CT-110C

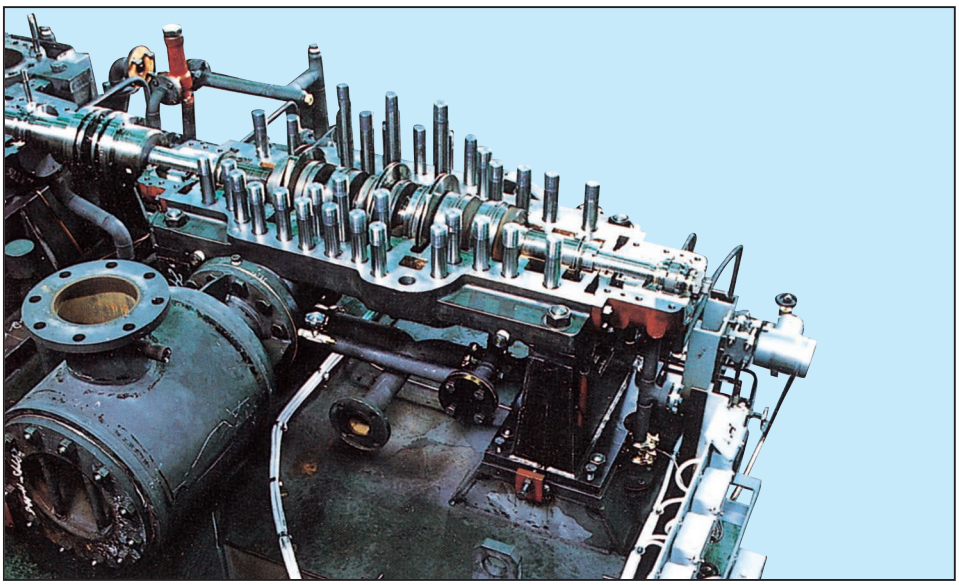
SHINKO

TURBO FEED PUMPS

DMG

DMG TURBO FEED PUMPS

Shinko DMG turbo feed pumps have been developed for LNG carriers designed with a 3-stage, double suction impeller for the 1st stage and a single suction impeller for the 2nd & 3rd stages to improve pump efficiency and suction performance.



GENERAL CHARACTERISTICS

	Item \ Model		DMG 100-3	DMG 125-3
Pump	Number of stages		3	
	Max. capacity	(m^3/h)	160	240
	Max. discharge press.	(MPaG)	9.5	
	Max. suction press.	(MPaG)	0.75	
	Max. suction temp.	(℃)	165	
	Suction bore of strainer	(mm)	150	200
	Discharge bore	(mm)	100	125
	Rotational direction		Clockwise when viewed from turbine	
Turbine	Type		Velocity compound impulse	
	Max. output	(kW)	800	
	Max. inlet steam press.	(MPaG)	6.5	
	Max. inlet steam temp.	(℃)	530	
	Max. exhaust steam press.	(MPaG)	0.6	
	Steam inlet bore	(mm)	80	
	Steam exhaust bore	(mm)	200	
	Lubrication system		Forced lubrication (turb. oil ISO VG68)	
	Governor		Woodward governor UG-10D	
	Total weight	(kg)	4500	4900

PERFORMANCE CHART

●Selection

Pump model selection can be made in accordance with the chart on the right classified by capacity and total pressure.

●Pump Efficiency

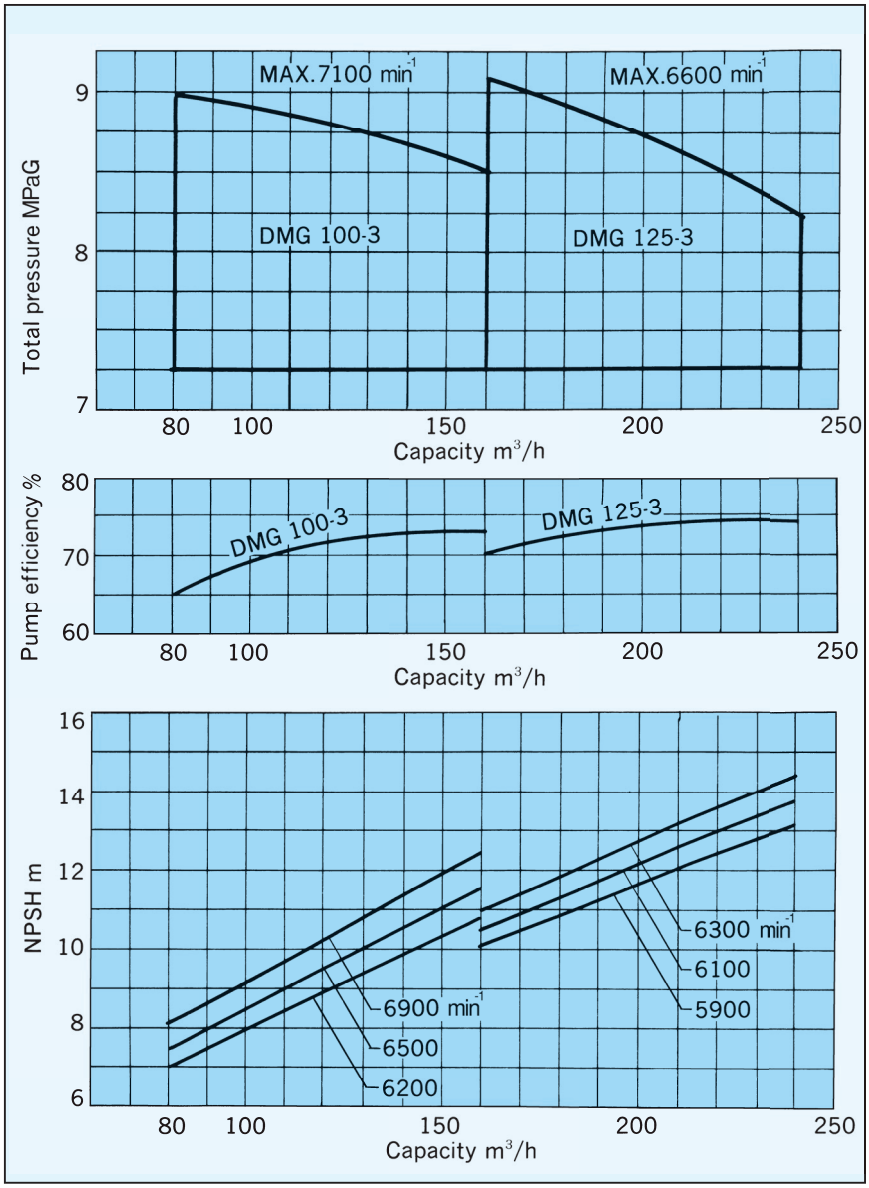
The efficiency of each pump varies between 65～74%, based on the capacity, as shown in the chart on the right.

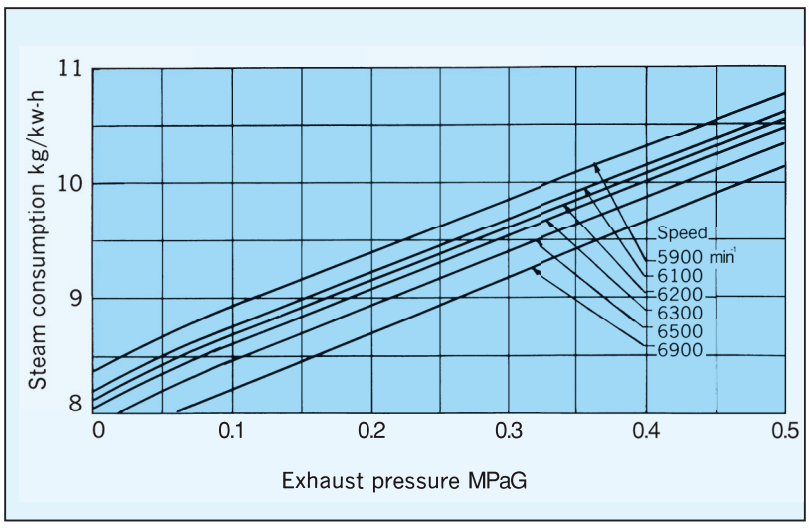
●NPSH

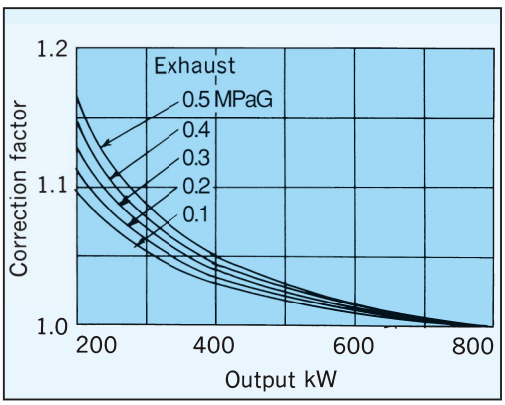
The NPSH of each pump varies according to the capacity and speed, as shown in the chart on the right.

●Steam Consumption

If inlet steam pressure is between 5.5～6.0 MPaG, steam consumption of the turbine can be determined by the speed and the exhaust steam pressure, and calculated by the correction factor based on output, as shown in the charts below.







OPERATION SYSTEM

The turbo-feed pump is equipped with various equipment for safe operation, auto change-over operation, and remote starting/stopping.

●Start Up in Cold Conditions

A turbo-feed-pump cold start can be carried out locally with the following procedure:

1. Open the drain valve ㉙ on the main steam line.
2. Condensate water is fed to the pump stuffing boxes as seal water after adjusting the pressure with the control valve ⑫.
3. Set the starter switch to MANUAL mode, and start the priming LO pump.
4. Open the inlet steam valve ㉖ slightly to warm up the pump, and widen the opening degrees for startup.
5. When the main LO pressure reaches 0.1MpaG, the turbo feed pump enters normal operation mode automatically at the constant pressure.

●Pump Overheating Prevent System

The system is designed to prevent casing overheating during minimum flow operation.
The recirculation control valve ㉔ is opened to send part of discharge flow back to the deaerator by detecting the differential pressure on flow-meter orifice ㉓.

●Warming Up the Pump & Turbine

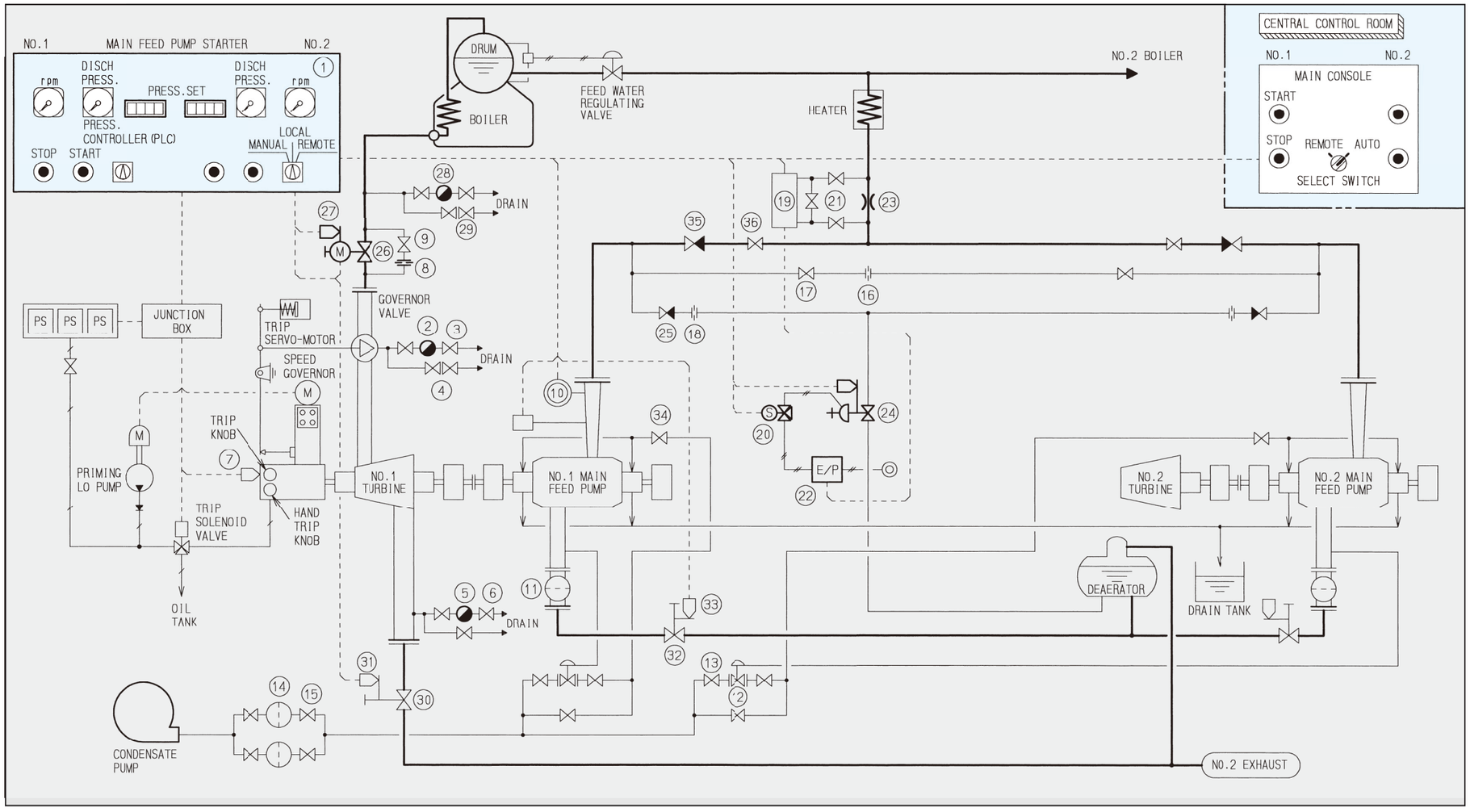
The stand-by pump and turbine can be warmed up using the discharge flow and steam flow and steam from the working pump and turbine through orifices ⑯ and ⑧.

●Auto Change-Over Operation

When the select switch on the main console is set to AUTO mode, the stand-by pump starts automatically and reaches normal operation levels within 10 seconds, whenever the discharge pressure on the working pump drops abnormally due to some trouble.

●Remote Staring & Stopping

When the select switch on the main console is set to REMOTE mode and the start button has been pushed, the necessary equipment is activated sequentially, enabling the stand-by pump to start in order to maintain normal discharge pressure. After that, the working pump can be stopped by pushing the stop button.



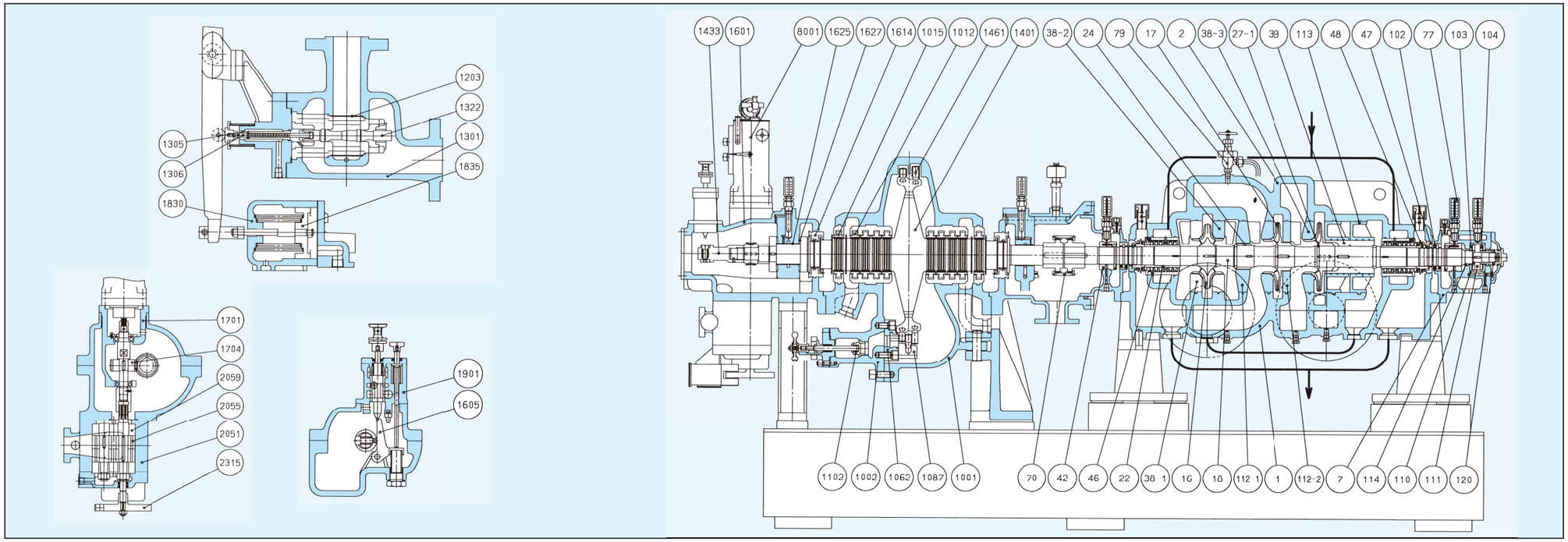
PART NO.	NAME OF PART	TYPE	REQ. NO. FOR 1 SET SHINKO	YARD
1	MAIN FEED PUMP STARTER		1	
2	GOV. VALVE CASING DRAIN TRAP	DISC TYPE	1	
3	〃 DRAIN VALVE	STOP VALVE	2	
4	〃 BY-PASS VALVE	〃	2	
5	TURBINE CASING DRAIN TRAP	DISC TYPE	1	
6	〃 DRAIN VALVE	STOP VALVE	3	
7	LIMIT SWITCH		1	
8	TURBINE WARMING-UP ORIFICE		1	
9	〃 VALVE	STOP VALVE		1
10	PRESS. TRANSMITTER		1	
11	SUCTION STRAINER		1	
12	SEALING W.CONTROL VALVE		1	
13	〃 VALVE	STOP VALVE		3
14	SEALING WATER STRAINER			2/SHIP
15	〃 VALVE	STOP VALVE		4/SHIP
16	PUMP WARMING-UP ORIFICE		1/SHIP	
17	〃 VALVE	STOP VALVE		1
18	PUMP O. H. PREVENT ORIFICE		1	
19	RECIRC. CONTROL TRANSMITTER		※	1/SHIP
20	〃 SOLENOID VALVE		※	1/SHIP
21	〃 VALVE	STOP VALVE	※	3/SHIP
22	〃 E/P TRANSMITTER		※	1/SHIP
23	〃 FLOW METER ORIFICE		※	1/SHIP
24	〃 CONTROL VALVE		※	1/SHIP
25	RECIRC. NON-RETURN VALVE			1
26	INLET STEAM VALVE	MOTOR D.		1
27	〃 LIMIT SWITCH	FULL OPEN & CLOSE		1
28	INLET STEAM LINE DRAIN TRAP			1
29	〃 DRAIN VALVE	STOP VALVE		4
30	EXHAUST STEAM VALVE			1
31	〃 LIMIT SWITCH	FULL OPEN		1
32	PUMP SUCTION VALVE			1
33	〃 LIMIT SWITCH	FULL OPEN		1
34	SEALING WATER ROOT VALVE	STOP VALVE		1
35	PUMP DISCH. NON-RETURN VALVE			1
36	〃 VALVE	STOP VALVE		1

※ : Option item

DESIGN & MATERIALS

The turbo feed pump is designed so that the DMG pump and the turbine are connected by a gear coupling installed on a common base plate.
The pump is a horizontal three-stage centrifugal type.
The stainless-steel casing is cast with sufficient heat treatment.
Since the casing is split horizontally into two halves and the suction and discharge nozzles are cast as an integrated unit, lower casing disassembly can be carried out easily without disturbing the piping.

The stem turbine is a horizontal single-stage velocity-compound impulse type. The turbine casing and bearing housing are both split horizontally. Thus, overhaul inspection can be carried out easily.
Each bearing, gear coupling, and other components for both the pump and the turbine are forcefully lubricated via the main LO pump located on the opposite of the coupling from the turbine. The discharge pressure, regardless of capacity, is continuously controlled by our most economical constant pressure governing system.



PART NO.	NAME OF PART	MATERIAL NAME	MATERIAL JIS	REQ.NO. FOR 1 TURBINE
1001	TURBINE CASING	CAST STEEL	SCPH2	1SET
1002	STEAM CHEST	Cr-Mo CAST STEEL	SCPH32	1SET
1012	LABYRINTH PACKING	Ni-BRASS CASTING		8SETS
1015	STEAM GUARD	〃		1SET
1062	NOZZLE	STAINLESS STEEL	SUS403	1
1087	STATIONARY BLADE SEAT	STEEL	SS400	1
1102	HAND NOZZLE	STAINLESS STEEL	SUS420J2	1
1203	STEAM STRAINER	〃	SUS304	1
1301	GOVERNOR VALVE CASING	Cr-Mo CAST STEEL	SCPH32	1
1305	GOVERNOR VALVE BUSH	STELLITE		1
1306	GOVERNOR VALVE STEM	〃		1
1322	GOVERNOR VALVE	STAINLESS STEEL	SUS420J2	1
1401	TURBINE ROTOR	Cr-Mo STEEL		1
1433	OVERSPEED TRIP SHAFT	CARBON STEEL	S35C	1
1461	MOVING BLADE	STAINLESS STEEL	SUS410J1	1SET

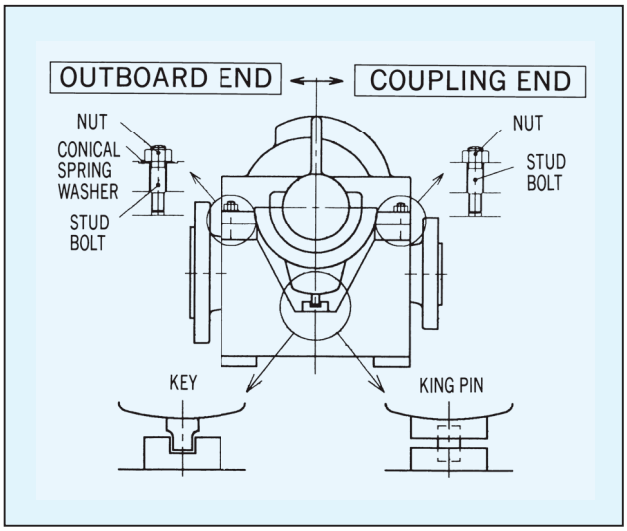
PART NO.	NAME OF PART	MATERIAL NAME	MATERIAL JIS	REQ.NO. FOR 1 TURBINE
1601	BEARING HOUSING	CAST IRON	FC200	1 TURBINE SET
1605	TRIP LEVER	Cr-Mo STEEL	SCM435	1
1614	OIL GUARD	BRONZE	CAC403	1SET
1625	BEARING METAL	WHITE METAL WITH STEEL	WJ2 S25C	1SET
1627	THRUST BEARING METAL	〃	〃	1SET
1701	GOVERNOR BEARING HOUSING	CAST IRON	FC200	1
1704	WORM WHEEL	PHOSPHOR BRONZE	CAC503	1
1830	TRIP SERVO-MOTOR CYLINDER	CAST IRON	FC200	1
1835	PISTON	STEEL	SS400	1
1901	TRIP CASING	CAST IRON	FC200	1
2051	LO. PUMP CASING	〃	〃	1
2055	PUMPING GEAR	CARBON STEEL	S45C	1SET
2059	BEARING METAL	LEAD BRONZE	CAC604	1SET
2315	TACHOMETER ROTOR	STEEL WITH MAGNETS	SS400	1SET
8001	GOVERNOR	WOODWARD		1SET

PART NO.	NAME OF PART	MATERIAL NAME	MATERIAL JIS	REQ.NO. FOR 1 PUMP
1	VOLUTE CASING	STAINLESS STEEL	SCS1	1
2	VOLUTE COVER	〃	〃	1
7	BEARING HOUSING	CAST IRON	FC200	1 PUMP SET
16	IMPELLER	STAINLESS STEEL	SCS1	1
17	〃	〃	〃	2
18	IMPELLER SHAFT	〃	SUS403	1
22	SLEEVE	〃	〃	2
24	STAGE SLEEVE	〃	〃	1
27-1	SPLIT RING	〃	〃	1
38-1	MOUTH RING	〃	SCS1	1
38-2	〃	〃	〃	1
38-3	〃	〃	〃	1
39	BALANCE PISTON	〃	SUS403	1
42	BERING METAL	WHITE METAL CARBON STEEL	WJ2 S25C	2SETS
46	FLOATING RING	STAINLESS STEEL	SUS403	2SETS

PART NO.	NAME OF PART	MATERIAL NAME	MATERIAL JIS	REQ.NO. FOR 1 PUMP
47	GLAND BUSH	BRONZE	CAC403	2
48	FLINGER	STAINLESS STEEL	SUS403	2
70	GEAR COUPLING	CARBON STEEL	S48C	1SET
77	THERMOMETER			3
79	VENT VALVE	FORGED STEEL	SF440	1
102	OIL GUARD	BRONZE	CAC403	2
103	CARRIER RING	CARBON STEEL	S15C	2SETS
104	THRUST PAD	WHITE METAL CARBON STEEL	W87 S15C	16SETS
110	ADJUSTING RING	STEEL	SS400	1
111	THRUST COLLAR	CARBON STEEL	S30C	1
112-1	STAGE PIECE	STAINLESS STEEL	SCS1	1
112-2	〃	〃	〃	1
113	BALANCE BUSH	〃	〃	2
114	OIL SEAL RING	BRONZE	CAC604	2
120	THRUST NUT	STEEL	SS400	1

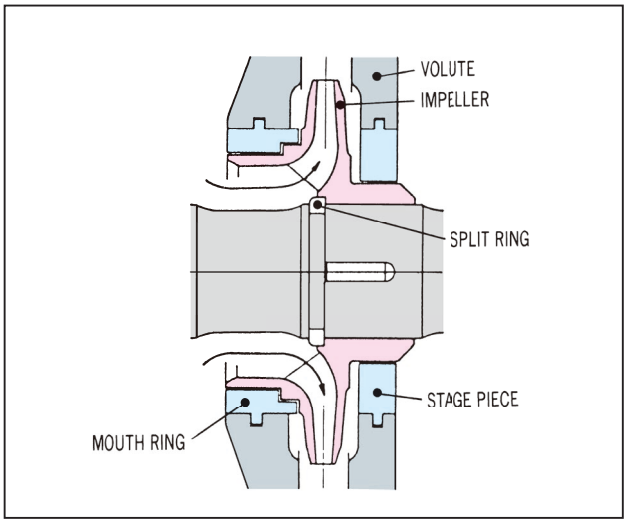
●Casing

The casing is split horizontally into 2 halves in the way that the suction and discharge nozzles and the lower casing are an integrated casting unit. So, disassembly can be carried out without disturbing the piping.
Since the casing is supported on the center line, thermal expansion by high water temperature does not affect the alignment. The casing is firmly secured to the pedestals at the coupling with a king pin and bolts, and fitted to the pedestals at the opposite end with a key and bolts with conical spring washers, so that it can move axially toward the opposite coupling side.
Therefore, expansion of the casing from high temperature water can be sufficiently absorbed.



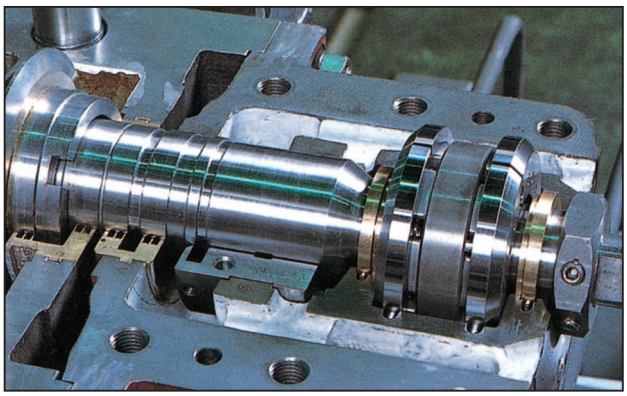
●Impeller

The impeller is designed and finished to maintain stability and high efficiency throughout the capacity range. It is perfectly balanced dynamically and statically.
Since the impeller is positioned on a shaft and firmly secured by a key and split ring, the shaft does not bend, and is free from axial expansion by high temperature water.



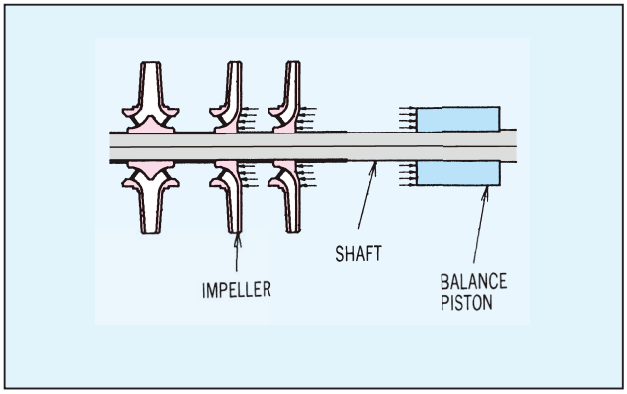
●Bearing

Bearing housings are equipped on both sides of the casing, and are split into the upper and lower parts. In order to support the radial load, a horizontally-split journal bearing is employed.
A Mitchell-type thrust bearing is equipped on the opposite side of the coupling to absorb the axial thrust.



●Thrust Balance

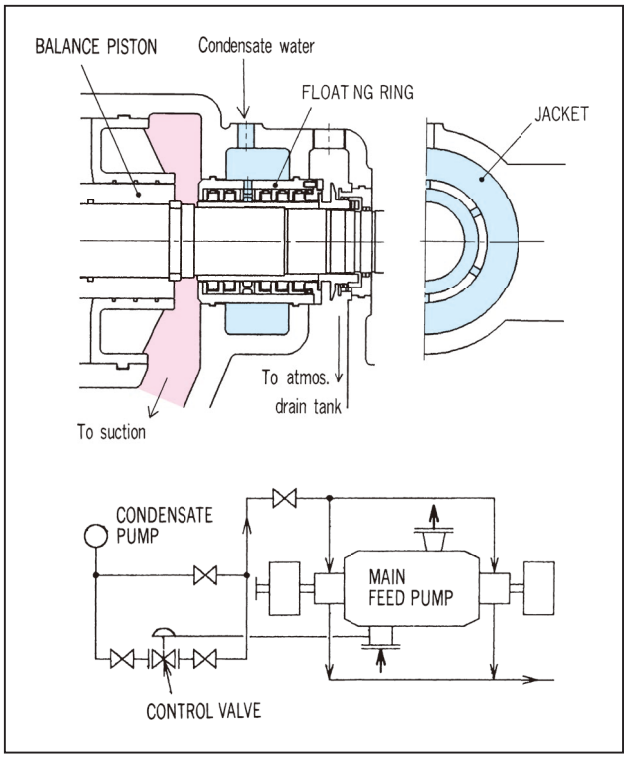
In order to balance axial thrust which occurs in the second-and-third impellers, a balance piston acting against discharge pressure is placed at the opposite side from the coupling.



●Floating Ring for Pump Shaft Seal

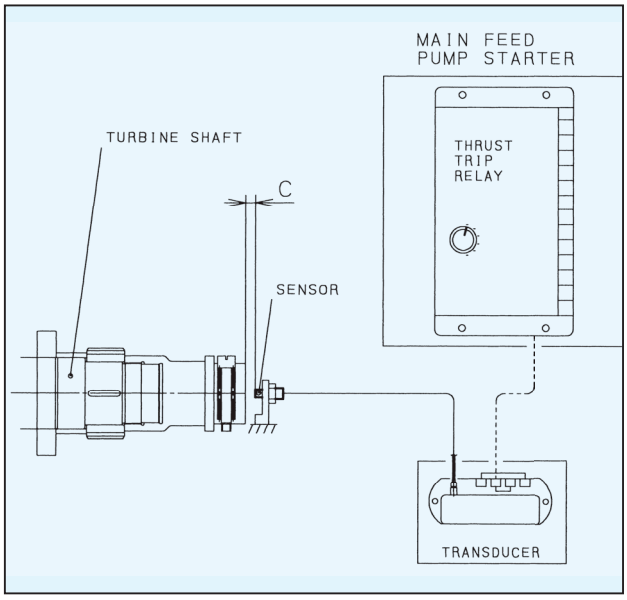
Both ends of the pump casing, through which the impeller shaft passes, are equipped with the stuffing boxes where floating rings are fitted. Some of the condensate water is led to the inside of the floating rings as sealing water to prevent the high temperature water from leaking.
To minimize the amount of sealing water, the pressure is adjusted by a sealing control valve to stay 0.1～0.25 MPaG higher than the suction pressure. The narrow clearance between the sleeve and the floating rings also reduces water leakage.

A jacket is installed around the stuffing box, and sealing water is led to the floating rings after cooling the stuffing box.



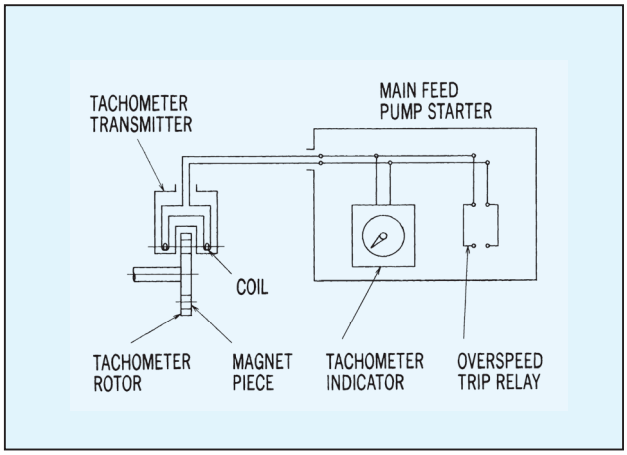
●Axial Movement Trip

When the turbine rotor moves abnormally in an axial direction for some reason, the moving and stationary blades may come into contact and may cause severe damage.
This trip is fitted in place with a 1 mm clearance（C）from the shaft end. When the thrust bearing wears down by 0.7mm and clearance（C） becomes 0.3mm, the turbine is tripped.



●Tachometer（Patented）

This tachometer, having three functions showing the number of revolutions, the running indications, and the overspeed trip, is a patented electronic system. As shown in the figure below, this system is composed of a transmitter, receivers, and speed relays, and needs no external power source.



●Constant Pressure Governing System

The turbine is equipped with a constant pressure governing system, which consists of a Woodward speed governor, a pressure controller, and a transmitter.
Pump discharge pressure is converted into a DC 4～20mA current by means of the transmitter and is used as an input signal for the pressure controller.
The pressure controller issues an ON-OFF pulse signal according to the deviation between the input signal and preset value. Turbine speed is controlled by the speed-setting motor in the governor via this pulse signal so that the pump discharge pressure becomes equal to the preset pressure.

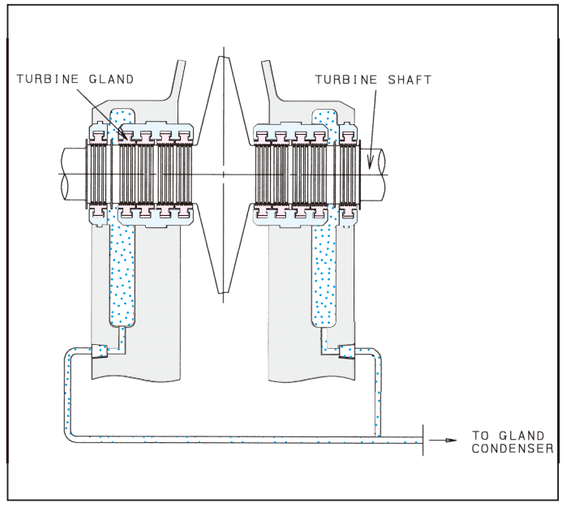
●Lubrication System

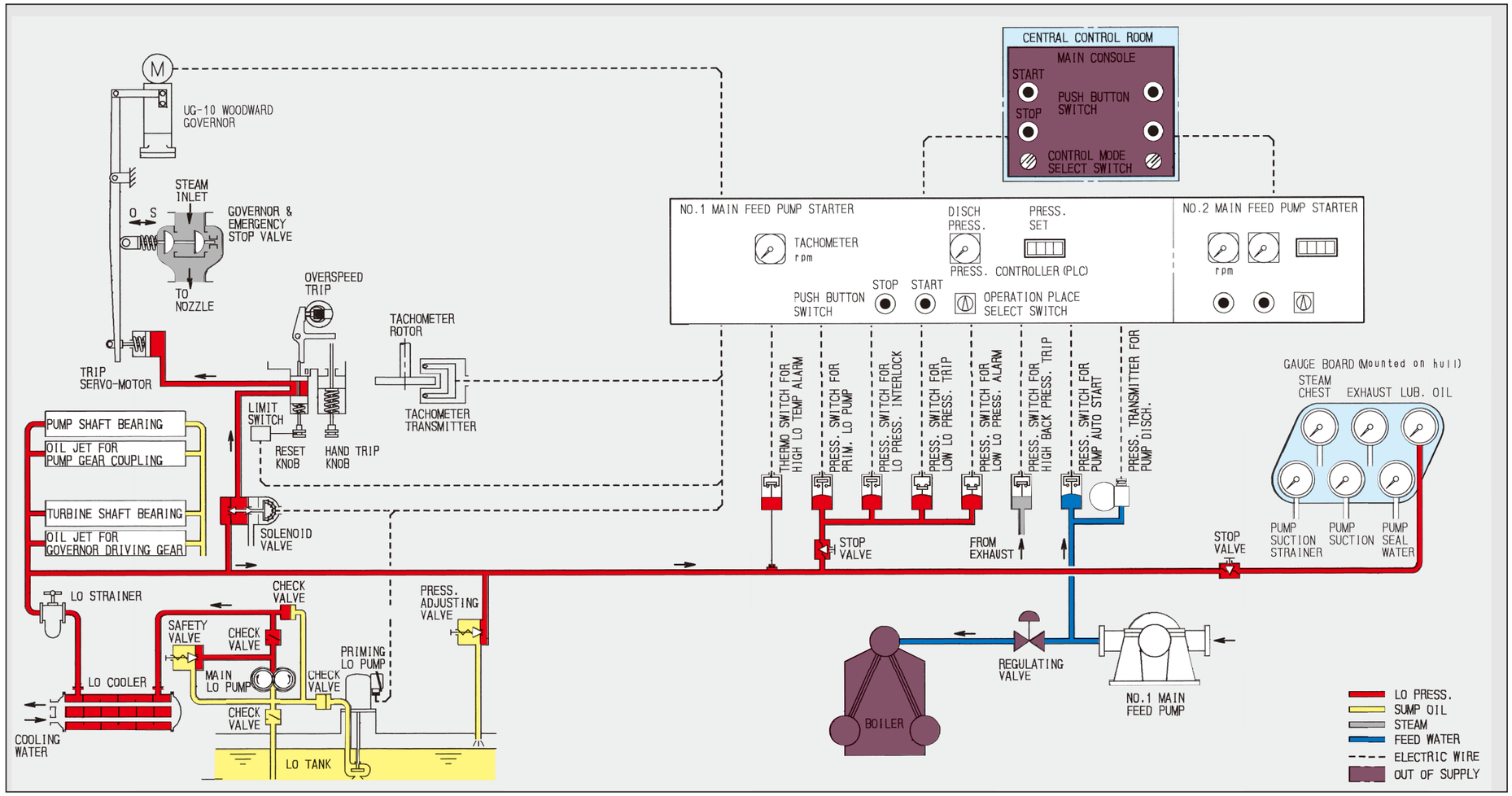
During operation of the turbine, the LO is supplied to the bearing metal, gear couplings, and other components through the main LO pump.
Besides, in order to maintain safe operation, an independent electric motor driven priming LO pump is utilized. When the turbine starts, it is inter-locked so as not to start even if the inlet steam valve is open until the pressure of the LO line reaches between 0.02 ～ 0.03MPaG. On the contrary when the turbine stops, the priming LO pump stays operating to keep the LO pressure at 0.02 to 0.03MPaG until the turbine stops completely.

	Actuation	P.LO pump	M.LO pump	LO press. MPaG
Start	Switch on（P.LO pump）	start	stop	0.02～0.03
	Main steam v. open	stop	start	0.1
	Normal operation	stop	nor. run.	0.1～0.15
Stop	Main steam v. close	start	down	0.045
	Turbine stop	run.	stop	0.02～0.03
	Switch off（P.LO pump）	stop	stop	0

●Turbine Gland

The turbine glands, where the turbine shaft passes through the casing, are sealed with labyrinth packing to prevent steam leakage.
Each of the labyrinth packing is split into 4 segments and suspended by a plate spring on their back sides, so that the turbine shaft does not get damaged even if the shaft makes contact with the labyrinth packing from excessive vibration.





ACCESSORIES [per pump]

For Pump

Suction strainer ····· 1 set
Sealing pressure control valve ····· 1 set
By-pass orifice ····· 2/ship
Warming orifice ····· 1/ship
Thermometer for bearings ····· 3 sets
Gauge root valve ····· 3 sets

For Turbine

Priming LO pump ····· 1 set
LO cooler ····· 1 set
LO Thermometer ····· 2 sets
Thermometer for bearings ····· 2 sets
Tachometer transmitter ····· 1 set
Tachometer indicator ····· 1 set
Pressure gauge ····· 6 sets
Gauge root valve ····· 3 sets
Gauge board ····· 1 set
Main feed pump starter with constant discharge pressure control device ····· 1 set

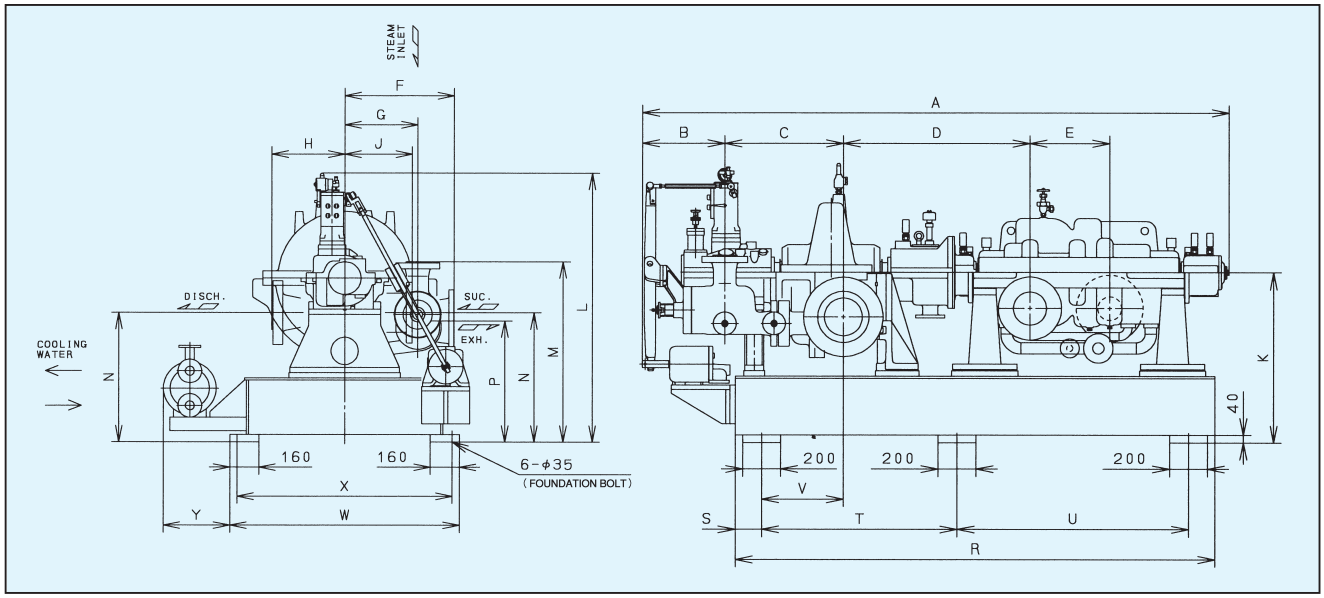
SPARE PARTS [per ship]

For Pump

Journal bearing metal ····· 1/set*
Thrust bearing ····· 1/set*
Floating ring for shaft seal ····· 1/set*
Coupling bolts and nuts ····· 1/set*

For Turbine

Journal bearing metal ····· 1/set*
Thrust bearing metal ····· 1/set*
Each kind of spring ····· 1/set*
Gasket and packing ····· 1/set*
LO cooler cooling tube ··· 2.5% of total amount/set*
Ball bearings for priming LO pump ····· 1/set*
Turbine starter auxiliary relay ····· 4/set*
Turbine starter pilot lamp ··· 10% of total amount/set*
Turbine starter pilot lamp globe ····· 2/set*
Turbine starter fuse element ····· 1/set*
Solenoid valve coil ····· 1/set*
(set* = all units of the same application and model)



Dimensions : mm

Model	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y
DMG 100-3	3048	434	625	974	395	600	400	350	325	900	1477	990	730	665	2425	95	1030	1160	430	1260	1180	315
DMG 125-3	3101	434	625	992	420	600	400	400	370	900	1477	990	710	665	2530	95	1030	1265	430	1260	1180	315

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