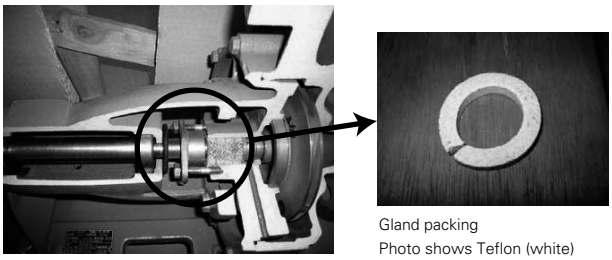
Pump structure

1-1. Shaft seal

(1) Above ground pump

● Gland packing type

Gland packing installed



Gland packing
Photo shows Teflon (white)

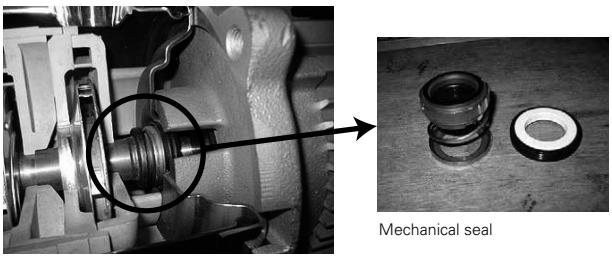
Fig.1

Table 1. Representative models

Type			Model		
Volute pump	Stainless steel	Single-stage direct coupled type	LS2	LS	
		Multi-stage direct coupled type	MKHS	SM	
	Cast iron	Single-stage direct coupled type	LS2	LS	S
		Multi-stage direct coupled type	M		
Single suction volute pump	Stainless steel	Single-stage direct coupled type	SP		
	Cast iron	Single-stage direct coupled type	SP3	SP	
		Multi-stage direct coupled type	MSP		
Oil pump	Gear type	Belt drive type	GV		

In an environment where some leakage is allowed, it is used as a shaft seal for handling fluid. In general, repair and replacement of the shaft seal can be done without disassembling the pump. For this reason, normal maintenance is possible even for beginners of machines.

Mechanical seal installed



Mechanical seal

Fig.2

Table 2. Representative models

Type			Model		
Volute pump	Stainless steel	Single-stage motor type	SJMS		
		Single stage line type	SLP2	LP	
		Single-stage coupling direct connection type	SJS	SJ4S	
		Multi-stage motor type	NX		
		Multi-stage coupling direct connection type	SVM		
	Cast iron	Single-stage motor type	SJM2	SJM3	
		Single-stage coupling direct connection type	SJ	SJ4	SKJ
Product name: Self-suction type	Resin fabrication	Single-stage motor type	ESPM		
	Cast iron	Single-stage motor type	MTP		
Oil pump	Gear type	Coupling direct connection type	GPL2	GPM2	

It is used in handling fluids and environments where leakage is not allowed, and in applications where leakage should be eliminated as much as possible.
Though the gland packing which is easy to handle was mainly used for pumps for equipment in the past, the mechanical seal has recently become the mainstream due to customers' advanced needs.

(2) Drainage pump

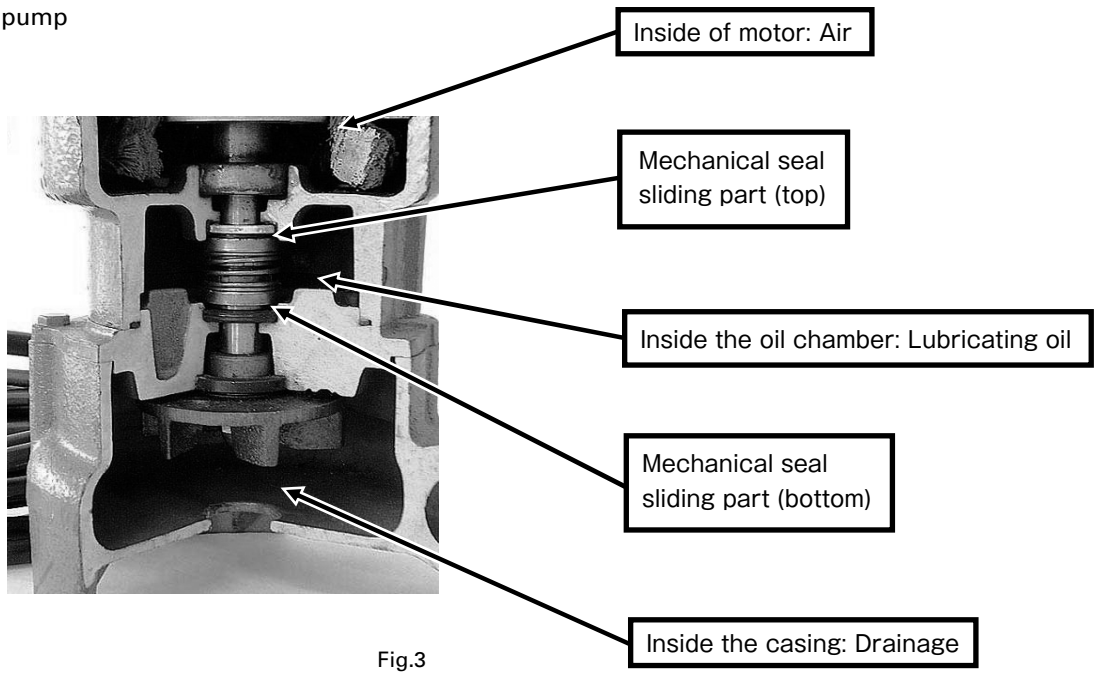
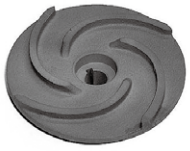
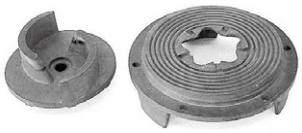


Fig.3

1-2. Impeller

(1) Shape and features of impeller

Table 3

Semi-open	Non-clog type semi-open	Non-clog type semi-open With cutter disc	(Special) Semi-open Pump structure: (Semi) Vortex
			
An impeller designed to deliver foreign matter in the fluid without clogging as much as possible. Since the area through which foreign matter passes is relatively small, it is used for sewage discharge with small foreign matter and small volume. It consists of a main plate and blades, and since there is no side plate, the blade can be visually observed, making inspection and maintenance easy. Because of the impeller considering the passage of foreign matter, the pump efficiency is inferior to that of the closed impeller.	An impeller with two blades of which height is increased to have a large passageway of foreign matter. Used for miscellaneous wastewater containing foreign matters. Pump efficiency is inferior to semi-open.	An impeller with a cutter disk for cutting fiber-like foreign matter in a non-clog type semi-open impeller. Used for miscellaneous wastewater and sewage containing fibrous foreign matter. The cutter is made of a strong material, but regular maintenance is required due to wear.	Vortex type: Semi-open type and non-clog semi-open type discharge foreign matter by a blade, while vortex impeller creates whirlpool and discharges foreign matter. Since the foreign matter does not pass through the impeller, the foreign matter is less likely to be clogged than other systems. Used for miscellaneous wastewater and wastewater containing foreign matters. Pump efficiency is inferior to semi-open. Semi-voltex type: The passage is narrower than the vortex type, and the solid material that can pass through is slightly smaller. However, the semi-vortex type impeller has higher pump efficiency than the vortex type because a part of water passes through the impeller.

Note: Closed impeller
It is mainly used in above ground and submersible pumps for fresh water.
It consists mainly of three parts: a main plate, a side plate, and a blade. By pushing out the fluid by centrifugal force, the energy of pressure can be efficiently given. Usually it is not used for drainage pumps that contain foreign matters.

(2) Features of vortex pump and semi-vortex pump

"Vortex" refers to "whirl or swirl."
Vortex impeller has semi-open blades, but the gap between impeller and casing is large. Foreign matter is sucked by the vortex generated by the blade, and it passes through the clearance and is discharged. It is mainly used for sewage pumps.

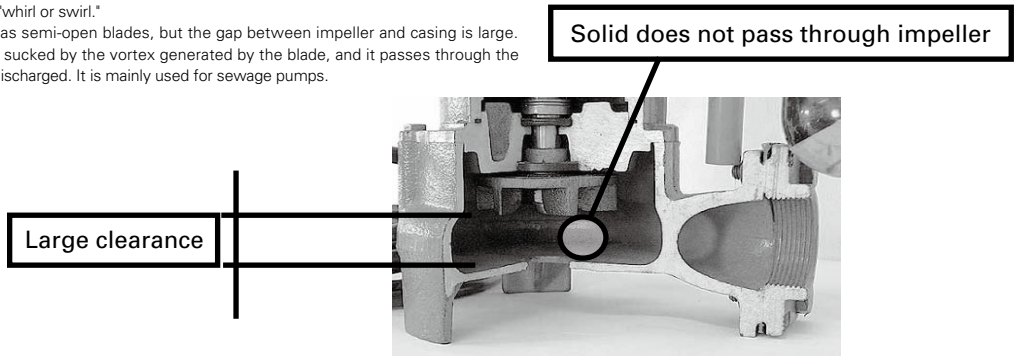


Fig.4

In general, vortex pump refers to a pump with a structure that can discharge solid substances of the same size as the pump discharge diameter.
Meanwhile, a part of the impeller of semi-vortex pump comes out into the waterway of the casing. Due to the narrower passage than the vortex pump, the solid matter that can pass through is slightly smaller, but the pump efficiency is higher than the vortex pump.

(3) Impeller shape and applications of submersible drainage pump

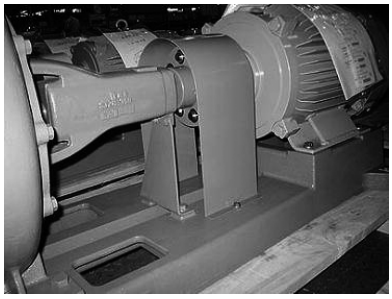
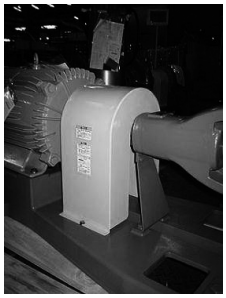
Table 4

Pump model	Impeller shape	Impeller material	Pump structure	*Foreign matter passing diameter	Application 1	Application 2	Operation method	Piping connection
PL	Semi-open	Resin	–	5mm	Wastewater		Non-automatic, automatic (with float)	Companion flange
PV	Semi-open	Resin	Semivortex	20mm	Wastewater and miscellaneous wastewater		Non-automatic, automatic (with float)	Companion flange
PV2	Semi-open	Resin	Semivortex	20mm	Wastewater and miscellaneous wastewater		Non-automatic	Companion flange
PVP	Semi-open	Resin	Semivortex	40mm	Wastewater, miscellaneous wastewater, and sewage		Non-automatic	Companion flange
TPV	Semi-open	Resin	–	15mm	Wastewater	Seawater	Non-automatic	Companion flange
SSU	Semi-open	Cast iron	–	10% of nominal diameter	Wastewater		Non-automatic, automatic (with float)	Companion flange
BO	Non-clog semi-open	Cast iron	–	50% of nominal diameter	Wastewater, miscellaneous wastewater, and sewage		Non-automatic, automatic (with float)	Companion flange
KO	Non-clog with semi-open cutter disc	Cast iron	–	50% of nominal diameter	Wastewater, miscellaneous wastewater, and sewage		Non-automatic	Companion flange
SVC	Semi-open	Cast iron	Semivortex	60% of nominal diameter	Wastewater, miscellaneous wastewater, and sewage		Non-automatic, automatic (with float)	Companion flange
SCU	Semi-open	Cast iron	Vortex	100% of nominal diameter	Wastewater, miscellaneous wastewater, and sewage		Non-automatic, automatic (with float)	Companion flange
FO	Bladeless	Cast iron	–	100% of nominal diameter	Wastewater, miscellaneous wastewater, and sewage		Non-automatic	Companion flange
KCS2	Semi-open	Stainless steel	–	–	Wastewater		Non-automatic	Screwed
SLA3	Semi-open	Stainless steel	–	–	Wastewater		Automatic (with float)	Hose
SSUS	Semi-open	Stainless steel	–	–	Wastewater	Chemical sewage	Non-automatic	Companion flange
BOS	Bladeless	Stainless steel	Vortex	–	Wastewater, miscellaneous wastewater, and sewage	Chemical sewage	Non-automatic	Companion flange
LD2	Semi-open	Rubber	–	–	Wastewater	Sediment water and construction wastewater	Non-automatic	Hose
LG2	Semi-open	Rubber	–	–	Wastewater	Cleaning water/sump water	Non-automatic	Hose

* Foreign matter passing diameter: Reference value. Differs depending on bore size and output even in the same model.

1-3. Security parts (coupling guard)

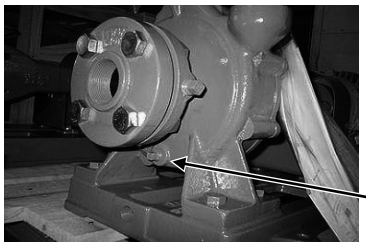
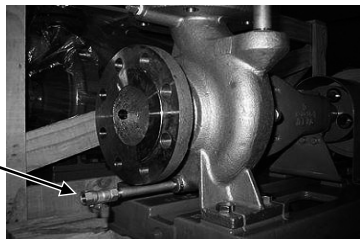
Table 5

	Specification 1 (TERAL standard)		Specification 2
Appearance			
Element		End bending ・Applicable to pumps with high core height. (Vibration prevention during operation)	Sealed type ・To prevent access to rotating parts.
Paint color	Standard color Munsell 7. 5BG5/1. 5		Standard color Munsell 7. 5BG5/1. 5 ＊Photos are for Munsell 2. 5Y8/12, the color specified by the customer
Mounting condition			

1-4. Security parts (draining)

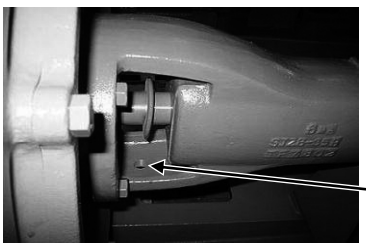
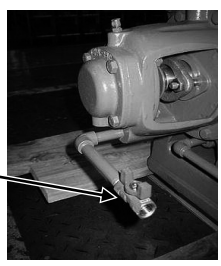
● Casing

Table 6

Standard (plug)	With piping
 Plug stopper	With piping and cock ＊Usually piping only. Piping and cock is a special specification. 

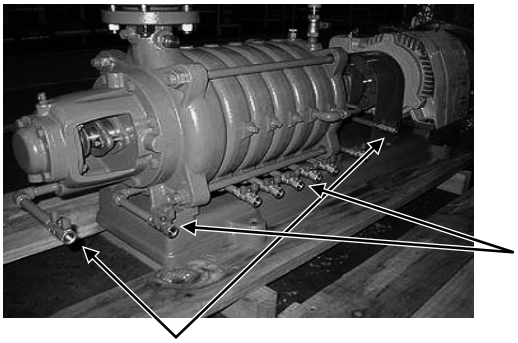
● Under ground

Table 7

Standard (drilling only)	With piping
 Hole machining	With piping and cock ＊Usually piping only. Piping and cock is a special specification. 

● Special specification example (Pump model :M)

Drain piping cock is installed under both casing and ground.



With casing piping

* Usually piping only.
Piping and cock is a special specification.

With piping under cable gland

Fig.5

1-5. Painting

(1) Examples of painting specifications

1) Outdoor specifications

Definition	: Outdoors without influence of sea breeze
Corrosion resistance	: Salt spray 240 hours cross-cut one side peeling width within 3mm

Table 8. Painting specifications

	Pump	
	Gray iron castings (FC)	
	Outer surface	Inner surface
Substrate preparation	Blasting (Shot Blast)	
Primer	Phenol alkyd resin paint Film thickness 25 μ or more Color tone 7. 5Y4. 0/1.0	
Top coat	Acrylic alkyd resin Film thickness 25μ or more Color tone 7. 5BG5. 0/1.5	————

2) Salt-resistant specification

Definition	: Location that is not exposed to sea breeze but is in the atmosphere
Corrosion resistance	: Salt spray 480 hours cross-cut one side peeling width within 3mm

Table 9. Painting specifications

	Pump	
	Gray iron castings (FC)	
	Outer surface	Inner surface
Substrate preparation	Blasting (Shot Blast)	
Primer	Phenol alkyd resin paint Film thickness 25 μ or more Color tone 7. 5Y4. 0/1.0	
Medium coat	Two-component epoxy resin paint Film thickness 30 μ or more	————
Top coat	Two-component urethane resin paint Film thickness 25μ or more Color tone 7. 5BG5. 0/1.5	————

(2) Additional Items for Outdoor and Salt-resistant Specifications

Table 10

pump	Tapped hole (drain /gauge)	Brush coating (top coat)
	Spigot section	Paint the bonding surface after assembly
	Backside of the base	Top coating before assembly
	Motor shaft	Brush coating (top coating)
	Coupling	Spray painting after being assembled into the motor
	Joint (base and casing, base and leg, motor and base, coupling cover and base)	Brush coating after assembly
	Screws (including washers) Bolt nut coupling cover for casing and base motor and base/phase flange and slide rail of base engine Bolt drain plug, gauge plug	SUS304 NOTE : Small head bolts can be replaced with cap screws.

(3) Features of various painting specifications

Table 11

Painting details				Corrosion resistance		Water resistance		Weather resistance		Oil resistance		Salt tolerance	
				Indoor	Outdoors	Indoor	Outdoors	Indoor	Outdoors	Indoor	Outdoors	Indoor	Outdoors
Standard Painting	Acrylic alkyd resin	Undercoating Top coating	Acrylic alkyd resin	△	△	△	△	○	○	△	△	△	△
Special Painting 1	Epoxy resin	Undercoating Top coating	Epoxy resin	◎	×	◎	×	◎	×	◎	×	◎	×
Special Painting 2	Vinyl chloride resin coating	Undercoating Top coating	Epoxy resin Vinyl chloride resin	○	△	△	△	○	○	△	△	△	△
Salt-resistant Painting	Urethane resin coating	Undercoating Top coating	Two-component epoxy resin Two-component urethane resin	○	○	○	○	◎	◎	○	○	◎	◎

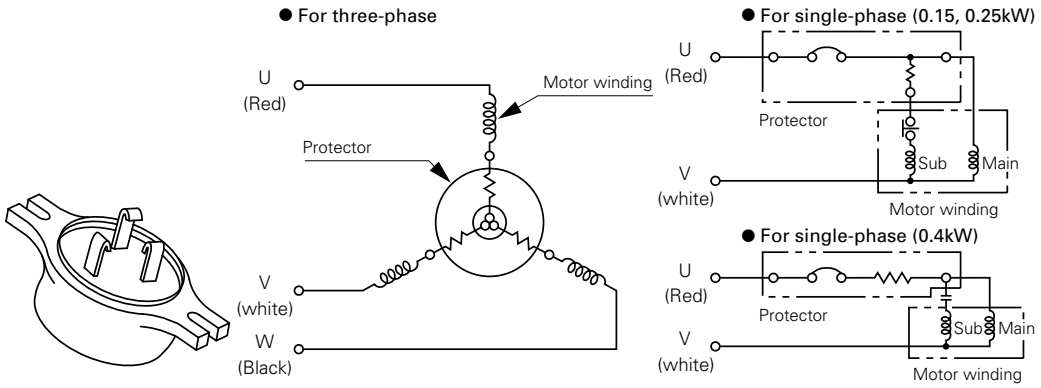
* Symbols
◎: Unaffected ○: Almost unaffected △: Can be used with caution ×: Cannot be used

1-6. Drainage pump motor protective device

The motor has a built-in protector to prevent burnout when the motor temperature rises abnormally due to overload, restraint, or phase loss.

1) 7.5kW or less: Auto-reset type auto-cut

Protectors for motors of 7.5kW or less are built into the windings. If the temperature of the winding rises abnormally, the protector will cut off the winding circuit and cut off the power supply. When the temperature of the winding drops after the cutoff, the protector automatically returns. Therefore, the motor is protected independently of the control panel on the ground.



* Connected to the neutral point of the motor winding (λ connection)
* Connected in series with the motor winding

Fig.6

2) 11 kW or more: Thermal protector (b-contact output)

For motors of 11 kW or more, the protector is built in a separate circuit from the winding circuit. If the temperature of the winding rises abnormally, the circuit containing the protector (P1-P2 circuit) is cut off, and the circuit returns when the temperature drops. To protect the motor, the ground control panel must supply power when the P1-P2 circuit is connected and shut off power when the circuit is shut off. Refer to the circuit diagram of control panel (Fig.8). This allows the motor to be protected by a protector and a ground control panel.

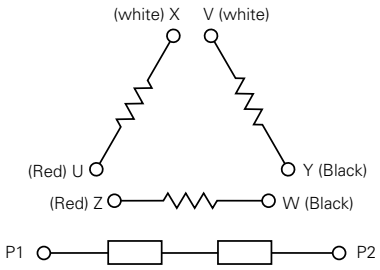


Fig.7

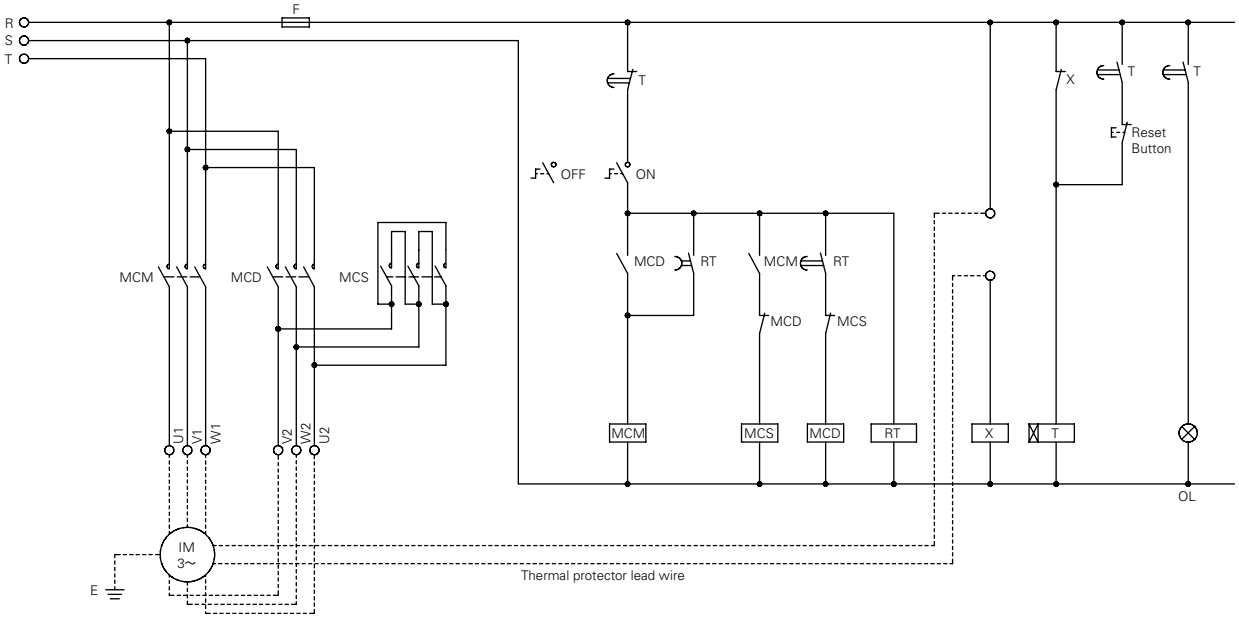


Fig.8

1-7. Drainage pump cable specification (representative)

Table 12. Specifications List

Motor Phase	Size mm²	Number of cores	Material Type	Material Sheath	Material Insulator	Dimensions Length (m)	Dimensions Finished outside diameter (mm)	Cross-sectional view
Single phase	1.25	3	VCT	Vinyl	Vinyl	10	10.1	● For single phase Insulator (Red/White/Green)
Three-phase	1.25	4	VCT	Vinyl	Vinyl	10	11.1	
Three-phase	1.25	4	VCT	Vinyl	Vinyl	10	11.1	
	2.0	4	VCT	Vinyl	Vinyl	10	11.8	● 4-conductor for three-phase Sheath Insulator (red, white, black, green) Conductor
	3.5	4	VCT	Vinyl	Vinyl	10	14.0	
	5.5	4	VCT	Vinyl	Vinyl	10	16.5	
	3.5	3	2PNCT	Chloroprene rubber	Ethylene-propylene rubber	10	13.0	
	3.5	4	2PNCT	Chloroprene rubber	Ethylene-propylene rubber	10	14.5	
	5.5	3	2PNCT	Chloroprene rubber	Ethylene-propylene rubber	10	15.5	
	5.5	4	2PNCT	Chloroprene rubber	Ethylene-propylene rubber	10	17.0	● 3-conductor for three-phase Insulator (Red/White/Black)
	8	3	2PNCT	Chloroprene rubber	Ethylene-propylene rubber	10	17.0	
	8	4	2PNCT	Chloroprene rubber	Ethylene-propylene rubber	10	18.5	
	14	3	2PNCT	Chloroprene rubber	Ethylene-propylene rubber	10	20	
	14	4	2PNCT	Chloroprene rubber	Ethylene-propylene rubber	10	22	Green insulator is for grounding

1-8. Drainage pump detachable device

■ Features

1) The pump is automatically connected to the discharge pipe by simply lowering it along the guide pipe.
2) Bolts, nuts, and packing at the connections are not required. (There is no risk of leakage.)
3) It can be separated from the discharge pipe only by lifting the pump.
4) The pump is easy to maintain and inspect, and economical in terms of maintenance and management.

Align the slide guide attached to the pump discharge port with the guide pipe, and lower it until the flange surface of the slide guide and discharge pipe are in close contact. The flange surface is in perfect contact due to its own weight and will not open due to the discharge pressure of the pump during operation. When removing the pump from the piping, simply lift the pump as it is to separate the flange surface.

● C type

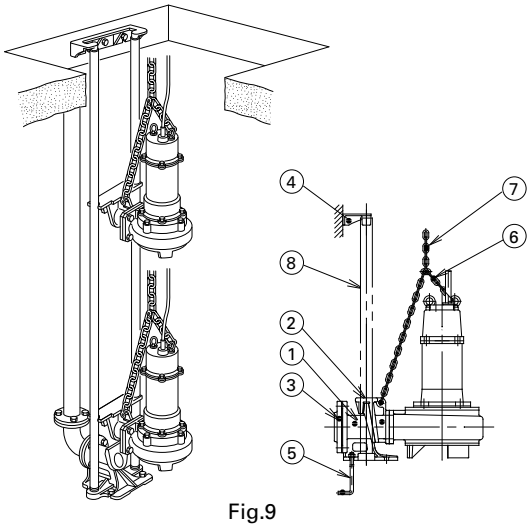


Fig.9

■ Applicable models

SSU	Up to 100φ
BO	100φ, 7.5kW or less
KO	100φ, 7.5kW or less
SVC	All types (excluding 50φ, 1.5kW)
SCU	80φ, 7.5kW or less and 100φ, 7.5kW or less

■ Component

Table 13

No.	Name	Material	Qty
1	Discharge pipe	FC200	1
2	Slide guide	FCD450	1
3	Phase flange	FC200	1
4	Pipe supporter	FCD450	1
5	Foundation bolt	SS400	4
6	Balance chain	SS400	1
7	Suspension chain	SS400	6m
8	* Guide pipe	SGPW	2

* Guide pipe is not a standard accessory.

● SEC type

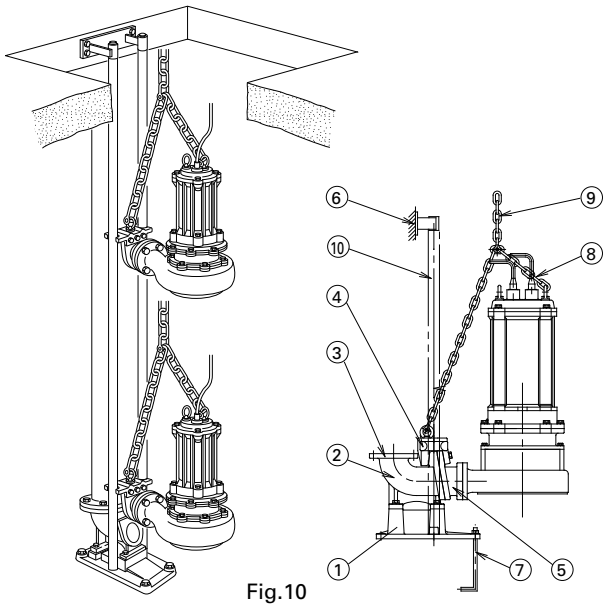


Fig.10

■ Applicable models

PL	All types
PV	All types
BO	65φ/80φ/100φ, 11kW or more, and 125φ or more
KO	65φ/80φ, 11kW or more
SVC	(50φ, 1.5kW only)
SCU	80φ, 11kW or more, and 100φ,11kW or more

■ Component

Table 14

No.	Name	Material	Qty
1	Support	FC200	1
2	Discharge elbow	FC200	1
3	Phase flange	FC200	1
4	Slide guide	FCD450	1
5	Tapered flange	FCD450	1
6	Pipe supporter	SS400	1
7	Foundation bolt	SS400	4
8	Balance chain	SS400	1
9	Suspension chain	SS400	6m
10	* Guide pipe	SGPW	2

* The guide pipe is not a standard accessory.

Table 15. Selection table of detachable device

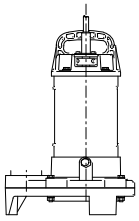
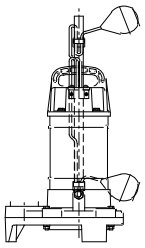
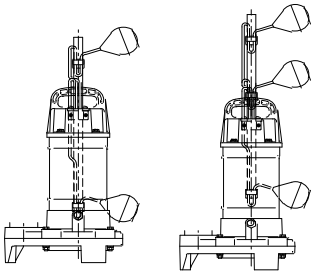
(Unit: mm)

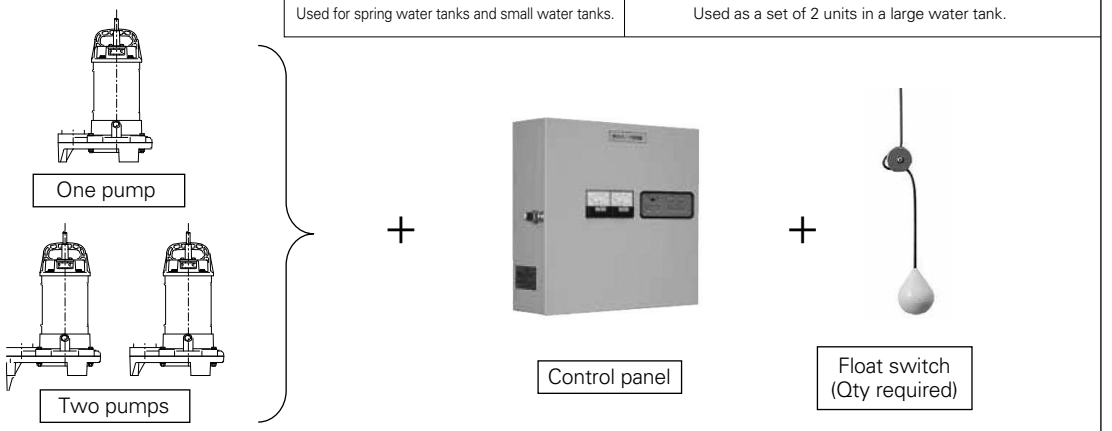
Nominal dia.*1	Type	Shape					Available pump model						
		Discharge direction	Nominal dia.of discharge pipe	Discharge elbow nominal dia. (piping side) × (body side)	Slide guide (taper flange) nominal dia.	Pump casing nominal dia.	PL	PV	SSU	BO	KO	SVC	SCU
50	C-1-50	Side discharge *2	50		50	50			50SSU	50BO	50KO		50SCU
65	C-1-65		70		70	65			65SSU	65BO (3.7kW or less)	65KO (3.7kW or less)	65SVC	65SCU
65	C-1-100×65		100		70	65				65BO (7.5kW)	65KO (7.5kW)		
80	C-1-80		80		70	80 *3			80SSU	80BO (3.7kW or less)	80KO (3.7kW or less)	80SVC	
80	C-1-100×80		100		70	80				80BO (5.5 - 7.5 or less)	80KO (5.5 - 7.5kW)		80SCU (7.5kW or less)
100	C-2-100		100		100	100			100SSU	100BO (7.5kW or less)	100KO		100SCU (7.5kW or less)
32	SEC-1B-A	Top discharge		50 × 50	50	50 *4	32PL						
40	SEC-1B-A			50 × 50	50	50 *4	40PL	40PV					
50	SEC-1B-A			50 × 50	50	50	50PL	50PV				50SVC	
65	SEC-2-80×65			80 × 100	100	65				65BO (11kW or more)	65KO (11kW or more)		
80	SEC-2-80			80 × 100	100	80 *3				80BO (11kW or more)	80KO (11kW or more)		80SCU (11kW or more)
100	SEC-2-100			100 × 100	100	100				100BO (11kW or more)			100SCU (11kW or more)
125	SEC-2-125			125 × 100	100	100				125BO			
150	SEC-4-150			150 × 150	150	150				150BO			
200	SEC-3-200			200 × 200	200	200				200BO			

NOTE) 1. *1 Nominal Dia. shows piping diameters.
2. *2 In case of changing side discharge to upper discharge, discharge bend (flange: JIS10K equivalent type) is available as a special accessory.
3. *3 The diameter is 65 for 7.5kW or more of BO,KO pump and SVC pump.
4. *4 The nominal dia. is obtained with the companion flange.

1-9. Operation method of drainage pump

Table 16

Operation method	Non-automatic	Automatic	Automatic alternate parallel operation
Number of pumps	1 (non-automatic type)	1 (automatic type)	2 units 1 set (automatic type + automatic alternating type)
Float	None	2 pcs	2 pcs (automatic type) + 3 pcs (automatic alternating type)
Operation control panel	Required	Not required	Not required
Appearance	 Non-automatic (no mark)	 Automated (type A)	 Automatic (type A) + Automatic alternating (type T)
How to use		Used for spring water tanks and small water tanks.	Used as a set of 2 units in a large water tank.



For non-automatic pumps, one or two pumps are actually combined with a control panel, float switch, etc. to perform automatic operation based on the water level. The control panel may be provided by TERAL (BD3L type or BD3S type) or may be arranged at the site including electrical work.

Automatic alternate parallel operation

1. When two pumps, type A and type T, are used together, automatic alternate parallel operation can be performed with the float switch supplied with the pump without using the control panel.
2. The power supply capacity is required for two pumps.
3. Required wiring is just connecting the pump to the power supply. Be sure to also connect the ground wire.

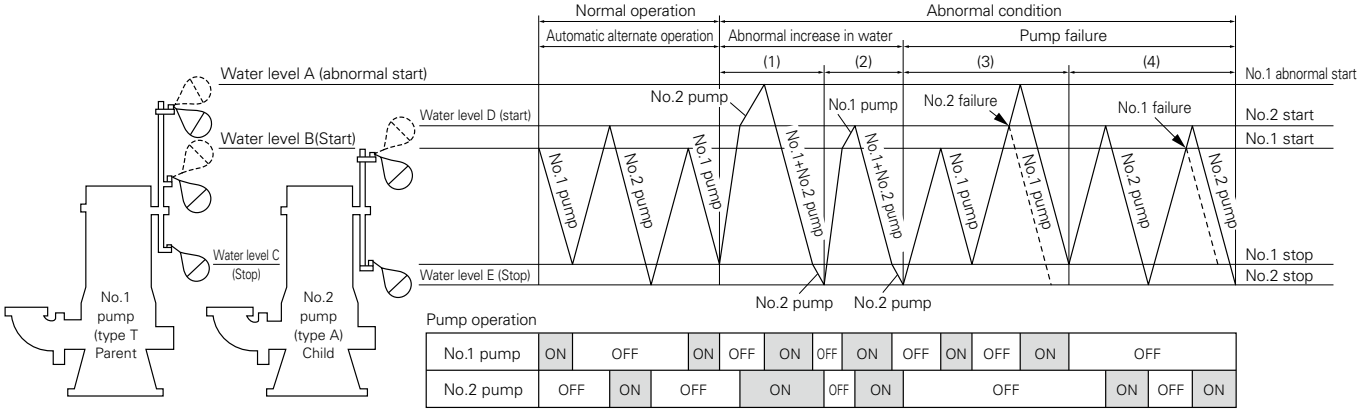


Fig.11

During normal operation

When the water level B is reached, pump No.1 turns on and off alternately, giving pump No.2 opportunity to start.

In case of abnormality

(1) When the water level continues to rise due to abnormal increase of water level during pump No.2 is running, No.1 pump also starts at water level A, and the two pumps run in parallel to lower the water level.
(2) When the water level continues to rise due to abnormal increase of water level during pump No.1 is running, No.2 pump also starts at water level D, and the two pumps run in parallel to lower the water level.
(3) WhenNo.2 pump fails, No.1 pump starts alternately at water level B and water level A, and stops at water level C repeatedly.
(4) When No.1 pump fails, No.2 pump starts at water level D and stops at water level E repeatedly.

NOTE) Set the operating water level so that water level E < water level C < water level B < water level D < water level A, and take the water level difference of each float to 50mm or more.
If the set water level is not normal, it may cause malfunction.