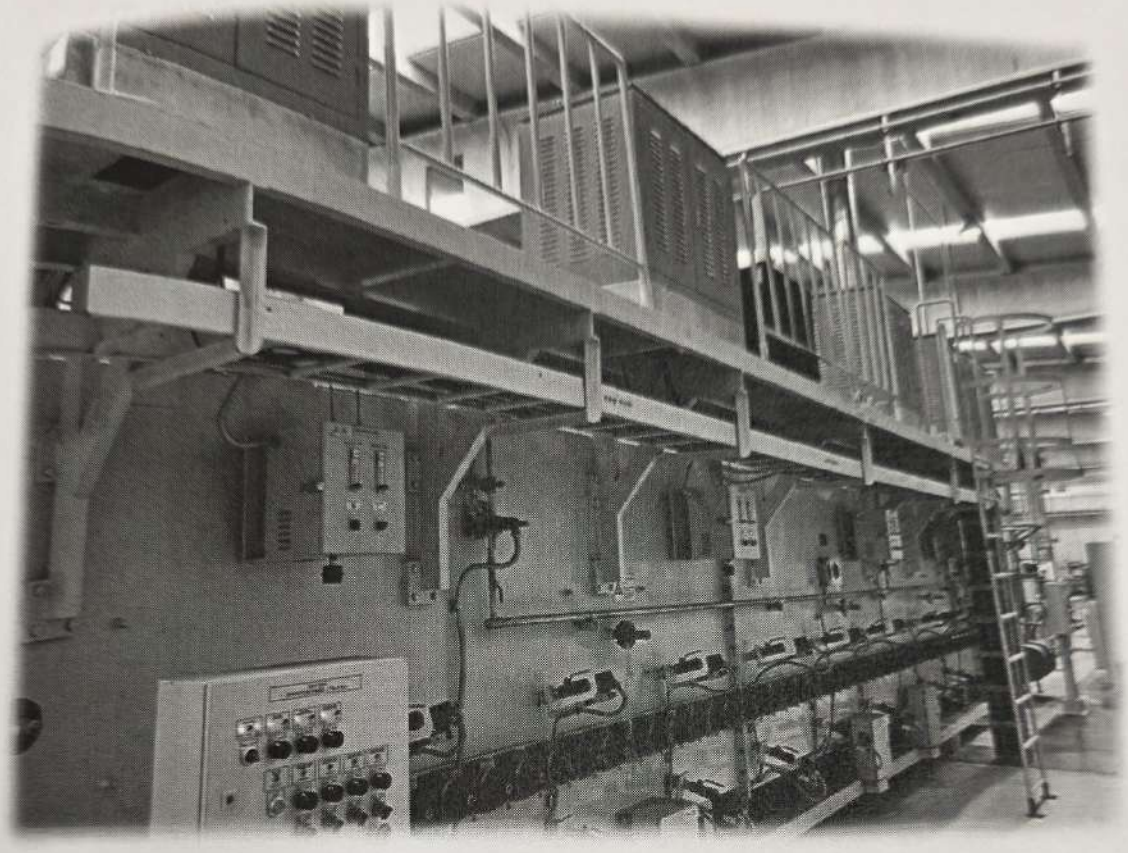
2. Continuous Q-T(carburizing) furnace (Roller hearth type)



2-1. General specification

(1) Model	DNR21E-3303030Q
(2) Effective dimension	750W×7500L×750H mm × 9 trays
(3) Loading capacity	Max. 480 Kg/Hr (Gross, Charge)
	Total 9 charges/furnace × 480Kg/charge
	= Max 4,320 Kg/furnace (Gross)

* Standard Item: OD: 95.21, ID: 64.72 H:42.22 (Weight: 1.02kg/PC)

(4) Temperature	Normal 800℃ ~ 900℃
	Max. 950℃
(5) Cycle time	15~20 min

(5) Atmosphere gas for carburizing	N2 + LNG
(6) Quenching method	Oil quenching
(7) Heating method	Radiant tube type electric heater
(8) Works transfer	By rollers with motor
Transfer speed control	Automatic control by inverter as per pattern

※ *Note.*

1. *Loading weight may have some difference according to shape of parts and loading method, etc.*
2. *Cycle time can be change by test result.*

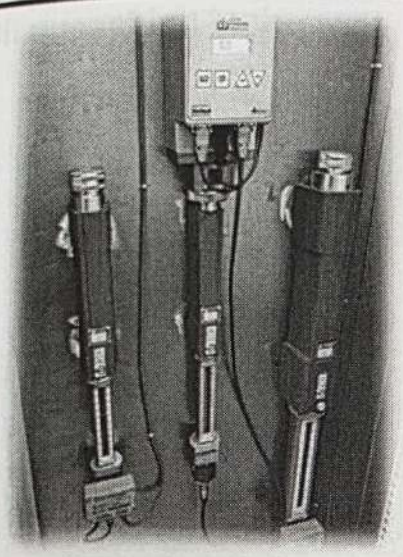
2-2. Consists of hardening (carburizing) furnace

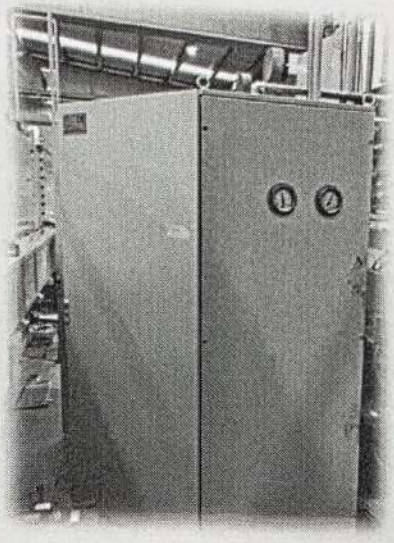
(1) Furnace body	Furnace body is made of thick welded steel plate and reinforced with structural members which are welded or bolted together.	
	The lining comprises of the high grade refractory backed up with suitable thickness of the block insulation.	
	Thermal-insulation layer	
	Side & Bottom	Silica board, Nano board B3, IB-5
	Roof	IB-5 Arch, castable, Nano board
(2) Composition of furnace	Heating zone	2 Trays
	Soaking 1 zone	3 Trays

	Soaking 2 zone	3 Trays
	Hardening zone	1 Tray
	Total	9 Trays
(3) Heating devices	Radiant tube electric heaters	62 nos.
Heating element	Kanthal 80-20Cr	
Tube material	Heating zone SCH-15	
	Other zones SCH-22	
Heating control method	SCR - PID control	
Heating capacity		
Heating zone	9.5 Kw □ 18nos. = 171 Kw	
Soaking 1 zone	3.7Kw □ 18nos. = 66.6 Kw	
Soaking 2 zone	3.7Kw □ 18nos. = 66.6 Kw	
Hardening zone	3.7Kw x 8nos. = 29.6 Kw	
Total	333.8 Kw	
(3)Transformer	φ3 & φ3/2 H-Class, Dry Type	
	4 zones	5 nos.
(4) Heater abnormal alarm	If there is ampere difference among R,S,T of 3 phase in electric circuit for heater, this device warns operator as the method using alarm and light signals.	

(5) Roller driving devices		
Roller material	Heat resistant steel KHR-35H	
Guide material	Heat resistant steel SCH-22	
Shaft material	Stainless steel SUS-310	
Bearing cooling	Air cooling.	
Tray position control	Photo sensor (BALLUFF)	
	2 sets/Tray position × 9 tray position/furnace	
	Total 18 nos.	
Geared motor	0.75Kw with inverter control	9 nos.
(6) RC fan		
Fan material	Stainless steel SCH-15	
Fan motor	All zone 2.2 Kw	4 nos.
Rotation sensing	By RPM meter	4 nos.
(7) CCF Entrance and exit door	Operated by air cylinder	2 nos.
	Inside of door case is insulated by silica board and adiabatic brick.	
	Door case material Mild steel SS400	
(8) Zone devided	By partition door	
Door material	Heat resistant steel SCH-15	2 nos
	Operated by air cylinder	2 nos
(9) Exhaust pipe	It is equipped on the top of furnace of which it is for control of furnace pressure and prevent air	

	into the furnace		
	Pilot burner		2 no.
	Flame detector		2 no.
(10) Curtain burner	for maintain atmosphere gas in furnace		
	Gas injection pipe is installed under the CCF entrance door for gas curtain		
	Solenoid valve	for gas and air, N_2	1 set.
	Pilot burner	for ignition	1 no.
	Flame detector	for pilot burner	1 no.
(11) Thermocouple	Temperature control & recording		8 nos.
Element	K-Type 3.2φ Double/Single elements, 0.5 class		
Tube	Stainless steel SUS-310S		
(12) Atmosphere control	These devices are used to supply and control atmospheric gas into the furnace and are attached to the separate board		
Pressure switch	To monitoring each gas pipe line (Enrich, N2 Gas), pressure switch is installed. These pressure switch can detect and sound an alarm if there is in abnormal situations		



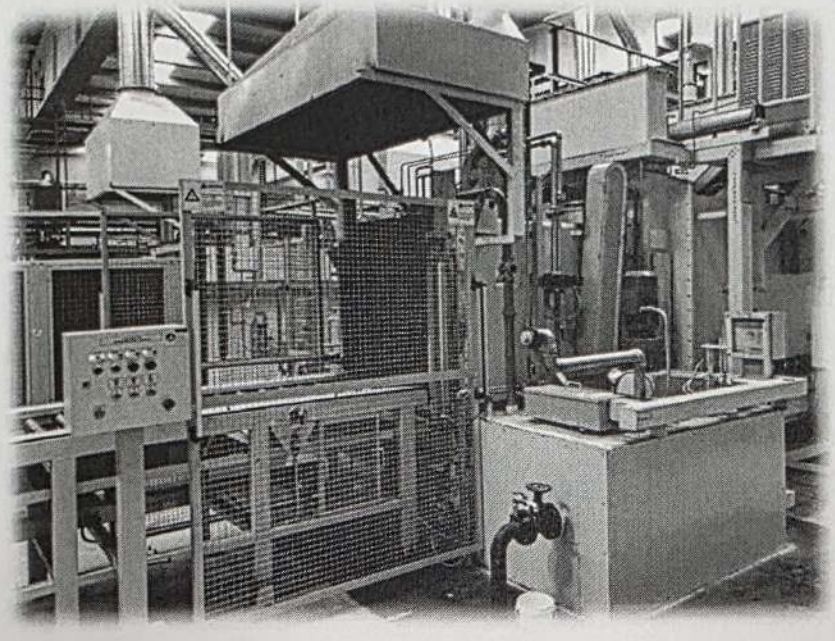


Used Gas	Flow meter	Maker	Scale	Remark
N2	MV-10	Waukee	1000CFH	- Q'ty: 3 nos - Flow tronic - Recording - Alarm for abnormal flow rate - With Pressure S/W Alarm for abnormal gas pressure
Enrich (LNG)	MV-1	Waukee	10 Liter/Min	- Q'ty: 3 nos. - Valve tronic (Automatic control) - Recording - Alarm for abnormal flow rate - Be able to set C.P on the HMI - With Pressure S/W Alarm for abnormal gas pressure

Enrich gas (LNG) is automatically reduced or adjusted by Valve tronic type flow meter & Sol. v/v attached to drain pipe lines according to the change in carbon potential in the furnace.

And enrich gas's quantity are also recorded by valve tronic type flow meter

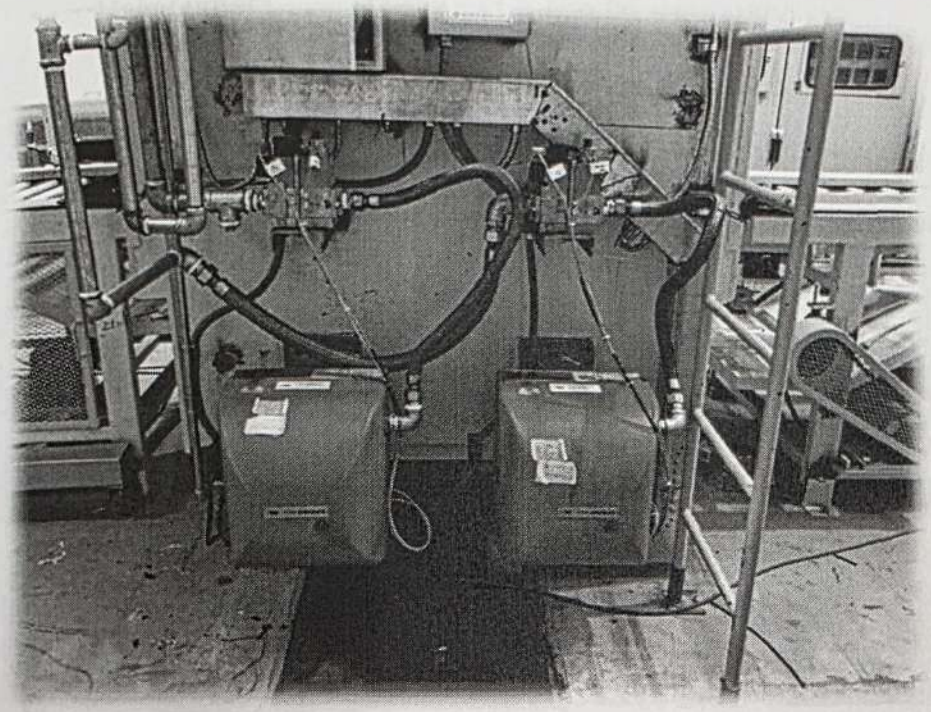
2-3. Oil quenching tank



(1) Heating method	Electric heating	
(2) Effective dimension	750W×750L×750H mm × 1 tray	
(3) Heating capacity	72Kw	
(4) Heater	Sheath heater (6Kw/set)	12 nos.
(5) Amount of quenching oil	About Max. 11,000 Liters (at 130℃)	
(6) Case	Thick steel plate welded type, For the cooling of the quenching chamber, Oil Jacket is fixed at upside. Because cooling speed much fasrer than furnace cooling. Bottom side is filled with thermal-insulation preservation layer	
Thermal-insulation preservation layer		50mm
Oil cooing		Line pump
(7) Circulation of quenching oil	Agitator type + Grid duct	

	Geared Motor 2.2 Kw	2 nos.
	Controlled rpm by Inverter	
(8) Oil cooling method	Air Cooling System	1 no.
	Heat exchanged 257kW-hr	
	MAKER – SBS(USA)	
(9) Oil circulation pump		
Pump type	Single suction volute pump	1 no.
Capacity	0.3m3/min × 15mH	

3. Pre-heating furnace



3-1. Purpose of equipment

Pre-heating furnace is designed for oil removal on the work surface and preheating before hardening (carburizing) which is heated by gas burner.

3-2. General specification

(1) Model	DEW21G-303030
(2) Use	Oil removal and preheating
(3) Heating method	Direct fired gas burner
(4) Effective dimension	750W×750L×750H mm × 1 Tray
(5) Loading capacity	Max. 480 Kg/charge (Gross)
(6) Operating temperature	500℃ ~ 550℃
(7) Cycle time	According to the cycle time for hardening furnace
(8) Furnace inside volume	about 1.7 m3

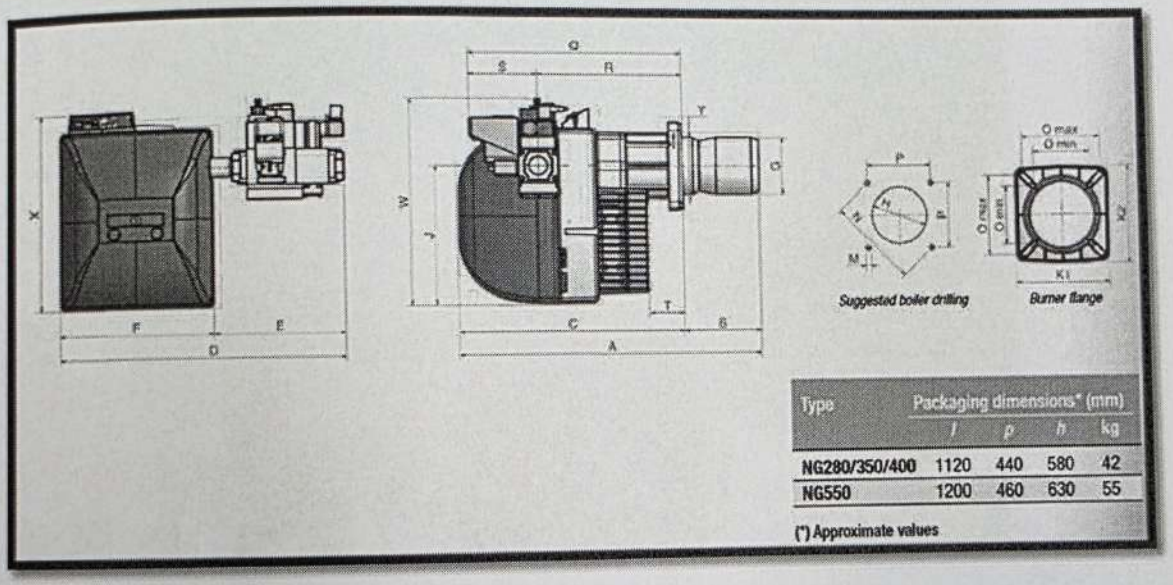
3-3. Consists of furnace

(1) Heating instruments

Main burner — Min 95 ~ Max. 300 kW — 2 nos

230V, Fan motor(0.25kW)

Maker(Model) – NG280(UNIGAS)



Type	Packaging dimensions* (mm)			
	l	*p*	*h*	kg
NG280/350/400	1120	440	580	42
NG550	1200	460	630	55

(*) Approximate values

(4) Driving mechanism — Skid rail and retriever by geared motor

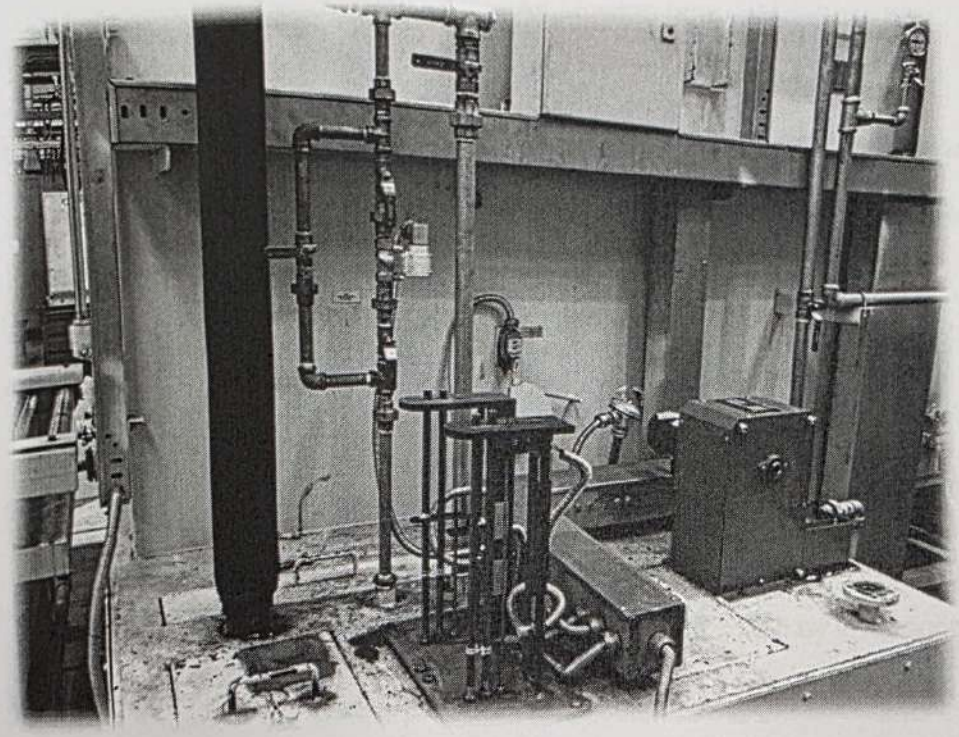
(5) Thermocouple — K type double — 1 no.

For control and recording

(6) Entrance & exit door — It is lined with fire brick.

Operation — by air cylinder

4. After cooling chamber



4-1. Purpose of equipment

This equipment is designed for stabilizing the micro-structure of parts by dipping into cold water after oil quenching, and consisted of 2 chambers.

This cooling chamber is the same structure equipmen with Post-washing maching.

But, it dose not use a electric heater.

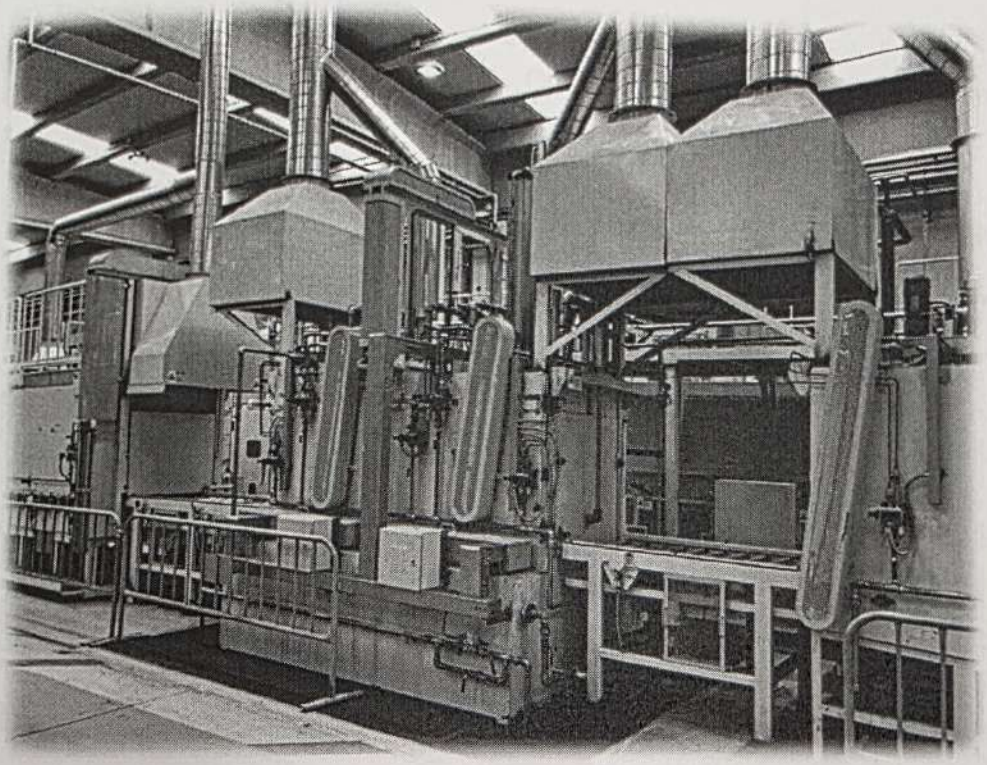
4-2. General specification

(1) Model	DCE32-306030
(2) Use	Stabilizing the micro-structure of parts
(3) Cooling method	Chiller
(4) Effective dimension	750W×750L×750H mm × 2 Tray
(5) Loading capacity	Max. 480Kg/charge (Gross)
(6) Cycle time	More than 6 minutes

4-3. Consists of equipment

(1) Tank capacity	Cooling tank	2,250 Liters
	Air blowing tank	
(2) Process		
Cooling tank	Charging → Dipping (Elevator down) → Elevator up → Move to sub tank	
Air blowing tank	Charging → Air blowing → Discharging	
(3) Operating temperature	8 ~ 10℃	
(4) Water level control	Automatic controlled by level sensor with Solenoid valve.	
(5) Elevator	Operated by air cylinder	
(6) Doors	Entrance, exit and Intermediate door	3 nos.
	Operated by air cylinder	
(7) Driving mechanism	Operated by the motor with chain	2 nos.
Geared motor	0.75Kw	2 nos
(8) Thermocouple	Temperature control & recording	2 nos.
(9) Oil skimmer	Rubber Belt type	2 nos.
(10) Chiller	App. 95,000 Kcal/Hr	1 no.

5. Post-washing machine (Alkaline washing machine)



5-1. Purpose of equipment

This equipment is designed for alkali solution and hot water washing after oil quenching and consisted of 2 chambers.

5-2. General specification

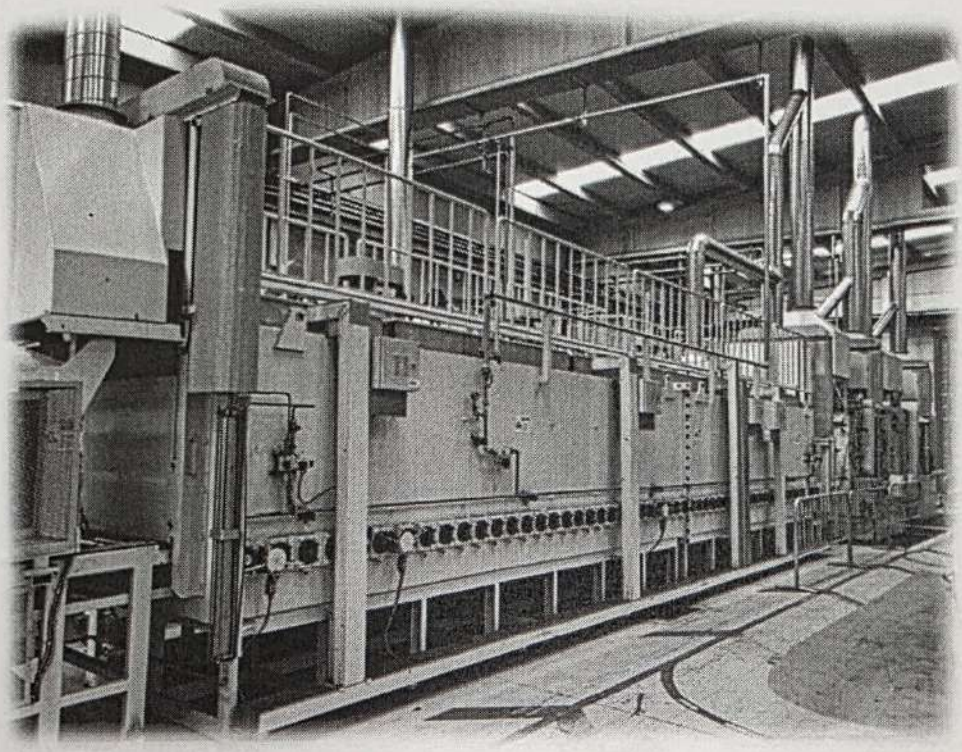
(1) Model	DHW61E-244826
(2) Use	Oil removal after quenching
(3) Heating method	Electric heater
(4) Effective dimension	750W×750L×750H mm × 2 Tray
(5) Loading capacity	Max. 480Kg/charge (Gross)
(6) Cycle time	More than 6 minutes (each zone)

5-3. Consists of equipment

(4) Tank capacity	Washing tank	2,250 Liters

	Rinse tank	2,700 Liters
(5) Process		
Washing tank	Charging → Dipping (Elevator down) → Air bubbling → Elevator up → Air blowing → Move to rinse tank	
Rinse tank	Charging → Rinse shower → Air blowing → Discharging	
(6) Operating temperature	Alkaline tank	80 ~ 90℃
	Rinse tank	60 ~ 80℃
(4) Heating devices	Electric sheath heaters	14 nos.
Washing tank	9 Kw □ 8 nos. = 72 Kw	
Rinse tank	9 Kw □ 8 nos. = 72 Kw	
	Total 144 Kw	
(5) Shower pump		
Rinse tank	0.3m3/min x 25mH x 7.5Kw	1 no.
(6) Shower nozzle	a spraying hole in the spray pipe, Dia 4	
(7) Oil skimmer	Rubber Belt type	2 nos.
(8) Water level control	Automatic controlled by level sensor with Solenoid valve.	

6. Tempering furnace



6-1. Purpose of equipment

It is divided into 3 zones and consisted of fire-proof board, circulating fans, doors, and conveyor device in furnace.

6-2. General specification

(1) Model	DFA21E-3021030L
(2) Heating method	Electric sheath heater
(3) Use	Low temperature tempering
(4) Effective size	750W×750L×750H mm ×11 trays
(5) Operating temperature	150 ~ 350℃ (Max 350℃)
(6) Loading capacity	Max. 480Kg/ch (Gross) × 11 = 5,280 Kg/furnace
(7) Cycle time	15 minutes

6-3. Consists of equipment

Description of Equipment — *for Continuous roller hearth type furnace*

(1) Composition of furnace	Heating zone		3 Trays
	Soaking 1, 2zone		8 Trays
	Total		11 Trays
(2) Heating devices	Electric sheath heaters		68 nos.
Heating element	Fe-Cr.		
Sheath material	Stainless steel SS304 φ8		
Heating control method	SCR- PID control		
Heating zone	3.0 Kw x 24 nos. =	72.0 Kw	
Soaking zone	3.0 Kw x 44 nos. =	132.0 Kw	
	Total	204.0 Kw	
(3) Circulating fan	Material	Mild steel MS400	
	Motor	2.2Kw ×6P	4 nos.
(4) Driving mechanism	Operated by rollers with geared motor		
Geared motor	0.75 Kw		2 nos.
	1.5 Kw		2 nos
(5) Entrance and exit door	It is filled with fire proof brick		
	Operated by air cylinder		
(6) Thermocouple	Temperature control & recording		6 nos.

7. Conveyors

(1) Charging stock conveyor	1 no.
(2) Manual traversor	1 no.
(3) Entrance lifter	1 no.
(4) Entrance stock conveyor to Continuous Q-T(carburizing) furnace	1 no.
(5) Charging lifter to continuous Q-T(carburizing) furnace	1 no.
(6) Exit conveyor from oil quenching tank	1 no.
(7) Auto traverser to post process line	1 no.
(8) Entrance conveyor to after cooling tank	1 no.
(9) Entrance conveyor to washing tank	1 no.
(10) Entrance conveyor to tempering furnace	1 no.
(11) Exit stock conveyor	1 no.
(12) Exit lifter	1 no.
(13) Discharging stock conveyor	1 no.

8. Electric control panel

It contains the electric distribution parts that supplies power for driving and controlling, and the control parts including temperature and sequence of all equipment.

Also It is designed to operate automatic cycle, and monitor all equipment of continuous furnace line.

8-1. General specification

(1) Structure	Dust and water proof structure.
(2) Dimension	
for CCF Line	3,100W × 700L × 2,000H mm (Distribution Panel)
	3,600W × 700L × 2,000H mm (Control Panel)
for Common Line	3,100W × 700L × 2,000H mm(Distribution Panel)
	2,700W × 700L × 2,000H mm (Control Panel)

8-2. Consists of continuous roller hearth type furnace

(1) Power distributors	Circuit breakers	
	Electromagnetic contactors	
	Overload relays	
	Meters (Ampere, Voltage, Watt-hour)	
	SCR unit	
(2) Temperature controller	Current output type PID	
	Input	K-type thermocouple
	Output	4~20 mA
	Use	Heating zone
		Soaking 1,2 zone
		Hardening zone
		Tempering furnace.

(3) Temperature controller	PID on-off type	
	Input	K-type thermocouple
	Output	SPDT relay output
	Use	Pre-heating furnace
		Oil quenching tank
		After cooling tank
		Post(Alkaline) washing M/C
(4) Temperature protector	PID on/off type	
	Model	UDC2500(Honeywell)
	Input	K-type thermocouple
	Output	SPDT relay output
	Use	Alarm for overheat and low temper in Continuous Q-T(carburizing) furnace
(7) PLC (Sequencer)	S7 series(Siemens)	1 no.
(8) Data gathering system		
HMI(Human Machine Interfaces)	Touch Screen PC(19")	1 no
Software		1 no

Main function

1. Data gathering (Data recording, monitoring)
2. Pattern control
3. Setted pattern will be linked with Inter-Lock in the system.
4. Linked with fool proof system
5. Notice (Alarm) system for replacement timing on main parts
6. Notice (Alarm) system for periodical inspection timing on key management point based on CQI-9
7. Auto save of Daily report(Saving as Excel):

Temperature, C.P,Inverter Hz,Alarm list

Monitoring system	For manage & Head office
(9) Inverter	
Use	Speed control for charging and discharging.
	Speed control for roller speed
	Control agitator RPM
Power	AC 380V 3φ 50Hz
(10) SCR Unit	
Use	Temperature control for
	Continuous Q-T(carburizing) furnace
	Tempering furnace.
Power	AC 380V 3ϕ 50Hz
(11) Air conditioner	Cooling for control panel inside
(12) Operation panels	For manual operation.
(13) Others	DC power supplies
	Control relays
	Push button switches
	Indicating lights
	Circuit protectors
	Alarm indicating lights