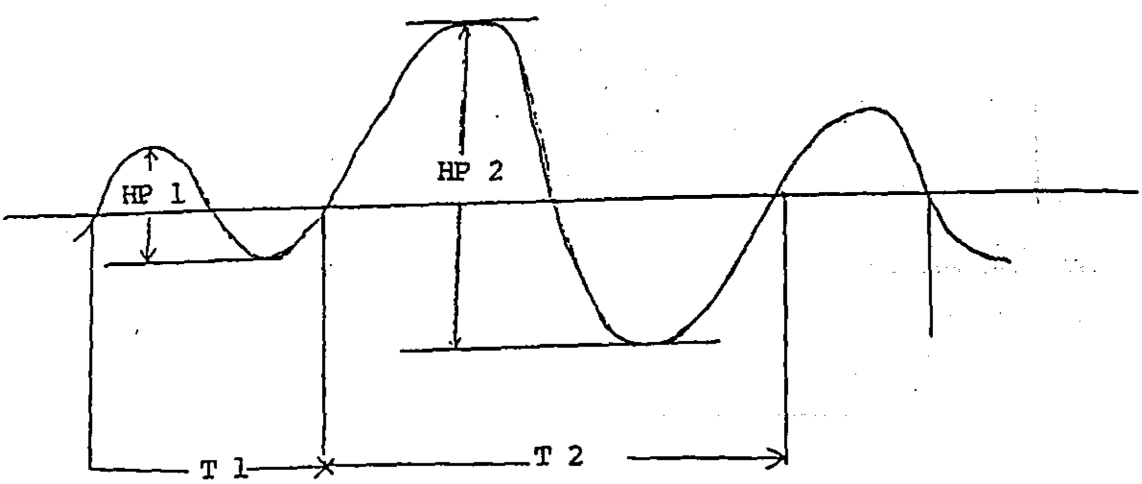
Record data is represented by 1 byte.



9-2 Calculation Method of Wave Height

9-2-1 Calculation method of wave height

(a) Detection of wave height and period by zero-up cross method.



Wave height and period are detected by the zero-up cross method as shown above from recorded data.

(b) Calculation of wave height

Detected wave height is converted to actual wave height value by the following formula.

$$H\ (cm) = \frac{So \times Hp}{1000}$$

where Hp : wave height by recorded value

H : actual wave height

So : recorded sensitivity coefficient

(1250, 2500, 3750, 5000)

Wave height value displayed and outputted in this wave height meter is a value calculated by the above formula.

9-2-2 Data processing

The following method is used for reading data recorded in the cassette tape. For the detail, ask sales engineer.

(1) Cause the calculation result to be displayed by the data-out function of the magnetic recorder of this system, and write the value displayed.

(2) Cause the teletypewriter to print the result of calculation by the data-out function of the magnetic recorder of this system. Refer to paragraph II for the connection with the teletypewriter.

(3) Connect magnetic tape reader (CTR-1) (option) with the user's computer. CTR-1 has RS-232 Cinterface. Cassette tape data can be read by a simple command from the computer.

(4) Use magnetic tape converter (COV-1) (option). Convert cassette tape data to computer open reel tape, and process by other computer.

10. MAINTENANCE AND INSPECTION

10-1 Action to be Taken in Case of Trouble

Table 2 shows a list of messages. Take action according to each message.

Table 1 Massage List

Message	Meaning	Action
8000	Check mode operation start.	
8002	CMT does not start normall.	Load cassette tape and set again.
8003	Data is not recorded on cassette tape normally.	Clean CMT write head using cleaner.
8004	Insufficient charging of battery.	Charge battery.
8005	Completely discharged battery.	Charge battery sufficiently.
8006	Data memory trouble.	Replace control circuit. (factory repair)
8008	Record remains on cassette tape.	Refer to check mode operation.
8888	End of check mode operation.	
9000	Measurement mode operation start.	
9001	Abnormal setting of mesurement interval.	Re-set as specified.
9002	Pre-measurement state.	
9009	Abnormal termination of observation.	Data is recorded normaly. Switch off power.
9999	Measurement mode operation end.	
7000	Data-out mode operetion start.	
7777	Data-out mode end.	

10-1-1 When battery is spent prematurely.

Terminate check mode operation, and cause 8888 to be displayed. Set mode switch to measurement mode, and switch off power. When 8888 goes off, immediately, the circuit is not operation normally. When the circuit is operation normally, 8888 is displayed 3-4 sec or more, beomes dim gradually, and goes off eventually.

10-2 Maintenance of Cassette Tape and Magnetic Recorder

10-2-1 Caution on handling cassette tape

(1) Magnetic tape is very sensitive to dust. Observe the following cautions.

(a) Be sure to enclose tape in the container (case) before storage regardless of period (long, short) of storage.

(b) Before taking out cassette tape from CMT, wind up to the clear reader (reader tape).

(c) Avoid using/storing in dusty environment.

(d) In the cassette tape, magnetic surface faces outside except the clear reader portion. If the magnetic surface is touched with finger, drop-out, etc. will occur. Never do such action.

(2) Don't apply excessive force to cassette. When a heavy material is placed on tape, or tape is twisted or dropped on the floor, cassette may be damaged or tape edge may be damaged.

Be careful.

When transporting cassette tape, be careful not to apply severe shocks and vibrations.

(3) Keep data recorded cassette tape out from strong magnetic field, otherwise data will be damaged severely.

Be careful not to expose to direct sunchine, microwave, far infrared rays, etc.

10-2-2 Write enable plug

On the side opposite the window of cassette tape, two write enable plugs are provided (Fig. 10-1). One is for the first track (A side) and another for the second track (B side). When recording new data erasing the previous data, use a cassette tape having the write enable plugs. Presence/absence is detected by the microswitch (file protect switch). When the write enable plug is pulled out, CMT becomes write unable condition. Use cassette tape to be used as data regenration by removing this plug. Data damage due to misoperation can be prevented.

Write enable plug can be installed/removed as many times as desired.

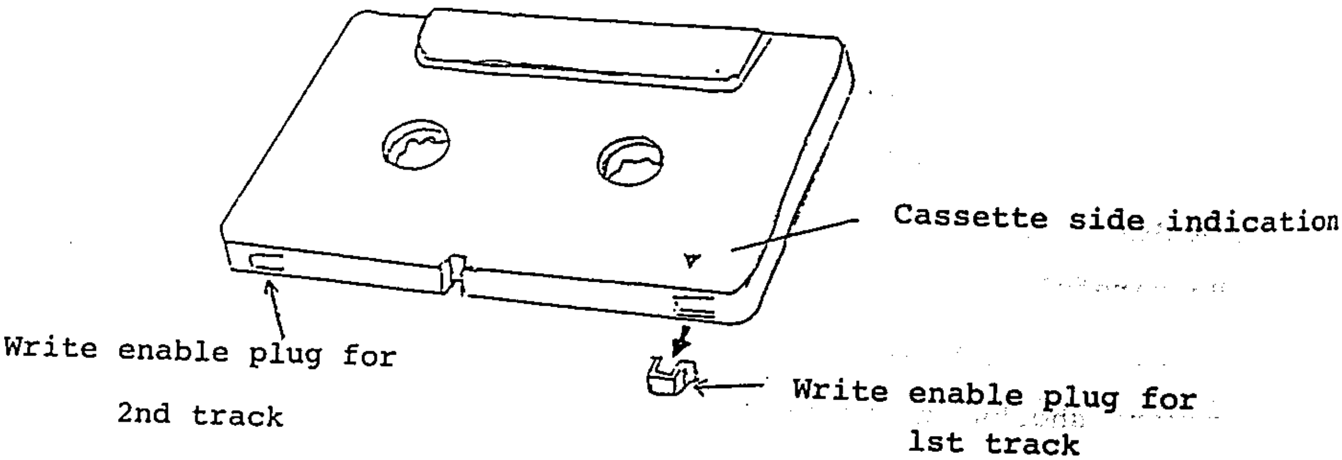


Fig. 10-1 Casette and write enable plug

10-2-3 Magnetic recorder cleaning

Cleaning material

(a) Cotton cloth free of waste piece of thread such as gauze, or swab.

(b) Cleaner of trichloroethane group.

The following is avalable as special cleaner kit.

Content : swab, gauze, cleaner liquid

TZ-350 (TEAC No.17930220-00)

Cleaning procedure

(a) Remove pocket cover. Remove tape.

Press entire pocket cover in the direction of arrow mark (head direction) (See Fig. 2), and remove by pulling paet at the botom of the cover in the left direction (arrow) of Fig. 10-2

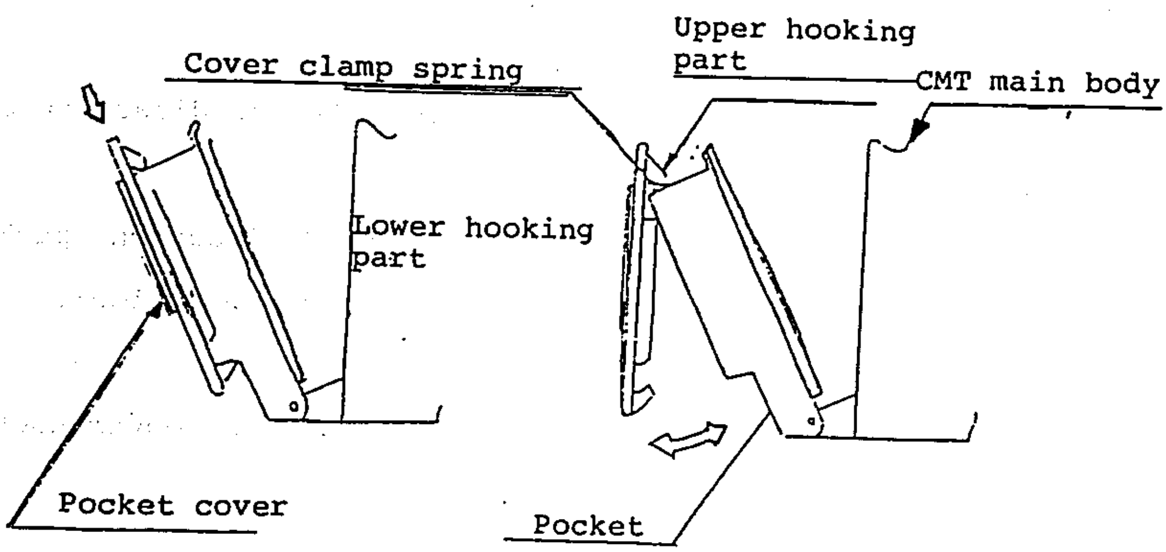


Fig. 10-2 Fig. 10-3

Pocket cover installation/removal

(b) Thoroughly clean the head surface with swab or cloth soaked with cleaner liquid. Similarly clean two tape guides and encorder tape contact part carefully. Since dust collection is small compared with the head, clean simply once every 2-3 times of head cleaning. Be sure not to over- apply cleaner liquid.

Clean encorder and left side tape guide (marker sensor) slowly and carefully so as not to apply force. Clean the encorder while turning by hand.

(c) Wipe guide pin (2ea) and other mechanical part surface with a dry cloth at times. Don't use cleaner liquid.

At this time, be careful there is no waste thread, etc. left on the lamp window of guide pin (w/lamp) on the left side.

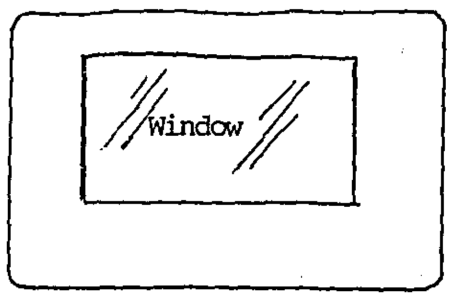
(d) Install pocket cover. Hook the upper hook of the cover on the cover clamp spring located on both sides of the input of pocket.

At this time, be careful not to mistake the direction of cover.

While pressing entire cover in the head direction, push in the arrow right direction (Fig. 10-3) (pocket direction), and insert into the pocket.

Make sure that hook part (both sides) of the cover hooks on the cover crank spring securely.

Top



Bottom (head side)

Fig. 10-4 Pocket cover

11. METHOD FOR CONNECTING WITH TELETYPEWRITER

The specification of interface with the TTY is as follows.

Transfer system	2	20mA current 100p system
Transfer speed	4	110baud
Number of stop bit	6	2bits
Number of data bit	8	8bits
Number of start bit	10	1bit
Connector used	12	D-SUB type 9 pin (female)

Type name HDC-9S (Hirose Denki)

Pin arrangement

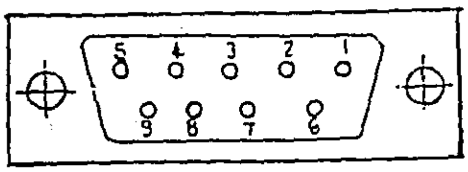


Fig. 11-1

Pin signal name

(1) Open
(2) Open
(3) Receive signal
(4) Receive return
(5) Open
(6) Send return
(7) Send signal
(8) + 12 V
(9) 0 V

12. TTY INSTERFACE CIRCUIT

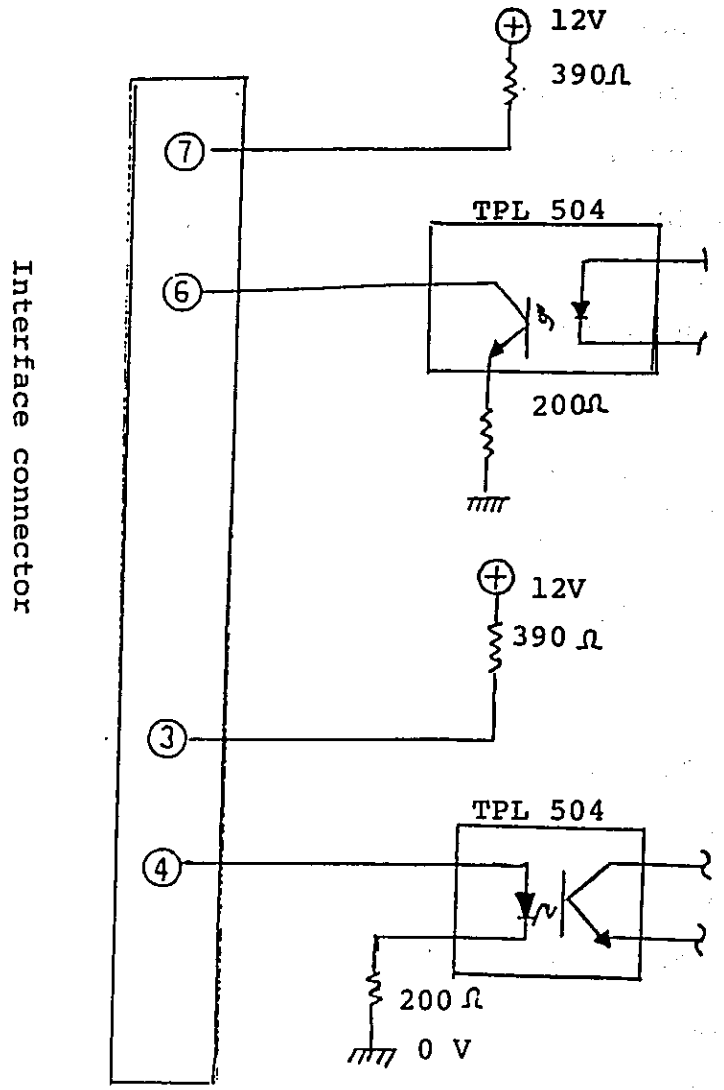


Fig. 11-2 TTY onsterface circuit

13. TTY PRINT FORMAT (STATISTICAL PROCESSING RESULT

Content of label block (hexadecimal)

Product No. (78001) — Measurement interval (120 min)

Sencitivity coefficient (2500) — Measurement time (10 min)

Sampling number (1022)

```
71 9 0 1 3 0 [illegible]
[illegible]
FFFF31F[illegible]
[illegible]
09C 119C[illegible]
[illegible]
```

```
0382 080
0365 079
0350 060
0335 075
0303 065
```

```
0062 075    Max. wave height, period (0.62m, 7.5sec)
0057 079    1/10 wave height, period
0047 083    1/3  wave height, period
0032 069    Average wave height, period
0327 072    Water depth, number of waves
            (3.27m, 72waves)
```

```
0168 065
0147 075
0120 081
0077 064
0377 077
```

```
0097 075
0077 083
0062 082
0040 070
0375 058
```

```
0092 080
0075 081
0057 082
0037 072
0370 058
```

```
0167 076
0057 080
0045 081
0030 073
0345 068
```

```
0082 080
0072 083
0055 083
0035 071
0330 074
```

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

0068	080	
0065	075	
0045	070	
0045	070	
0035	060	
0035	090	
0027	085	
0027	070	
0020	050	
0032	120	
0042	055	
0027	050	
0022	055	Wave height, period (0.47m, 8.0sec)
0047	080	
0047	085	
0025	090	
0025	075	
0025	090	
0030	070	
0022	055	
0042	080	
0040	070	
0025	055	
0015	025	
0012	040	
0035	095	
0025	070	
0032	055	
0032	130	
0032	130	
0025	090	
0022	075	
0045	080	
0040	095	
0035	070	
0030	070	
0025	[illegible]	
0015	050	
0045	080	
0047	130	
0042	025	
0032	095	
0037	070	
0030	140	
0025	085	
0010	045	
0022	050	
0080	080	Statistical processing result
0065	079	
0050	058	
0035	075	
0030	065	

15. CAUTION ON SYNCHRONIZATION SYSTEM HANDLING

(1) Connect synchronization cable during observation waiting status.

(2) In case of independent use, be sure to enter dummy connector into underwater connector of the main body, otherwise inoperative in water.

(3) Disconnect synchronizarion cable while in observation waiting.

(4) As a natural result of connection with the synchronization cable, start time of each observation always coincides, however, set so that individual observation start time does not deviate. When individual start time deviates to a large extent, battery is wasted and specified observation days cannot be realized at times.

(5) Synchronization signal check procedure

(a) Connect all equipment with syncronization cable.

(b) Power on individual equipment, and set to check condition.

(c) Start individual equipment sequentially.

After CMT check, each equipment stops with 8000 or 8008 (in the case of 8008, equipment stops individually) displayed.

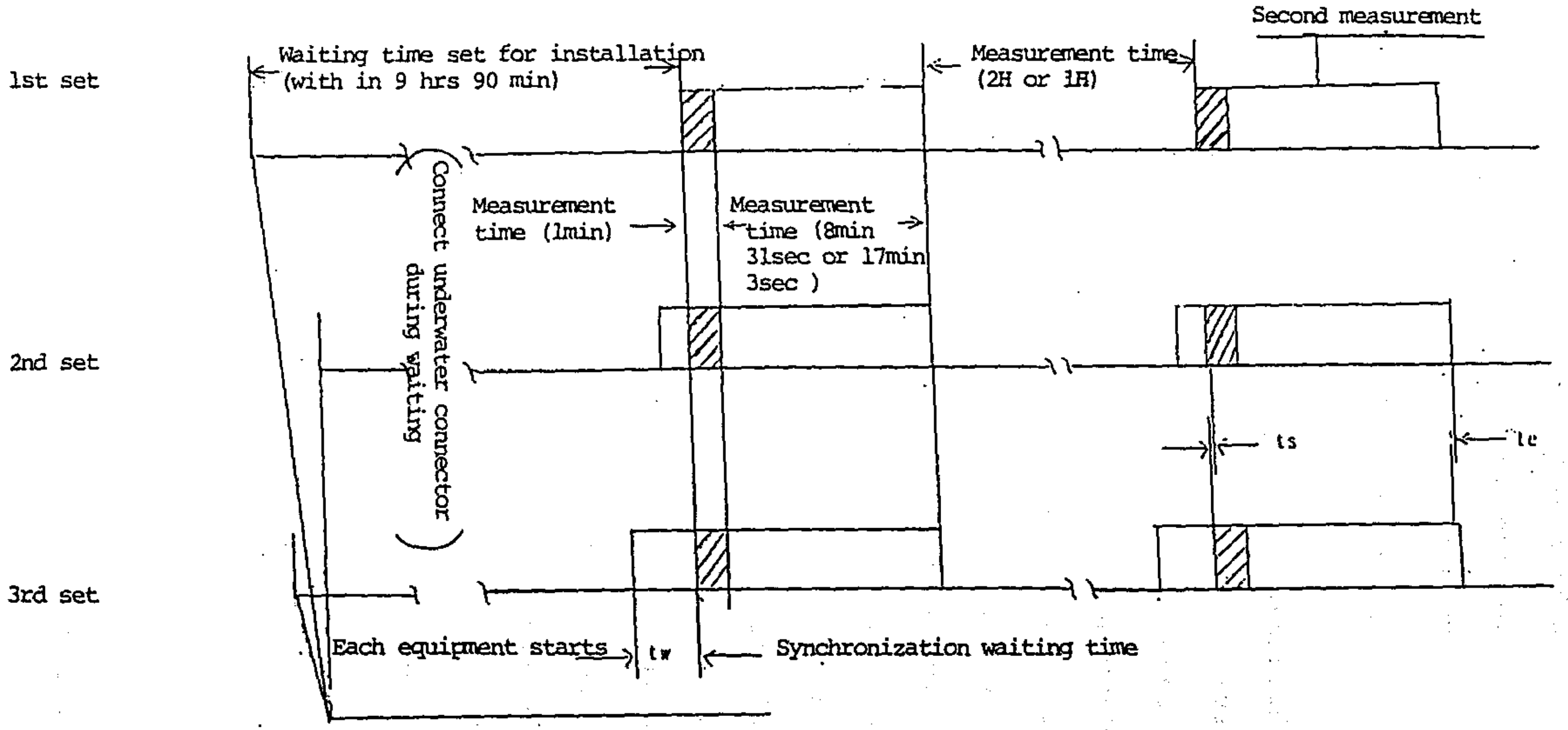
Synchronization condition is set in the condition where the last equipment completed CMT check, and individual displays are counted up by the same number. When the synchronization signal does not operate normally, 8000 is kept displayed.

(6) Be sure to insert dummy plug into unused underwater connector of the equipment at the both ends conncted with synchronization cable.

(7) For insertion/removal of underwater connector apply sufficient silicon grease.

(8) When underwater connector is used, wash it with water, apply sufficient grease, and insert dummy connector for storage.

(9) Synchronization system time chart



1. Start each equipment as desired. At this time, set waiting so that synchronization waiting time (TW) does not deviate each other.
2. Ts : Max. deviation time of measurement start one equipment from the other

   Ts 200 Ms

   Te : Max. deviation time of measurement end one equipment from the other

   Te 5.7 ms or t 10.8 ms

APPENDIX 7

INSTRUCTION MANUAL
OF
SELF RECORDING CURRENT METER
(MODEL:MTC-2) AND (MODEL:MTC-3)

KYOWA SHOKO CO., LTD

TOKYO

CONTENTS

1. Preface

This self recording current meter equipped one constant-pitched impeller by which can survey from low speed to high speed current range. Both current velocity and direction are recorded in magnetic tape of recording unit for about one month.
Installation in this operation manual is as the same settlement as other type current meter. However, this current meter is equipped with many functions compare with other ones. The reason why is micro preocessor already builts in this recording unit.

For avoiding the mismeasuring by mistaking, please make sure to use this current meter under a full understanding of handling and action in accordance with this operation manual.
Also, mainpart (i.e. electric circuit board, magnetic tape unit, etc.) of this current meter is very sensitive to dust and dirt.
This current meter shall be stored always in a well-conditioned room when no use even a short time, in order to keep its reliability.

2. Component

2-1. Current meter	1	set
(1) Water-proof case	1	pc.
(2) Impeller	2	pcs. (one as spare)
(3) Magnet compass	1	pc.
(4) Magnetic tape recording unit	1	set
(5) Battery	1	pc.
(6) Tail plane	1	set
2-2. Suspension device	1	set
(1) Suspension arms	1	pair
(2) Stay	1	set
2-3. Housing box	1	pc.
2-4. Standard accessories	1	set

3. Specifications

3-1. General specification

(1) Dimension	276 W x 520 H x 920 L mm
(2) Weight	Approx. 30 Kg
(3) Measuring range for velocity	0.02 - 5.00 meter/sec.
(4) Accuracy for velocity	1 % FS
(5) Measuring range for direction	0 - 360 degree
(6) Accuracy for direction	± 5 degree
(7) Maximum depth	200 meter
(8) Measuring period	According to setting mode. For example, 2 min. for measuring at every 10 min. is for one month.
(9) Source power	Nickel cadmium battery DC 6 V and 12 V, 3.5 Ah

3-2. Magnetic tape recording unit

(1) Data format	Data recording and data reproducing by the magnetic tape unit comply with ISO-3407, JIS-C6281 and other similar standards.
(2) Magnetic cassette tape	Single track, double play tape type for information interchangeable. Standard model: CT-300 (TEAC)
(3) Recording method	Phase-encoding
(4) Densitity	800 bpi

3-3. Impeller

(1) Dimension	144 ∅ x 112 L mm
(2) Weight	50 g

4. Name of each part

4-1. Water-proof case

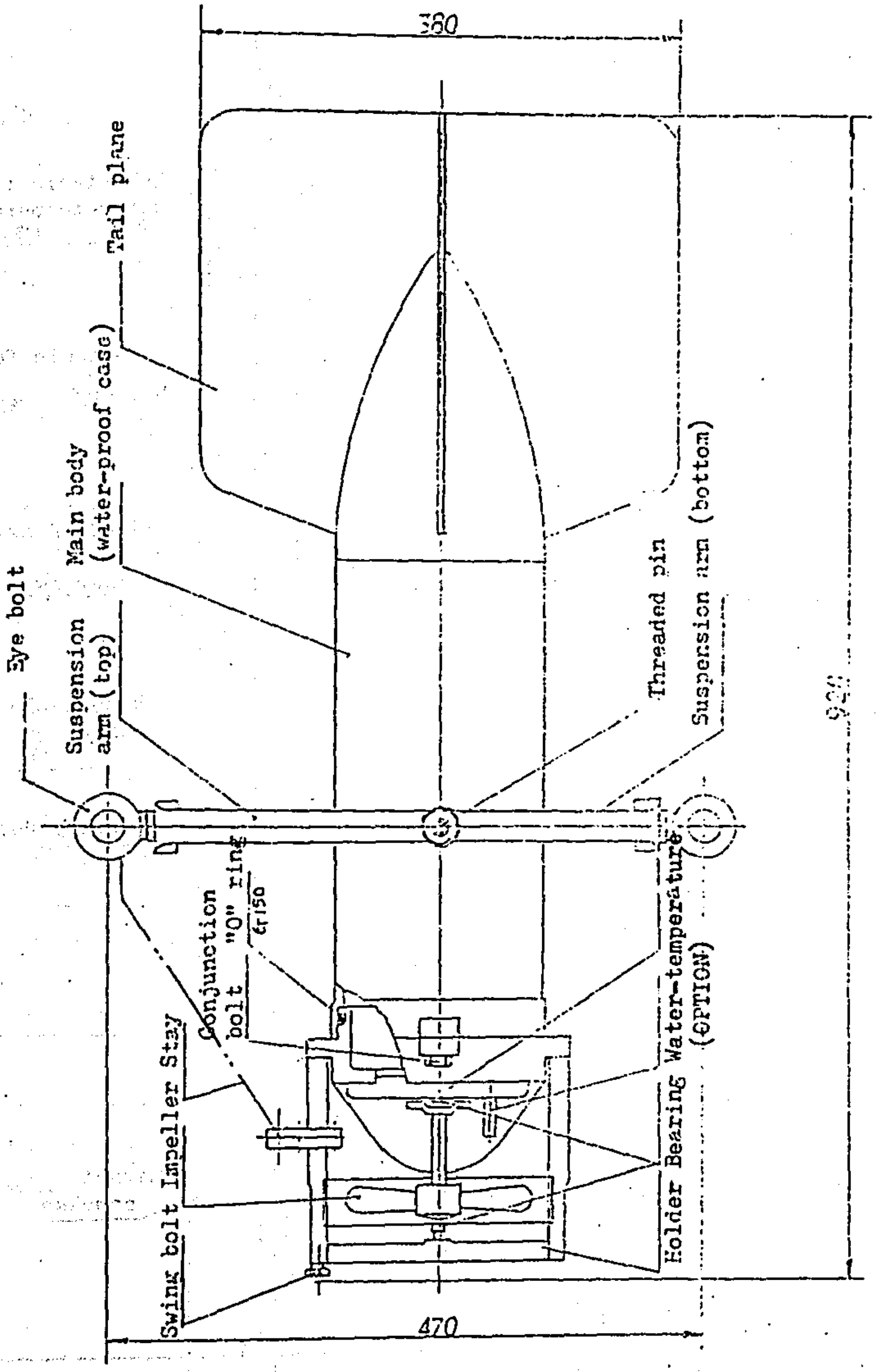
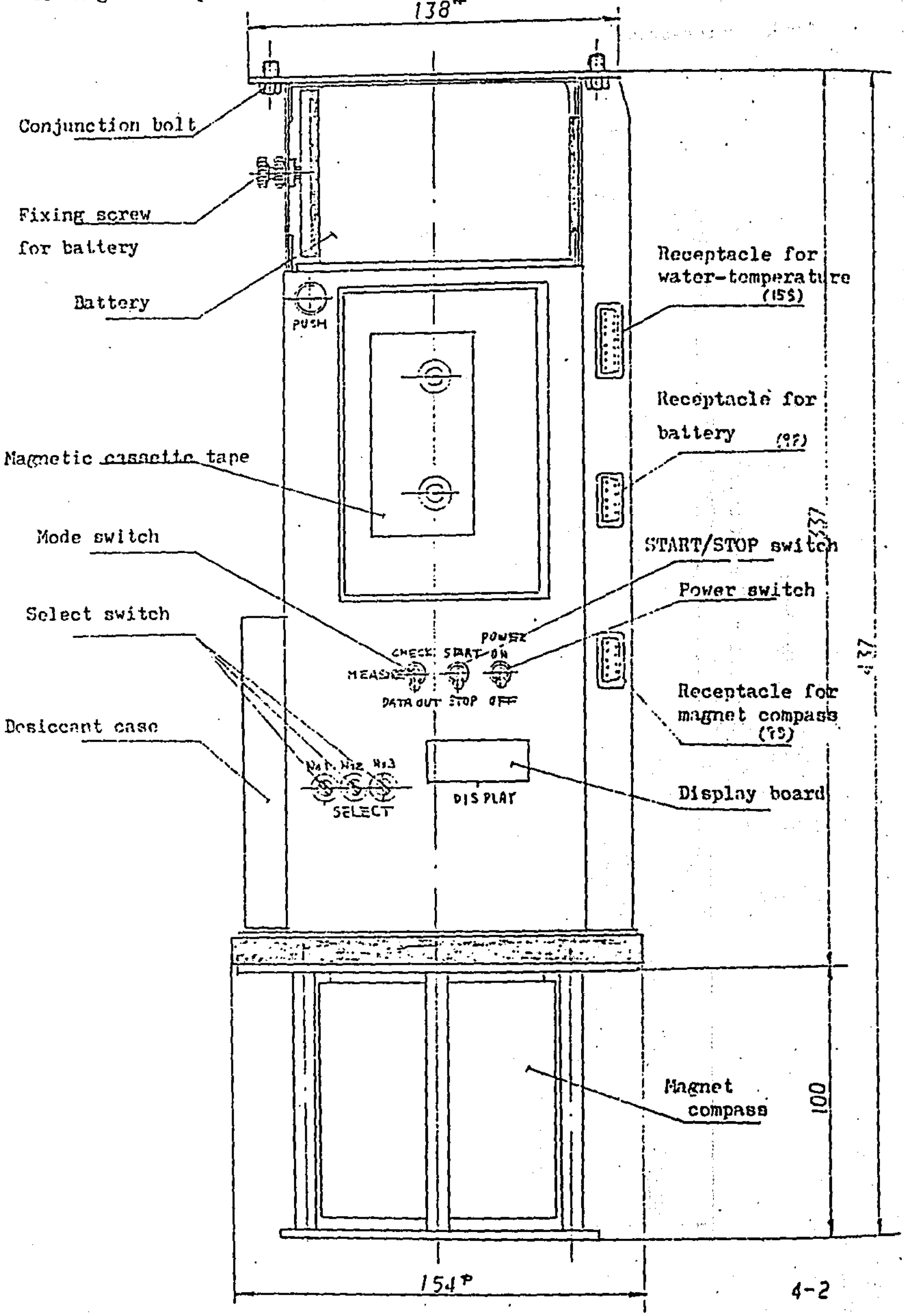


Figure 4-1

4-2. Magnetic tape recording unit



5. Construction of water-proof case

5-1. Construction of suspension arm

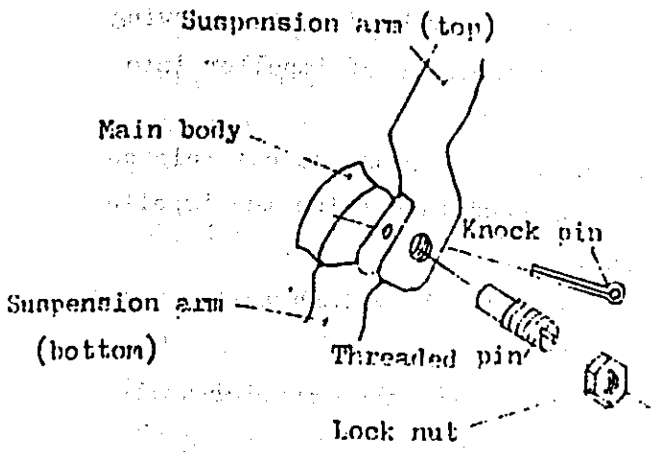


Figure 5-1

First, pull out each threaded pin from suspension arm, screw its pin and lock nut again after fitting each hole of suspension arm.
In addition to the above, put each knock pin between lock nuts and set bolts without becoming loose during the survey.

5-2. Removal of recording unit

Removal the current meter from the housing case and stand it as figure 5-2.
Pull out a recording unit after removing a conjuntion bolt.
In this time, pull an impeller in advance.
In case of housing, clean the "O" ring packing with cloth and put silicon grease around its face and inside of main body. Then, insert the recording unit into the water-proof case.
Pay attention to the face of "O" ring packing without making a scratch.

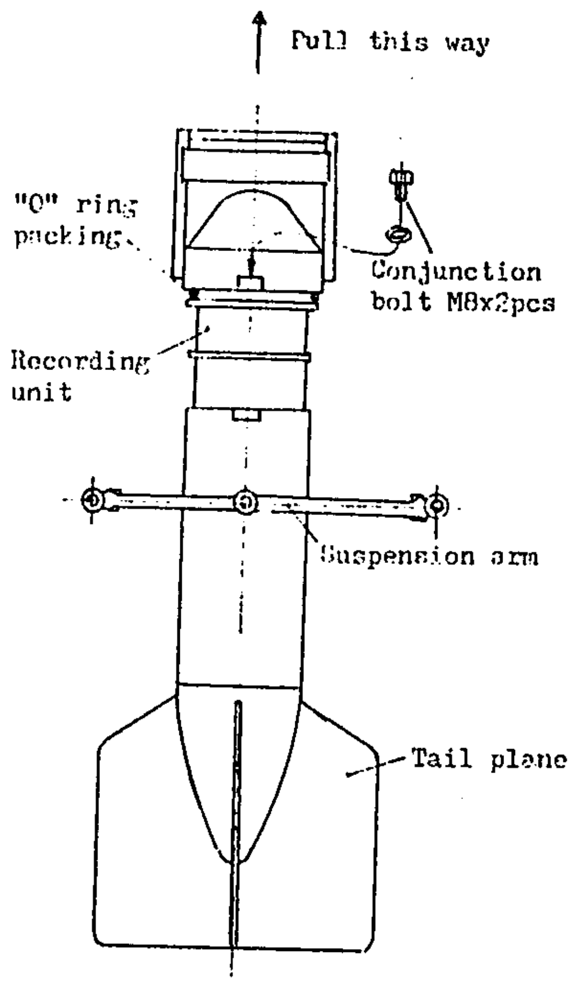


Figure 5-2

5-3. Insertion of impeller

Insertion of impeller is, unscrew a swing bolt and slant a holder for impeller. Fit the impeller to the body at its head, unscrew swing bolt, slant the holder of impeller and put the axle of impeller into the hole at the head of the body.

When the axle is properly put into the rear bearing, do not release the impeller and still holding it by your hand then raise the impeller holder and put the axle into the front.
In this case, it is necessary to leave a little back-lash to the rotation of impeller.
Confirm the condition of swing bolt not releasing the impeller while surveying.

In case of change for impeller, pay attention not to break the blade of impeller.

6. Handling of recording unit

6-1. Preparation

6-1-1. Change of battery

Turn off a power switch, pull out a power plug. Unscrew fixing bolt then, push the battery out from the chamber. Put the full charged battery into the chamber, screw up fixing bolts and clamp the lock nuts. Then, commect the power plug into the receptacle perfectly.

6-1-2. Insertion of magnetic cassette tape

Use the cassette tape with the information interchange which comply with ISO, ECMA, ANSI, JIS and other similar standards.
(IT CAN NOT USE A SOUND TRACK TAPE)

Open the pocket of the magnetic tape unit (MTU) by depressing the eject button. Insert the cassette fully into the pocket showing its front side opposite to the operator. The cassette will be stopped when it is fully inserted to the bottom. Be sure to push the cassette straight into the pocket. Do not force the cassette when it will not go into the pocket smoothly. If the pocket does not close perfectly, repeat the action in above way.

Lock the pocket by manually depressing on the center area.
Use the new cassette tape or full erased magnetic tape perfectly.
If the user uses the recorded tape without erasing, it will be happened to can not read out from it.
In case of using the recorded tape, erase the recorded data perfectly by the action of check mode completely, then use it again.

6-1-3. Change of dessicant

It is used "Nitto gel" (net weight 20 g) as a desiccant.
Put it into the desiccant pocket located the side of recording unit with attention.
Change it at every surveying times in advance.

6-1-4. Calculation of measuring period

Measuring period of this current meter can calculate as following. Select the measuring mode with this calculation in advance.

$$\text{Maximum measuring period} = \frac{3.5\ I}{1.44\left[0.039 + 0.026 \cdot I + (0.25V+0.16)\ M\right]} \quad \text{Formula 6-1}$$

I: Meauring interval (minute)

M: Measuring time (minute)

V: Mean current velocity (meter/sec.)

For example, In case of measuring time:2 minutes
measuring interval: 10 minutes
mean current velocity : one meter/sec.

$$\frac{3.5 \times 10\ (\text{minutes})}{1.44\left[0.039+0.026 \times 10+(0.25 \times 1.0+0.16) \times 2\right]} = 21.7\ (\text{days})$$ as maximum measuring period.

ATTENTION: Above maximum period will be changed according to the condition such as battery life, length of cassette tape, other fuctors, etc.

6-2. Operation and movement of check mode

6-2-1. Switch on of source power

First, switch on a source power. In this time, display board indicates no displaying or indefinite value will be displaied. These are not troubles because the indicated value will be out of order caused by charging or discharging of condenser. Example. [8 8], [8888.]
Also, these are instance as indicating [999], [0 0] on the display board.

6-2-2. Start of check mode action

Turn the mode switch to the check side. It will be start to work. In case of display shows [8000], it means well start.
After about two secounds, cassette magnetic tape (CMT) will start to move.
If the CMT was already recorded some data, display board shows [8008].
In this case, there are two operating ways as follows. choose one way of them.

First way is erase all recorded data of cassette magnetic tape. start with the original condition. After writing test in magnetic tape, CMT will start to rewind and erase the recorded data. After 5 minutes, all recorded data are erased and then rewound. After above action was finished, next action skips to clause 6-2-3.

Second way is operator no wishs to erase the recorded data. After stop to move, CMT will be rewound with the original condition, then skip to clause 6-2-3. The value $\boxed{8008}$ displayed on the board will not change its value until start to move in the clause 6-2-3. In case of using a new tape or erased tape (all data were already erased completely or a part which recorded at the begining of tape), CMT will acts to test for writing in with holding the value $\boxed{8000}$.

After above action, CMT will be erasing, it will be rewound and then start to erase inorder to erase the recorded data. After erasing, CMT will be rewound again and then skip to the clause 6-2-3.

ATTENTION:

1. This check will not act a full length of CMT. In case of resurveying with the recorded tape or used one, use the CMT after erasing all recorded data completely.
2. In the action of clause 6-2-2, the displaied value is abnormal condition except the value $\boxed{8000}$ and $\boxed{8008}$. Please recheck it with the clause 10-1.

6-2-3. Check of detector

Check the builts in each sensor. Each sensor will choose by select switch No. 1. Current velocity and current direction are correspond to the position of 8 and 9 respectively.

(1). Metal plate(s) (contact plate) attached with impeller's axis cuts the magnetic field existed at the front of non-contact switch by revolution of impeller. A current pulse signal given by the non-contact switch when the impeller makes 1/2 revolution.
Display board shows the calculated revolution numbers of impeller with the position 8 of select switch No. 1.
The value $\boxed{NN.NN}$ revolution/sec. For example, the value $\boxed{0123}$ indicated on display board means 1.23 revolution/sec. This value will be changed by new impeller's pulse then its value will hold until next impeller's pulse come out.

(2). The data stem from magnet compass will input by the resolution of 1.4 degree.
This value will indicate with the position "9" of select switch No.1. It will display $\boxed{0NNN}$ degree. The range from $\boxed{0000}$ degree to $\boxed{358}$ degree. The value is not a continued value the the relation of resolution.

The relation with current direction shows as figure 6-1.

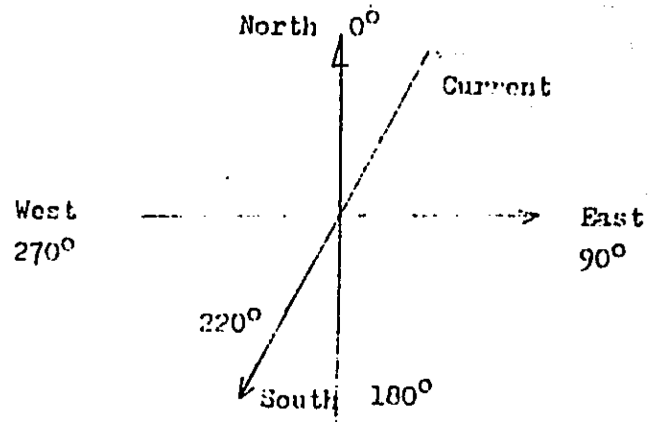


Figure 6-1

6-2-4. Finish of check mode action

Depress the START/STOP switch, display board indicates the value $\boxed{8888}$. It means an end of check mode. In case of using the check mode action, depress STAR/STOP switch down (OFF) without fail after final check.

ATTENTION:

1. If shift the mode switch to MEASURE or DATA OUT side without stop control of START/STOP switch. It can not control the commands.
2. If no action of stop control, all circuits become check mode function then battery will discharge completely within 10 hours.

6-3. Operation and action of measuring mode

6-3-1. Setting of measuring period and interval

Set the mode switch to the measuring position (middle point). Select the measuring time by the position from "1" to "9" of select switch No. 1. And also select the measuring interval by the position from "0" to "9" of select switch No. 2 and No. 3 respectively.

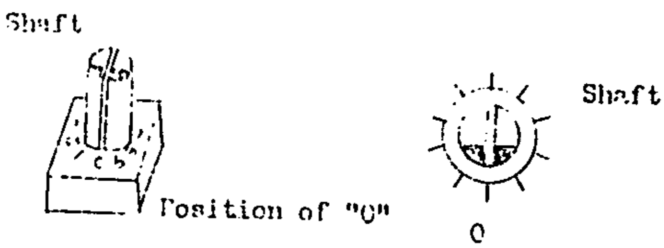
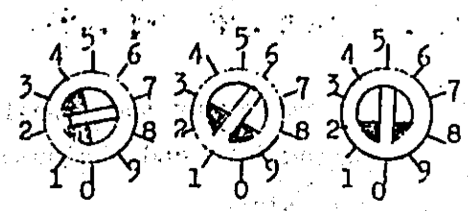


Figure 6-2 (A) (B)

Structure of select switch is as figure 6-2 (A). Confirming with the zero ("0") position, turn the shaft of select switch to the desired point with minus type screw driver.

In case of setting a condition as figure 6-3, measuring time is 2 minutes and measuring interval is 10 minutes.

No.1 No. 2 No. 3



2 Min. 1 0 Min.
Measuring period Measuring interval

Figure 6-3

$1 \leqq$ Measuring period $\leqq 9$ (minutes)

$2 \leqq$ Measuring interval $\leqq 99$ (minutes)

Measuring period $<$ Measuring interval

Measuring period = 0

6-3-2. Begining of measuring

After above setting of measuring time mode, push up START/STOP switch, CMT will start soon. In case of normal start, display board indicates the value $\boxed{9000}$. CMT will move after about 2 secounds and label data will will be written in the magnetic tape. After stopping the CMT, the first measuring will start to measure. The revolution numbers of impeller will be displayed on board by revolving the impeller. If the display board indicates the value $\boxed{0000}$ after revolving the impeller, pulse of impeller will not input into the recording unit. After the preset-time passing, measuring will be finished and display the measuring number $\boxed{0001}$ on the board.

After that, display board indicates the numbers of revolution during the measuring time and previous measuring number during the waiting time. Holding on this condition, insert the recording unit into the water-proof case after pulling impeller out.

Measured data will be stored until 64th surveying, CMT will move one time at the every 64 surveying. Data-writing time will finish within 5 or 6 secound.

ATTENTION:

1. Start time for measuring is an instant time when push up the START/STOP switch.
2. If the operator resets the measuring mode again after starting to measure, memory circuit board stores a previous value of started condition. If the operator wishes to change the preset measuring mode, turn off the power switch and erase the recorded label data by operating the check mode action again then, reset the new measuring mode.

6-3-3. Operation and action at the end of measuring

1. Draw out the recording unit and confirm the indicated value from the display board. If the display board shows the value $\boxed{9009}$, skip to the clause 2.
   If the display board shows the other values (except for the value $\boxed{9009}$), next operation will be required as follows. Confirm the condition of CMT

is waiting for measuring.

If the display board shows the number of revolution by revolving the impeller, it is a measuring time. By confirming the final measuring time and the number of revolution, depress START/STOP switch then, CMT will stop.

After two secounds, CMT will work to write in the stored data of memory circuit and end mark then, CMT will be rewound.

After pausing of CMT, display board indicates the value $\boxed{9999}$ and all measuring will be finished.

This operation of STOP control has to act at the final measuring period. If the operator neglects to handle this operation, the remained data in memory circuit will not be written in and/or recording of end mark. at the data processing time, it can not read out correctly.

2. If the display shows the value $\boxed{9009}$, there are two reasons.

It means to stop the measuring at the middle of recording caused by two reasons as follows;

A. Run out of CMT at the middle of recording.

B. Dropped down the voltage of battery compare with the stipulated value.

In this case, operater acts other operations after turning off a power switch. Displaied value $\boxed{9009}$ in such a condition, START/STOP switch refuses to command a new request.

ATTENTION:

1. Do not operate with check mode or measuring mode by leaving the recorded cassette tape in the cassette pocket.

   In order to protect the recorded data, it is better to pull out the enable plugs. No data can be written or erased into the original data in the cassette are protected from a careless erasure.

6-4. Confirmation of recorded data (Data out mode)

For the purpose of confirmation of the recorded data in cassette tape, this operation will be needed.

6-4-1. Setting of coefficient for impeller

Depress the mode switch to the data out position. Set the values of A and B from the certificate of impeller written V=AN+B into the each position of No. 1, No. 2, and No. 3 of select switch.

For example, in case of certificate as followings coefficient wrote,

$$V=0.492\ N + 0.019$$

The value 0.492 rounded to three decimal as 0.49 and the value 0.019 becomes 0.02.

· Set the values as figure 6-4.

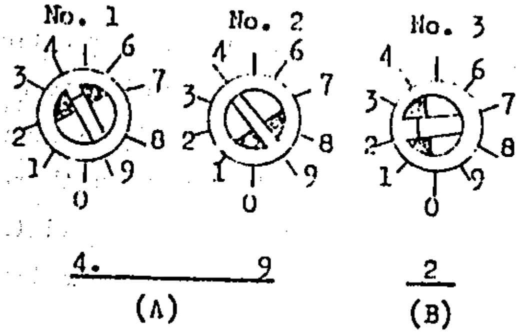


Figure 6-4 Set of coefficient for impeller

Set the correct value in order to calculate the current velocity by its value.

6-4-2. Begining and finish of data indication

Push up START/STOP switch in order to make a start. CMT will work after two secounds and read the label data. After reading the label data, CMT will pause for 30 secounds with holding the displaied value [7000] which is no change during this time. It is a time for going out the contents of label block into the teletype writer (T.T.Y.) even as it looks like no action.

After 30 secounds, CMT will move again and read out the 64 measuring data. The readed data will be calculated by the builts in micro processor, then display its result (at the same indicating time, output signal goes out into the T.T.Y. if connected.)

The recorded data will be displaied as following order, and repeat the data-display and one measuring at the rate of 5 secounds.

Cycle of Indication:

Numbers of measuring ---> [0012] ---> The 12th measuring data
Mean current velocity ---> [0123] > 1.23 meter/sec.-current velocity
Mean current direction ---> [0358] > 358 degree - current direction

ATTENTION:

1. This data, at the same indicating time, output signal goes out into T.T.Y.
2. Mean current direction is calculated and recorded at the measuring time.

Its value can let the indication alone.

At the final indication of the 64th measuring data by holding to leave the indication alone, CMT will move again and read the next 64 measuring data then continue to indicate that data. This action will be repeated until indicate the last data. CMT will rewind the cassette tape automatically after finishing the last indication. Finally the display board indicates the value

$\boxed{7777}$. At the same time, interface of T.T.Y. will be cut out like a break state.

Control unit accepts two operations during data out time.
One operation is push up START/STOP switch in order to make a start. Display board indicates as a cycle of numbers of measuring, velocity and direction then stop to indicate at the end of 64th measuring data. Push up START/STOP switch again, CMT will move to read the next 64 measuring data. This restart operation accepts at any time during the display period.
This operation is convenience for confirmation of recorded data within a short time.

Another operation is depress START/STOP switch in order to make a stop during the data out time. The indicating data until display the mean current direction, CMT will rewind and stop to output the action of data out with indicating the value $\boxed{7777}$.

7. Installation

7-1. For surface current survey

Generally, in case of surface current surveying is install the current meter as figure 7-1. Determine the buoyancy of bouy A, weight of anchor D, diameter and length of rope E in proportion to the depth H and maximum current velocity.

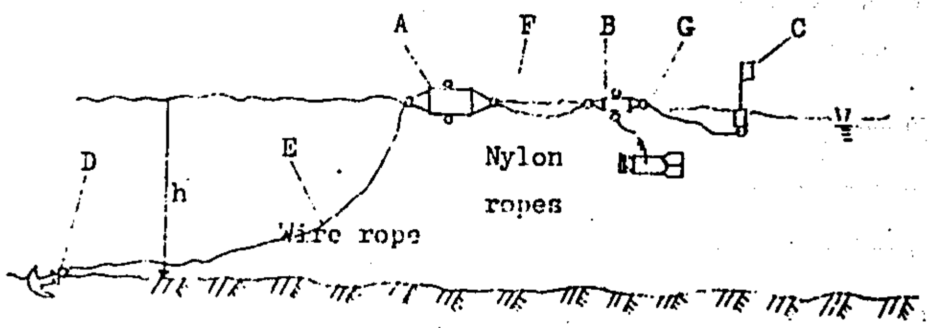


Figure 7-1

h (meter)	A bouyancy Strong current	Weak current	B Bouyancy	E m	D kg	F m
10	50	30	30	6ϕx30	10	18ϕx5
50	80	50	30	8ϕx125-150	30	"
100	80	50	30	8ϕx250-300	50	"
200	100	80	30	8ϕx400-500	80	"

7-2. For bottom current survey

In case of bottom current survey, install the current meter as figure 7-2.

For example, depth is 10 meter. They are determined with previous table. That is, buoyancy of buoy B is 30 kg, weight of cross anchor K is 35 kg, weight of anchor D is approximately 10 kg, Manila rope E is 15 ∅ x 15 meters, Manila rope C is 18 ∅ x 2 meters, Manila rope G2 is determined according to the desired length.

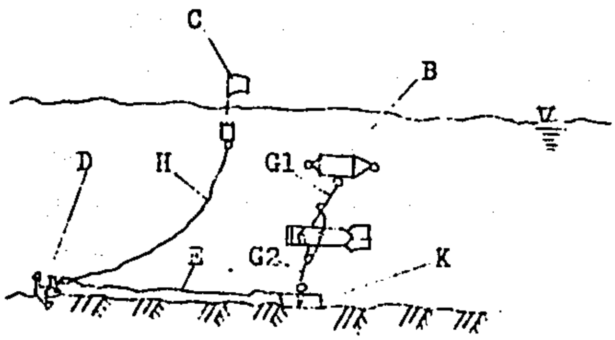


Figure 7-2

7-3. For surveying at the stormy weather

In case of bottom surveying at rough sea condition. It is better to set iron tripod on the sea bed and suspend the current meter with both top and bottom of suspension arms by ropes as figure 7-3.

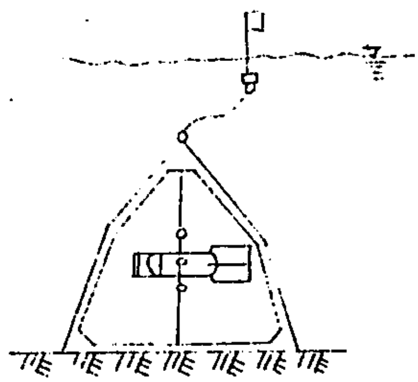


Figure 7-3

7-4. Proceeding at the end of measuring

In case of dismantlement of impeller, unscrew the swing-bolt, slant the holder of impeller by holding it in your hand and pay attention not to break a bearing and blades of impeller.

Clean a waterdrop with cloth when drawing out the recording unit in order not to get wet with water drops.

8. Charge of battery

Use the exclusive battery charger for the protection of battery. Insert a plug of battery into the receptacle of exclusive charger. Switch on a power source of charger, lamp will be lit and begin to charge. CHARGE THE BATTERY FOR 15 HOURS BECAUSE DISCHARGE QUANTITY OF BATTERY IS UNCERTAINTY.

If the battery is discharged completely, it is possible to recharge for 15 hours. It becomes well charged condition. If the battery is discharged a small quantity, charge the battery for 15 hours. It will become over charged but no mind.

During the charging hours, battery will become a warm slightly when it becomes over charged condition. Judge by it, battery is charged well or not. Use the well charged battery which was over charged for 4 to 5 hours.

9. Recording data

9-1. Tape format

Magnetic cassette tape recorded by this current meter comply with ISO-3407, JIS-C6281 and other similar standards.

9-1-1. Tape format

Figure 9-1 shows the format of the full span of cassette tape.

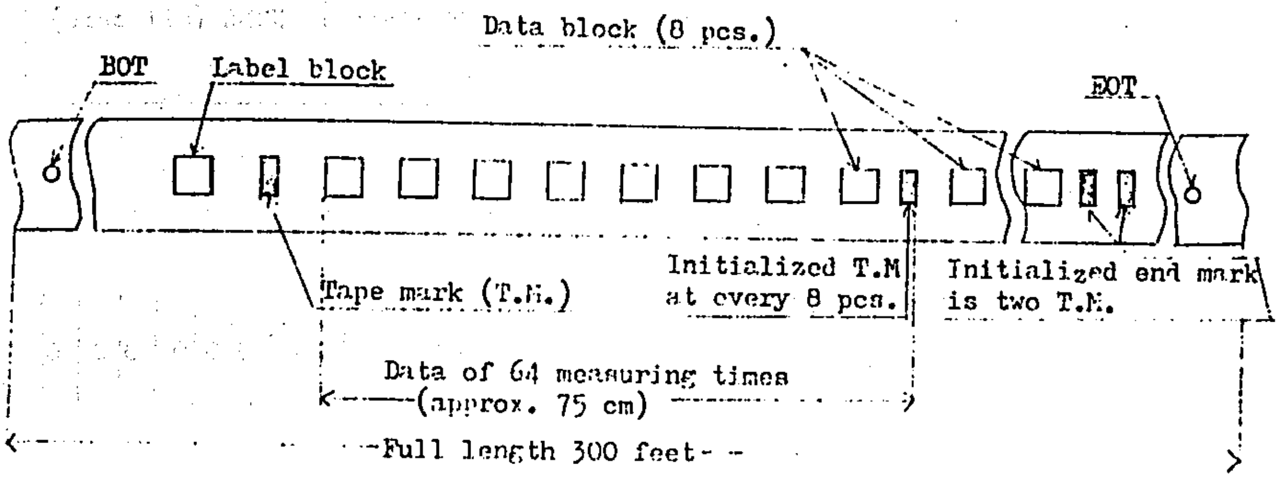


Figure 9-1. Tape format 256 byte/block

(A). Lable block

Recorded with serial number, measuring period, measuring interval and other similar informations.

(B). Tape mark

T.M. (Tape mark) is a period of recording data. Tape marks are recorded at the every 8 pieces of data block after the label block.

(C). Data block

Measuring data are recorded in the data block. 8 measuring data are recorded in one block. All blocks including label block, are composed 256 byte/block.

(D). End of tape mark

End of tape mark (EOT) is recorded two tape marks. The data will not record after the end of tape mark.

9-1-2. Contents of label block

256 byte

32 byte	32 byte	32 byte	32 byte	128 byte
Measuring condition	Number of data	Coefficient (1)	Coefficient (2)	NULL (all zero)

(A). Contents of measuring condition

two byte — Optional condition — 32 byte

A	0 0	B	C	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0

A ... Serial number — Serial number of this current meter is recorded. In case of model MTC-2, its serial number is 32xxx.

B ... Measuring period — Measuring period is variable from one to 9 minutes.

C.... Measuring interval — Measuring interval is recorded by setting the the select switch. Measuring interval is variable from two to 99 minutes.

(B). Contents of data number

two byte — 32 byte

CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8	CH9	CH10	CH11	CH12	CH13	CH14	CH15	CH16

A definition of this data number is an indication as a composition of one measuring data and number for each channel (CH1 - CH16). Namely, in case of recording data is one byte composition.
Its data number will be shown a positive value. In case of 2 byte composition, the data number will be shown a negative value. In case of Model MTC-2, the value from CH 1 to CH 16 are recorded the value - 1 (minus one) wholly. In short, one measuring data is recorded 16 pieces of data which composites each 2 byte.

(C). Contents of coefficient (1) and (2)

Generally, in case of processing the recording the recording data, coefficient values, etc will be recorded on tape but, in case of MTC-2 it is no need them.

ATTENTION:

1. MTC-2 is composited both label block and data block are composited two byte composition.

←——— 2 byte ———→

S	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

Therefore, the range of recording value x is

$$-32768 \leqq x \leqq 32767$$

9-1-3. Contents of data block

one measuring data 32 byte	256 byte — 8 measuring data			
M 1	M 2	M 3	M 4	

Data block is composited one block (256 byte) and written down 8 measuring data in it.

One measuring data 32 byte

CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	CH 9	CH10	CH11	CH12	CH13	CH14	CH15	CH16

(A). CH 1 - CH 8

Data in CH 1 to CH 8 are all zero.

(B). CH 9

Numbers of measuring are recorded. Maximum measuring number of MTC-2 is 7,600 times. Therefore, this value is a value from 1 to 7,600.

(C). CH 10

The revolution numbers of impeller's pulse are recorded during the measuring period. Its value is 0 to 11,000.

(D). CH 11

The reversion numbers of impeller's pulse are recorded during the measuring period.

(E). CH 12

The numbers of impeller's pulse which count at the calculation of mean current direction.

(F). CH 13

The value of mean current direction is recorded and its value is 0 to 358.

(G). CH 14 - CH 16

All zero. If put the other detectors on MTC-2, it will use from CH 14 in order.