JAPAN INTERNATIONAL COOPERATION AGENCY
EAST TIMOR TRANSITIONAL ADMINISTRATION

THE STUDY
ON
URGENT IMPROVEMENT PROJECT
FOR
WATER SUPPLY SYSTEM
IN
EAST TIMOR

FINAL REPORT

VolumeⅣ: QUICK PROJECT IMPLEMENTATION MANUAL

FEBRUARY 2001

TOKYO ENGINEERING CONSULTANTS, CO., LTD.
PACIFIC CONSULTANTS INTERNATIONAL

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THE STUDY
ON
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IN
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FINAL REPORT

CONSTITUENT VOLUMES

VOLUME Ⅰ **SUMMARY REPORT**

VOLUME Ⅱ **MAIN REPORT**

VOLUME Ⅲ **APPENDIX**

VOLUME Ⅳ **QUICK PROJECT IMPLEMENTATION MANUAL**

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1. WATER LEAKAGE CONTROL IN DILI

1.1 INTRODUCTION

Most structures of water supply facility were destroyed by the independence conflict in September 1999. Simultaneously, a circumstance of a maintenance and management organization is still annihilating. The UNTAET is being organized a temporary water supply authority. The function of its organization is not yet fully developed. An early restoration and a stable supply of portable water are certainly essential for fundamental development to lead a steady life of the citizens of Dili. The Quick Project has a great and vital responsibility in order to sustain the restoration immediately. A possibility of realization for early restoration for the leakage control was presented to let an investigation of current water supply situation in Dili and to perform a concrete plan for leakage detection, leakage repairs and measures of comprehensive leakage control in the model block.

1.2 PROJECT BASIC MANUAL FOR PIPELINE NETWORK REHABILITATION

In order for the water supply system to meet its basic function, from a viewpoint of leakage protection, at first, the present condition of the pipelines shall be evaluated precisely. This evaluation works are placed on the first work to formulate an integrated operation/maintenance and rehabilitation plan of the existing water supply facilities.

It is necessary to verify the difference between the proposed pipeline network ability in the rehabilitation plan and inspection results of the existing pipeline network. Typical methods to evaluate the ability of pipeline network are as follows:

1) Diagnosis Method of Direct Pipeline Network

The condition of the pipeline network is diagnosed from the inside and outside of the pipes. This method includes non-destructive method, quasi-non-destructive method and sampling test. The indices of this method include internal/external corrosion, blockage condition with pipe thickness, joint and inside of pipe, soil corrosive test and physical property of the soil.

2) Diagnosis Method of Indirect Pipeline Network

The condition of the pipeline network is diagnosed mainly by investigating and analyzing continuous monitoring records of water volume, water pressure and water quality and the results are used for stepwise important to the expected ability of the facility. An example of this method is that classification and analysis of the records obtained from leakage investigations.

3) Distribution Network Mathematical Modeling Method (Hydraulic Analysis Simulation)

The condition of the pipeline network is diagnosed by using mathematical modeling. The results are used generally for an evaluation of distribution ability restored after the rehabilitation. The same method is introduced in this *Urgent Improvement Project*. In order to apply the model effectively, the model requires accurate mapping and pipeline

network information of water supply facilities, detailed construction condition of pipelines and time-scale fluctuations of water demand prediction.

In the result of Phase I Study, water supply facility in Dili has an ability of water supply unsteadily, so that the measures of leakage control was performed mostly installation of new pipelines to build up pressure pipeline network in the selected Model Block.

The most important establishment goal of the Quick Project is make practical and effective methods to reduce of unaccounted-for water. Rehabilitation methods are generally classified into two methods; installation of new pipes and utilization of existing pipeline network.

The installation of new pipes can be classified in anew installation, renewal and reinforcement. On the other hand, utilization of existing pipeline network have divided into whole or part improvement as lining scraping construction. Moreover, pipeline facility consists of pipes and annexed structure that is essential for efficient water supply control. In case of selection of these classifications, it is necessary to pay attention to influenced factors by qualitative and denatured environmental conditions and to choose material and diameter of pipe for enough demonstrable of its characteristics.

However, partial adoption of the metal pipe was adopted by taking into consideration of nonmetal pipe and applied mechanics, a slope of the construction site is reliable to occurrence of erosion and special plumbing that is easy to influence by environmental factors is made up largely.

Although not only Dili but also other towns are built up unavoidable topographical characteristics, pipeline structural conditions always should be decided the correspondence to complicated geographical features.

A standpoint of water demand, it is supposed that a purpose of the water use by differences between center of the town and mountain area. Ordinary water supply is also expected to reserve water for agricultural irrigation in the mountain area.

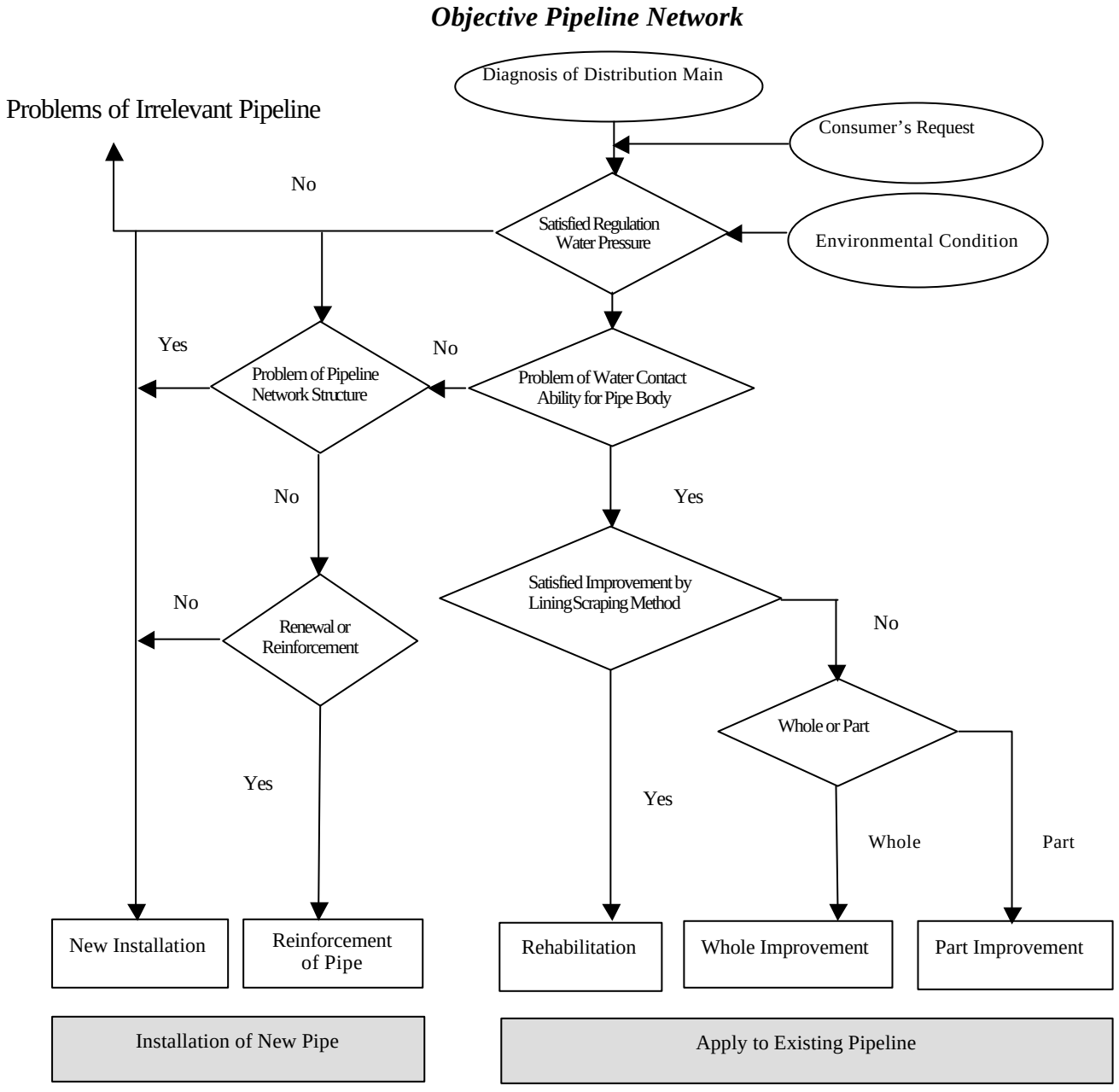


Fig. 2.1 Flowchart of Selection of Construction Method for Rehabilitation of Service/Distribution Pipe

2. CONSTRUCTION OF THE INFILTRATION GALLERY IN MANATUTO

2.1 BACKGROUND

The people of Manatuto are obliged to use water from unsafe sources such as from shallow wells and nearby river because the town's water supply system is not in operation. The primary cause of the system's breakdown is the damage to the transmission main.

Normally, the Manatuto water supply system operates with only one source to supply its water consumers. Water from the source located some 12 km upstream flows by gravity via 6-inch transmission main into the town's reservoir located uphill in the town at an elevation of approximately 80 m above mean sea level. From the town's reservoir, water is then distributed by gravity to the consumers spread around town. However, the transmission main is poorly designed. It is constructed mainly on the flood plain of Laclo River without adequate protection. Most part of the pipelines could not withstand the turbulent actions of the floodwaters and soil erosion created by the Laclo River. In 1998, heavy floods occurred on Laclo River creating heavy erosion on the floodplain that resulted to serious damage on some sections of the transmission main. For some reasons, the damages could not be repaired resulting to the non-operation of the Manatuto water supply system since then.

The JICA Study Team envisages that the rehabilitation/restoration of the water supply system in Manatuto will take into consideration a new water source and transmission pipeline. Safe and reliable water source will be evaluated and selected together with transmission mains that will be designed and constructed in such a manner less vulnerable to damage. It has to take into consideration, that the pipelines are constructed away from the flood prone area.

Restoration of the Manatuto water supply system was considered one of the "Quick Projects" of JICA. Its aim is mainly to address the immediate need of the people through rehabilitation works and putting back the water supply system into operation. Although this is a temporary measure, it is considered the most practical under the present circumstances. Thus, several options were considered to study the most viable alternative to restore the water supply system in Manatuto on a least possible time.

For the long-term planning, the existing water source of the town's water supply system (spring source before the violence) maybe an economically viable source for Manatuto. Its high location though far from the service area is typical for gravity distribution system requiring less operation and maintenance cost. Although, rehabilitation of this source will require big capital investment and more technical investigations, it is likely to incur less operational cost compared to the energy-intensive operational cost of the infiltration gallery.

2.2 MAIN FEATURES OF THE INFILTRATION

The infiltration gallery was constructed to draw water from the Laclo River. It is composed of GSP 200 m x 8" with perforation and GSP 65 m x 8". Naturally-filtered water collected from the Laclo riverbed will flow into the collection chamber where it will be pumped into the service reservoir in town via the existing transmission main. New transmission main (GSP 6-inch) will be constructed from the pump house site and connected to the existing main located about 100 m The main features of the proposed infiltration gallery are shown in the table below.

Table 2.1 MAIN FEATURES OF THE PROPOSED INFILTRATION GALLERY

Item	No.	UNIT	Specification
Equipment			
Pump & Motor	3	set	$27m^3$/hx80mx15kw
Diesel Engine Generator	1	set	60kw
Piping Material			
Water Collection Pipe			
- Perforated pipe	200	m	GSP 8"
- Galvanized pipe	65	m	GSP 8"
Connection pipe to connect to the existing transmission main	100	m	GSP 6"
Gate Valve			
- dia. 6"	4	sets	
- dia. 4	3	sets	
Check Valve dia. 4"	3	sets	
Air Release Valve dia. 4"	1	set	
Instrument Material			
Pressure Gauge	3	set	$12kg/cm^2$ G
Electrical Material			
Power Receiving Cable	1600	m	for receiving 30kw, 400v
Power Receiving & Transmission Panel	1	set	
Motor Control Panel & Cable	1	set	
Civil Material & Construction			
Excavation	8900	m^3	
Soil Disposal	800	m^3	
Gravel Layer	130	m^3	
Sand Layer	660	m^3	
Backfilling	8100	m^3	
Concrete	1	set	
Collection Pipe Layer	400	m	
Pump Pit & Transmission Line			Pit Size: 2mx2mx8mD
Excavation	1100	m^3	
Soil Disposal	50	m^3	
Backfilling	1050	m^3	
Concrete	1	set	
Pipe Layer	200	m	
Pump House			6mx7m

2.3 CONSTRUCTION OF THE INFILTRATION GALLERY

JICA commissioned Dai Nippon Construction (DNC) to carry out the construction of the infiltration gallery at a cost of US$ 0.60M. To take advantage of the low flow on the Laclo River, actual construction work started on the middle of August and was completed at the end of October. The construction work was categorized into 2 components namely:

Component 1: Pipework including Construction of the Collection Chamber (Pump Pit)
Component 2: Construction of the Pumping Station including Installation of the Pumping and Electrical Facilities

Pipework commenced towards the end of August by excavation on the riverbed of the Laclo River. Two hundred (200) meters of GS perforated pipe and sixty-five (65) metres GSP were installed at about 5 meters below the riverbed. From the Laclo riverbed the 265 m water collection pipe was connected to the water collection chamber (dia. 2.6 m x 5.9 m depth) constructed of reinforced concrete. A 200 mm diameter valve controls the flow of water into the collection chamber. The collection pipes was installed with a slope of 1/500 to allow gravity flow of naturally filtered water into the collection chamber. The outlet (GSP 6-inch) of the pump facilities was then connected (in a valve box) to the existing transmission main located about 84.24 m distance.

Soon after the completion of Component 1, Component 2 started with the construction of the concrete slab for the 42 m^2 pumping station. Appropriate preparatory connectors and pipe sleeves were planted on the concrete slab. Steel frames were then installed where steel wall panels and roofing were securely fastened/welded. This type of structure was adopted mainly because of its flexibility, ease in construction and to expedite the work. Prior to the installation of the walls and roof, the pumps (3 sets: 2 duty + 1 standby) and generator set were securely set-up on the space provided. Connections of the cables and pipes were then completed. The specifications of the pumps, generator set and other electro-mechanical equipment are provided in the supporting documents of the project.

The construction of the whole infiltration facility lasted more than 2 months. About 30 local labors were utilized fully supervised by the DNC engineer who was present during the whole construction period. Test operation of the infiltration gallery started in November. The pumps were allowed to operate for 1-month period at a discharge rate of 15 L/s (total discharge rate for 2 pumps operating). The water quality collected from the infiltration gallery revealed an acceptable water quality wherein all the parameters measured are within the limits set by the WHO Standard for Drinking Water.

2.4 OPERATION HANDBOOKS AND PARTS CATALOG

The operation handbook and parts catalog of diesel engine for generating system as incidental facilities is attached the following page.

The specification, operation manual, and drawing. of the
Feed Water Pump units for East Timor

Page 1 : The specification of the pump units

Page 2 : The operation manual.

Page 3 : The pump installation drawing.

Page 4 : The assembly drawing of three pump units.

Page 5 : The pump performance curve of each pump.

Page 6 : The dimensional drawing of the pump .

Page 7 : The sectional drawing of the pump.

Page 8 : The specification of the control panel.

Page 9 : The wiring diagram of the control panel as No1

Page 10 : The wiring diagram of the control panel as No2.

Page 11 : The wiring diagram of the control panel as No3.

Page 12 : The dimensional drawing of the control panel

Page 13 : The drawing of the foot valve.

2000/05/21.

The Pump specification

1. The type of pump.
   CR32 – 6 / 50 Hz x 11Kw x 400V

2. The units
   Three(3) units of pumps.

3. The Motor
   In door type induction motor. 50Hz x 400V x 11 Kw
   Star – Delta operation.

4. The duty point of each pump.
   27 m3 /h x 80 m.

5. The scope of supply.
   - 3 units of pumps which are assembled on the pump base and stop valve, check valve connected to each pumps in out let side.
     Also the accumulate pipe for each 3 pumps are connected on each out let side.
     1 units of control panel for each pumps equipped with amp meter, magnetic switch, relay for water level and start stop aut-manual button.
   - 2 sets of electrode with 10m cable for water level for each panel.
     1sets for high level.
     1sets for low level.
   - 3 sets of suction pips for each pump. (see attached installations drawing.)
     (1 set are consist from three 1m pipe, bending pipe and 0.88m straight pipe)
   - 15 sets(each 5 sets)of bolts, nuts and gaskets for suction pipe flanges JIS10K 65φ.
   - 1 set of companion flange JIS10K150φ.
   - 1 set of bolt ,nut and gasket for JIS10K, 150φ flange.
   - 3 sets of foot valves.

6. Spare parts.
   3 sets of mechanical shaft seal kids including with the gaskets.

Operation Manual.

1) This feed water supply units are operate automatically by the signal of electrode at high water level (start) and low water level (stop).. Also manual operation can be done by the manual button
2) Three pumps operate independently.
   Three isolated Auto-manual operation button(No1 pump, No2pump, No3pump) are putted on a panel.
3) Before the pump operation, it is very *important to fill prime water in the suction pipe side from the foot valve to pumps*. If the air existed in a suction pipe, not only the water could not be driven, also would create the damage on the pump.(Dry running)
4) *The priming water should be supplied from the top of the pump* ,(From the valve plug) connected with the city water hose or hose from the small water tank.
   These hose should be prepared by you.
5) *When you start the pumps, confirm the stop valve shut down* on the out let side of pump. If you start up with the valve opened, the dangerous water hammer will be occurred.
6) After several second, must open the valve gradually up to reach the normal flow.
7) The pump have the higher performance than the duty point. Therefore you should *adjust the valve lift not to exceed the flow 27m3/h(out let pressure around 9.7bar)to avoid the cavitation.*
   The cavitation diminish the performance of the pump, also give the damage on the pump.
8) *If some strange noise come from the pump or can not get the performance after switch on, you must stop the pump immediately*, And confirm again the priming water to be filled up in suction side at first. After confirm the priming water filled up enough, take the next step. The next considerable problem is cvitation.
9) If the *cavitation can not be disappeared*, you should *pull up the electrode cable each 0.5m at one time*. And continue this work until the cavitation disappear
   This means that the suction head is too big to suck the water in this case.
10) The limited low water level make stop the pump automatically and can confirm by the pilot lamp on the panel (low water).

図番 0n-20T

PUMP PERFORMANCE CURVES

ポンプ性能曲線図

No.

DATE 日付

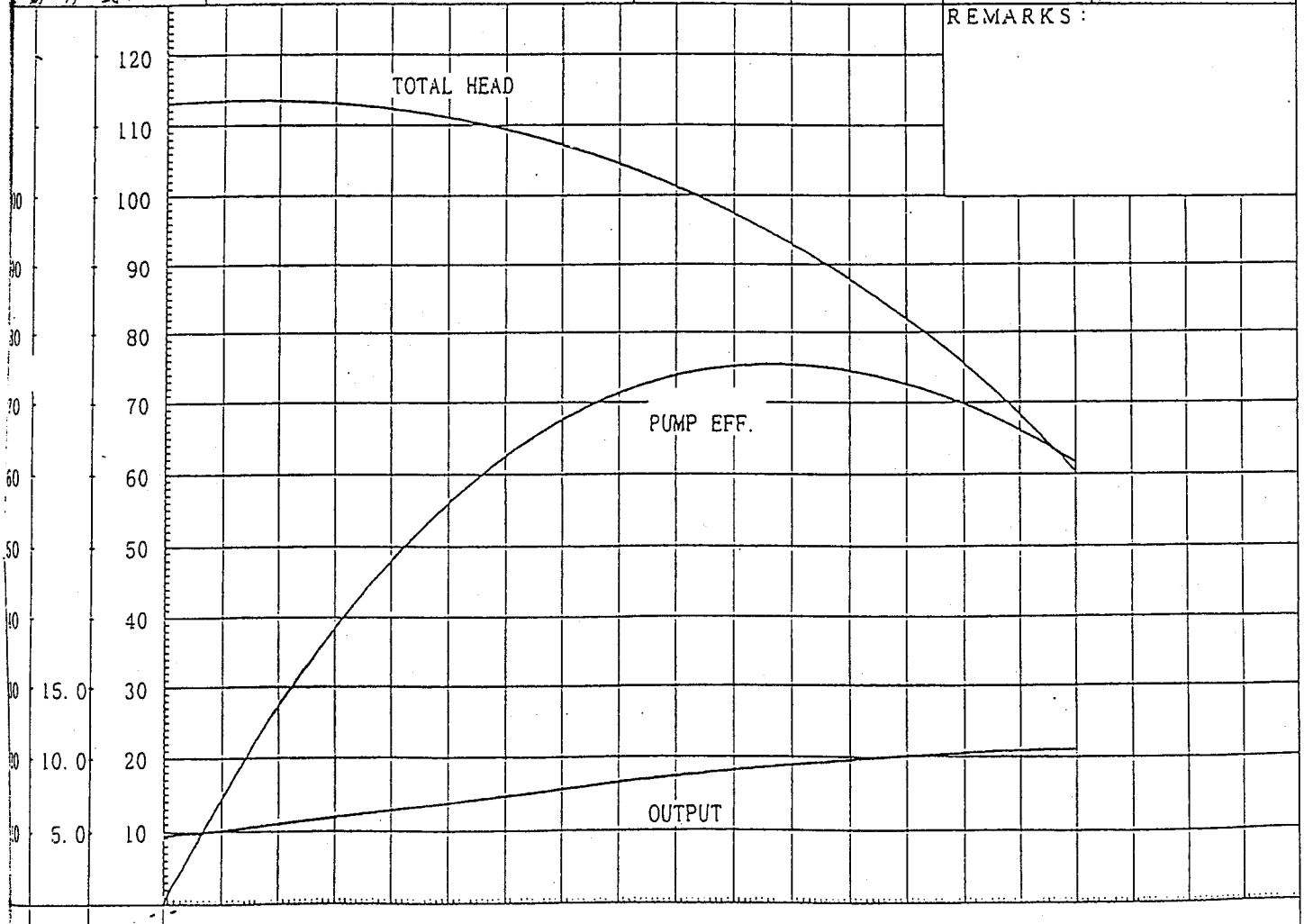
CALCULATION 想定

CUSTOMER'S NAME 御注文先

SOURCE OF POWER 電源	200 V
	50 Hz

電動機 MOTOR		ポンプ PUMP	
OUTPUT 出力	11.0 kW	TYPE 型式	CR32-6
FREQUENCY 周波数	50 Hz	W.F.G.No. 製造番号	
PHASES VOLTAGE 相×電圧	3φ × 400 V	SUCTION 入口口径	J仕様：65／F仕様：65 mm
AVERAGE 電流	20.0 A	DELIVERY 出口口径	J仕様：65／F仕様：65 mm
POLE 極数	2 P	TOTAL HEAD 全揚程	m
REVOLUTION 回転数	SS. 3000 min⁻¹	CAPACITY 吐出し量	m³/min
INSULATION CLASS 種級	B	TESTED BY 試験	DRAWN BY 製表 / CHECKED BY 検印 / TEST LIQUID 試験液: CLEAR WATER 清水
形式	IKK-FCKL8		
STARTING METHOD 始動方式			

REMARKS：



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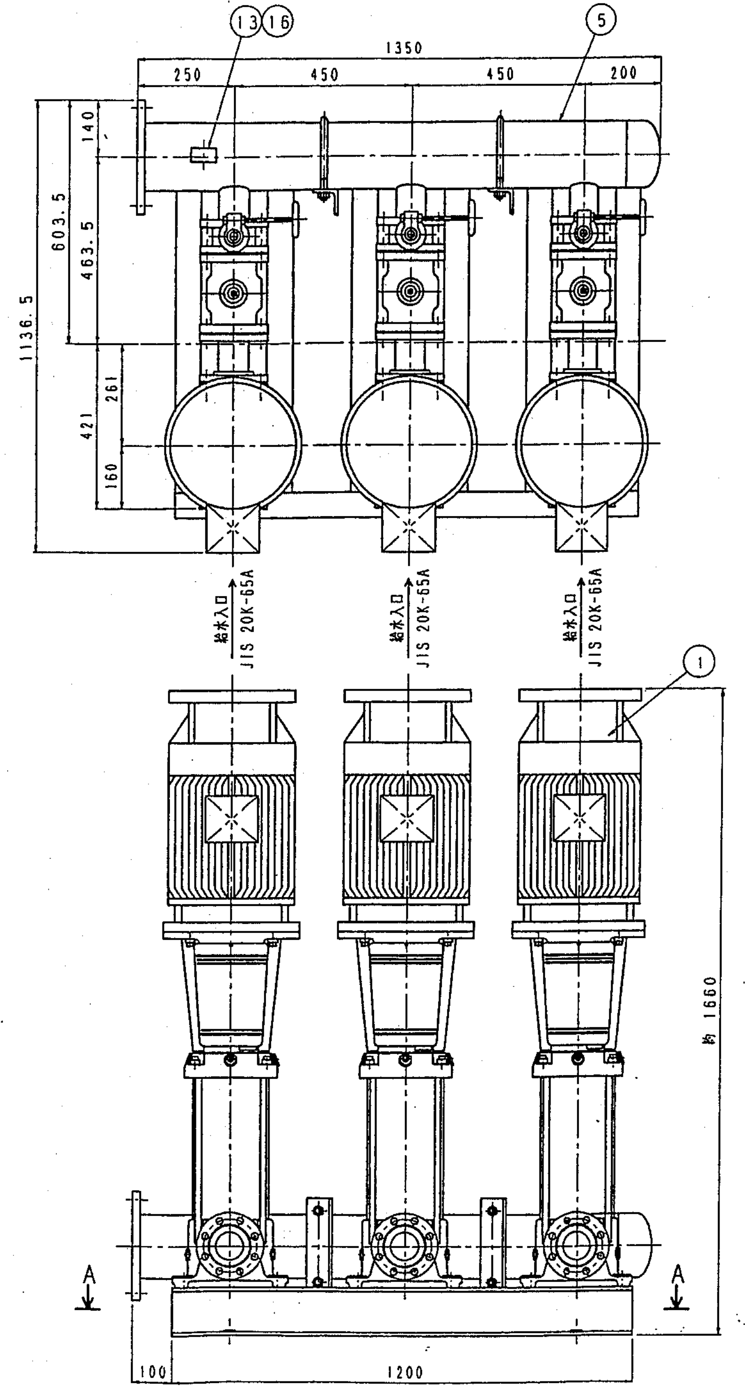
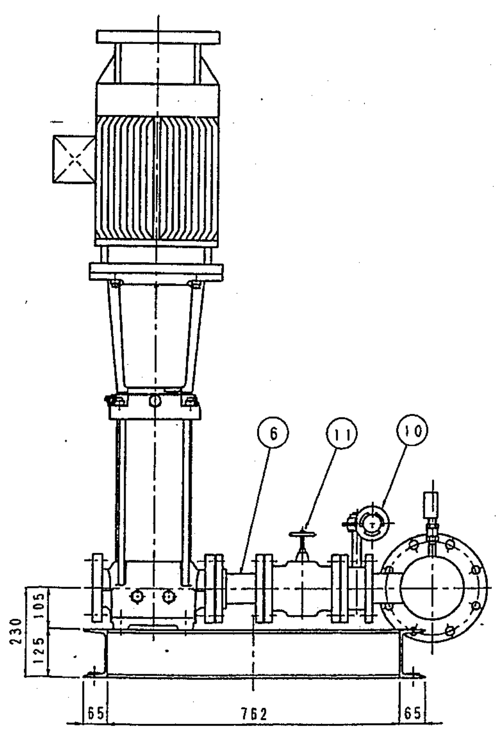
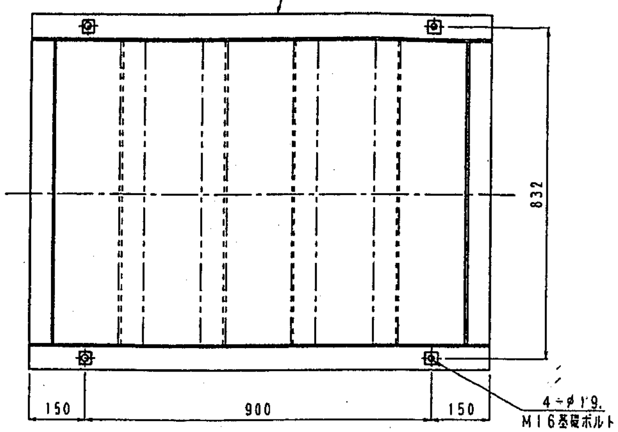
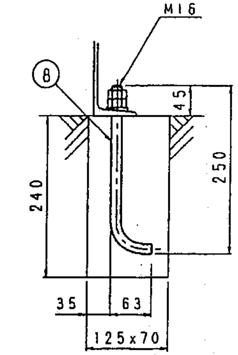






断面A－A



基礎ボルト詳細

品番 Pos. No.	数量 No. Req'd	名称 Description	材質 Material	寸法/型式 Dim./Patt. No.	備考 Remarks
16	1	圧力計元弁	BC	10A	KITZ
13	1	圧力計	BC	φ60	長野計器
11	3	逆止弁	FC200	65A	進工社
10	3	止弁（バタフライ弁）	SUS316L	65A	巴水鉄工所
8	4	基礎ボルト・ナット	SS400	M16	FB-000001-4
6	3	配管	SUS304	65A	PI-320001
5	1	出口管寄せ	SUS304	150A	OM-320016
3	1	架台	SS400		CF-320016
1	3	ポンプ	SUS304+FCD500	CR32-6	

注 記

1. 詳細設計により変更する場合があります。

注意事項

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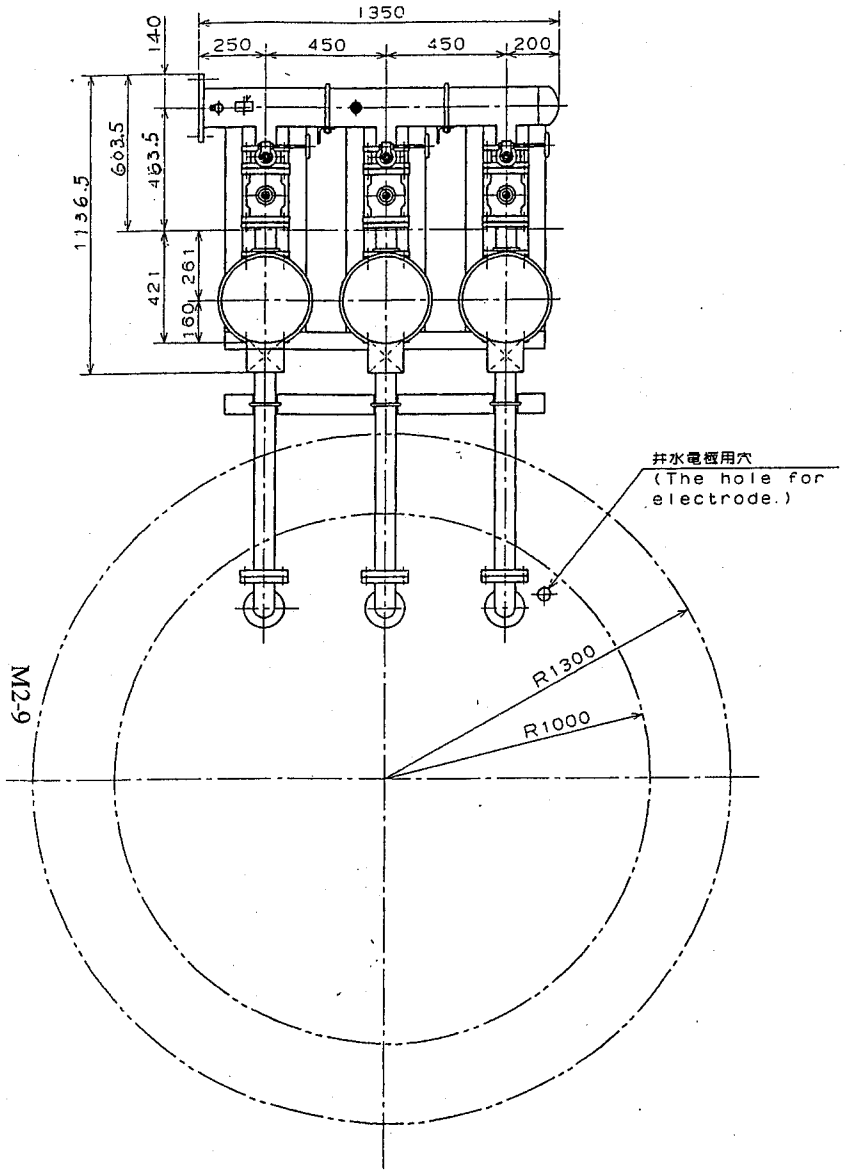
参照番号 Ref. No.

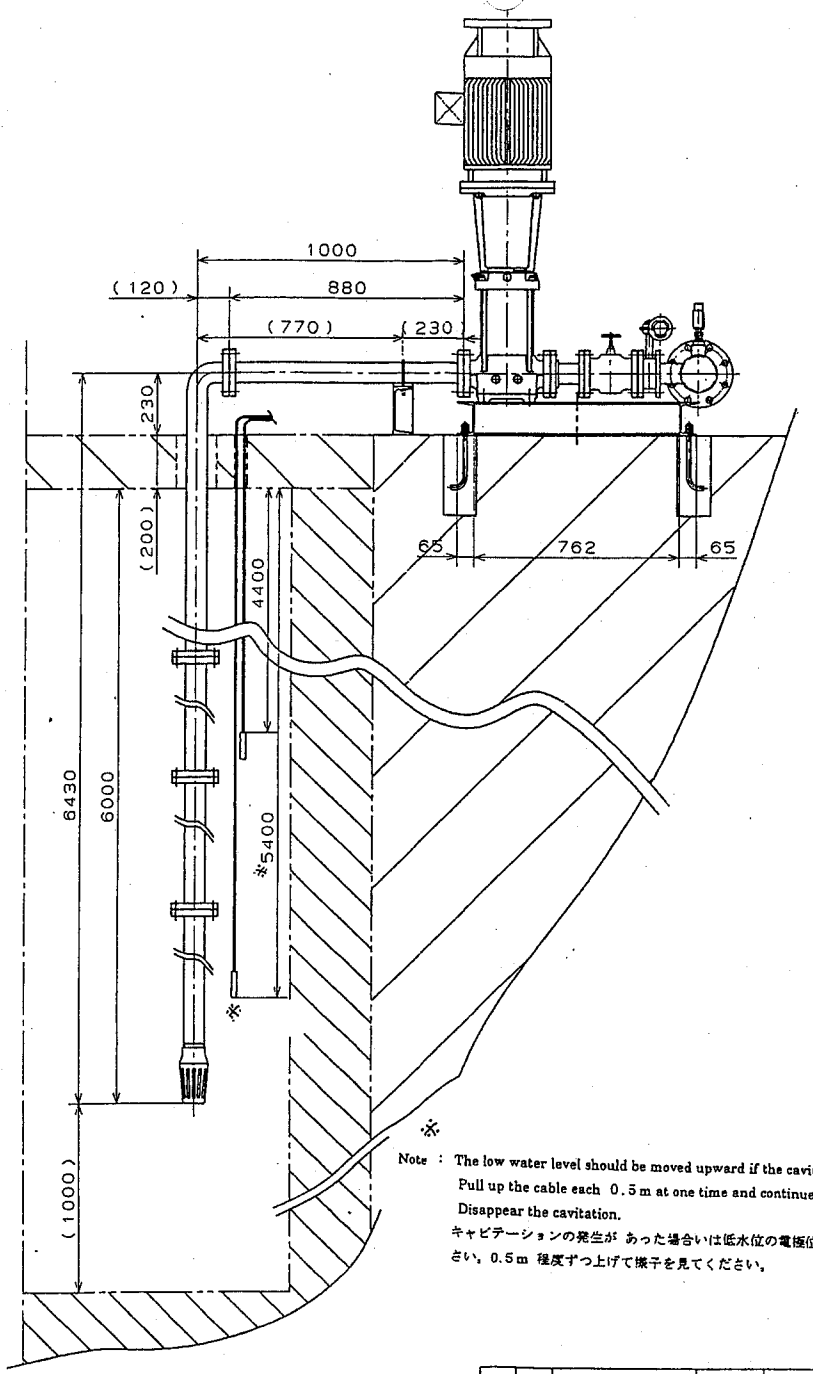
電動機：東芝
50Hz

グルンドフォス ポンプ株式会社

給水装置
3CR32-6
全体組立図

設計 KS / 検図 / 承認
尺度 Scale
作成日付 2000.06.03
GRUNDFOS
図番 CF-320016





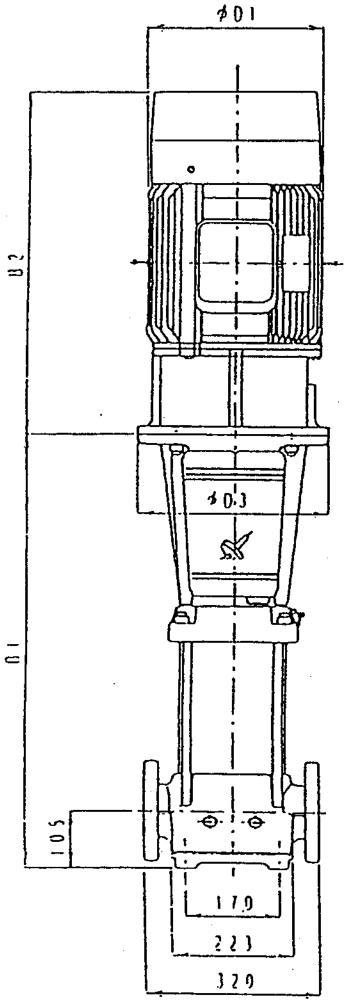
Note : The low water level should be moved upward if the cavitation occurred..
Pull up the cable each 0.5m at one time and continue this work till Disappear the cavitation.
キャビテーションの発生が あった場合いは低水位の電極位置を 上側に上げて下さい。0.5m 程度ずつ上げて様子を見てください。

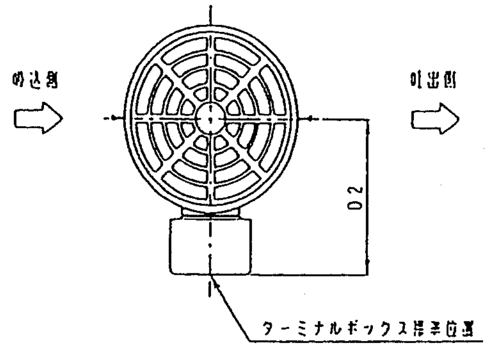
Pos. No.	Req'd	Description	Material	Dim./Patt No.	Remarks

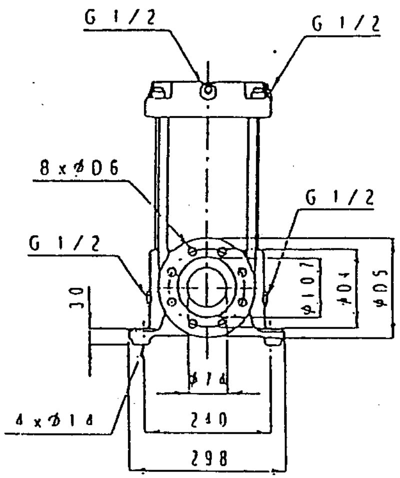
Ref. No.

Design	Check	APPr.

注1) ターミナルボックスの位置は変更できます。







型式名	出力 (kW)	B1	B2	B1+B2	D1	D2	D3	重量 (kg)
CR32-1-1	1.5	505	253	761	138	113	110	71
CR32-1	2.2	505	253	761	183	118	110	75
CR32-2-2	3.0	575	332	907	202	155	150	91
CR32-2	4.0	575	332	907	202	155	150	91
CR32-3-2	5.5	645	374	1019	243	139	100	113
CR32-3	5.5	645	374	1019	243	139	100	113
CR32-4-2	7.5	715	409	1124	243	189	100	123
CR32-4	7.5	715	409	1124	243	189	100	123
CR32-5-2	11	895	570	1465	324	272	350	212
CR32-5	11	895	570	1465	324	272	350	212
CR32-6-2	11	965	570	1535	324	272	350	215
CR32-6	11	965	570	1535	324	272	350	215
CR32-7-2	15	1035	570	1605	324	272	350	231
CR32-7	15	1035	570	1605	324	272	350	231
CR32-8-2	15	1105	570	1675	324	272	350	235
CR32-8	15	1105	570	1675	324	272	350	235
CR32-9-2	18.5	1175	614	1789	324	272	350	252
CR32-9	18.5	1175	614	1789	324	272	350	262
CR32-10-2	18.5	1245	614	1859	324	272	350	265
CR32-10	18.5	1245	614	1859	324	272	350	265

型式名	60Hz							
	出力 (kW)	ポンプ寸法 (mm)						重量 (kg)
		B1	B2	B1+B2	D1	D2	D3	
CR32-1-1	3.0	505	332	837	202	155	150	87
CR32-1	3.0	505	332	837	202	155	150	87
CR32-2-2	5.5	575	374	949	243	139	100	103
CR32-2-1	5.5	575	374	949	243	189	100	103
CR32-2	7.5	575	409	984	243	183	100	115
CR32-3-2	11	645	570	1215	324	272	350	201
CR32-3	11	645	570	1215	324	272	350	201
CR32-4-2	11	825	570	1395	324	272	350	203
CR32-4	15	825	570	1395	324	272	350	219
CR32-5-2	15	895	570	1465	324	272	350	223
CR32-5	18.5	895	614	1509	324	272	350	246
CR32-6-2	18.5	965	614	1579	324	272	350	250
CR32-6	18.5	965	614	1579	324	272	350	250

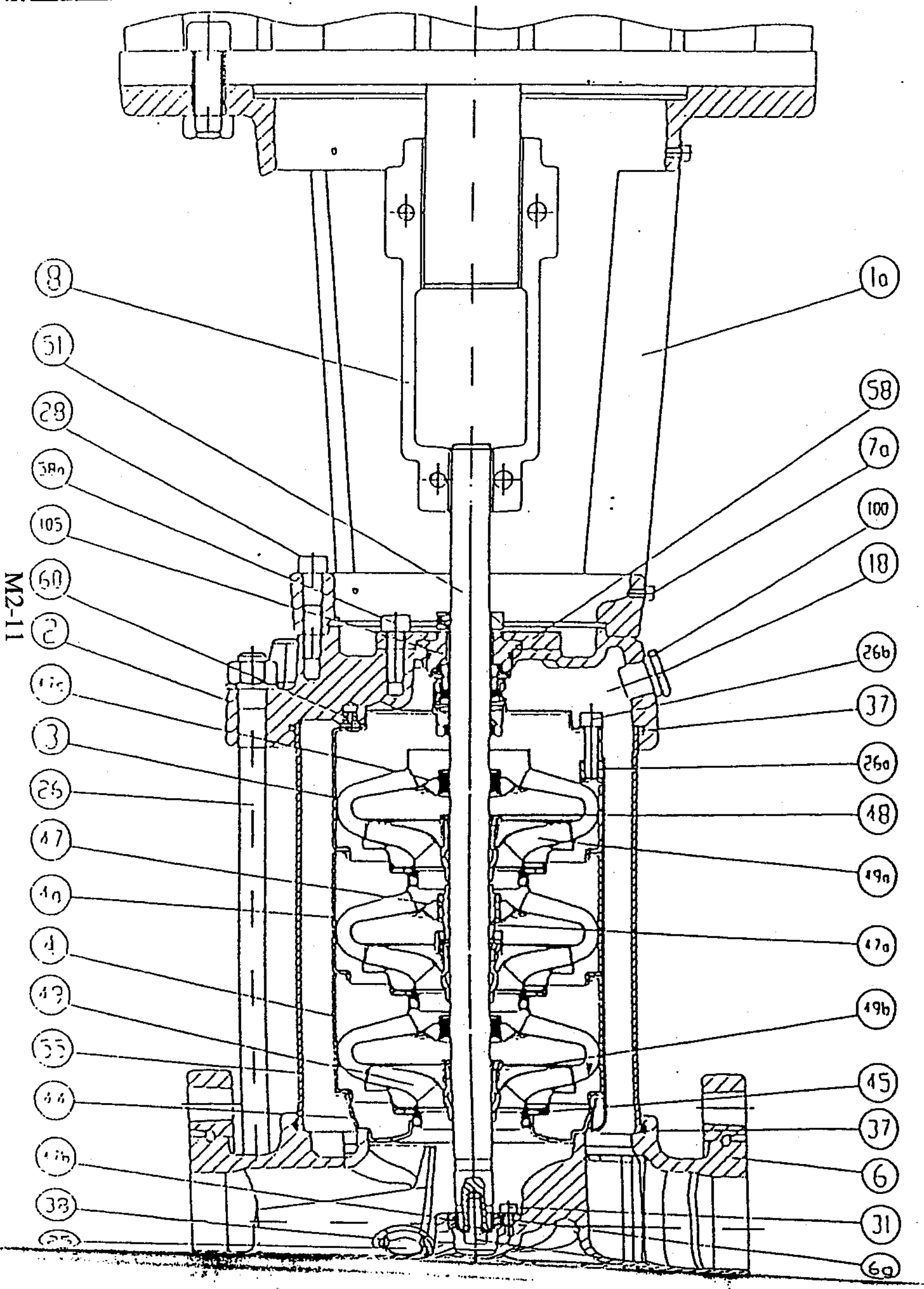
	JIS規格フランジ65A相当					JIS規格フランジ80A相当				
	記号	D4 (mm)	D5 (mm)	D6 (mm)	相フランジ 適合規格	記号	D4 (mm)	D5 (mm)	D6 (mm)	相フランジ 適合規格
20K	J2	140	175	19	JIS20K-65A 差込溶接型	W2	160	200	23	JIS20K-80A 差込溶接型
30K	J3	160	200	23	JIS30K-65A 差込溶接型	W3	170	210	23	JIS30K-80A 差込溶接型

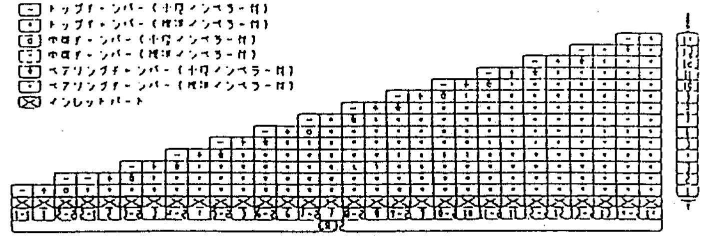
	DINフランジDN65相当					DINフランジDN80相当				
	記号	D4 (mm)	D5 (mm)	D6 (mm)	相フランジ 適合規格	記号	D4 (mm)	D5 (mm)	D6 (mm)	相フランジ 適合規格
PN40	F3	145	185	19	DIN2635 溶接型	W3	160	200	18	DIN2635 溶接型

三相誘導電動機仕様	
形式	全閉外扇
極数	2極
絶縁種別	F種(1.5-2.2 kW)
	B種(3.0 5.5-18.5 kW)
保護方式	JP44

外形寸法図	CR32
50/60Hz	グルンドフォス
図番	GRUNDFOS

10000-81





別表1

型式	EUUE	EUUV	EUBE	EUBV	HUBE	HUBV
メカニカルシール材質	IC/IC	IC/IC	IC/カーボン	IC/カーボン	IC/カーボン	IC/カーボン
ゴム材質	EPDM	バイトン	EPDM	バイトン	EPDM	バイトン

別表2

品番		37 O-リング	38, 100 O-リング	45 ネックリング	47 ベアリングリング	60 スプリング	47c サポートベアリング
材質指定	A	EPDM	EPDM	充填テフロン樹脂	充填テフロン樹脂	EPDM	充填テフロン樹脂
	B	バイトン	バイトン	充填テフロン樹脂	充填テフロン樹脂	バイトン	充填テフロン樹脂

品番	個数	名称	材質	寸法／型式	備考
203	2	ロックリング	SUS304		
201	2	フランジ	FCD500		
105	1セット	メカニカルシール	別表1参照		
100	2	O-リング	別表2参照		
67	1	スクリュー	SUS303		
60	4	スプリング	別表2参照		
58a	4	スクリュー	SUS304		
58	1	シールキャリア	SS400		
55	1	アウタースリーブ	SUS304		
51	1	シャフト	SUS431	ø22	
49b	N	スプリットコーン	SUS316		
49a	N	小径インペラー	SUS304		
49	N	標準インペラー	SUS304		
48	N	スプリットコーンナット	SUS316		
47c	2	サポートベアリング	別表2参照		
47b	1	ベアリングリング	タングステンカーバイド		
47a	N	ベアリングドライバー	SUS316		
47	N	ベアリングリング	別表2参照		
45	N	ネックリング	別表2参照		
44	1	インレットパート	SUS304		
38	2	O-リング	別表2参照		
37	2	O-リング	別表2参照		
31	1	スクリュー	SUS303		
28	4	スクリュー	SS		
26b	2	スクリュー	SUS303		
26a	2	ストラップ	SUS304		
26	4	スティボルト	SS		
25	4	プラグ	SUS316	G 1/2	
18	1	排水プラグ	SUS316	G 1/2	
8	1	カップリング cpl.	FCD500		
7a	4	スクリュー	SUS304		
6a	1	ベアリングリング	タングステンカーバイド		
6	1	ベース	FCD500		
4a	N	ベアリングチャンバー	SUS304		
4	N	中間チャンバー	SUS304		
3	1	トップチャンバー	SUS304		
2	1	ポンプヘッド	FCD500		
1a	1	モータースツール	FC200		

Drawing type:	Part Drawing
Related drawings:	
Projection:	
グルンドフォス	
Drawn:	KMS 99-03-11
Approved:	NMD 99-03-13

2 塗装色

盤外面	塗装 2.5Y9/2 半ツヤ
盤内面	〃
扉裏面	〃
中パネル，中板	〃
基礎ベース	〃

3 銘板

盤銘板	アルミ製 白地青文字
用途銘板	アクリライト製 白地黒文字

4 配線

主回路	600Vビニル絶縁電線 黄色 端部色分け							
	銅帯 メッキ仕上げ							
操作回路	600Vビニル絶縁電線 1.25mm² 黄色 マークチューブ付							
計器用変成器二次回路	600Vビニル絶縁電線 2mm² 黄色 マークチューブ付							
接地線	600Vビニル絶縁電線 緑色							
主回路色別	配線方式	3φ3W 400V	1φ3W 100/200V	1φ2W 100V	DC			
	第1相	赤	黄					
	第2相	白	黄					
	第3相	青	黄					

5 押釦スイッチ，表示灯の色別

用途	取付穴	用途	押釦		表示灯		用途	押釦		用途	表示灯	
押釦スイッチ	25φ	運転（入）			赤		警報停止			電源	乳白	
切換スイッチ	25φ	停止（切）					故障復帰（リセット）			故障	橙	
表示灯	丸型											

名称	記号	仕様		
配線用遮断器	MCB	25-CP 3P/125A	三菱	1
漏電遮断器	ELB	NV50-CP 3P/50A 30mA	三菱	3
電磁接触器	52	S-N25 AC200V	三菱	3
電磁接触器	42	S-N20 AC200V	三菱	3
電磁接触器	6	S-N20 AC200V	三菱	3
コンデンサー	SC	KK-1 50μF	三菱	3
電圧計	V	YS-208NAV 600V	三菱	1
電流計	A	YS-208NAA 50/5A	三菱	3
変流器	CT	CT-25A 50/5A	春日	3
液面リレー	WL	61F-GPN AC200V （ソケット付き）	オムロン	1
3Eリレー	3E	K2CM-2MRV	オムロン	3
補助リレー	X	MY4N AC200V （ソケット付）	オムロン	6
S-Dタイマー	2	H3CR-G8L AC200V （ソケット付き）	オムロン	3
タイマー	T	H3CR-A8 AC200V （ソケット付き）	オムロン	2
切換スイッチ	COS	ASS210N （2ノッチ 1a）	和泉	3
押し釦スイッチ	BS	SW-80	サトウ	1
ヒューズホルダー	F	FH-001F 1A	エコー	1
栓型ヒューズ	F	AFaC-3 3A	富士	3
表示灯	PL	AH164-ZWM1 AC200V 白	富士	1
表示灯	RL	AH164-ZRM1 AC200V 赤	富士	3
表示灯	GL	AH164-ZGM1 AC200V 緑	富士	3
表示灯	OL	AH164-ZOM1 AC200V 橙	富士	4
トランス	Tr	ITB-200 440,400,380/220,200V 200VA	今井	1
トランス	Tr	TR-20 440,400,380/220,200V 20VA	今井	1

Mark 記号	Alterations 訂正事項	Date 訂正日付	Sign 署名	Appr. 承認

グルンドフォス
グルンドフォスポンプ株式会社

仕様書

屋内自立型

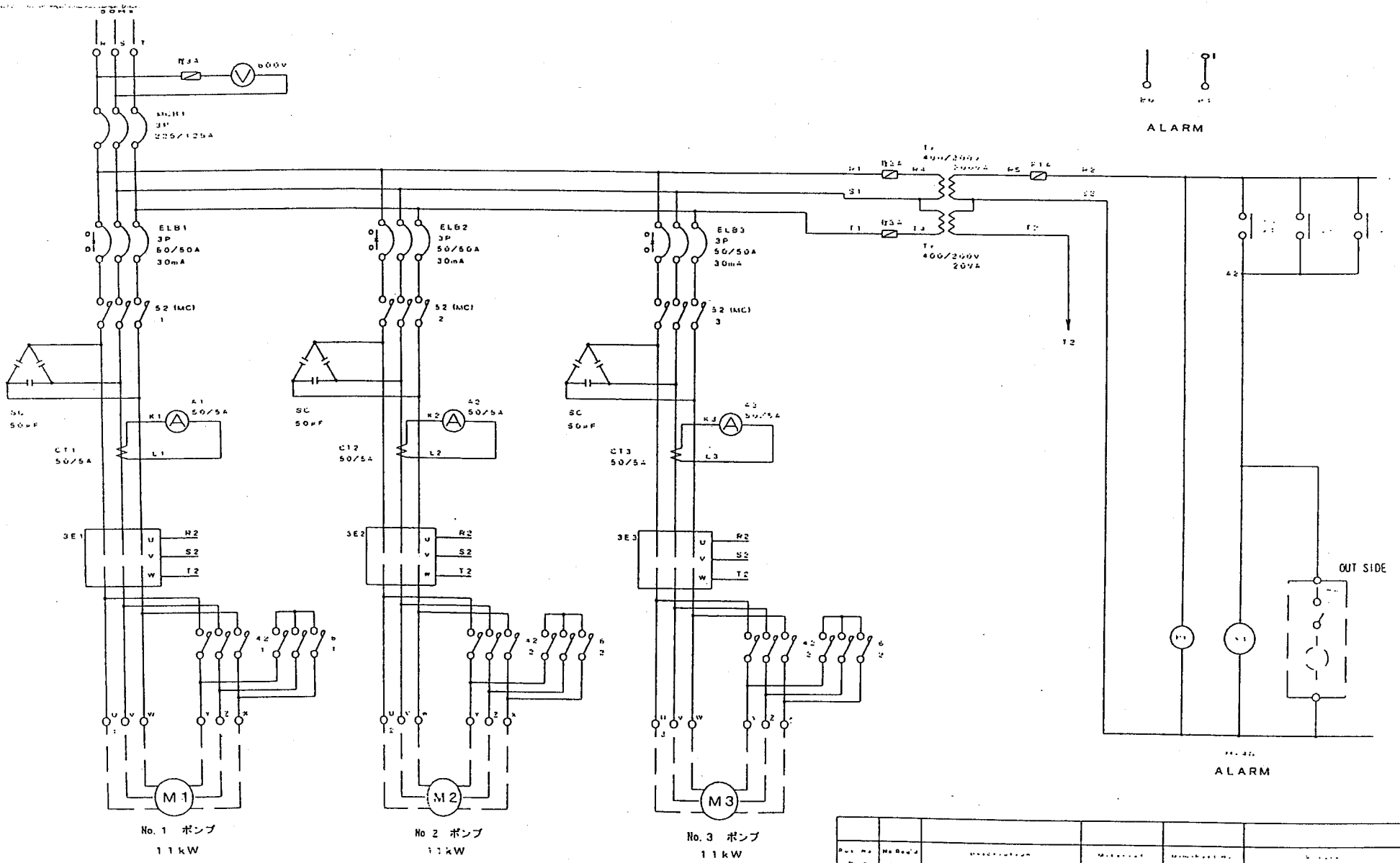
ELB，SC，単独運転

400V 11Kw 3台

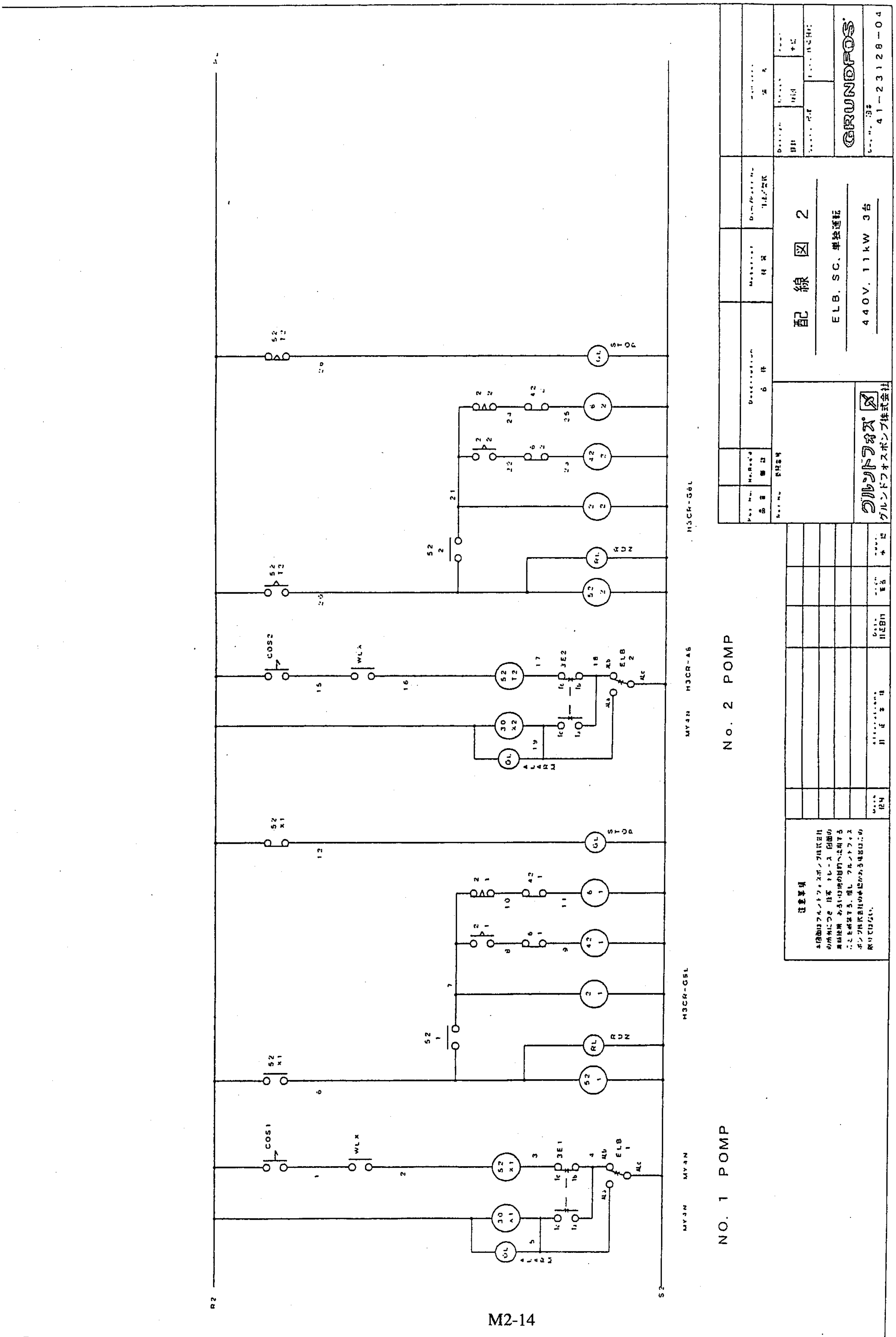
GRUNDFOS

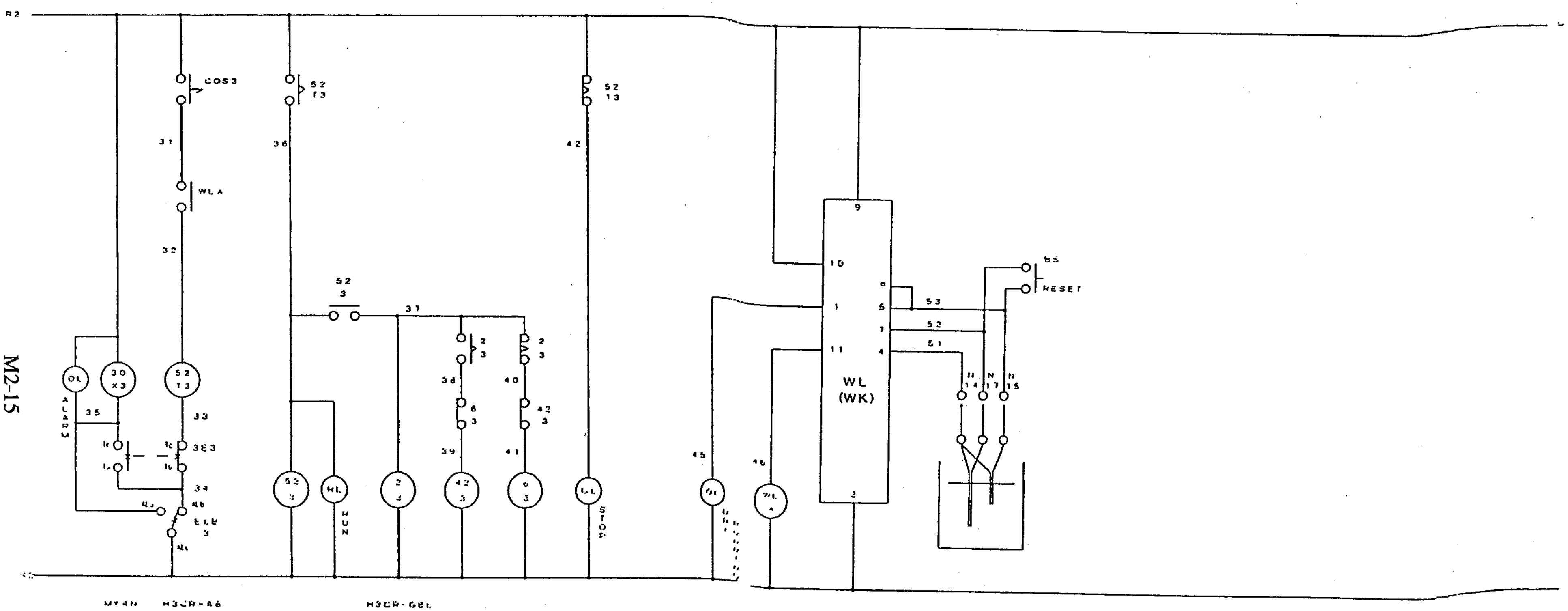
41-23128-01

M2-12



配線図 1	
ELB, SC, 単独運転	
400V, 11kW 3台	
グルンドフォス	GRUNDFOS
	41-23128-03


No. 1 POMP
No. 2 POMP
COS1
COS2
WLX
STOP
RUN
ALARM
ELB
配 線 図 2
ELB, SC, 単独運転
440V, 11kW 3台
GRUNDFOS
グルンドフォスポンプ株式会社
41-23128-04



No. 3 POMP

M2-15

注意事項

配線図 3

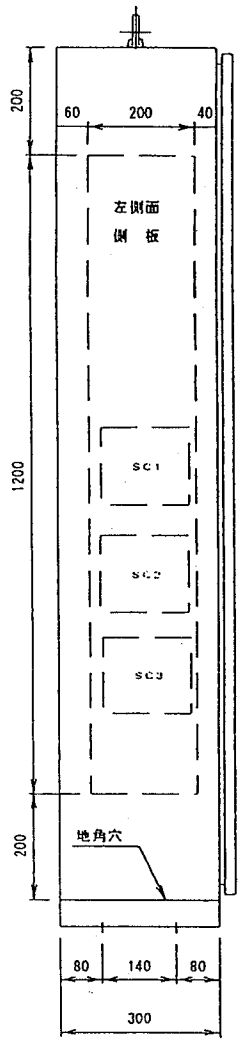
ELB, SC、単独運転

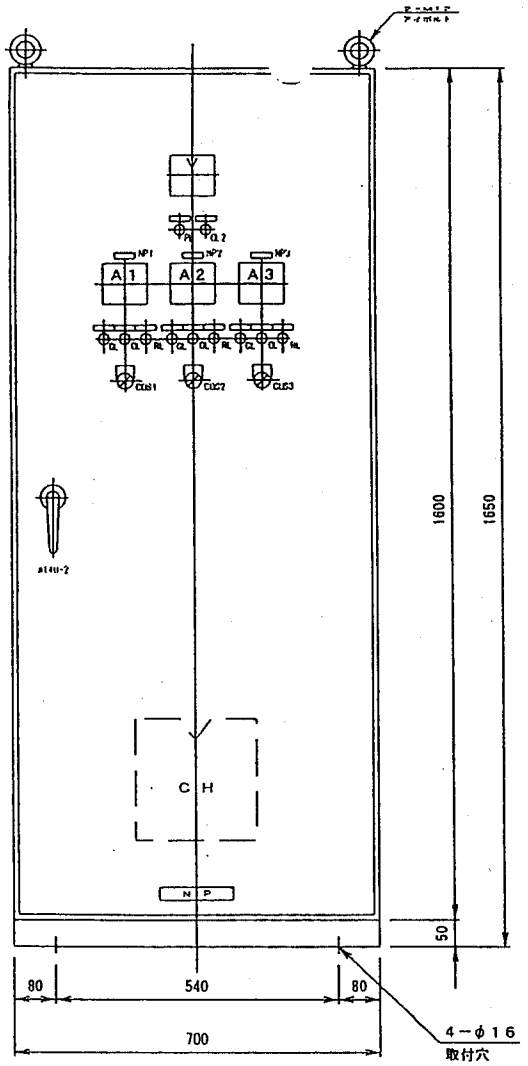
440V, 11kW 3台

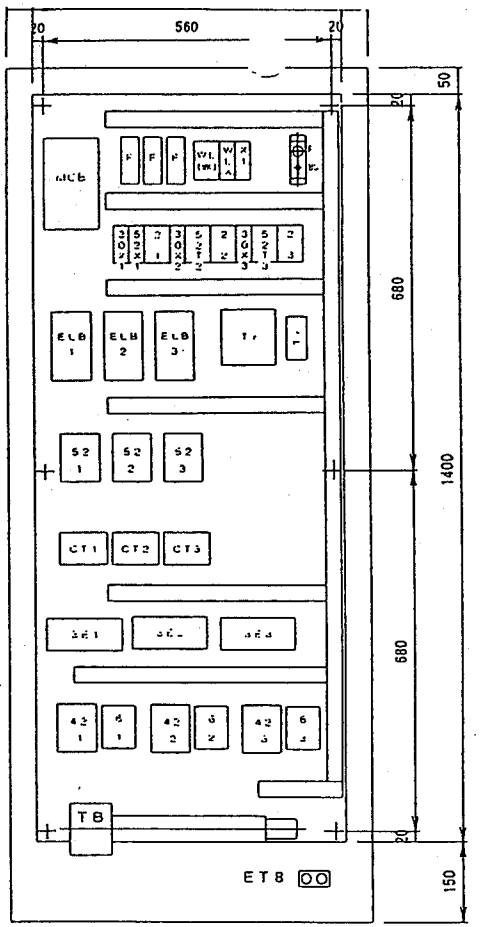
グルンドフォス
グルンドフォスポンプ株式会社

GRUNDFOS

41-23128-05







銘 板

PL	POWER	1	※
RL	RUN	3	※
GL	STOP	3	※
OL	ALARM	3	※
OL2	DRY RUNNING	1	※
COS	OFF ON	3	
BS	RESET	1	※
NP	GRUNDFOS	1	
NP1	No. 1 PUMP	1	※
NP2	No. 2 PUMP	1	※
NP3	No. 3 PUMP	1	※

(※：アクリル 40×10)

T B

R	S	T	U1	V1	W1	Y1	Z1	X1	U2	V2	W2	Y2	Z2	X2	U3	V3	W3	Y3	Z3	X3	A2	S2	N14	N15	N17	B0	B1

T4150
T×30

M2-16

塗装色 2.5Y9/1
箱 t1.6 扉 t2.3 鋼板製
ベース t4×50×50 L形鋼

注意事項

グルンドフォス
グルンドフォスポンプ株式会社

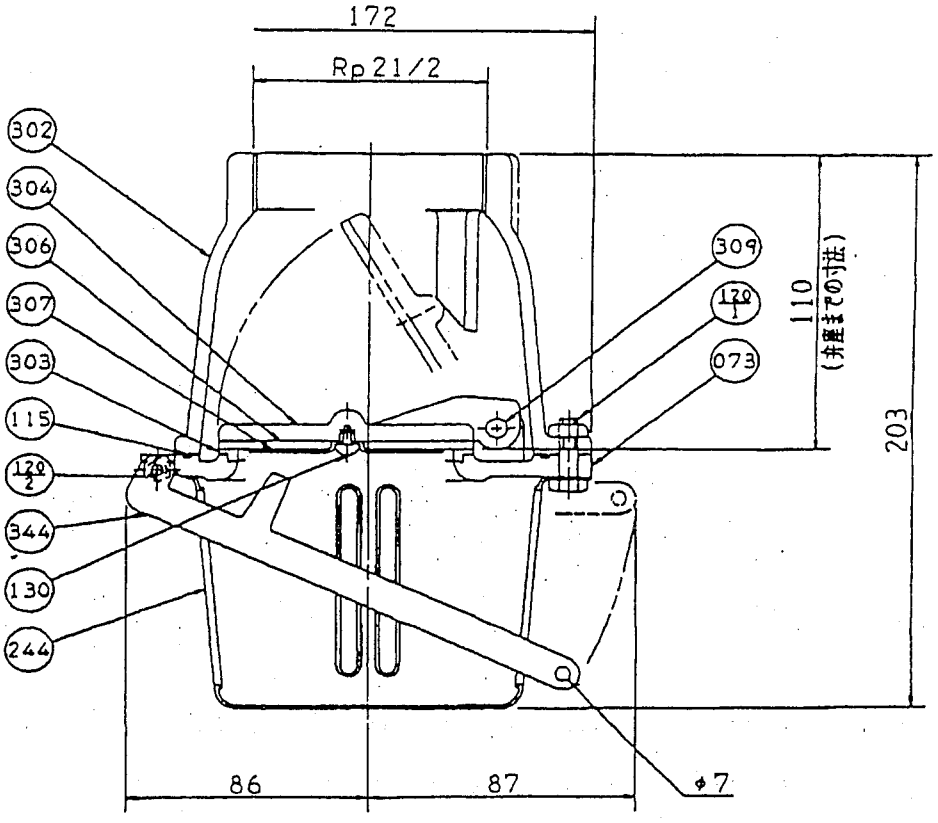
制御盤外形寸法図
屋内自立形
ELB、SC、単独運転
400V、11Kw 3台

GRUNDFOS
41－23128－02

エバラ標準フート弁
EBARA FOOT VALVES

構造図
CONSTRUCTION

型番 MODEL NFT-65



質量 MASS 5.5 kg

344	レバー	LEVER	SUS304	304 STAINLESS
309	弁棒	VALVE ROD	SUS420J1	420 STAINLESS
307	当板	SETTING PLATE	SUS304	304 STAINLESS
306	ゴムシート	RUBBER SEAT	ゴム/NBR	RUBBER/NBR
304	弁体	VALVE	FC200	CAST IRON
303	弁座	VALVE SEAT	CAC406 (BC6)	BRONZE
302	弁箱	VALVE CASING	FC200	CAST IRON
244	ストレーナ	STRAINER	SUS304	304 STAINLESS
130	丸小ねじ	MACHINE SCREW	SUS304	304 STAINLESS
120-2	ボルト	BOLT	SUS304	304 STAINLESS
120-1	ボルト	BOLT	SUS304	304 STAINLESS
115	Oリング	O RING	ゴム/NBR	RUBBER/NBR
073	仕切板	COMPARTMENT PLATE	FC200	CAST IRON
番号 PART NO.	部品名 PART NAME		材料 MATERIAL	

仕様
SPECIFICATION

取扱液 LIQUID	清水 WATER
液温 LIQUID TEMP.	0~80°C
最高使用圧力 MAX. WORKING PRESS.	0.69 MPa
ストレーナ通過面積 STRAINER PASSAGE AREA	110 cm²

御注文主 CUSTOMER 殿		機器番号 ITEM NO.	0001				
御使用先 FINAL USER 殿		機器名称 ITEM NAME					
originals SER. NO.	機名 MODEL	吐出し量 CAPACITY	全揚程 TOTAL HEAD	同期速度 SPEED min⁻¹	出力 OUTPUT	数量 Q'TY	

図番 DWG. NO. CNFT-65 001

MNFT-C011

No. B28443 00504

INSTRUCTION MANUAL

DENYO

DIESEL GENERATING SETS

Before using, be sure to read this manual for the sake of safety.

Be sure to observe the items under symbol marks "⚠ WARNING" and "⚠ CAUTION" for the sake of safety.

Always keep this manual at your machine for the sake of safety.

DCA-SP SERIES
25SP~90SP CLASS

Denyo Co., Ltd.

4-2-2, Kamitakada, Nakano-ku, Tokyo, 164, Japan

FORWARD

* Your machine is a portable type diesel generating set.
  (Specifications: See p.68 to p.70)

* Do not install, operate or repair this machine without reading this operating manual.

* This generator set (machine) must be operated by a person having sufficient knowledge and skill for the sake of safety.

Notes on instruction manual

* This instruction manual explains correct operation and maintenance of the machine to ensure its performance.
  Incorrect handling of the machine may lead to a serious injury or decease.
  Before using, be sure to read this manual carefully.
  Particularly, the items under " Safety precautions" (See p.1 to p.10),
  "⚠ WARNING" and "⚠ CAUTION" must be read thoroughly.
* Keep this manual in the case behind the rear door for future reference.
* Read the contents of the warranty card attached to the machine.

· If this manual becomes illegible by spot or damage, contact distributor or our office to get new manual.

— *Contents* —

1. Safety Precautions

In order to ensure safe operation, the following symbols are used for explanation of the machine operation.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

⚠ **WARNING:** This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.

⚠ **CAUTION:** This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.

[Note] : This symbols show handling precautions for effective operation and many years of satisfactory operation.

Some of the items shown by "⚠ CAUTION" may also cause death or serious injury.
Be sure to observe all the items, as they are important for safe operation.

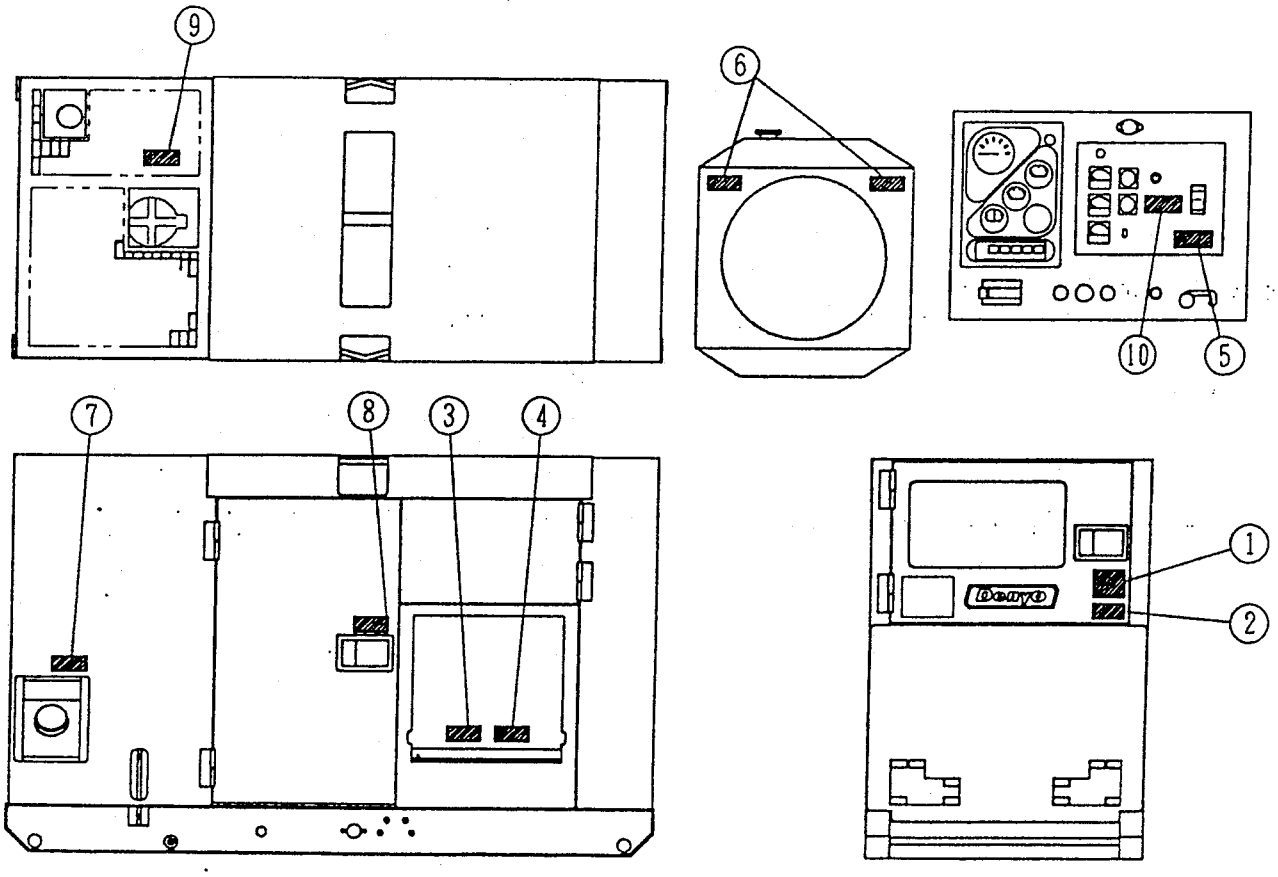
* If the machine is used by an outsider, you are requested to explain him correct handling and advise him to read this instruction manual carefully.
* Do not modify the machine at your discretion, as it affects the safety, performance or the life of the machine.
* If the machine is modified or it is used incorrectly against this manual or unauthorized parts are used, the warranty of manufacturer will become invalid.

Safety label

Safety labels are attached to the following positions of the machine.

* Keep these safety labels clean at all times.
* When safety labels are spoiled or lost, contact distributor or our office specifying the nameplate No. shown below and ask for new ones. Following numbers are for model 45SPI.

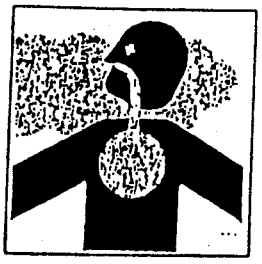
No.	Parts name	Parts number	No.	Parts name	Parts number
1	Safety instruction	B9211 0040	6	Warning : moving part	B9040 0040
2	Warning : exhaust gas	B9042 0000	7	Warning : fire accident	B9045 0000
3	Warning : output voltage	B9311 0050	8	Caution : high temp	B9040 0030
4	Warning : electric leakage	B9111 0040	9	Warning : radiator cap	B9041 0010
5	Warning : electrical shock	B9311 0060	10	Warning : house wiring	B9111 0030



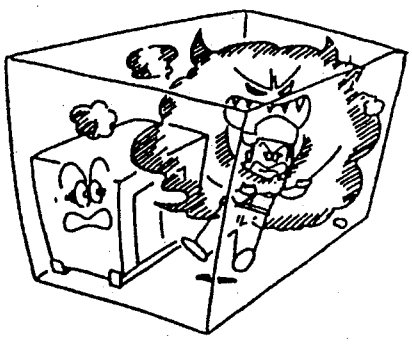
⚠ WARNING

ENGINE EXHAUST can kill.

■ Insufficient ventilation may lead to death due to lack of oxygen or poisoning by exhaust gases.



* Do not use the machine in a place of poor ventilation or in a place where exhaust gases stays.
* Do not use the machine indoors or in storehouse, tunnel, ship hold, tank, etc. of poor ventilation.
* If it becomes necessary to use the machine in the above places, the exhaust pipe should be extended to a well ventilated place. In this case, use a ventilator to ensure proper ventilation.
* Do not direct the exhaust outlet to nearby pedestrians and houses.

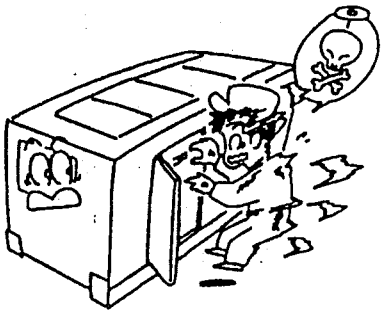


⚠ WARNING

ELECTRIC SHOCK can kill.

■ Do not touch the output terminals during operation to prevent decease due to electric shock.

* Never touch the output terminals during operation. If your hands or the machine are wet, it will result in a death or serious injury.
* When a wiring work is required, be sure to turn OFF the circuit breaker and stop the machine.
* Keep the output terminal cover closed and the terminal bolts tightened while the machine is running.
* A low voltage is generated even when the machine is in low speed idle operation. Be sure to stop the machine completely.



■ Do not touch the electrical parts in the machine during operation, as it may lead to death due to electric shock.

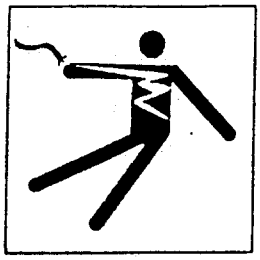
* Always close the control panel and tighten the fixing bolts before operating the machine.
* Always close the side door and lock it before operating the machine.
* When opening the control panel for voltage selection, etc. , turn OFF the circuit breaker and stop the machine.

⚠ WARNING

ELECTRIC SHOCK by leak can kill.

■ Improper grounding may lead to death due to electric shock.

「4−3. Grounding See p.29」

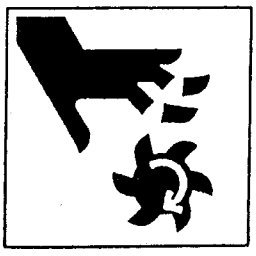


* Be sure to execute the grounding of the machine and the load according to the local rule.

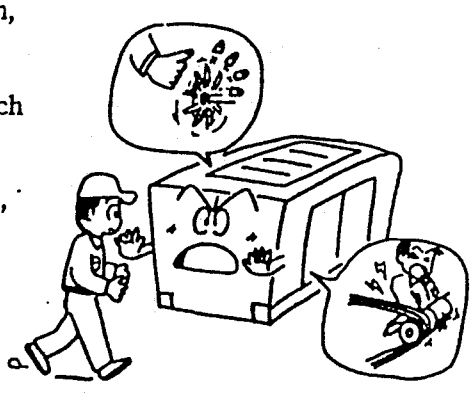
⚠ WARNING

MOVING PARTS can cause severe injury.

■ Rotary unit which runs at a high speed is located in the machine.
(Note that it is very dangerous if you touch it.)



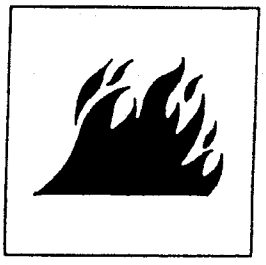
* Be sure to close the door and lock it during operation.
* When the door needs to be opened during operation, do not get your hands and head in the machine to prevent them from being caught in the machine which may lead to injury.
* When making check or maintenance of the machine, be sure to stop the machine in advance.



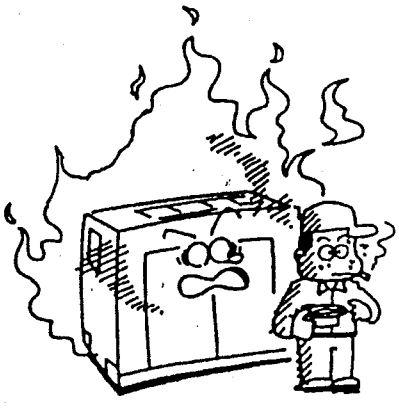
⚠ WARNING

DIESEL FUEL can cause fire or explosion.

■ Fuel and oil are flammable. Incorrect handling results in danger of ignition or fire.



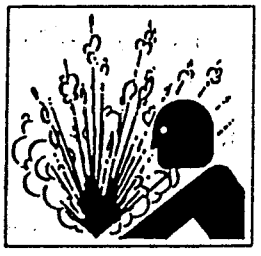
* When fuel needs to be supplied to the machine, be sure to stop the engine. Refrain from smoking. Keep the machine away from fire.
* Do not leave flammable objects (paper, wood chips, etc.) and hazardous objects (oil, powder, etc.) near the machine.
* Wipe off spilt fuel and oil.



⚠ WARNING

HOT COOLANT can cause severe scalds.

■ If the radiator cap is opened while the water temperature is high, steam or hot water will spout out.



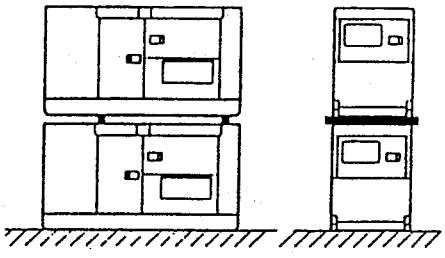
* During operation or immediately after stopping the machine, do not open the radiator cap while the water temperature is high.
* When cooling water needs to be checked or supplied, wait until the engine is cooled (50 °C or less as measured with the water temperature gauge).

⚠ CAUTION

Stacking

■ Improper stacking of machines may cause falling or dropping accidents.
When stacking other machines on this machine, be sure to observe the following points.

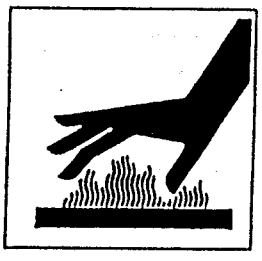
* Check that the bonnet of the machine is free from damage and that the fixing bolts are not loosened and missing.
* Put the machine horizontally on a solid foundation which withstands the weight of stacked machines.
* Machines can be stacked up to 2 stages.
The weight and size of stacked machines should be less than those of this machine.
* Using square timbers as shown right, put each machine making sure that the weight is even.



■ Do not operate the machines in the state of stacking to prevent falling or dropping accidents.

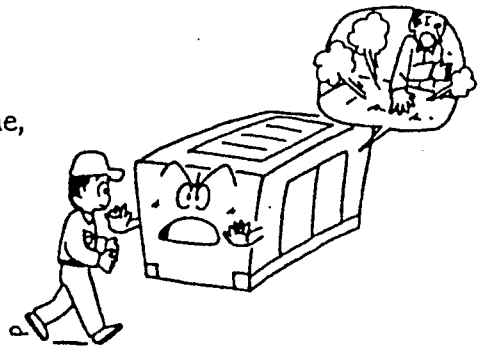
⚠ CAUTION

HOT PARTS can burn skin.



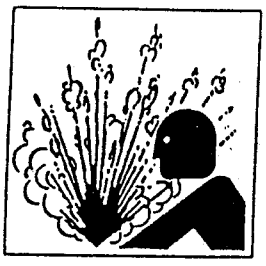
■ High temperature units are located in the machine. (Note that these units are very dangerous if they are used incorrectly.)

* Be sure to close the door and lock it during operation.
* If the door needs to be opened during operation, do not get your hands and head in the machine to prevent unexpected burns.
* When making check or maintenance of the machine, be sure to stop the machine.
* The bonnet is still hot even after the machine is stopped.
Be careful until the engine is completely cooled.



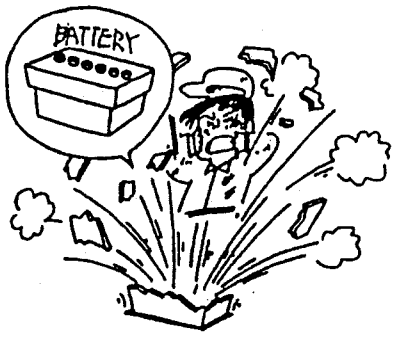
⚠ CAUTION

BATTERY



■ Battery generates flammable gases.
Improper handling may lead to explosion or serious injury.

* Battery should be charged in a well ventilated location. Otherwise, flammable gases are accumulated which may be ignited and exploded.
* When connecting a booster cable, do not jumper the terminals (+ and −). Otherwise, the flammable gases generated from the battery may be ignited and exploded by sparks.
* For maintenance of the machine, disconnect the ground cable on the ground side.



■ The battery acid is dilute sulfuric acid. Improper handling will cause unexpected burns.

* When the battery acid gets on your clothes or skin, wash it out with a large volume of water immediately. If it gets in your eyes, wash with a large volume of water immediately and consult your doctor.
  − In the worst case, it will put out your eyes.

■ For checking or handling of the battery, be sure to stop the engine and turn OFF the battery switch in advance.

⚠ CAUTION

Operator

■ Do not operate the machine, if operator is tired too much or drinks some alcohol or take some drugs.

* Otherwise, it may cause unexpected accidents or injury.

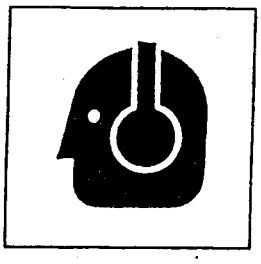
■ During checking or maintenance, be sure to put on suitable clothes and protectors.

* Do not put on baggy clothes, necklace, etc., because they are easily caught by projections which may cause injuries.

⚠ CAUTION

Noise

■ This machine generates large noise, if the door is open. Surrounding to large noise may cause hearing trouble.



* Close and lock the door during operation.
* If opening the door is necessary during operation, be sure to put on the ear protector.

⚠ CAUTION

Connection to house wiring

■ Before connecting this machine to any building's electrical system, a licensed electrician must install an isolation(transfer) switch.

* Serious injury or death may result without this transfer switch.

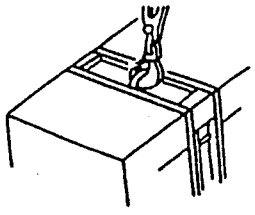
⚠ CAUTION

Transportation

■ Do not lift the machine at the support hook or the ladder because it is not strong enough for lifting and may cause a falling accident.

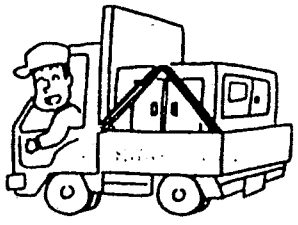
* When lifting the machine, use the hanger located at the roof center.
* Keep out under the lifted machine.

■ Do not lift or do not transport the machine during operation, as it may cause damage to the fan or serious trouble.



* When loading the machine on the truck or the like, fix the machine firmly by support hooks on the both side.

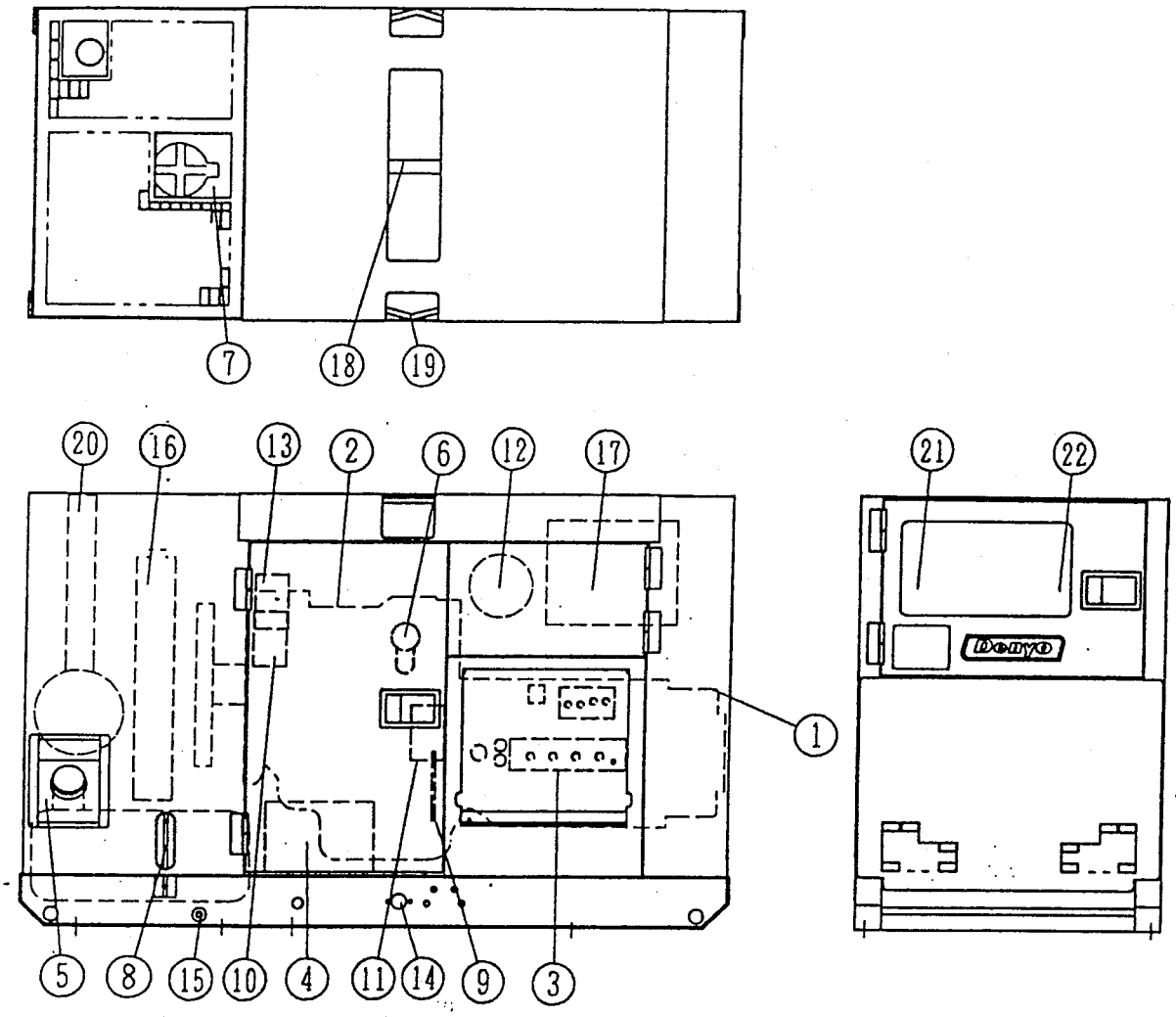
The detail as machine size is referred to
「11−1. Specifications See p. 68 to p.69」.



2. Construction

2–1 Outline and part names

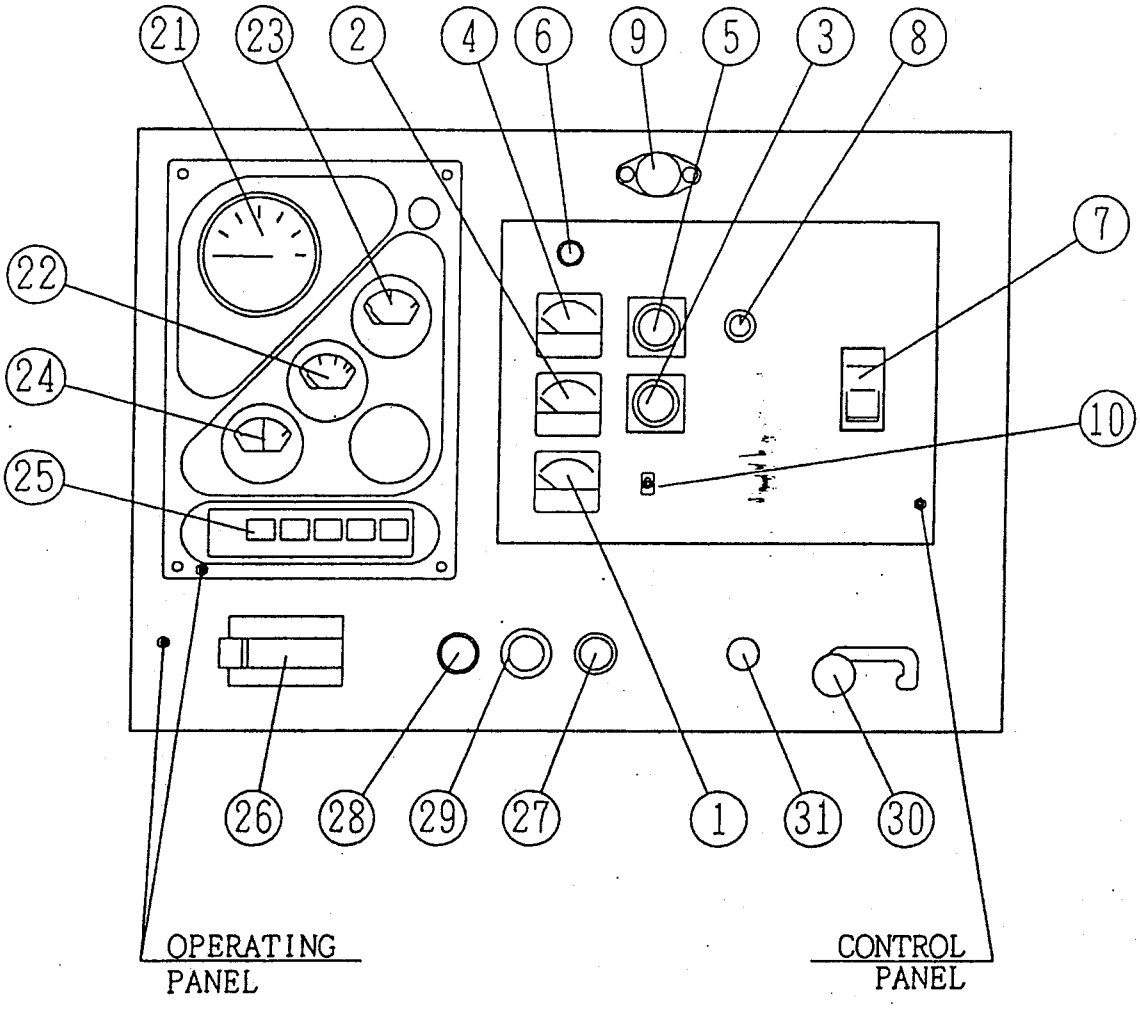
Following is 45SPI.



1 AC generator	9 dipstick	17 control box
2 diesel engine	10 fuel filter (opposite side)	18 hanger rod
3 output terminal	11 oil filter (opposite side)	19 support hook
4 battery	12 air cleaner	20 exhaust gas outlet
5 fuel in	13 coolant reserve tank	21 operating panel
6 engine oil in	14 oil drain plug	22 control panel
7 coolant in	15 fuel drain plug	
8 fuel level gauge	16 radiator	

2–2 Operating panel, control panel and part names

Following is 45SPI.



control panel

1 frequency meter
2 AC ammeter
3 ammeter change over switch
4 AC voltmeter
5 voltmeter change over switch
6 pilot lamp
7 circuit breaker (3-phase)
8 voltage regulator
9 panel light
10 panel light switch

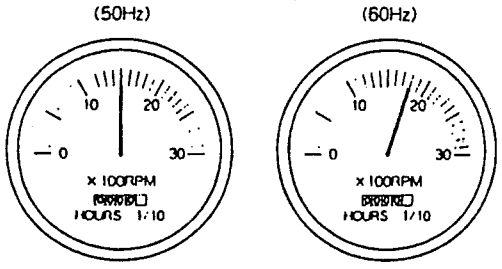
operating panel

21 tachometer
22 oil presure gauge
23 water tempreture gauge
24 charging ammeter
25 warning lamp unit
26 battery switch
27 starter switch
28 preheat lamp
29 emmergency stop button
30 throttle lever
31 frequency adjusting screw

2–3 Meters

Engine indicators

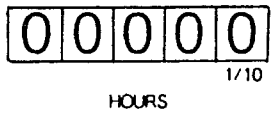
(1) Tachometer (0–3000rpm)

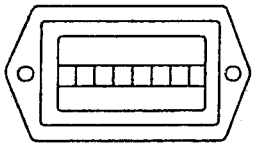


This meter indicates the number of revolutions (per minute) of the engine.

It indicates 1500rpm at 50Hz or 1800rpm at 60Hz.

(2) Hour meter





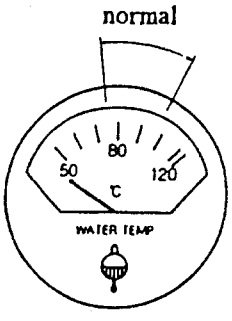
25SPI-C, 35SPI

This meter indicates the total running time of the engine. This meter is built in the tachometer, except 25SPI–C and 35SPI.

The hour meter has been set for use at 1500rpm. Accordingly, when the machine is used at 1800rpm, it indicates the total time approximately 20% more than the actual operation time.

In the case of 25SPI–C and 35SPI, it has hour meter which runs electrically. This meter integrates the time, when the starter is at the "RUN" position whether the engine is at a run or stop. And this meter indicates actual running time irrespective of engine speed.

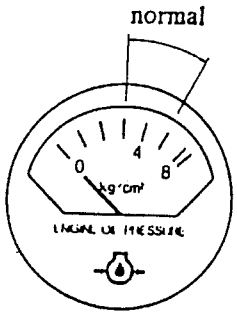
(3) Water temperature gauge



This is normal when it indicates 75 to 95 ℃ during operation.

[Note] If it indicates higher values, turn OFF the load and set the machine in cooling operation by setting the throttle lever to the "START/IDLING" position, and wait until the temperature lowers.

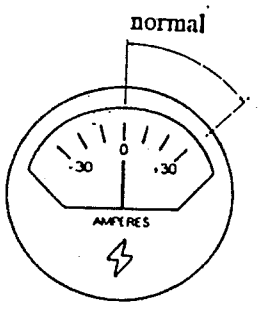
(4) Oil pressure gauge



This is normal when it indicates 3 to 5kg/cm ² during operation.

If the engine is cool, it may indicate higher values at the time of startup. Put the engine in warming up operation and wait until oil pressure becomes normal.

(5) Charging ammeter

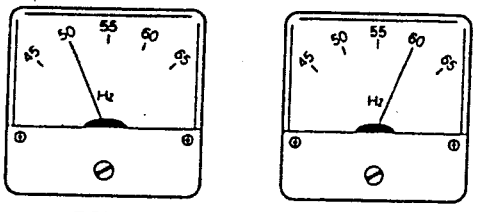


This meter indicates the current supplied by the alternato· to batteries.

It is normal when it indicates the range of 0 or +.

Generator indicators

(1) Frequency meter

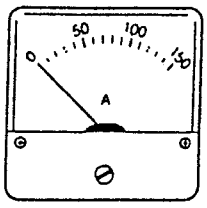


50Hz 60Hz

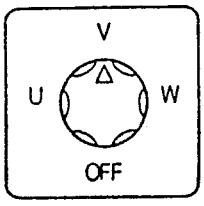
This meter indicates frequency of the output voltage.

Make sure that it indicates 50Hz or 60Hz during operation.

(2) AC ammeter



AC Ammeter



Ammeter change over switch

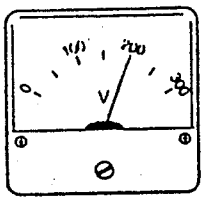
This meter indicates AC current flowing into the connected load. Make sure that it is always pointing below the rated current.

When running the three phase and single phase loads together, this meter indicates total current of them.

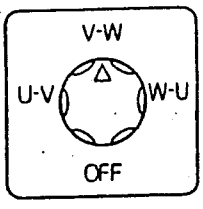
When running either the three phase or single phase load, this meter indicates the current flowing into the load.

The current of each phase can be checked using the ammeter change over switch. Ammeter change over switch is provided with the machine 45kVA or larger.

(3) AC voltmeter



AC Voltmeter



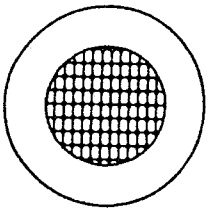
Voltmeter change over switch

This meter indicates AC output voltage. Make sure that it indicates rated voltage.

Line-to-line voltages can be checked using the voltmeter change over switch. Voltmeter change over switch is provided with the machine 45kVA or larger.

Indication/alarm lamp

(1) Preheat lamp



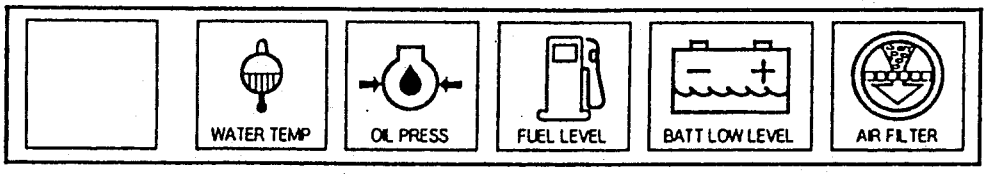
When the starter switch is set in the preheat position, this lamp becomes red heated in about 30 seconds, indicating that the machine has been preheated to be ready for startup.

In the case of 25SPI–C and 35SPI, it has automatic preheating device.

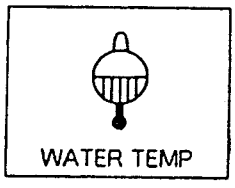
If turn the starter switch to "RUN" position, it will automatically preheat according to cooling water (coolant) temperature with the preheat lamp goes on. When the preheat lamp goes off, it indicates that preheating is completed.

(2) Warning Lamp Unit

This monitor indicates the following failures, if any one of them occurs.



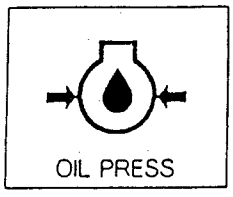
① High jacket water temperature (WATER TEMP)



This lamp goes on when the cooling water temperature rises abnormally. If the lamp goes on during operation, the emergency stop device immediately operates to shut down the engine automatically.

「5–1.(2) Check on engine cooling water See p.33」

② Oil pressure failure (OIL PRESS)

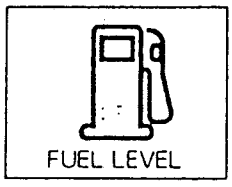


If the machine is in normal operation, this lamp stays off. When the starter switch is turned to "RUN" position to start the engine, the lamp goes on, and when the oil pressure rises after startup, it goes off. If this lamp goes on during operation, the emergency stop device immediately operates to shutdown the engine automatically.

It should be noted, however, that 25SPI–C, 35SPI, 45SPH, 60SPH, 90SPH are designed that this lamp does not go on even if the starter switch is set at the "RUN" position to startup the engine.

「5–1.(1) Checking on engine oil See p.32」

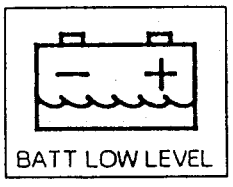
③ Fuel level failure (FUEL LEVEL)



When fuel is running low, this lamp goes on, and it should be supplied at the tank.

「5–1.(4) Check on fuel See p.34」

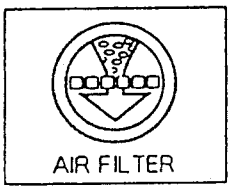
④ Battery acid level failure (BATT LOW LEVEL)



When battery acid is running low, this lamp goes on, and distilled water should be supplied to the battery.

「5–1.(5) Check on battery acid See p.35」

⑤ Air filter blinding (AIR FILTER)



When the air element is blinded, this lamp goes on. Indicating that the element should be immediately cleaned or replaced.

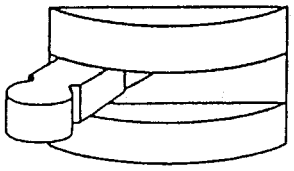
「8–3.(3) Cleaning of air cleaner element See p.55」

「8–5.(2) Replacement of air cleaner element See p.61」

2–4 Use of switches and controllers

Switches

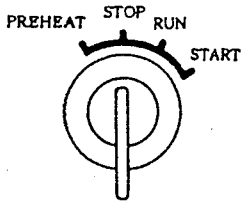
(1) Battery switch



This switch should be set in the "ON" position during operation. And after stop the engine, this switch should be set in the "OFF" position.

[Note] Do not turn this switch to "OFF" position during operation. Otherwise, the engine may not be able to be stopped by normal operation, or it may cause damage to the electric equipment.

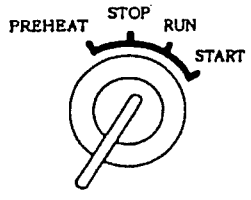
(2)Starter switch



Functions:

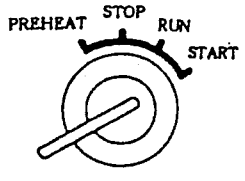
① Stop

This switch should be set in this position unless the machine is in operation. The key can be inserted or pulled out in this position.



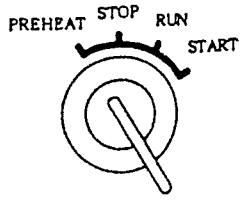
② Run

This switch should be set in this position when the machine is in operation.



③ Start

This is the position to start the engine. When your hand is released from the key after starting, it is automatically set in the position of "RUN".

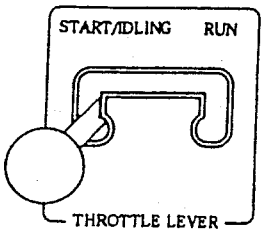


④ Preheat

This is the position to start the engine when the air temperature is low. Set the switch in this position until the preheat lamp becomes red heated, and then set it in the start position. However, in the case of 25SPI–C and 35SPI, there is not the "PREHEAT" position on the starter switch, because it automatically preheats at "RUN" position

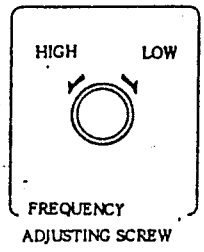
(3) Speed control device

· Throttle lever



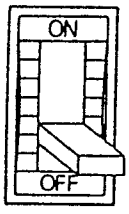
This lever is used to control the engine speed. Set the lever at the "START/IDLING" position for startup or warm up/cooling operation of the engine and at the "RUN" position for constant speed operation of the machine (at 50Hz or 60Hz).

· Frequency adjusting screw



This screw is used to adjust the frequency. With the throttle lever set at the "RUN" position, turn the screw to the "HIGH" side to increase the frequency and to the "LOW" side to decrease it.

(4) Circuit breaker



This is a main switch to supply power to a load.
When the load is shorted or in the state of overload, it trips to protect the generator against trouble.

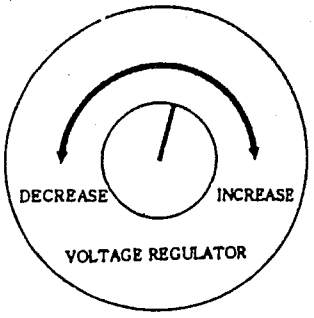
[Note]

Do not use this circuit breaker to turn ON/OFF the load, to prevent damage to the circuit breaker.

When it trips with overcurrent, the handle of the breaker stops between ON and OFF positions. This is what is called the trip condition.
In this case, push the handle down to the OFF position to reset it, or else, it cannot be set in ON position.

Voltage regulator and overcurrent relay

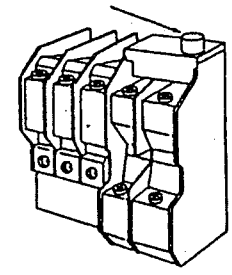
(1) Voltage regulator



This regulator is used to control the output voltage. Turn the regulator to clockwise to increase the voltage and counter clockwise to decrease it.

Adjust the voltage to the rated voltage with this regulator.

Overcurrent relay

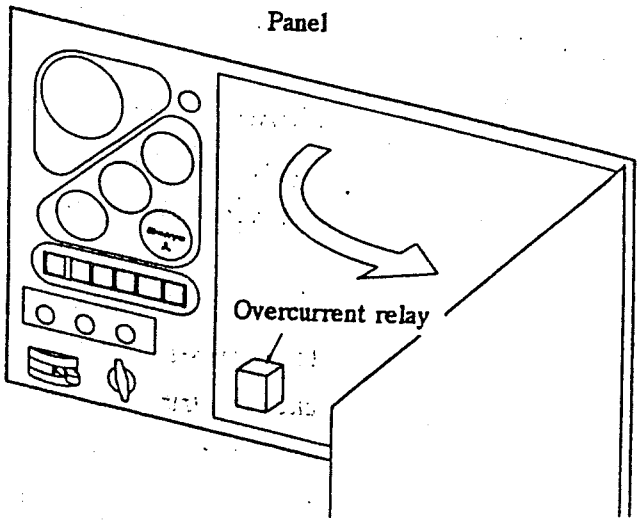


This relay is used to trip the circuit breaker (for 3 phase) when overcurrent flows into the circuit.

If the circuit breaker (for 3−phase) trips and cannot be closed, stop the engine and open the control panel. Then, press the reset button.

[Note]

Do not change the set value unnecessarily.



3. Transportation and installation

3−1 Transportation of machine

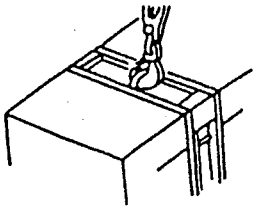
⚠ CAUTION

Transportation

■ Do not lift the machine at the support hook or the ladder because it is not strong enough for lifting and may cause a falling accident.

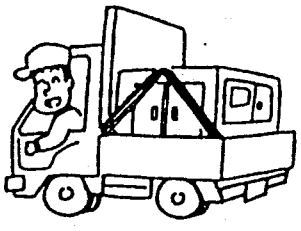
* When lifting the machine, use the hanger located at the roof center.
* Keep out under the lifted machine.

■ Do not lift or do not transport the machine during operation, as it may cause damage to the fan or serious trouble.



* When loading the machine on the truck or the like, fix the machine firmly by support hooks on the both side.

The detail as machine size is referred to
「11−1. Specifications See p.68 to p.69」.



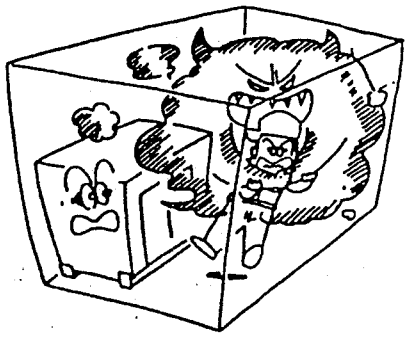
3−2 Installation of machine

⚠ WARNING

ENGINE EXHAUST can kill.

■ Insufficient ventilation may lead to death due to lack of oxygen or poisoning by exhaust gases.

* Do not use the machine in a place of poor ventilation or in a place where exhaust gases stays.
* Do not use the machine indoors or in storehouse, tunnel, ship hold, tank, etc. of poor ventilation.
* If it becomes necessary to use the machine in the above places, the exhaust pipe should be extended to a well ventilated place. In this case, use a ventilator to ensure proper ventilation.
* Do not direct the exhaust outlet to nearby pedestrians and houses.



[Note] vibration:

The engine, running, generates vibration during operation of the machine.

When installing the machine, be sure to observe the following points.

① Install the machine horizontally on a solid foundation.

Operation on an uneven place will generate unusual vibration.

② The machine should be installed on a substantial base to prevent claims from nearby living people. For details of the vibration level of the machine and foundation work, contact distributor or our office.

[Note] noise:

The engine is running during operation of the machine.

If the door is open, much noise will be generated. But some noise will stay, when door is closed.

When installing the machine, be sure to observe the following points.

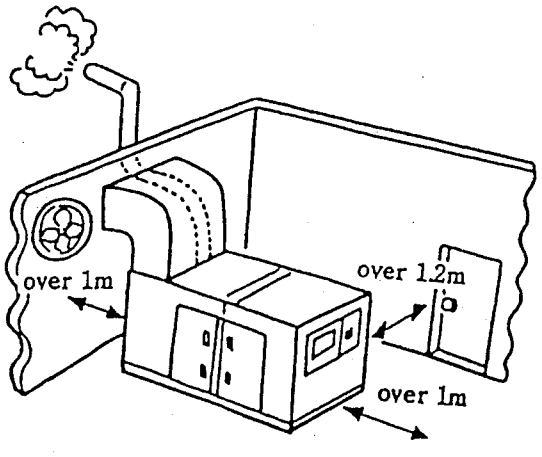
* Close and lock the door after installation.
* We recomend to execute the measure for sound level to prevent claims from nearby living people.

Installation procedure

* Install the machine horizontally on a solid foundation.
* Provide a space of more than about 1m at the side of the control panel and fuel feed port to ensure correct operation and supply.
* Provide a space of more than about 1.2m on the left and right sides for check of the engine, oil supply and cable connection work.
* A sufficient space is required at the top of the machine to allow hot air (exhaust air) from the radiator and exhaust gases to be discharged and to supply water to the radiator.
* When the machine is operated in a place with much dust or salt, careful maintenance is required to prevent clogging or damage to the radiator or poor insulation of electric parts.

Indoor installation

* Exhaust gases should be discharged outdoors using an exhaust pipe.
* Exhaust air should also be discharged outdoors using a duct or the like.
* Insufficient indoor ventilation will raise the (indoor) temperature and affects the performance of the machine.
* For details of required volume of ventilation, contact distributor or our office.



4. Connecting the load

4–1 Cables to be used

Selection of cables:

Use cables having sufficient size in consideration of the allowable current of the cables and the distance between the machine and the load.

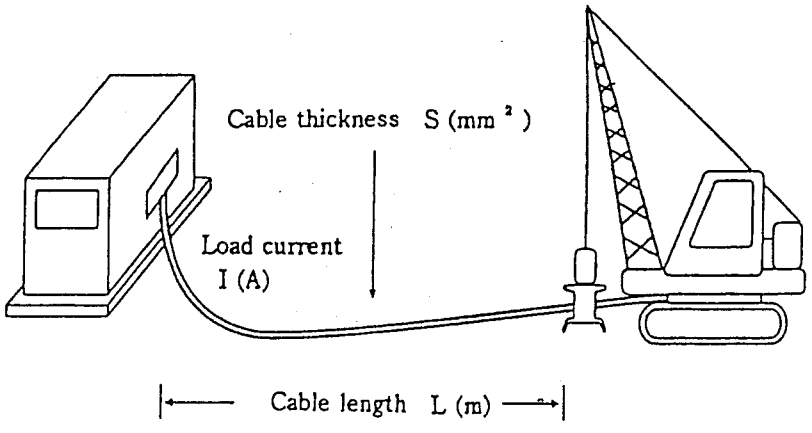
If the load current exceeds the allowable current of cables, the cable may be damaged by overheat. Also, if the cables are too small in size for the length, the input voltage of the load drops which lowers the working efficiency or causes failure in operation.

Select the length and size of cable so that the voltage drop "e" obtained by the following equation is within 5% of the rated voltage.

* Equation to obtain 3–phase, 3–wire system voltage drop "e" from the length and size of cable and operating current is as follows.

$$e = \frac{1}{58} \times \frac{L}{S} \times I \times \sqrt{3}$$

where e: voltage drop (V) L: length (m)
S: cable thickness(mm^2) I: load current (A)



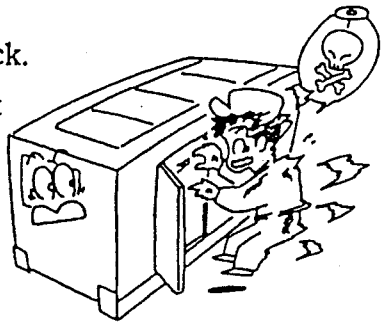
4-2 Connecting the load

ELECTRIC SHOCK can kill.

■ Do not touch the output terminals during operation to prevent decease due to electric shock.

* When a wiring work is required, be sure to turn OFF the circuit breaker and stop the machine.
* When operating the engine, close the output terminal cover. Tighten the fixing bolts before operating the machine.

■ Do not use damaged cables to prevent electric shock. Insufficient tightening of bolts will generate heat at connections which may result in fire accidents.



* When connecting, make sure the connecting cables are normal and connected firmly to the output terminals.

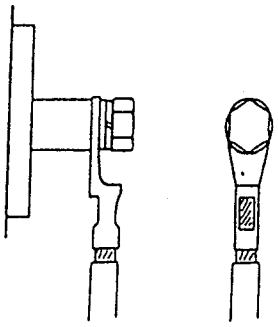
⚠ CAUTION

Connection to house wiring

■ Before connecting this machine to any building's electrical system, a licensed electrician must install an isolation(transfer) switch.

* Serious injury or death may result without this transfer switch.

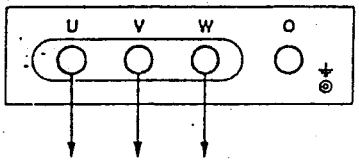
(1) Fastening the output terminal



[Note] In connecting the load, tighten locking bolts securely with a spanner or the like to prevent burning.

(2) Connecting three phase output terminal

Connect the load to the output terminal after confirmation of load phase and voltage.



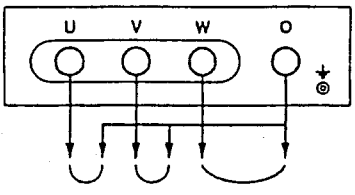
Use U/V/W for three phase load

200/220V or 400/440V

(190V) (380V)

{415V}

[240V] [480V]



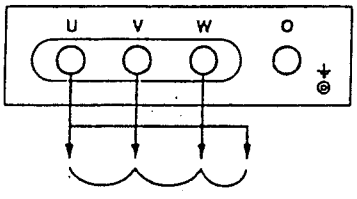
Use O/U,O/V,O/W for single phase load

115/127V or 231/254V

(110V) (219V)

{240V}

[139V] [277V]



Use U/V,V/W,W/U for single phase load

200/220V or 400/440V

(190V) (380V)

{415V}

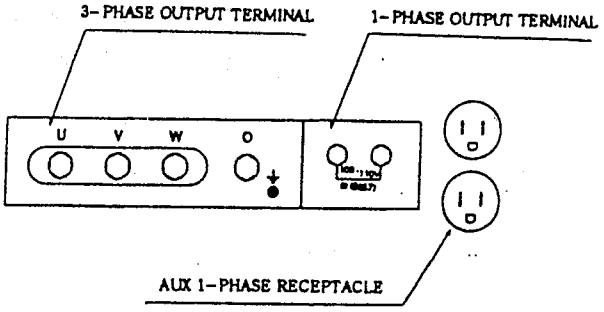
[240V] [480V]

(3) Single phase output

① 25SPI-C, 25SPI II

Single phase output terminal and two receptacles are equipped on the output terminal block. The breaker for them is on the control panel.

Single phase output voltage differs according to three phase output voltage.



「 11-2. AC generator specifications See p.70 」

[Note]

Single phase output terminal can be used to 3kVA with two receptacles. Receptacles can be used up to 1.5kVA each other. And in using the single phase and three phase output terminals concurrently, the three phase output lowers by the single phase output level.

Single phase output terminal and the receptacles use phase U.

② 35kVA or larger

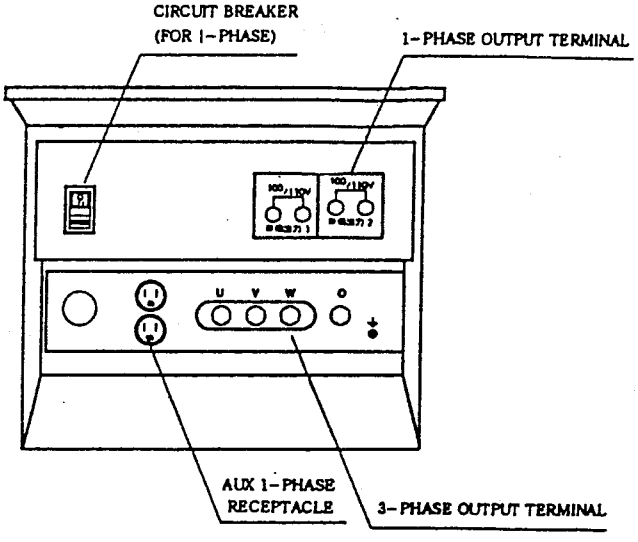
Single phase output terminal, two receptacles and breaker for them are equipped on the output terminal block.

Single phase output voltage differs according to three phase output voltage.

「 11-2. AC generator specifications See p.70 」

Single phase output capacity differs according to model of the machine.

「 11-1. Specifications See p.68 」



[Note]

Single phase output terminal 1 can be used to the capacity described in the 「 11-1. Specifications See p.68 」 .

But single phase output terminal 2 can be used with the two receptacles to the capacity in specification table. Receptacles can be used to 1.5kVA each other. And in using the single phase and three phase output terminals concurrently, the three phase output lowers by the single phase output level.

Single phase output terminal 1 uses phase U . Single phase output terminal 2 and the receptacles use phase W.

(4) Precaution in load connection

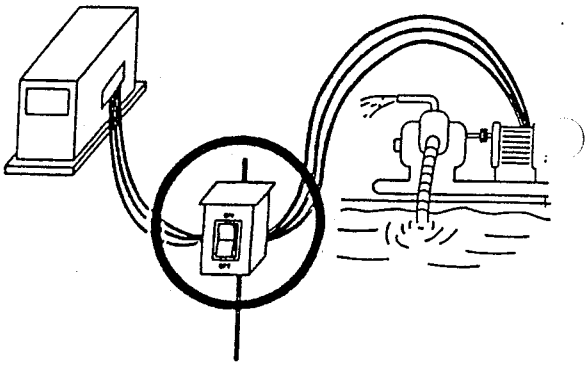
① Be sure to provide a switch for turning the load ON and OFF between the output terminal block and the load.

Note that the use of the breaker of the machine for turning the load ON and OFF may result in breaker failure.

② In connecting the load, be sure to stop the engine and turn OFF the breakers on the control panel and the out put terminal block.

③ Don't contact the connecting cable to the output terminal of other phase on the output terminal block.

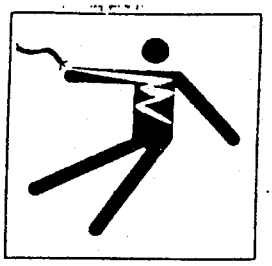
④ When the load connection is finished, close the cover of output terminal and tighten by the bolts.



4–3 Grounding

⚠ WARNING

ELECTRIC SHOCK by leak can kill.



■ Improper grounding may lead to death due to electric shock.

* Be sure to execute the grounding of the machine and the load according to the local rule.

Grounding

Execute the grounding certainly to prevent the electric shock by leak.

(1) Case grounding of the machine

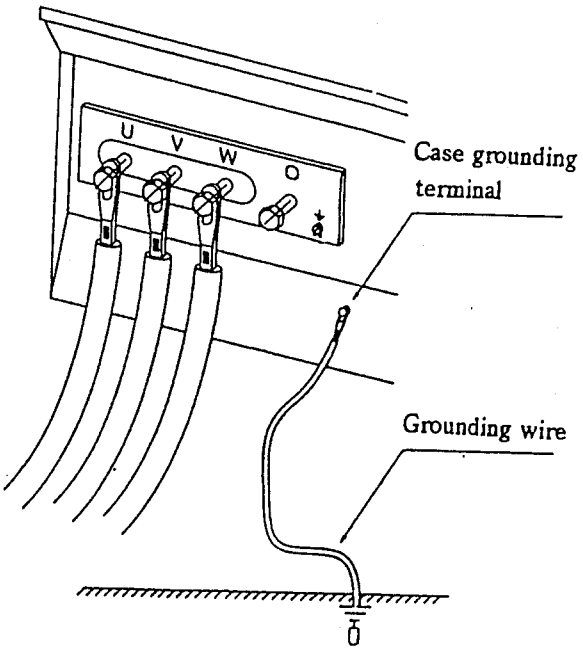
Use the grounding wire which sectional area conforms to the local rule.

Provide the grounding rod to satisfy the grounding resistance which conforms to the local rule.

(2) Case grounding of the load

Execute the grounding for the load similarly.

Provide the grounding rod to satisfy the grounding resistance which conforms to the local rule.



(3) Precaution in grounding

① Select a shady and highly moist place, and burry the grounding rod in such way that its top end is completely hidden in the ground.

② If burying the grounding rod on the place that many pedestrians walk on, clamp the lead wire to prevent catching on it.

③ If the lead wire is not long enough for the connection, connect it as directed below:

(1) Connect the lead wire and the extension wire by soldering or sleeve coupling securely and apply insulating tape to the connection.

(2) Do not burry the connection in the ground.

④ Avoid the places within 2m of lightning conductor grounding location for burying of grounding rod.

⑤ Do not use a telephone set grounding conductor.

5. Operation

– From pre-start check to shut down –

Be sure to check the machine prior to starting.

1.. Pre-start check : Check oil, cooling water, fuel and so on.

2.. Periodical check: Check each part of the machine according to operating time.

3.. Startup: Check the surroundings of the machine for safe operation.
Use a sign before startup.

4.. Operation: ⚠ In the machine there are moving parts, high temperature parts and high voltage parts. Before operating, close the door and lock the side door for safe operation and for prevention of noise.

[Note] If the warning lamp lights, stop the engine and check the cause of it.

[Note] Check for leaks of oil, water, exhaust gases, and for unusual noise.

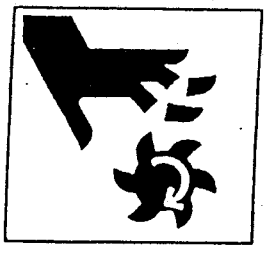
5.. Shut down

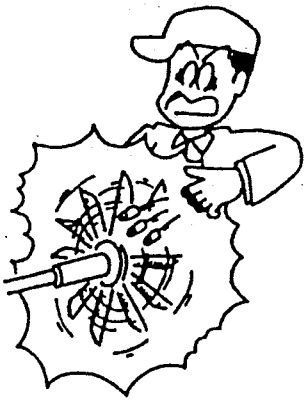
5–1 Checking prior to operation

⚠ WARNING

MOVING PARTS can cause severe injury.

■ Rotary unit which runs at a high speed is located in the machine.
(Note that it is very dangerous if you touch it.)





* Be sure to close the door and lock it during operation.
* When making check or maintenance of the machine, be sure to stop the machine in advance.

– To prevent unexpected trouble, be sure to check the following points.

(1) Check on engine oil (lubricating oil)

(2) Check on engine cooling water

(3) Checking on fan belt

(4) Checking on fuel

(5) Checking on battery acid

(6) Checking on grounding for electric shock protection

(7) Checking for leakage of oil and water

(8) Checking for loose parts

(9) Removal of foreign objects in machine

Inspection:

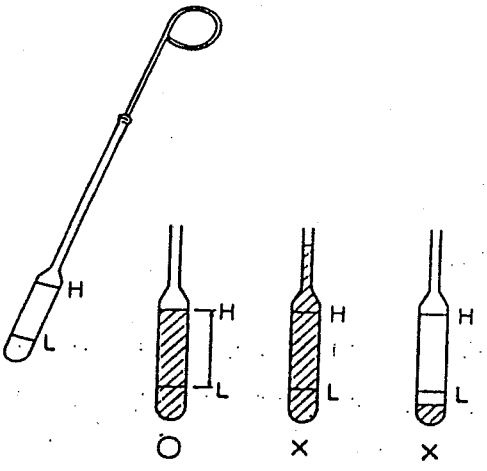
(1) Checking on engine oil

(Read the instruction manual for the engine furnished separately.)

① Checking the level of engine oil by the dipstick. Make sure the oil level is always between H and L.

② When it is below the low limit, supply oil immediately.

③ At the same time, check condition of oil by the dipstick.



[Note]

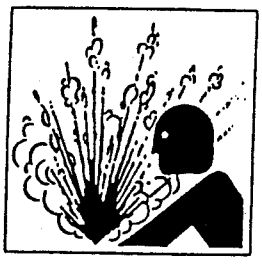
Oil is consumed gradually during operation. When the machine is to be used continuously for a long time, be careful with lack of oil.

Handling of the machine equipped with an automatic oiler refers to 「12–1 Automatic Oiler See p.94」

(2) Check on engine cooling water
(Read the instruction manual for the engine furnished separately.)

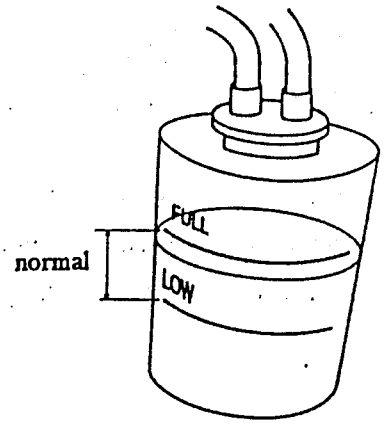
⚠ WARNING

HOT COOLANT can cause severe scalds.

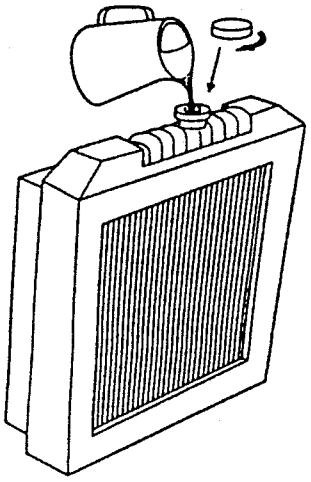


■ If the radiator cap is opened while the water temperature is high, steam or hot water will spout out.

* During operation or immediately after stopping the machine, do not open the radiator cap while the water temperature is high.
* When cooling water needs to be checked or supplied, wait until the engine is cooled (50 °C or less as measured with the water temperature gauge).



① Check (to see) that cooling water in the reserve tank is within the range of FULL–LOW.
② When it is below the low limit, supply (additional) water immediately.
③ Normally, only the water level of the reserve tank needs to be checked.
But, the radiator cap should be opened once a week to check that water is full in the radiator.



[Note]

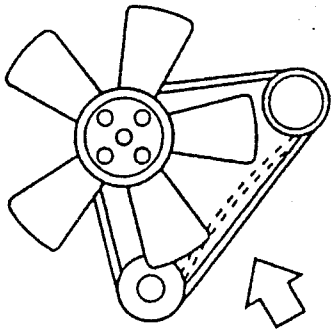
When closing the radiator cap after water level is checked or water is supplied, turn the cap fully clockwise so that it can be firmly tightened.
Otherwise, cooling water is evaporated which results in serious damage to the engine.

(3) Check on fan belt

(Read the instruction manual for the engine furnished separately.)

① Check the belt for tension and elongation. Also, check it for damage. Replace if necessary.

② For adjustment or replacement of the belt, refer to the instruction manual for the engine.

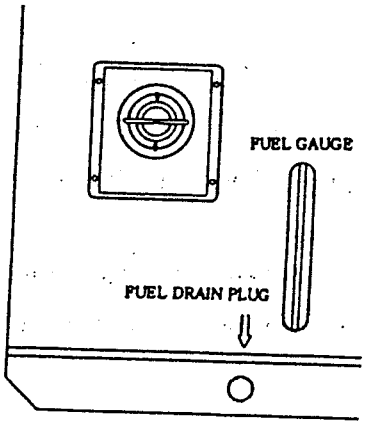


Press (about 6kg) the position shown by arrow mark (middle of belt) with your thumb. The bend should be within the range of 10–15mm.

(4) Check on fuel

① Be sure to check the quantity of fuel prior to operation to prevent lack of fuel during operation.

② Loosen the drain plug of the fuel tank from time to time, and remove sediments and water at the bottom of the tank.



(5) Check on battery acid

⚠ CAUTION

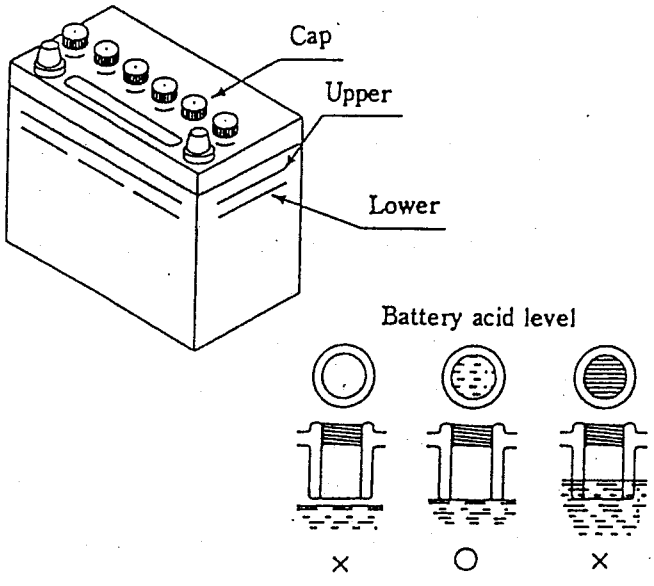
BATTERY

■ The battery acid is dilute sulfuric acid. Improper handling will cause unexpected burns.

* When the battery acid gets on your clothes or skin, wash it out with a large volume of water immediately. If it gets in your eyes, wash with a large volume of water immediately and consult your doctor.

– In the worst case, it will put out your eyes.

Remove the battery acid plug(cap) and check the liquid level (10–12mm above the electrodes). Supply distilled water if necessary.

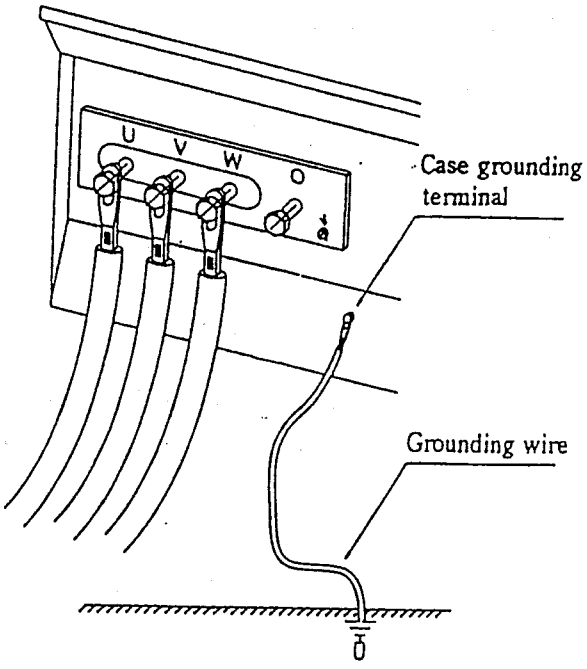


(6) Check grounding for electric shock protection

Make sure that the case grounding of the machine and the load are certainly.

「4−3. Grounding See p.29」

Do not ground directly 「O」 terminal.



(7) Check for leak of water and oil

Check the machine for the trace of leak of oil or water. If a leak is found, check the location of leak and stop it. When the leak cannot be stopped, contact our service factory.

(8) Check for loose parts

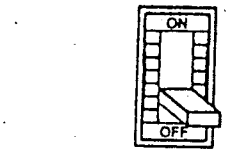
Check for loose bolts and nuts. Loose parts should be tightened firmly. Particularly, make check on (the fitting of air cleaner, muffler, turbo−charger, etc.), disconnection of electric wiring, short−circuit and loose terminals.

(9) Removal of foreign objects in machine

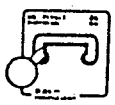
* Check that tools and cleaning cloth are not left in the machine. Remove if necessary.
* Check the surroundings of the muffler and engine for presence of dust and flammable objects. Remove if necessary.
* Check that the cooling air inlet and the cooling air outlet of the machine are not clogged with dust or other objects. Remove if necessary.

5－2 Startup

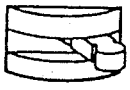
Following is flow of startup.



circuit breaker : OFF



throttle lever : START/IDLING



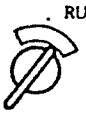
battery switch : ON

When engine is already warm.

starter switch : PREHEAT

preheat lamp : check preheat lamp is red heated

starter switch : START



starter switch : RUN

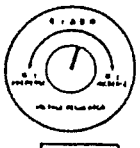
engine startup

When it is cold.

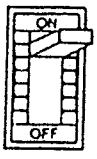
warm up operation : about 5 minutes　　warm up operation : sufficiently

throttle lever : RUN

adjustment of speed



adjustment of voltage



circuit breaker : ON

supply power to load

⚠ CAUTION

* Do not start the engine when the machine and the load circuit breaker are ON, or else, power is supplied to the load at the start of the engine which causes electric shocks or trouble in the load.

Startup procedure:

(1) Make sure that the circuit breakers of the machine and the loads are all OFF.

(2) Turn the battery switch to ON and set the throttle lever in the "START/IDLING" position.

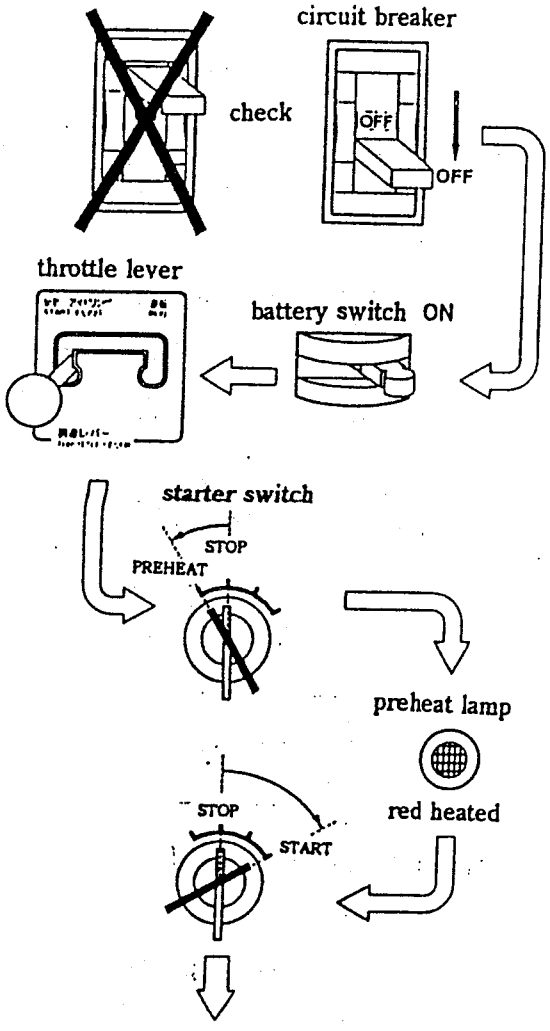
(3) Set the starter switch in "Preheat" position. This switch must be ON until the preheat lamp becomes red heated. ※ Turn the starter switch to "START" position until engine starts.

[Note]

If the engine is warm, the preheat operation is not required.

※ In the case of 25SPI–C and 35SPI, turn the starter switch to "START" position after the going OFF of the preheat lamp at the "RUN" position of the starter switch.

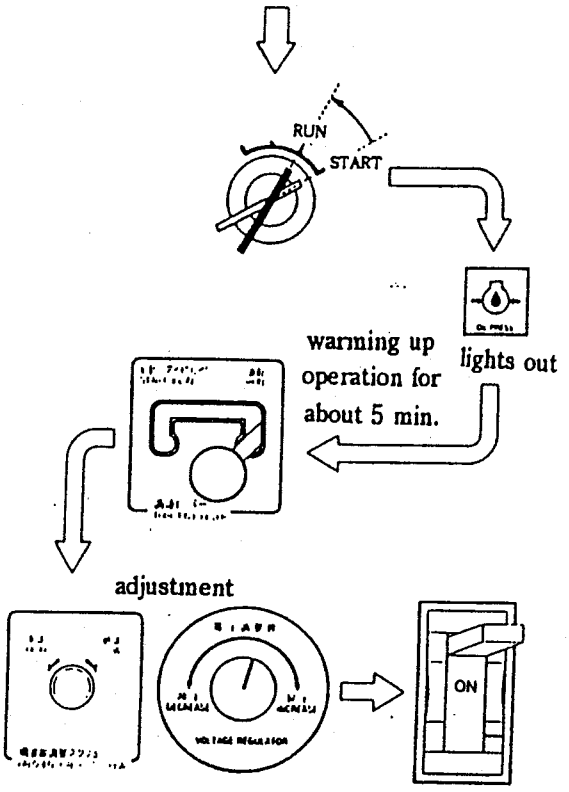
The duration of preheating differs according to the temperature of cooling water. And if the temperature of cooling water is high enough, the preheat lamp does not light because no preheating is required.



(4) If engine starts up, set free the starter switch. Make sure that 「 Oil Pressure Failure 」 in the warning lamp unit goes off.

(5) Drive the machine for warming up the engine for about 5 minutes at the "START/IDLING" position of the throttle lever.

(6) After warming up the engine, set the throttle lever to the "RUN" position. And check on the idling speed is as specified in the following table by the frequency meter. If the idling speed is not as specified or change of frequency is required, adjust the idling speed by the frequency adjusting screw.



	Frequency (Idling speed)
Operation at 50Hz	52.5Hz (1575rpm)
Operation at 60Hz	62.5Hz (1875rpm)

If the idling speed set above speed, frequency becomes nearly 50Hz or 60Hz in the rated load.

(7) Set the voltage to the rated by the voltage regulator, and turn the breaker to "ON". The machine starts power transmission state.

5–3 Handling during operation

(1) Checking after startup

① Make sure that each meter and lamp are normal.

normal : warning lamp is all off

(See p.16)

② Make sure that the color of exhaust gases from the engine is normal.
Check for unusual noise and vibration.

Color of exhaust gases

- Colorless or light blue: Normal
- Black: Abnormal, incomplete combustion
- White: Abnormal, combustion of oil due to failure of oil

(2) Adjustment during operation

Set the tachometer and frequency meter to the rated by the frequency adjusting screw.
Set the voltmeter to the rated by the voltage regulator.

[Note]

* Do not set the throttle lever in "START/IDLING" position or do not decrease the speed by the frequency adjusting screw during operation of the load, or else, the generator voltage and frequency will go down, resulting in failure in operation of the load device or any other trouble.

Do not turn the battery switch to "OFF" position or do not remove the battery, or else, engine will not stop normally or resulting in trouble of electrical equipment.

5-4 Shut down

(1) Turn OFF the circuit breaker of the load.

(2) Turn OFF the circuit breaker of the machine.

(3) Set the throttle lever in "START/IDLING" position and put the machine in cooling operation for about 5 minutes.

(4) Set the starter switch in "Stop" position. The engine will stop immediately.

(5) Turn the battery switch to "OFF" .

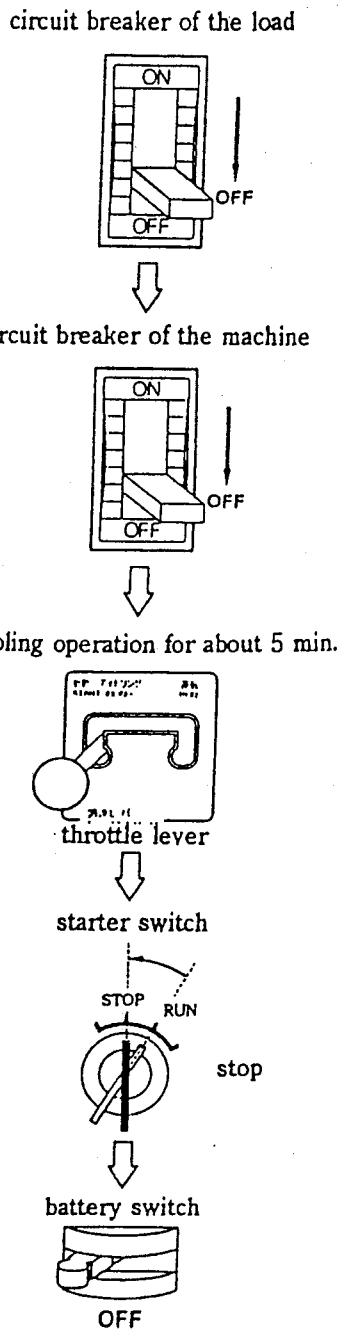
[Note]

Do not leave the machine keeping the battery switch at "ON", the battery is discharged.

(6) Remove the key from the starter switch and keep it at hand.

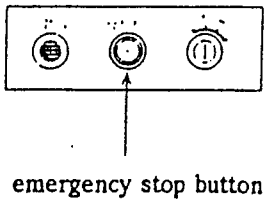
(7) Check the amount of fuel. Supply additional fuel if necessary.

(8) Check for leakage of oil, fuel and water.



[Note]

For emergency stop, keep pushing the "EMERGENCY STOP" button until the engine stops.



5–5 Protection device

Protection devices and emergency stop devices are provided for protection of the machine against trouble during operation. When the running caution lamp lights, stop the engine immediately. Check and remove the cause of trouble.

Table of protection device

action / warning	turn OFF the circuit breaker	stop the engine	indicate by warning lamp	function
high jacket water temperature (WATER TEMP)	—	○	○	When the cooling water temperature rises abnormally, the device acts. Set point: 102℃(45,60,90SPH) 105℃(25SPI II 35,45,60,75SPI) 110℃(25SPI-C)
oil pressure failure (OIL PRESS)	—	○	○	When the oil pressure falls abnormally, the device acts. Set point: 1.0kg/cm²(25SPI-C, 25SPI II,35,45,60,75SPI) 0.5kg/cm² (45,60SPH) 0.6kg/cm² (90SPH)
fuel level failure (FUEL LEVEL)	—	—	○	When fuel supply is necessary because of fuel shortage, the device acts.
battery acid level failure (BATT LOW LEVEL)	—	—	○	When the battery acid is failure, the device acts.
air filter blinding (AIR FILTER)	—	—	○	When replace or cleaning of air filter is necessary because of blinding of filter, the device acts
overcurrent	○	—	—	When overcurrent flows, the device acts