

DAIKIN
Marine type
Container Refrigeration Unit

Service manual

Model

LX8B
LX8B-A
LX5B
LX5B-A

DAIKIN INDUSTRIES, LTD.

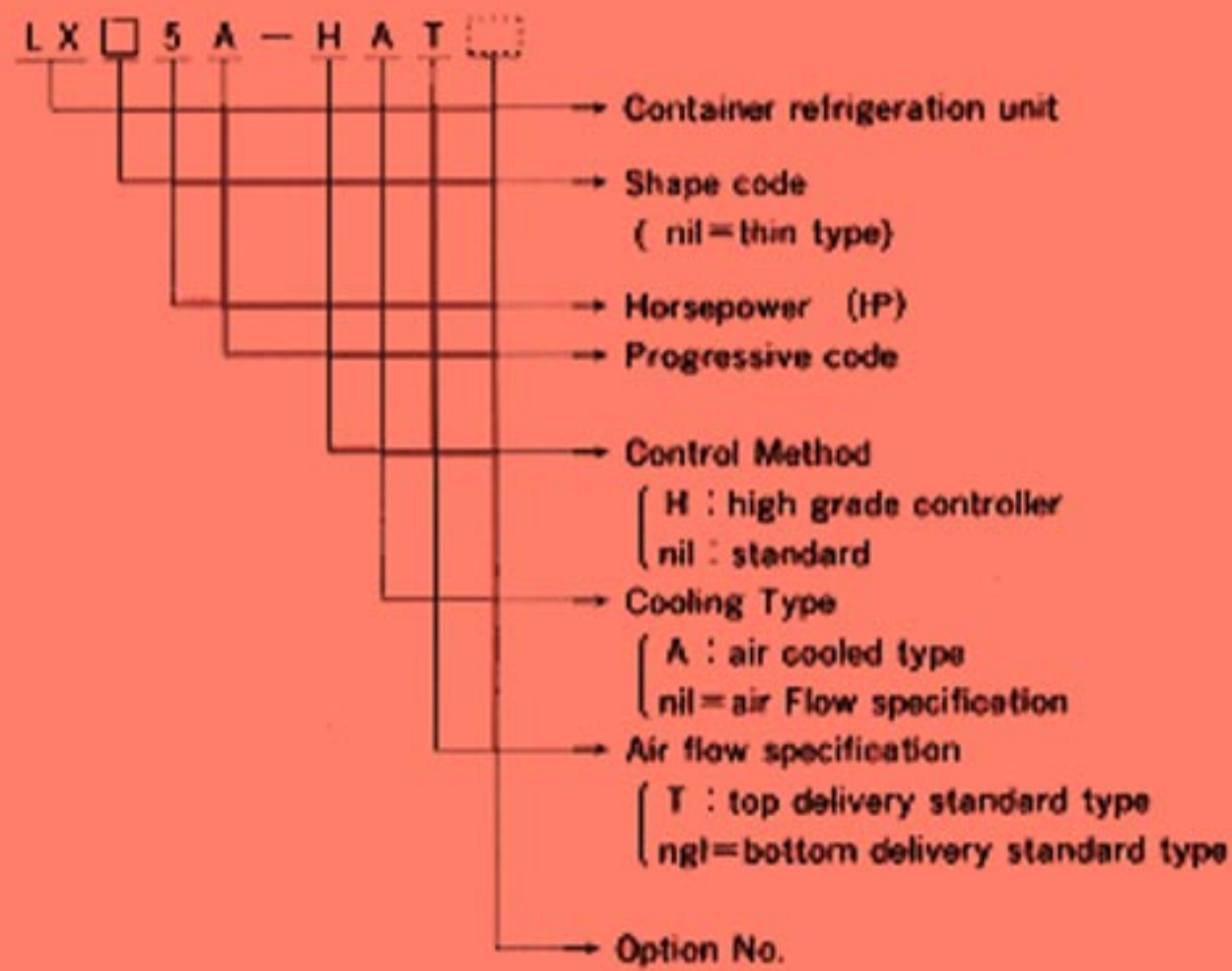
TR92-02

This manual describes the features, functions, operation, and maintenance of the container refrigeration unit. In addition, the manuals listed below are also available.

● Parts list

Please refer also to these manuals.

4. Container refrigeration unit



NOTE)1. "R" GIVEN AFTER OPTION NUMBER STANDS FOR "REVISE" AND IT IS GIVEN FOR THE UNIT WHICH IS SPECIALLY MODIFIED.

DANGER

1. Do not disconnect plug until power supply is shut off.
2. Be sure to set the voltage selector to the position corresponding to your power supply before connecting the power plug.

CAUTION

1. Do not start the unit until a plug is connected and generator plant is operated.
2. Do not rotate the compressor in the reverse direction. Doing so could cause the scroll to get abnormally worn, eventually resulting in burning.

NOTE

1. Confirm the function of the temperature recorder and life of the battery when the chart paper is replaced with a new one.
2. Tighten the control box cover till perfect watertightness is obtained.
3. Confirm that the stop valves in the refrigeration circuit are opened before operation.
4. Confirm that the cargos are cooled down to the temperature for transportation in advance.
5. After operating the Container Refrigeration Unit for service, wash the unit with fresh water. Especially the external unit and air-cooled condenser need to be thoroughly rid of salt.

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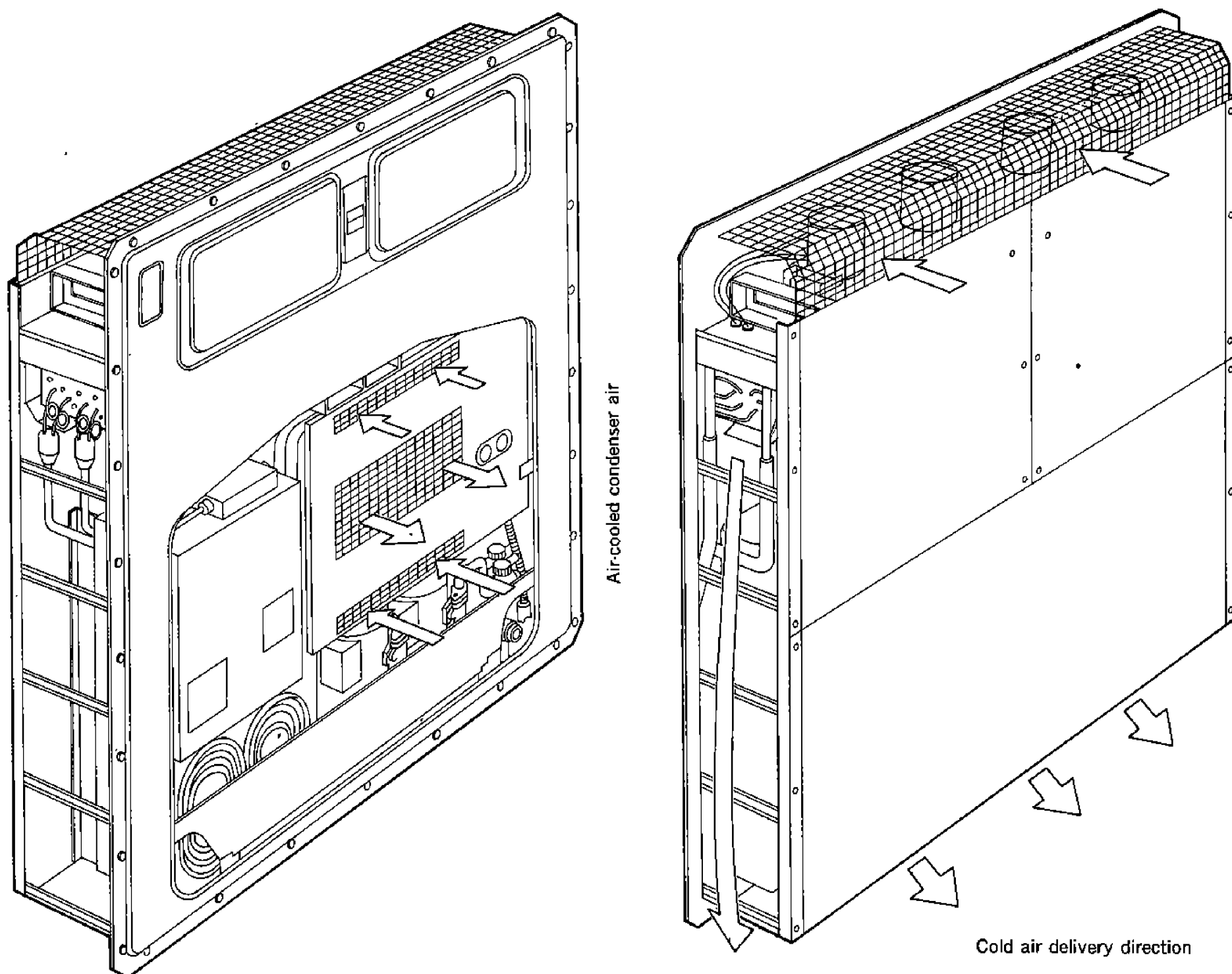
Chapter for operation

1. Operation ranges

Use the units within the following ranges

Item	Operation range	
Ambient temperature range	-30°C~+50°C (-22°F~+122°F)	
Cooling water (Air/water cooled type)	Quality of water	Fresh water
	Temperature	10°C~36°C (50°F~96.8°F)
	Water flow rate	20~46 ℓ /min.
	Pressure	2~5kg/cm ²
Inside temperature range	-30°C~+25°C (-22°F~+77°F)	
Voltage	200V class 200V 50/60Hz, 220V 60Hz	
	400V class 380V~415V 50Hz, 400V · 440V 60Hz	
	Voltage fluctuation rate ±10%	
Vibration and shock	2G	

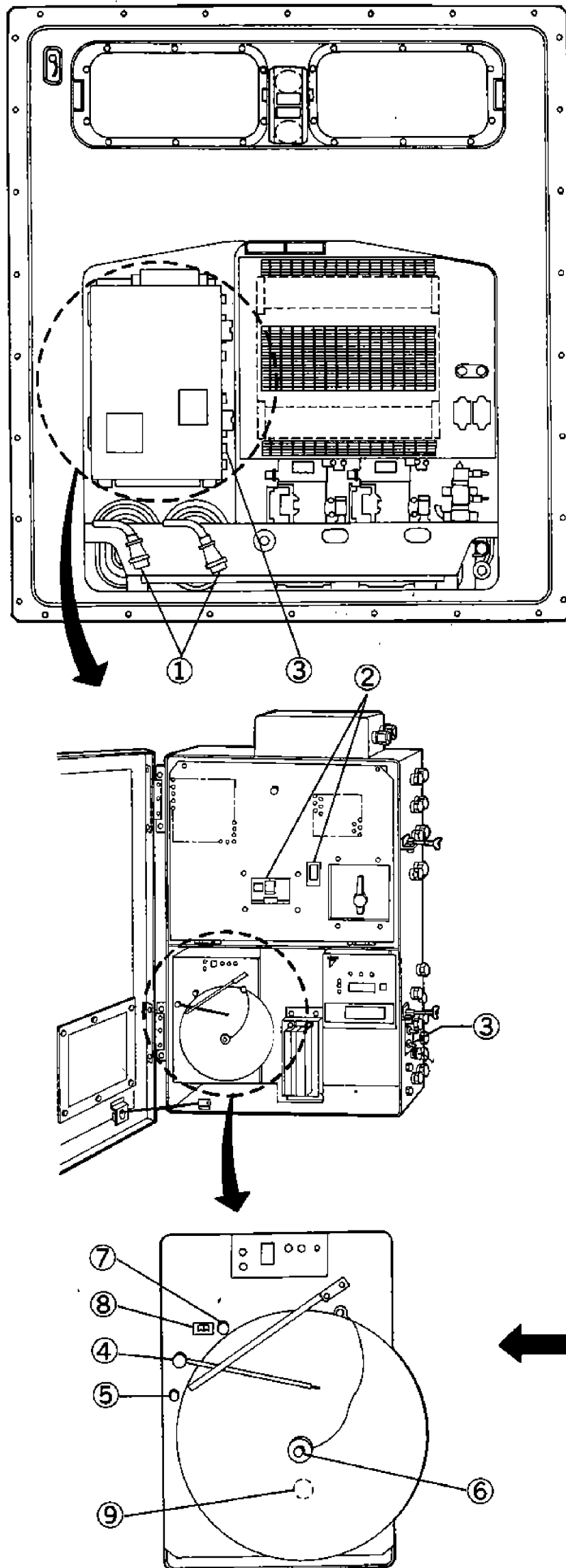
2. Air-cooled condenser air/cold air delivery direction



3. Operation

Operate the unit by the procedures given below.

- Preparation and operation
- Checking during operation
- Maintenance after operation



3.1 Preparation and operation

Confirm that supply power is off.

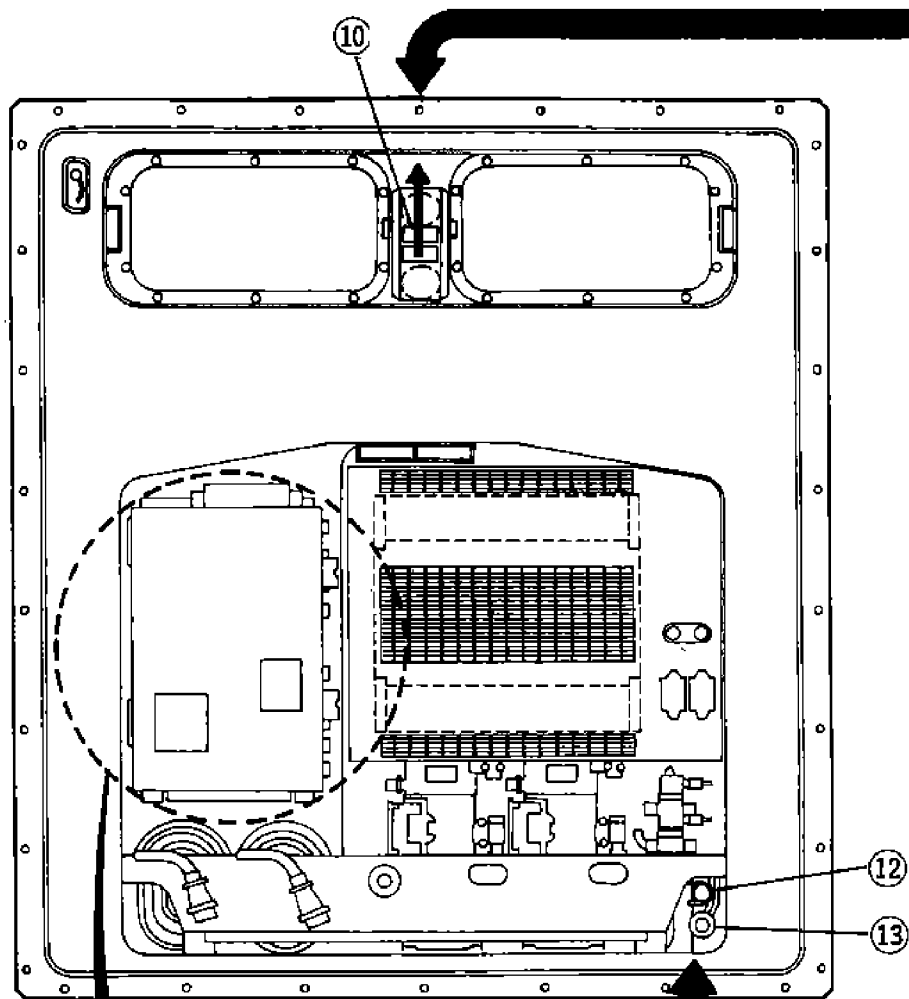
Confirm that the power source ①, the circuit breaker ② and unit ON-OFF switch ③ are turned off before checking for safety's sake.

Confirming function of drive for the recording chart

- Confirming life of a dry element battery
Press the push button ⑦ and confirm that the needle of the remaining voltage indicator ⑧ remains in the blue zone. (The meter functions only when the push button ⑦ is pressed down)
- Confirming the function of quartz motor
After confirming the life of dry element battery, check through the inspection window ⑨ the inside fly wheel is rotating.

Setting a sheet of recording paper

- Raise the pen by the pen holder ④, loosen the chart nut ⑥, and set a new sheet of recording paper.
- Set the date on the paper to an arrow of present time plate ⑤.
- Firmly tighten up the chart nut ⑥ and release the pen so that recording can be accomplished.

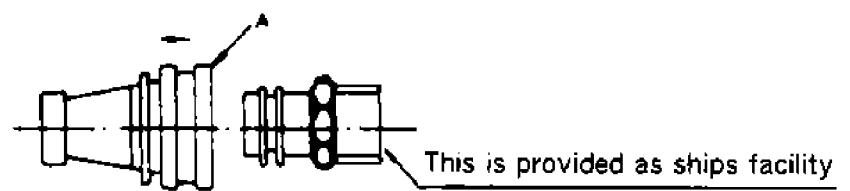


Open or close the ventilator.

Adjust the opening degree of ventilator ⑩ according to the kind of load. (Be sure to shut the ventilator when transporting frozen goods.)

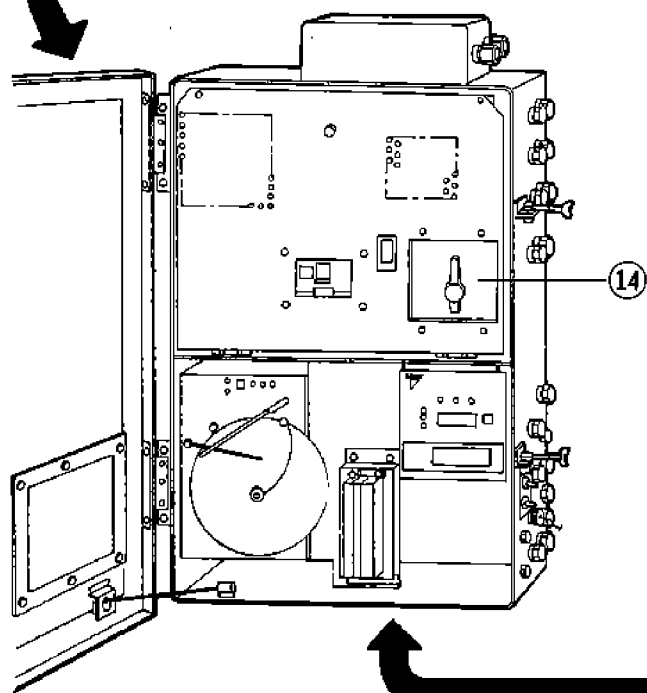
Connect the cooling water piping. (Air/water cooled type)

- In the case of water cooled operation, connect the water piping, and supply water through it.
 - Connecting method
 1. Connect the cooling water inlet coupling ⑫.
 2. Connect the cooling water outlet coupling ⑬.
 - Disconnecting method.
 1. Disconnect the cooling water outlet coupling ⑬.
 2. Disconnect the cooling water inlet coupling ⑫.
- When the cooling water couplings are connected, insert the coupling on the ship side into the coupling on the unit side until a "click" is heard.



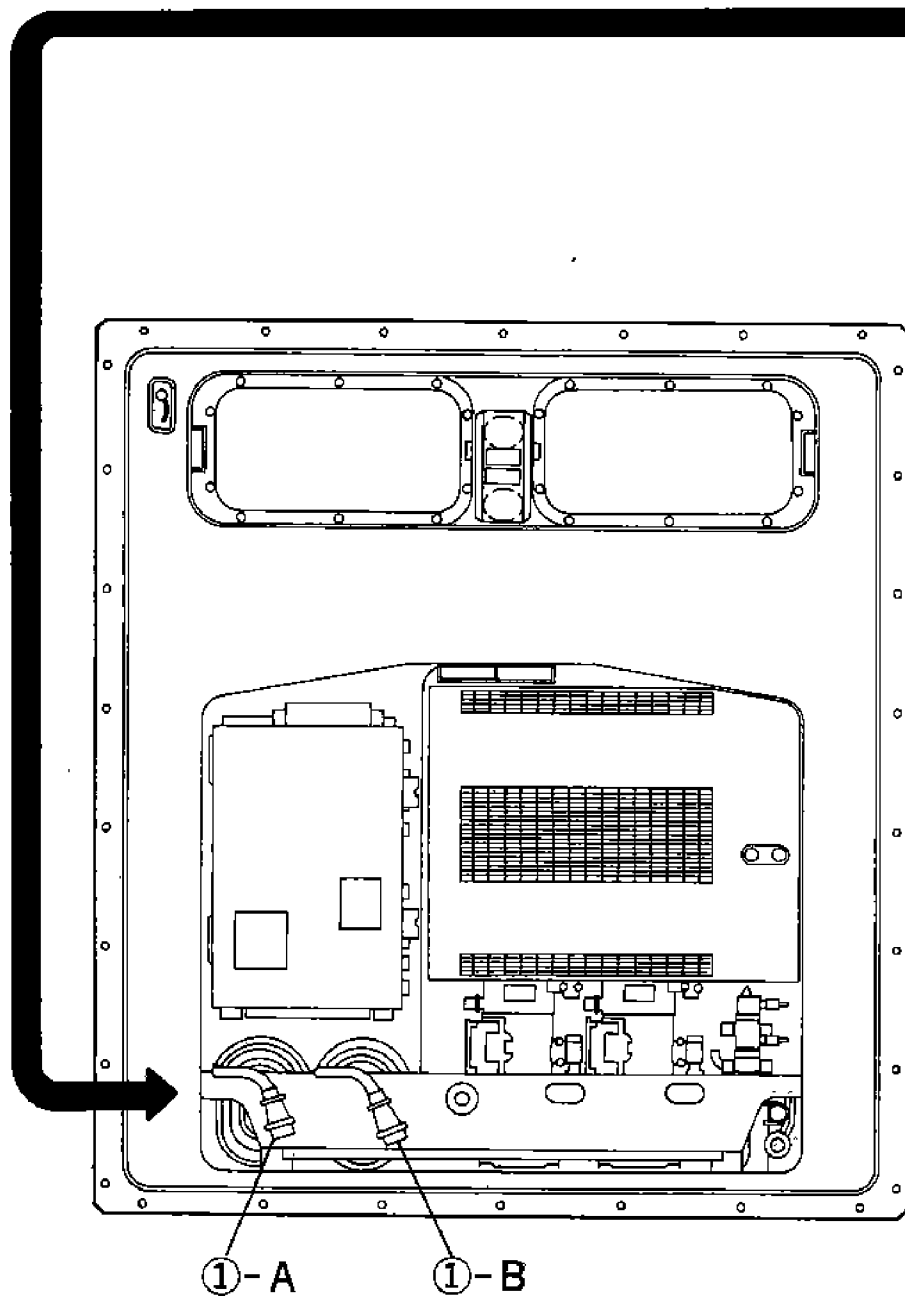
When disconnecting them, pull the coupling on the ship side toward you while pushing the "A" part of the female coupling in the direction pointed by an arrow mark.

Both at connecting and disconnecting, be careful for splash of cooling water.



Check that all refrigerant stop valves are opened. (Refer to "piping diagram")

Set the voltage selector ⑭ according to the supply voltage.



↓

Plug ① in the power source which supplies the proper voltage, and fasten the plug ① firmly.

↓

Turn on the power switch of the facility (outside the unit).

↓

Turn ON the circuit breaker ② and unit ON-OFF switch ①.

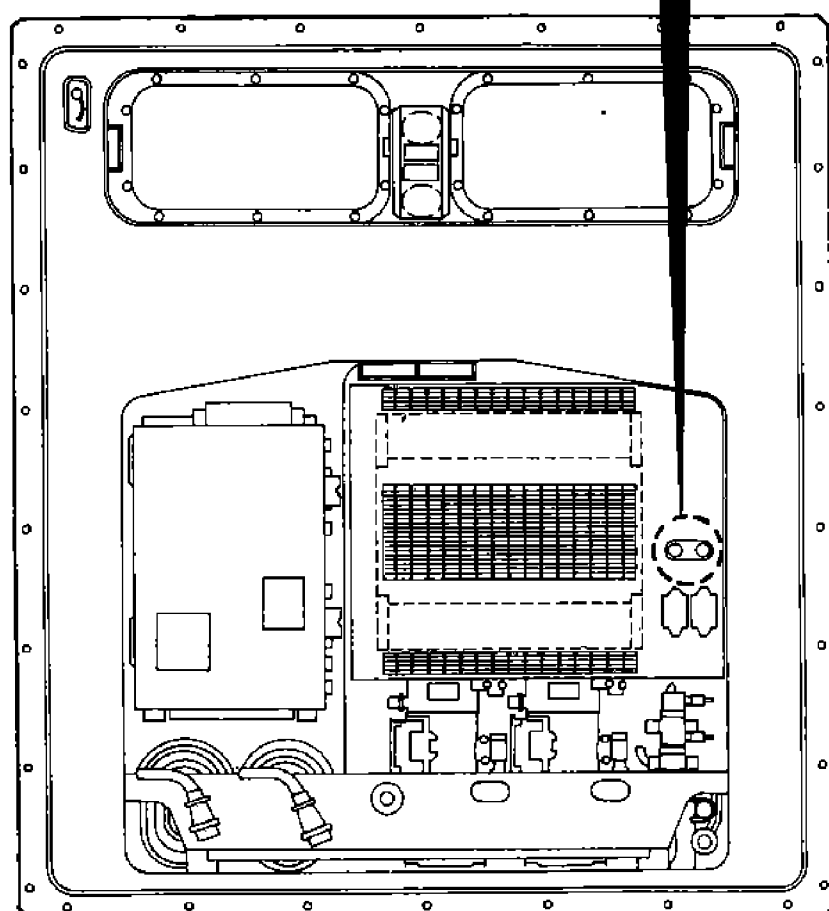
↓

Close the cover of the switch box.
Because imperfect sealing can cause water intrusion, check the packing and then tighten the cover securely.

- ① power plug
- ①-A 200V class
- ①-B 400V class

3.2 Checking during operation

Checking items (precautions)	Method of check
1. Check if unusual noise and vibration is not produced from compressor, fan and piping etc.	Visual, listening and touching.
2. Check suction and discharge pressures of the compressor. (For installation of a gauge, refer to Section 6 "Maintenance".)	Compare the measured values with the standard values. Operate only compressor No. 1 (left side) when chilling or partial freezing mode is selected or when the return air temperature is 0 °C or higher with freezing mode selected. before operating compressor No.2 (right side), be sure to operate the test switch of the overcurrent relay of compressor No.1.
3. Check to see if refrigerant is sufficient. (The refrigerant bubbles immediately after starting, but this does not mean that refrigerant is lacking.)	Shortage of refrigerant is indicated by bubbles in the moisture indicator.
4. Check if any moisture is present in refrigerant circuit. (The color of moisture indicator may turn to orange if it has been exposed to gaseous refrigerant for a long time, but this is no indication of trouble.)	Visual The moisture indicator should normally appear deep blue. Orange color is a sign of trouble.
5. Check if the recorder operates according to the inside temperature.	Visual
6. Check operating conditions with the pilot lamps and check instrument	Visual



3.3 Maintenance after operation

Stopping

To stop the unit, set the unit ON-OFF switch to the OFF position. Subsequently, turn OFF the circuit breaker.

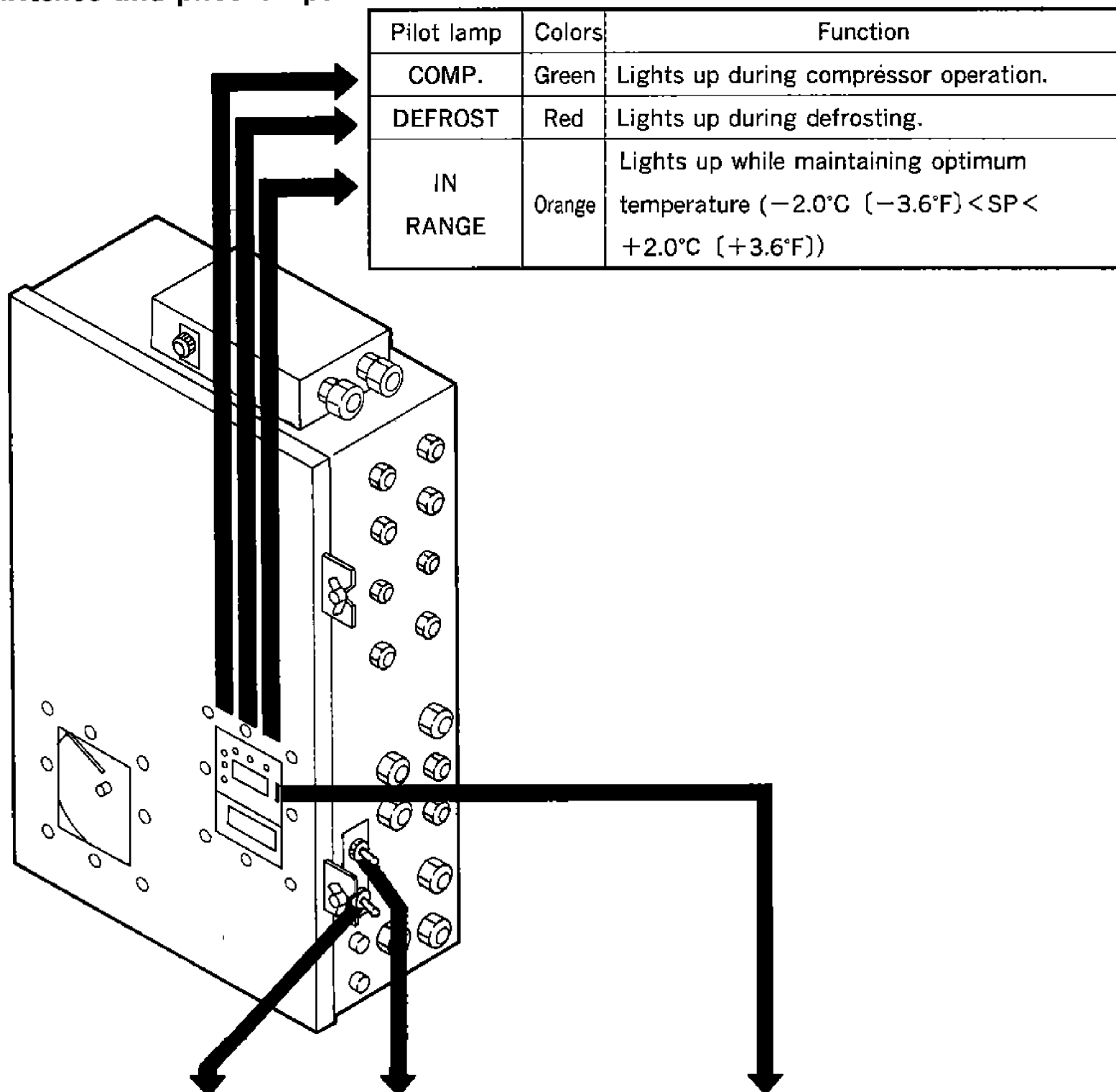
Stowing the power cable

Turn the plug's opening downward so that sea and rain water cannot enter the plug when stowing it.

Close the cover of the switch box.

After water cooled operation, remove the water piping. (Air/water cooled type)

3.4 Operation switches and pilot lamps



Pilot lamp	Colors	Function
COMP.	Green	Lights up during compressor operation.
DEFROST	Red	Lights up during defrosting.
IN RANGE	Orange	Lights up while maintaining optimum temperature (-2.0°C [-3.6°F] $< \text{SP} < +2.0^{\circ}\text{C}$ [$+3.6^{\circ}\text{F}$])

Switches	Unit ON-OFF	Defrost AUTO/MANUAL		Set point selector		
	Operation mode	Defrosting		Chilled operation	Partial frozen operation	Frozen operation
Operation points	Turn on the switch	Automatic comes on automatically in accordance with the timer setting.	Manual Turn on the switch.	Set the selector within $+25.0 \sim -2.9^{\circ}\text{C}$. ($+77 \sim +26.8^{\circ}\text{F}$)	Set the selector within $-3.0 \sim -10^{\circ}\text{C}$. ($+26 \sim +14^{\circ}\text{F}$)	Set the selector within $-10.1 \sim -25.0^{\circ}\text{C}$. ($+13.8 \sim -13^{\circ}\text{F}$)
Functions	Operate the unit on and off.	Hot gas defrosting begins. When defrosting is terminated, chilled or frozen operation will begin automatically.		Chilled operation begins. Inside temperature is controlled in PID by the supply sensor. The evaporator fan is running in high speed when controlled air temperature is under 25°C . (77°F)	Partial frozen operation begins. Inside temperature is controlled in PID by the return sensor.	Frozen operation begins. Inside temperature is controlled in ON/OFF operation by the return sensor. The evaporator fan is running in low speed.

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Chapter for maintenance and repair

1. Data of the products

1.1 Main specifications

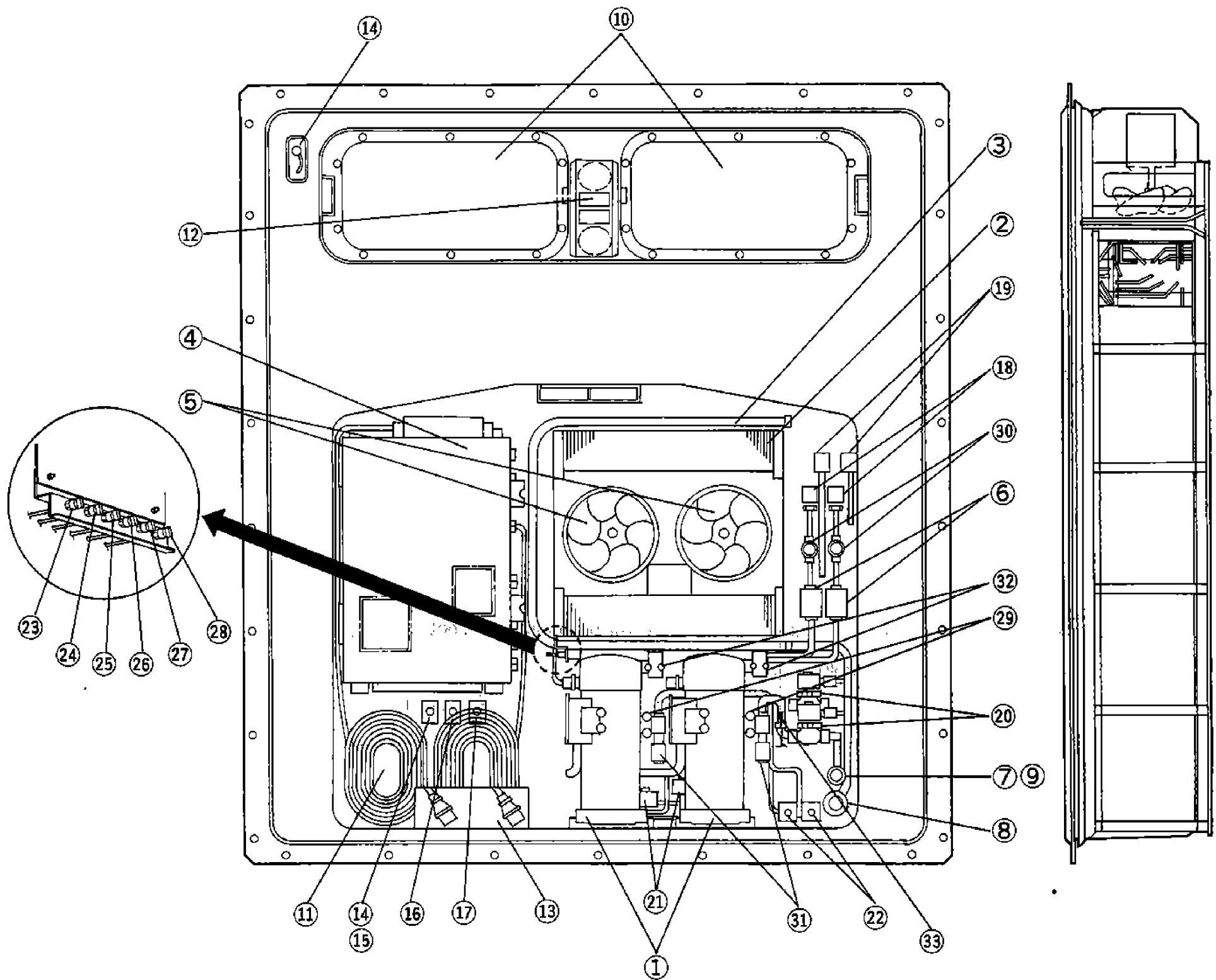
Item	Model	LX8B	LX8B—A
Inside air discharge direction		Bottom air discharge type	Bottom air discharge type
Condenser cooling methods		Air/water cooled type	Air cooled type
Power supply		AC 200V 3 Phase 50Hz AC 200V, 220V 3 Phase 60Hz AC 380~415V 3 Phase 50Hz AC 400V, 440V 3 Phase 60Hz (Dual-rating voltage system by voltage selector switch)	
Compressor		Totally enclosed type (power : 3.75 kW×2)	
Evaporator		Cross finned coil type	
Air cooled condenser		Cross finned coil type	
Water cooled condenser		Double tube type	—
Fan		Motor direct driven propeller type	
Fan motor		Three-phase squirrel-cage induction motor	
Defrost			
Heating		Hot-gas defrost	
Initiation		Timer or manual switch	
Termination		Sensing suction pipe temperature by the defrost termination thermistor	
Refrigerant control		Electronic expansion valve	
Capacity control		Refrigerant circulation control by means of electronic expansion valve and suction side solenoid valve.	
Protection devices		Circuit breaker, overcurrent relay, compressor protection thermostat, discharge pipe thermostat, fan motor protection thermostat, high pressure switch, low pressure switch	
Refrigerant (charged amount)		R22 : 2.6 (kg)×2/5.7 (lbs)×2	
Lubricant (charged amount)		SUNISO 3GS-DI : 1.5 (ℓ)×2	
Weight		Approx. 580 (kg)/1278 (lbs)	Approx. 570 (kg)/1256 (lbs)

Main specifications

Item	Model	LX5B	LX5B—A
Inside air discharge direction		Bottom air discharge type	Bottom air discharge type
Condenser cooling methods		Air/water cooled type	Air cooled type
Power supply		AC 200V 3 Phase 50Hz AC 200V, 220V 3 Phase 60Hz AC 380~415V 3 Phase 50Hz AC 400V, 440V 3 Phase 60Hz (Dual-rating voltage system by voltage selector switch)	
Compressor		Totally enclosed type (power : 2.2 kW×2)	
Evaporator		Cross finned coil type	
Air cooled condenser		Cross finned coil type	
Water cooled condenser		Double tube type	—
Fan		Motor direct driven propeller type	
Fan motor		Three-phase squirrel-cage induction motor	
Defrost			
Heating		Hot-gas defrost	
Initiation		Timer or manual switch	
Termination		Sensing suction pipe temperature by the defrost termination thermistor	
Refrigerant control		Electronic expansion valve	
Capacity control		Refrigerant circulation control by means of electronic expansion valve and suction side solenoid valve.	
Protection devices		Circuit breaker, overcurrent relay, compressor protection thermostat, discharge pipe thermostat, fan motor protection thermostat, high pressure switch, low pressure switch	
Refrigerant (charged amount)		R22 : 2.6 (kg)×2/5.7 (lbs)×2	
Lubricant (charged amount)		SUNISO 3GS-DI : 1.2 (ℓ)×2	
Weight		Approx. 560 (kg)/1234 (lbs)	Approx. 550 (kg)/1212 (lbs)

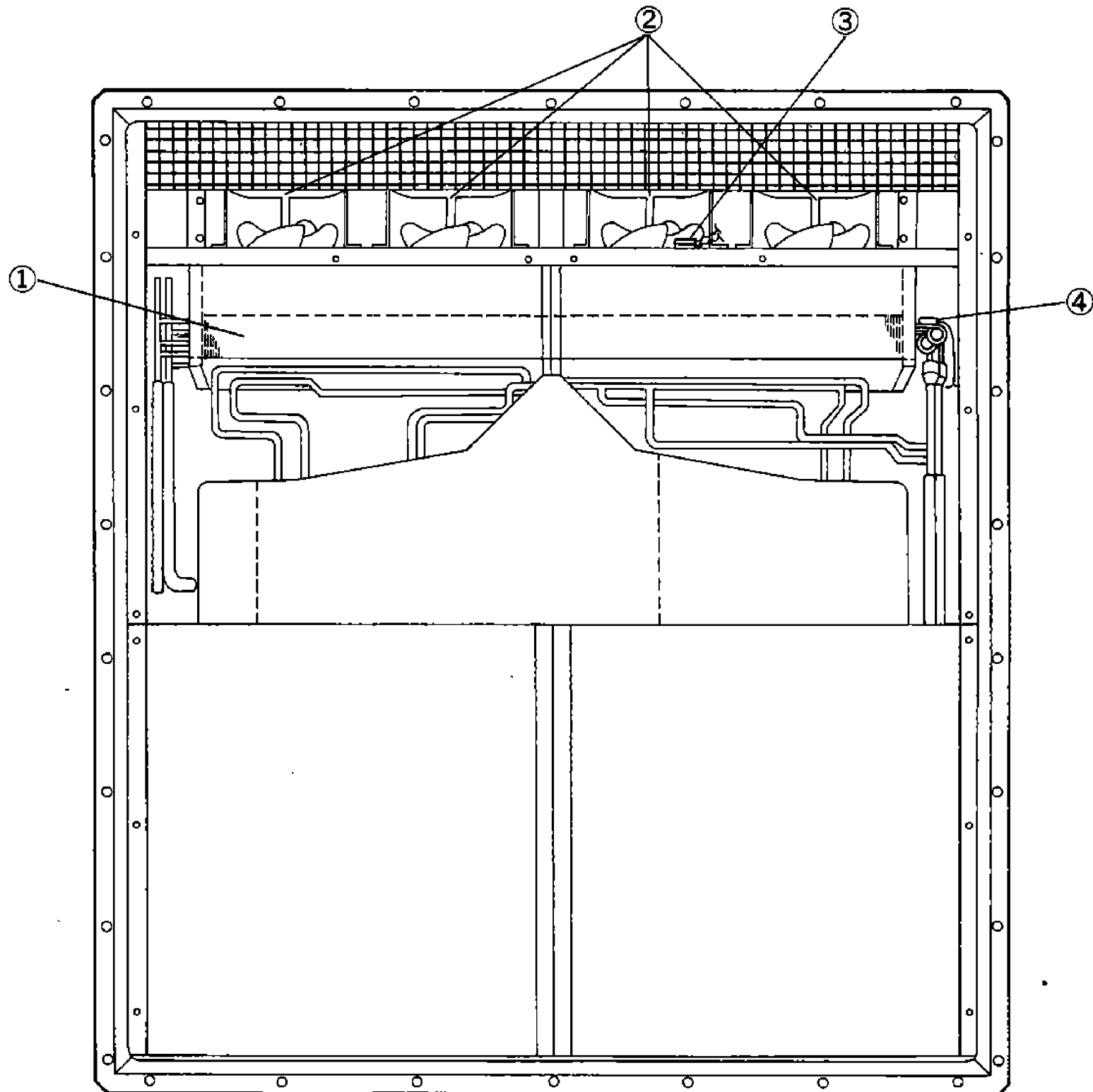
1.2 Names of parts

1.2.1 Outside



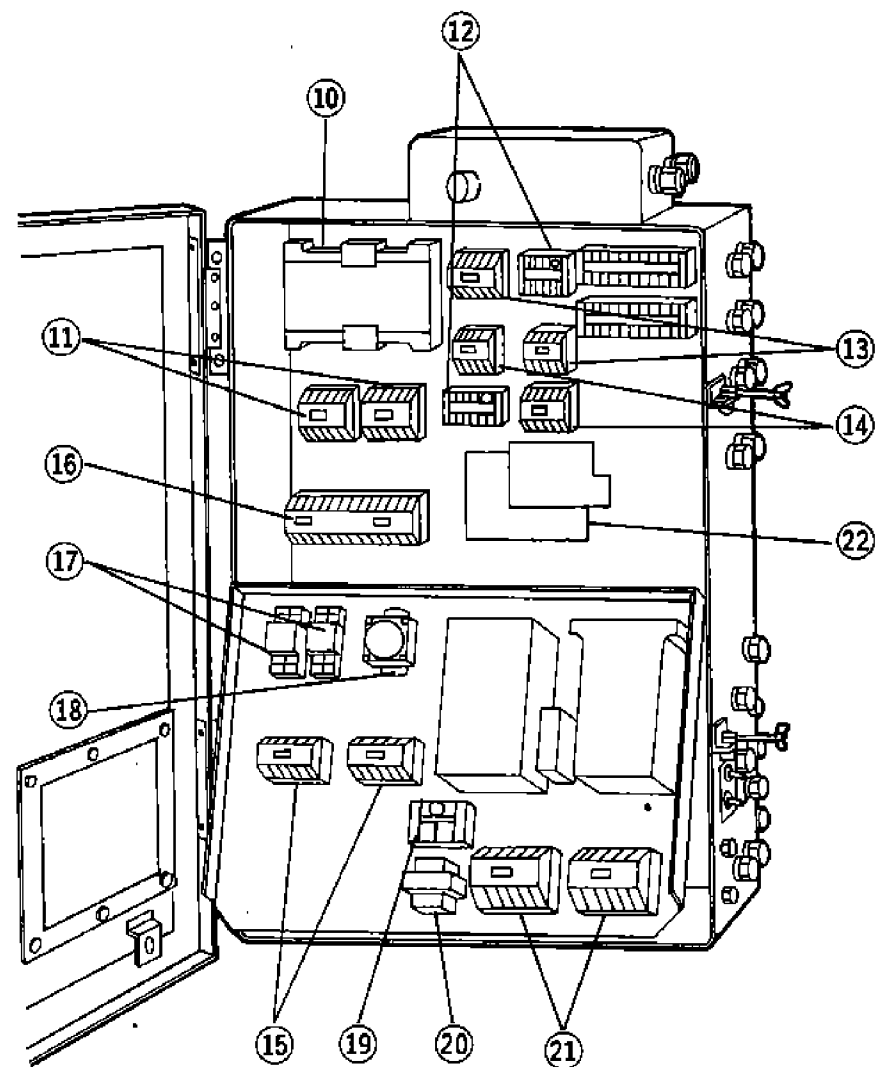
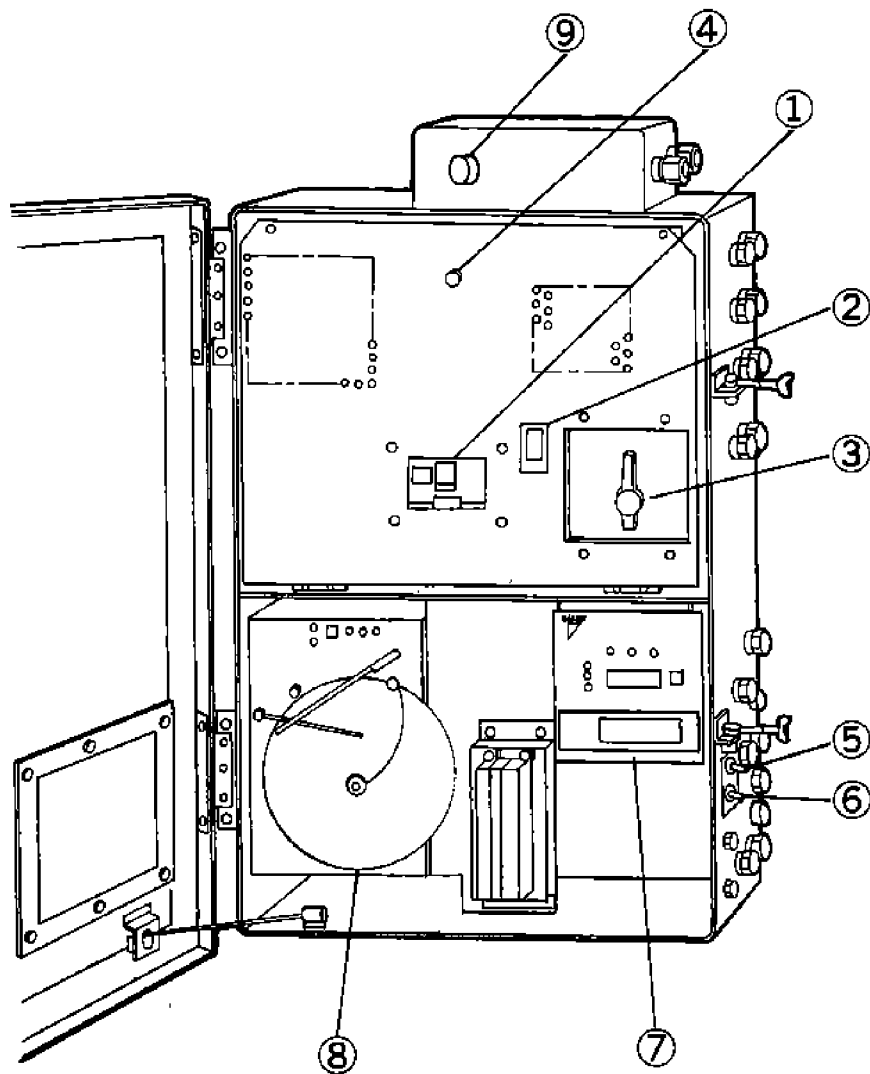
- | | | |
|----------------------------------|---|--|
| ① Compressors | ②④ Thermometer insertion hole | ②⑦ High pressure control switch No.2 |
| ② Air-cooled condenser | ⑤ Gas sampling port | ②⑧ Pressure switch No.2 for refrigerant pressure control in water-cooled operation (Moldes commonly used for both air cooling and water cooling) |
| ③ Water-cooled condenser | ⑥ Delivery sensor insertion hole | ②⑨ Low pressure switch |
| ④ Control box | ⑦ Recorder sensor insertion hole | ③⑩ Liquid indicator |
| ⑤ Air-cooled condenser fan motor | ⑧ Refrigerant solenoid valve | ③⑪ Suction side stop valve |
| ⑥ Dryer | ⑨ Electronic expansion valve | ③⑫ Discharge side stop valve |
| ⑦ Cooling water inlet joint | ⑩ Suction side solenoid valve | ③⑬ Suction pipe temperature sensor |
| ⑧ Cooling water outlet joint | ⑪ Injection solenoid valve | |
| ⑨ Water pressure switch | ⑫ Delivery 3-way solenoid valve | |
| ⑩ Access panel | ⑬ High pressure switch No.1 | |
| ⑪ Power cord storage space | ⑭ High pressure switch No.2 | |
| ⑫ Ventilator | ⑮ High pressure control switch No.1 | |
| ⑬ Transformer | ⑯ Pressure switch No.1 for refrigerant pressure control in water-cooled operation | |

1.2.2 Inside



- ① Evaporator
- ② Evaporator fan motor
- ③ Return air temperature sensor and recorder sensor
- ④ Heat exchanger inlet sensor

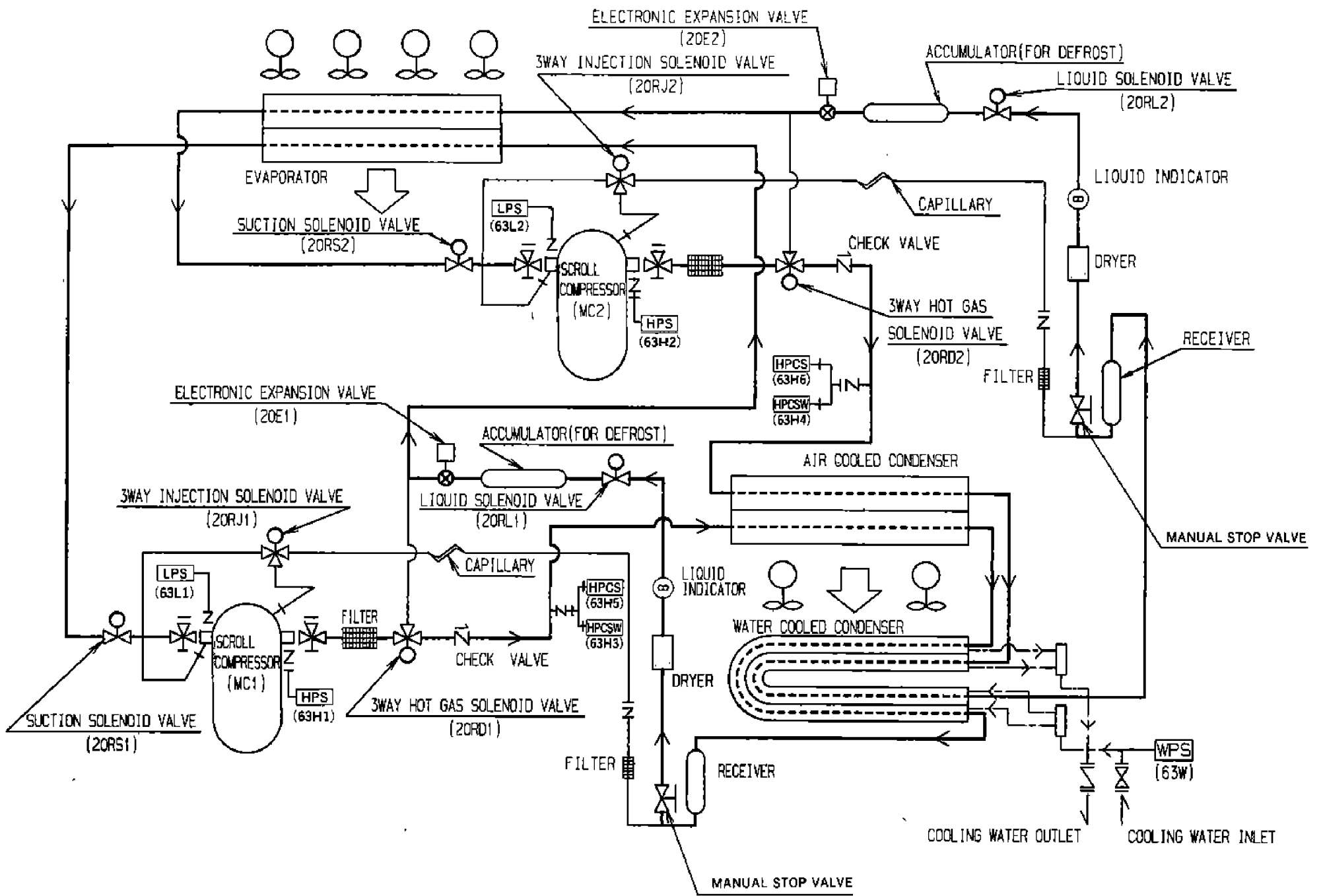
1.2.3 Control box



- ① Circuit breaker
- ② Circuit protector
- ③ Voltage selector switch
- ④ Fuse
- ⑤ Manual defrost switch
- ⑥ Unit on-off switch
- ⑦ Controller display panel
- ⑧ Electronic temperature recorder
- ⑨ monitoring receptacle
- ⑩ Transformer
- ⑪ Electromagnetic switches for compressors

- ⑫ Overcurrent relays for compressors
- ⑬ Electromagnetic switches for evaporator fan motors for high speeds
- ⑭ Electromagnetic switches for evaporator fan motors for low speeds
- ⑮ Electromagnetic switches for air-cooled condenser fan motors
- ⑯ Electromagnetic contactors (for fans)
- ⑰ Mini power relays
- ⑱ Fuse
- ⑲ Surge absorber
- ⑳ Transformer (for recorder)
- ㉑ Electromagnetic contactors
- ㉒ Reverse phase switching device

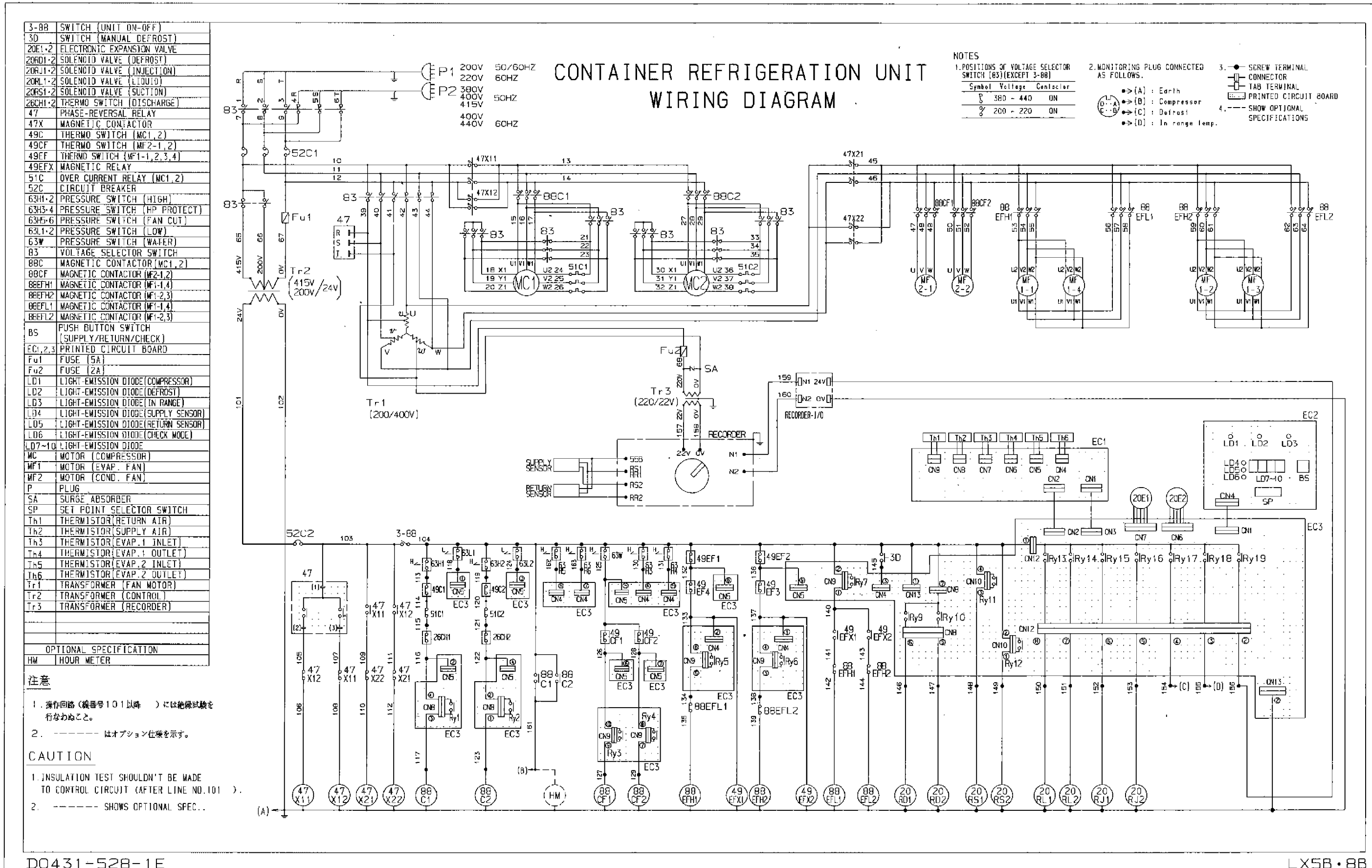
1.3 Piping diagram



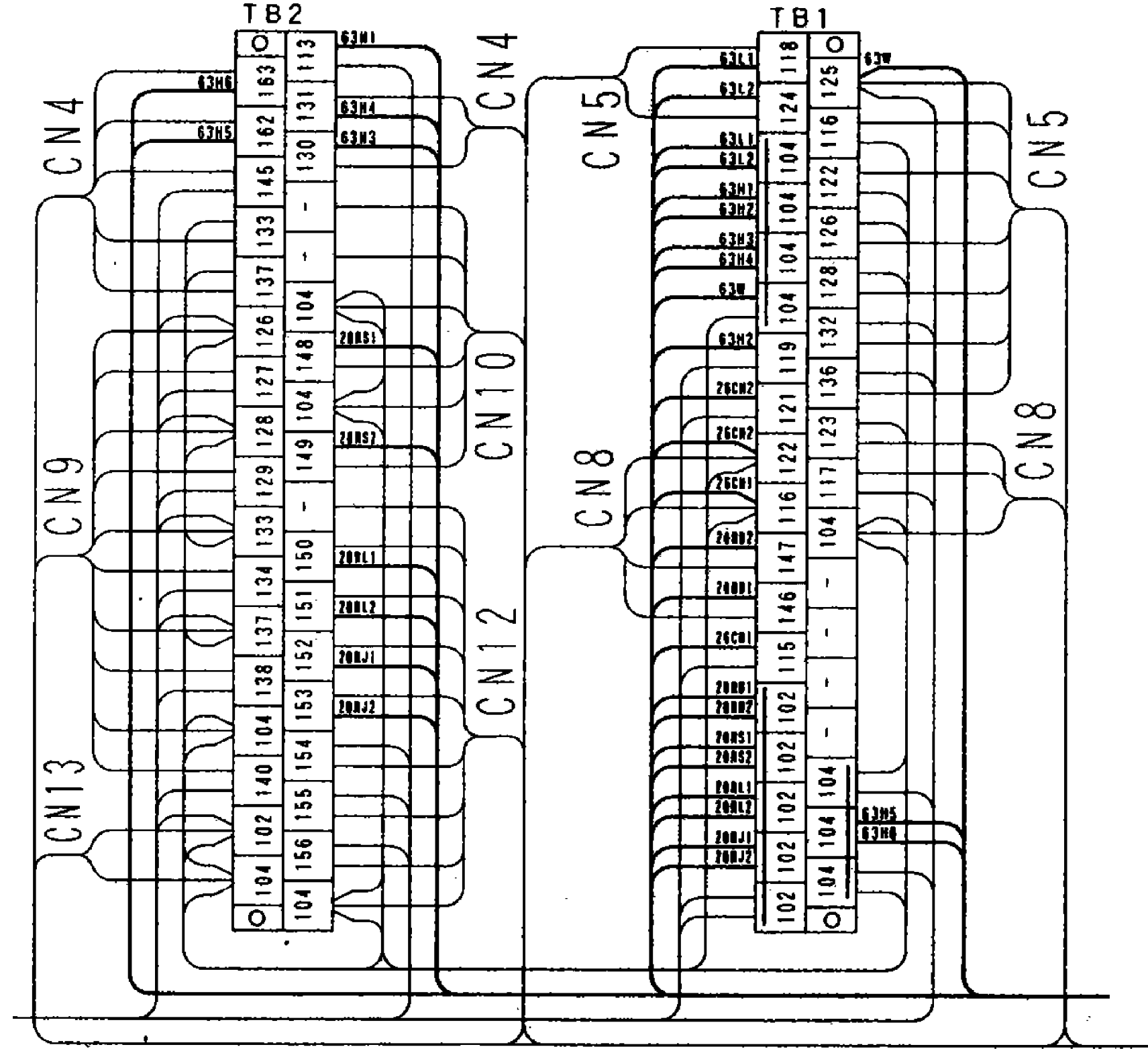
HPS	(63H1, 63H2)	High pressure switch
HPCSW	(63H3, 63H4)	Pressure switch for refrigerant pressure control in water-cooled
HPCS	(63H5, 63H6)	Operation
LPS	(63L1, 63L2)	High pressure control switch
WPS	(63W)	Water pressure switch

(Moldes commonly used for both air cooling and water cooling)

1.4 Electric wiring diagrams 1.4.1 Sequence



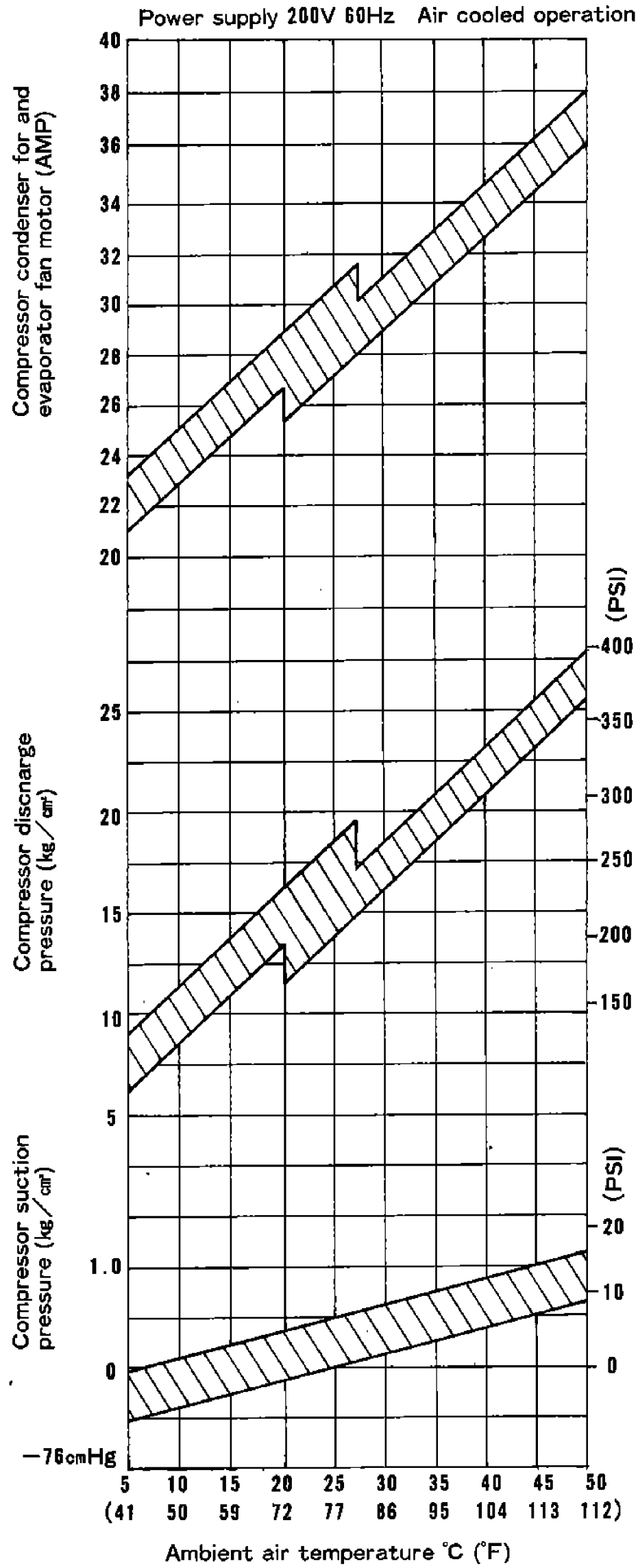
1.4.3 TB1 • 2 Detailed Connection Diagram



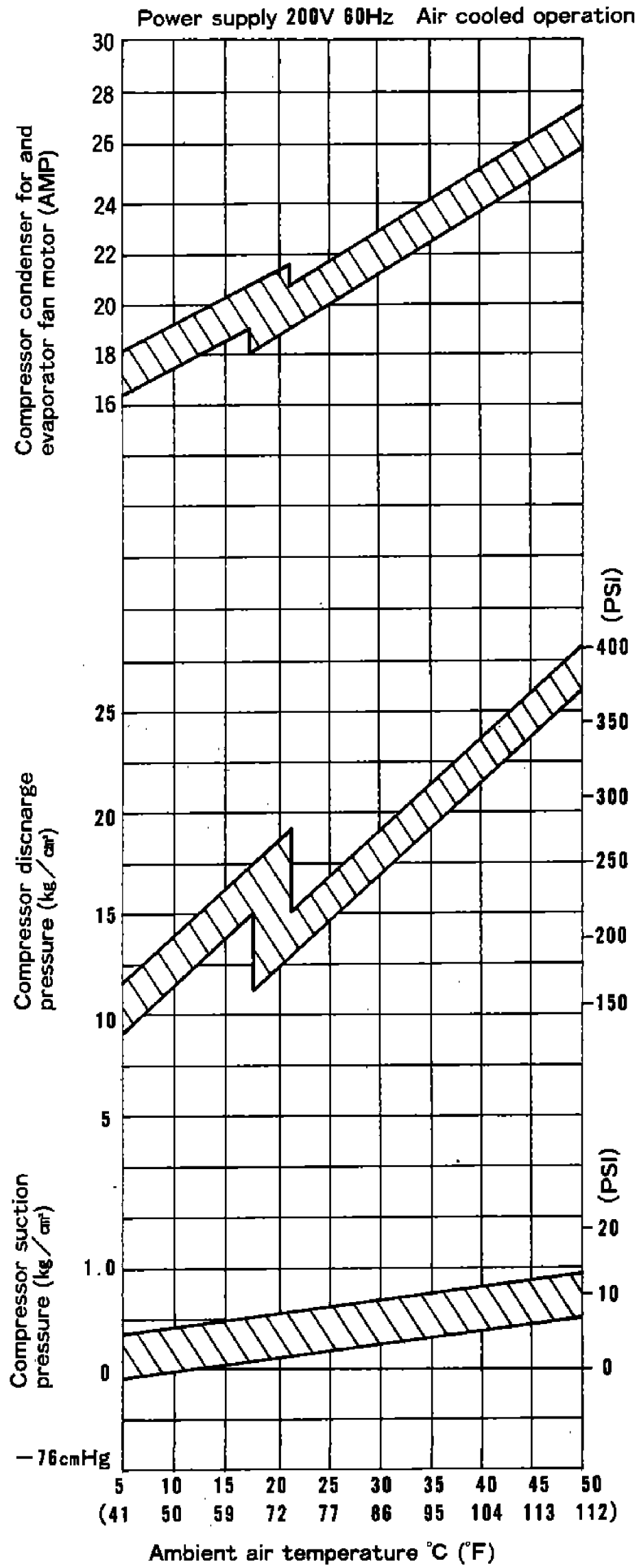
1.5 Set values of functional parts and protective devices

Parts Name		Mark	Function	Set Value		
Pressure switch	High pressure switch 20PS-K200	63H1, H2, H3, H4	OFF	28kg/cm ²		
			ON	20kg/cm ²		
	High pressure control switch ACB-BA26	63H5, H6	OFF	19kg/cm ²		
			ON	11kg/cm ²		
Low pressure switch 20PS-K100	63L1, L2	OFF	40cmHgV			
		ON	0.2kg/cm ²			
Water pressure switch LCB-BB07 (Air/water cooled type)	63W	OFF	1kg/cm ²			
		ON	0.4kg/cm ²			
Electronic controller	Operation mode selector	Chilled Partial frozen Frozen	ON	+25.0~-2.9°C(+77~+2.7°F)		
				-3.0~-10.0°C(+26.6~+14°F)		
				-10.1~-30.0°C(+14~-22°F)		
	Delay timer	Fan	Chang over for H→L	ON	10 seconds	
			After defrosting		60 seconds	
		Compressor	Starting		30 seconds	
	Defrost timer	Initiation	Short	ON	3 hours	
			Long		Variable: 3, 6, 9, 12hours	
		Compressor off			20 seconds	
		Back-up			90 minutes	
	In range mask		90 minutes			
	Fan speed selector thermostat (Chilled · Partial frozen operation mode)			L→H	25°C (77°F)	
				H→L	30°C (86°F)	
Defrost termination thermostat			OFF (Termination temperature)	35°C (95°F)	Suction gas temperature	
			ON (Reset temperature)	20°C (68°F)		
Delivery pipe thermostat		26CH1, CH2	OFF	135°C (275°F)		
			ON	86°C (187°F)		
Breaker OC	Over-current relay GT-20-NP2S4	51C1, CH2	OFF	LX8B	LX5B	
				10A	6.8A	
	Circuit breaker (Main circuit) MK53	52C1	OFF	50A	30A	
Circuit breaker (Control circuit) CP31/10-Z	52C2	OFF	15A			
Motor	Condenser fan motor protective thermostat	49CF	OFF	132°C (269.6°F)		
	Evaporator fan motor protective thermostat	49EF	OFF	140°C (284°F)		
	Compressor protective thermostat	49C	OFF	105°C (221°F)		

**1.6 Operation pressure and running current
LX8B**



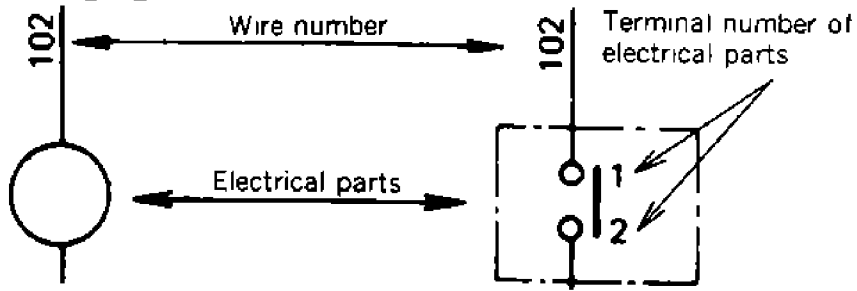
Operation pressure and running current
LX5B



2. Operation modes and circuits

2.1 How to read wiring diagram

(1) In the wiring diagram, marks and numbers have the meanings given below.



(2) Operation of contacts

- a. The wiring diagram indicates the stationary state in which the circuits are not activated.
- b. when a coil is energized (supplied with power), the associated contact changes its position.

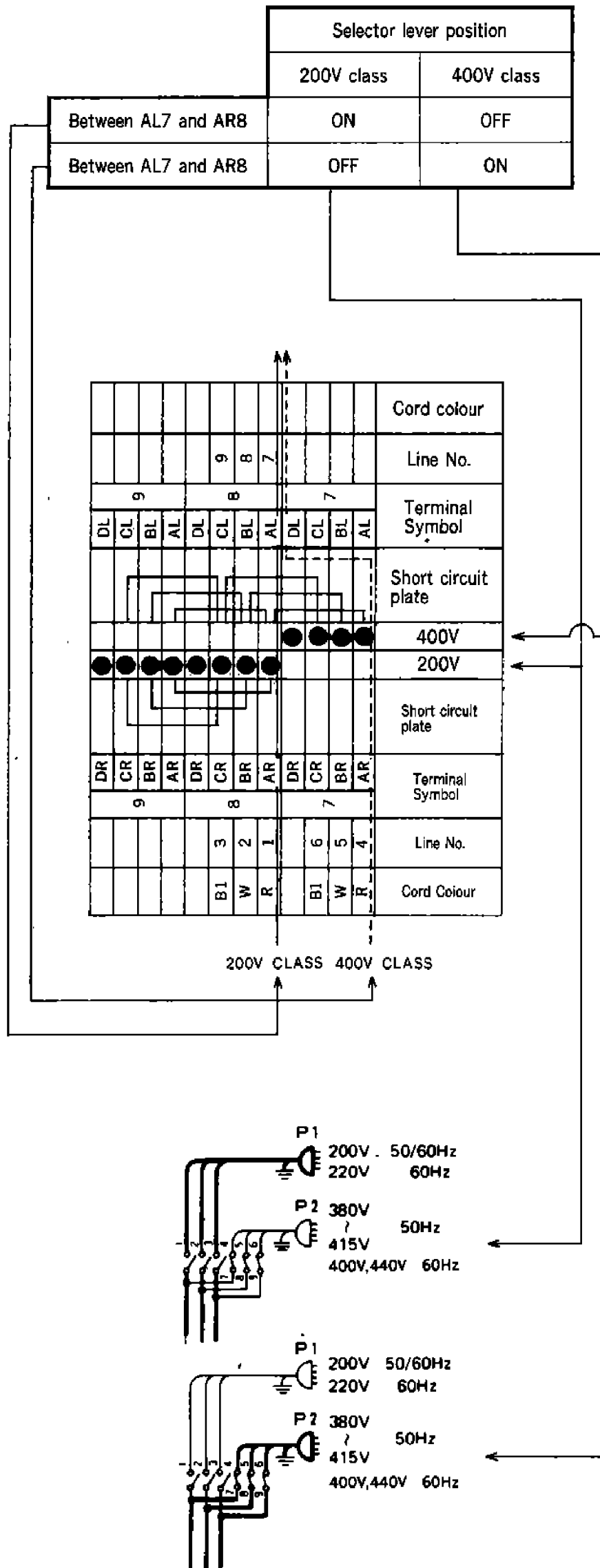
a-contact (normal open contact)	Contact is OFF when coil is not energized
	Contact is ON when coil is energized
b-contact (normal close contact)	Contact is ON when coil is not energized
	Contact is OFF when coil is energized

c. Kinds of contacts

	a-contact Operated by electromagnetic force, temperature, or pressure. ("X" denotes the manual reset.)
	b-contact
	Time-limit a-contact Operates when the timer counting has completed.
	3D Manual contact Contact of a snap switch. This turns on as long as the switch is kept pressed and turns off immediately when released.
	3-88 3-30L Manual contact Contact of a snap switch. This turns on and holds the on state once the switch is turned on.
	Voltage selector contact (except 3-88) This turns on when the selector is set to 200V class
	This turns on when the selector is set to 400V class

d. How to read the wiring diagram of the voltage selector switch.

In the chart, "●" denotes that the contact is on.
The following example shows the states between terminals AL7 and AR8, and between



2.2 High pressure control

When ambient temperature drops during air cooled operation, condensing pressure (high pressure) drops accordingly.

In addition, low pressure drops in accordance with condensing pressure drop and cooling capacity reduces. In order to prevent high pressure from dropping, the high pressure control pressure switch (63H5, 63H6) is installed to turn off the magnetic switch (88CF) for condenser fan when high pressure drops lower than 11 kg/cm². So one of the condenser fan (MF2) stops automatically, which prevents high pressure from dropping.

2.3 Air cooled and water cooled operation (Air/water cooled type)

The unit is possible to operate on either operations of air cooled or water cooled.

During the transit on the land, in the yard or on the deck, the air cooled operation is normal, and the operation in ship holds is normally water cooled. The operation can be changed from air cooled to water cooled and vice versa automatically by the water pressure switch; i.e. when water pressure at the inlet of the water cooled condenser rises higher than the presetting value, the contact points of the water pressure switch are cut out, so the condenser fan motors stop, and the water cooled operation starts. On the contrary, when water supply is suspended during the water cooled operation, the contact points of the water pressure switch come in contact and the condenser fan motors rotate. Thus, the air cooled operation starts.

2.4 Refrigerant Pressure Control (applies to water-cooled operation)


During single compressor cooling operation, the internal pressure of the active evaporator (which is in heating operation) or the nonactive evaporator can possibly rise abnormally if refrigerant is overcharged. In such a case, the contacts of the pressure switch (63C3 or 63H4) for refrigerant pressure control will break the circuit, thereby stopping the Container Refrigeration Unit. Subsequently, when the pressure has lowered to normal level, the contacts will make the circuit, thereby restarting the compressor on the non-cooling side.

**2.5 Voltage selection system
(Change-over for 200V/400V class)**

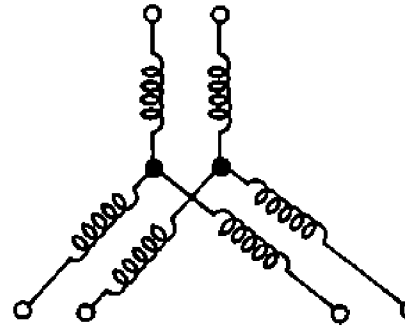
(1) The dual rating system is adopted to the compressor motor and the transformer method to the fan motor of the units. Turn the lever of the voltage selector switch (multi-contact cam switch) manually in accordance with the power supply available to change the wiring of the transformers of each motor and the control circuit suited for respective power supply. The internal wiring of the dual rating system in the compressor is as shown on the right.

(2) Circuitry formation

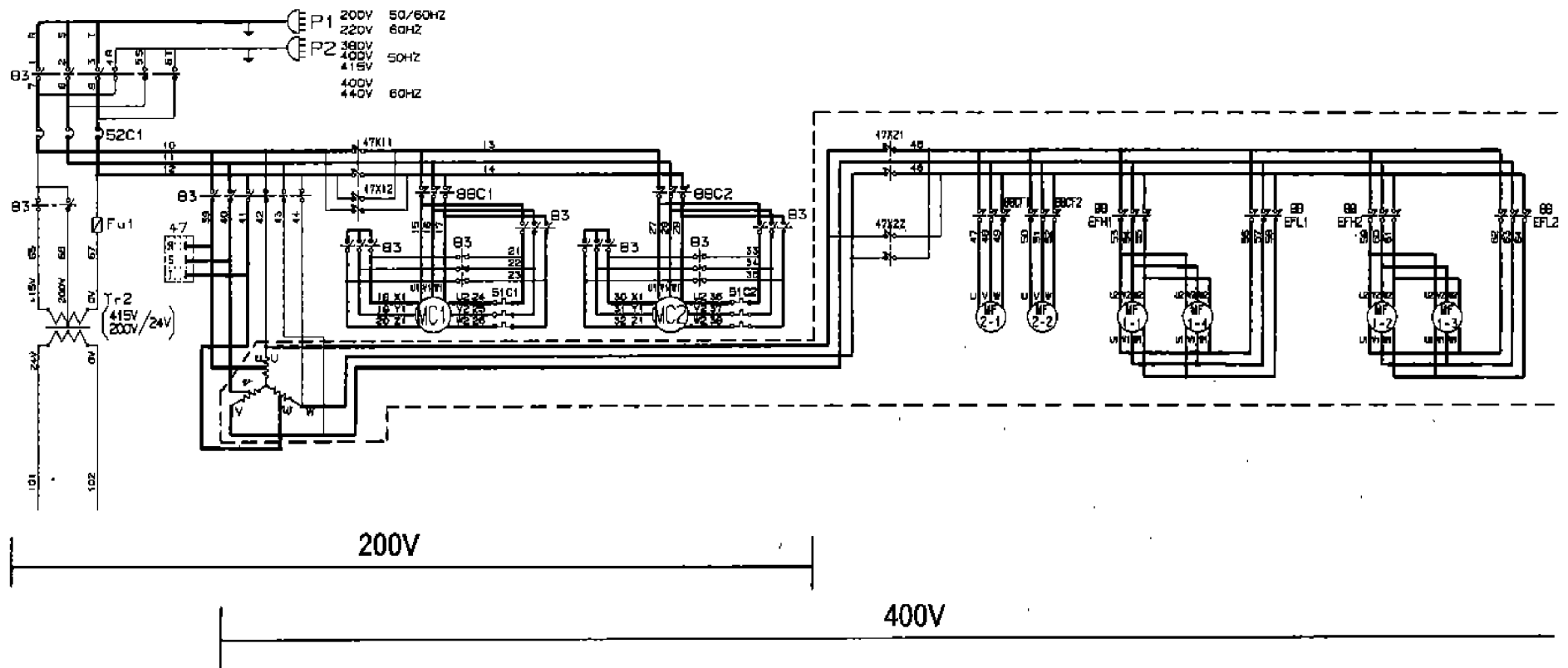
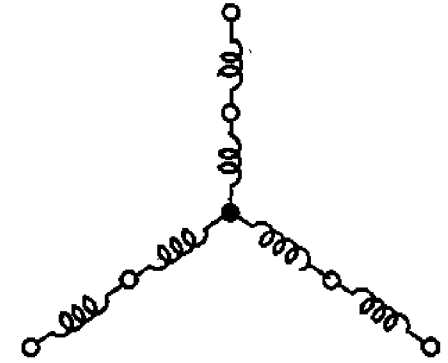
○ In case of 200V class (Set the selector lever to "200V Class".)

The contacts (except 3-88 and 3-30L) shown by  have continuity on the sequence diagram.


In case of 200V CLASS
(2 Δ -connection)

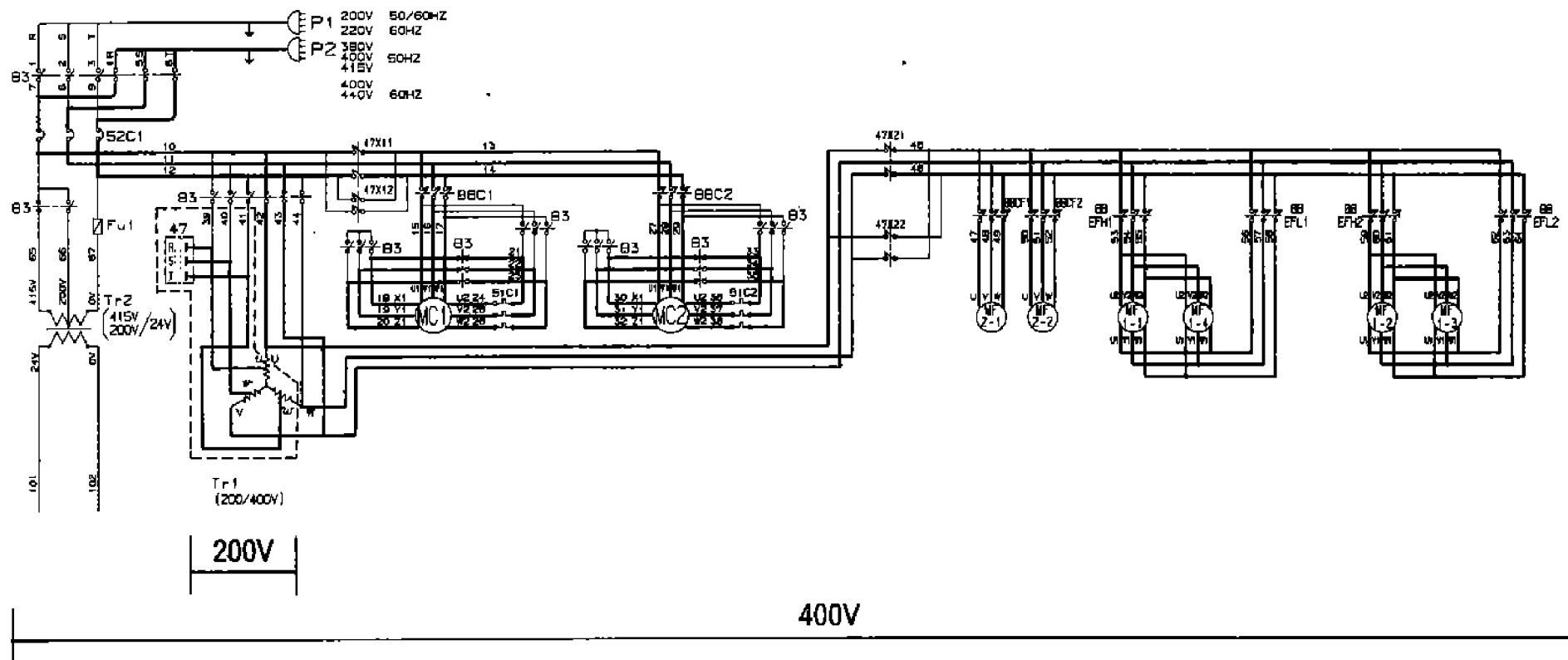


In case of 400V CLASS
(1 Δ -connection)



○ In case of 400V Class (set the selector lever to "400V Class".)

The contacts shown by  have continuity on the sequence diagram and form the 400V class circuit.



(3) Phase Switching

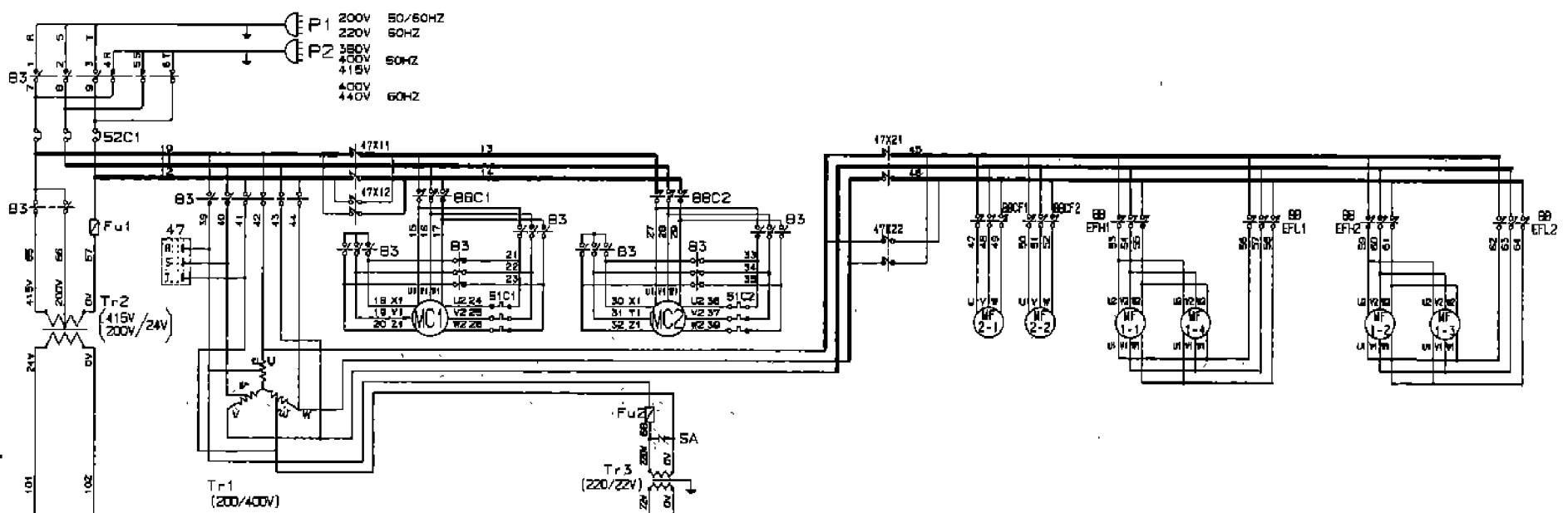
The Container Refrigeration Unit is capable of automatically switching reversely connected phases for both compressors and fan motors. This capability is implemented by a reverse phase switching device, which automatically swaps phases R and T when they are detected being reversely connected.

47: reverse phase detector

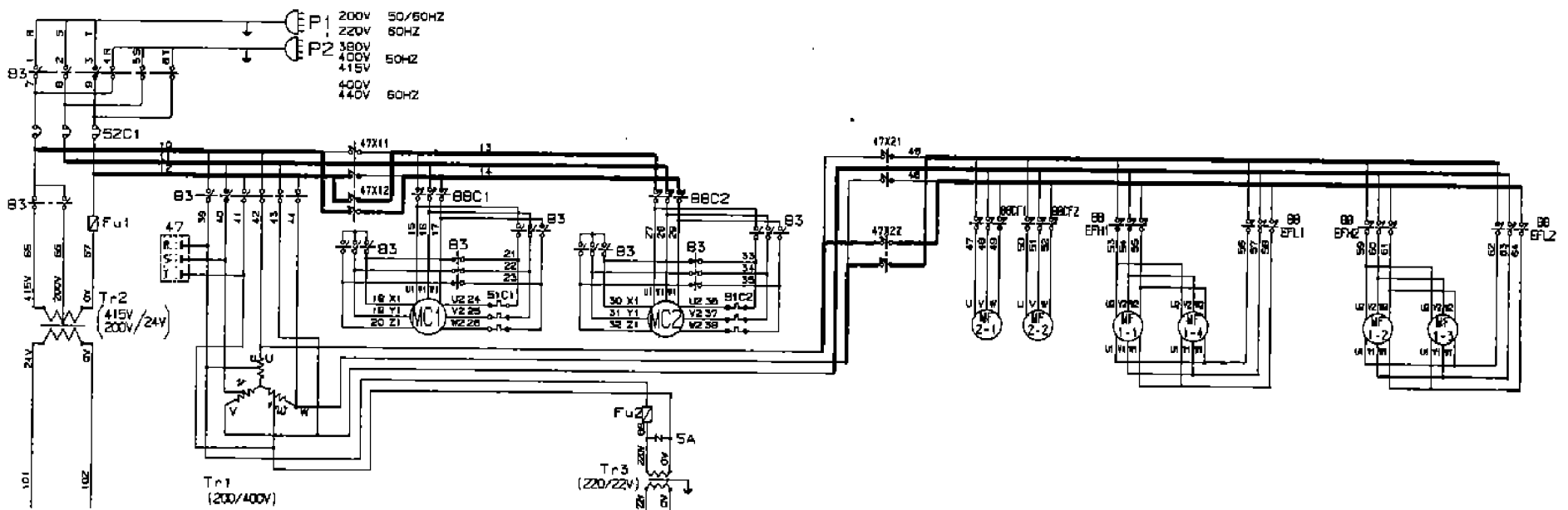
47X11 and 47X12: phase switching electromagnetic switches with mechanical protective device

47X21 and 47X22: phase switching electromagnetic switches with mechanical protective device

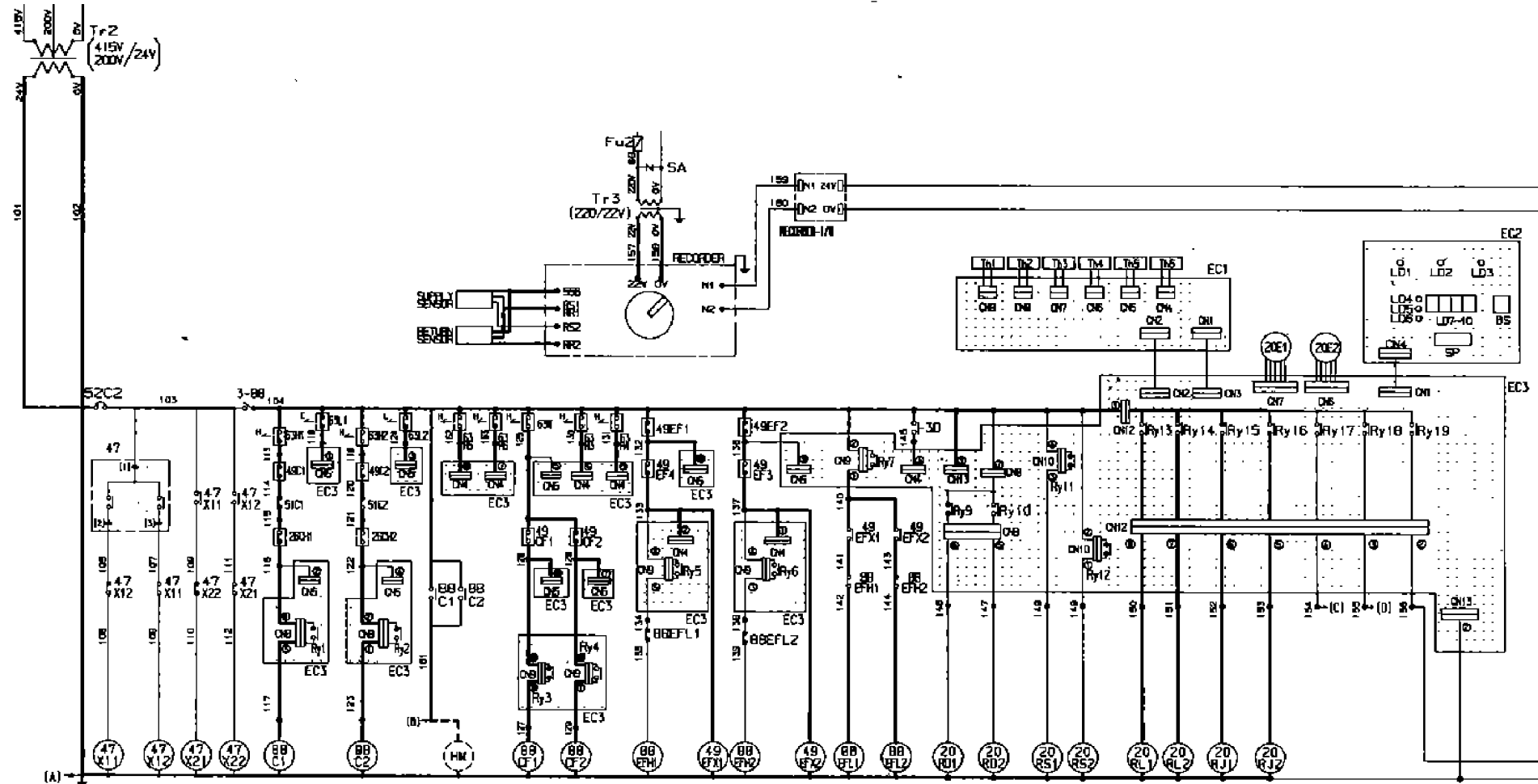
● Proper phase



● Wrong phase

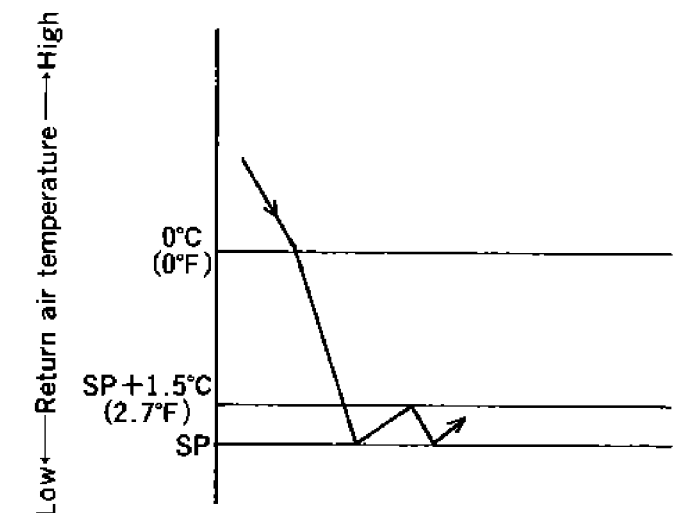


2.6 Frozen operation

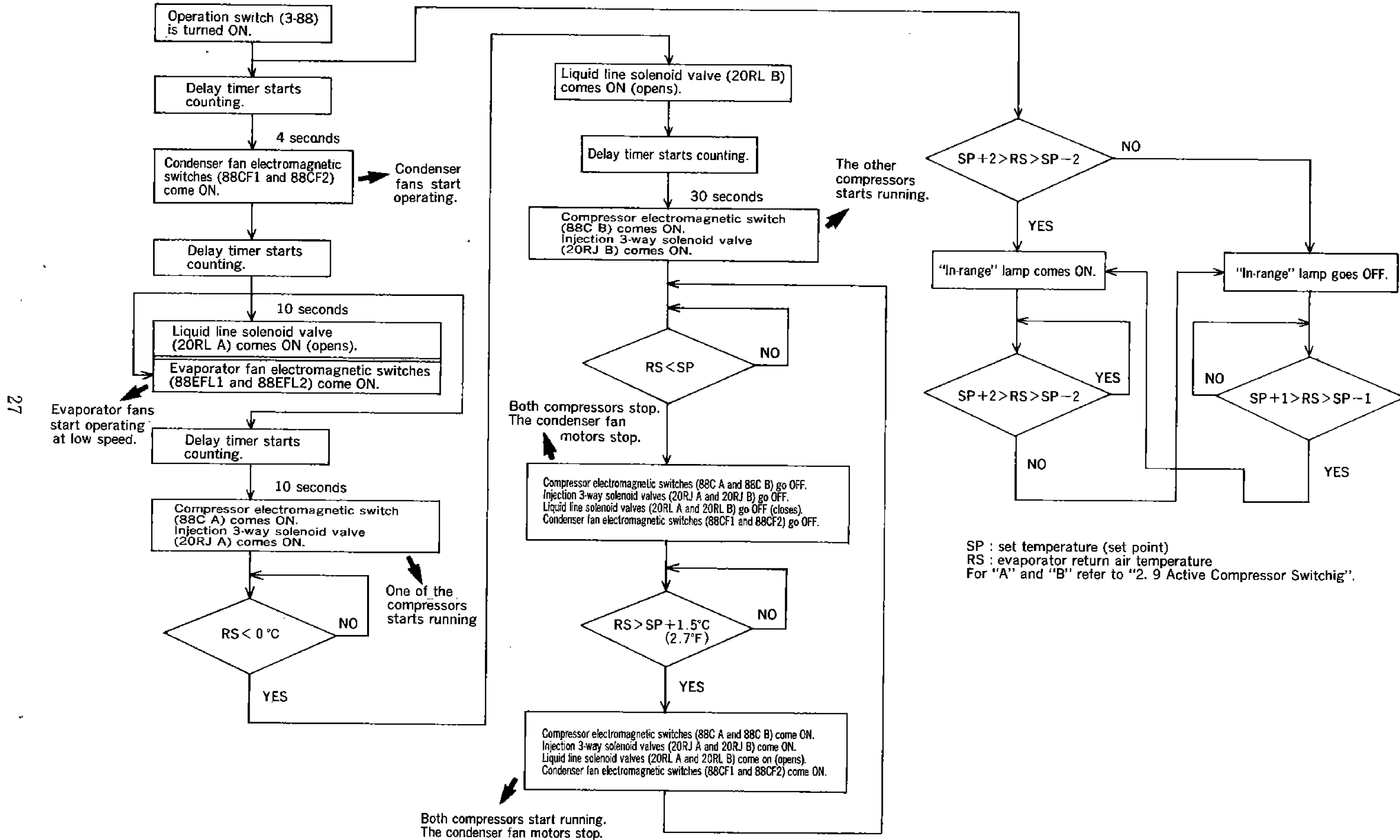


26

- (1) The Container Refrigeration Unit automatically switches operation modes in accordance with the settings of the electronic controller.
Freezing (frozen operation): -10.1°C (13.8°F) or lower; return air temperature control
- (2) Four seconds after the operation switch (3-88) has been turned ON:
 - (a) The condenser fans start operating with the liquid line solenoid valve (20RL1) coming ON.
 - (b) Ten seconds later, the evaporator fans—which are controlled by a delay timer—start operating at low speed.
 - (c) Other ten seconds later, compressor No. 1 and the injection 3-way valve (20RJ1) come ON, being controlled by a delay timer.
- (3) When the evaporator return air temperature has fallen to 0° or lower.
 - (a) The liquid line solenoid valve (20RL2) comes ON.
 - (b) Thirty seconds later, compressor No.2 and the injection 3-way valve (20RJ2) come ON, being controlled by a delay timer.
- (4) The Container Refrigeration Unit automatically turns ON/OFF the compressors according to the evaporator return air temperature.
 - (a) When the return air temperature has reached the set point (SP), the Container Refrigeration Unit turns OFF compressors No.1 and No.2, the injection 3-way valves (20RJ1 and 20RJ2), and the liquid line solenoid valves (20RL1 and 20RL2).
 - (b) When the condenser fan return air temperature has reached a temperature of $\text{SP}+1.5^{\circ}\text{C}$ (2.7°F) or higher, the Container Refrigeration Unit turns ON compressors No.1 and No.2, the injection 3-way valves (20RJ1 and 20RJ2), the evaporator fans.
- (5) The “compressor run” alarm is lit when either or both of two compressors are in operation.
- (6) The “inrange” lamp comes ON when the return air temperature is within $\pm 1^{\circ}\text{C}$ of sp and goes OFF when the return air temperature is 2°C above/below SP.



<Operation Sequence>



2.7 Chilling and Partial Freezing

- (1) The Container Refrigeration Unit performs "high-temperature chilling" when the set temperature (SP) is +20 °C (+68.0 °F) or higher; "chilling" when SP is between -3.0 °C (+26.6 °F) and +19.9 °C (+67.8 °F); "Partial freezing" when SP is between -3.1 °C (+26.4 °F) and -10.0 °C (+14 °F).
- (2) The Container Refrigeration Unit controls its components detecting the evaporator delivery air temperature for "high-temperature chilling" and "chilling", or detecting the return air temperature for "partial freezing".

The evaporator fans are switched between low and high speeds according to whether the return air temperature is above or below 25 °C (+77 °F).

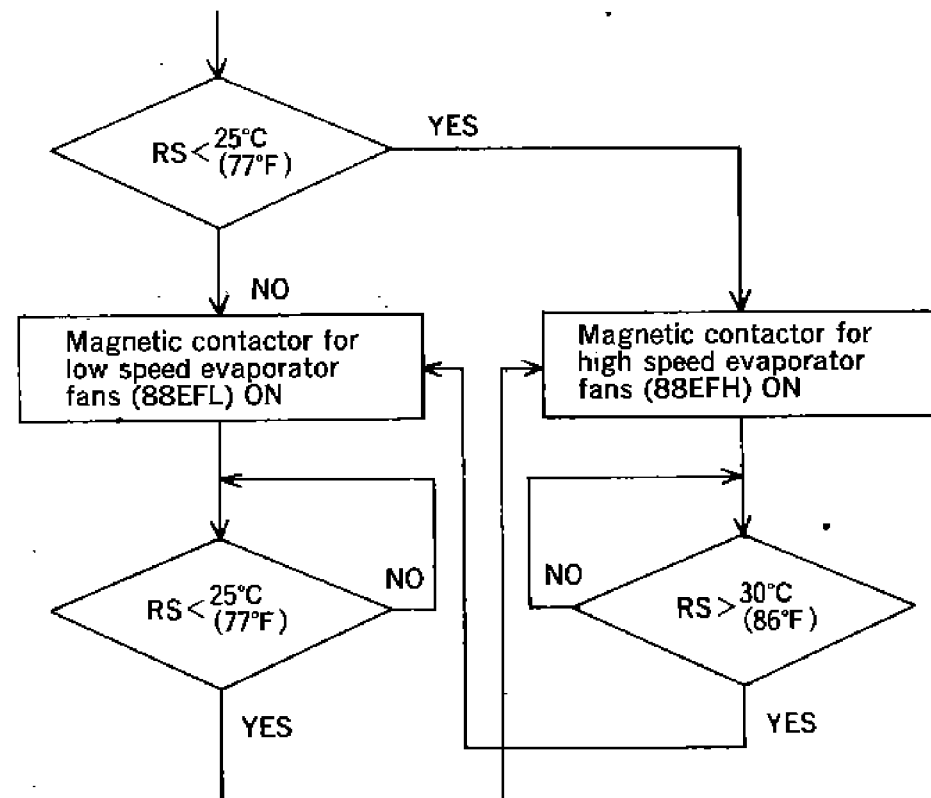
When operating at low speed, the evaporator fans will be switched to high speed if the return air temperature (RS) has been detected 5 °C (9 °F) above this temperature for 10 seconds. When operating at high speed, they will be switched to low speed if the return air temperature (RS) has been detected 5 °C (9 °F) above this temperature for 10 seconds.

Thus the Container Refrigeration Unit uses a temperature differential of 5 °C (9 °F) and a delay time of 10 seconds for switching the evaporator fans between low and high speeds. This is in order to prevent chattering between low and high speeds and the counter electromotive force to the motors.

- (3) In "high-temperature chilling", "chilling", and "partial freezing", the Container Refrigeration Unit uses electronic expansion valves (20E1 and 20E2) to control the refrigerant circulation.

The opening degree of the electronic expansion valves is determined by the deviation between the control air temperature and set temperature in each operation mode.

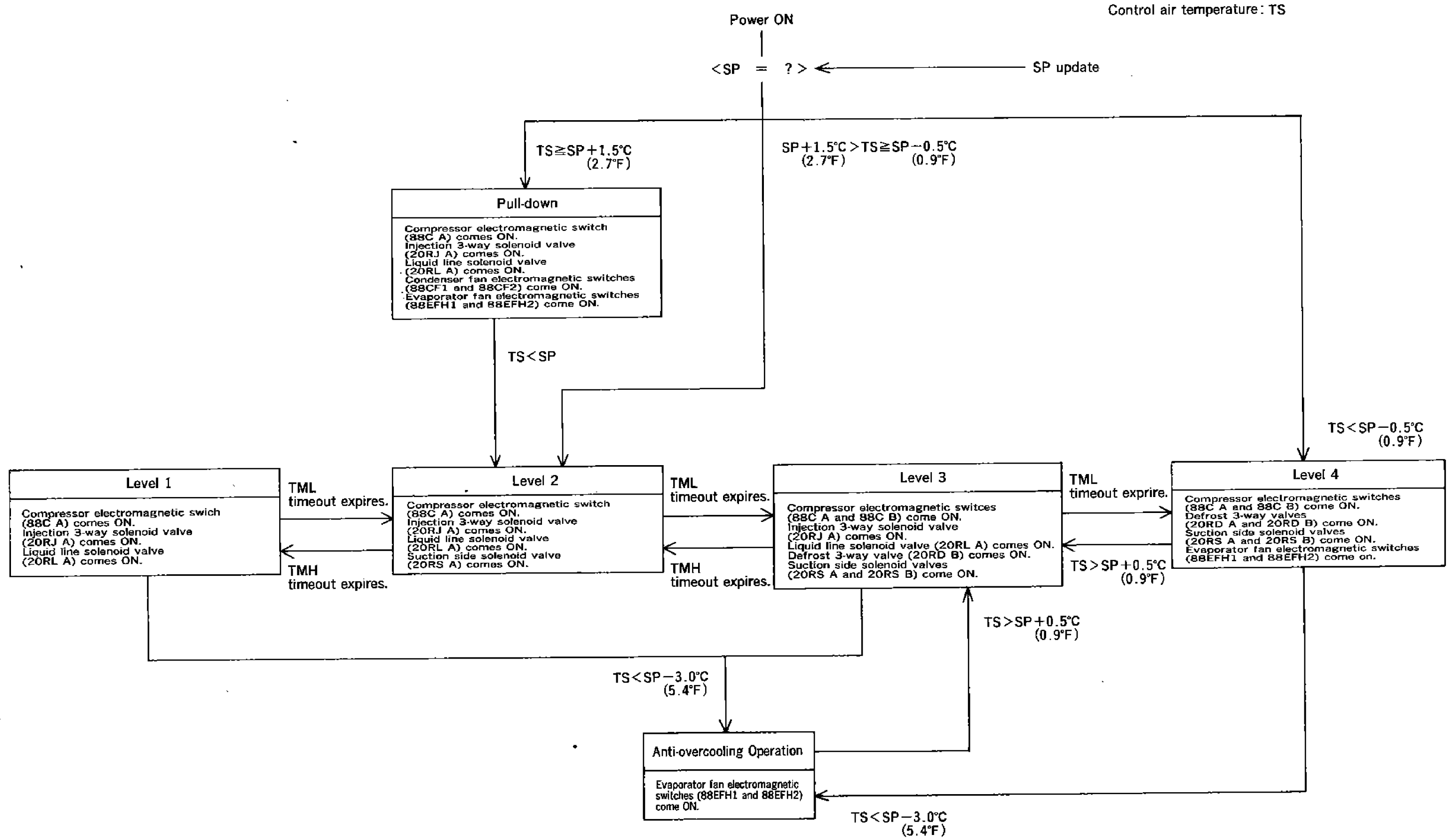
- (4) For both "chilling" and "partial freezing", the Container Refrigeration Unit automatically adjusts its refrigerating capacity to one of the following four levels:
 - (a) Level 1
The Container Refrigeration Unit disables circuit B and performs cooling operation through only circuit A with the following solenoid valves are ON: liquid line solenoid valve (20RL A) and injection 3-way solenoid valve (20RJ A).
 - (b) Level 2
The Container Refrigeration Unit disables circuit B and performs cooling operation through only circuit A with the following solenoid valves are ON: liquid line solenoid valve (20RL A), injection 3-way solenoid valve (20RJ A), and suction side solenoid valve (20RS A).
 - (c) Level 3
The Container Refrigeration Unit performs cooling operation through circuit A and heat-up operation through circuit B, with the following solenoid valves are ON: injection 3-way solenoid valve (20RJ A), liquid line solenoid valve (20RL A), defrost 3-way valve (20RD B), suction side solenoid valves (20RS A and 20RS B).
 - (d) Level 4
The Container Refrigeration Unit performs heat-up operation through both circuits A and B, with the following solenoid valves ON: defrost 3-way valves



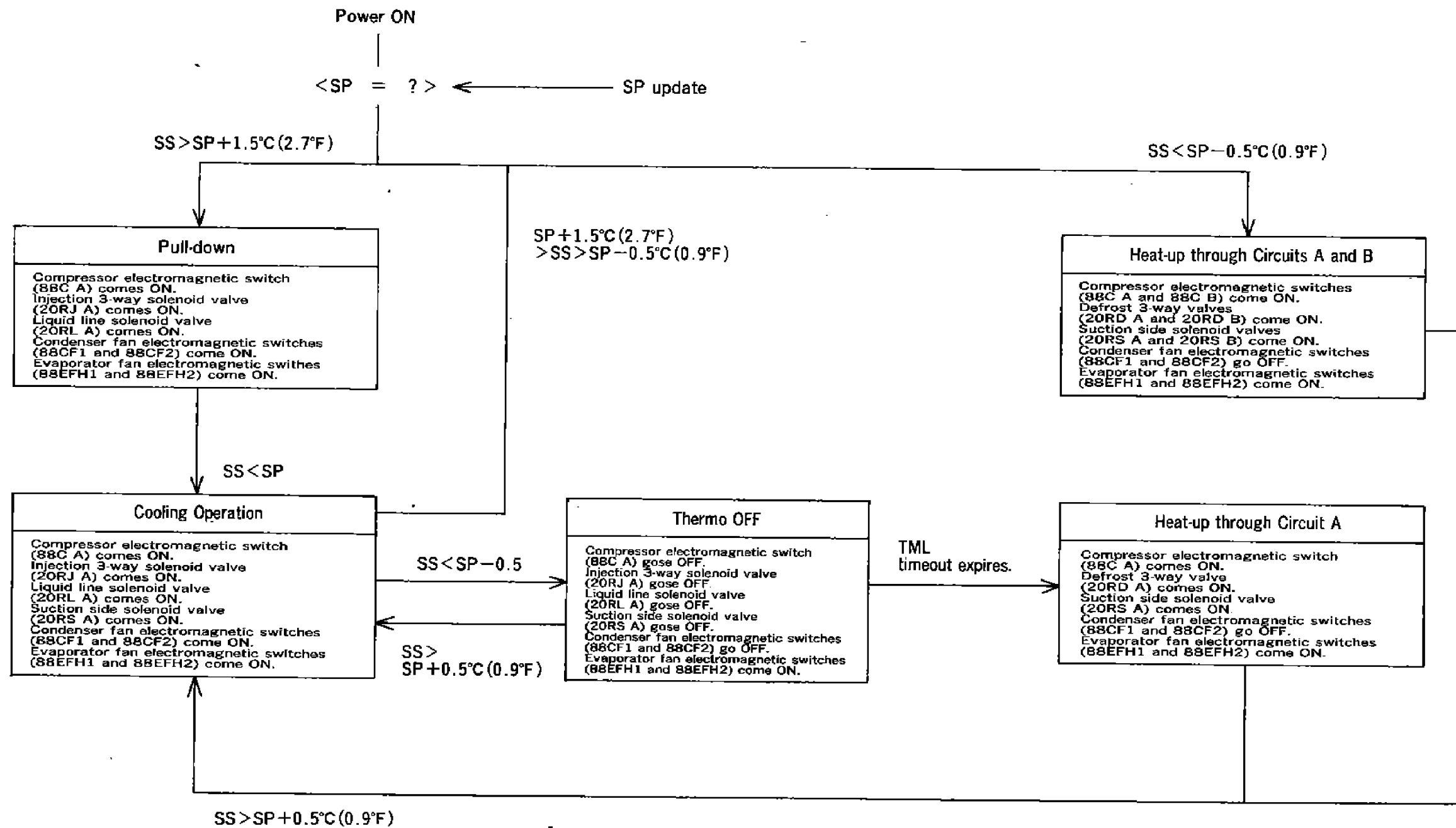
(20RD A and 20RD B) and suction side solenoid valves (20RS A and 20RS B).

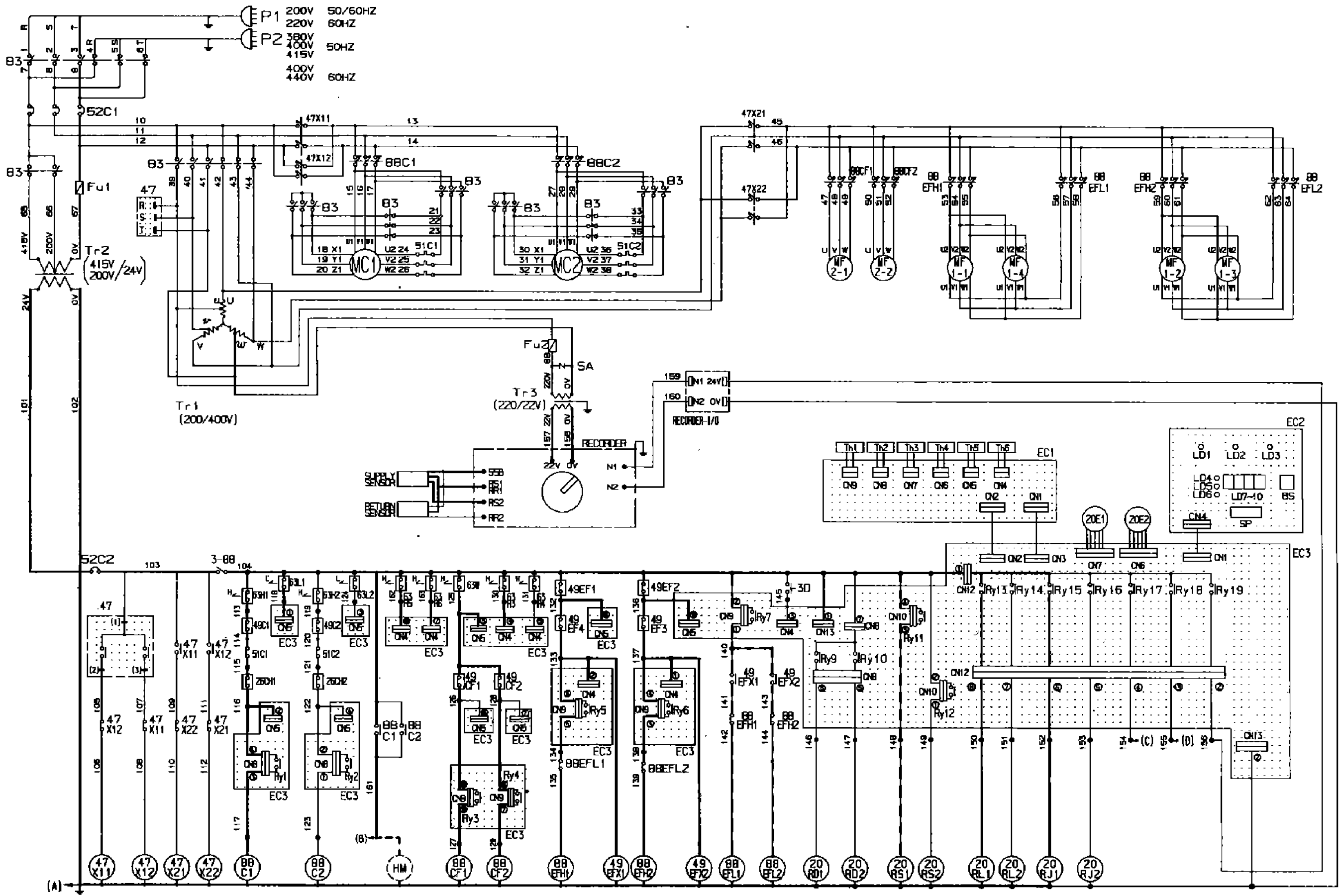
- (5) The Container Refrigeration Unit switches from one level to another when the timeout of a timer has expired, except that it switches from Level 4 according to the control air temperature.
- (a) Refrigerating capacity lower limit mask (TML) This timer is enabled where the current refrigeration level is Level 1 to 3. It will start counting toward the set point of 10 seconds when the control sensor has detected the temperature falling below $SP - 0.5\text{ }^{\circ}\text{C}$ ($SP - 0.9\text{ }^{\circ}\text{F}$). If the timer's timeout (10 seconds) has expired without the temperature rising above $SP - 0.5\text{ }^{\circ}\text{C}$, the Container Refrigeration Unit will switch to the next higher level (the current level + 1).
 - (b) Refrigerating capacity upper limit mask timer (TMH) The timer is enabled where the current refrigeration level is Level 2 or 3. It will start counting toward the set point of 10 seconds when the control sensor has detected the temperature rising above $SP + 0.5\text{ }^{\circ}\text{C}$ ($SP + 0.9\text{ }^{\circ}\text{F}$). If the timer's timeout (10 seconds) has expired without the temperature falling below $SP + 0.5\text{ }^{\circ}\text{C}$, the Container Refrigeration Unit will switch to the next lower level (the current level - 1).
- (6) In each of "high-temperature chilling", "chilling", and "partial freezing", the Container Refrigeration Unit performs anti-overcooling operation when the control air temperature has fallen below $SP - 3.0\text{ }^{\circ}\text{C}$ ($SP - 5.4\text{ }^{\circ}\text{F}$); in this case, it stops the compressors and condenser fans, keeps only the evaporator fans operating, and turns OFF all the solenoid valves.
- Subsequently, when the control air temperature has reached $SP + 0.5\text{ }^{\circ}\text{C}$ ($0.9\text{ }^{\circ}\text{F}$) or a higher temperature, the Container Refrigeration Unit will switch to Refrigerating Level 3 (except that it will enter cooling operation if it has been in "high-temperature chilling").
- (7) In "high-temperature chilling", the Container Refrigeration Unit automatically turns ON/OFF the compressors according to the control air temperature. When the control air temperature has fallen below $SP - 0.5\text{ }^{\circ}\text{C}$ ($SP - 0.9\text{ }^{\circ}\text{F}$), it turns OFF the compressors and condenser fan motors, keeps only the evaporator fans operating, and turns OFF all the solenoid valves.
- Upon turning OFF the compressors, the Container Refrigeration Unit will start the TML timer. If the TML timer's timeout (10 seconds) has expired without the control air temperature rising above $SP - 0.5\text{ }^{\circ}\text{C}$ ($SP - 0.9\text{ }^{\circ}\text{F}$), the Container Refrigeration Unit will perform heat-up operation through circuit A.
- NOTE) For heat-up operation, refer to "2.8 Defrost Operation".

Refrigerating Level Transition in "Chilling" / "Partial Freezing"

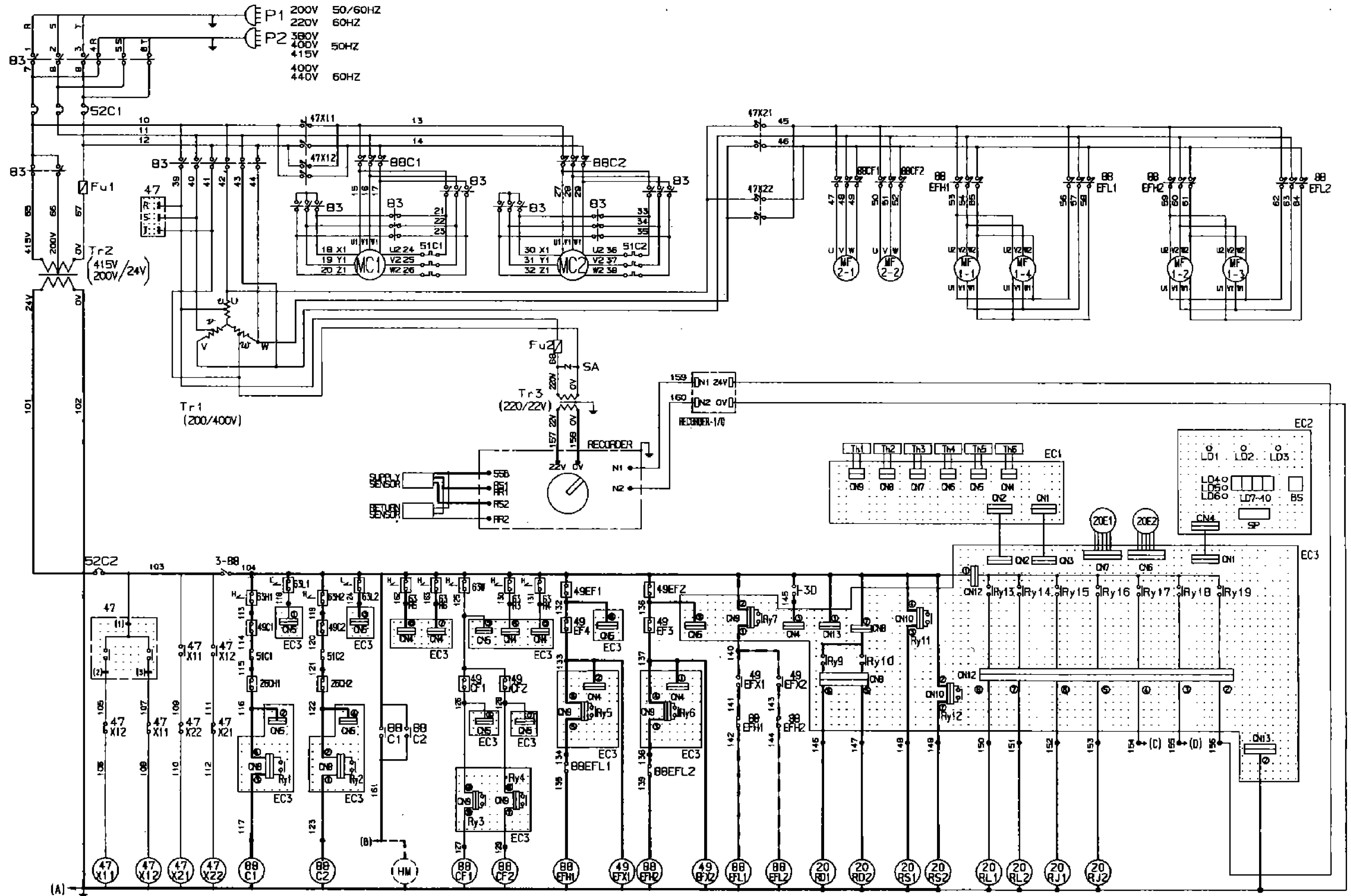


Heat-up Operation





Level 1 and Level 2



Level 4

2.8 Defrost operation

The hot-gas defrost system is adopted in the units; i.e. the high temperature and high pressure refrigerant (hot gas) from the compressor is sent to the evaporator and drain pan for defrosting. Since the evaporator is heated directly by the hot refrigerant in the evaporator, defrosting can be performed effectively.

(1) Defrosting starts

The dual timer method and manual switch method are adopted to start defrosting.

(a) Dual timer method

○ Short-cycle defrosting

During the time when controlled air temperature drops to in

Notes: When suction pipe temperature is above 20°C (68°F) defrost-initiation command may sometimes not be received.

range temperature from pull down operation, defrosting starts every 4 hours by the short timer of the electronic controller.

○ Long cycle defrosting

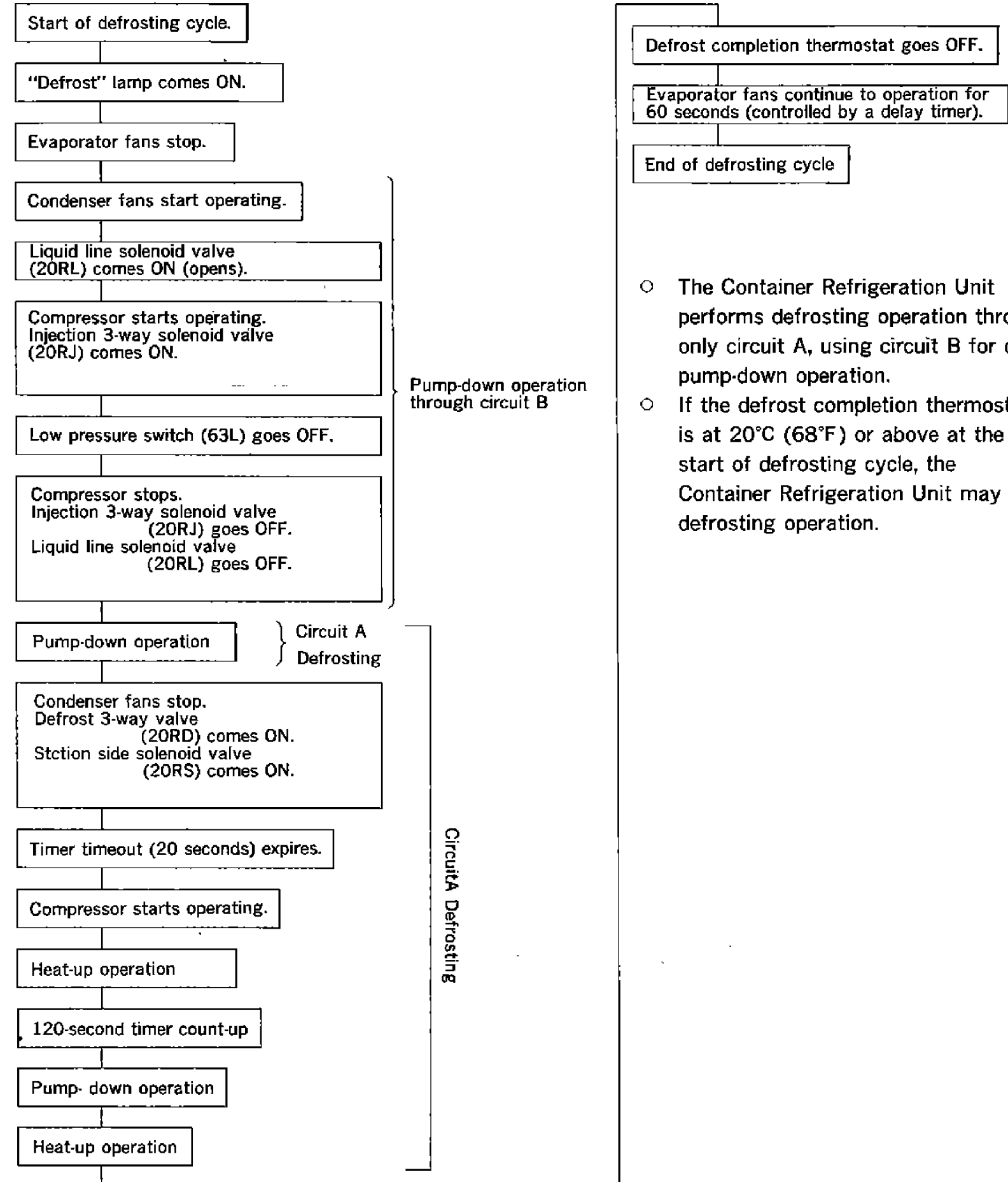
When controlled air temperature becomes within in range temperature (in range lamp lights up), defrosting starts every 12 hours by the long timer of the electronic controller.

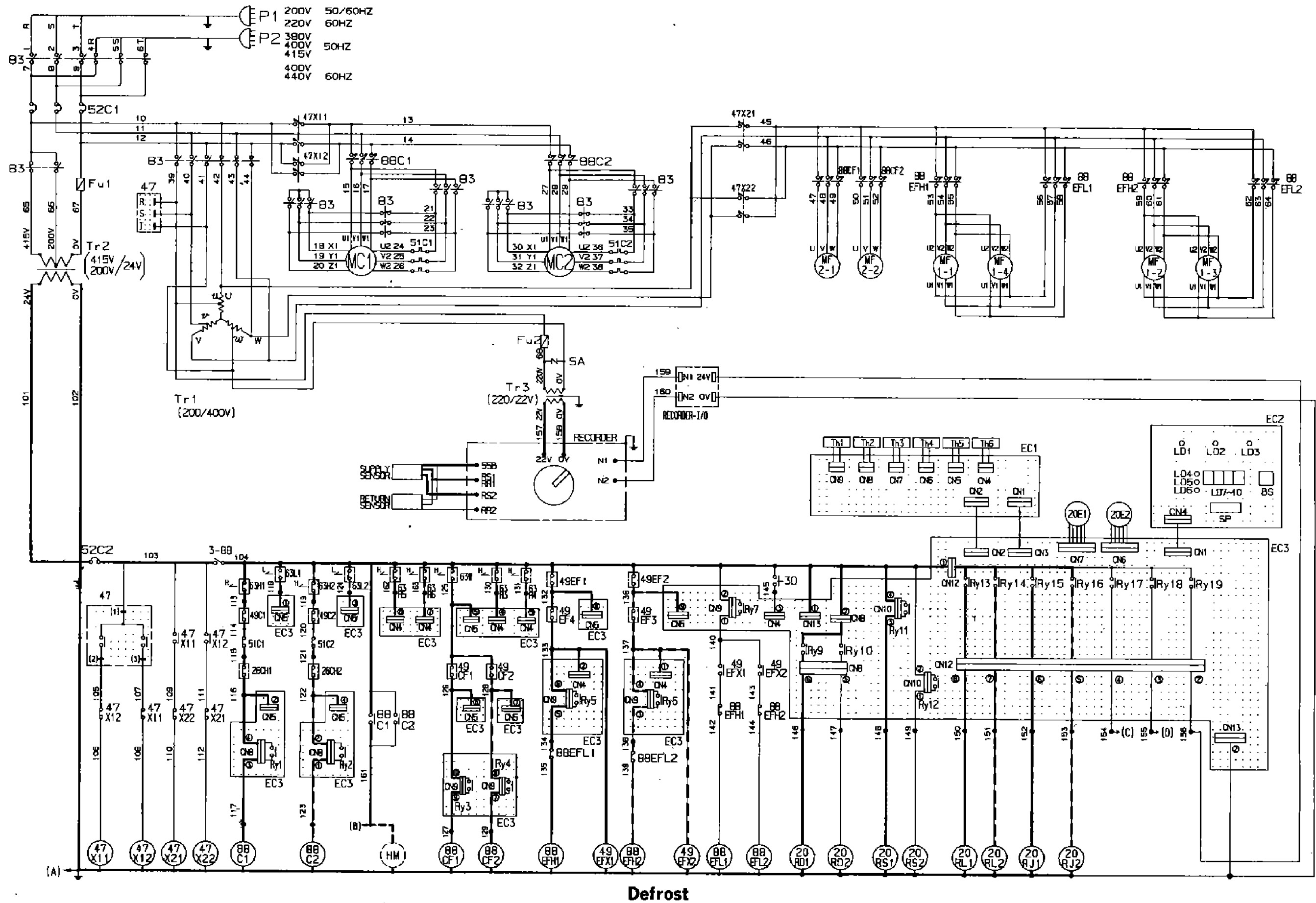
(b) Manual switch method

When the manual defrost switch (3D) is set to "MANUAL", defrosting starts.

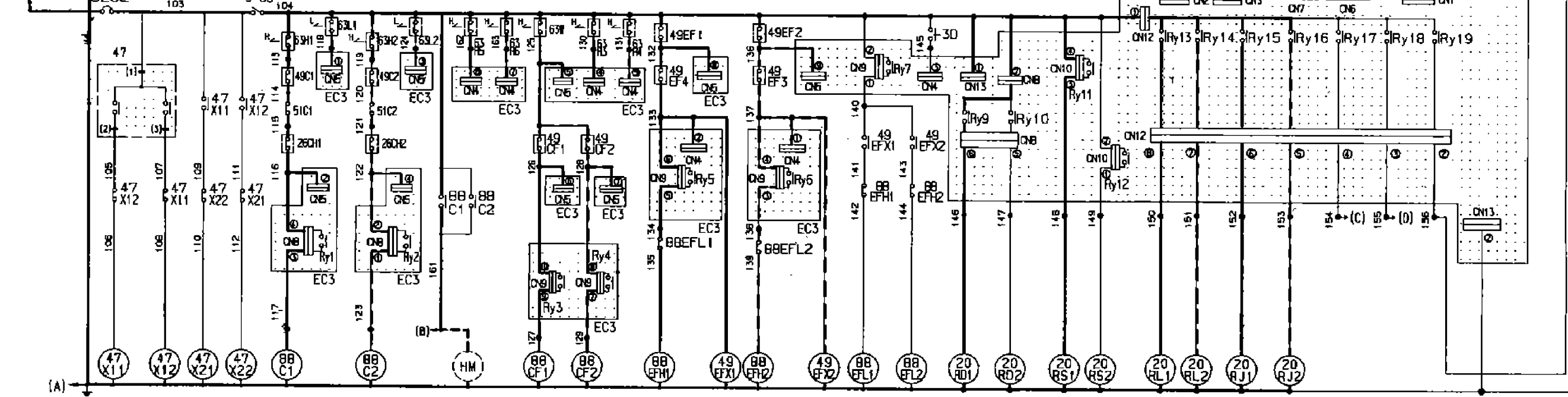
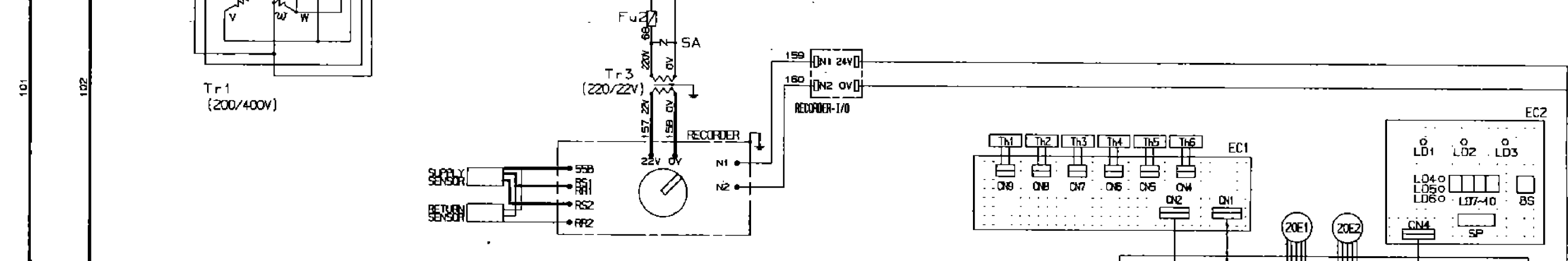
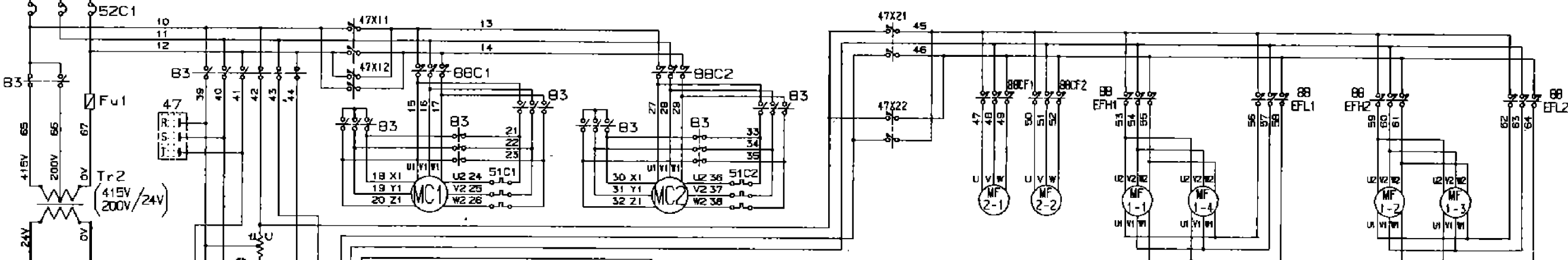
(2) Defrost operation

The devices and components operate as shown below during defrost operation





P1 200V 50/60HZ
220V 60HZ
P2 380V 50HZ
400V 50HZ
415V 50HZ
400V 60HZ
440V 60HZ



2.9 Active compressor switching

The container refrigeration unit has two refrigerant circuits, say, circuit No.1 and circuit No.2. these correspond to No.1 and No.2 indicated on the sequence diagram.

In actual operation, the container refrigeration unit activates one of the compressors of these two circuits alternately. the container refrigeration unit uses the circuit with its compressor active mainly for cooling operation, and the other circuit (whose compressor is non-active) mainly for heat-up. the former is referred to as circuit A, and the

"A" and "B" indicated on the operation flow stand for circuit A and circuit B, respectively.

At power-on time, circuit No.1 serves as circuit A.

Circuit A and B assignments are interchanged at the end of defrosting cycle.

Before defrosting

Circuit No.1 = circuit A ; circuit No.2 = circuit B

After defrosting

Circuit No.1 = circuit B ; circuit No.2 = circuit A

2.10 Backup capabilities

○ Compressors

The container refrigeration unit is capable of back up compressor operation when the active compressor is halted with the protective device operated.

When the protective device of circuit A has been operated during operation, the container refrigeration unit interchanges circuits A and B, activating the compressor that has been non-active. the circuit with its protective device operated will serve as circuit

B ; also after the protective device has been reset, this circuit will be controlled as circuit B.

When the protective device of circuit B has been operated during operation, the container refrigeration unit will continue to operate circuit A, without interchanging the circuits. circuit B will resume operation after the protective device has been reset.

However, in the event the protective device of circuit A has been operated within 30 seconds of the start of compressor operation (remember that circuit No.1 serves as circuit A just after power-on), there is a great possibility of fatal failure (such as burning). in this case, the container refrigeration unit interchanges the circuits but inhibits the halted compressor from restart even after the protective device has been reset.

○ Air temperature sensors

If on of the two control air temperature sensors (intake and delivery) has gone faulty in each operation mode, the container refrigeration unit backs up the function of the faulty sensor with the other sensor.

○ Refrigerant temperature sensors

The evaporator has inlet and outlet refrigerant temperature sensors for each refrigerant circuit. if on of the two refrigerant temperature sensors has gone faulty, the container refrigeration unit backs up the function of the faulty sensor with the other sensor (of the same circuit).

○ Evaporator fan motors

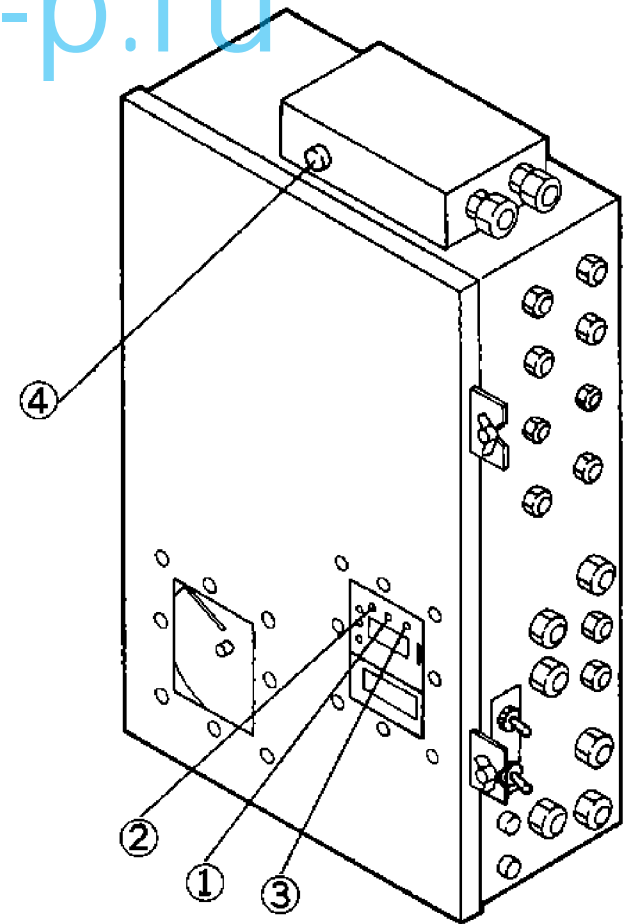
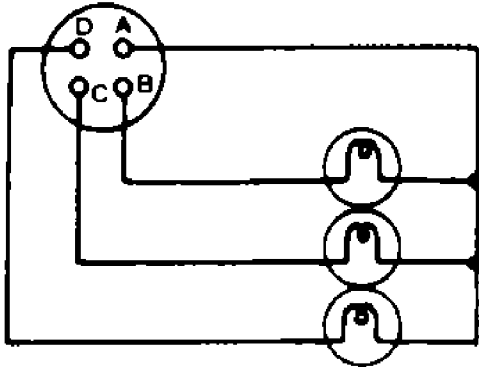
If one of the evaporator fan motors has gone faulty during low speed operation, the container refrigeration unit halts the faulty fan motor and the paired fan motor (No.1 and No.4 ; No.2 and No.3), and backs up the function of the two halted fans by slitching the remaining two fans to high speed after a delay of 10 seconds.

2.11 Pilot lamps and monitoring circuit

(1) Four lamps which indicate operating mode are mounted on the front panel of the control box.

- Red : indicates defrost mode (RL)
- Green : indicates that the compressor is running (GL)
- Orange : indicates that inside temperature is with in range (Within $\pm 2^{\circ}\text{C}$ ($\pm 3.6^{\circ}\text{F}$) of the preset temperature) (OL)

Receptacle for monitoring is fitted and its connections is shown at below.



- ① Red
- ② Green
- ③ Orange
- ④ Monitoring receptacle for pilot lamp

- A : Earth
- B : Compressor (Green)
- C : Defrost (Red)
- D : Inrange (Orange)

(2) How to judge operation state by pilot lamps and function of the components.

Names of parts	Temperature setting of chilled mode Above -2.9°C ($+25.8^{\circ}\text{F}$)			Temperature setting of partial frozen mode $-3 \sim -10^{\circ}\text{C}$ ($+26.6 \sim +14^{\circ}\text{F}$)		Temperature setting of frozen mode Below -10.1°C ($+13.8^{\circ}\text{F}$)		Defrost Operation	Water cooled operation (Air/water cooled) type		
	Pull down	Single-compressor cooling	Single-compressor heating	Pull down	In range	Pull-down (inside temperature 0°C or lower)	In range				
Pilot lamps	Defrost-Red		×	×	×	×	×	×	○	Water cooled condition is the same as air cooled except ○ Water pressure switch (63W) -open ○ Condenser fan motor (MF2) De-energized	
	Comp. ON-Green		○	○	○	○	○	○ or ×	○		
	In range-Orange		×	○	×	×	○	×	○		
Magnetic switches	Condenser fan motor		○	○	○	○	○	○ or ×	○		
	Evaporator fan motor in low speed (88EFL)	Controlled air temperature Above 25°C (86°F)	○	○	×	○	×	○	×		
	Evaporator fan motor in high speed (88EFH)	Controlled air temperature Below 25°C (77°F)	○ or ○	○ or ○	○ or ○	○ or ○	○ or ×	○ or ×	○ or ×		
Solenoid valves	20R1		×	×	× or ○	×	○	×	× or ×		○
	20R2		○	○	×	○	○	○	○		×
	20RS1, 2		×	×	×	×	×	×	×		○
	20RJ1, 2		×	○	○	×	○	×	×		○
Compressor • MC			○	○	○	○	○	○	○ or ×	○	

Note 1. ○ : Energized or ON × : De-energized or OFF

No.1 left side/No.2 right side

This table assumes that circuit No.1 (left side) is serving as circuit A (main circuit).

3. Trouble and countermeasures

If the unit does not work properly, inspect it in accordance with "Trouble and countermeasures" to find causes of trouble and provide appropriate countermeasures.

State	Phenomena	Functioning places	Cause of trouble	Countermeasures
I. Unit does not operate.	A : Evaporator fans, condenser fans and compressor do not operate.	a. No trouble with unit	Electric interruption.	Trace causes of trouble.
			Power plug is not connected to power source receptacle.	Connect power plug to power source receptacle.
		b. Circuit breaker (main circuit) functions	It functions with large current due to short circuit.	Trace causes of trouble
		c. Circuit breaker (control circuit) functions	It functions with large current due to short circuit	Trace causes of trouble
		d. Phase sequence controller does not function.	Open phase power supply circuit.	Trace a cause of trouble.
			Phase sequence controller is faulty.	Replace faulty phase sequence controller.
	e. Controller malfunctions.	Sensor is damaged or other reasons.	Replace controller.	
	B : Evaporator fans operate. Condenser fans and compressor do not operate.	a. No trouble with unit	Controller functions to stop the unit.	—
			Setting of set-point selector is high	Adjust setting appropriately.
	II. Unit can operate but stops soon.	A : Condenser fans and compressor stop, keeping evaporator fans in operation.	a. No trouble with unit	LPS is operated due to a low outside temperature.
Controller functions and stops unit.				—
B : Condenser fans and compressor operate on and off. Evaporator fans continue operating.		a. High pressure switch functions.	Refrigerant is over-charged.	Discharge refrigerant.
			Air is intermixed in refrigeration system.	Purge air
			Cooling air volume is short during air cooled operation.	—
			● Condenser is clogged or air passages are blocked.	Clean condenser or remove obstacles
			● Fan blades are damaged.	Repair faulty fan blades or replace them.
			● Fan motor does not rotate.	Check electric wiring.
			Fan motor protective thermostat functions.	Trace causes of trouble.
			Cooling water is insufficient during water cooled operation.	—
			● Condenser is clogged with scale.	—
b. Over-current relay and compressor protective thermostat function.		Current is excessively large due to over-load operation. Open phase power supply circuit.	Trace causes of trouble.	

State	Phenomena	Functioning places	Cause of trouble	Countermeasures
II. Unit can operate but stops soon.	C : Condenser fan and compressor operate. Evaporator fan operates on and off.	a. No trouble with unit.	One minute stopping of fan after defrosting.	—
	D : Although the evaporator fan and condenser fan continue rotating, the compressor will stop within 30 seconds.	Protection thermo is operated.	Burnt compressor	Replace.
		High pressure Switch is operated.	Dust clogged in INJ solenoid valve	Clean.
III. Inside temp. is low than temperature setting	Compressor does not stop. (In frozen operation)	a. Controller does not function.	Sensor is disconnected	Replace sensor.
		b. Sensor is installed incorrectly.	—	Reattach sensor.
IV. Inside temperature does not drop	Inside temperature does not reach to preset temperature. (Fans and compressor operate.)	a. Solenoid valve does not open.	Solenoid valve is clogged with dust.	Clean solenoid valve or remove obstacles.
		b. Suction pressure is low.	Charged refrigerant volume is short.	Additionally charge refrigerant, find leaking points or repair them.
			Dryer is clogged.	Replace dryer.
			Choked with water.	Replace dryer.
			Gas leaks from feeler tube of expansion valve.	Replace expansion valve.
Loosening of screws for connection of sensor.	Additional tightening of screws.			
V. Water cooled operation is not performed (Air/water cooled type)	Fan continues running although water couplings are connected.	Water pressure switch does not function.	Cooling water becomes insufficient. (Piping system is clogged or leaks.)	Trace causes of trouble
			Water leaks to switch	Repair leaking point.

● **Trouble and countermeasures for defrosting and heating-up operation.**

Read the sequence operation of each operation mode again. If operation does not accord with the sequence operation, take the necessary countermeasures in accordance with the following table.

The red and green pilot lamps light up during defrosting, and the green pilot lamp lights up during heating-up operation.

Phenomena	Functioning places	Causes of trouble	Countermeasures
Compressor stops soon after starting defrosting (heating-up).	No trouble with unit.	Unit stops for 20 seconds by timer.	—
Compressor operates on and off.	High pressure switch function.	Liquid solenoid valve is not closed.	Clean solenoid valve or remove obstacles.
Compressor continues to evacuate for 90 minutes.	Expansion valve is not opened.	Expansion valve is defective. (Dust clogged in valve)	Clean or remove foreign matter.
It takes 90 minutes to defrost although frost collected is small.	No trouble with unit.	It takes time to defrost because of low ambient temp.	—
	Thermister temperature does not rise.	Thermister is defective.	Replace defrost thermistor.
Frozen operation continues for 24 hours or more and defrosting will not start.	Controller does not function.	Controller is faulty.	Replace faulty controller.
Defrosting and refrigerating operations repeat every 3 or 4 hours.	No trouble with unit.	Storage temperature is out of in range temperature.	—
Heat-up does not complete.	Control sensor temperature does not rise.	Control sensor is defective.	Replace.

4. PTI (Pri Trip Inspection)

To keep the unit in good operating condition, check adjust or repair the unit when necessary. The following is the checking items of PTI (an example of container refrigeration unit checklist).

Container refrigeration unit inspection card

Installed ship name				Date of inspection			
Container No.				Place of inspection			
Loaded cargo				Unit Model No.			
Customer's Staff				Unit No.			
Servise staff				Compressor No.	No. 1 (Left side)	No. 2 (Right side)	
Check	No.	Check point		Check method	Reference value		
	1	External appearance of importans parts of container (doors, equipment mount, damaged points)		Visual			
	2	Cleaning interior and exterior of container		Visual			
	3	Checking the smudge of the unit (air-cooled condenser, evaporator)		Visual			
	4	Checking penetration between inside and outside of unit		Visual			
	5	checking leakage of gas and oil on refrigerant circuit (mainly at joints)		Halide torch			
	6	Checking external appearance of power cable and plug		Visual			
	7	Cleaning drain hose		Visual	Shall be free from clogging		
	8	Checking operation of heat-up function		Check operation			
	9	Tightened condition of cable glands and monitoring receptacle		Retighten	Make sure that they are firmly tightened		
	10	Checking condenser and evaporator fan motors for vibration and noise		Touch and listen			
	11	Checking seal of liquid indicator		Check liquid indicator	Make sure that it is sealed		
	12	Checking for water in refrigerant		Check liquid indicator	Dry indication		
	13	Checking operation and battery of recorder		Visual			
	14	Checking operation of each solenoid valve		Listen or touch each tube			
	15	Checking operation of controller and pilot lamps		Reefer check instrument			
	16	Unit operating current	No. 1 R <input type="checkbox"/> S <input type="checkbox"/> T <input type="checkbox"/> No. 2 R <input type="checkbox"/> S <input type="checkbox"/> T <input type="checkbox"/>	Clamp meter	-18°C	<input type="checkbox"/> V <input type="checkbox"/> Hz <input type="checkbox"/> V <input type="checkbox"/> Hz	
	17	Unit insulation resistance	Evaporator fan circuit <input type="checkbox"/> MΩ	DC 500V megger	2MΩ or more		
	18	Checking manual defrosting operation		Manual defrost switch			
	19	checking operation of defrost termination thermostat (Completing temperature)	No. 1 <input type="checkbox"/> °C No. 2 <input type="checkbox"/> °C	Mount thermistor to completion thermostat mounting position	OFF 40~60°C		
	20	Checking operation of high pressure control switch		Visual left or right side air cooled condenser fan to be stopped			
	21	Checking operation of high pressure switch	H-CUT (OUT) No. 1 <input type="checkbox"/> kg/cm ² No. 2 <input type="checkbox"/> kg/cm ²	Operate the air cooled condenser without fan operation	28kg/cm ²		
		Checking operation of low pressure switch	L-CUT (OUT) No. 1 <input type="checkbox"/> mmHgV No. 2 <input type="checkbox"/> mmHgV	Accomplish pump down by use of the stop valve at the water cooled condenser outlet	400mmHgV		
	22	Checking operation of water pressure switch	Checking switchover from air-cooled to water-cooled operation	Disconnect water coupling	Condenser fan motor shall operate		
			Checking switchover from air-cooled to water-cooled operation	Connect water coupling and supply water	Condenser fan motor shall stop		
	23	Checking power supply changeover switch	Checking 400V class operation	Place changeover switch lever upward			
			Checking 200V class operation	Place changeover switch lever downward			
	24	Operating time	Immediately after operation	operation starting →0°C <input type="checkbox"/> Hr <input type="checkbox"/> M	Operation → 0°C <input type="checkbox"/> Hr <input type="checkbox"/> M -18°C <input type="checkbox"/> Hr <input type="checkbox"/> M	Automatic operation at -18°C <input type="checkbox"/> Hr <input type="checkbox"/> M	
Operation starting time <input type="checkbox"/> <input type="checkbox"/>							
	25	Storage temperature °C	<input type="checkbox"/>	-18°C	Automatic operation at -18°C		
		Ambient temperature °C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	in one cycle	
		LP kg/cm ²	No. 1 <input type="checkbox"/> No. 2 <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	COMP OFF <input type="checkbox"/> M	
		HP kg/cm ²	No. 1 <input type="checkbox"/> No. 2 <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	COMP ON <input type="checkbox"/> M	
	26	Checking automatic defrosting operation	Defrost time <input type="checkbox"/> M				

5. Major components and maintenance

5.1 Components related with refrigeration circuit

5.1.1 Compressor

The Container Refrigeration Unit adopts fully-enclosed scroll compressors complete with built-in driving motors, so there is no portion where refrigerant can possibly leak. However, since they are scroll type, take care not to rotate the compressors in the reverse direction during operation.

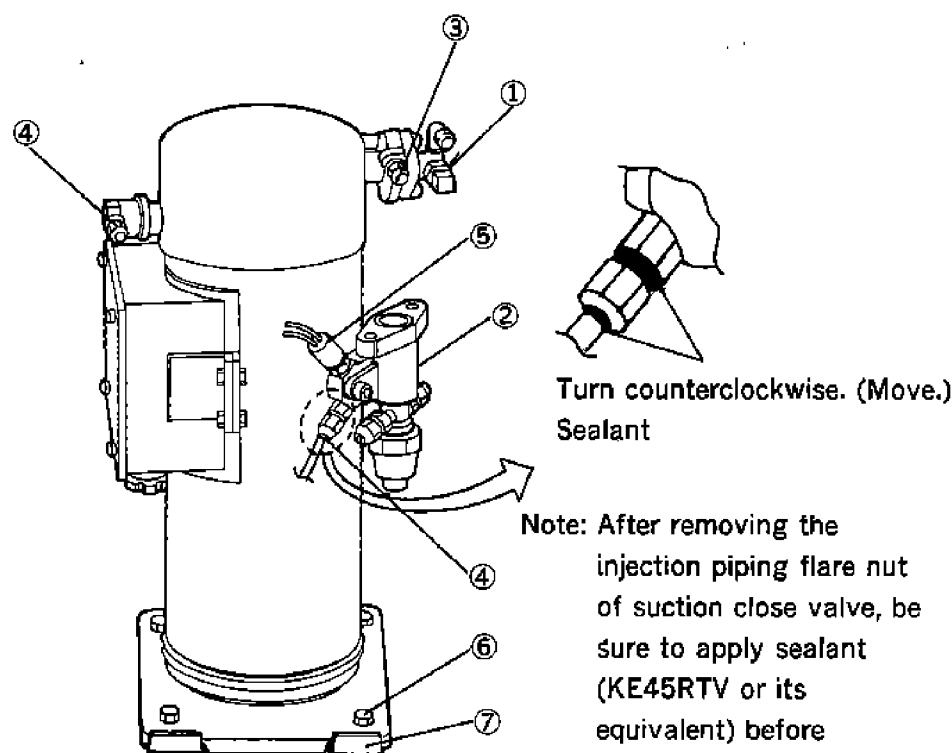
(1) Dismantling Procedure

To dismantle each compressor, proceed through the following steps:

- 1) Remove the compressor front branch.
- 2) Remove the supply shut-off valve, the return shut-off valve, the gauge pipe and injection pipe flare nuts (on the compressor side), and the high pressure switch.
- 3) Remove the four lock bolts of the compressor and mount.
- 4) Turn the compressor 90° counterclockwise so that the terminal box comes in front.
- 5) Draw the compressor and mount out of the front face unit.

(2) Installation Procedure

Reverse the above sequence. For tightening of bolts, refer to the tightening torque list.



Note: After removing the injection piping flare nut of suction close valve, be sure to apply sealant (KE45RTV or its equivalent) before tightening it.

- ① Supply shut-off valve
- ② Return shut-off valve
- ③ Gauge pipe flare nut
- ④ Injection pipe flare nut
- ⑤ Low pressure switch
- ⑥ Lock bolt
- ⑦ Mount

	Item	Unit	Value
Tightening torque of bolts	Compressor	kg·cm/lb·ft	109/8.9
	Compressor shutoff valve flange		255/21
	Fan motor		
	Solenoid valve		
	Expansion valve		
	Fan · Access panel		

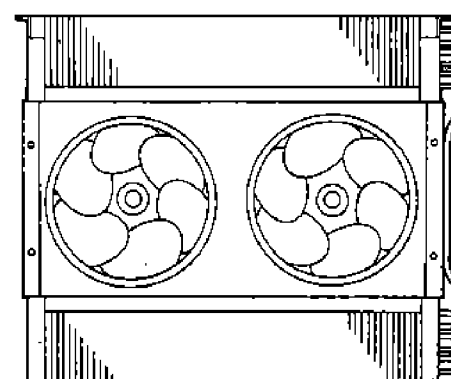
Note : Allowable range of tightening torque $\pm 10\%$

5.1.2 Air cooled condenser and evaporator

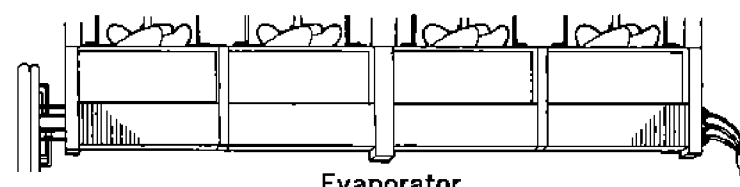
Of the "cross fin" coil type having special corrugated fins are compact and very efficient in producing uniform heat exchange efficiency.

Maintenance

Remove the front plate to access the air-cooled condenser. Remove the access panel to access the evaporator. For the condenser, be sure to remove the front branch and wash it in water at PTI time.



Air cooled condenser



Evaporator

5.1.3 Water cooled condenser (Air/water cooled type)

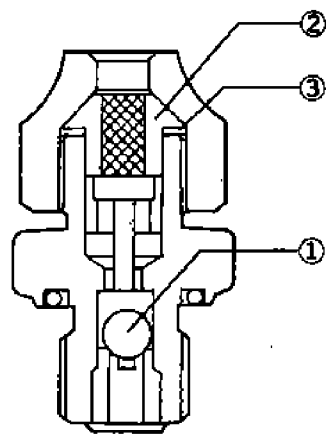
The water-cooled condenser is a double-pipe condenser and adopts specially finned pipe as the cooling pipe, thus being light in weight and compact in size. The inner pipe (cooling pipe) feeds cooling water, and the outer pipe refrigerant. Be sure to use fresh water as cooling water.

Replacement procedure of the fusible safety plug

When pressure rises abnormally in the system, the fusible plug melts itself, so if the fusible plug is melted check possible causes thoroughly.

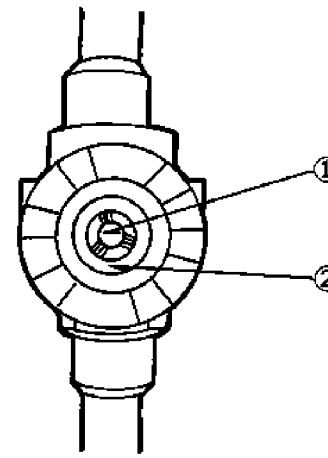
When fusible plug functions, the centre of the fusible plug alloy ② melts, from which the refrigerant jets out. When the flare nut is removed, ① is apt to come out by pressure and clogs the passage of the refrigerant outlet, which prevents the refrigerant from jetting out and also the air from entering. Thus, refrigerant loss is extremely minimized.

Insert a new ② with ③, and tighten the flare nut.



- ① Ball
- ② Fusible plug alloy
- ③ packing

Construction of fusible safety plug

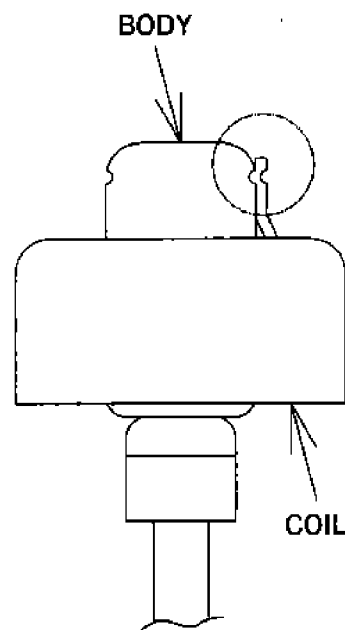


- ① Moisture indicator
- ② Corrugated glass

- Note:**
1. The indicator may appear orange if it has been exposed to gaseous refrigerant for a long time.
 2. The indicator is to be checked at being sealed with liquid refrigerant after operating for a few hours.
 3. Change of the indicator is influenced by the temperature of liquid refrigerant. The lower temperature cause the change of indicator to take the longer time.
 4. To shorten the time for change of indicator, raise up the temperature of liquid refrigerant.

5.1.4 Expansion valve

1) The Container Refrigeration Unit adopts an electronic expansion valve, which senses the refrigerant temperature difference between the evaporator inlet and outlet and automatically keeps the refrigerant amount optimum to the actual running conditions. Thus, unlike an auto equalizing expansion valve with a temperature sensing element, this expansion valve does not require the adjustment of superheat degree. However, when installing the coil on the valve, make sure that the coil bracket's convexity is engaged with the valve's concavity.



② Flow of the refrigerant

- When the liquid refrigerant is sealed, corrugation on the sight glass disappears.
- Check

Operation	Indicator state
At start	Bubbles appear but liquid refrigerant is sealed in 30 minutes to an hour after starting.
During operation	Air bubbles may possibly be created depending on the outside air temperature.

If bubbles develop continuously, the refrigerant is possibly running short.

③ Replacement

- 1) Put the system in "pump down" state.
- 2) Turn the sight glass counterclockwise, and remove it together with the O-ring.
- 3) Apply refrigeration oil to the new O-ring, and fasten the sight glass with torque of 70 ± 5 kg-cm. (Do not tighten the O-ring excessively. Otherwise, the O-ring may be damaged.)

5.1.5 Liquid/moisture indicator

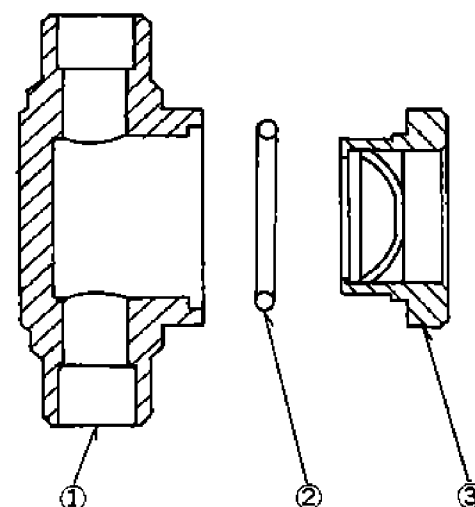
This indicator permits checking of flow of the refrigerant and moisture content in the refrigerant.

① Moisture content

- The indicator indicates moisture content by the color at the center of the window.

Check this indicator during the unit is operating.

Color	State
Deep blue	Dry
Orange	Wet (moisture contained)



- ① Body
- ② O-ring
- ③ Sight glass

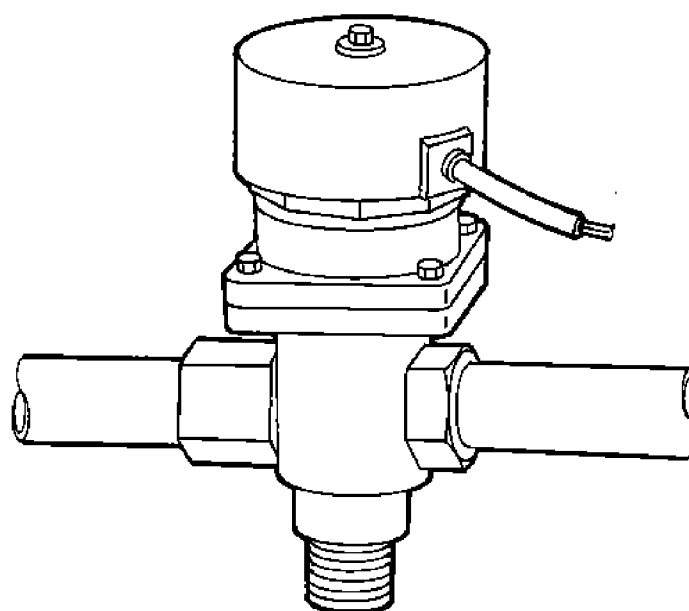
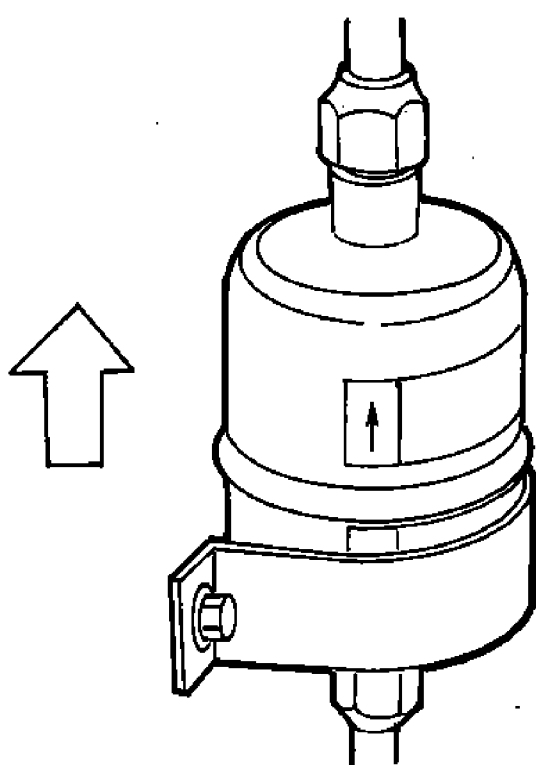
5.1.6 Dryer

This removes moisture and dust from the refrigerant while it is circulated. Replace the dryer if it does not remove moisture or is clogged.

When installing the new dryer, follow the directions given on the nameplate and do not make any mistake about the direction of the dryer. (Flange connection type is option)

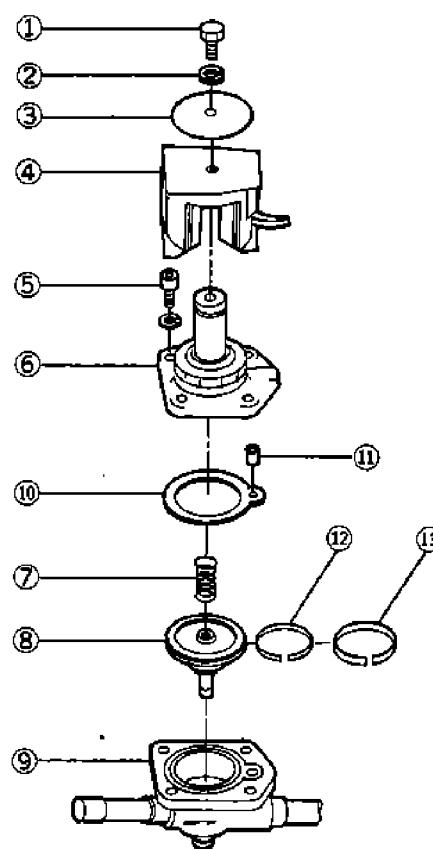
Replacement

- 1) In "pump down" state (refer to "Maintenance"), close the compressor suction stop valve.
- 2) Then, loosen the flares (the flange bolts) at the both end of the dryer and replace the dryer quickly.
- 3) Be careful not to get air into the piping on the solenoid valve side while removing the dryer.
- 4) After reattachment of the dryer, open the stop valve a little to purge the air in the dryer from the flare (flange) on the solenoid valve side and then close it at once.
- 5) Loosen the flare (the flange bolt) on the other side, turn on the unit ON/OFF switch instantly and open the solenoid valve only to purge the air.
- 6) After completion of the work, open the stop valves to its original state and then inspect the system for gas leakage. Confirm no gas leakage is found.



Disassembly

- 1) The structure of the solenoid valve is shown at right. (For disassembly, checking, and reassembly, refer to this diagram.)
- 2) When brazing a pipe to the valve, cool the valve body with a wet cloth. (It is not required to disassemble the valve. Remove the coil ass'y from the body.)
- 3) During reassembly, tighten the four bolts×4 with torque of 50–60 kg-cm.



5.1.7 Solenoid valves

① Solenoid valves in the liquid line (2ORL1, 2)

2OR1, 2 are opened or closed by the signal of the controller.

When the current does not flow, this valve is closed, stopping the flow of refrigerant.

No.	Parts name
①	Set bolt (M5)
②	Spring lock washer (M5)
③	Name plate
④	Coil ass'y
⑤	Set bolt
⑥	Cover ass'y
⑦	Spring
⑧	Piston
⑨	Valve body
⑩	Packing
⑪	Sleeve
⑫	Inner ring
⑬	Piston ring

② **Three-way solenoid valve for drain pan heater (20RD1, 2)**

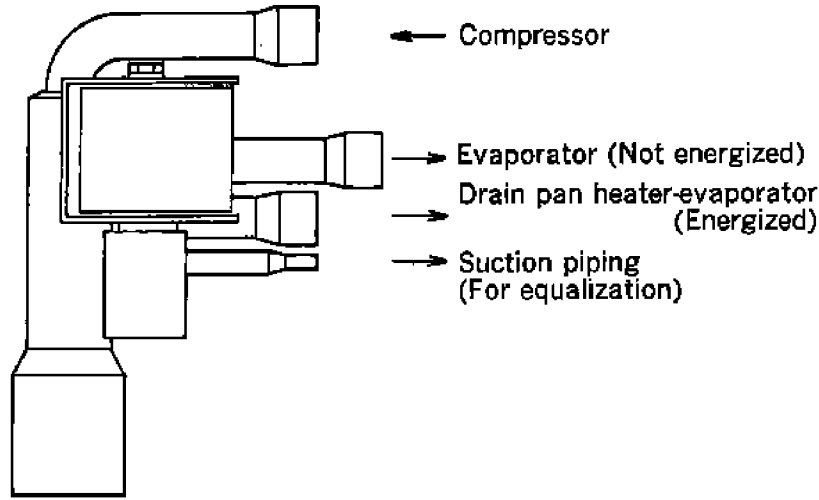
● Model: DHV804DXF

● Power supply: AC 24V, 50/60Hz

The three-way solenoid valve is provided to change the discharge gas flow to the evaporator.

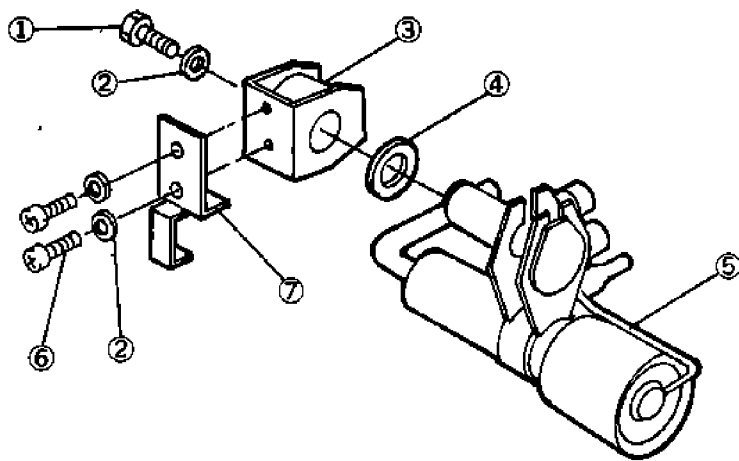
During chilled or partial frozen operation, the discharge gas flow to the evaporator directly and during defrosting, it flows to the evaporator through the drain pan heater.

a. Piping connection



b. Replacing method

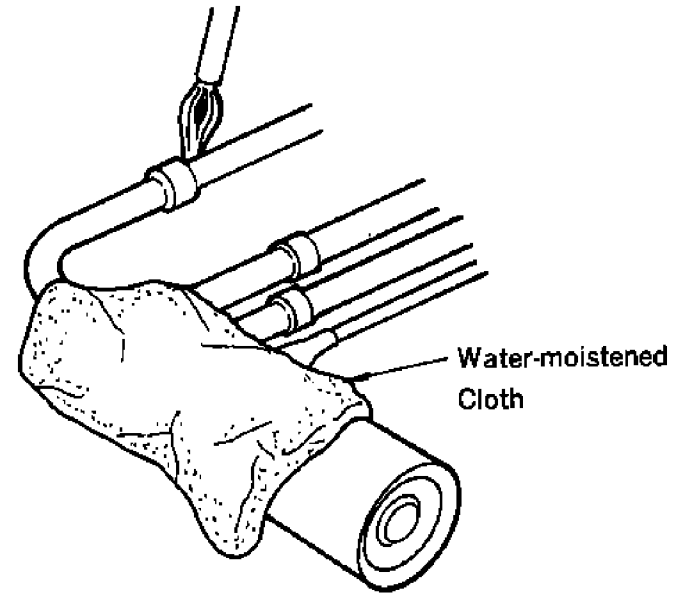
(1) Replacement of coil



No.	Parts name
①	Set bolt (M4)
②	Spring lock washer (M4)
③	Coil
④	Washer
⑤	Valve body
⑥	Set screw (M4)
⑦	Bracket

(2) Replacement of valve body

Before brazing the valve body, remove the coil and braze it while cooling it sufficiently (under 120°C [248°F]) with water-moistened cloth.

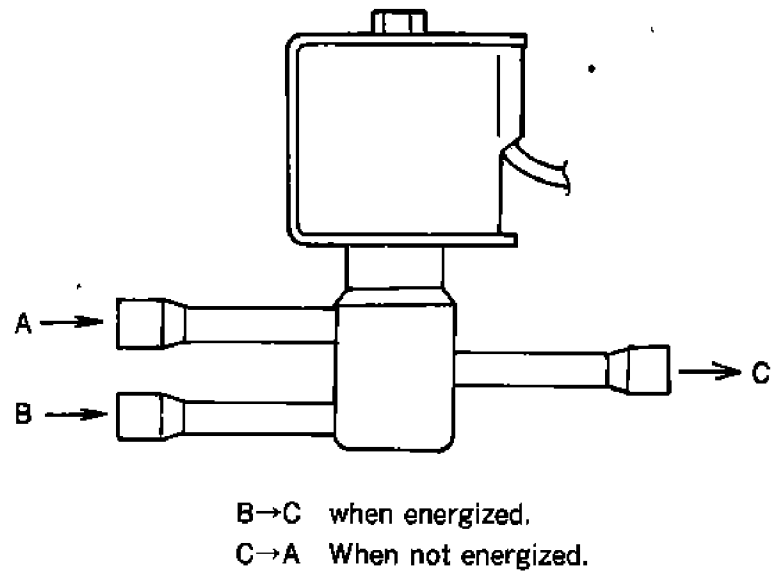


③ **Return line solenoid valve (20RS1, 2)**

Installed in the return piping at a position close to the compressor, this solenoid valve operates according to the inside return or supply air temperature; it closes when energized and opens when not energized. Having an internal bleed port, the valve allows the flow of refrigerant even when it is closed.

④ **Injection solenoid valve (20RJ1, 2)**

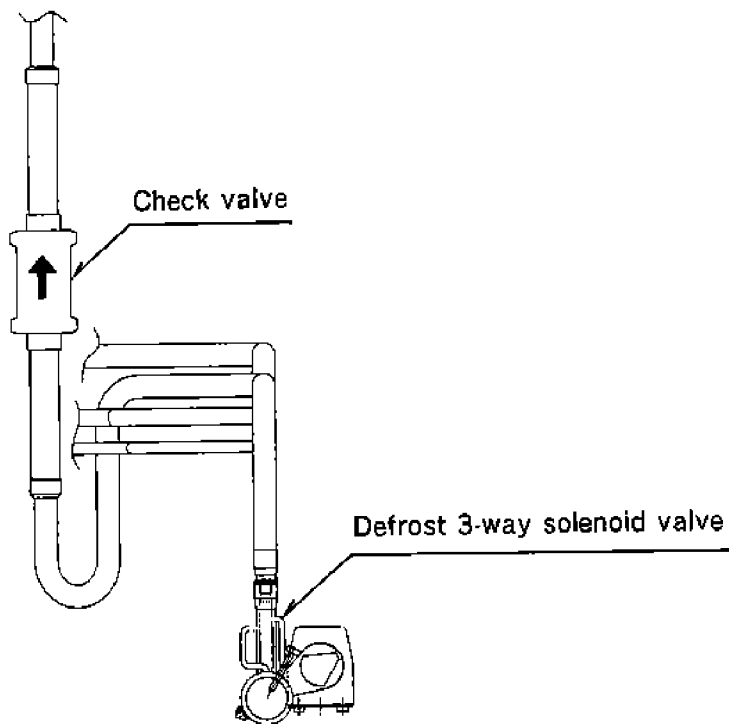
Installed in the piping through which liquid refrigerant is injected into the compressor, this valve provides the flow from B to C to thereby allow injection when it is energized and provides the flow from C to A to thereby equalize the pressure in the injection portion and in the return portion when not energized.



5.1.8 Check valve

During hot-gas defrost and heat-up operation, the refrigerant in the condenser flows reversely to prevent against over-loading caused by excessive refrigerant.

Replacing points



Note the direction of a check valve when it is replaced in accordance with the arrow mark on the nameplate. Braze it while cooling it sufficiently with water-moistened cloth.

5.1.9 Compressor Discharge Closing Valve

When opening or closing the closing valve, pay attention to the following.

- 1) Since the valve stem has hexagonal head, it can not be operated with the valve key.
- 2) When spanner or monkey wrench is used, the ridges of hexagonal head may be deformed. Be sure to use a socket wrench.

5.2 Components related with the air system

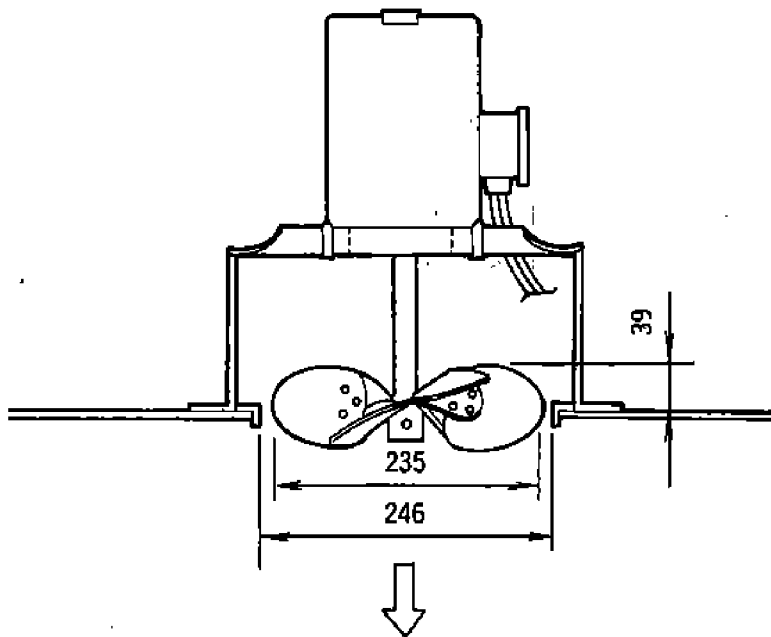
5.2.1 Fans and motors

① Specifications

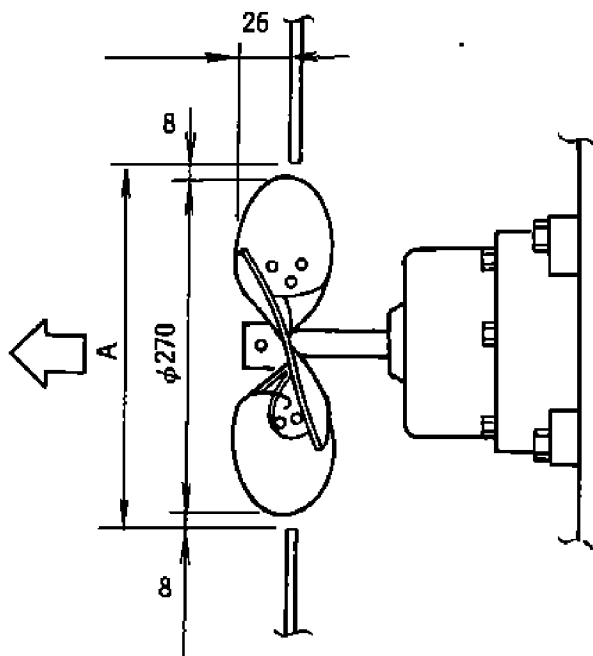
		Evaporator	Condenser	
Fan	Type	Propeller fan		
	Numbers of blades	6 pcs.		
	Blade diameter	$\phi 235$	$\phi 235$	LX8B $\phi 270$ / LX5B $\phi 300$
Motor	Type	3 phase squirrel-cage induction motor		
	Motor output (Pole numbers)	190/280W(2P) 25/40W(4P)	LX8B 320/475W (2P)	LX5B 85/125W (4P)
	Bearing	Ball bearing, 6203 Non-contacting type Rubber seal	Ball bearing, 6204 Non-contacting type Rubber seal	

② Installation procedure

a. Evaporator fan and motor



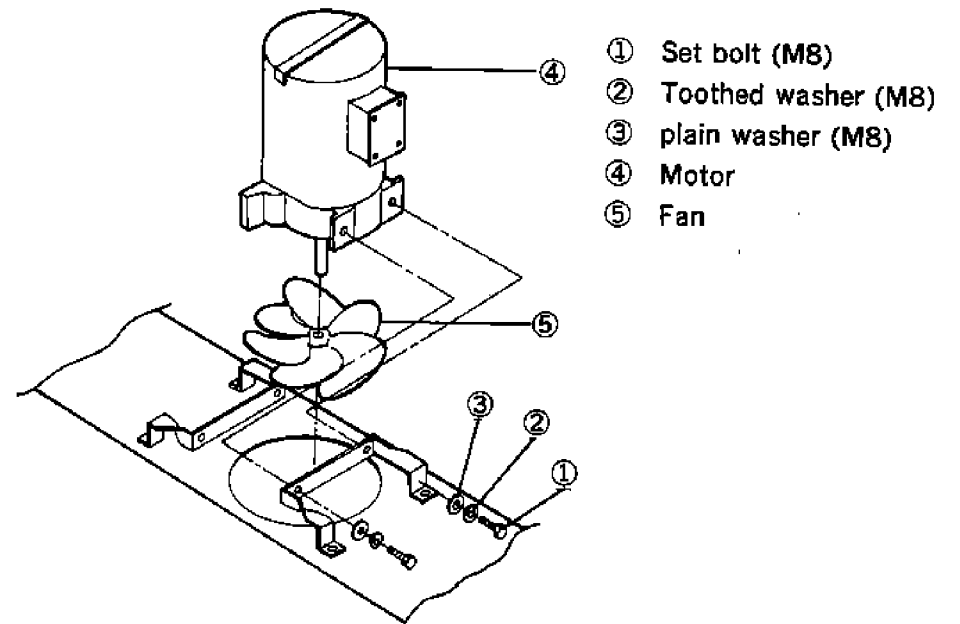
b. Condenser fan and motor



	LX8B	LX5B
A	$\phi 286$	$\phi 315$

③ Replacing method for evaporator fan

Before removing the evaporator fan, loosen the bolts on the fan motor and remove the motor.

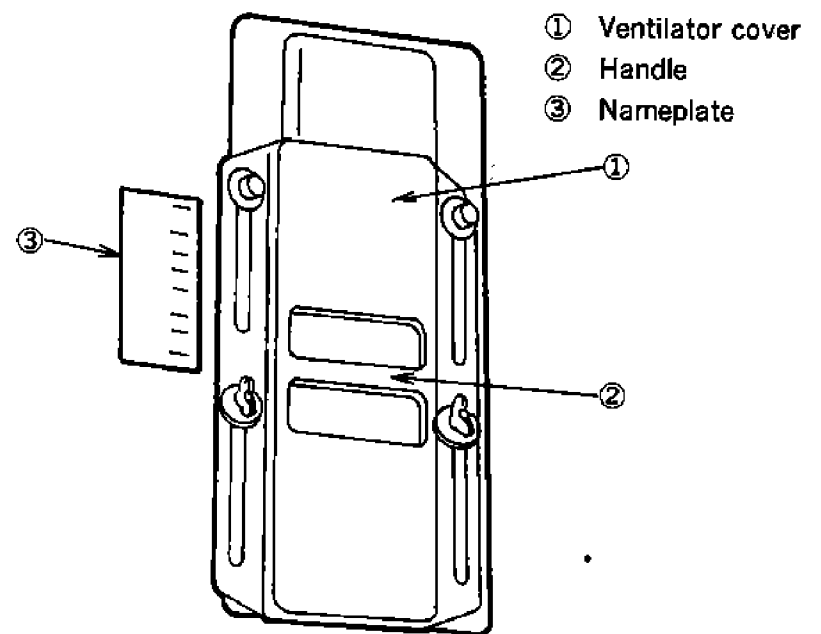


5.2.2 Ventilator

Handling method

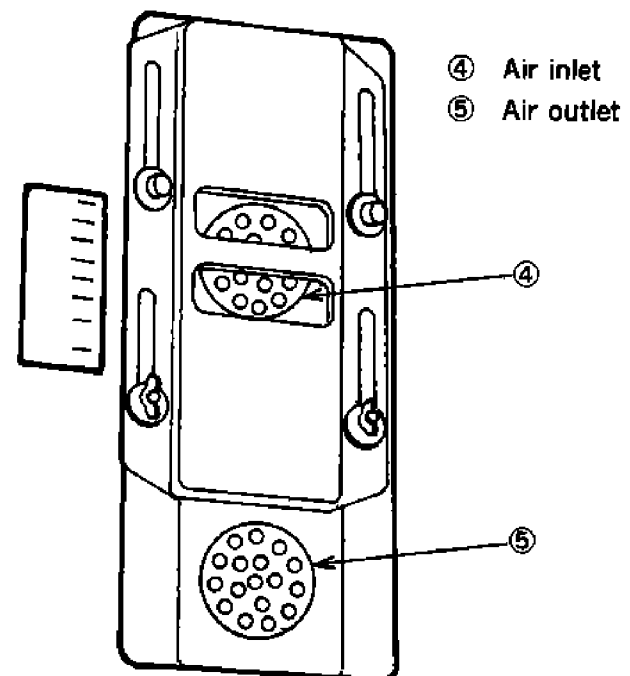
1) In case ventilation is not needed:

Set the handle to "CLOSE".



2) In case ventilation is needed:

Set the handle to "FULL OPEN".



5.3 Functional electric parts

5.3.1 High pressure switch (63H1, 2)

This switch causes compressor to stop, as the operation pressure of the unit has risen abnormally. Thus HPS is adapted to stop the compressor if the high pressure has gone up above its set value due to failure of condenser fan, obstructive passage to cooling water, etc.

5.3.2 Low pressure switch (63L1, 2)

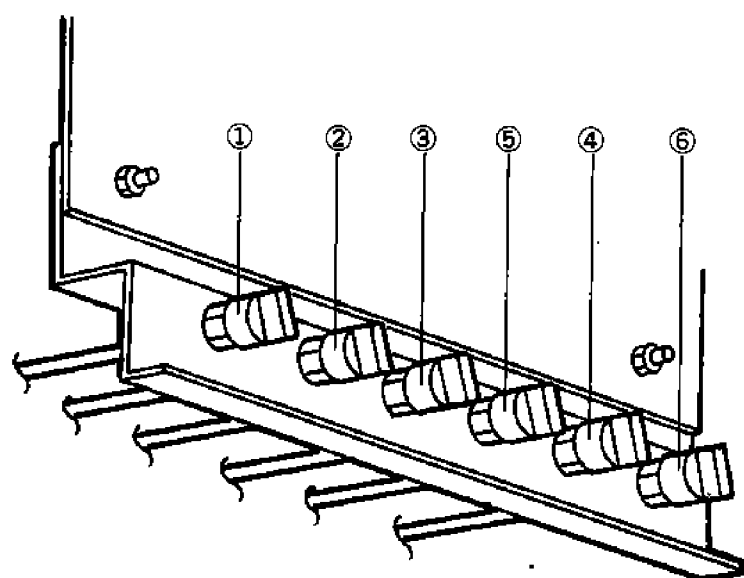
When low pressure is lower than the predesigned value due to measured pump-down during defrosting or heat-up operation, this switch switches over the solenoid valve, detecting termination of measuring

5.3.3 High pressure control switch (63H5, 6)

If the ambient temperature is low during air cooled operation, one out of two condenser fans are turned off so that the high pressure should not fall. (As for more details, refer to "high pressure control")

5.3.4 Pressure Switch for Refrigerant Pressure Control

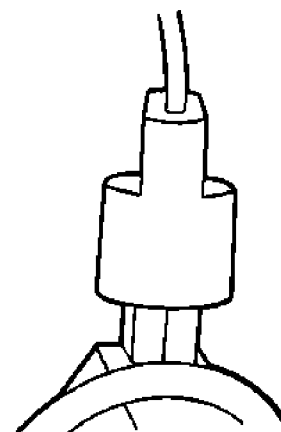
During water-cooled operation with only one compressor active, there are times when the non-active circuit evaporator internal pressure rises excessively. If this is the case, this pressure switch will go OFF (with its contacts breaking), thereby stopping the Container Refrigeration Unit. (For more information, refer to "Operation Modes" and "Refrigerant Pressure Control" elsewhere in this manual.)



- ① High pressure switch (63H1)
- ② High pressure switch (63H2)
- ③ Pressure switch for high pressure control (63H5)
- ④ Pressure switch for high pressure control (63H6)
- ⑤ Pressure switch for refrigerant pressure control (63H3) (Moldes commonly used for both air cooling and water cooling)
- ⑥ Pressure switch for refrigerant pressure control (63H4) (Moldes commonly used for both air cooling and water cooling)

5.3.5 Water pressure switch (63W) (Air/water cooled type)

This switches over air and water cooled modes. If cooling water flows and water pressure rises above a preset water pressure at the inlet, the contact is turned off to stop the condenser fan motor and water cooled operation will start.



5.3.6 Evaporator inlet and outlet sensors (Th1, 2, 3, 4)

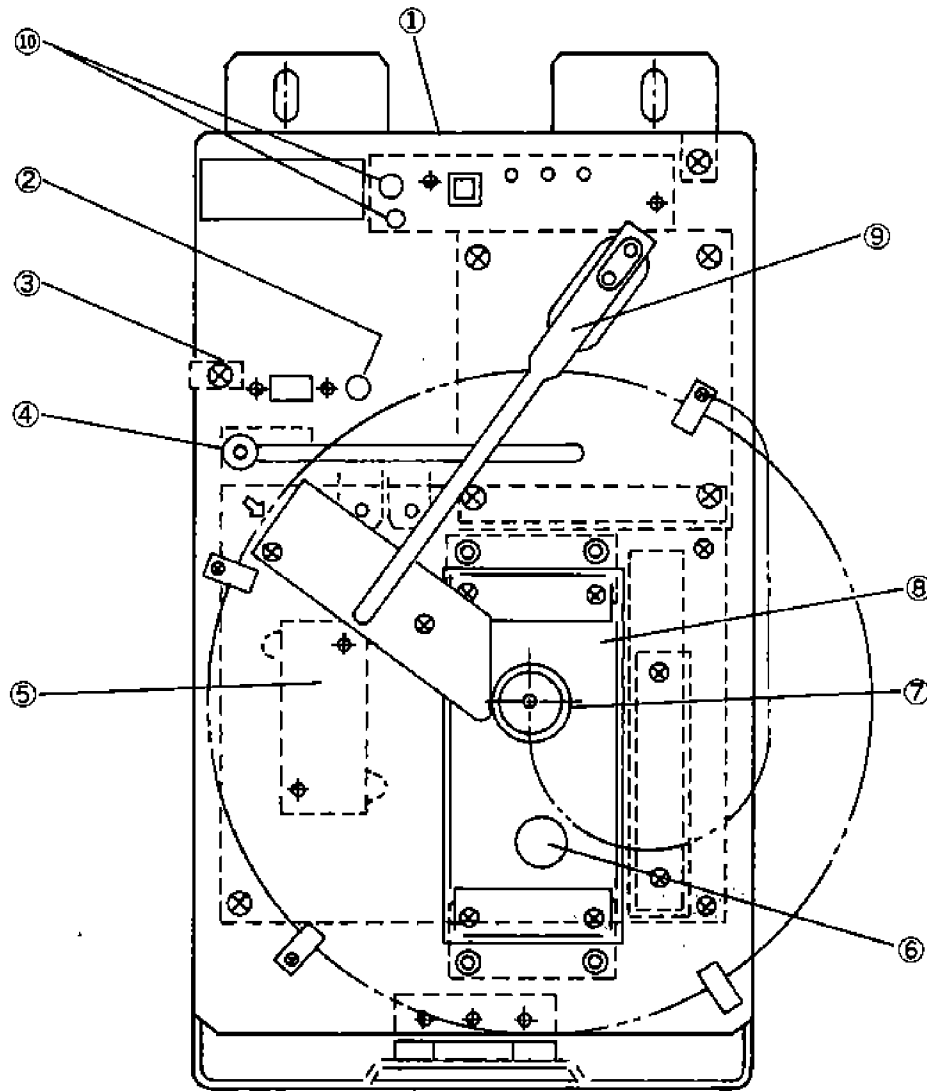
These sensors detect the coolant temperature at the evaporator inlet and outlet, and control the degree of superheat referring to the difference of inlet and outlet temperatures.

As for the evaporator inlet and outlet sensors, pay special attention to the insulating material of the compressor suction pipe.

When the insulating material has been unintentionally removed, or when the sensor maintenance has been carried out, be sure to mount the insulating material.

5.3.7 Electronic temperature recorder (DER8801)

This recorder records supply or return air temperature in the container by the switching signal for FROZEN/CHILLED mode. In addition, the detective function for abnormality of the sensors and the calibration function are provided.



DER8801

- ① Calibration button
- ② Push button
- ③ Remaining V indicator
- ④ Pen lifting arm
- ⑤ Dry battery
- ⑥ Inspection window for checking of quartz motor running
- ⑦ Chart nut
- ⑧ Quartz clock
- ⑨ Pen
- ⑩ Adjust volume

① Specifications

- Model : DER8801
- Power supply : AC22V 50/60Hz
- Recording method : Pressure sensing type
- Recording temperature range : $-30.0^{\circ}\text{C} \sim +25.0^{\circ}\text{C}$
($-22^{\circ}\text{F} \sim +77^{\circ}\text{F}$)
- Recording chart : Circular 8inch Disk type pressure sensible paper
(Graduation $1/1^{\circ}\text{C}$)
(Corresponding to PSD-217C (REV. A) of PARTLOW CO.)
- Driving method for recording chart :
Timer (Quartz motor+Reducing gear) 31 days per rev.
Driving source for quartz motor : Dry battery (DC 1.5V)
Corresponding to JISC8501SUM2
IECR14
Life ; Approx. 1 year
(Confirmed by the remaining volt indicator)
- Recording pen driving method : Driven by the pulse motor
- Sensors :
 - S. S. : For recording supply air temperature
 - R. S. : For recording return air temperature
 Thermistor
- Indication-LED
 - Recording temperature Supply air
 - Recording temperature Return air
 - Alarm sensor

Note : Recording accuracy

Accuracy of the recorder body and sensor is as shown below. Adjustment of the recorder body, only by the calibration is possible.

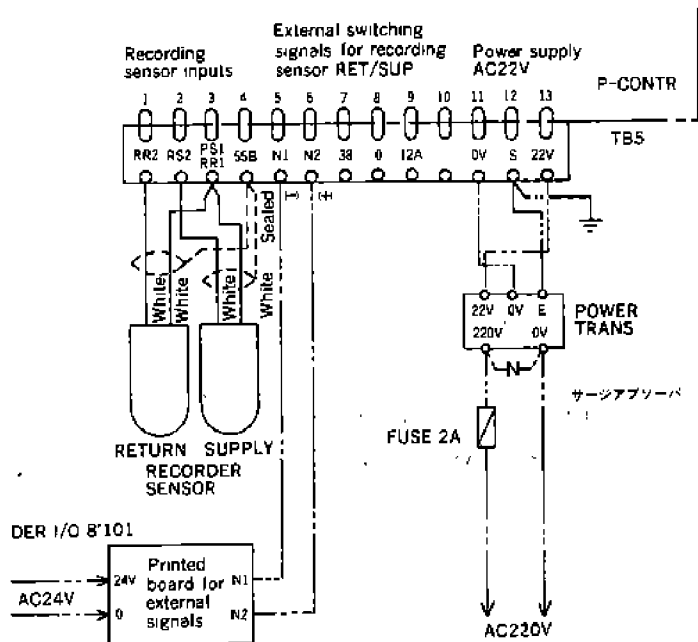
Recording temperature range	Accuracy $^{\circ}\text{C}$		
	Body	Sensor	Total
$25^{\circ}\text{C} \sim 10^{\circ}\text{C}$	± 1.0	± 1.0	± 2.0
$10^{\circ}\text{C} \sim -15^{\circ}\text{C}$	± 0.5	± 0.3	± 0.8
$-15^{\circ}\text{C} \sim -30^{\circ}\text{C}$	± 1.0	± 1.0	± 2.0

② Components and electric wiring diagram

1) Components

Names of components	Positions to be attached
Recorder body	Inside control box
Return air sensor	Suction part of evaporator
Supply air sensor	Discharge part of evaporator
PCB for external signals	Inside control box Back of electronic temperature recorder
Transformer for electronic temperature recorder (220V/22V)	Inside switch box
Fuse (3A)	Inside switch box

2) Wiring diagram
DER8801



③ Checking the indications of the recorder (Calibration)

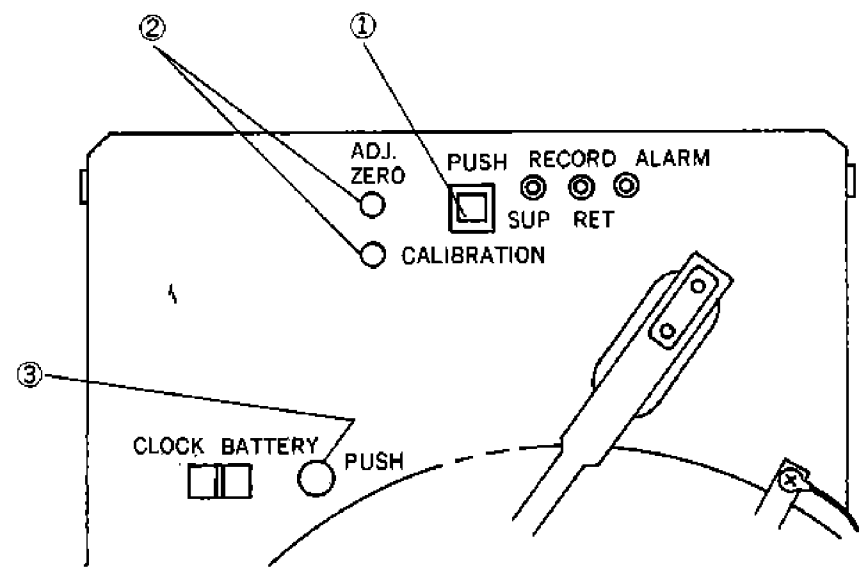
This recorder can be checked for its switching function for recording sensors and temperature indication functions regardless of inside temperature, and can be adjusted.

1) Switching function for recording sensors

Manipulate the set point of the controller and check whether the recording sensors can be switched over from RETURN (Frozen) to SUPPLY (Chilled) and vice versa with operation of the LED on the recorder.

- Chilled mode
(Temperature setting above -2.9°C ($+26.8^{\circ}\text{F}$))
...Supply air temperature is recorded.
- Frozen and partial frozen modes
(Temperature setting below -3°C ($+26.6^{\circ}\text{F}$))
...Return air temperature is recorded.

DER8801



- ① Calibration button
- ② Adjust volume
- ③ Push button

2) Calibration
(DER8801)

Calibration can be made stepwise by pushing the CALIBRATION button. The second push on the button indicates 0°C, the second push -20°C, and the third push +20°C. The fourth push brings the recorder back to the regular recording mode.

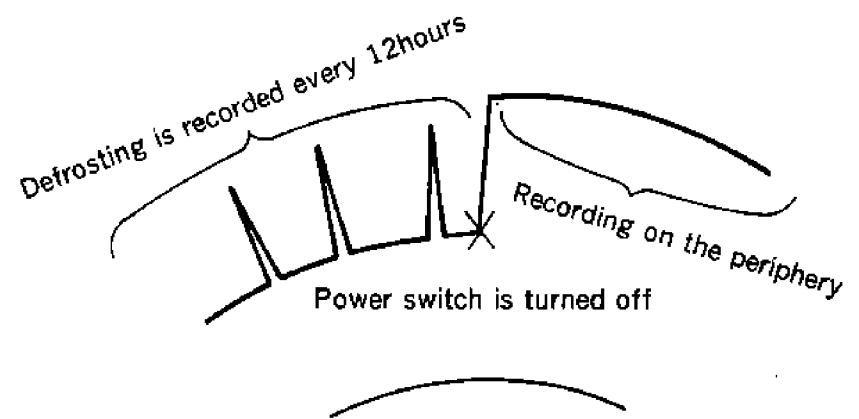
When the button is kept depressed, the then temperature is held. 30 seconds after releasing the button, the regular recording mode is resumed.

- Adjustment is required when indication error exceeds $\pm 0.5^\circ\text{C}$. In this case, manipulate the adjusting volume.
- Zero adjustment
 - Turn it clockwise, and temperature indication falls.
(about -21.5°C is indicated when it is turned fully clockwise at -20°C)
 - Turn it counterclockwise, temperature indication rises.
(about -16.5°C is indicated when it is turned fully counterclockwise at -20°C)
- Span adjustment
 - Turn it clockwise, and temperature indication falls.
(About $+14^\circ\text{C}$ is indicated when it is fully turned clockwise at $+20^\circ\text{C}$ in zero adjustment)
 - Turn it counterclockwise, temperature indication rises.
(About $+21.5^\circ\text{C}$ is indicated when it is fully turned counterclockwise at $+20^\circ\text{C}$ in zero adjustment)

Notes :

1. The recording pen is adjusted to suit PSD-217C (REV. A) recording chart or similar kinds.
Do not use recording charts which are not corresponding to PSD-217C (REV. A).
2. Do not adjust span when charts which are not corresponding to PSD-217C (REV. A) are used.
3. Do not adjust the recording pen while transporting goods.
4. When the power is supplied, the pen vibrates momentarily and will return to its original position because of the recording characteristics, but this is not a sign of trouble.

- ④ **Temperature recording while the power switch is turned off (DER8801/DER8702)**
When the power switch is turned off, the pen shakes out of the periphery of recording paper.



⑥ **Indicating functions of LED**

The LED light up in accordance with the states of power supply, and recording sensors as shows below. If the 24V signal from the controller is turned on (chilled mode), LED for SUP lights up and if it is turned off (partial frozen and frozen modes), LED for RET lights up.

COMMERCIAL POWER SUPPLY		ENERGIZED																
SELECTOR SWITCH ※ 1		AUTO								SUP				RET				
SENSOR SELECTOR MODE		Chilled operation mode				Frozen / partial frozen operation mode												
RECORDING TEMPERATURE		SUP				RET				SUP				RET				
SUP SENSOR		Normal		Abnormal		Normal		Abnormal		Normal		Abnormal		Normal		Abnormal		
RET SENSOR		Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	
LED DISPLAY	DER 8801	SUP RECORD	○	○	○	○	●	●	●	●								
		RET RECORD	●	●	●	●	○	○	○	○								
		ALARM	●	●	○	○	●	○	●	○								
	DER 8701 (8702)	SUP RECORD	○	○	○	○	●	●	●	●	○	○	○	○	●	●	●	●
		RET RECORD	●	●	●	●	○	○	○	○	●	●	●	●	○	○	○	○
		SUP ALARM	●	●	○	○	●	●	●	●	●	●	○	○	●	●	●	●
RET ALARM		●	●	●	●	●	○	●	○	●	●	●	●	●	○	●	○	

COMMERCIAL POWER SUPPLY		DE-ENERGIZED (operate by buck-up battery)																
SELECTOR SWITCH ※ 1		AUTO								SUP				RET				
SENSOR SELECTOR MODE		Chilled operation mode				Frozen / partial frozen operation mode												
RECORDING TEMPERATURE		RET				RET				SUP				RET				
SUP SENSOR		Normal		Abnormal		Normal		Abnormal		Normal		Abnormal		Normal		Abnormal		
RET SENSOR		Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	Normal	Abnormal	
LED DISPLAY	DER 8801	SUP RECORD																
		RET RECORD																
		ALARM																
	DER 8701 (8702)	SUP RECORD	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		RET RECORD	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
		SUP ALARM	●	●	●	●	●	●	●	●	●	●	○	○	●	●	●	●
		RET ALARM	●	○	●	○	●	○	●	○	●	●	●	●	●	○	●	○

- Light up
 - Blink
 - Go out
- ※1 DER 8801 is not provided with a change-over switch.
- The record sensor is automatically switched according to the measured chamber temperature.
- When the commercial power supply is turned off, all LEDs of DER 8702 and DER 8701 go out.

⑦ Thermistor sensor temperature characteristics
(Temperature vs resistance characteristics)

Temperature °C	Standard resistance kΩ	Allowable range	
		MIN.	MAX.
-30	53.65	51.89	55.48
-25	41.27	40.18	42.40
-20	32.01	31.36	32.68
-15	25.03	24.67	25.40
-10	19.72	19.44	20.00
-5	15.64	15.43	15.36
0	12.50	12.34	12.67
5	10.05	9.926	10.18
10	8.139	8.038	8.241
15	6.629	6.515	6.745
20	5.431	5.312	5.552
25	3.474	4.357	4.595
30	3.707	3.594	3.823

Note) when the detected temperature by the thermistor sensors becomes above 60°C (about 1.3kΩ or lower) or below -40°C (about 93.1kΩ or higher), the abnormal displays are shown in the electronic recorder.

5.3.8 Hour meter (HM) (Option)

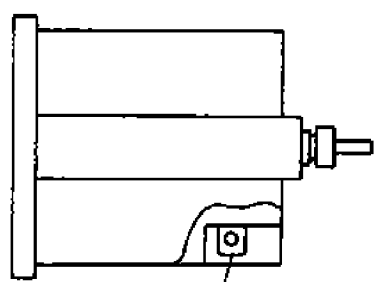
① Specifications

● Model : TH-1327

● power supply : AC24V

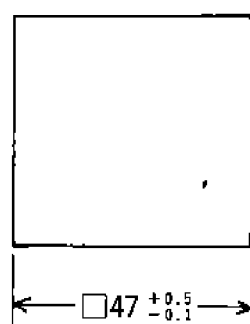
The hour meter is supplied as an optional equipment to integrate the operation time of compressor.

It has 6-digit indication. One decimal count is 6 seconds.



Connecting terminal

Size of mounting hole



5.3.9 Phase sequence controller (47)

① **Specifications**

- Type: PR8601
- Power supply: 190~200V 50Hz
200~220V 60Hz

The phase sequence controller opens or closes the magnetic contactor for changing-over of phases, detecting phases, R. S. T. in the power supply to prevent the fan motor from reverse turning.

The integrated microcomputer detects voltage of each phase and phase order and operates as tabulated below.

State of power supply		Relay RY1	Relay RY2	Between terminals 1-2	Between terminals 1-3
De-energized period		OFF	OFF	No continuity	No continuity
Energized period	Proper phase	ON	OFF	Continuity	No continuity
	Wrong phase	OFF	ON	No continuity	Continuity
	Single phasing before supplying power	OFF	OFF	No continuity	No continuity
	Single phasing during energization	State before single phasing is retained.			

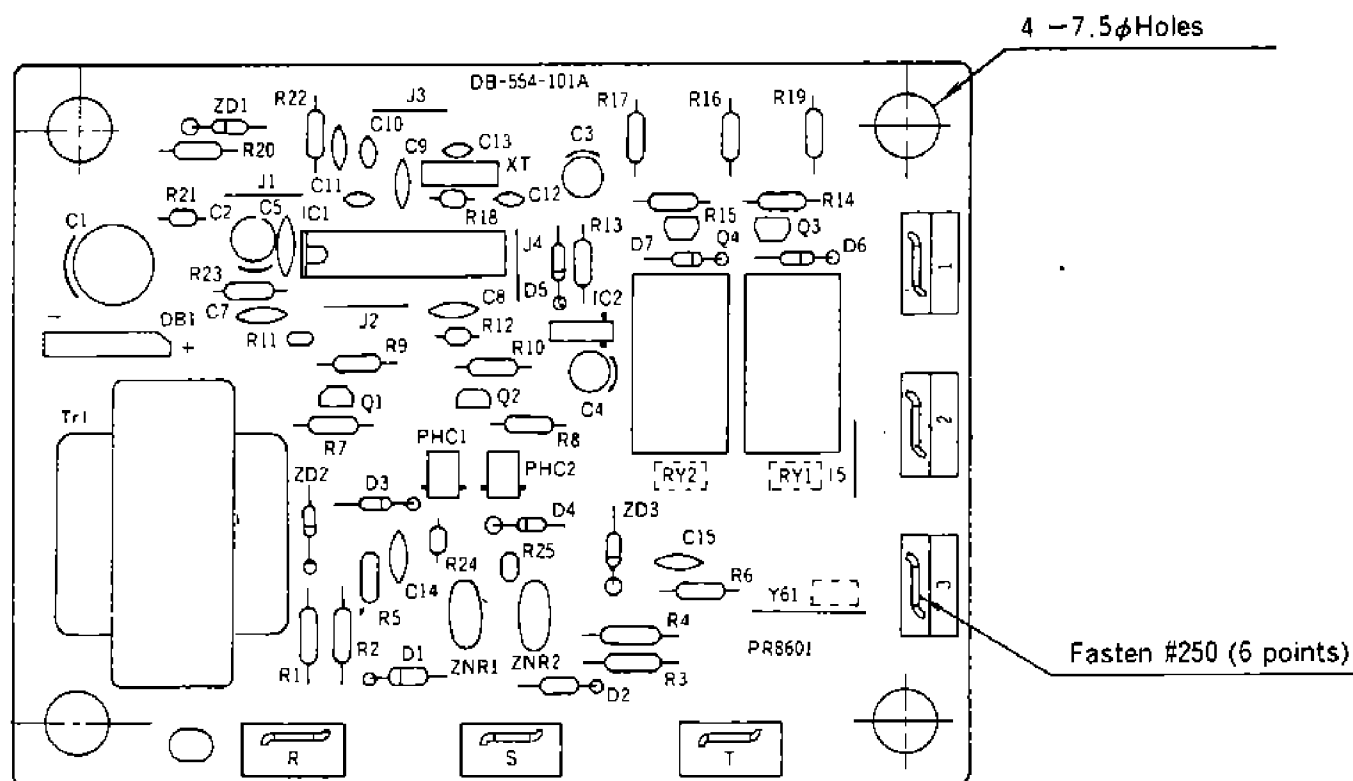
Note: Single phasing can be judged only on the power supplying side, but not on the load side.

② **Checking method for operation**

Exchange the power sources and check that the microcomputer operates as tabulated above. If not, replace the phase sequence controller.

③ **Cautions for replacing the switch**

Correctly connect each terminal in accordance with the wiring diagram. If not the switch may be burnt, or the microcomputer becomes erratic.



5.3.10 Electronic Controller (23A)

① Specifications

- Supply voltage : 24VAC, 50/60Hz
- Temperature setting range: $-30.0^{\circ}\text{C} \sim +25^{\circ}\text{C}$
($-22^{\circ}\text{F} \sim +77^{\circ}\text{F}$)
- Sensor/thermistor/temperature sensing element
 - SS: for supply air temperature control
 - RS: for return air temperature control
 - EVI1.2: for the detection of heat exchanger inlet refrigerant temperature
 - EVO1.2: for the detection of heat exchanger outlet refrigerant temperature
- Electronic timers
 - Defrost timers: short (within "In-range") long (beyond "In-range") backup
"In-range" mask
 - Delay timers: evaporator fan switching
compressor start
evaporator fan start
 - Control timers: freezing capacity lower limit mask
timer freezing capacity upper limit
mask timer
- Output
 - ON/OFF relays
 - CS1 (for compressor No.1)
 - CS2 (for compressor No.2)
 - CF1 (for condenser No.1 fan)
 - CF2 (for condenser No.2 fan)
 - EFH (for evaporator fan High)
 - EFL (for evaporator fan Low)
 - LS1 (for liquid solenoid valve No.1)
 - LS2 (for liquid solenoid valve No.2)
 - INJ1 (for injection solenoid valve No. 1)
 - INJ2 (for injection solenoid valve No. 2)
 - DS1 (for defrost 3-way solenoid valve No.1)
 - DS2 (for defrost 3-way solenoid valve No.2)
 - SV1 (for return side solenoid valve No.1)
 - SV2 (for return side solenoid valve No.2)
 - IRS (for "In-range" lamp)
 - DFS (for "Defrost" lamp)

● Indicators

- Digital temperature display
 - SUPPLY AIR TEMPERATURE
 - RETURN AIR TEMPERATURE
 - CHECK
- Light emitting diodes (LEDs)
 - COMP. RUN
 - DEFROST OPERATION
 - IN-RANGE CONTROL
 - SUPPLY AIR TEMPERATURE
 - RETURN AIR TEMPERATURE
 - CHECK (...flashes against a fault/error)
- Backup capabilities
 - Compressor backup operation
 - Sensor backup (supply air temperature, return air temperature, refrigerant temperature at heat exchanger inlet/outlet)
 - Evaporator fan motor backup operation
- Control capabilities
 - High pressure regulation in air-cooled operation
 - High pressure protection in water-cooled operation
 - "In-range" masking
- Control (PID) constant
 - The applicable model is set to LX5B or LX8B according to the setting of SW3 on the rear side of display PCB.

Setting of SW3	Model
1	LX8B
2	LX5B

② **Operating Instructions—Controls and Indicators**

1) **Temperature setting**

- Set the set point selector, provided at the controller indication section, to the specified temperature.

Setting range: Variable between -39.9°C and $+39.9^{\circ}\text{C}$ (-39.8°F and $+103.8^{\circ}\text{F}$). However, a setting between -30.1°C and -39.9°C (-22°F and -39.8°F) is regarded as -30°C (-22°F); a setting between $+25.1^{\circ}\text{C}$ and $+39.9^{\circ}\text{C}$ ($+77.2^{\circ}\text{F}$ and $+103.8^{\circ}\text{F}$) is regarded as $+25^{\circ}\text{C}$ ($+77^{\circ}\text{F}$).

Note 1: Do not forcibly stop the switches. When setting the set point selector, be sure that all numbers appear perfectly in the window.

Note 2: The 10°C digit has only four alternatives: 0, 1, 2, and 3. Do not forcibly operate the switch.

Note 3: Avoid accessing the set point selector except when selecting the set point.

Note 4: If your selected temperature is beyond -30°C or $+25^{\circ}\text{C}$ (-22 or 77°F), the CHECK lamp will flash to prompt you to select CHECK mode by pressing the indication selector (IND. SELECTOR) pushbutton. When you have done so, message "E. SPO" (set point beyond the range) will appear. In this case, the unit will operate regarding the set point as -30°C or $+25^{\circ}\text{C}$ (-22°F or $+77^{\circ}\text{F}$). The CHECK lamp will go off when you re-select a temperature between -30°C and $+25^{\circ}\text{C}$ (-22°F and $+77^{\circ}\text{F}$).

2) **Measurement of Supply/Return Air Temperatures**

- You can have the supply or return air temperature displayed by pressing the indication selector pushbutton

(IND. SELECTOR) so that the "SUPPLY" or "RETURN" LED, at the left of the digital temperature display comes ON.

"SUPPLY".....Supply air temperature

"RETURN".....Return air temperature

NOTE) Message "E" will appear in the "SUPPLY" position if the supply air temperature sensor (SS) is faulty; the "RETURN" position if the return air temperature sensor (RS) is faulty. At the same time, the CHECK lamp will flash to prompt you to select CHECK mode; when you have done so, message "E.-01" (supply air temperature sensor) or "E.-02" (return air temperature sensor) will appear.

3) **Operation Mode and Control Sensors**

The unit automatically switches the operation mode and the control sensors depending on the temperature set point.

- (a) -10.1°C (-13.8°F) or lower

- Freezing mode

The following lamps will come ON:

— FROZEN MODE

— RETURN

- (b) Between -3°C and -10.1°C ($+26.6^{\circ}\text{F}$ and $+14^{\circ}\text{F}$) or lower

- Partial freezing mode

The following lamps will come ON:

— PARTIAL FROZEN MODE

— RETURN

- (c) Between -2.9°C and $+20.0^{\circ}\text{C}$ ($+26.8^{\circ}\text{F}$ and $+68^{\circ}\text{F}$) or lower

- Chilling mode

The following lamps will come ON:

— CHILLED MODE

— SUPPLY

- (d) $+20.0^{\circ}\text{C}$ ($+68^{\circ}\text{F}$) or lower

- High-temperature chilling mode

— HI CHILLED MODE

— SUPPLY

4) **Display Functions**

- (a) **Operation State Display**

- COMPcompressor running

- DEFdefrost operation

- IN RANGE ...proper temperature [Control sensor temperature is within $\pm 2^{\circ}\text{C}$ ($\pm 3.6^{\circ}\text{F}$) of the set point.]

- (b) **Alarm Display**

- When the CHECK lamp is flickering, select CHECK mode by pressing the indication selector pushbutton (IND. SELECTOR), and the digital display will show one of the error/fault messages listed on the following pages. In the case multiple errors/faults have occurred, the display will show the applicable messages one by one each time you press the indication selector pushbutton (IND. SELECTOR).

In the event a system error/fault has occurred, the digital display will show an error message with the CHECK LED flashing or staying lit. Error messages are listed in the following table. In the case multiple errors/faults have occurred, the digital display will show the applicable messages in accordance with the priority numbers shown in the table.

No.	Priority Error	Message Description
1.	E.Pd1	Indicates that COMP1 has failed in pump-down by 120-second LPS in refrigerant measuring mode. This error message will keep displayed till pump-down by LPS succeeds at the next refrigerant measurement time.
2.	E.Pd2	Indicates that COMP2 has failed in pump-down by 120-second LPS in refrigerant measuring mode. This error message will keep displayed till pump-down by LPS succeeds at the next refrigerant measurement time.
3.	E.-01	Indicates that the supply air temperature sensor (SS) is abnormal. The message will be automatically reset when the sensor turns normal.
4.	E.-02	Indicates that the return air temperature sensor (RS) is abnormal. The message will be automatically reset when the sensor turns normal.
5.	E.EI1	Indicates that the evaporator inlet temperature sensor (EVI1) of circuit 1 is abnormal. The message will be automatically reset when the sensor turns normal.
6.	E.EI2	Indicates that the evaporator inlet temperature sensor (EVI2) of circuit 2 is abnormal. The message will be automatically reset when the sensor turns normal.
7.	E.EO1	Indicates that the evaporator outlet temperature sensor (EVO1) of circuit 1 is abnormal. The message will be automatically reset when the sensor turns normal.
8.	E.EO2	Indicates that the evaporator outlet temperature sensor (EVO2) of circuit 2 is abnormal. The message will be automatically reset when the sensor turns normal.
9.	E.CP1	Indicates that an abnormality has occurred in the compressor of circuit No. 1. Operation differs depending on whether or not the abnormality occurred after the compressor operated continuously for 30 seconds from power-ON. The error message will keep displayed till power reset is made.
10.	E.CP2	Indicates that an abnormality has occurred in the compressor of circuit No. 2. Operation differs depending on whether or not the abnormality occurred after the compressor operated continuously for 30 seconds from power-ON. The error message will keep displayed till power reset is made.
11.	E.CF1	Indicates that an abnormality has occurred in air-cooling fan 1. Once this message has appeared, the fans of that circuit will keep masked against energization till power reset is made.
12.	E.CF2	Indicates that an abnormality has occurred in air-cooling fan 2. Once this message has appeared, the fans of that circuit will keep masked against energization till power reset is made.
13.	E.-F1	Indicates that an abnormality has occurred in evaporator fan 1. Once this message has appeared, evaporator fan 14 will keep masked against energization till power reset is made.

No.	Priority Error	Message Description
14.	E.-F2	Indicates that an abnormality has occurred in evaporator fan 2. Once this message has appeared, evaporator fan 23 will keep masked against energization till power reset is made.
15.	E.-F3	Indicates that an abnormality has occurred in evaporator fan 3. Once this message has appeared, evaporator fan 23 will keep masked against energization till power reset is made.
16.	E.-F4	Indicates that an abnormality has occurred in evaporator fan 4. Once this message has appeared, evaporator fan 14 will keep masked against energization till power reset is made.
17.	E.2E1	Indicates that the electronic expansion valve coil for circuit 1 has short-circuited or opened. Once this message has appeared, the refrigerator of that circuit will keep disabled till power reset is made.
18.	E.2E2	Indicates that the electronic expansion valve coil for circuit 2 has short-circuited or opened. Once this message has appeared, the refrigerator of that circuit will keep disabled till power reset is made.
19.	E.HDS	Indicates that MDS has been ON for 110 seconds since the end of defrosting. This message will be automatically reset when MDS has gone OFF.
20.	E.SPO	Indicates that the set point selector is set to a value beyond the controllable range. This message will be automatically reset when the set point selector is set to a value within the controllable range.
21.	E.SP	Indicates that the set point selector read-in data is in a pattern that is impossible under normal conditions. This message will be automatically reset when the data is returned to a normal pattern.
22.	E.PID	Indicates that the read-in data of rotary switch 3 is in a pattern that is impossible under normal conditions. This message will be automatically reset when the data is returned to a normal pattern.

7-segment LED display patterns (red light)

0	1	2	3	4	5	6	7	8	9	A	B	C	D
0	1	2	3	4	5	6	7	8	9	A	b	[d
E	F	G	H	I	L	N	O	P	S	U	Z	-	
E	F	9	H	I	L	n	o	P	S	U	=	-	

① **Control Sensor Backup Operation**

1) Freezing (F) Mode

(1) When the supply air temperature sensor (SS) is abnormal:

- The controller only displays error message "E.-01" because of no influence on control.

(2) When the return air temperature sensor (RS) is abnormal:

- The controller performs temperature control by adding +5.0°C to the value of the supply air temperature sensor (SS).

- It also displays error message "E.-02".

(3) When both sensors (SS and RS) are abnormal:

- The controller displays error messages "E.01" and "E.-02".

- For the defrost interval, the controller uses the interval set with the long defrost timer.

2) Partial Freezing (PF) Mode

(1) When the supply air temperature sensor (SS) is abnormal:

- The controller only displays error message "E.-01" because of no influence on control.

(2) When the return air temperature sensor (RS) is abnormal:

- The controller performs temperature control by adding +2.0°C to the value of the supply air temperature sensor (SS).

- It also displays error message "E.-02".

(3) When both sensors (SS and RS) are abnormal:

- The controller turns OFF all relays except the mode output relay (MS) and maintains this state till either temperature control sensor turns normal.

- The sensor error messages will be automatically reset.

- No defrosting.

3) Chilling (C)/High-temperature Chilling (HC) Mode

(1) When the supply air temperature sensor (SS) is abnormal:

- The controller performs temperature control by adding -2.0°C to the value of the return air temperature sensor (RS).

- It also displays error message "E.-01".

(2) When the return air temperature sensor (RS) is abnormal:

- For evaporator fan operation, the controller performs temperature control by adding +5.0°C to the value of the supply air temperature sensor (SS).

- It also displays error message "E.-02".

(3) When both sensors (SS and RS) are abnormal:

- The controller turns OFF all relays except the mode output relay (MS) and maintains this state till either temperature control sensor turns normal.

- The sensor error messages will be automatically reset.

- No defrosting.

④ **Heating Sensor Backup Operation**

1) **Freezing (F) Mode**

(1) When an evaporator inlet temperature sensor (EVI*) is abnormal:

- The normal circuit is used as the main (active) circuit (where defrosting is performed).
- In the case of two-unit operation, the controller controls heating so that the corresponding evaporator outlet temperature sensor (EVO*) is SP-10+SH.

(2) When an evaporator outlet temperature sensor (EVO*) is abnormal:

- The normal circuit is used as the main (active) circuit (where defrosting is performed).
- In the case of two-unit operation, the controller controls heating so that the corresponding evaporator inlet temperature sensor (EVI*) is SP-10.

(3) When both inlet and outlet sensors of an evaporator are abnormal:

- The normal circuit is used the main (active) circuit (where defrosting is performed).
- In the case of two-unit operation, the controller controls heating by use of the normal circuit evaporator temperature sensor values.

2) **Chilling (C)/Partial Freezing (PF)/High-temperature Chilling (HC) mode**

(1) When an evaporator inlet sensor (EVI*) is abnormal:

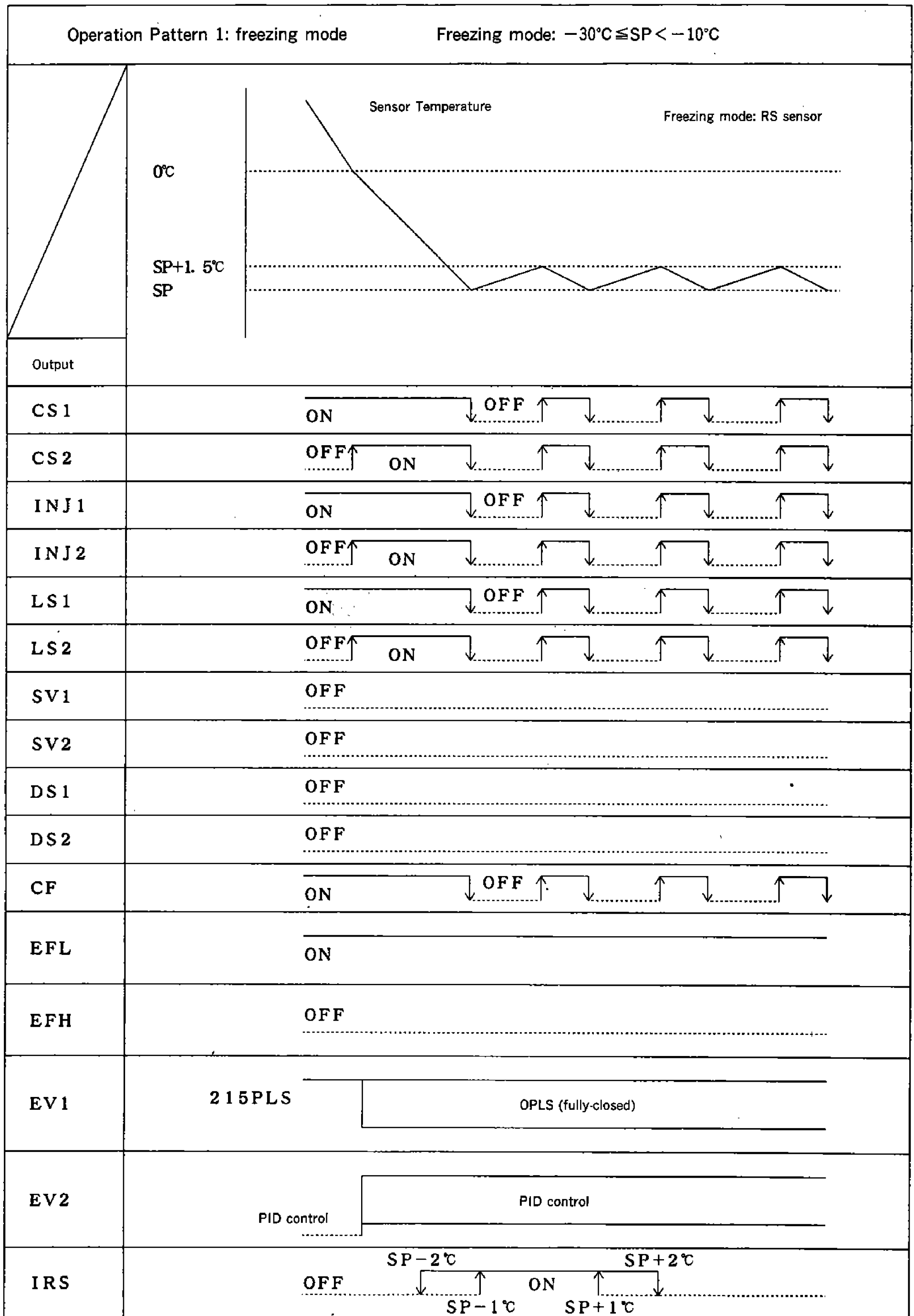
- The normal circuit is used as the main circuit (where defrosting is performed). The abnormal circuit is stopped or used for refrigerant measuring & heating operation.

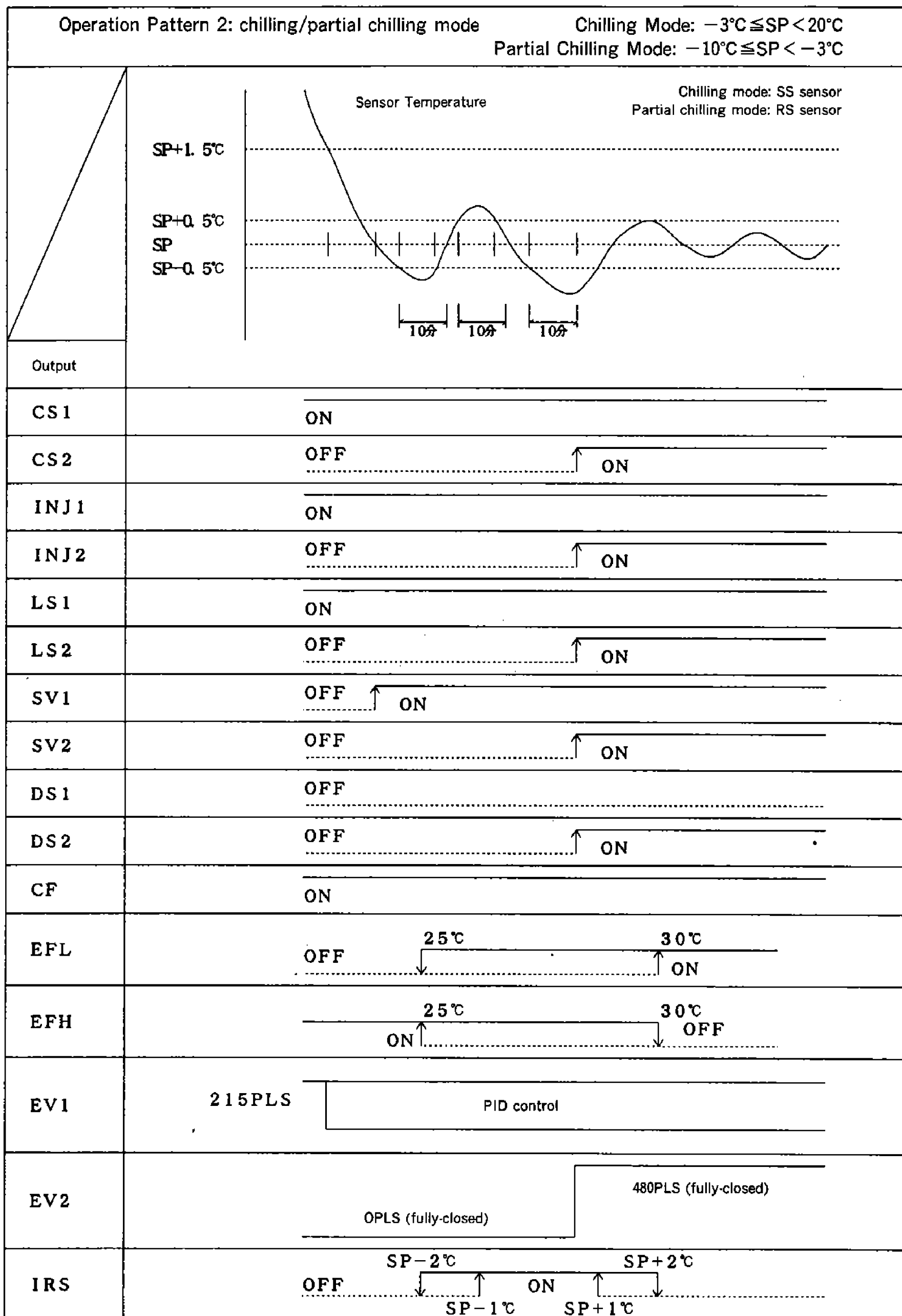
(2) When an evaporator outlet sensor (EVO*) is abnormal:

- The normal circuit is used as the main circuit (where defrosting is performed). The abnormal circuit is stopped or used for refrigerant measuring & heating operation.

(3) When both inlet and outlet sensors of an evaporator are abnormal:

- The normal circuit is used as the main circuit (where defrosting is performed). The abnormal circuit is stopped or used for refrigerant measuring & heating operation.





Operation Pattern 3: high-temperature chilling mode High-temperature Chilling Mode: $20^{\circ}\text{C} \leq \text{SP} < 25^{\circ}\text{C}$	
	<p>Sensor Temperature High-temperature chilling mode: SS sensor</p> <p>SP+1.5°C SP+0.5°C SP SP-0.5°C</p> <p>10分 10分</p>
Output	
CS1	ON OFF ON OFF ON
CS2	OFF
INJ1	ON OFF ON OFF ON
INJ2	OFF
LS1	ON OFF ON OFF ON
LS2	OFF
SV1	OFF ON OFF ON OFF ON
SV2	OFF
DS1	OFF ON
DS2	OFF
CF	ON OFF ON OFF ON
EFL	OFF 25°C 30°C ON
EFH	ON 25°C 30°C OFF
EV1	<p>Latest opening degree retention</p> <p>215 PLS PID control PID control 480 PLS PID control</p> <p>Latest opening degree retention</p>
EV2	OPLS (fully-closed)
IRS	OFF SP-2°C SP-1°C ON SP+1°C SP+2°C