DAIKIN

Marine type
Container Refrigeration Unit

Service manual

Model

LXE8A-C
LXE8A-CA
LXE8-C
LXE8-CA

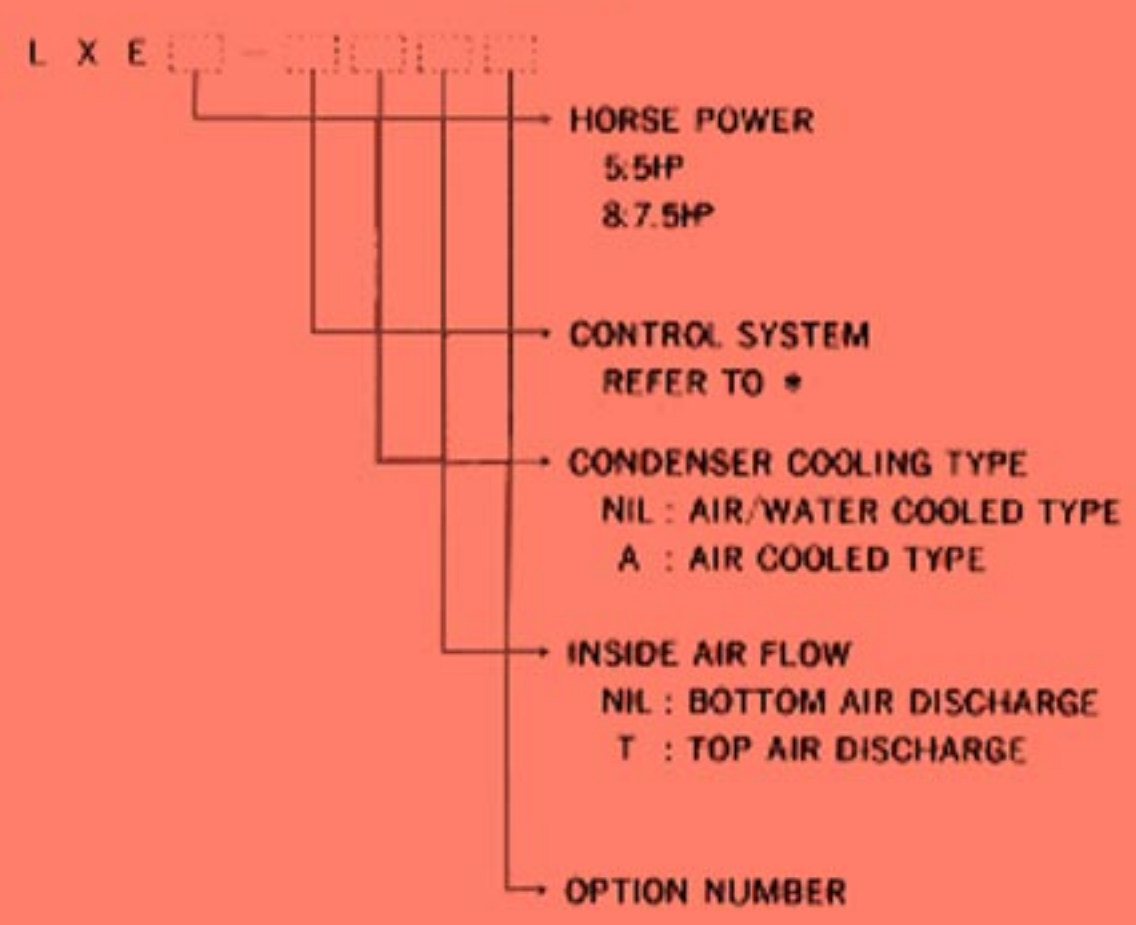
DAIKIN INDUSTRIES, LTD.

TR88-1B

This manual describes the features, functions, operation, and maintenance of the container refrigeration unit. In addition, please refer also to these manuals.

- Parts list
- Supplement (for the unit which has special specifications)

NOMENCLATURE



* (NIL) : DECOS (DAIKIN ELECTRONIC CONTAINER OPERATION SYSTEM)
C : COMP. ON/OFF CONTROL
H : COMP. ON/OFF + HOT GAS BYPASS CONTROL
R : RMC (REFRIGERATING MACHINE CONTROLS)
E : DECOS + ELECTRONIC RECORDER

NOTE)1. THERE ARE SEVERAL STANDARD SERVICE MANUALS & PARTS LISTS FOR EACH CONTROL SYSTEM. PLEASE USE PROPER SERVICE MANUAL & PARTS LIST.

2. "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. Do not touch the condenser fan during water cooled operation. (The condenser fan operates on and off to cool the switch box.)
3. Change over the cam switch before connecting the power plug.

CAUTION

Do not start the unit until a plug is connected and generator plant is operated.

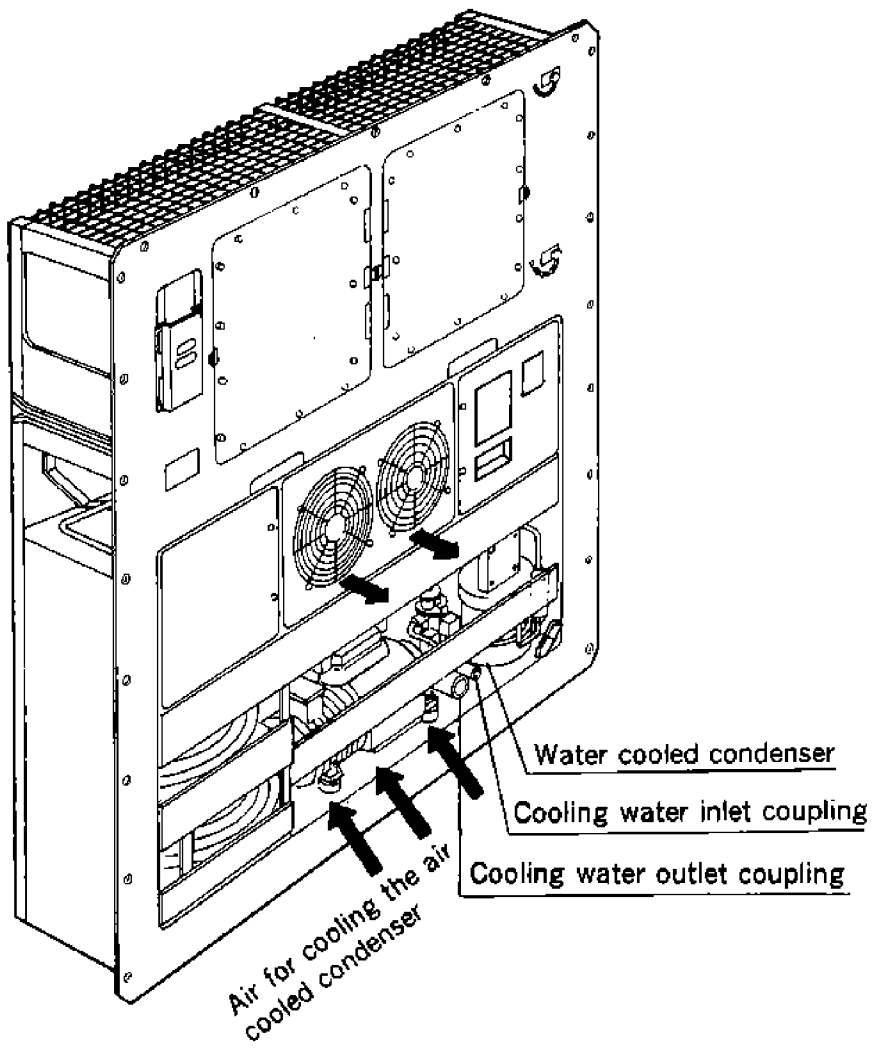
NOTE

1. Confirm the function of the temperature recorder and life of the battery when the chart paper is replaced with a new one. Properly set the date of chart paper.
2. Firmly tighten the covers of the switch box and control box not to make water ingress.
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 section of the unit carefully, because much salt sticks on the unit.

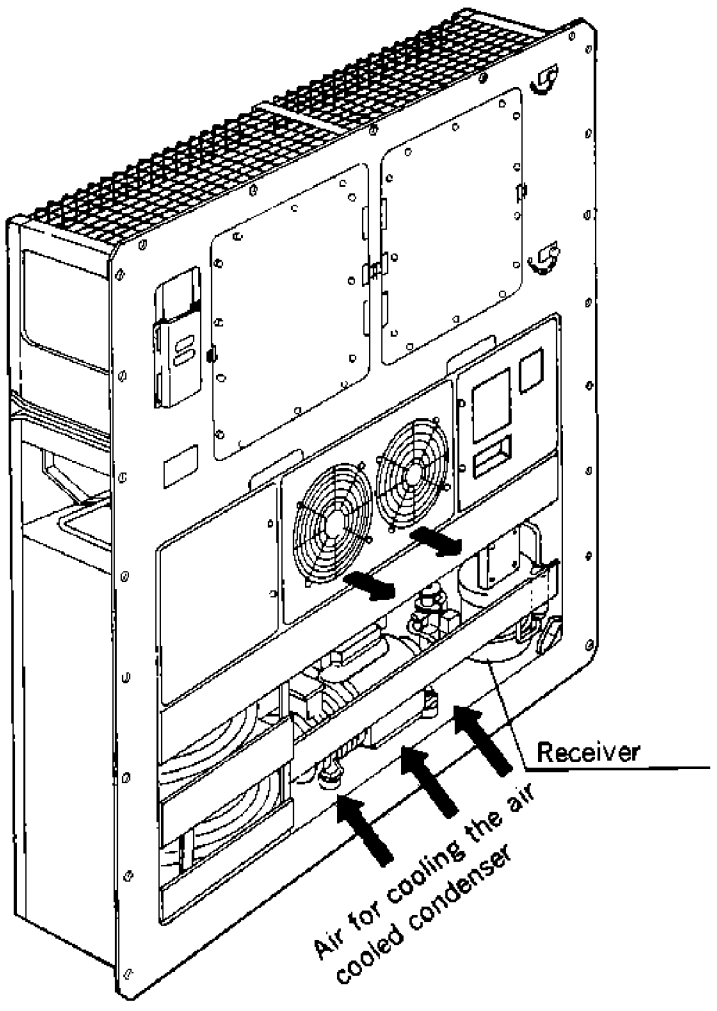
Relevant models

The following models are described in this service manual.

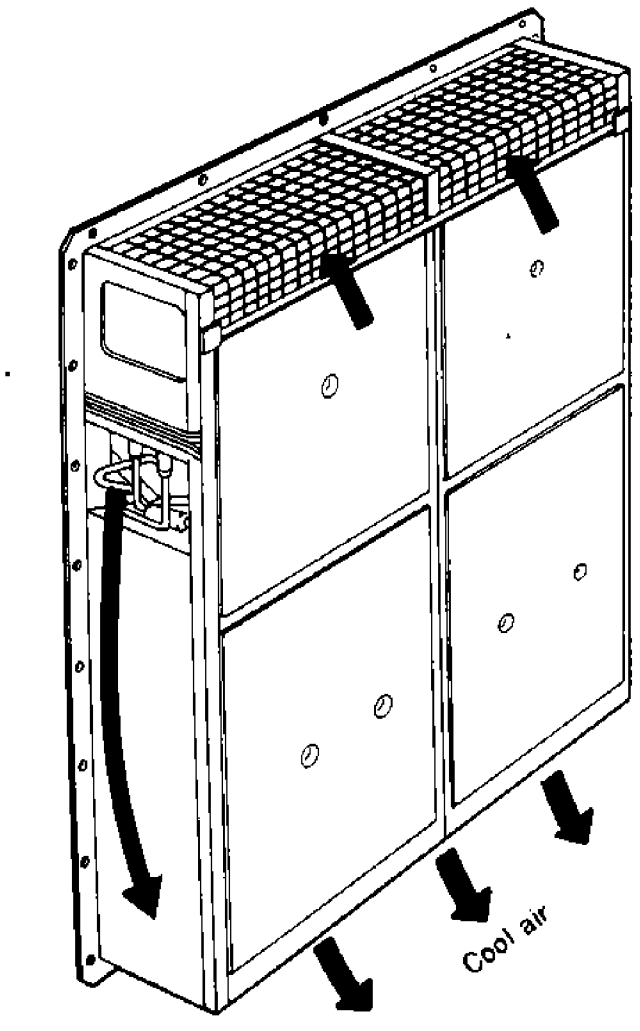
Model	LXE8(A)-C	LXE8(A)-CA
Inside air discharge direction	Bottom air discharge type	Bottom air discharge type
Condenser cooling type	Air/water cooled type	Air cooled type



Air/water cooled type (LXE8(A)-C)



Air cooled type (LXE8(A)-CA)



Bottom discharge type { LXE8(A)-C / LXE8(A)-CA }

Contents

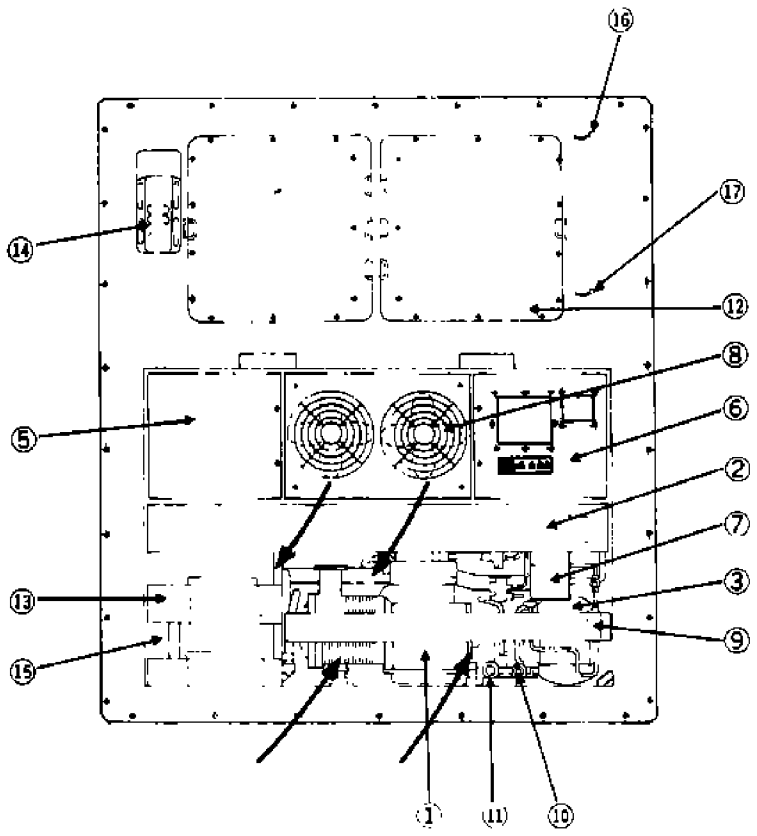
Chapter for operation

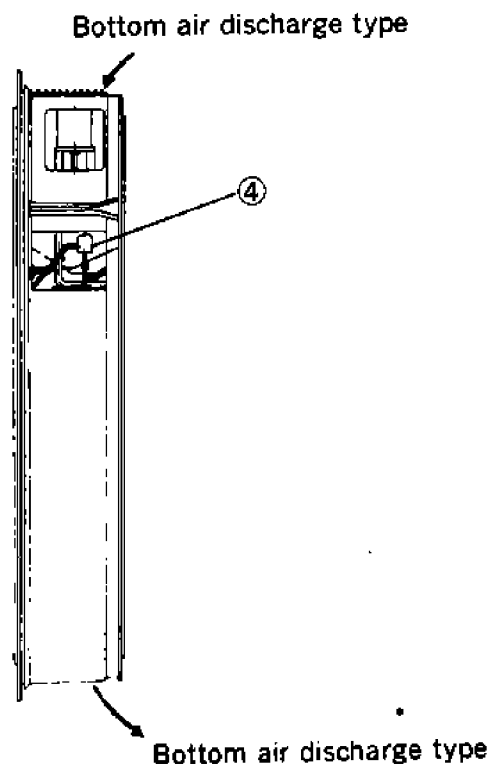
1. Operation ranges

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/cm²
Inside temperature range	−25°C～+25°C (−13°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. Names of parts



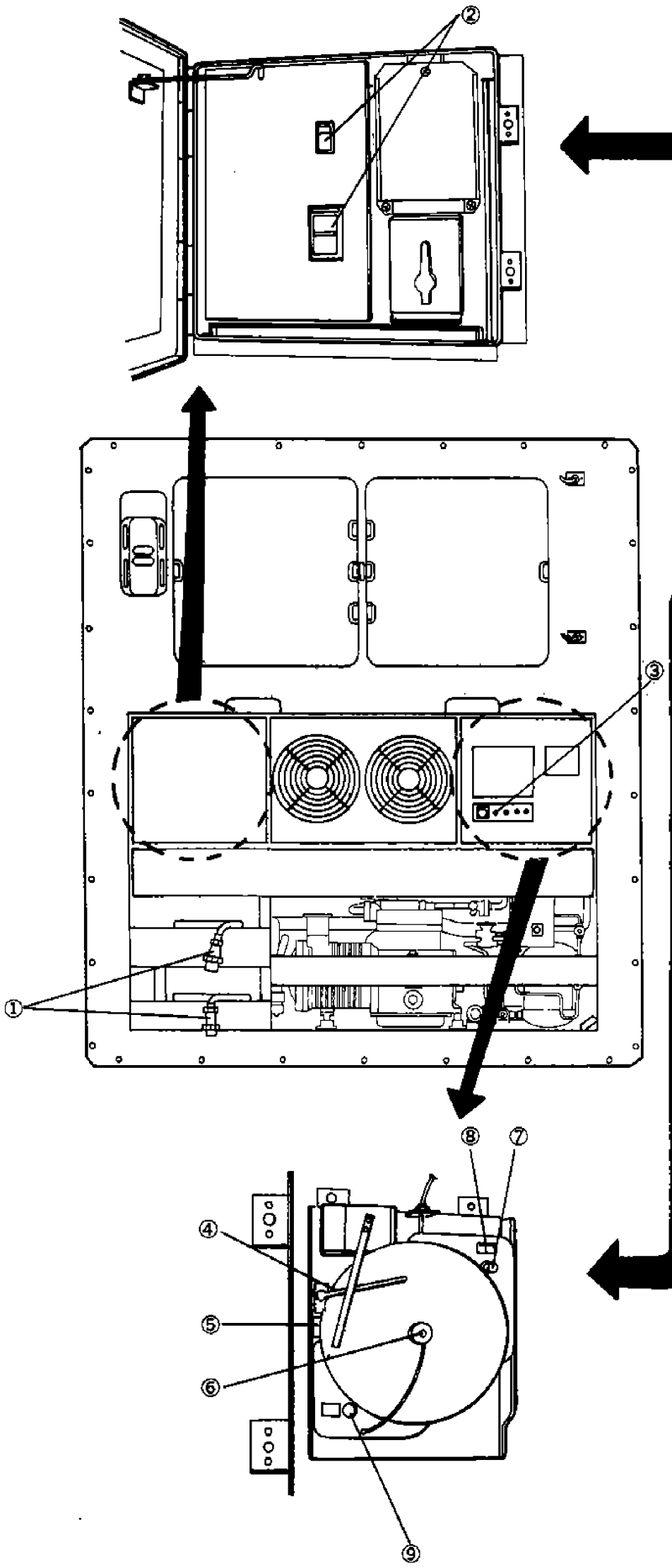


① Compressor
② Air cooled condenser
③ Water cooled condenser (Air/water cooled type)
Receiver (Air cooled type)
④ Evaporater
⑤ Switch box
Breaker for main circuit, breaker for control circuit voltage selector switch are installed in the box.
⑥ Control box
On the front, the operation switches are arranged, and controller and recorder are installed inside.
⑦ Oil pressure protection switch box (Option)
(The reset button is installed on the front cover of the box.)
⑧ Air cooled condenser fans
Operate during air cooled operation. Note that they sometimes operate to cool the switch box during water cooled operation.
⑨ Dryer
⑩ Cooling water inlet coupling
⑪ Cooling water outlet coupling
(Air/water cooled type)
Connect the water piping to them before water cooled operation, and air cooled operation is automatically changed to water cooled operation.
⑫ Access panel
⑬ Storage space for power cable
⑭ Ventilator
⑮ Transformer
⑯ Thermometer check point
⑰ Gas sampling port
○ Thermometer check point
(Use this port to measure inside temperature)
○ Gas sampling port
This port is available for CO_2 gas sampling as well as thermometer check point.

3. Operation

Operate the unit by the procedures given below.

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



3.1 Preparation and operation

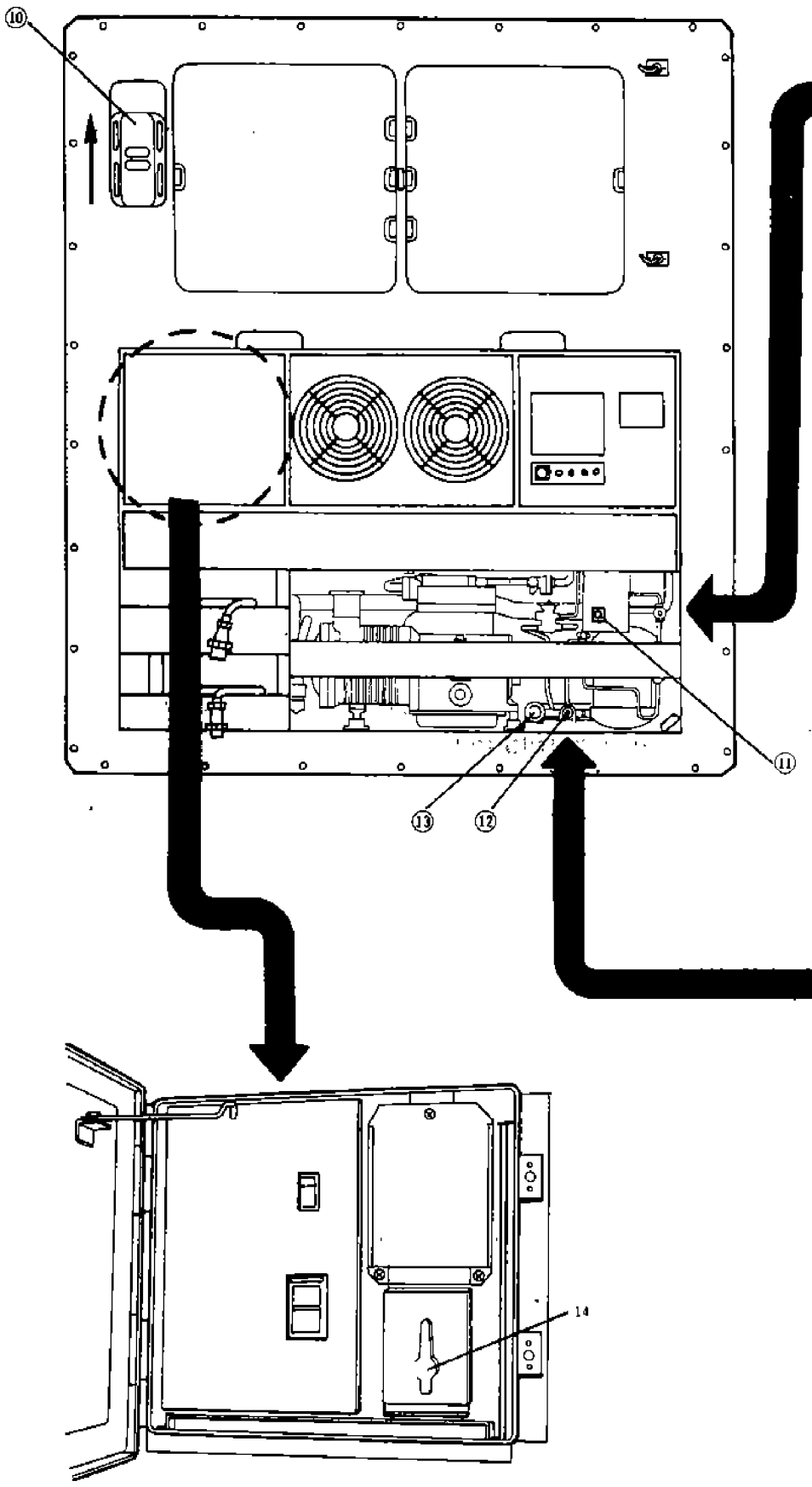
Confirm that supply power is off.
Confirm that the power source ①, the circuit breaker ② and unit ON-OFF switch ③ are turned off before checking for safety's sake.

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.
Open or close the ventilator ⑩ according to the cargo. (Be sure to keep it closed during transportation of frozen cargo.)

Reset the oil pressure protection switch. (Option)
Reset by pressing the button ⑪ on the front panel of the PS (Pressure switch) box. The unit does not start unless the switch is reset.

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

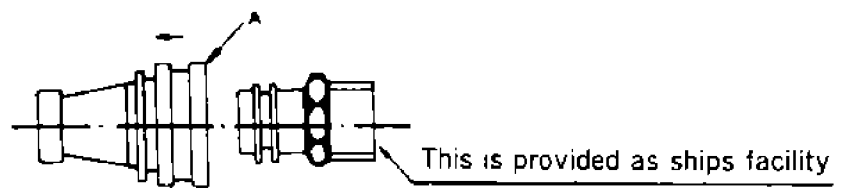
- In the case of water cooled operation, connect the water piping, and supply water through it.
- Connecting method

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.

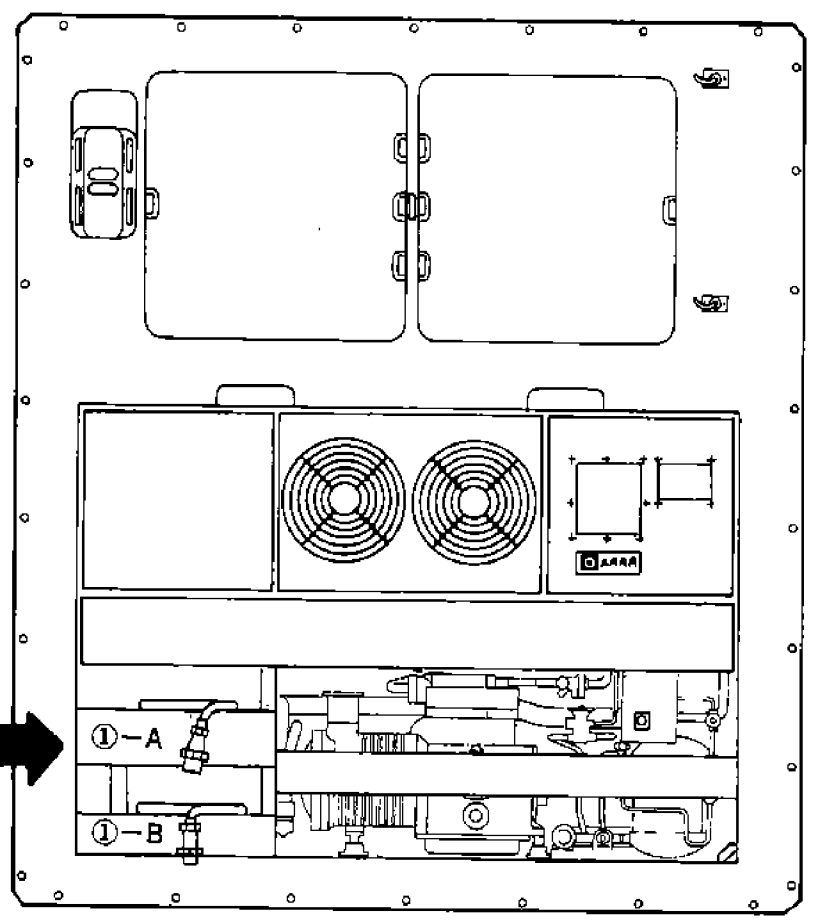
When the cooling water couplings are connected, insert the coupling on the ship side into the coupling on the unit side until a "click" is heard.



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.



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

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).

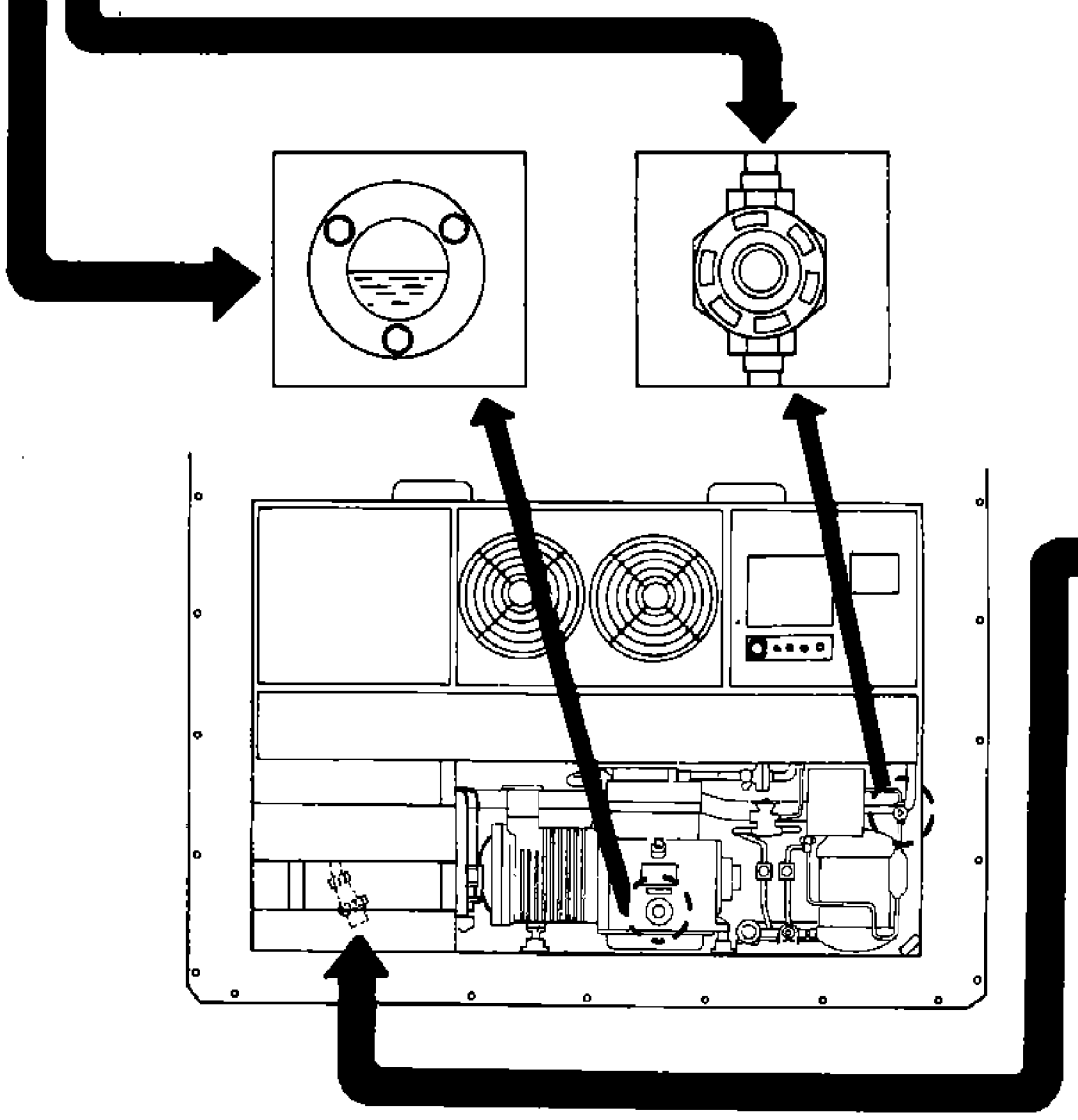
Turn ON the circuit breaker ② and unit ON-OFF switch ①.

Close the cover of the switch box.
If it is loose, water will intrude. Check around the packing and tighten the cover securely

Note: In case the oil pressure switch is attached (Option)
If the unit stops 2~3 minutes after starting, the oil pressure protection switch in many cases has been activated.
If this happens, depress the reset button a few minutes after the unit stops. If it stops again, repeat the same action.

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 to ensure oil pressure protection switch does not functions, and the unit does not stop.	—
3. Check suction and discharge pressures of the compressor. (For installation of a gauge, refer to Section 6 "Maintenance".)	Compare observed data with standard ones.
4. Check for proper oil level of compressor. Check to see the oil is clean. (Oil level may fall for a while after starting, but it rises gradually.)	Visual Oil level should be approx. ¼ to ¾ of its full scale.
5. 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.
6. 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.
7. Check if the recorder operates according to the inside temperature.	Visual
8. Check operating conditions with the pilot lamps and check instrument	Visual



3.3 Maintenance after operation

Stopping
To stop the unit, perform defrosting operation with the manual defrost switch and immediately turn off the unit ON-OFF switch after the compressor has stopped, (stop the unit with "pump-down" state.)
After pump down, turn off the circuit breaker.

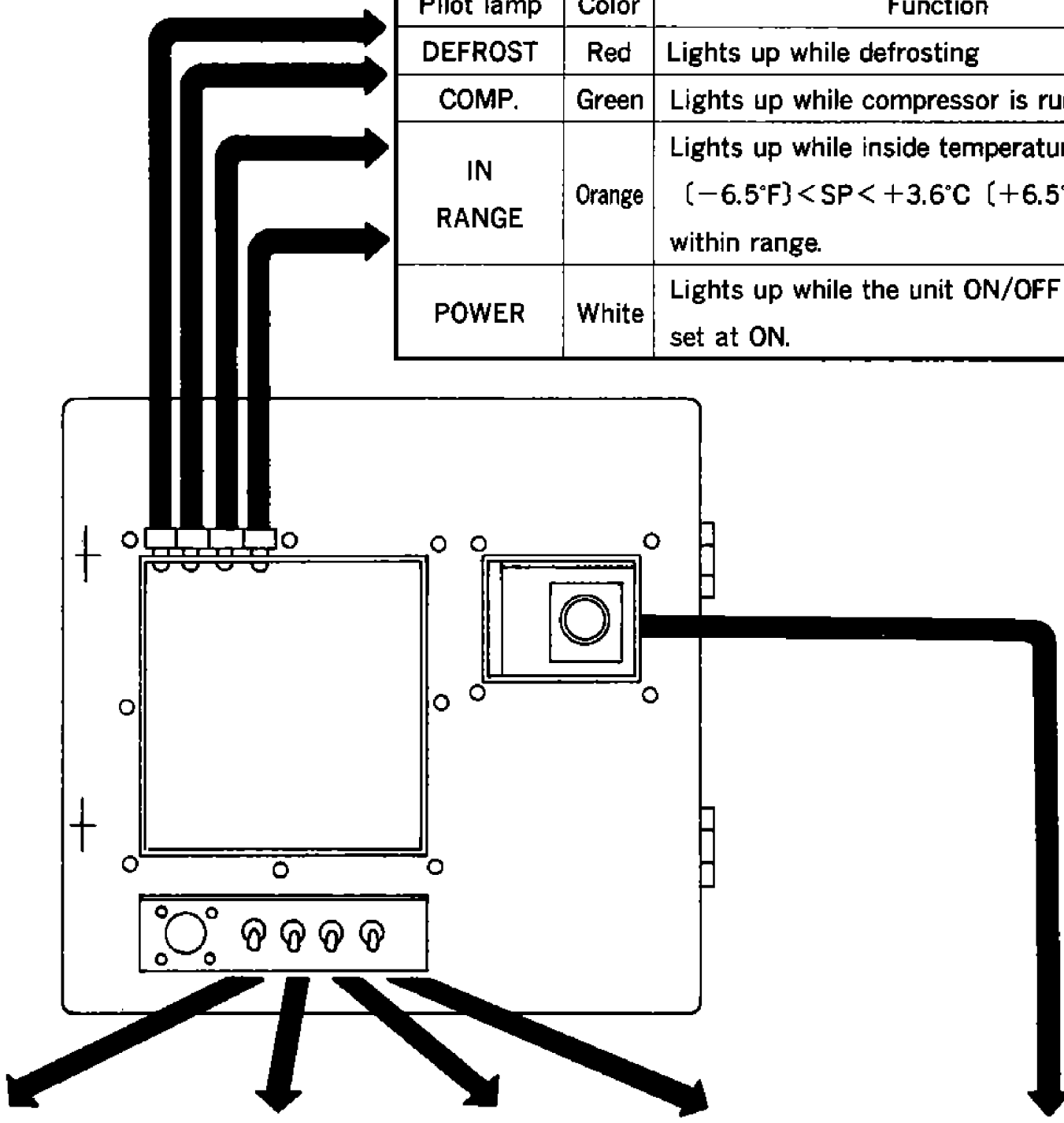
Stowing the power cable
Turn the plug's opening downward so that sea and rain water cannot enter the plug when stowing it.

Close the cover of the switch box.

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

3.4 Switches and pilot lamps

Pilot lamp	Color	Function
DEFROST	Red	Lights up while defrosting
COMP.	Green	Lights up while compressor is running
IN RANGE	Orange	Lights up while inside temperature (−3.6°C〔−6.5°F〕< SP < +3.6°C〔+6.5°F〕) is within range.
POWER	White	Lights up while the unit ON/OFF switch is set at ON.



Switch	Unit ON-OFF	Defrost AUTO-MANUAL		Heat-up ON-OFF	Lamp ON-OFF	Set point selector	
Operation mode	—	Defrost operation		Heat-up operation	—	Chilled operation	Frozen operation
Operation point	Turn on the switch	Automatic Defrosting starts automatically by the timer S : 4Hr L : 12Hr	Manual Turn on the switch	Turn on the switch (Only for chilled operation)	Turn on the switch.	Set the set point to −4.5°C～+25°C. (+23.9°F～+77°F)	Set the set point to −25°C～−6.5°C (−13°F～+20.3°F)
Function	The unit is operated on and off. After turning on the switch, the evaporator fan will operate one minute later.	The unit is put in hot-gas defrost operation. After finishing defrost operation, the unit is automatically put in chilled or frozen operation.		The unit is put in heat-up operation. After finishing heat-up operation, the unit is automatically put in chilled operation.	The pilot lamp lights up.	The unit is put in chilled operation and the evaporator fans operate in high speed. (If supply air temperature is above 20°C (68°F), evaporator fans operate in low speed.	The unit is put in frozen operation, and the evaporator fans operate in low speed.

Chapter for maintenance and repair

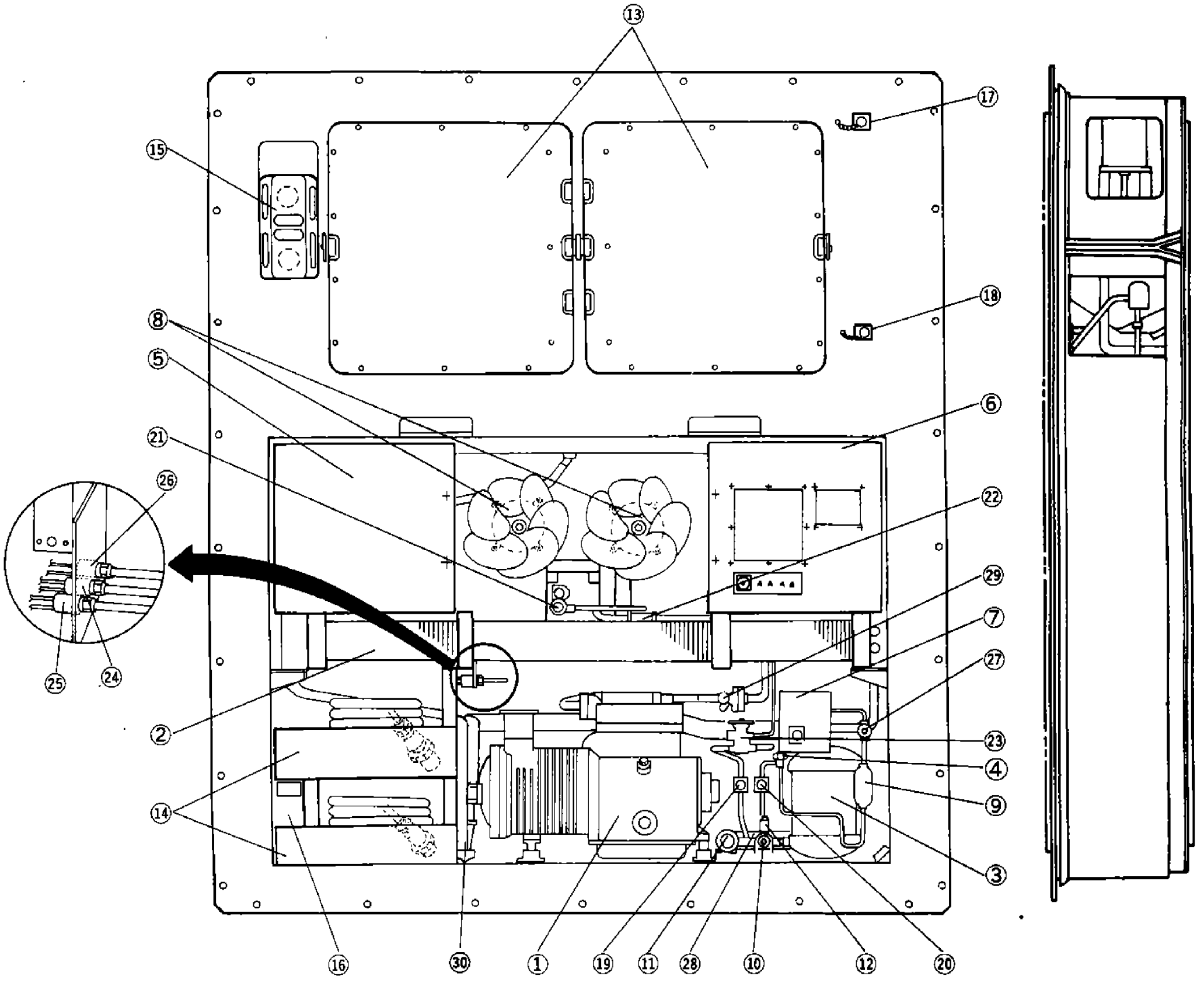
1. Data of the products

1.1 Main specifications

Item \ Model	LXE8(A)—C	LXE8(A)—CA
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	Semi hermetic type (5.5 kW)	
Evaporator	Cross finned coil type	
Air cooled condenser	Cross finned coil type	
Water cooled condenser	Vertical shell type	—
Fan	Motor direct driven propeller type	
Fan motor	Three-phase squirrel-cage induction motor	
Defrost Heating Initiation Termination	 Hot-gas defrost Timer or manual switch Sensing suction pipe temperature by the defrost termination thermistor	
Refrigerant control	Thermostatic expansion valve	
Capacity control	Compressor ON/OFF system	
Protection devices	Circuit breaker, over-current relay, compressor protective thermostat, fan motor protective thermostat, high pressure switch, and fusible safety plug, oil pressure protection switch (option)	
Refrigerant (charged amount)	R12 : 6.0 (kg)/13.3 (lbs)	
Lubricant (charged amount)	SUNISO 3GS-DI : 4.0 (ℓ)	
Weight	Approx. 665 (kg)/1466 (lbs)	Approx. 660 (kg)/1455 (lbs)

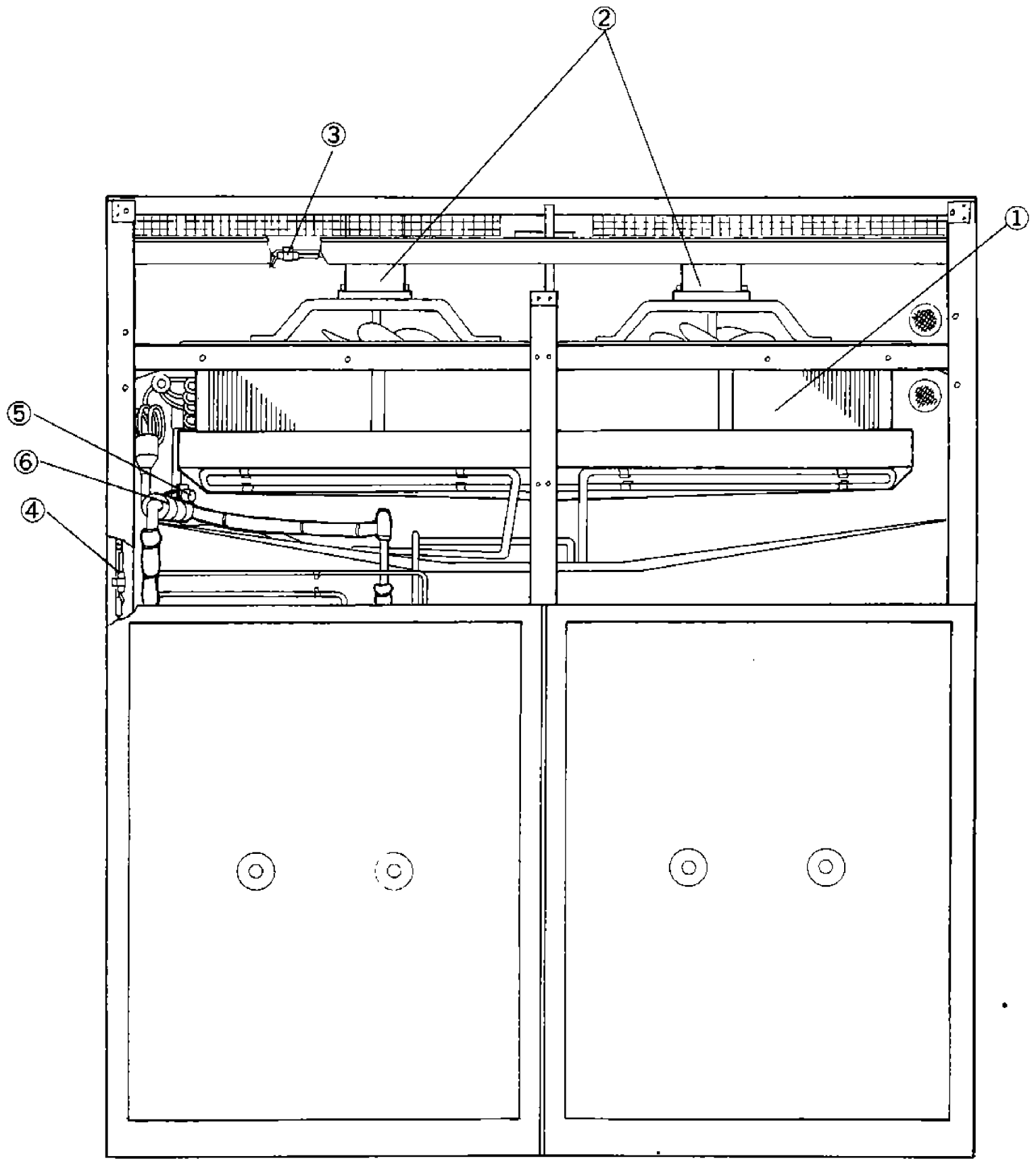
1.2 Names of parts

1.2.1 Outside



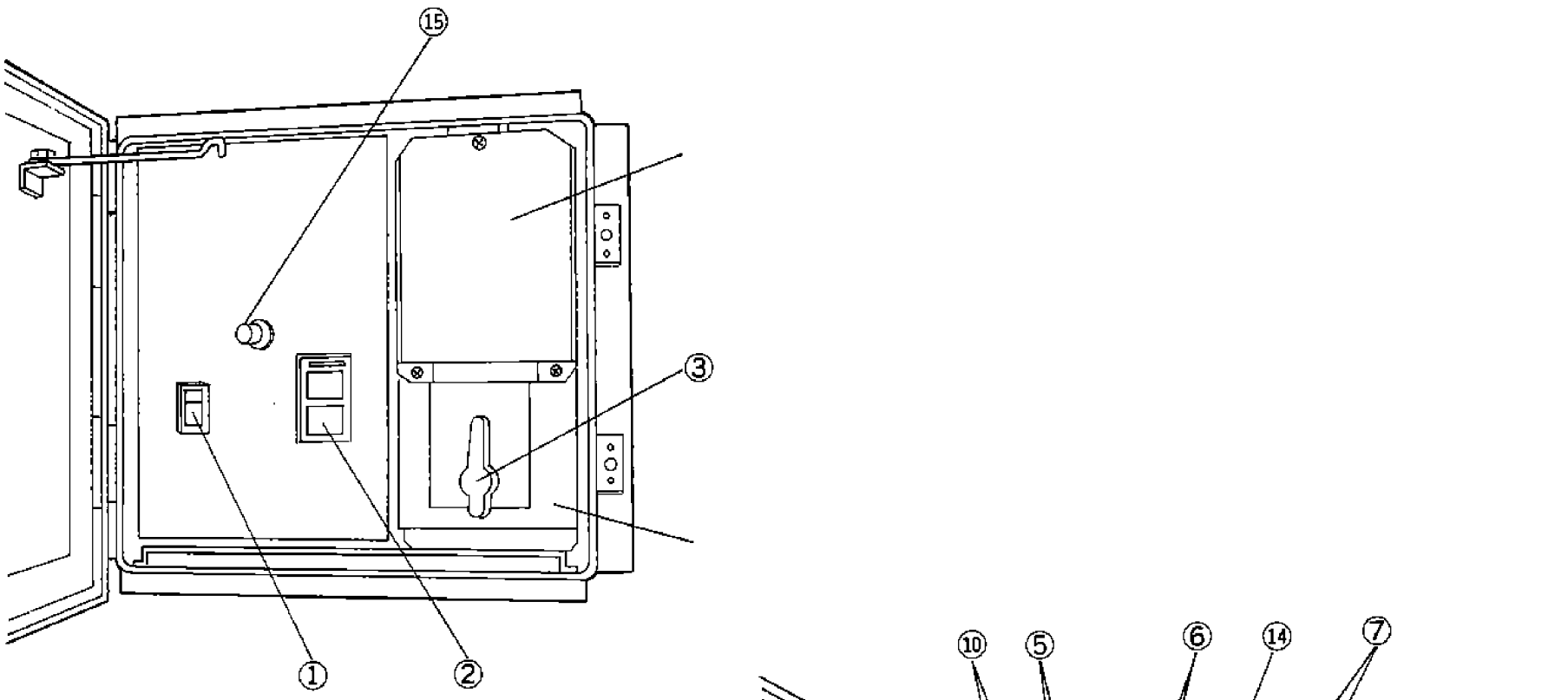
① Compressor
② Air cooled condenser
③ Water cooled condenser (Air/water cooled type) Receiver (Air cooled type)
④ Stop valve at water cooled condenser (receiver) outlet side
⑤ Switch box
⑥ Control box
⑦ Oil pressure protection switch box (Option)
⑧ Air cooled condenser fan motor
⑨ Dryer
⑩ Cooling water inlet coupling
⑪ Cooling water outlet coupling
⑫ Water pressure switch (63W)
(Air/water cooled type)
⑬ Access panel
⑭ Storage space for power cable
{Upper stage: 200V class / Lower stage: 400V class}
⑮ Ventilator
⑯ Transformer
⑰ Thermometer check point
⑱ Gas sampling port
⑲ Main liquid solenoid valve (20R1)
⑳ Measuring liquid solenoid valve (20R2)
㉑ 3 way solenoid valve for defrosting (20R4)
㉒ Check valve
㉓ Expansion valve
㉔ High pressure switch (63H1)
㉕ Low pressure switch (63L)
㉖ High pressure control switch (63H2)
㉗ Liquid/moisture indicator
㉘ Accumulator (for defrosting)
㉙ Stop valve at compressor discharge side
㉚ Stop valve at compressor suction side

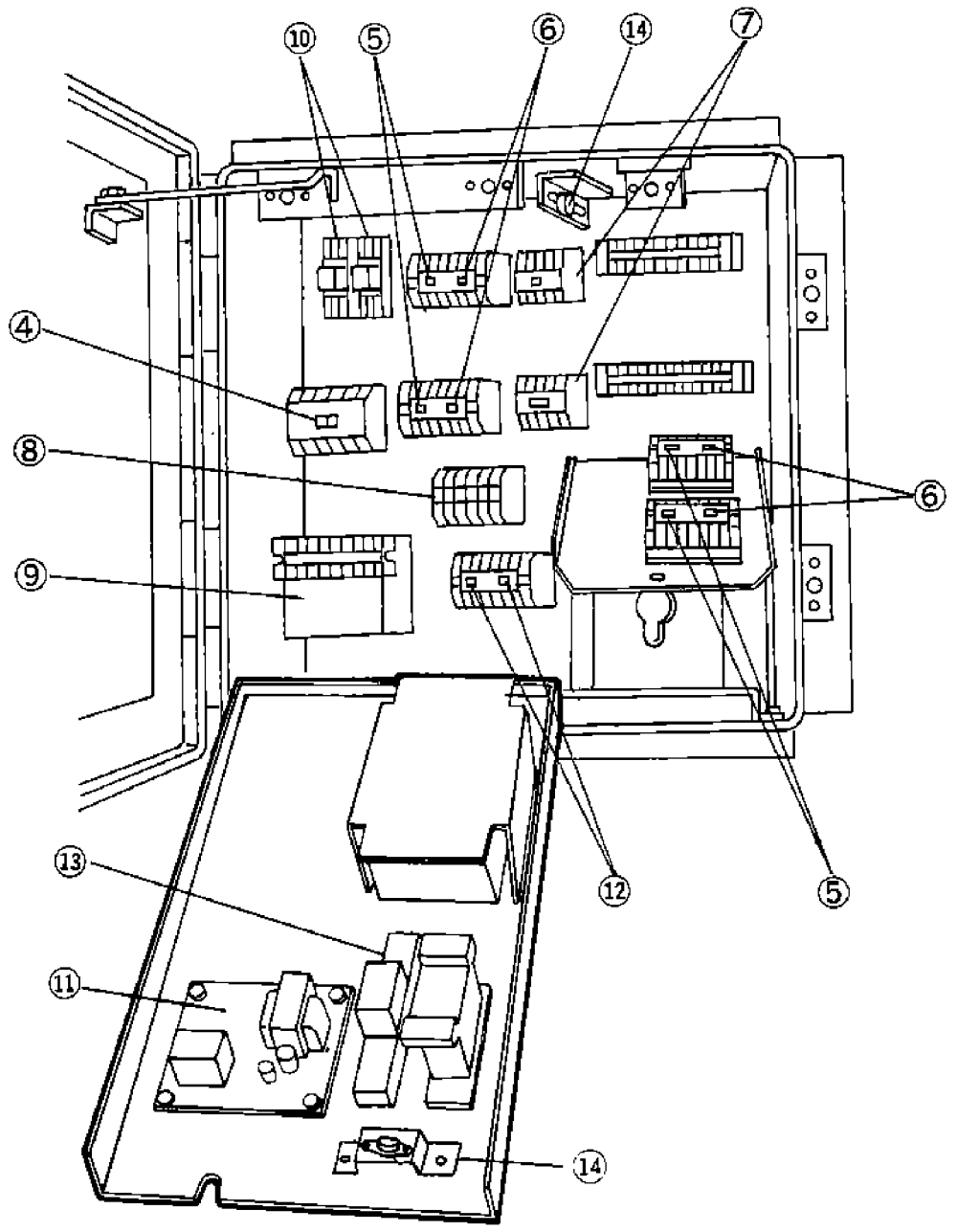
1.2.2 Inside



① Evaporator
② Evaporator fan motor
③ Return sensor and feeler tube (recorder)
④ Supply sensor
⑤ Defrost termination thermistor
⑥ Feeler tube (expansion valve)

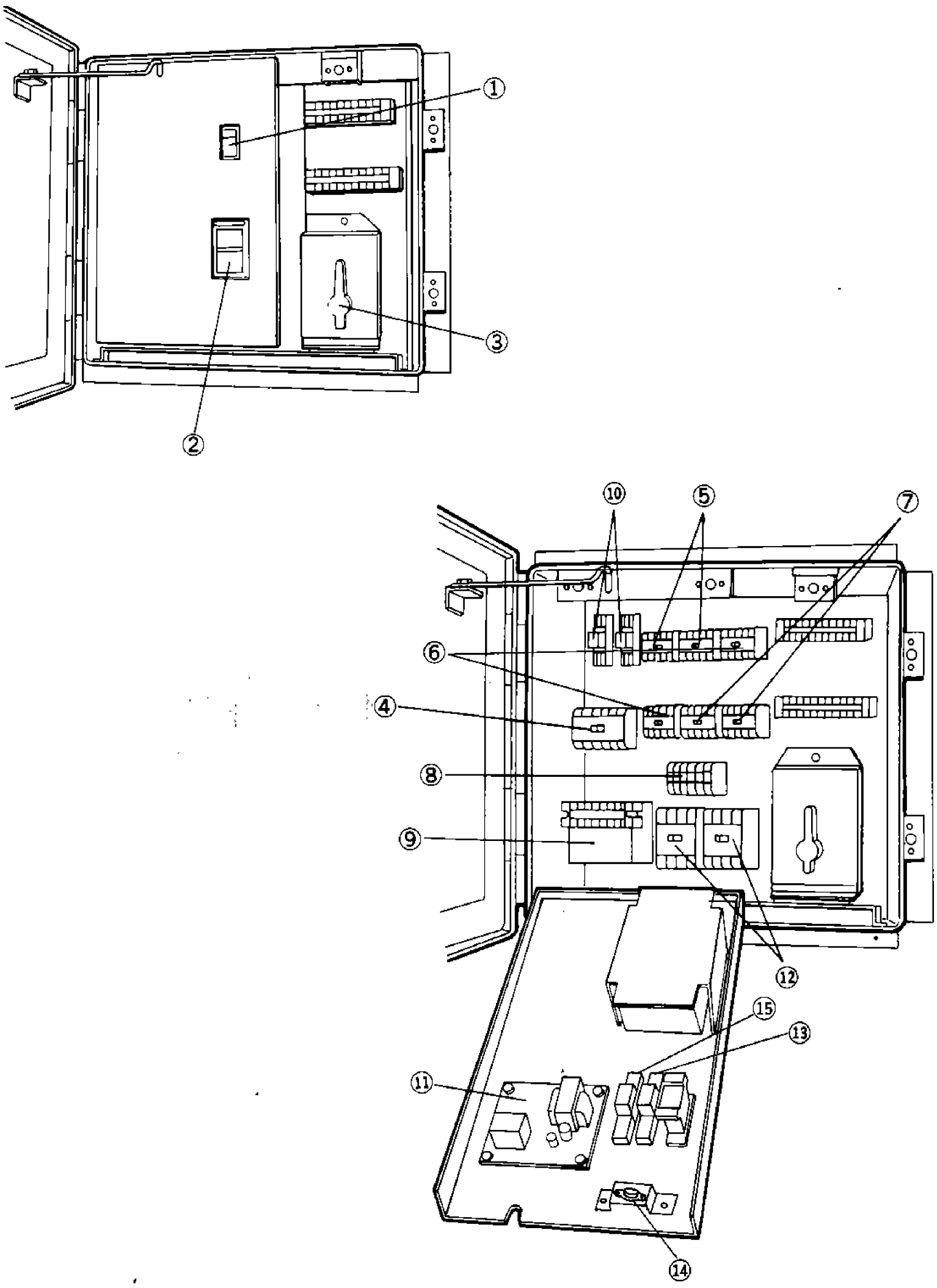
1.2.3 ①Switch box (producted after November, 1990)





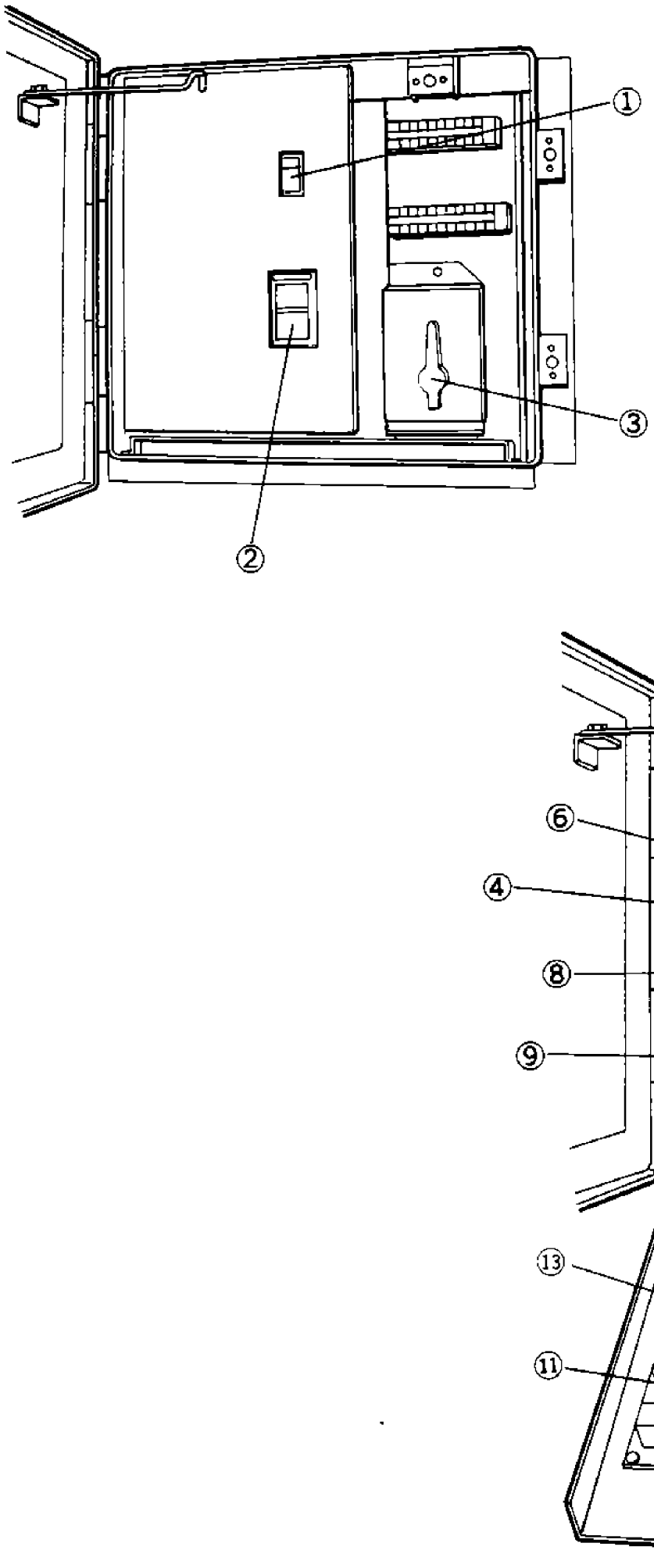
① Circuit breaker (52C2)
② Circuit breaker (52C1)
③ Voltage selector switch (83)
④ Magnetic contactor for compressor (88C)
⑤ Magnetic contactors for high speed evaporator fan motor (88EFH1-4)
⑥ Magnetic contactors for low speed evaporator fan motor (88EFL1-4)
⑦ Magnetic contactors for air cooled condenser fans (88CF1・2)
⑧ Over-current relay (51C)
⑨ Transformer (Tr2)
⑩ Auxiliary relays (49EFX1・2)
⑪ Phase sequence controller (47)
⑫ Magnetic contactors (47X1・2)
⑬ Auxiliary relay (63WX) } Air/water cooled type
⑭ Switch box thermostat }

1.2.3 ②Switch box (producted between February, 1989, and October, 1990)



① Circuit breaker (52C2)
② Circuit breaker (52C1)
③ Voltage selector switch (83)
④ Magnetic contactor for compressor (88C)
⑤ Magnetic contactors for high speed evaporator fan motor (88EFH1 • 2)
⑥ Magnetic contactor for low speed evaporator fan motor (88EFL1 • 2)
⑦ Magnetic contactors for air cooled condenser fans (88CF1 • 2)
⑧ Over-current relay (51C)
⑨ Transformer (Tr2)
⑩ Auxiliary relays (49EFX1 • 2)
⑪ Phase sequence controller (47)
⑫ Magnetic contactors (47X1 • 2)
⑬ Auxiliary relay (63WX) } Air/water cooled type
⑭ Switch box thermostat (26BH) } Air/water cooled type
⑮ Auxiliary relay (88EFHX2)

1.2.3 ③Switch box (producted before January, 1989)

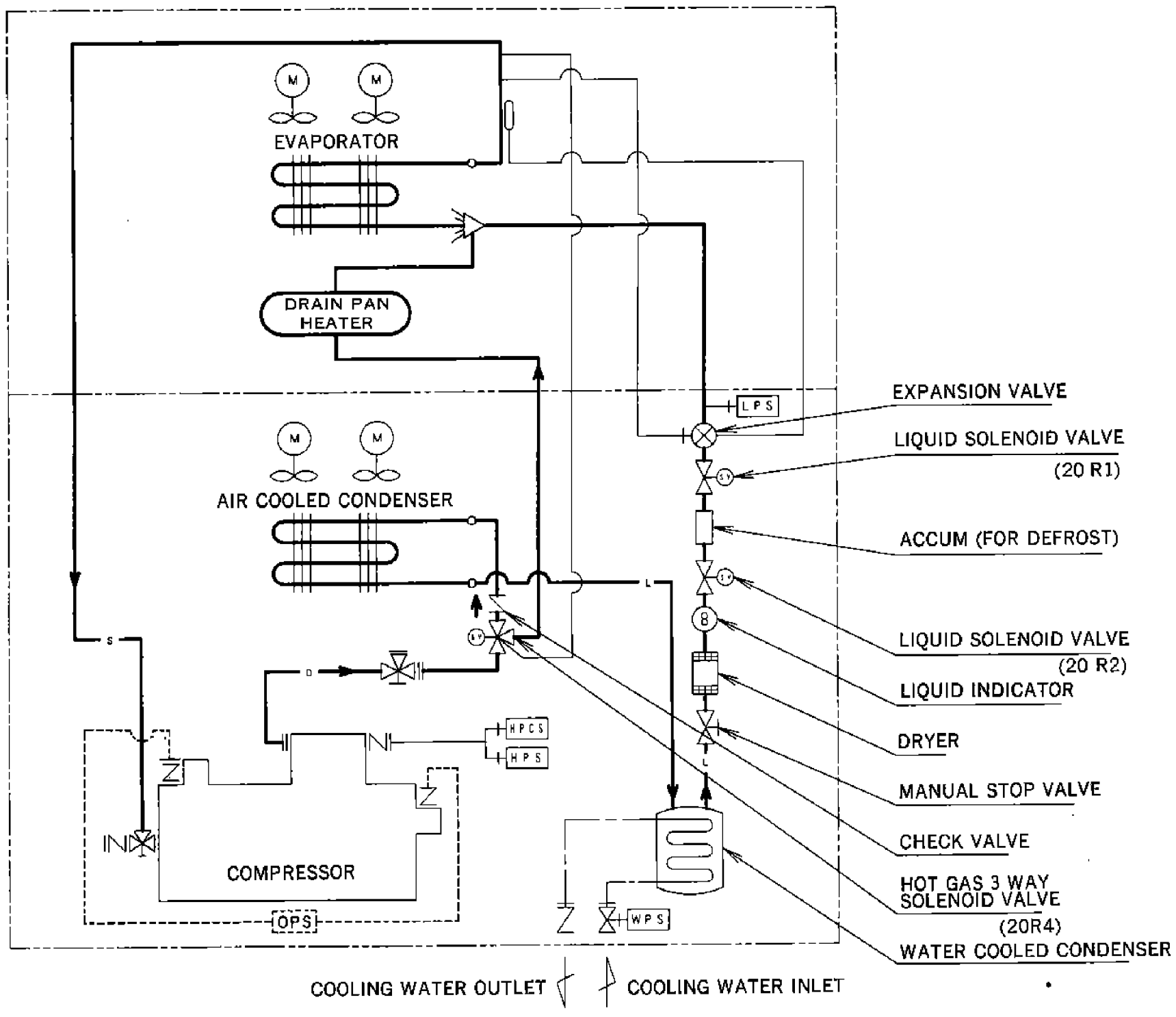


① Circuit breaker (52C2)
② Circuit breaker (52C1)
③ Voltage selector switch (83)
④ Magnetic contactor for compressor (88C)
⑤ Magnetic contactors for high speed evaporator fan motor (88EFH1 • 2 • 3)
⑥ Magnetic contactor for low speed evaporator fan motor (88EFL)
⑦ Magnetic contactors for air cooled condenser fans (88CF1 • 2)
⑧ Over-current relay (51C)
⑨ Transformer (Tr2)
⑩ Auxiliary relays (49EFX1 • 2)
⑪ Phase sequence controller (47)
⑫ Magnetic contactors (47X1 • 2)
⑬ Auxiliary relay (63WX) } Air/water cooled type
⑭ Switch box thermostat (26BH) }

1.2.4 Control box

① Unit ON-OFF switch (3-88)
② AUTO-MANUAL defrost switch (3-D)
③ ON-OFF heat-up switch (3-H)
④ ON-OFF pilot lamp switch (3-30L)
⑤ Set point selector
⑥ Receptacle for monitoring
⑦ Pilot lamp (Red-DEFROST)(RL)
⑧ Pilot lamp (Green-COMP.)(GL)
⑨ Pilot lamp (Orange-IN RANGE)(OL)
⑩ Pilot lamp (White-POWER)(WL)
⑪ Recorder
⑫ Electronic controller (23A1 · 2)
⑬ Magnetic relays for defrost (2DX1 · 2 · 3)
⑭ Magnetic relays (3X1 · 2 · 3)
⑮ Magnetic relays for heat up (3HX)
⑯ Auxiliary relays (88EFHX) (producted before October, 1990)
⑰ Magnetic relay (63LX)

1.3 Piping diagram

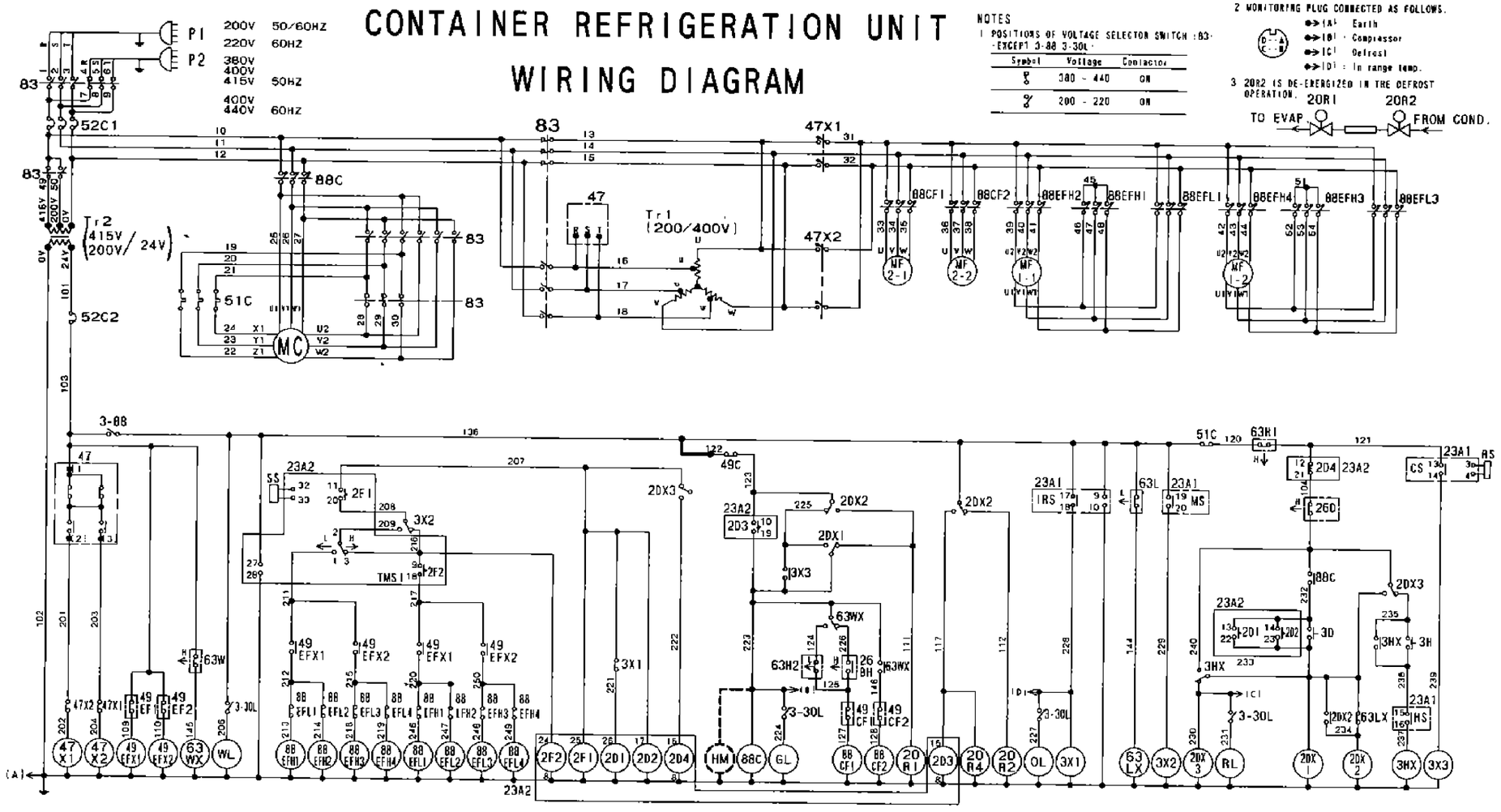


HPS (63H1)	HIGH PRESSURE SWITCH
LPS (63L)	LOW PRESSURE SWITCH
HPCS (63H2)	HIGH PRESSURE CONTROL SWITCH
OPS (63QL)	OIL PRESSURE PROTECTION SWITCH (Option)
WPS (63W)	WATER PRESSURE SWITCH (Air/water cooled type)

—L—	LIQUID PIPE
—S—	SUCTION PIPE
—D—	DISCHARGE PIPE
—||—	FLANGE CONNECTION
—|—	FLARE CONNECTION
— - —	WATER PIPE

Note: ····· **Shows optional specifications.**

CONTAINER REFRIGERATION UNIT
WIRING DIAGRAM



20T	TIME-LAG RELAY (4HOUR)	47X1,2	MAGNETIC CONTACTOR	MF2	MOTOR (COND. FAN)
2D2	TIME-LAG RELAY (12HOUR)	49C	THERMO SWITCH (MC)	OL	LAMP (ORANGE)
2D3	TIME-LAG RELAY (20SEC.)	49CF1,2	THERMO SWITCH (MF2)	P1,2	PLUG
2D4	TIME-LAG RELAY (90MIN.)	49EF1,2	THERMO SWITCH (MF1)	RL	LAMP (RED)
2F1	TIME-LAG RELAY (60SEC.)	49EFX1,2	MAGNETIC RELAY	R.S.	RETURN AIR SENSOR
2F2	TIME-LAG RELAY (10SEC.)	51C1,2	OVER CURRENT RELAY (MC)	S.S.	SUPPLY AIR SENSOR
2DX1~3	MAGNETIC RELAY (DEFROST)	52C	CIRCUIT BREAKER	Tr1	TRANSFORMER (MF)
3-88	SWITCH (UNIT ON-OFF)	63H1	PRESSURE SWITCH (HIGH)	Tr2	TRANSFORMER (CONTROL)
3-30L	SWITCH (LAMP)	63H2	PRESSURE SWITCH (FAN CUT)	WL	LAMP (WHITE)
3D	SWITCH (MANUAL DEFROST)	63L	PRESSURE SWITCH (LOW)		
3H	SWITCH (HEAT UP)	63W	PRESSURE SWITCH (WATER)		
3HX	MAGNETIC RELAY (HEAT UP)	63WX	MAGNETIC RELAY		
3X1~3	MAGNETIC RELAY	63LX	MAGNETIC RELAY		
20R1	SOLENOID VALVE (MAIN)	83	VOLTAGE SELECTOR SWITCH		
20R2	SOLENOID VALVE (MEASURING)	88C	MAGNETIC CONTACTOR (MC)		
20R4	SOLENOID VALVE (3 WAY)	88CF1,2	MAGNETIC CONTACTOR (MF2)		
23A1	ELECTRONIC CONTROLLER	88EFH1~4	MAGNETIC CONTACTOR (MF1)		
23A2	ELECTRONIC CONTROLLER	88EFL1~4	MAGNETIC CONTACTOR (MF1)		
26BH	THERMO SWITCH (SWITCH BOX)	GL	LAMP (GREEN)	OPTIONAL SPECIFICATION	
26D	THERMO SWITCH (DEF.TERMINATION)	MC	MOTOR (COMPRESSOR)	HM	HOUR METER
47	PHASE-REVERSAL RELAY	MF1	MOTOR (EVAP. FAN)		

注意

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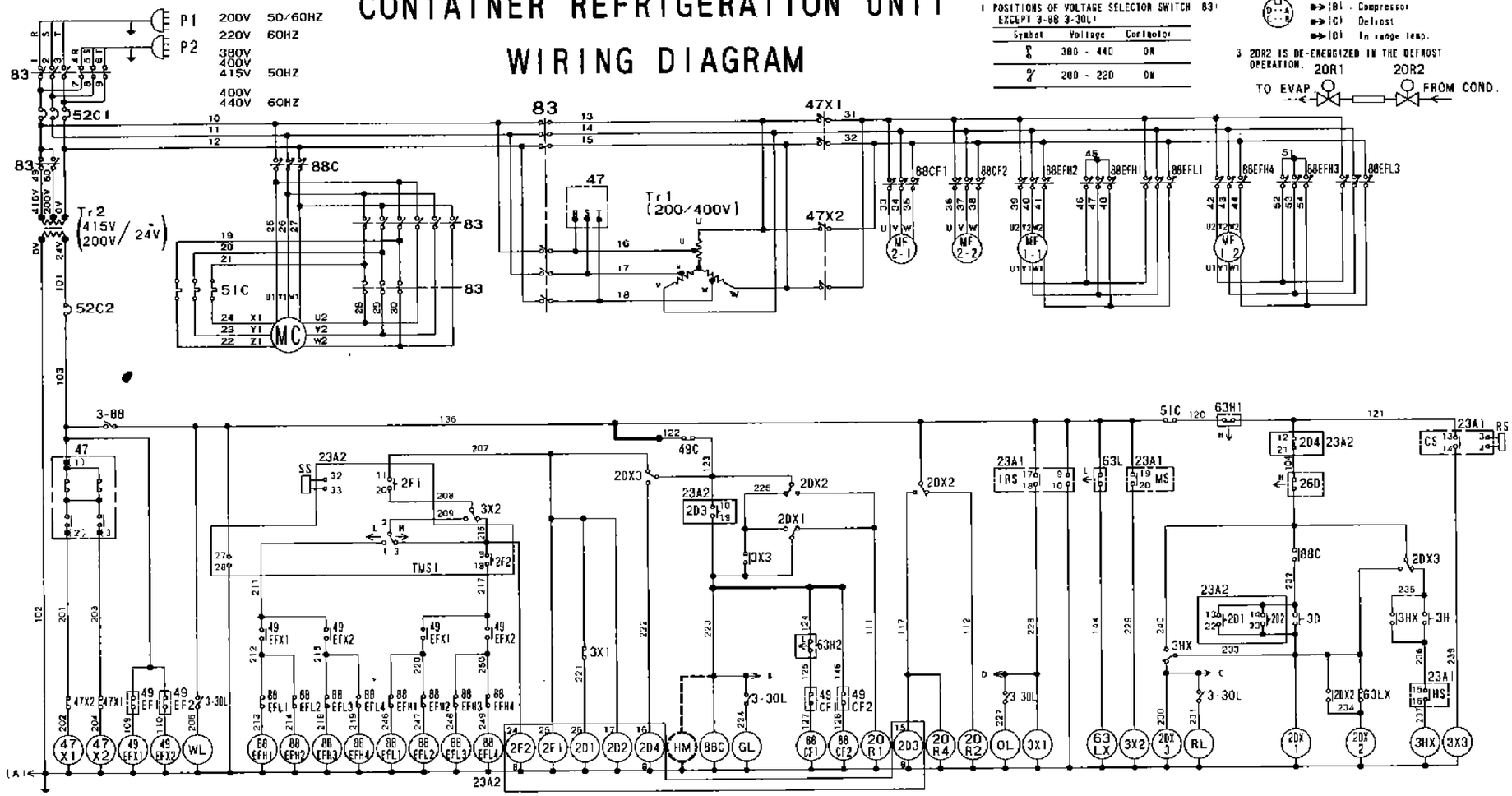
2. ------はオプション仕様を示す。
3. ●——●は短絡線を示す。

CAUTION

1. INSULATION TEST SHOULDN'T BE MADE TO CONTROL CIRCUIT (LINE NO.101~).
2. ------SHOWS OPTIONAL SPEC..
3. ●——●SHOWS JUMPER WIRE.

CONTAINER REFRIGERATION UNIT WIRING DIAGRAM



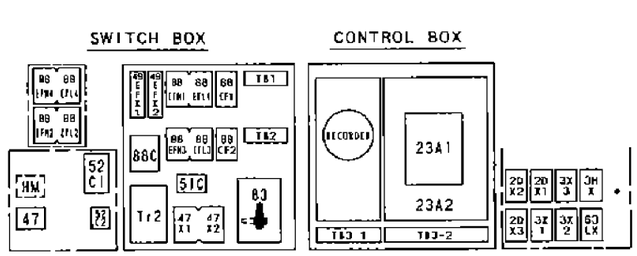
NOTES

1 POSITIONS OF VOLTAGE SELECTOR SWITCH 83 EXCEPT 3-88 3-30L

Symbol	Voltage	Contactor
R	380 ~ 440	ON
Y	200 ~ 220	ON

2 MONITORING PLUG CONNECTED AS FOLLOWS.
- (A) Earth
- (B) Compressor
- (C) Defrost
- (D) In range lamp.

3 20R2 IS DE-ENERGIZED IN THE DEFROST OPERATION.



2D1	TIME-LAG RELAY (4HOUR)	49C	THERMO SWITCH (MC)	RL	LAMP (RED)
2D2	TIME-LAG RELAY (12HOUR)	49CF1,2	THERMO SWITCH (MF2)	R S	RETURN AIR SENSOR
2D3	TIME-LAG RELAY (20SEC.)	49EF1,2	THERMO SWITCH (MF1)	S.S.	SUPPLY AIR SENSOR
2D4	TIME-LAG RELAY (90MIN.)	49EFX1,2	MAGNETIC RELAY	Tr1	TRANSFORMER (MF)
2F1	TIME-LAG RELAY (60SEC.)	51C1,2	OVER CURRENT RELAY (MC)	Tr2	TRANSFORMER (CONTROL)
2F2	TIME-LAG RELAY (10SEC.)	52C	CIRCUIT BREAKER	WL	LAMP (WHITE)
2DX1~3	MAGNETIC RELAY (DEFROST)	63H1	PRESSURE SWITCH (HIGH)		
3-88	SWITCH (UNIT ON-OFF)	63H2	PRESSURE SWITCH (FAN CUT)		
3-30L	SWITCH (LAMP)	63L	PRESSURE SWITCH (LOW)		
3D	SWITCH (MANUAL DEFROST)	63LX	MAGNETIC RELAY		
3H	SWITCH (HEAT UP)	83	VOLTAGE SELECTOR SWITCH		
3HX	MAGNETIC RELAY (HEAT UP)	88C	MAGNETIC CONTACTOR (MC)		
3X1~3	MAGNETIC RELAY	88CF1,2	MAGNETIC CONTACTOR (MF2)		
20R1	SOLENO D VALVE (MAIN)	88EFH1~4	MAGNETIC CONTACTOR (MF1)		
20R2	SOLENO D VALVE (MEASURING)	88EFL1~4	MAGNETIC CONTACTOR (MF1)		
20R4	SOLENO D VALVE (3 WAY)	GL	LAMP (GREEN)		
23A1	ELECTRONIC CONTROLLER	MC	MOTOR (COMPRESSOR)		
23A2	ELECTRONIC CONTROLLER	MF1	MOTOR (EVAP. FAN)		
26D	THERMO SWITCH (DEF.TERMINATION)	MF2	MOTOR (COND. FAN)	OPTIONAL SPECIFICATION	
47	PHASE-REVERSAL RELAY	OL	LAMP (ORANGE)	HM	HOUR METER
47X1,2	MAGNETIC CONTACTOR	P1,2	PLUG		

注意

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CAUTION

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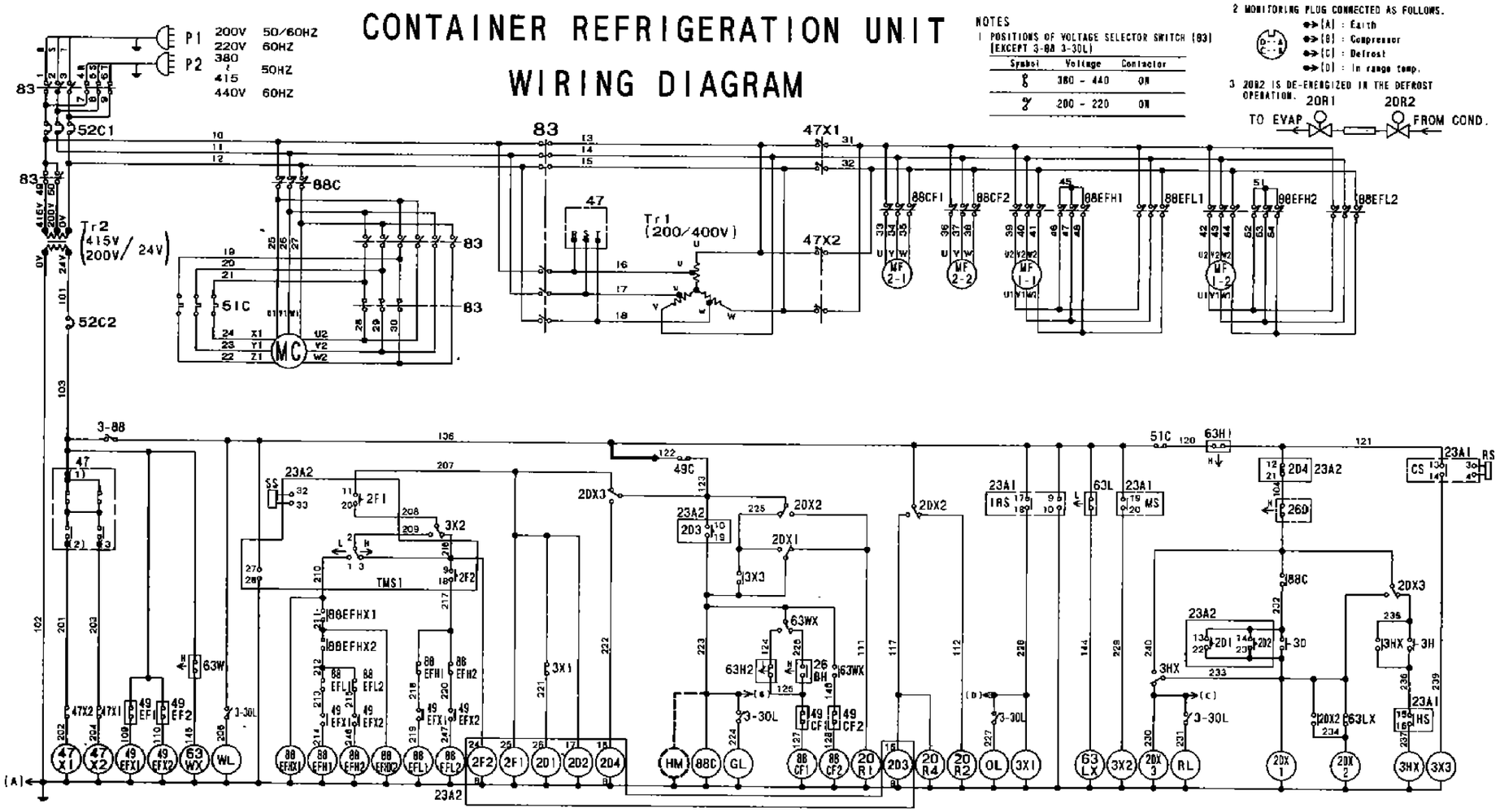
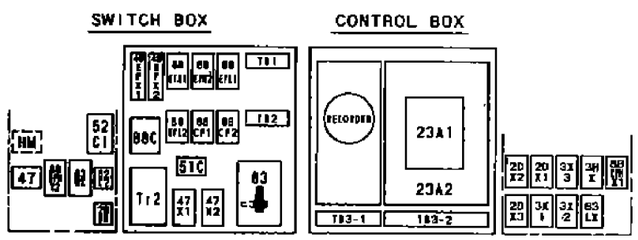
2. ----SHOWS OPTIONAL SPEC..
3. ●━━●SHOWS JUMPER WIRE.

CONTAINER REFRIGERATION UNIT
WIRING DIAGRAM





2D1	TIME-LAG RELAY (4HOUR)	47X1,2	MAGNETIC CONTACTOR	MF1	MOTOR (EVAP. FAN)
2D2	TIME-LAG RELAY (12HOUR)	49C	THERMO SWITCH (MC)	MF2	MOTOR (COND. FAN)
2D3	TIME-LAG RELAY (20SEC.)	49CF1,2	THERMO SWITCH (MF2)	OL	LAMP (ORANGE)
2D4	TIME-LAG RELAY (90MIN.)	49EF1,2	THERMO SWITCH (MF1)	P1,2	PLUG
2F1	TIME-LAG RELAY (60SEC.)	49EFX1,2	MAGNETIC RELAY	RL	LAMP (RED)
2F2	TIME-LAG RELAY (10SEC.)	51C1,2	OVER CURRENT RELAY (MC)	R.S.	RETURN AIR SENSOR
2DX1~3	MAGNETIC RELAY (DEFROST)	52C	CIRCUIT BREAKER	S.S.	SUPPLY AIR SENSOR
3-88	SWITCH (UNIT ON-OFF)	63H1	PRESSURE SWITCH (HIGH)	Tr1	TRANSFORMER (MF)
3-30L	SWITCH (LAMP)	63H2	PRESSURE SWITCH (FAN CUT)	Tr2	TRANSFORMER (CONTROL)
30	SWITCH (MANUAL DEFROST)	63L	PRESSURE SWITCH (LOW)	WL	LAMP (WHITE)
3H	SWITCH (HEAT UP)	63W	PRESSURE SWITCH (WATER)		
3HX	MAGNETIC RELAY (HEAT UP)	63WX	MAGNETIC RELAY		
3X1~3	MAGNETIC RELAY	63LX	MAGNETIC RELAY		
20R1	SOLENOID VALVE (MAIN)	83	VOLTAGE SELECTOR SWITCH		
20R2	SOLENOID VALVE (MEASURING)	88C	MAGNETIC CONTACTOR (MC)		
20R4	SOLENOID VALVE (3 WAY)	88CF1,2	MAGNETIC CONTACTOR (MF2)		
23A1	ELECTRONIC CONTROLLER	88EFH1,2	MAGNETIC CONTACTOR (MF1)		
23A2	ELECTRONIC CONTROLLER	88EFHX1,2	MAGNETIC RELAY		
26BH	THERMO SWITCH (SWITCH BOX)	88EFL1,2	MAGNETIC CONTACTOR (MF1)	OPTIONAL SPECIFICATION	
26D	THERMO SWITCH (DEF.TERMINATION)	GL	LAMP (GREEN)	HM	HOUR METER
47	PHASE-REVERSAL RELAY	MC	MOTOR (COMPRESSOR)		

注意

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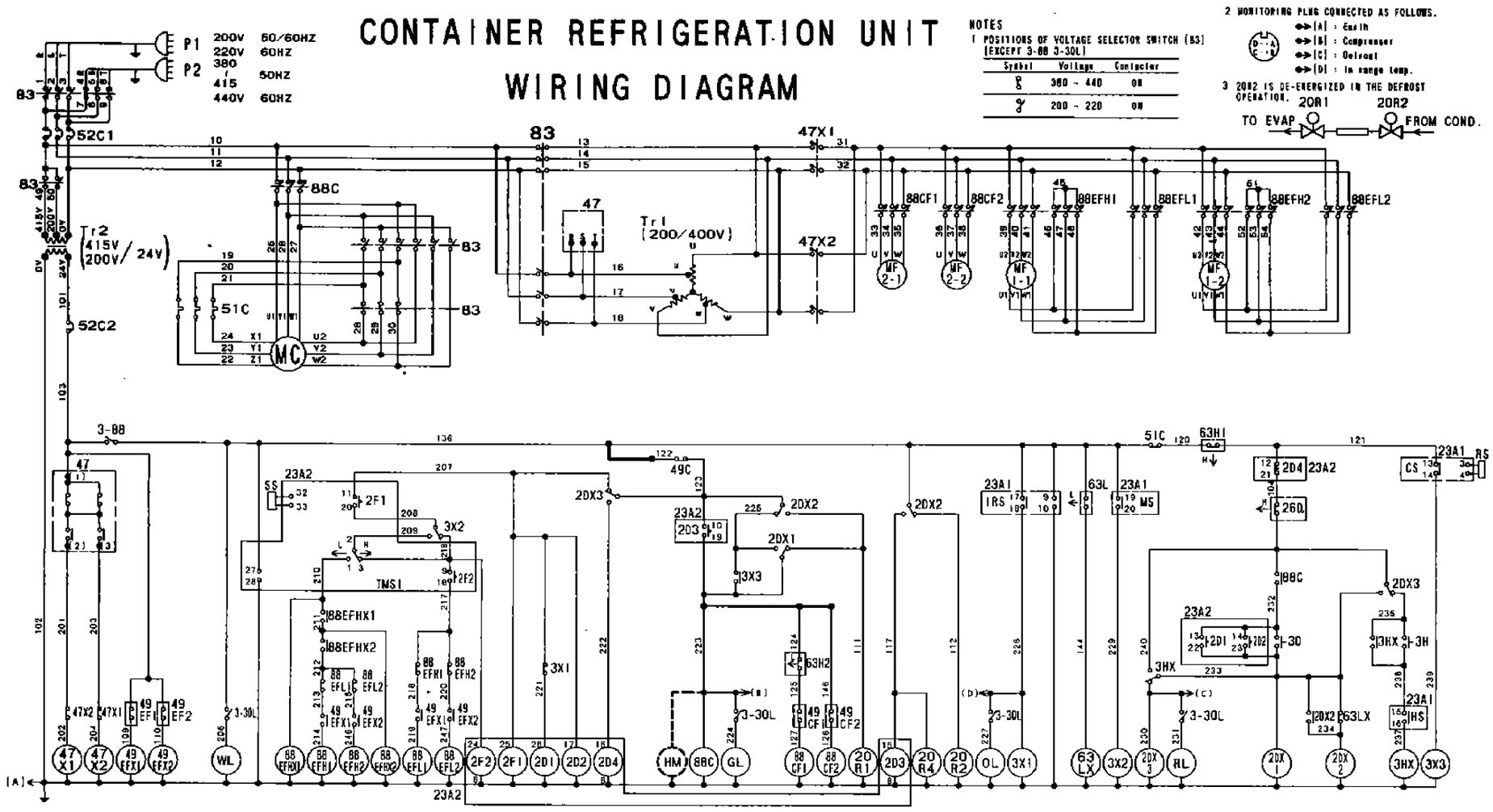
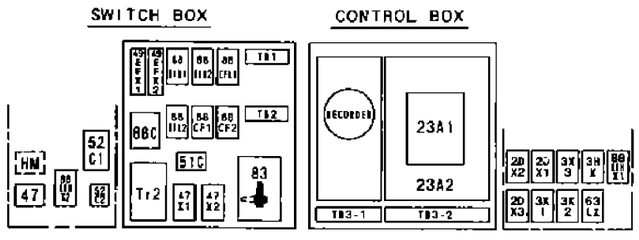
CAUTION

1. INSULATION TEST SHOULDN'T BE MADE TO CONTROL CIRCUIT (LINE NO.101～).
2. ---- SHOWS OPTIONAL SPEC..
3. ●——● SHOWS JUMPER WIRE.

CONTAINER REFRIGERATION UNIT
WIRING DIAGRAM





2D1	TIME-LAG RELAY (4HOUR)	49C	THERMO SWITCH (MC)	P1,2	PLUG
2D2	TIME-LAG RELAY (12HOUR)	49CF1,2	THERMO SWITCH (MF2)	RL	LAMP (RED)
2D3	TIME-LAG RELAY (20SEC.)	49EF1,2	THERMO SWITCH (MF1)	R.S.	RETURN AIR SENSOR
2D4	TIME-LAG RELAY (90MIN.)	49EFX1,2	MAGNETIC RELAY	S.S.	SUPPLY AIR SENSOR
2F1	TIME-LAG RELAY (60SEC.)	51C1,2	OVER CURRENT RELAY (MC)	Tr1	TRANSFORMER (MF)
2F2	TIME-LAG RELAY (10SEC.)	52C	CIRCUIT BREAKER	Tr2	TRANSFORMER (CONTROL)
2DX1-3	MAGNETIC RELAY (DEFROST)	63H1	PRESSURE SWITCH (HIGH)	WL	LAMP (WHITE)
3-88	SWITCH (UNIT ON-OFF)	63H2	PRESSURE SWITCH (FAN CUT)		
3-30L	SWITCH (LAMP)	63L	PRESSURE SWITCH (LOW)		
3D	SWITCH (MANUAL DEFROST)	63LX	MAGNETIC RELAY		
3H	SWITCH (HEAT UP	83	VOLTAGE SELECTOR SWITCH		
3HX	MAGNETIC RELAY (HEAT UP)	88C	MAGNETIC CONTACTOR (MC)		
3X1-3	MAGNETIC RELAY	88CF1,2	MAGNETIC CONTACTOR (MF2)		
20R1	SOLENOID VALVE (MAIN)	88EFH1,2	MAGNETIC CONTACTOR (MF1)		
20R2	SOLENOID VALVE (MEASURING)	88EFHX1,2	MAGNETIC RELAY		
20R4	SOLENOID VALVE (3 WAY)	88EFL1,2	MAGNETIC CONTACTOR (MF1)		
23A1	ELECTRONIC CONTROLLER	GL	LAMP (GREEN)		
23A2	ELECTRONIC CONTROLLER	MC	MOTOR (COMPRESSOR)		
26D	THERMO SWITCH (DEF.TERMINATION)	MF1	MOTOR (EVAP. FAN)	OPTIONAL SPECIFICATION	
47	PHASE-REVERSAL RELAY	MF2	MOTOR (COND. FAN)	HM	HOUR METER
47X1,2	MAGNETIC CONTACTOR	OL	LAMP (ORANGE)		

注意

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2. ------はオプション仕様を示す。
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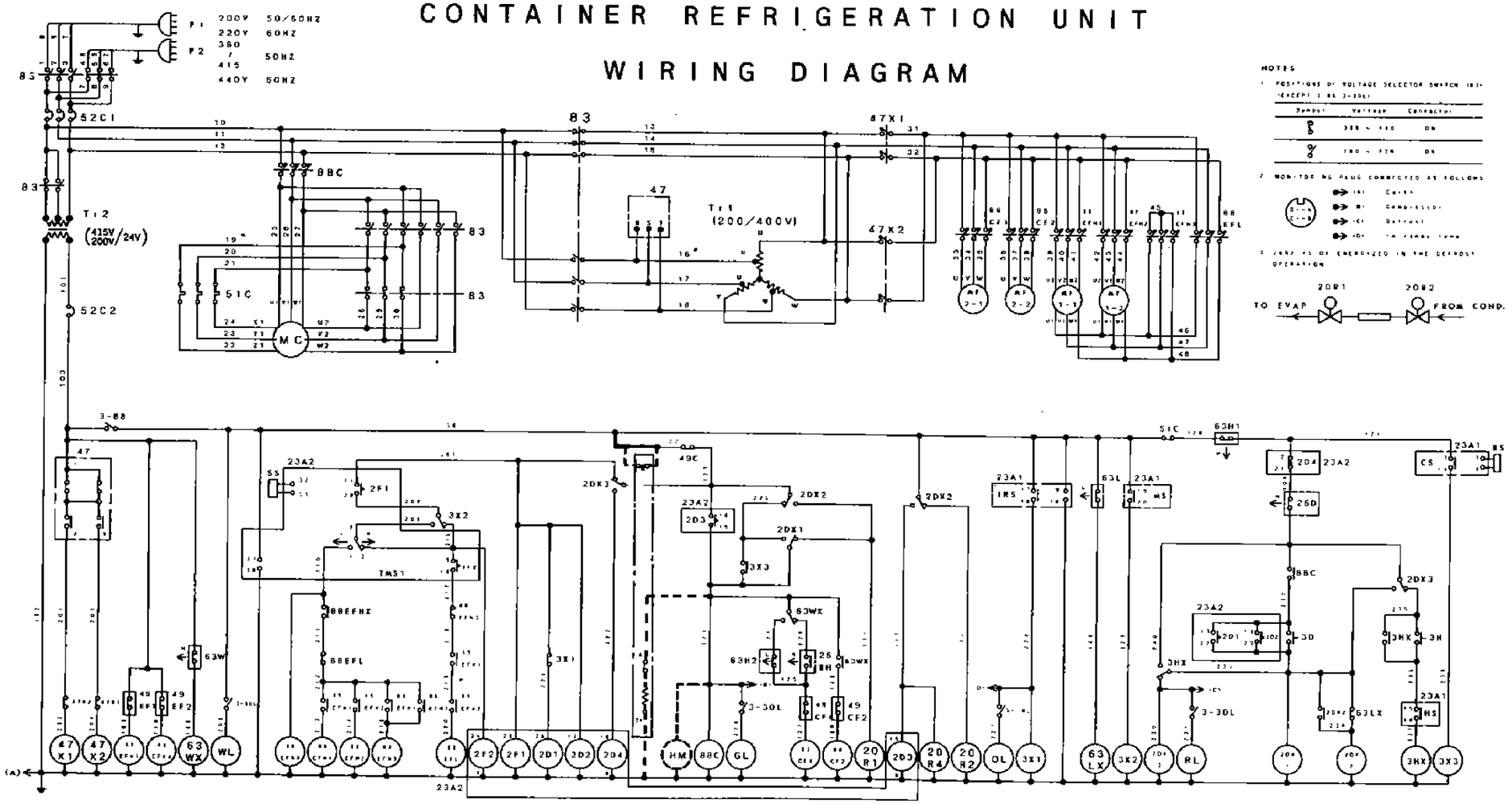
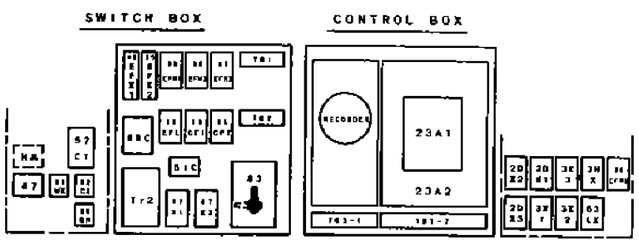
3. ●—● SHOWS JUMPER WIRE.

CONTAINER REFRIGERATION UNIT

WIRING DIAGRAM





2D1	TIME-LAG RELAY (4HOUR)	47X1, 2	MAGNETIC CONTACTOR	MC	MOTOR (COMPRESSOR)
2D2	TIME-LAG RELAY (12HOUR)	49C	THERMO SWITCH (MC)	MF1	MOTOR (EVAP. FAN)
2D3	TIME-LAG RELAY (20SEC.)	49CF1, 2	THERMO SWITCH (MF2)	MF2	MOTOR (COND. FAN)
2D4	TIME-LAG RELAY (90MIN.)	49EF1, 2	THERMO SWITCH (MF1)	OL	LAMP (ORANGE)
2F1	TIME-LAG RELAY (60SEC.)	49EFR1, 2	MAGNETIC RELAY	P1, 2	PLUG
2F2	TIME-LAG RELAY (10SEC.)	51C	OVER CURRENT RELAY (MC)	RL	LAMP (RED)
2DX1~3	MAGNETIC RELAY (DEFROST)	52C1, 2	CIRCUIT BREAKER	R.S.	RETURN AIR SENSOR
3-88	SWITCH (UNIT ON-OFF)	63H1	PRESSURE SWITCH (HIGH)	S.S.	SUPPLY AIR SENSOR
3-30L	SWITCH (LAMP)	63H2	PRESSURE SWITCH (FAN CUT)	Tr1	TRANSFORMER (MF)
3D	SWITCH (MANUAL DEFROST)	63L	PRESSURE SWITCH (LOW)	Tr2	TRANSFORMER (CONTROL)
3H	SWITCH (HEAT UP)			WL	LAMP (WHITE)
3HX	MAGNETIC RELAY (HEAT UP)	63W	PRESSURE SWITCH (WATER)		
3X1~3	MAGNETIC RELAY	63WX	MAGNETIC RELAY		
20R1	SOLENOID VALVE (MAIN)	63LX	MAGNETIC RELAY		
20R2	SOLENOID VALVE (DEFROST)	83	VOLTAGE SELECTOR SWITCH		
20R4	SOLENOID VALVE (3 WAY)	88C	MAGNETIC CONTACTOR (MC)		
23A1	ELECTRONIC CONTROLLER	88CF1, 2	MAGNETIC CONTACTOR (MF2)		
23A2	ELECTRONIC CONTROLLER	88EFR1~3	MAGNETIC CONTACTOR (MF1)		
26H	THERMO SWITCH (SWITCH BOX)	88EFR	MAGNETIC RELAY	OPTIONAL SPECIFICATION	
26D	THERMO SWITCH (DEF. TERMINATION)	88EFL	MAGNETIC CONTACTOR (MF1)	HM	HOUR METER
47	PHASE-REVERSAL RELAY	GE	LAMP (GREEN)	63QL	PRESSURE SWITCH (OIL)

注意

1. 操作回路（線番号101～　）には絶縁試験を行なわぬこと。
2. ――はオプション仕様を示す。

CAUTION

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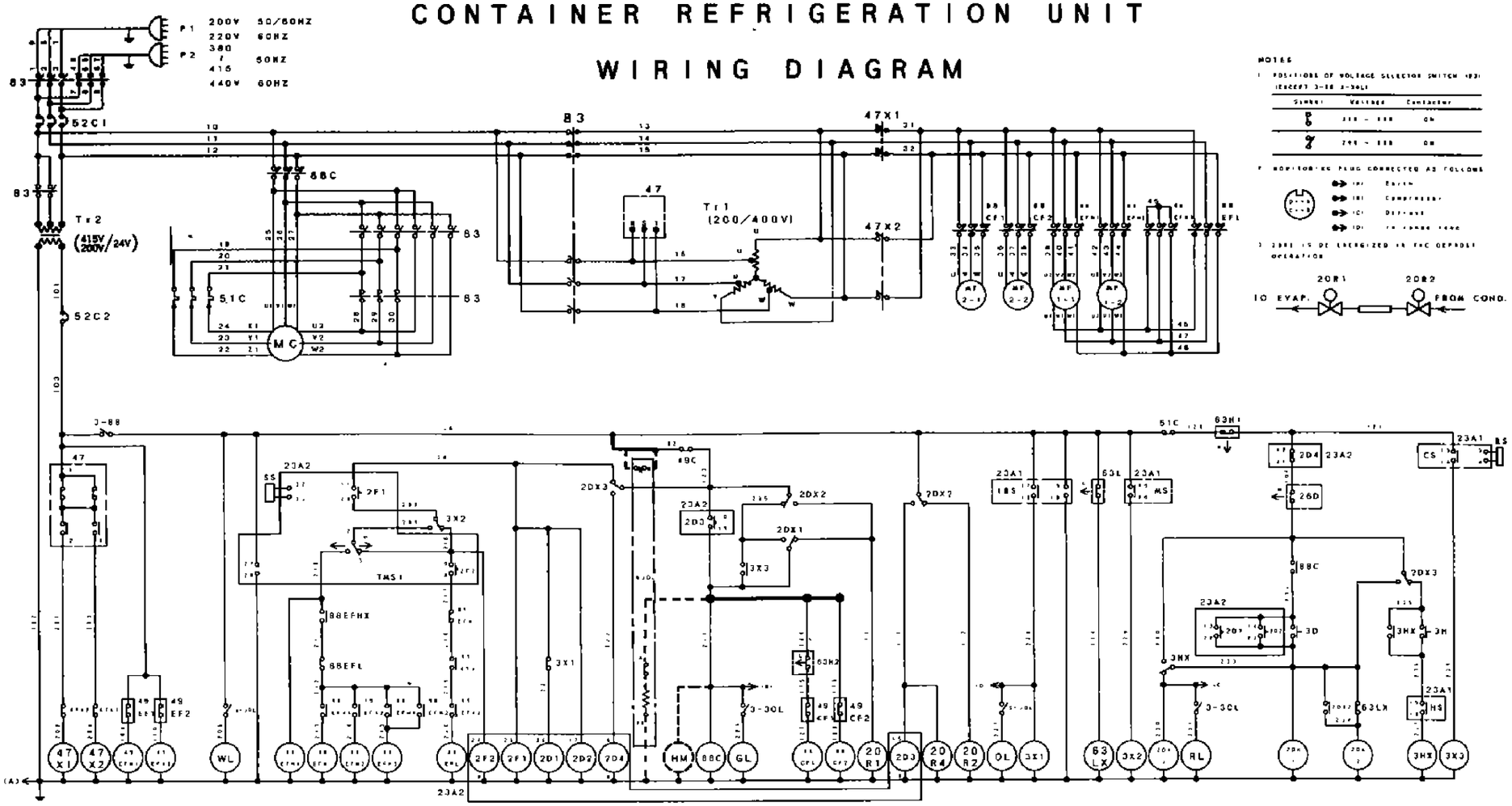
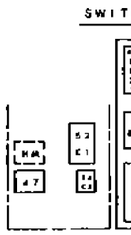
2. ――SHOWS OPTIONAL SPEC..

CONTAINER REFRIGERATION UNIT

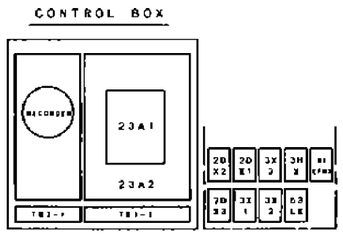
WIRING DIAGRAM



SWITCH BOX



CONTROL BOX



2D1	TIME-LAG RELAY (4HOUR)	49C	THERMO SWITCH (MC)	OL	LAMP (ORANGE)
2D2	TIME-LAG RELAY (12HOUR)	49CF1, 2	THERMO SWITCH (MF2)	P1, 2	PLUG
2D3	TIME-LAG RELAY (20SEC.)	49EF1, 2	THERMO SWITCH (MF1)	RL	LAMP (RED)
2D4	TIME-LAG RELAY (90MIN.)	49EFX1, 2	MAGNETIC RELAY	R.S	RETURN AIR SENSOR
2F1	TIME-LAG RELAY (60SEC.)	51C	OVER CURRENT RELAY (MC)	S.S	SUPPLY AIR SENSOR
2F2	TIME-LAG RELAY (10SEC.)	52C1, 2	CIRCUIT BREAKER	T.1	TRANSFORMER (MF)
2DX1~3	MAGNETIC RELAY (DEFROST)	63H1	PRESSURE SWITCH (HIGH)	T.2	TRANSFORMER (CONTROL)
3-88	SWITCH (UNIT ON-OFF)	63H2	PRESSURE SWITCH (FAN CUT)	WL	LAMP (WHITE)
3-30L	SWITCH (LAMP)	63L	PRESSURE SWITCH (LOW)		
3D	SWITCH (MANUAL DEFROST)				
3H	SWITCH (HEAT UP)	63LE	MAGNETIC RELAY		
3HX	MAGNETIC RELAY (HEAT UP)	63	VOLTAGE SELECTOR SWITCH		
3X1~3	MAGNETIC RELAY	88C	MAGNETIC CONTACTOR (MC)		
20R1	SOLENOID VALVE (MAIN)	88CF1, 2	MAGNETIC CONTACTOR (MF2)		
20R2	SOLENOID VALVE (INJECTION)	88EFH1~3	MAGNETIC CONTACTOR (MF1)		
20R4	SOLENOID VALVE (HOT GAS)	88EFHX	MAGNETIC RELAY		
23A1	ELECTRONIC CONTROLLER	88EFL	MAGNETIC CONTACTOR (MF1)		
23A2	ELECTRONIC CONTROLLER	GL	LAMP (GREEN)		
26D	THERMO SWITCH (DEF TERMINATION)	MC	MOTOR (COMPRESSOR)	OPTIONAL SPECIFICATION	
49	PHASE-REVERSAL RELAY	MF1	MOTOR (EVAP. FAN)	HM	HOUR METER
47X1, 2	MAGNETIC CONTACTOR	MF2	MOTOR (COND. FAN)	63OL	PRESSURE SWITCH (OIL)

注意

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2. ――― はオプション仕様を示す。
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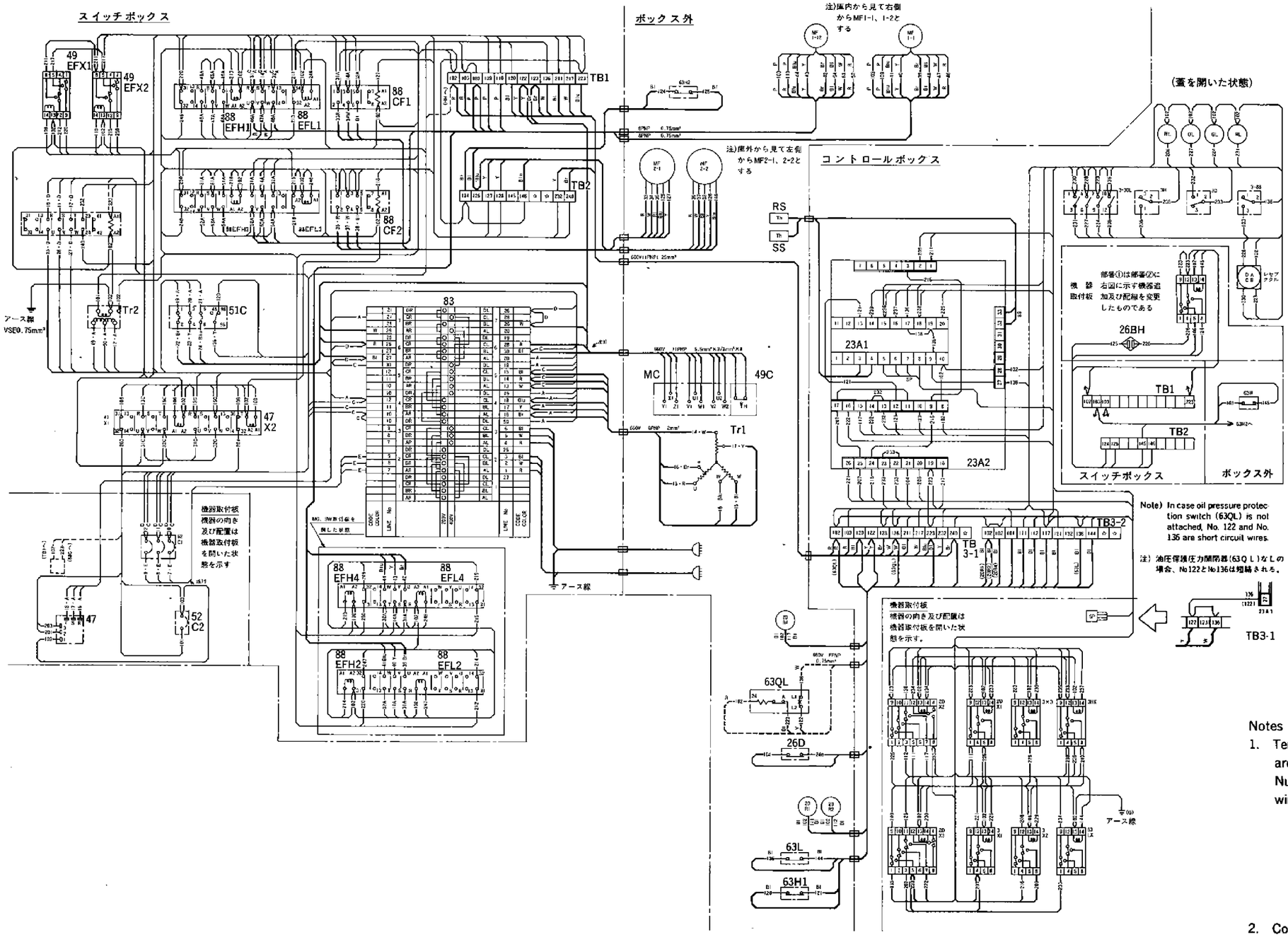
CAUTION

1. INSULATION TEST SHOULDN T BE MADE TO CONTROL CIRCUIT (LINE NO. 101～)
2. ――― SHOWS OPTIONAL SPEC
3. ●――● SHOWS JUMPER WIRE.

1.4.2 Electric wiring diagramms

(1) LXE8A-C(producted after November, 1990)
LXE8A-CA



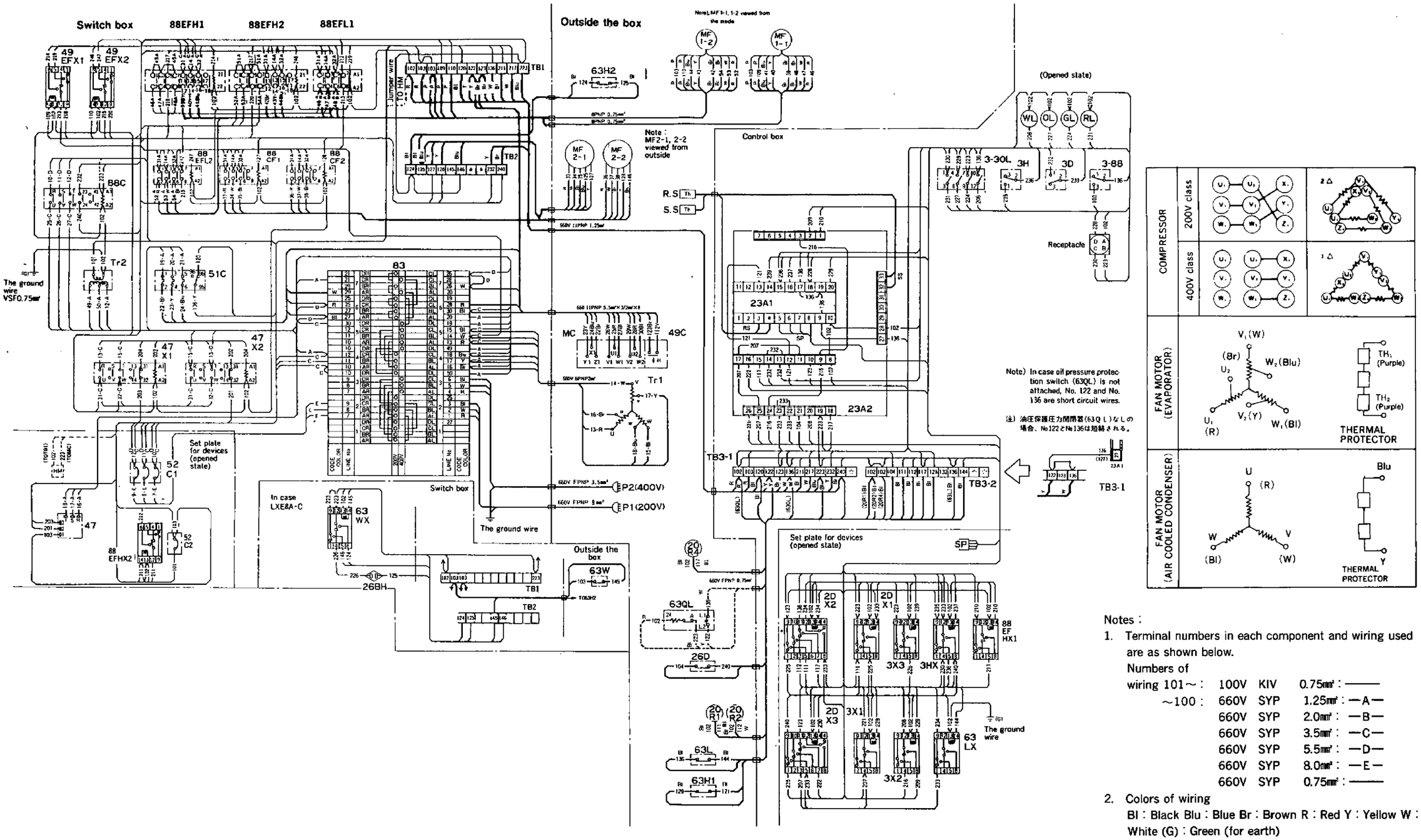
Notes :

1. Terminal numbers in each component and wiring used are as shown below.

Numbers of wiring 101～ :	100V	KIV	0.75mm² :	——
～100 :	660V	SYP	1.25mm² :	—A—
	660V	SYP	2.0mm² :	—B—
	660V	SYP	3.5mm² :	—C—
	660V	SYP	5.5mm² :	—D—
	660V	SYP	8.0mm² :	—E—
	660V	SYP	0.75mm² :	——

2. Colors of wiring
   Bl : Black Blu : Blue Br : Brown R : Red Y : Yellow W : White (G) : Green (for earth)
3. The ground wire is VSF 0.75mm².
4. ····· Shows the optional parts.

(2) LXE8A-C (producted between February, 1989, and October, 1990)
LXE8A-CA



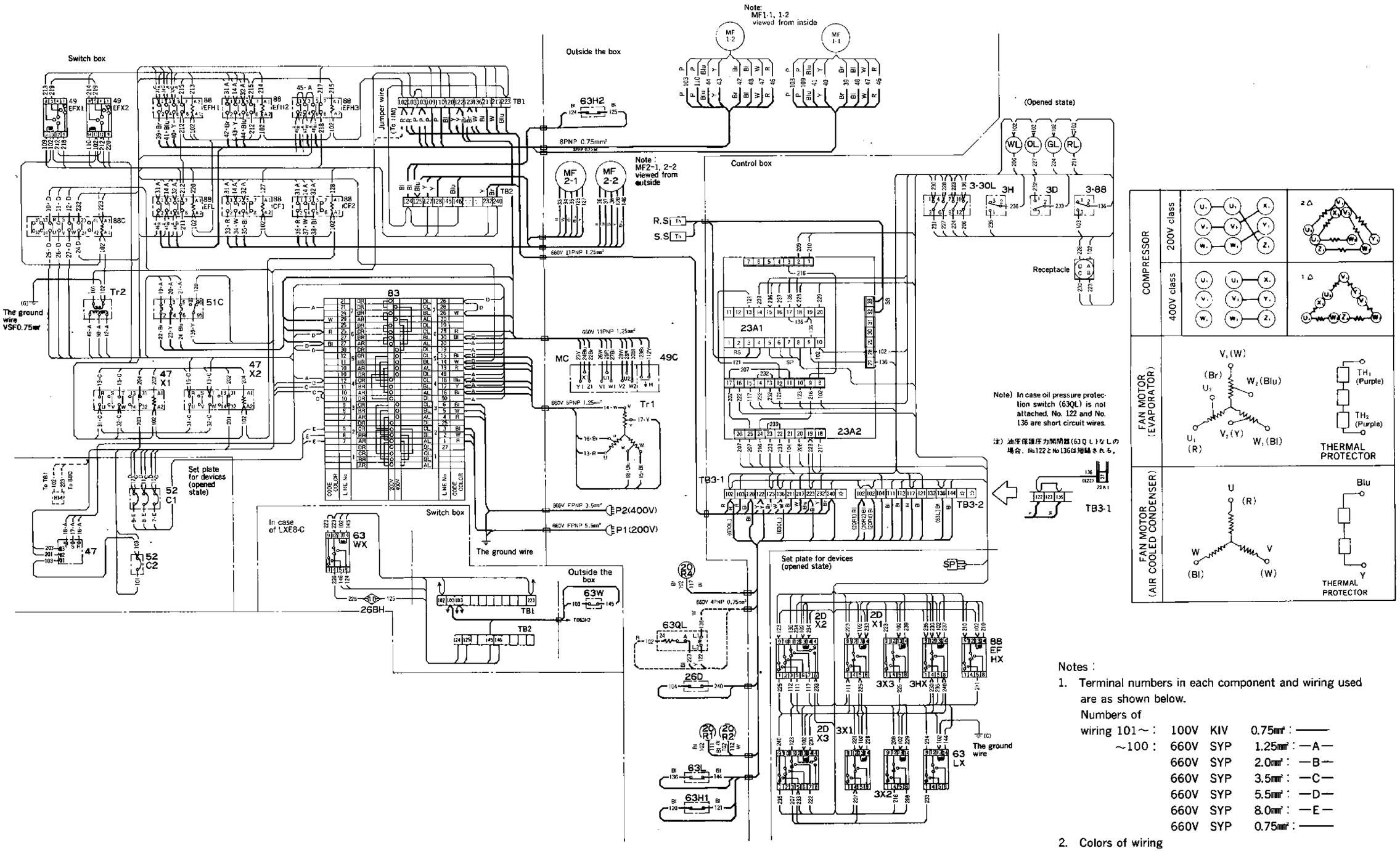
Notes :

1. Terminal numbers in each component and wiring used are as shown below.

Numbers of wiring				
101～ :	100V	KIV	0.75㎟ :	———
～100 :	660V	SYP	1.25㎟ :	—A—
	660V	SYP	2.0㎟ :	—B—
	660V	SYP	3.5㎟ :	—C—
	660V	SYP	5.5㎟ :	—D—
	660V	SYP	8.0㎟ :	—E—
	660V	SYP	0.75㎟ :	———

2. Colors of wiring
   Bl : Black Blu : Blue Br : Brown R : Red Y : Yellow W : White (G) : Green (for earth)
3. The ground wire is VSF 0.75㎟.
4. ····· Shows the optional parts.

(3) LXE8-C (producted before January, 1989)



Notes :

1. Terminal numbers in each component and wiring used are as shown below.

Numbers of wiring			
101～ :	100V	KIV	0.75mm² : ———
～100 :	660V	SYP	1.25mm² : —A—
	660V	SYP	2.0mm² : —B—
	660V	SYP	3.5mm² : —C—
	660V	SYP	5.5mm² : —D—
	660V	SYP	8.0mm² : —E—
	660V	SYP	0.75mm² : ———

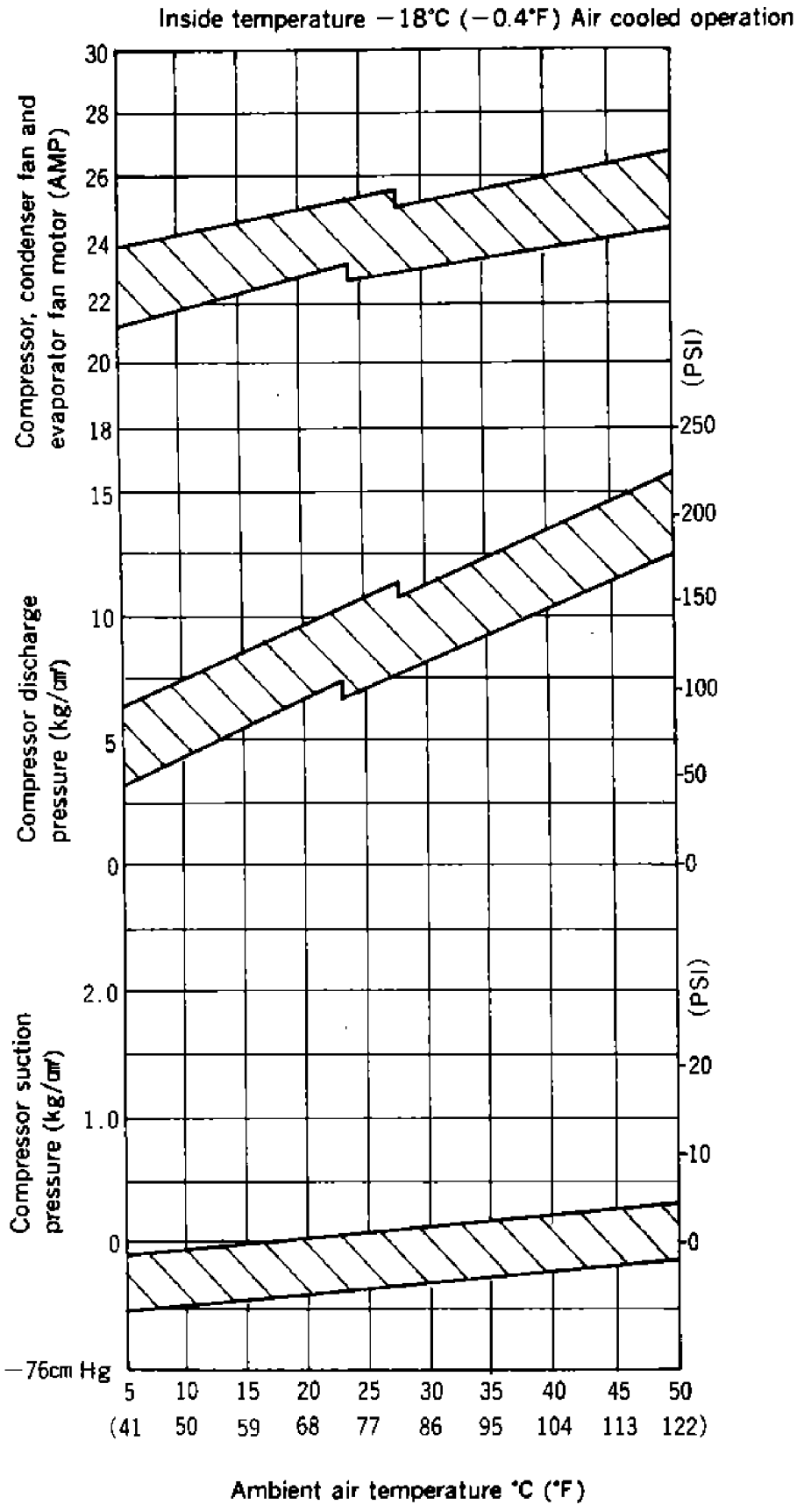
2. Colors of wiring
   Bl : Black Blu : Blue Br : Brown R : Red Y : Yellow
   W : White P : purple : (G)Green (for earth)
3. The ground wire is VSF 0.75mm².
4. ····· Shows optional specifications.

1.5 Set values of functional parts and protective devices

	Parts Name	Mark			Function		Set Value
Pressure switch	Oil pressure protection switch (Option) ONS−C106Q	63QL			Heater circuit	OFF	1.0kg/cm²
						ON	0.5kg/cm²
						Timer	110 seconds (Ambient temp. 25°C (77°F))
							Above 5 seconds (Ambient temp. 70°C (158°F))
	High pressure switch 20PS−K200	63H1				OFF	20kg/cm²
						ON	16.5kg/cm²
	High pressure control switch ACB−BA26	63H2				OFF	7kg/cm²
						ON	11kg/cm²
	Low pressure switch 20PS−K100	63L				OFF	40cmHgV
						ON	0.2kg/cm²
	Water pressure switch LCB−BB07 (Air/water cooled type)	63W				OFF	1kg/cm²
						ON	0.4kg/cm²
Thermostat and timer	Fan speed change-over thermostat	23A2	Terminals	2−1 (2-3)		ON (OFF)	15°C (59°F)
						OFF (ON)	20°C (68°F)
	※Over-cooling protective thermostat			4−5	29−30 short-circuit (Option)	OFF	−1.5°C (29.3°F)
						ON	+1.5°C (34.7°F)
					29−30 open (Factory set)	OFF	−3°C (26.6°F)
						ON	0°C (32°F)
	※Thermostat for solenoid valves			6−7	Low temp. side	OFF	−10°C (14°F)
						ON	−7°C (19.4°F)
					High temp. side	ON	9°C (48.2°F)
						OFF	10°C (50°F)
	Fan operation delay timer			2F1		ON	60 seconds
	Fan Hi/Lo speed change-over timer			2F2		ON	10 seconds
	Defrost timer	Short		2D1		ON	4 hours
		Long		2D2		ON	12 hours
		Compressor stop		2D3		ON	20 seconds
		Back-up		2D4		OFF	90 minutes
Thermostat	Defrost thermistor ST−5B 30/20	26D				OFF	35°C (95°F)
						ON	20°C (68°F)
	Switch box thermostat CS−7 (Air/water cooled type)	26BH				OFF	35°C (95°F)
						ON	50°C (122°F)
Breaker OC	Over-current relay GT−20−NP2S4	51C				OFF	10A
	Circuit breaker (Main circuit) MK53	52C1				OFF	50A
	Cricuit breaker (Control circuit) CP31/7−Z	52C2				OFF	10A
Motor	Condenser fan motor protective thermostat	49CF				OFF	125°C (257°F)
	Evaporator fan motor protective thermostat	49EF				OFF	130°C (266°F)
	Compressor protective thermostat	49C				OFF	105°C (221°F)

Note : The devices marked with ※ may sometimes not be used depending on models.

1.6 Operation pressure and running current



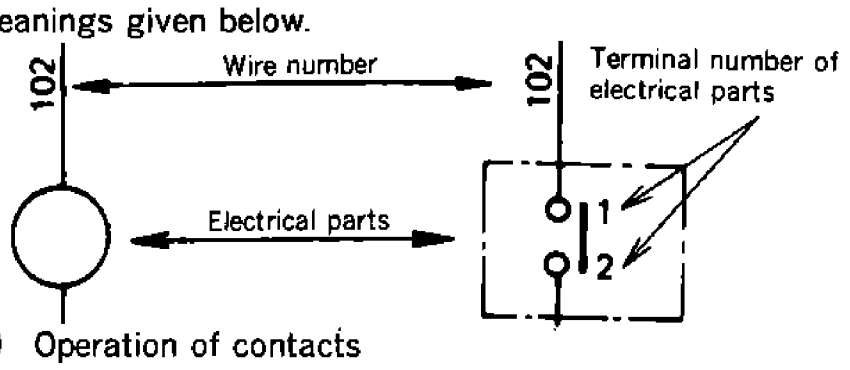
〈For reference〉

	Item	Unit	Value
1	Condenser fan motor Running current (for 2 pcs.)	A	0.7 (AC400V)
2	Evaporator fan motor Running current (for 2 pcs.)	A	High speed 3.2 (AC400V) Low speed 0.9 (AC400V)

2. Operation modes and circuits

2.1 How to read wiring diagram

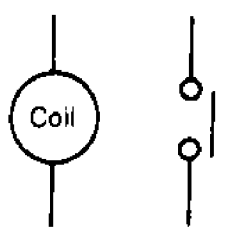
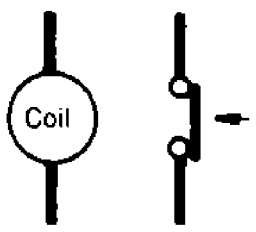
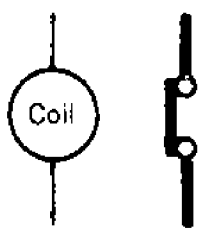
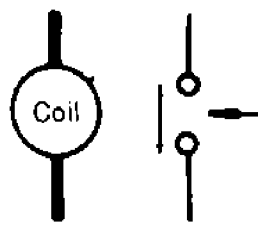
(1) In the wiring diagram, marks and numbers have the meanings given below.



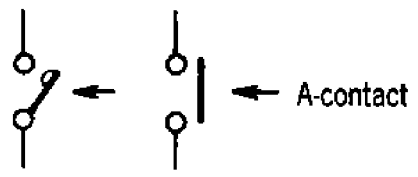
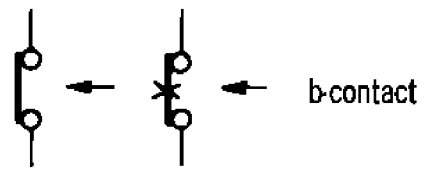
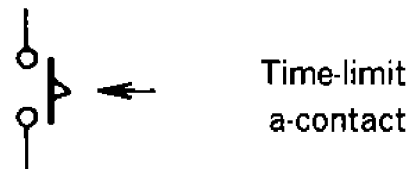
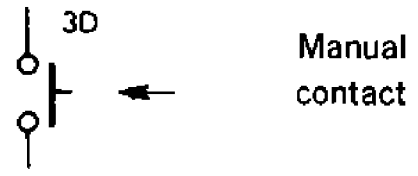
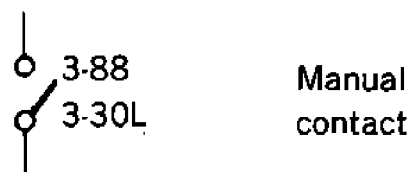
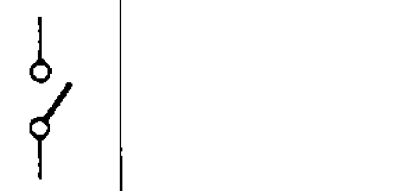
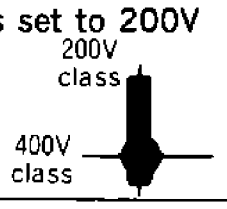
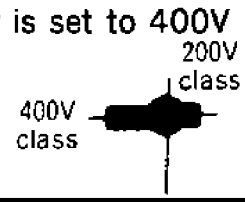
(2) Operation of contacts

a. The wiring diagram indicates the stationary state in which the circuits are not activated.

b. when a coil in energized (supplied with power), the associated contact changes its position.

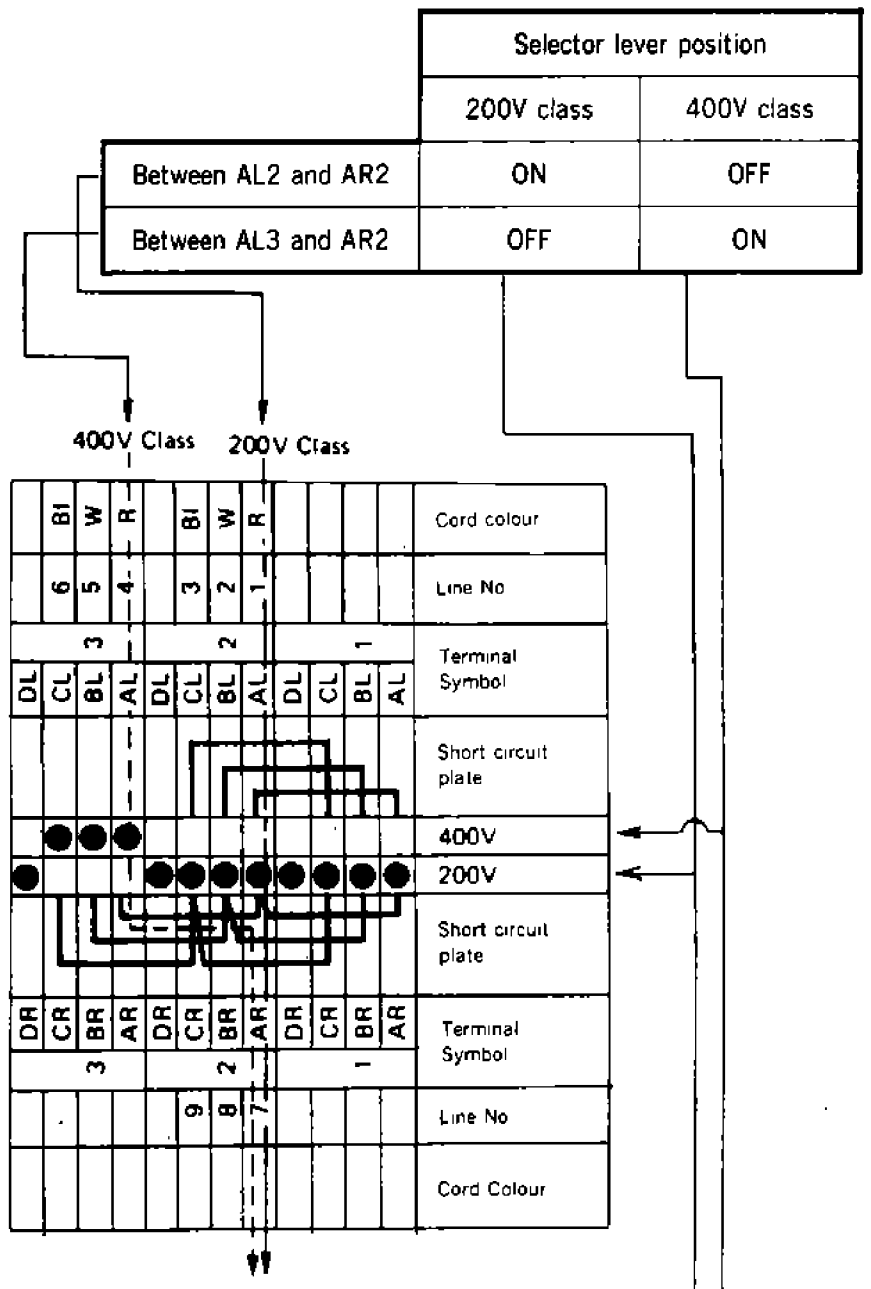
a-contact (normal open contact)	Contact is OFF when coil is not energized	
	Contact is ON when coil is energized	
b-contact (normal close contact)	Contact is ON when coil is not energized	
	Contact is OFF when coil is energized	

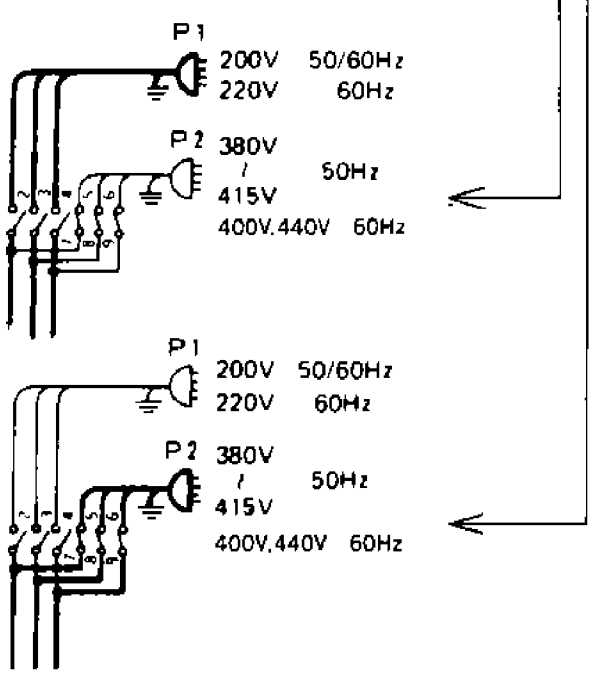
c. Kinds of contacts

	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.
	Manual contact	Contact of a snap switch. This turns on as long as the switch is kept pressed and turns off immediately when released.
	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, 3-30L)	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 AL2 and AR2, and between AL3 and AR2.

	Selector lever position	
	200V class	400V class
Between AL2 and AR2	ON	OFF
Between AL3 and AR2	OFF	ON





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 (63H2) is installed to turn off the magnetic switch (88CF1) for condenser fan when high pressure drops lower than 7 kg/㎠. So one of the condenser fan (MF2-1) stops automatically, which prevents high pressure from dropping.

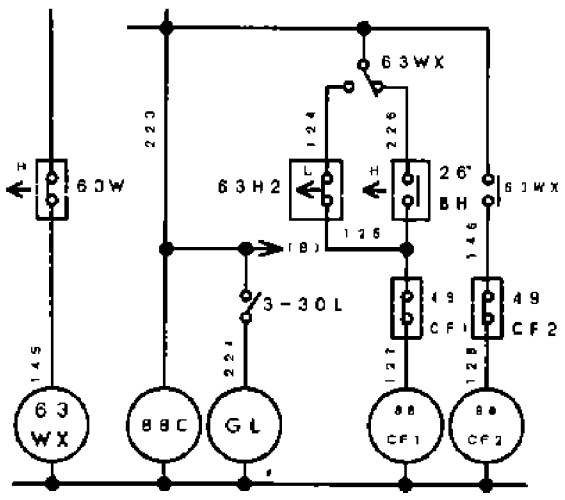
2.3 Air cooled and water cooled operation (Air/water cooled type)

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.

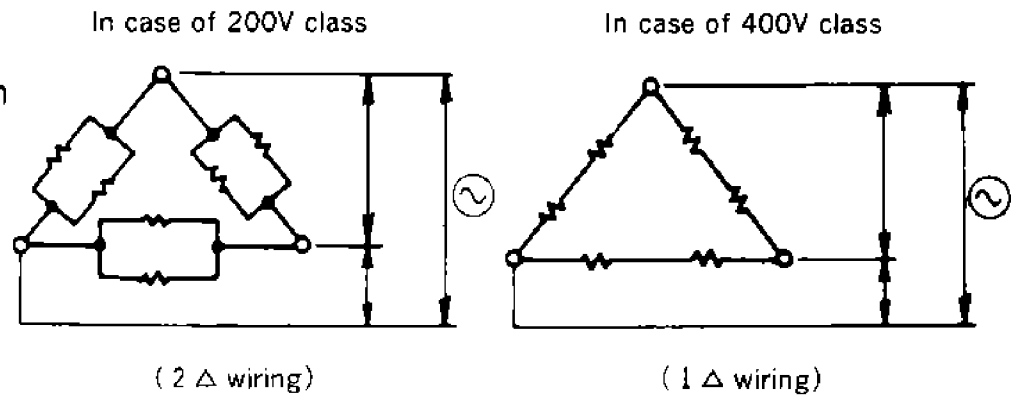
Note :

Note that the condenser fan on the left may sometimes operate to cool the control box during water cooled operation.



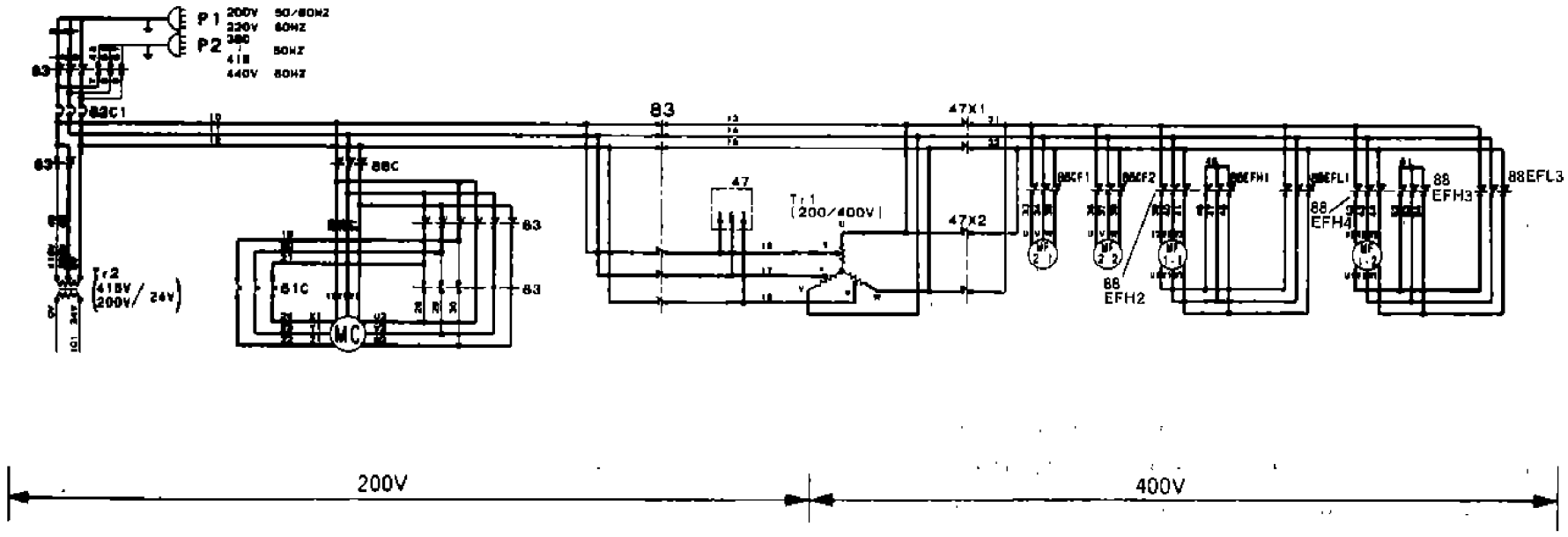
2.4 Voltage selector system (Change-over for 200V/400V class)

(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.

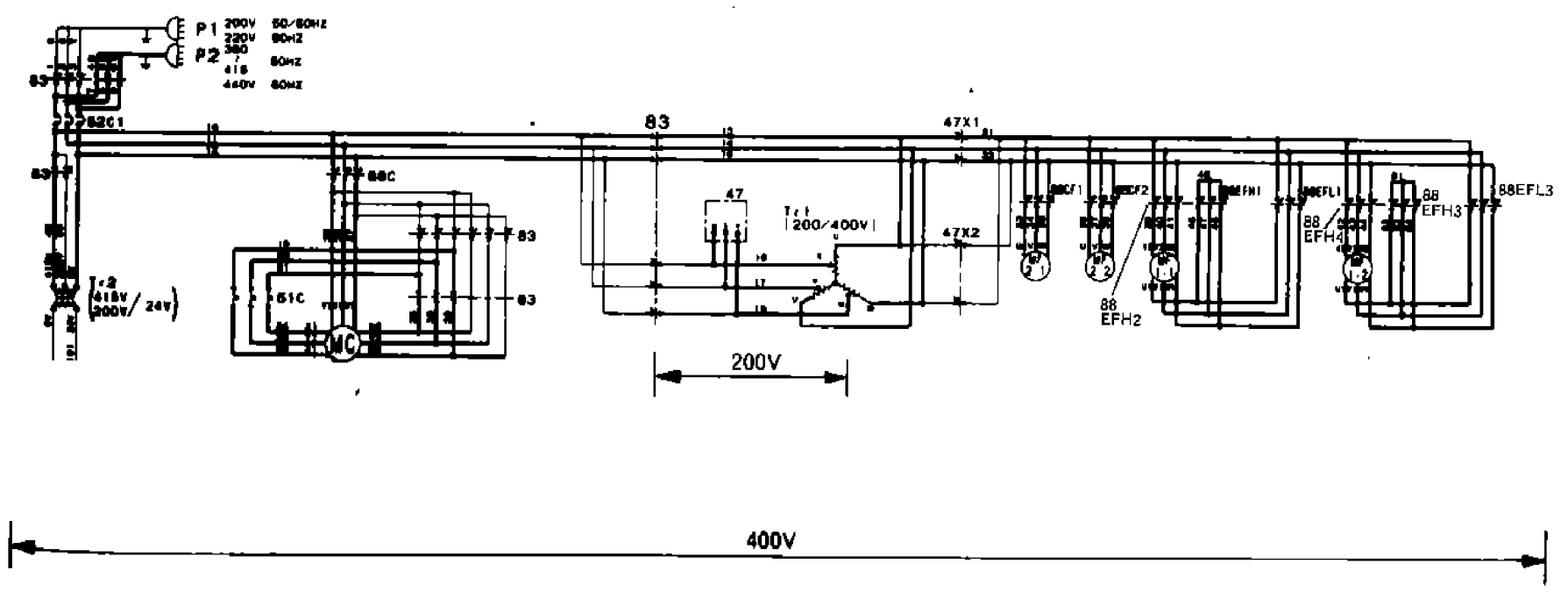


(2) Circuit formation

○ 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 400V Class (set the selector lever to "400V Class".)
The contacts shown by ⊸|⊸ have continuity on the sequence diagram and from the 400V class circuit.

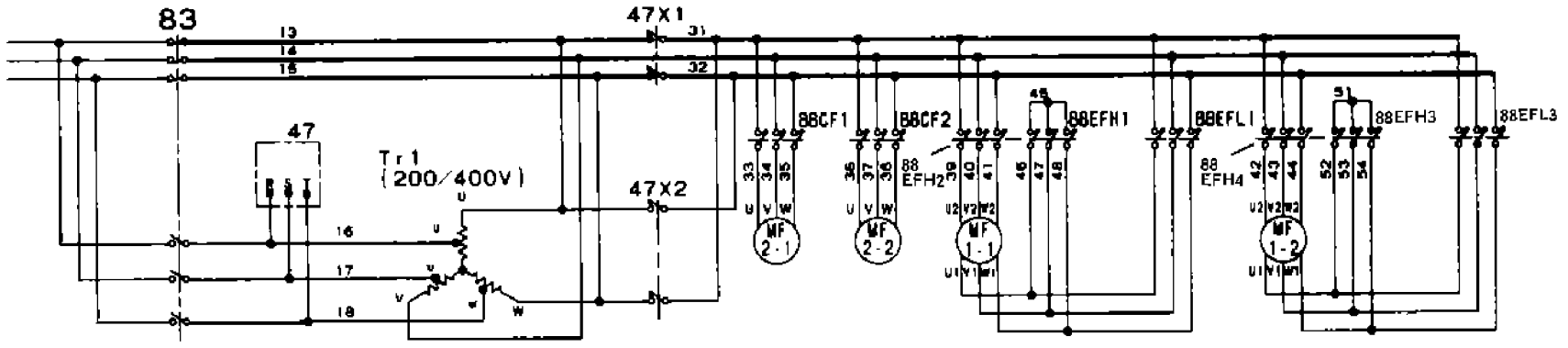


(3) Phase selection
The reversible method is adopted to the compressor and the proper phase selection method to the fan motor of the units.

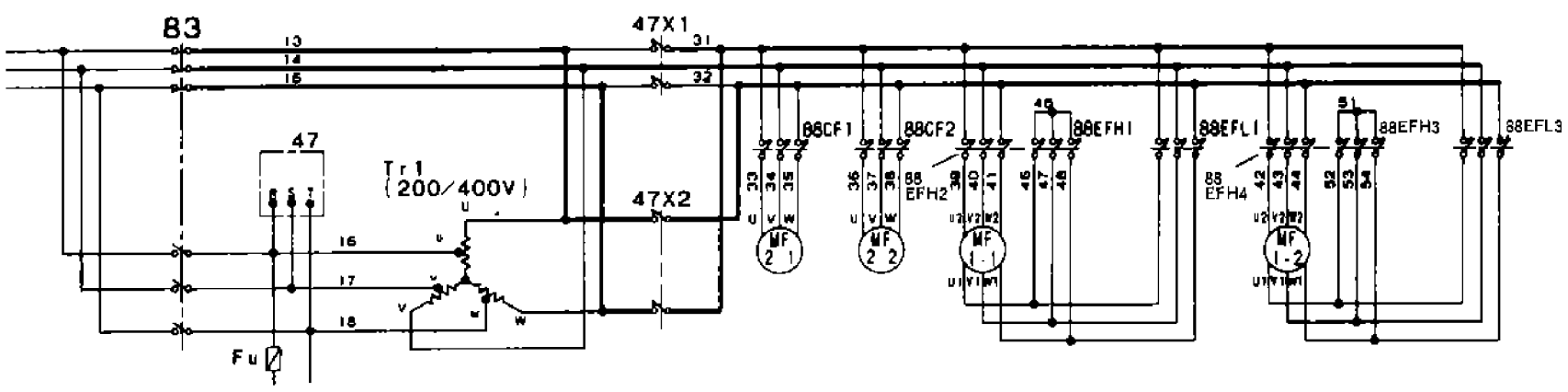
○ Compressor
The hydraulic pump adopted is a reversible trochoid pump, so the predesigned oil pressure can be obtained regardless of turning direction of the built-in motor.

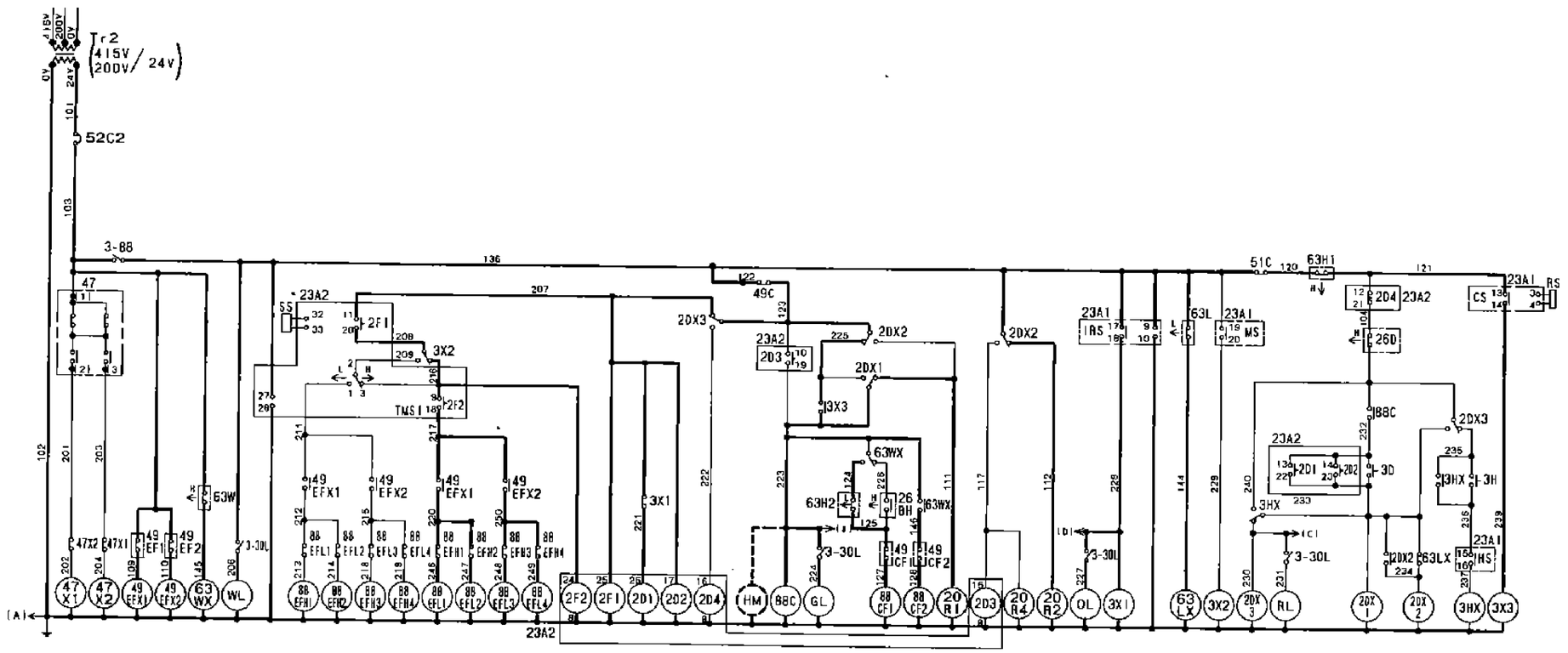
○ Fan motor
The phase sequence controller adopted exchanges R phase with T phase automatically in case of wrong phase.
47: phase sequence controller
47X1•2: Magnetic switches for phase selection.

● Proper phase



● Wrong phase





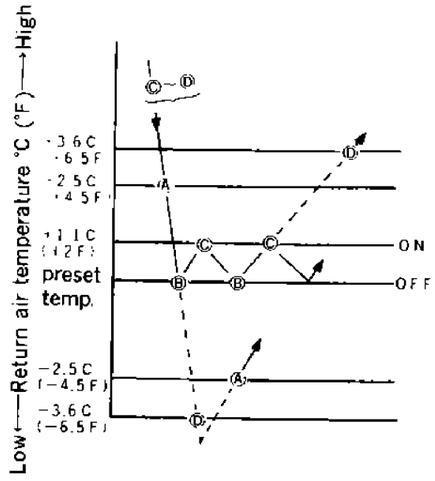
(1) Change-over for frozen-chilled is performed automatically by means of setting of the electronic controller.
Chilled operation: above −4.5°C (+23.9°F)
Frozen operation: below −6.5°C (+20.3°F)

(2) When the unit ON-OFF switch (3−88) is turned on,
(a) The pilot lamp for power supply lights up.
(b) The measuring liquid solenoid valve (upstream side) (20R2) is open.
(c) The fan will operate after a lapse of 70 seconds by the delay timers (2F1, 2F2).

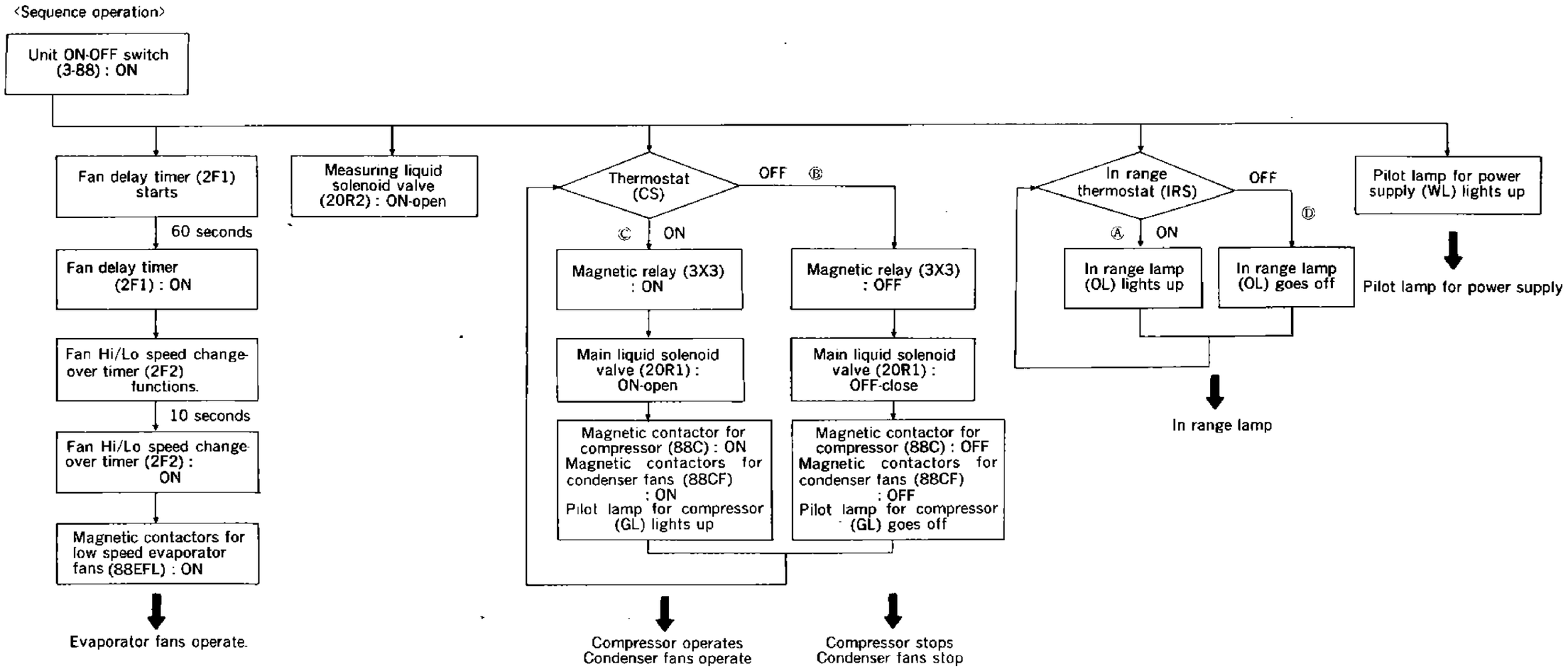
(3) The compressor is operated on and off by sensing the return temperature of the evaporator.
Compressor OFF: Preset temperature (Ⓑ point)
Compressor ON: Preset temperature+1.1°C(+2°F) (Ⓒ point)
When the compressor operates,
The pilot lamp for compressor operation (Green) lights up.
The condenser fans operate.
The main liquid solenoid valve (downstream side) (20R1) opens.

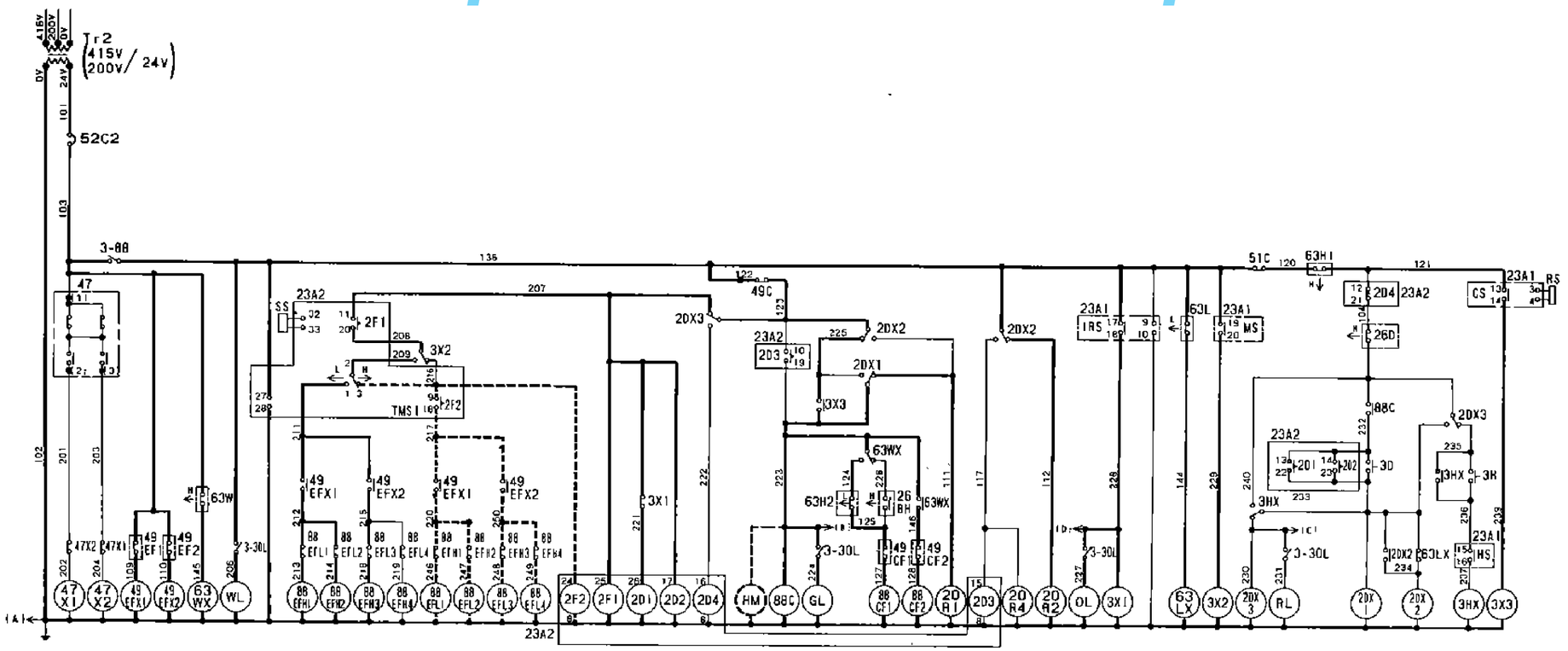
(4) When return air temperature in the storage drops to the preset temperature, the in range lamp (Orange) lights up.

	Upper limit	Lower limit
ON (Ⓐ point)	+2.5°C (+4.5°F)	−2.5°C (−4.5°F)
OFF (Ⓓ point)	+3.6°C (+6.5°F)	−3.6°C (−6.5°F)



<Sequence operation>





The difference between chilled operation and frozen operation is operation of the evaporator fan circuit only.

Frozen operation

The evaporator fans operate always in low speed.

Chilled operation

(1) Speed of the evaporator fans are changed from Hi to Lo and vice versa by the supply air thermostat (23A2-TMS1) of the electronic controller.

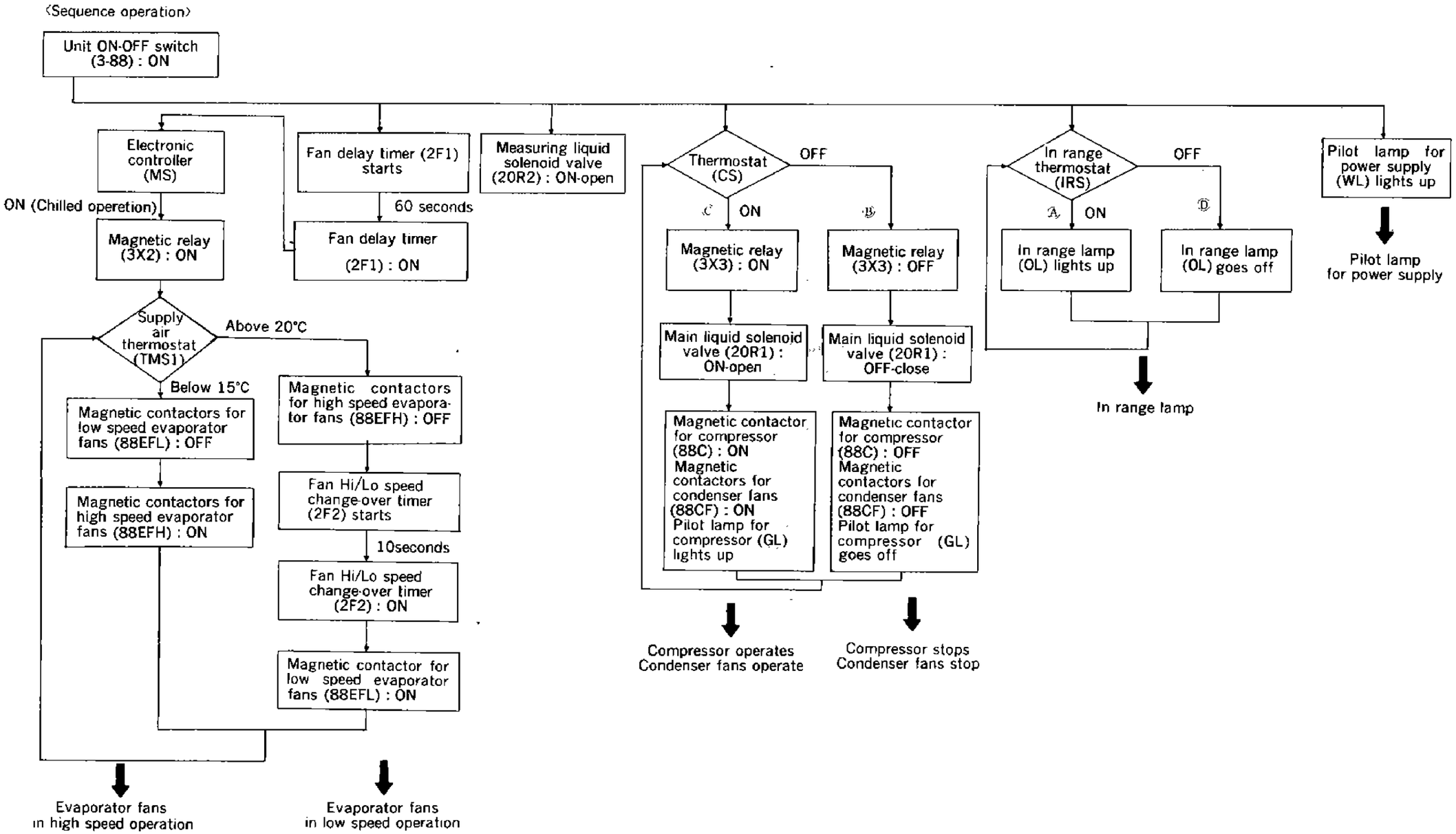
Supply air temperature : above 20°C (68°F) ·····Low fan speed operation

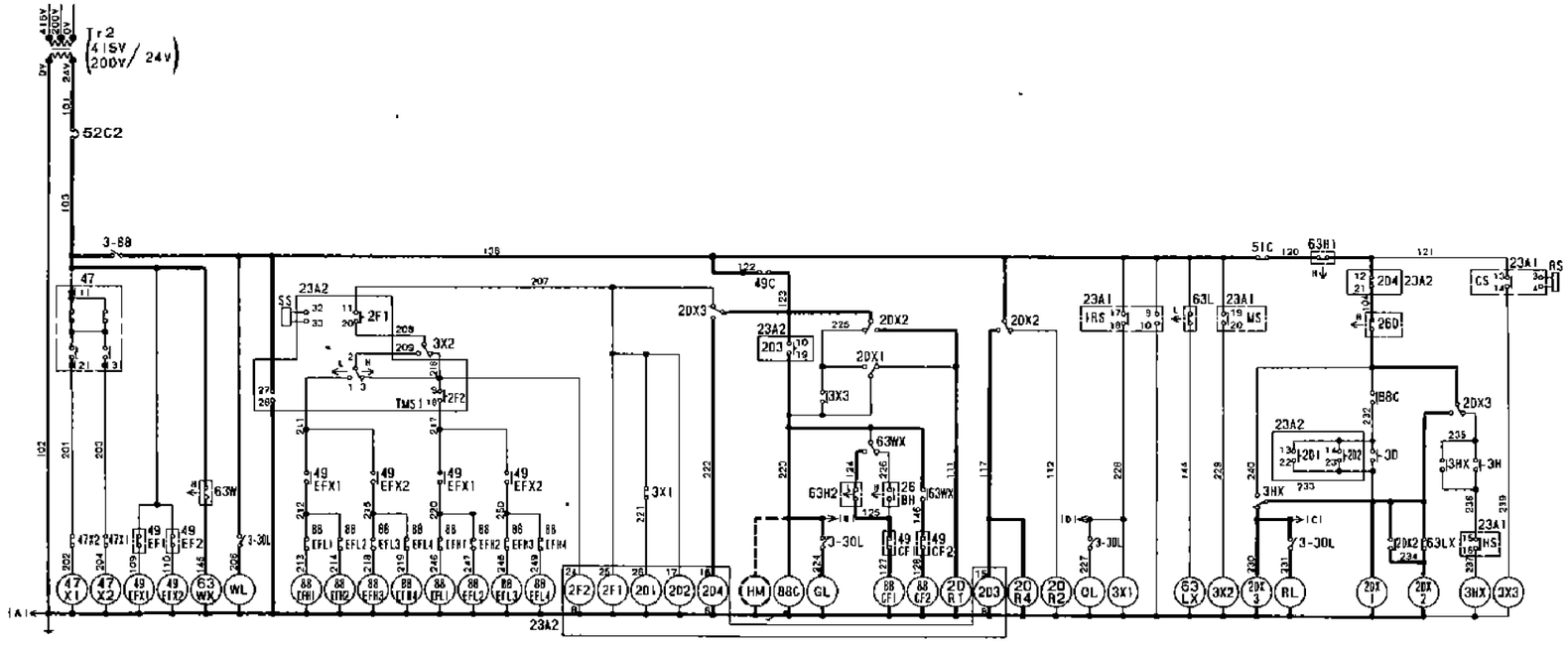
Supply air temperature : below 15°C (59°F) ·····High fan speed operation

If supply air temperature reaches to the temperatures shown above during pull-down operation, the evaporator fan speed will be changed automatically from Lo to Hi.

(2) When the fan speed is changed from Hi to Lo, 10 seconds will be delayed in order to prevent reverse torque.

〈Sequence 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 return air temperature drops to the in range temperature from pull down operation, defrosting starts every 4 hours by the short timer (2D1) of the electronic controller (23A2).

○ Long cycle defrosting

When return air temperature becomes within in range temperature (in range lamp lights up), defrosting starts every 12 hours by the long timer (2D2) of the electronic controller (23A2).

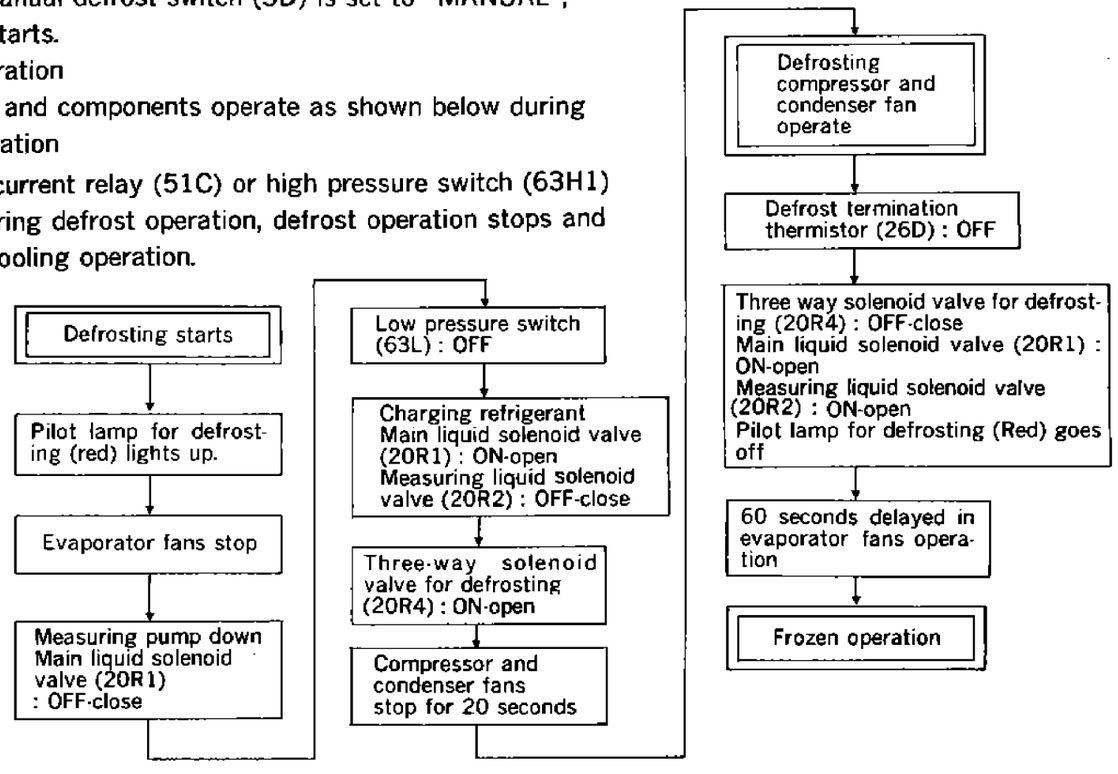
(b) Manual switch method

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

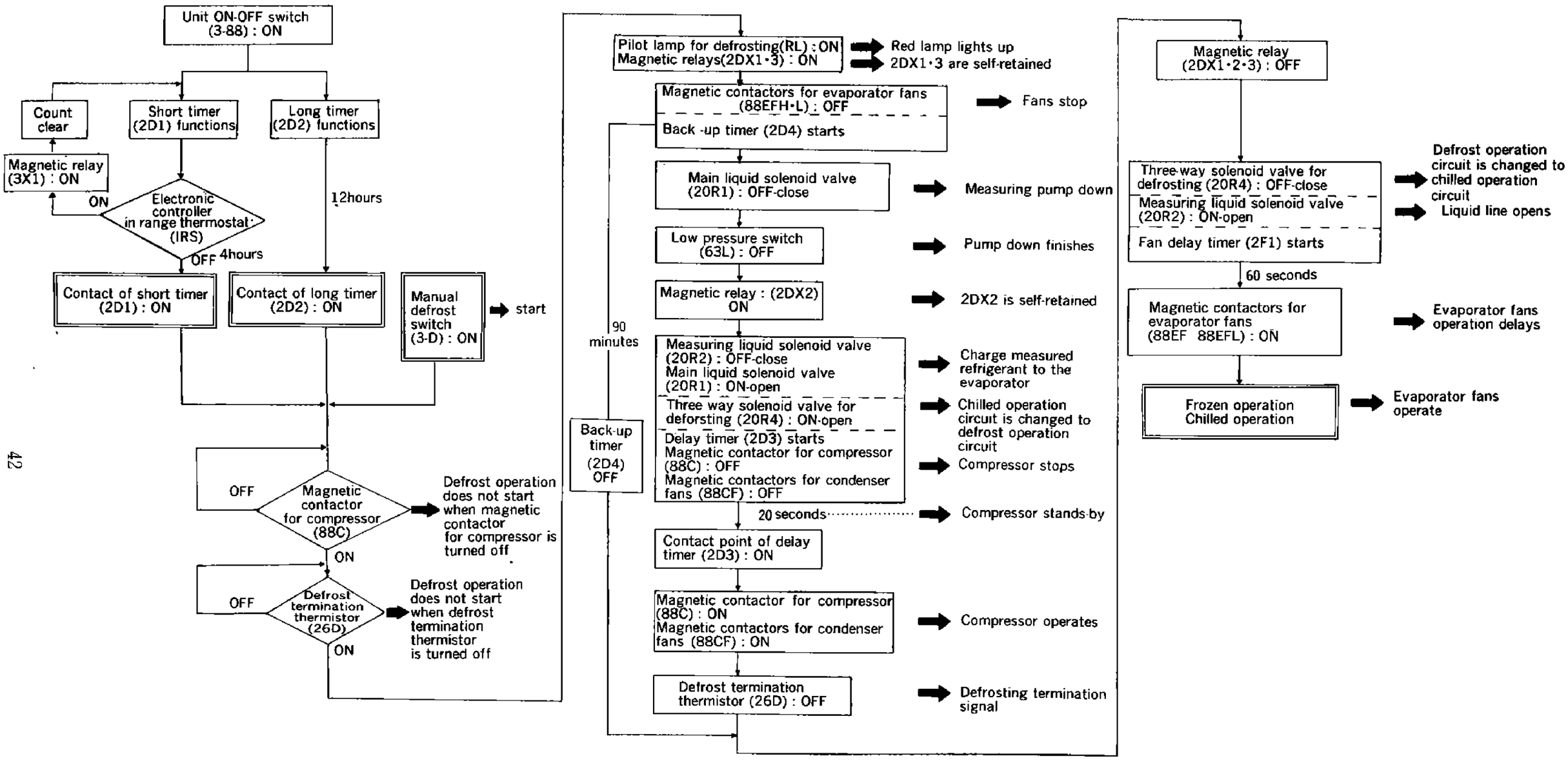
(2) Defrost operation

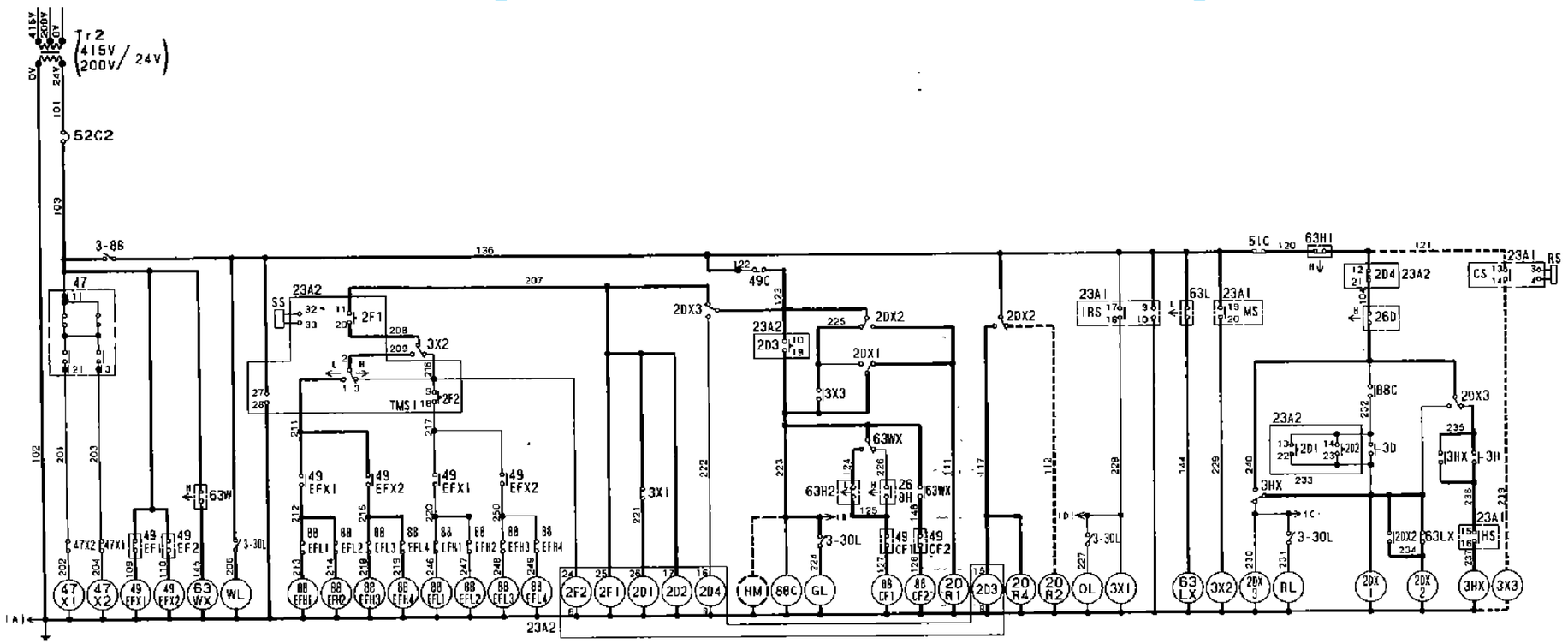
The devices and components operate as shown below during defrost operation

(3) When over current relay (51C) or high pressure switch (63H1) operates during defrost operation, defrost operation stops and change to cooling operation.



<Sequence operation>



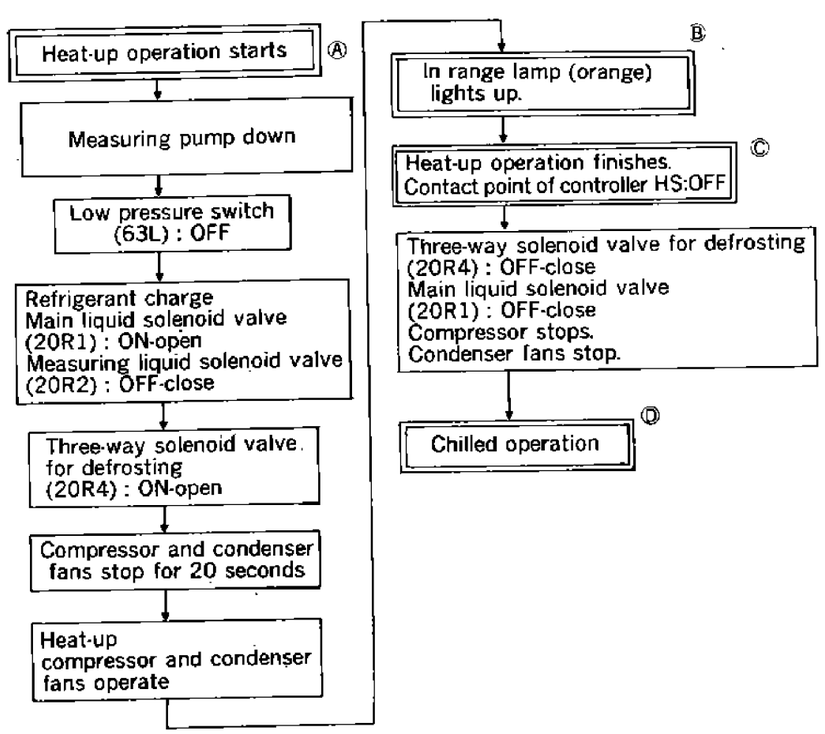


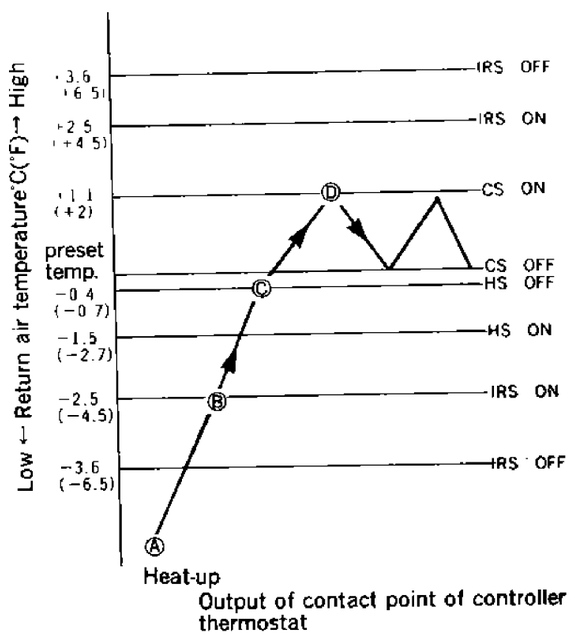
The hot gas heat-up system is adopted in the units; i. e. the high temperature and high pressure refrigerant (hot gas) from the compressor is sent to the evaporator to heat inside temperature.

(1) Starting of heat-up
Heat-up is performed only when the thermostat is set to "chilled mode" (above −4.5°C [+23.9°F]). Heat-up operation starts when the heat-up switch (3H) is set to "ON".

(2) Heat-up operation
The devices and components operate as described on the right during heat-up operation

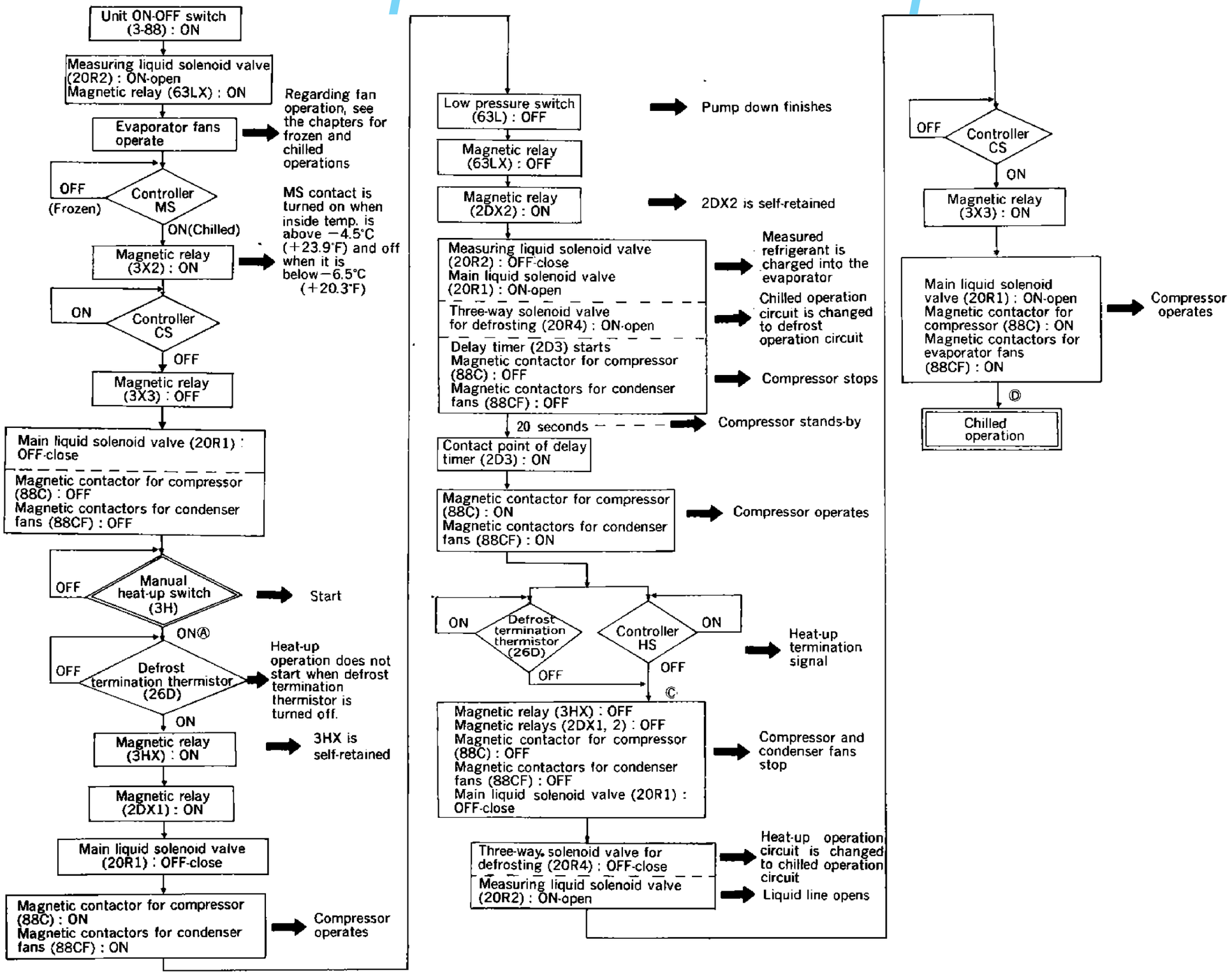
(3) When over current relay (51C) or high pressure switch (63H1) operates during heat-up operation, compressor stops and only evaporator fan motors continue to heat up.





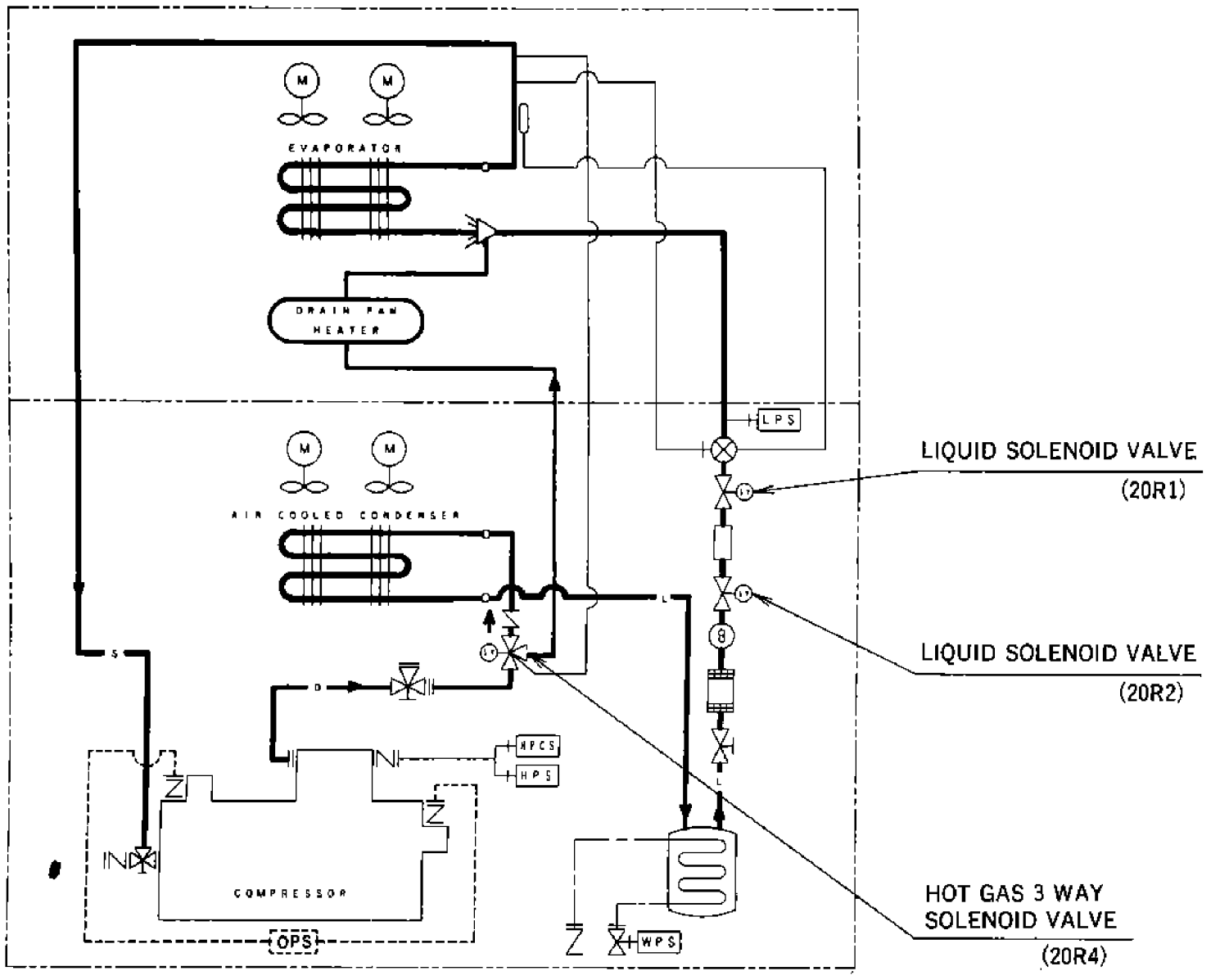
Output of contact point of controller thermostat

〈Sequence operation〉

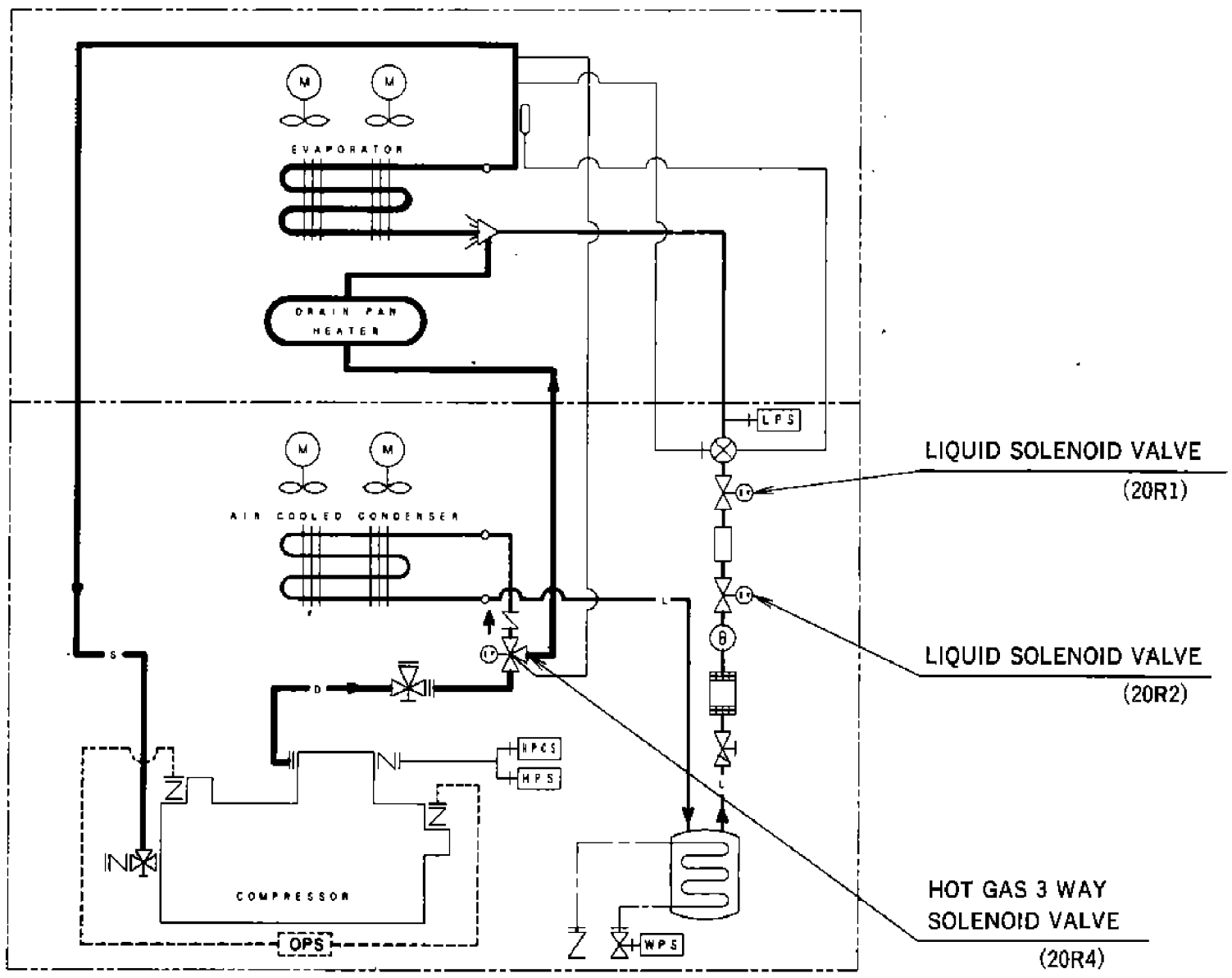


2.9 Refrigerant flow at each operation mode

●Frozen · chilled operation



●Heat-up · defrost operation

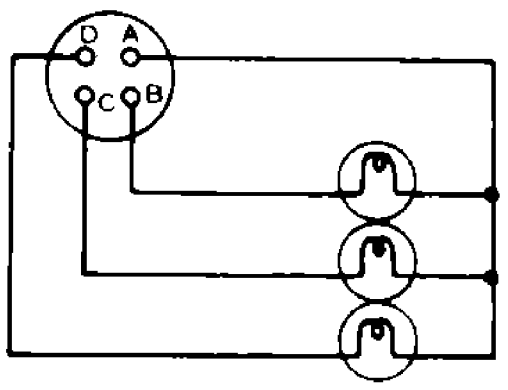


2.10 Pilot lamps and monitoring circuit

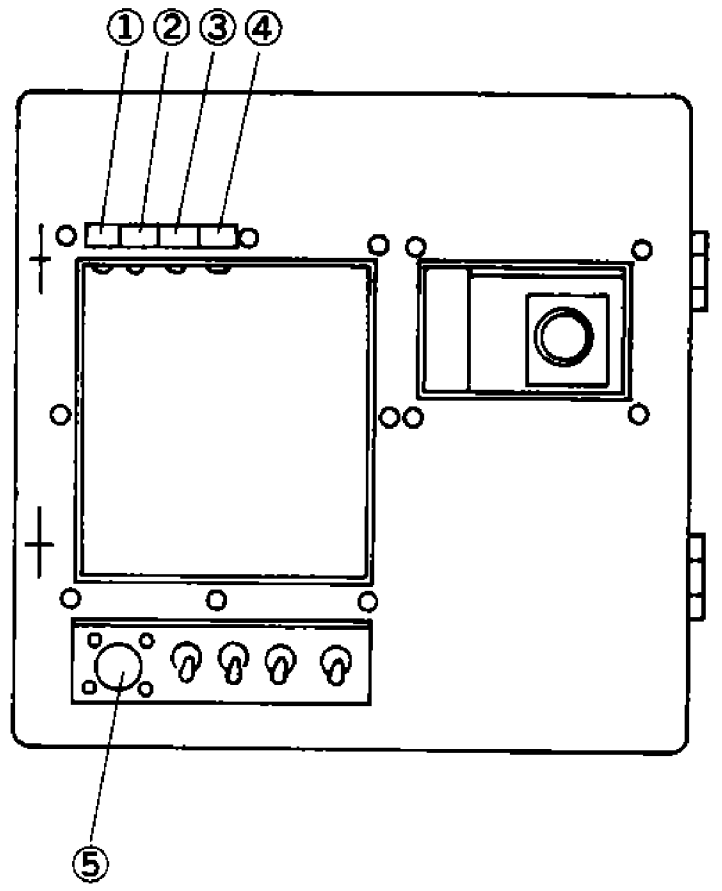
(1) Four lamps which indicate operating mode are mounted on the front panel of the control box.

Red : indicates defrost mode (RL)
Green : indicates that the compressor is running (GL)
Orange : indicates that inside temperature is with in range (Within ±3.6°C(±6.5°F) of the preset temperature) (OL)
White : indicates that electrical source is supplied.

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



A : Earth
B : Compressor (Green)
C : Defrost (Red)
D : In range (Orange)



① Red
② Green
③ Orange
④ White
⑤ Monitoring receptacle for pilot lamp

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

Parts Name		Setpoint selector set above −4.5°C (+23.9°F) chilled mode			Setpoint selector set below −6.5°C (+20.3°F) frozen mode		Defrost operation	Water cooled operation (Air/water cooled type)
		Pull down	In range	Heat-up operation (manual)	Pull down	In range		
pilot lamp	DEFROST—Red	×	×	×	×	×	○	Water cooled condition is the same as air cooled except ○ Water pressure switch (63W) opens ○ Condenser fan motor (MF2) de-energized ○ According to conditions, one of two condenser fan motors rotates even though water cooled operation.
	COMP—Green	○	○or×	○	○	○or×	○	
	IN RANGE—Orange	×	○	×	×	○	○	
	POWER—White	○	○	○	○	○	○	
Magnetic contactor	Compressor・Condenser fan motor (88C)	○	○or×	○	○	○or×	○	
	Evaporator fan motor low speed (88EFL)	※ ○or×	※ ○or×	※ ○or×	○	○	×	
	Evaporator fan motor high speed (88EFH)	※ ○or×	※ ○or×	※ ○or×	×	×	×	
Solenoid valve	20R1	○	○or×	○	○	○or×	○	
	20R2	○	○	×	○	○	×	
	20R4	×	×	○	×	×	○	
Compressor. MC ,		○	○or×	○	○	○or×	○	

Notes 1) ○ : Energized or ON, × : De-energized or OFF
2) ※Shows operation mode changes by supply air temperature
●Supply air temperature : above 20°C (68°F)
···low fan speed operation
●Supply air temperature : below 15°C (59°F)
···high fan speed operation

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.

●Frozen, chilled operation

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. Oil pressure protection switch is functioning.(Option)	It is left as it has functioned.	Repair trouble and set reset switch to on.
		e. Compressor protective thermostat function.	Current is excessively large due to over-load operation. Open phase power supply circuit.	Trace causes of trouble.
		f. 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.
	C : Compressor only operates, but evaporator and condenser fans do not operate	a. Phase sequence controller does not function	Open phase power supply circuit.	Trace causes of trouble.
			Phase sequence controller is faulty.	Replace faulty phase sequence controller.
II. Unit can operate but stops soon.	A : Evaporator fans, condenser fans and compressor do not operate.	a. Oil pressure protection switch is functioning.(Option)	Oil pressure will not rise. Oil is short or oil pump is out of order.	Additional oil charge, or repair oil pump.
		b. Compressor protective thermostat function.	Current is excessively large due to over-load operation. Open phase power supply circuit.	Trace causes of trouble.
	B : Condenser fans and compressor stop, keeping evaporator fans in operation.	a. Oil pressure protection switch is functioning.(Option)	Oil pressure will not rise. Oil is short or oil pump is out of order.	Additional oil charge, or repair oil pump.
		b. No trouble with unit.	Controller functions and stops unit.	—
	C : 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

State	Phenomena	Functioning places	Cause of trouble	Countermeasures
II. Unit can operate but stops soon.	C : Condenser fans and compressor operate on and off. Evaporator fans continue operating.	a. High pressure switch functions.	● 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 insufficent 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.
II. Unit can operate but stops soon.	D : Condenser fans and compressor operate. Evaporator fans operate on and off.	a. No trouble with unit.	One minute stopping of fan after defrosting.	—
		b. Protective thermostat is activated.	Coil temperature rise due to overcurrent to fan motor.	Trace causes of trouble.
III. Inside temp. is low than tempea -ture 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 tempera -ture 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.

●Defrost 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.

State	Phenomena	Functioning places	Cause of trouble	Countermeasures
I. Defrosting does not start.	A : Turn on manual defrost switch, but defrosting does not start.	a. No trouble with unit.	Compressor stops.	—
		b. Defrost termination thermistor does not close.	Defrost termination thermistor is faulty.	Replace defrost thermistor.
		c. controller does not function.	Controller is faulty.	Replace faulty controller.
	B : Frozen operation continues for 13 hours or more.	Controller does not function.	Controller is faulty.	Replace faulty controller.
II. Defrosting starts but stops soon.	Defrosting starts condenser fans, compressor stop soon.	a. No trouble with unit.	Unit stops for 20 seconds by timer.	—
		b. Liquid solenoid valves do not close.	Valves are clogged with dust.	Clean valves or remove obstacles.
		c. Low pressure switch is opening.	Low pressure switch is faulty, wire is disconnected.	Replace or repair.
III. Defrosting time is too long.	A : It takes 90 minutes to defrost although frost collected is small.	a. No trouble with unit.	It takes time to defrost because of low ambient temp.	—
		b. Defrost termination thermistor does not open.	Defrost termination thermistor is faulty.	Replace defrost thermistor.
		c. Three way solenoid valve does not change to defrosting circuit.	Valve is clogged with dust. Three way solenoid valve is faulty.	Clean valve, remove obstacles or replace valve.
		d. Main liquid solenoid valve (20R1) is not opened.	Low pressure swich is faulty.	Replace faulty low pressure switch.
			Wrong wiring for measuring liquid solenoid valve (20R2) and main liquid solenoid valve (20R1).	Check wiring.
	B : Defrosting operation continues for 90 minutes or more.	Controller does not function.	Cotroller is faulty.	Replace faulty controller.
IV. Defrosting repeat every 4 hours.		No trouble with unit.	Inside temperature is out of in range temperature.	—

●Heat up operation.

State	Phenomena	Functioning places	Cause of trouble	Countermeasures
I. Heat up operation does not start.	Turn on manual heat up switch, but defrosting does not start.	a. No trouble with unit.	Temperature setting is lower than inside temperature.	—
		b. Defrost termination thermistor does not close.	Defrost termination thermistor is faulty.	Replace defrost thermistor.
		c. Controller does not function.	Controller is faulty.	Replace faulty controller.
II. Heat up operation starts but stops soon.	Heat up operation starts condenser fans, compressor stop soon, evaparator fans continue to operate.	a. No trouble with unit.	Unit stops for 20 seconds by timer. Inside temparature reaches to temperature setting , controller operates and unit stops.	—
		b. Liquid solenoid valves do not close.	Valves are clogged with dust.	Clean valves or remove obstacles.
		c. Low pressure switch is opening.	Low pressure switch is faulty, wire is disconnected.	Replace or repair.

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 — **DAIKIN INDUSTRIES, LTD.**

Installed ship name		Date of inspection	
Container No.		Place of inspection	
Loaded cargo		Unit Model No.	
Customer's staff		Unit No.	
Service staff		Compressor No.	

Check	No.	Check point	Check method	Reference value
	1	External appearance of importants 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	Cleaning defrost air hose and checking that there is no trap on it. (option)	Visual	Shall be free from clogging
	9	Checking operation of heat-up function	Check operation	
	10	Checking appearance of defrost termination thermostat	Visual	
	11	Tightened condition of cable glands and monitoring receptacle	Retighten with tool	Make sure that they are firmly tightened
	12	Checking condenser and evaporator fan motors for vibration and noise	Touch and listen	
	13	Checking seal of liquid indicator	Check liquid indicator	Make sure that it is sealed
	14	Checking for water in refrigerant	Check liquid indicator	Dry indication
	15	Checking compressor oil level (operating condition)	Check compressor oil level gauge	⊖ (oil level 1/4 ~ 3/4)
	16	Checking operation and battery of recorder	Visual	
	17	Checking operation of each solenoid valve	Listen or touch each tube	
	18	Checking operation of controller and pilot lamps	Refer check instrument	
	19	Checking operation of defrost initiation air switch (option)	Check with U tube ☐ mmH_2O CUTIN	
	20	Unit operating current R ☐ S ☐ T ☐	Clamp meter −18°C ☐ V ☐ Hz	
	21	Unit insulation resistance — Compressor circuit ☐ MΩ	DC 500V megger	2MΩ or more
		Unit insulation resistance — Evaporator fan circuit ☐ MΩ		
	22	Checking manual defrosting operation	Manual defrost switch	
	23	Checking operation of defrost termination thermostat (Completing temperature) ☐ °C	Mount thermistor to completion thermostat mounting position	OFF 40 ~ 60°C
	24	Checking operation of high pressure control switch	Visual left side air cooled condenser fan to be stopped	
	25	Checking operation of high pressure switch — H-CUT OUT ☐ IN ☐ kg/cm²	Operate the air cooled condenser without fan operation	20 Kg/cm² / 16.5 Kg/cm²
		Checking operation of low pressure switch — L-CUT OUT ☐ mmHgV	Accomplish pump down by use of the stop valve at the water cooled condenser outlet	400 mmHgV
		Checking operation of low pressure switch — L-CUT IN ☐ kg/cm²		0.2 Kg/cm²
	26	Checking operation of water pressure switch — Checking switchover from air cooled to water cooled operation	Disconnect water coupling	Condenser fan motor shall operate
		Checking operation of water pressure switch — Checking switchover from air-cooled to water-cooled operation	Connect water coupling and supply water	Condenser fan motor shall stop
	27	Checking power supply changeover switch — Checking 200V class operation	Place changeover switch lever upward	
		Checking power supply changeover switch — Checking 400V class operation	Place changeover switch lever downward	
	28	Storage temperature °C ☐	0°C	−18°C	Automatic operation at −18°C
		Ambient temperature °C ☐ ☐ ☐	☐ in one cycle
		LP kg/cm² ☐ ☐ ☐	☐ COMP OFF ☐ M
		HP kg/cm² ☐ ☐ ☐	☐ COMP ON ☐ M
		Operating time — Immediately after operation ☐	Operation starting → 0°C ☐ Hr ☐ M	Operation 0°C → −18°C ☐ Hr ☐ M	Automatic operation at −18°C ☐ Hr ☐ M
		Operation starting time ☐ ☐	
	29	Checking automatic defrosting operation	Defrost time ☐ M	

5. Major components and maintenance

5.1 Components related with refrigeration circuit

5.1.1 Compressor

The compressor is of a semi-hermetic type with the built-in motor so that there are few places where leakage of refrigerant may occur. The reversible trochoid pump used produces the required oil pressure regardless of the direction of rotation of the built-in motor.

- In order to prevent vibration of the compressor from transferring, the compressor is equipped with vibration elimination rubbers and flexible tubes. However, severe vibration may sometimes take place during unloading operation, but this is not a sign of trouble.

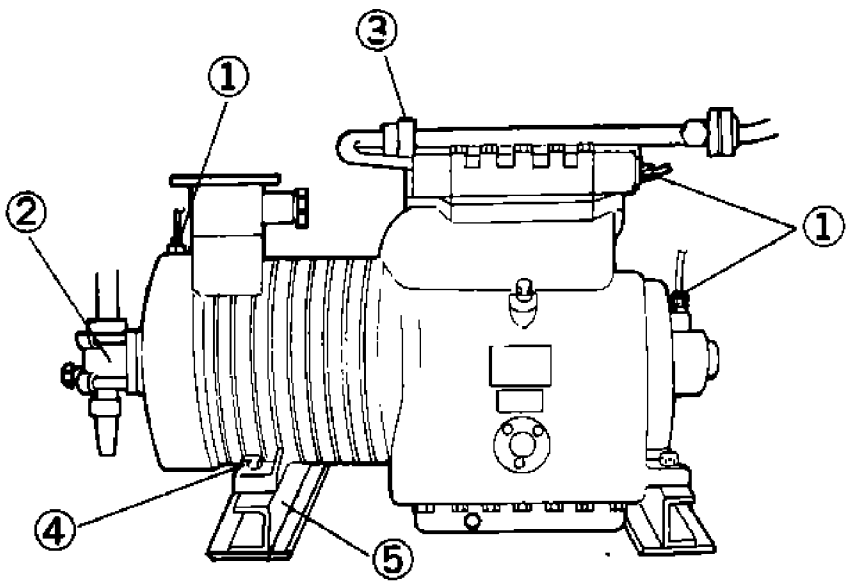
① **Replacement**

Remove the compressor by the following procedure.

1) Remove the front and base plates and protective stay of the cable stowage.
2) Remove companion flange for discharge side, suction stop valve, gauge piping flare nut (compressor side).
3) Remove four bolts (two on each side) fastening the compressor and base.
4) Take out the compressor to the front of the unit.

② **Installing procedure**

Install the compressor according to reverse procedure given above. When tightening the bolts, refer to the list for torque.



① Gauge piping flare nut
② Stop valve at compressor suction side
③ Companion flange for dischange side
④ Bolt
⑤ Base

	Item	Unit	Value
Tightening torque of bolts	Compressor	kg·cm/lb·ft	435/36
	Compressor stop valve flange		255/21
	Fan motor		
	Solenoid valve		30/2.3
	Expansion valve		250/20.5
	Fan·access panel		55/4.3

Note : Allowable range of tightening torque ±10%

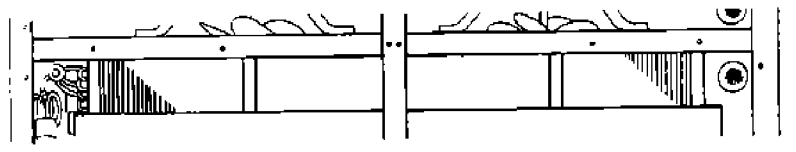
5.1.2 Air cooled condenser and evaporator

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

Maintenance

Service the air cooled condenser after removing the front panel. Service the evaporator after removing the access panels from outside.

Air cooled condenser

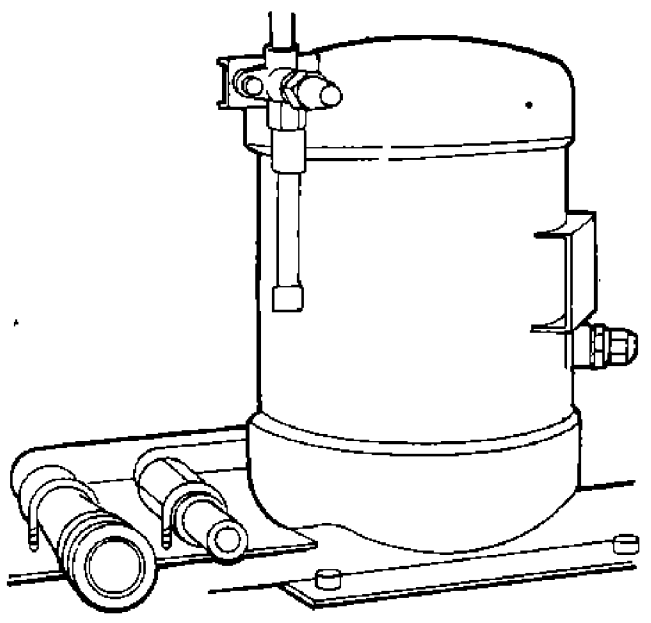


Evaporator

5.1.3 Water cooled condenser (Air/water cooled type)

Receiver (Air cooled type)

The water cooled condenser is mounted in case of the air/water cooled type and the receiver is installed in case of the air cooled type. Since the condenser is of the shell and coil type, cooling water flows in the inner cooling tubing and the refrigerant flows in the condenser shell. The cooling tubing having special fins are used to make it light and compact.

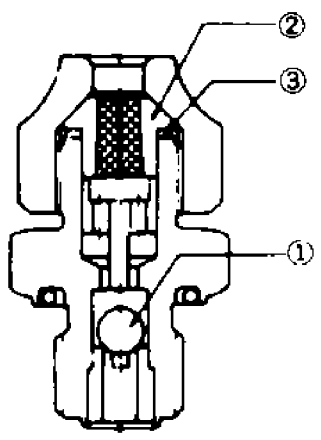


Replacement procedure of the fusible safety plug

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.

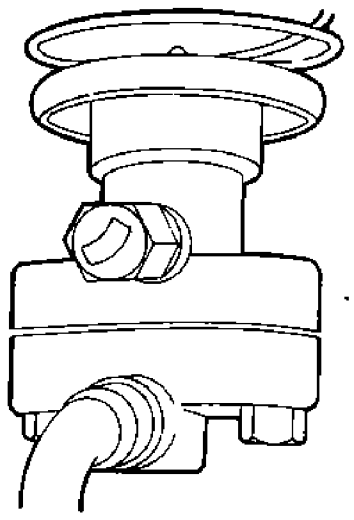


① Ball
② Fusible plug alloy
③ packing

Construction of fusible safety plug

5.1.4 Expansion valve

The externally equalized thermal expansion valve which is fitted before the evaporator and senses super-heat degree of leaving evaporator refrigerant and controls flow of the refrigerant automatically according to operating conditions. The expansion valve with MOP. (MAXIMUM OPERATING PRESSURE) is adopted to protect the compressor motor from overload.



"CAUTION" Whenever adjusting and replacing the expansion valve, the unit should be stopped securely for safety sake.

① **Adjusting the expansion valve**

There are two methods to adjust the expansion valve; i.e, one is the adjustment based on the suction operation standard and the other is that based on the frost conditions on the compressor.

a. **Adjustment based on the suction operation pressure**

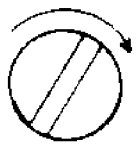
1) Confirm that the predesigned volume of the refrigerant has been charged.
2) Attach a pressure gauge to each gauge port and operate the refrigeration unit, maintaining inside temperature at −18°C(−0.4°F). (refer to "Maintenance").
3) When inside temperature comes to the preset temperature, compare the suction pressure reading with the standard pressure. (refer to "Standard operation pressure curve")
4) If suction pressure reading differs with the standard pressure, adjust the expansion valve as stated below.
5) After loosening the clamp screw, turn the adjusting screw.
6) Note that pressure will not change after a certain lapse of time.

b. **The adjustment based on frost stated on the compressor.**

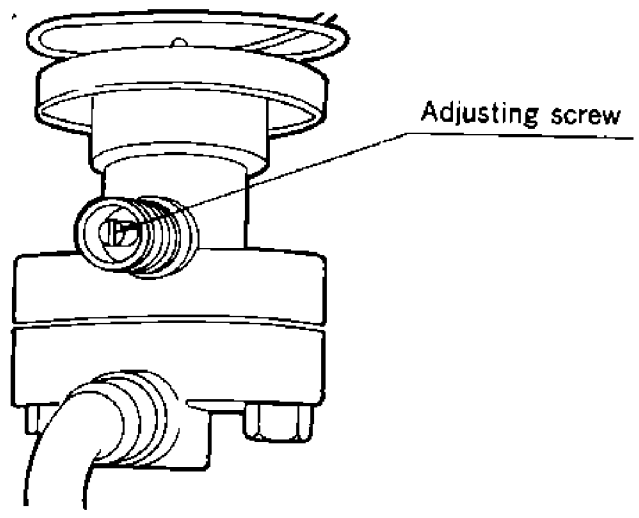
1) Refer to the caution for adjustment of expansion valve as above. At this time, inside temperature should be maintained to −18°C(−0.4°F).
2) Regulate the adjusting screw as stated below based on frost state on the suction pipe and the stop valve of the compressor.
3) Whether or not the adjustment required is judged by frost state of the flange on the suction side of the suction valve.
4) However note that frost state differs with outdoor air conditions (temperature and humidity).

c. **Adjusting points for expansion valve**

- Suction pressure is higher than the standard pressure (Frost forms on the compressor side rather than the suction flange of the stop valve). Clockwise rotation of the adjusting screw decreases running pressure.



- Suction pressure is lower than the standard pressure (Frost forms on the suction pipe rather than the suction flange of the stop valve). Counterclockwise rotation of the adjusting screw increases running pressure.



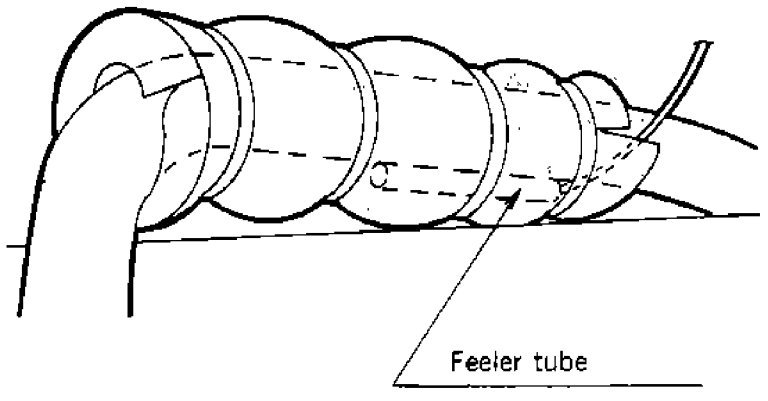
d. Countermeasures after operation

1) Remember the original setting of the expansion valve. If any change is found with the setting after adjustment of the expansion valve, return the adjusting screw to the original position, as trouble occured caused by other reasons.
2) When the adjusting screw is returned to its original position, firstly turn it passing the original position and then return it to the original position.
3) After adjustment, be sure to tighten up the clamp screw and cap it to prevent the refrigerant from leaking.
4) After completion of the adjustment, operate the unit, keeping inside temprature at −18°C(−0.4°F) and confirm that low pressure does not go down below standard operation pressure

② **Replacement**

Remove the access panel, the front panel of the air cooled condenser fan and fan guide which are located outdoors, before undertaking the work.

1) Remove the feeler tube, equalizing pipe flare, and fastening bolts. (To replace the cage alone, there is no need to remove the feeler tube.)
2) Remove the power assembly, cage, and packing.
3) Be sure to install a new packing when replacing it.



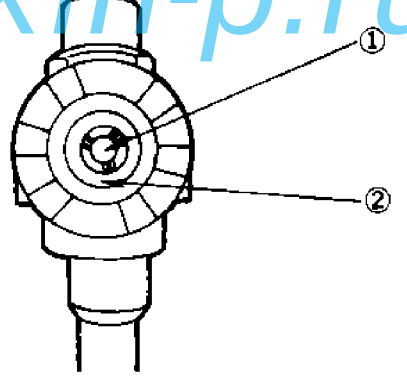
5.1.5 Liquid/moisture indicator

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 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.

② **Flow of the refrigerant**

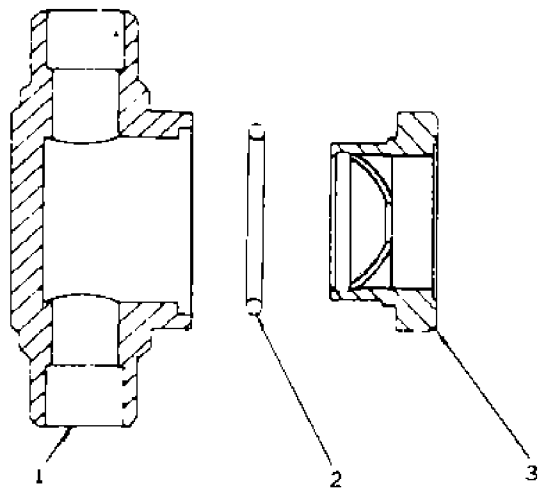
- When the liquid refrigerant is sealed, corrugation on the sight glass disappears.
- Check

Operation	Indicator state
At start	Bubbles appear but liquid refrigerant is sealed in 30 minutes to an hour after starting.
During operation	Bubbles may appear more or less.

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 apply excessive torque, or the O-ring will break.)



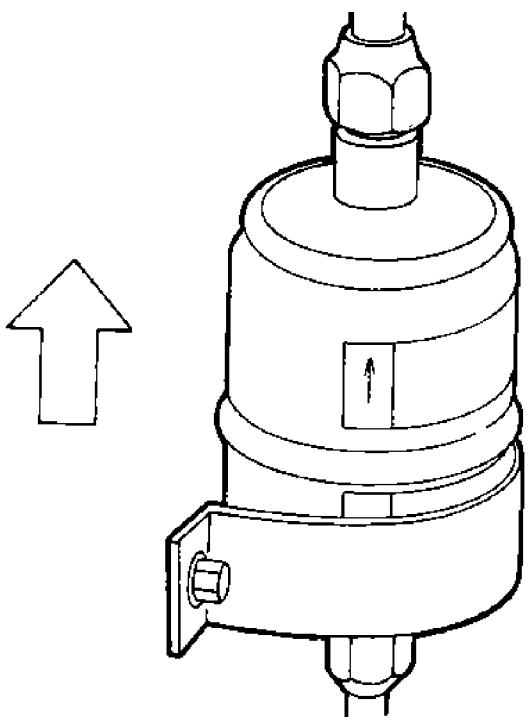
① Body
② O-ring
③ Sight glass

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.

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 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.

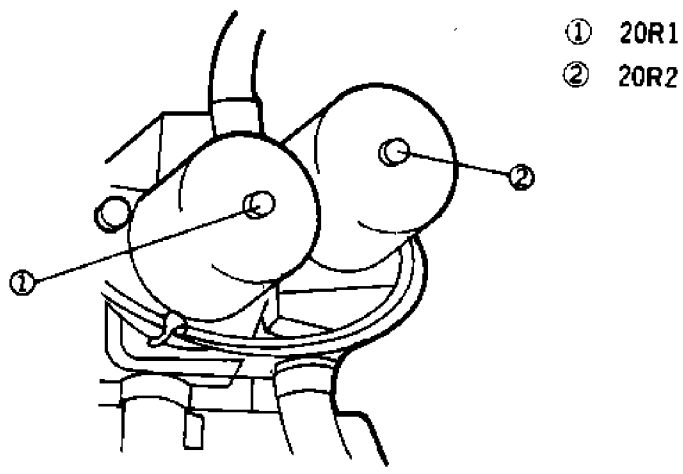


5.1.7 Solenoid valves

① Solenoid valves in the liquid line (20R1, 2)

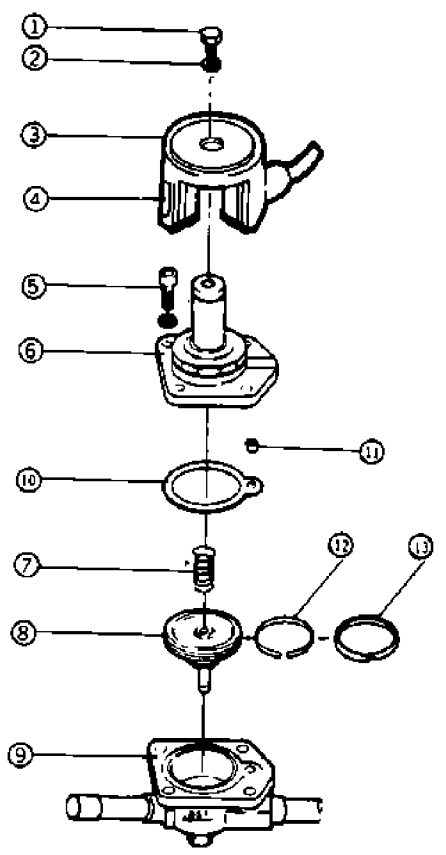
- Model: REV1004DXF
- Power supply: AC 24V, 50/60Hz

20R1, 2 are opened or closed by the signal of the controller.
When 20R1, 2 are closed, the refrigerant flow is blocked.



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.



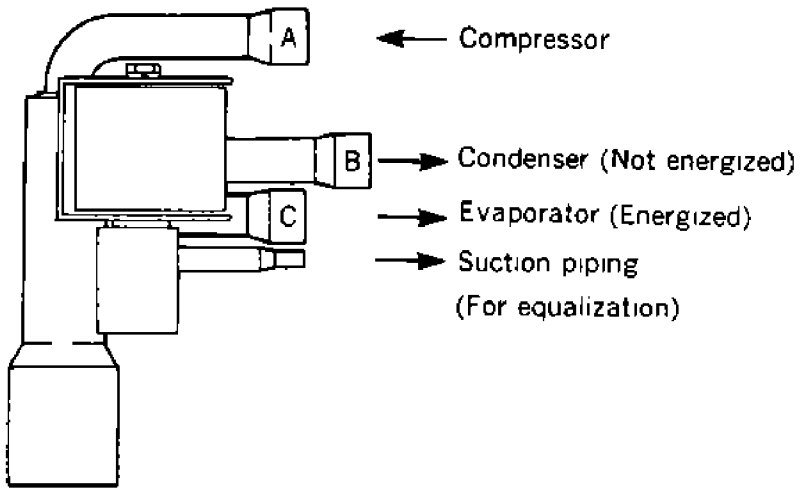
No.	Parts name
①	Set bolt (M5)
②	Spring lock washer (M5)
③	Name plate
④	Coil ass'y
⑤	Set bolt
⑥	Cover ass'y
⑦	Spring
⑧	Piston
⑨	Valve body
⑩	Packing
⑪	Sleeve
⑫	Inner ring
⑬	Piston ring

② **3 way solenoid valve for defrosting (20R4)**

- Model: DHV804DXF
- Power supply: AC 24V, 50/60Hz

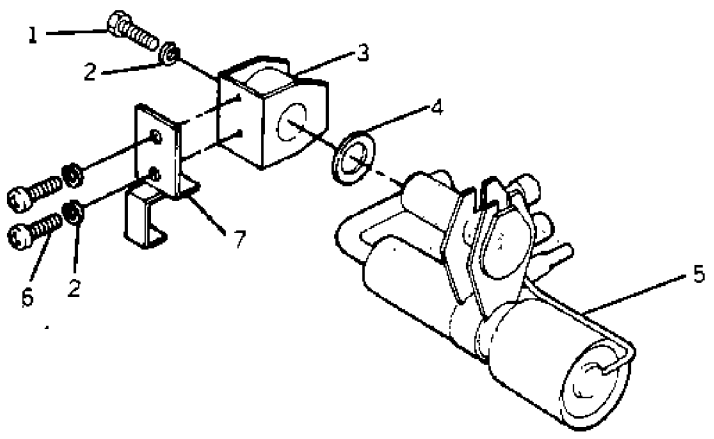
The 3 way solenoid valve is provided to change the discharge gas flow to the condenser during frozen operation to the evaporator during defrosting.

a. Piping connection



b. Replacing method

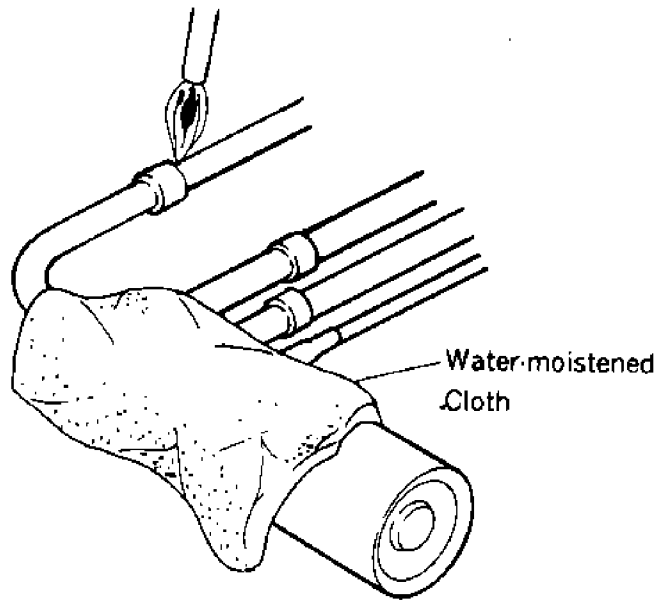
(1) Replacement of coil



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

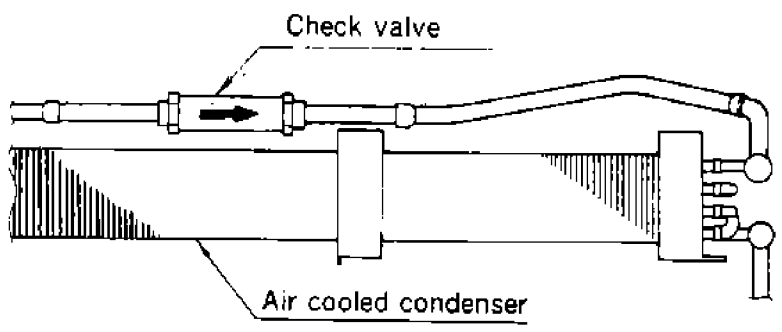
Before brazing the valve body, remove the coil and braze it while cooling it sufficiently (below 120°C 〔248°F〕)with water-moistened cloth.



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.

5.2 Components related with the air system

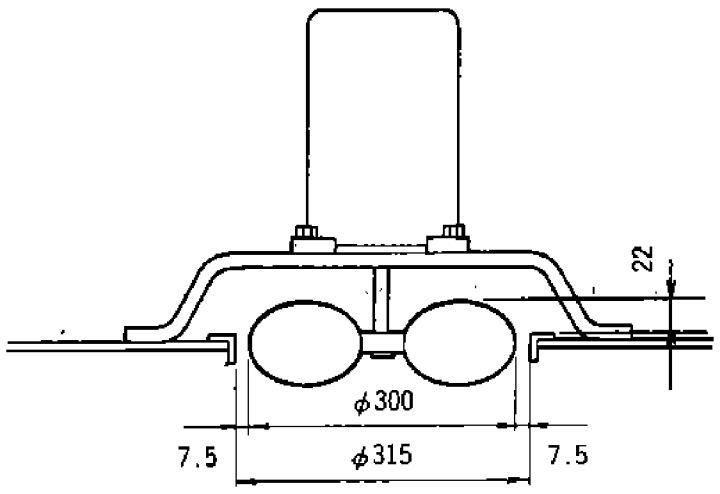
5.2.1 Fans and motors

① **Specifications**

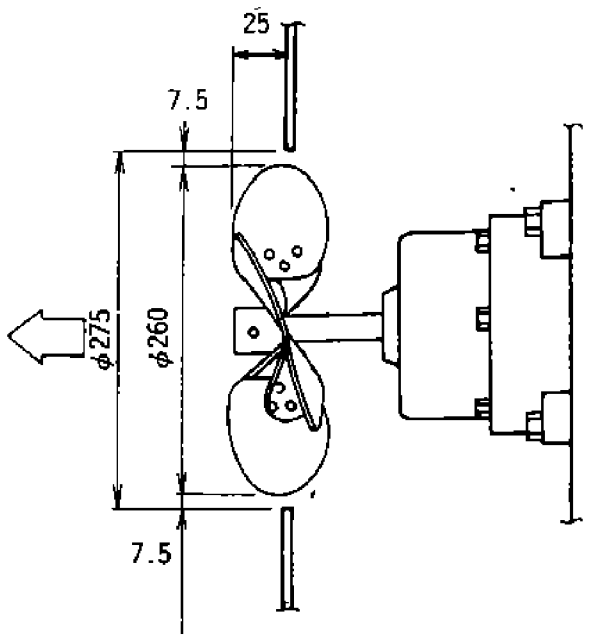
		Evaporator	Condenser
Fan	Type	Propeller fan	
	Numbers of blades	6 pcs.	
	Blade diameter	ϕ300	ϕ260
Motor	Type	3 phase squirrel-cage induction motor	
	Motor output (Pole numbers)	420/700W(2P)	200/330W(4P)
		60/90W(4P)	
	Bearing	Ball bearing, 6203 Non-contacting type Rubber seal	

② Installation procedure

a. Evaporator fan and motor

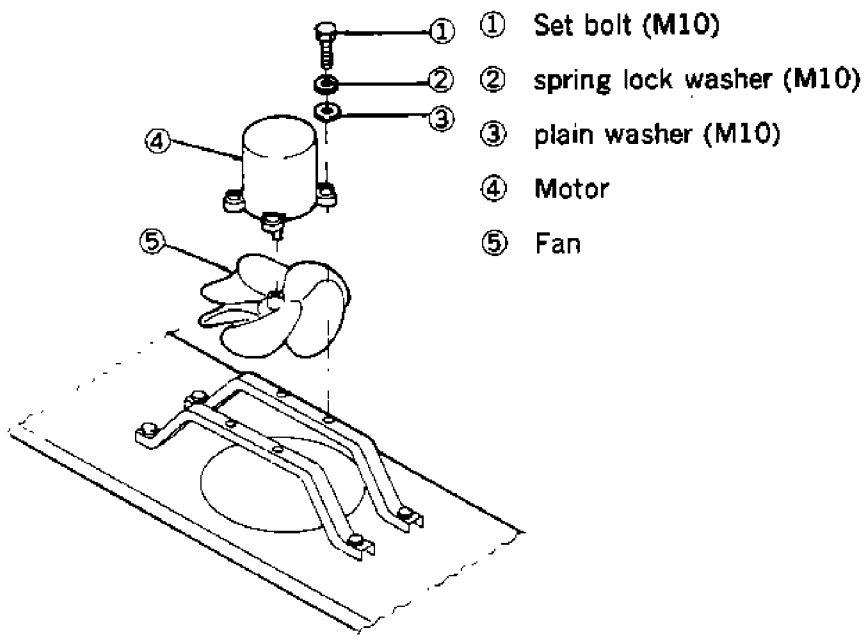


b. Condenser fan and motor



③ **Replacing method for evaporator fan**

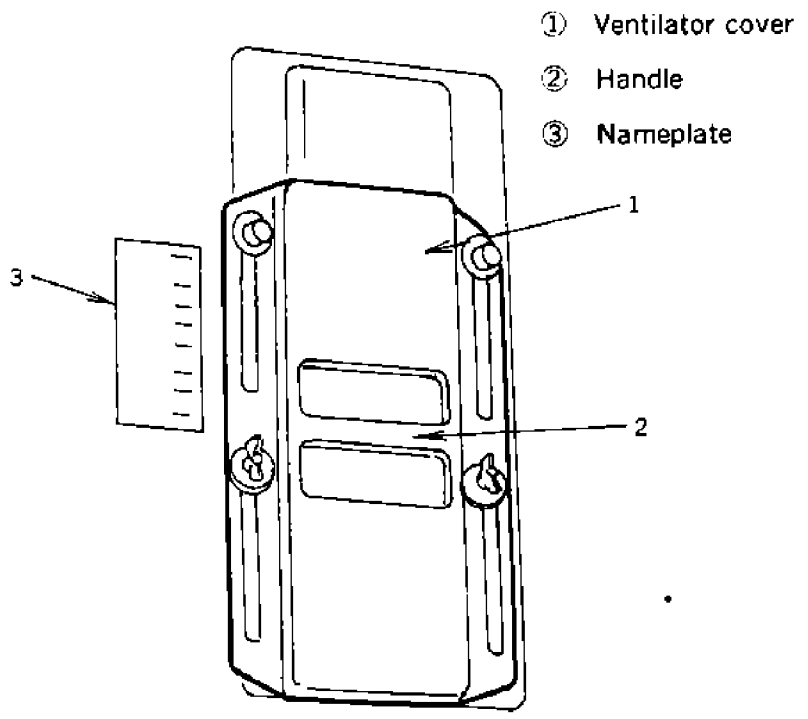
Before removing the evaporator fan, loosen the bolts on the fan motor and remove the motor.



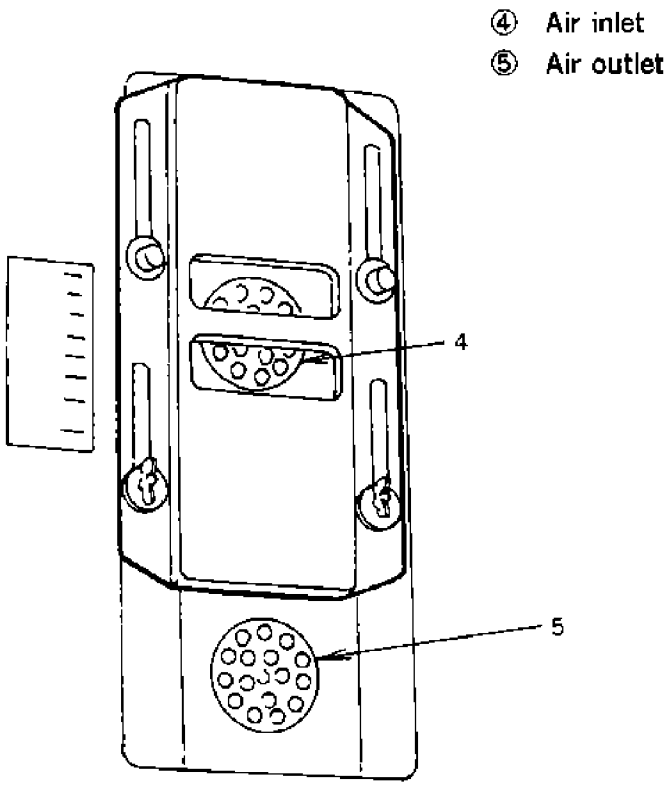
5.2.2 Ventilator

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)

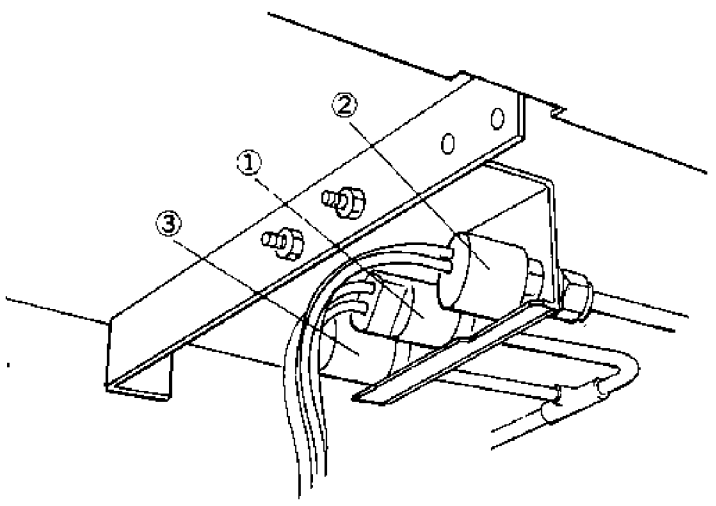
This switch causes compressor to stop, as the operation pressure of the unit has risen abnormally. Thus HPS is adapted to stop the compressor if the high pressure has gone up above its set value due to failure of condenser fan, obstructive passage to cooling water, etc.

5.3.2 Low pressure switch (63L)

This switch causes the compressor to stop when the operation pressure of the unit has dropped abnormally or when"pump down" operation has been conducted. Thus LPS is adapted to stop the compressor, if the low pressure has gone down below its set value if a result of "pump-down" due to stuffed cooling system or closed liquid line solenoid valve.

5.3.3 High pressure control switch (63H2)

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")



① High pressure switch (63H1)

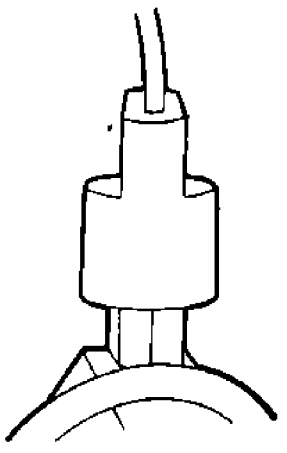
② Low pressure switch (63L)

③ High pressure control switch (63H2)

5.3.4 Water pressure switch (63W)

(Air/water cooled type)

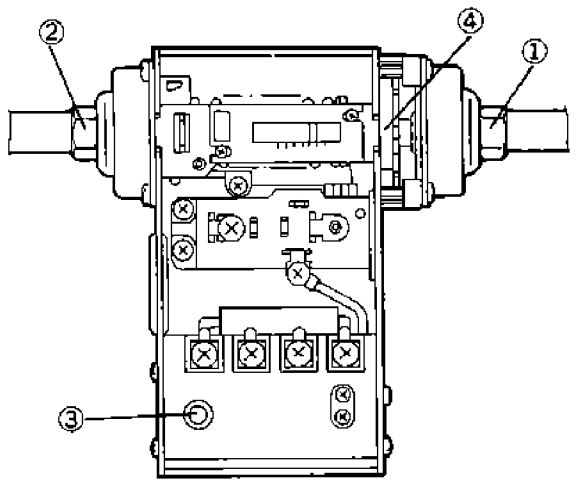
This switches over air and water cooled type. If coolig water flows and water pressure rises above a preset water pressure at the inlet, the contact is turned off to stop the condenser fan motor and water cooled operation will start.



5.3.5 Oil pressure protection switch(63QL) (Option)

Oil pressure (difference between oil pressure and low pressure) falls due to oil pump failure, clogging and oil foaming.

This stops the compressor automatically when oil pressure continuously remains low, because the compressor may be burnt because of oil shortage.



①LP ③Reset button
②OP ④Adjusting gear for setting

① **Operation**

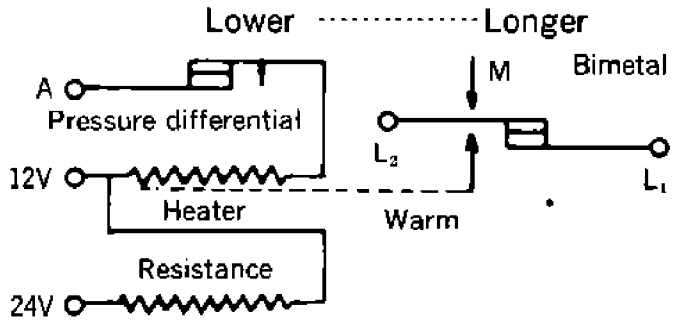
The oil pressure (pressure difference) normally rises when the compressor has started. If the pressure does not rise, power will be supplied to the heater of a timer and a bimetal operate after a preset interval, thereby stopping the compressor will stop.

Note: Timing device is affected by ambient temperature and its set period differs with ambient temperature. (Standard temperature 25°C (77°F))

Ambient temperature Set period

Higher ---------- Shorter

Lower ---------- Longer



Electric wiring in oil pressure protection switch

② **Reseting**

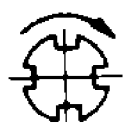
If 63QL has operated, cepress the reset button several minutes after when the compressor stops. (The button will not be reset unless the bimetal is cold.)

③ **Adjustment method**

Adiust the oil pressure protection switch by turning the adjusting gear as described below.

Adjusting points for oil pressure protection switch

- When rotate the adjusting screw clockwise, functional pressure (differential) becomes low and heater circuit is disconnected with low pressure difference.



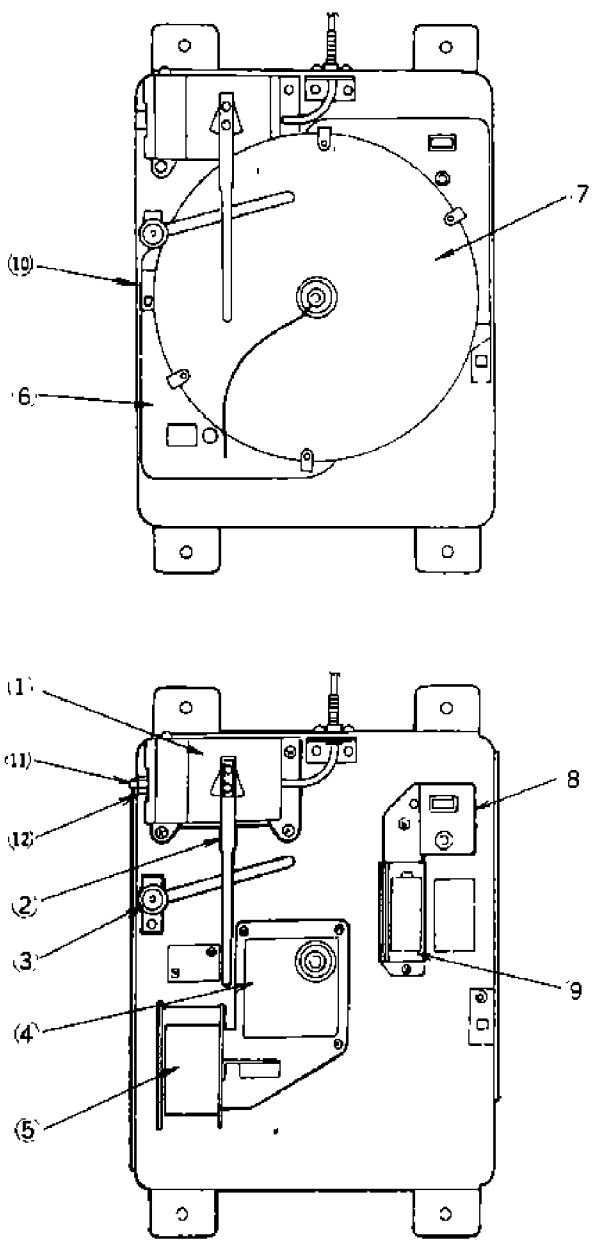
- When rotate the adjusting screw counterclockwise, functional pressure (differential) becomes high and heater circuit is disconnected with high pressure difference.

Note: The following turning directions are viewed from the low pressure connection side.

5.3.6 Recorder (SKM−2924A)

① **Specifications**

● Model	SKM-2924A
● Feeler tube	Gas sealed
● Recording method	Pressure sensing type
● Recording temperature range	−25～+25°C(−13～+77°F)
● Recording paper	Dia. 203 Disk type pressure sensible paper (Graduation 1/1°C) (Corresponding to PSD-217C (REV. A) made by PARTLOW Co.)
● Driving method for recording paper	Timer (Quartz motor + reducing gears) a turn/31 days Quartz motor driving source: Goods corresponding to Dry battery (DC 1.5V) JIS C 8501 ·····SUM2 IEC ·····R14 Life is approx. 1 year (Remaining voltage indicator)



① Element
② Pen
③ Pen lifting arm
④ Reducer
⑤ Quartz motor
⑥ Recording board
⑦ Recording paper
⑧ Remaining V indicator
⑨ Battery
⑩ Present time plate
⑪ Adjusting screw
⑫ Lock screw

② **Inspection of recorded temperature**

Operate the unit in chilling mode at 0°C (32°F) setting and confirm with the thermometer that the return air temperature has stabilized at 0°C(32°F). Then calibrate the recording pen according to the return air temperature at stop of compressor on the thermometer.

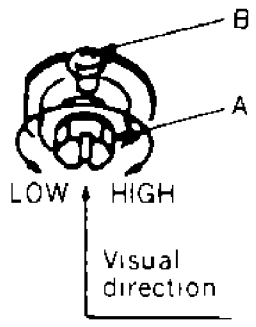
③ **Adjustments**

1) Make adjustments subsequent to the inspection in item.

2) Turn the temperature setting screw (A) to adjust the temperature. Loosen the lock screw (B) and turn the setting screw (A) clockwise to temporarily raise the temperature setting by approximately 5°C (9°F). Then turn the setting screw (A) counterclockwise to lower the temperature setting of the pen until the temperature is adjusted to the digital temperature. Tighten the lock screw (B) after the adjustment.

Note: 1 One turn of the setting screw (A) changes the temperature setting by approx. 5°C (9°F).

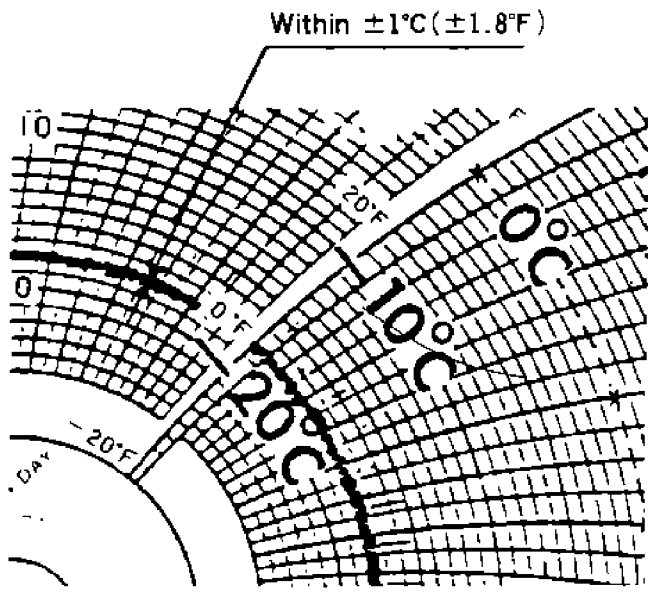
2 Be careful that the temperature setting may be altered by tightening the lock screw (B).



3) Generally a temperature recorder should be adjusted at 0°C (32°F), but the following method is available when the setting temperature is known.
- Chilled mode(Setting temperature : above −4.5°C [+23.9°F])····· "Adjust at 0°C (32°F)."
- Frozen mode (Setting temperature : below −6.5°C [+20.3°F])····· "Adjust at −18°C (−0.4°F)."

4) Inspection and adjusting method
- adjust a temperature recorder when the container inside temperature becomes decreasing. Temperature recorder's pen shows the temperature correctly when it is decreasing. Don't adjust it when the temperature becomes increasing. It is caused from its hysteresis that a pen sometimes shows the temperature lower from 1°C (1.8°F) to 3°C (5.4°F) when the temperature is increasing.
- It is a normal phenomena that the recording curves are a little influenced by the fluctuations of the ambient temperature. (Note : Basically the temperature recorder is designed for 25°C [77°F] ambient, and 10°C (18°F) fluctuations of the ambient temperature cause the error of ±0.2°C. [± 0.4°F])

- A temperature recorder adjusted at 0°C (32°F) sometimes shows the following curves at −18°C (−0.4°F) inside. It is a normal and allowable range.
  If the range exceeds the above, readjust it at 0°C (32°F) (or−18°C 〔−0.4°F〕).
- Don't move the pen by hand, because it will cause an increase of error.
- When the pen is holded by the pen lifter the pen may move unsmoothly, but it is no problem.

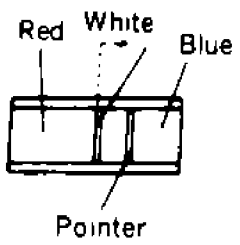


④ Replacement of parts

a. Battery

1) Replacement interval

- When the indicator is out side the blue zone after checking the residual voltage of the battery. (When the indicator is above the dotted lines, i.e., within the white zone shown in the right figure, the battery has approximately one-month life.)



Residual voltage indicator

2) Replacement method

- Remove the recording panel and insert the new battery making certain that the battery polarity is correct. Use SUM-2 of JIS C8501 or IEC R14 battery or the equivalent (DC1.5V dry cell).
- After replacement, confirm that the pointer of the residual voltage indicator is within the blue zone and that the quartz motor functions properly.

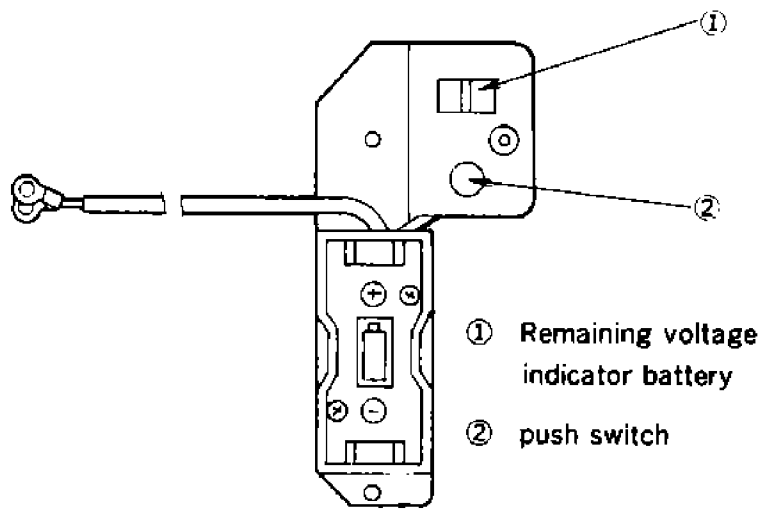
b. Residual voltage indicator battery

1) Replacement interval

- In case oscillation of the needle is unstable when the push switch is pressed down for confirmation of remaining voltage.
- In case the remaining voltage indicator needle is within the white zone or in the red zone, although a new battery is set in.

2) Replacement method

- Remove the recording panel by loosening the screw.
  Remove the residual voltage indicator battery from the body, and replace it with a new one.
- When replacing the battery make certain that the terminal wirings are connected red to red and black to black
- After replacement confirm that the pointer is within the blue zone and that the quartz motor functions properly.
- Battery is to be replaced every 12 months.



(DKM-AA003)

Residual voltage indicator battery

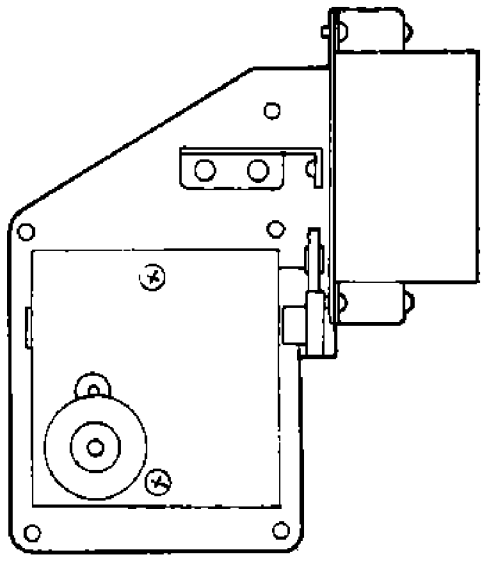
C. Timer (quartz motor speed reducing gear)

1) Replacement interval

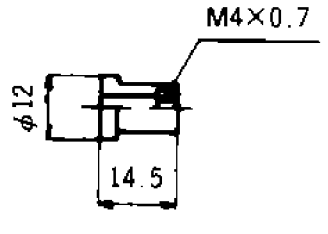
- When the quartz motor does not function even though residual voltage battery is normal.
- When the timer delays over three hours a day.

2) Replacement method

- Remove the recording panel to remove the wiring. Loosen the screws (5 pcs) to remove the timer, and replace the timer with a new one.
- When replacing the timer, also replace the antivibration rubbers (5 pcs). The red wire is for (+) and the black wire for (−), therefore, connect the red terminal with red and the black with black. Tighten the anti-vibration rubbers with torque of 4 ~5kg-cm.
- Confirm that the quartz motor functions correctly after replacement.



Timer (quartz motor speed reducer)



Accessory (anti-vibration rubber : 5 pcs)

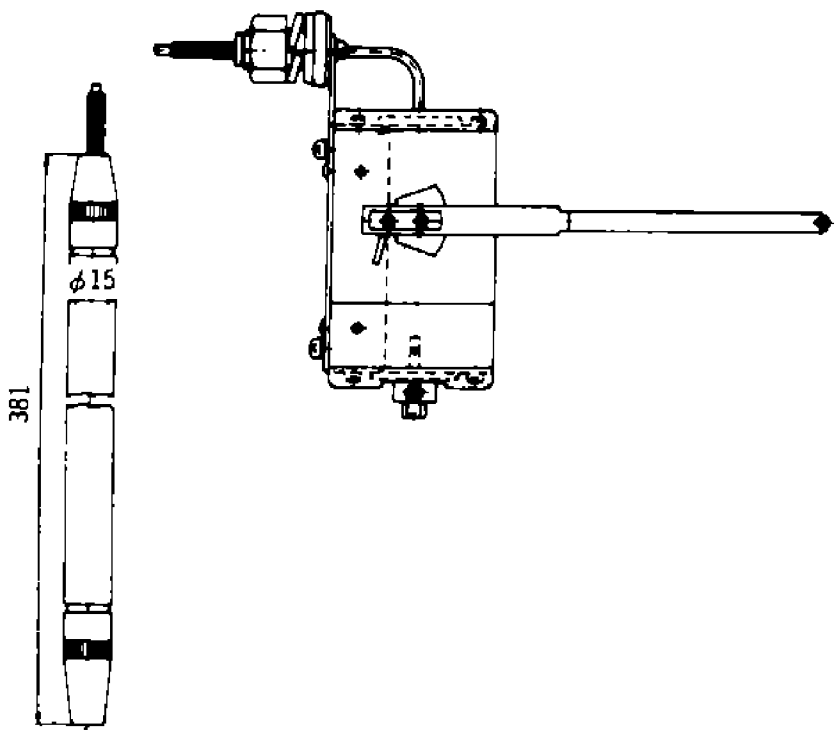
d. Thermal feeler tube

1) Replacement interval

- After the pen has been adjusted and the controller has been operated within the temperature range of −18 to+10°C (−0.4 to+50°F), with the inside temperature stabilized at the temperature setting: When the temperature indication under the above conditions deviates by more than 2°C (4°F) against the temperature setting. (When the temperature indication is substantially less than the temperature of the thermal feeler tube, gas leakage may be suspected.)

2) Replacement method

- Loosen the screw and remove the thermal feeler tube-element. Replace it with a new one.
- After replacement, inspect and adjust.

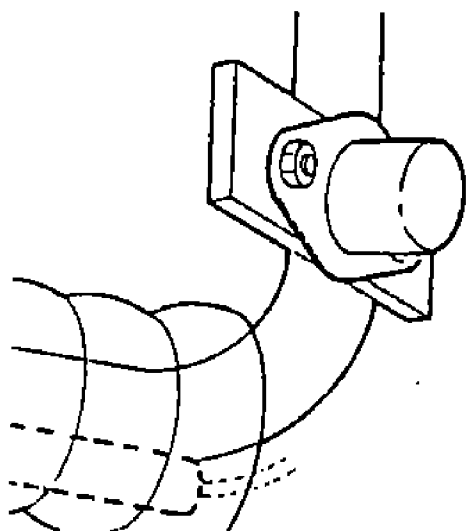


Feeler tube—element ···SKM-AA001

5.3.7 Defrost termination thermistor (26D)

The thermistor indicates termination of defrosting, sensing temperature of the suction piping.

OFF 35°C (95°F)
ON 20°C (68°F)



5.3.8 Phase sequence controller (47)

① **Specifications**

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

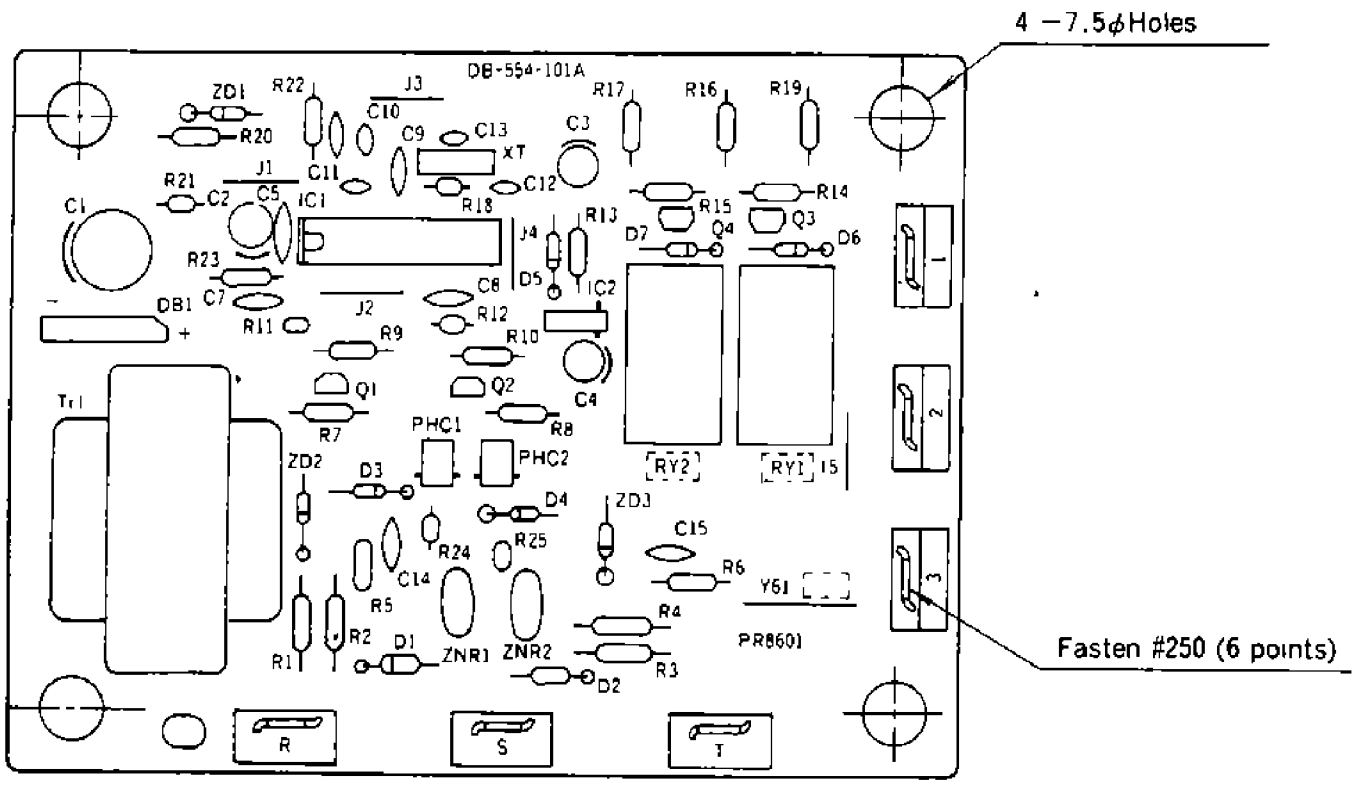
The phase sequence controller opens or closes the magnetic contactor for changing-over of phases, detecting phases, R. S. T. in the power supply to prevent the fan motor from reverse turning.
The integrated microcomputer detects voltage of each phase and phase order and operates as tabulated below.

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.

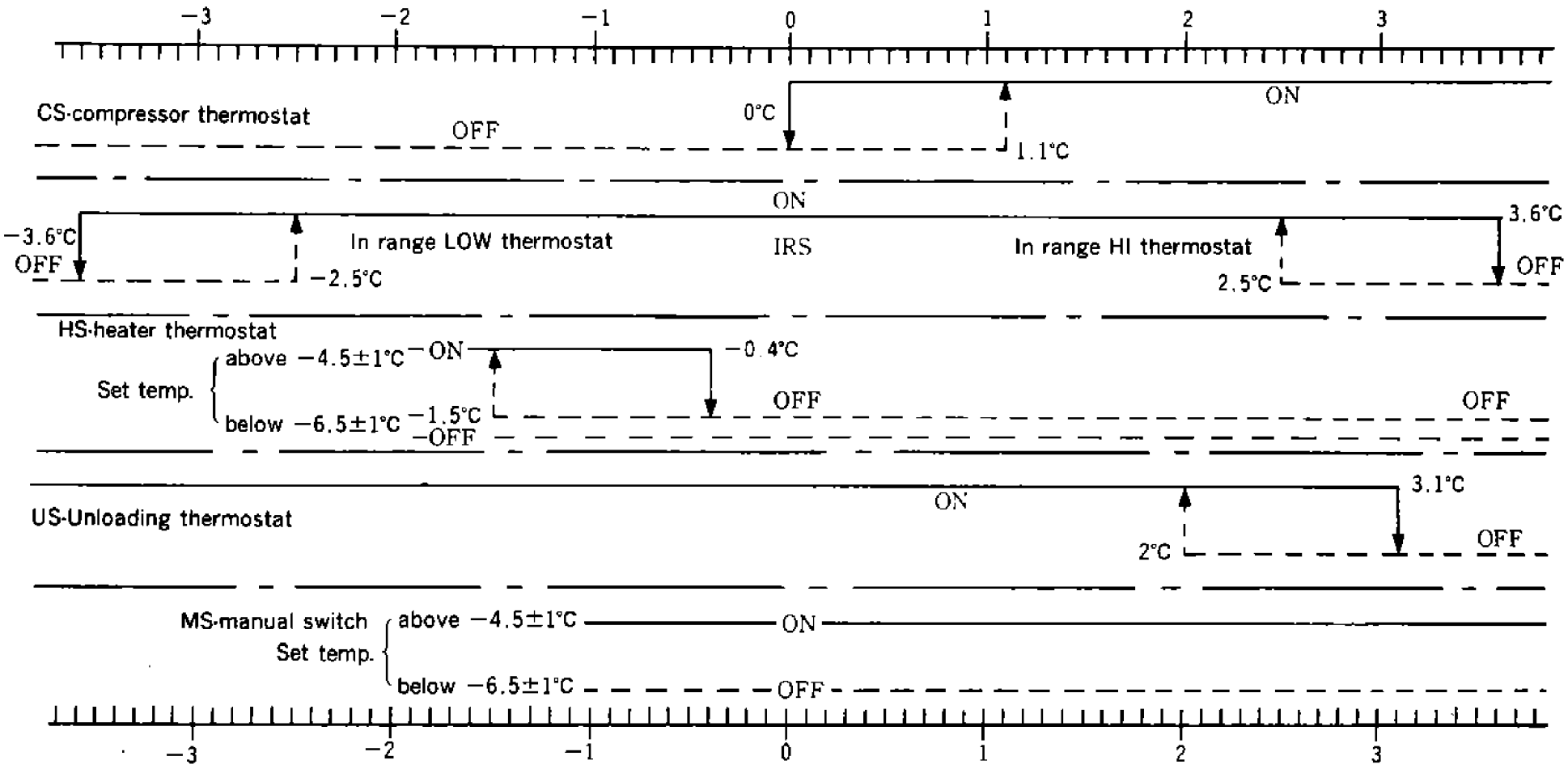
③ **Cautions for replacing the switch**
Correctly connect each terminal in accordance with the wiring diagram. If not the switch may be burnt, or the microcomputer becomes erratic.



5.3.9 Electronic controller (23A1)

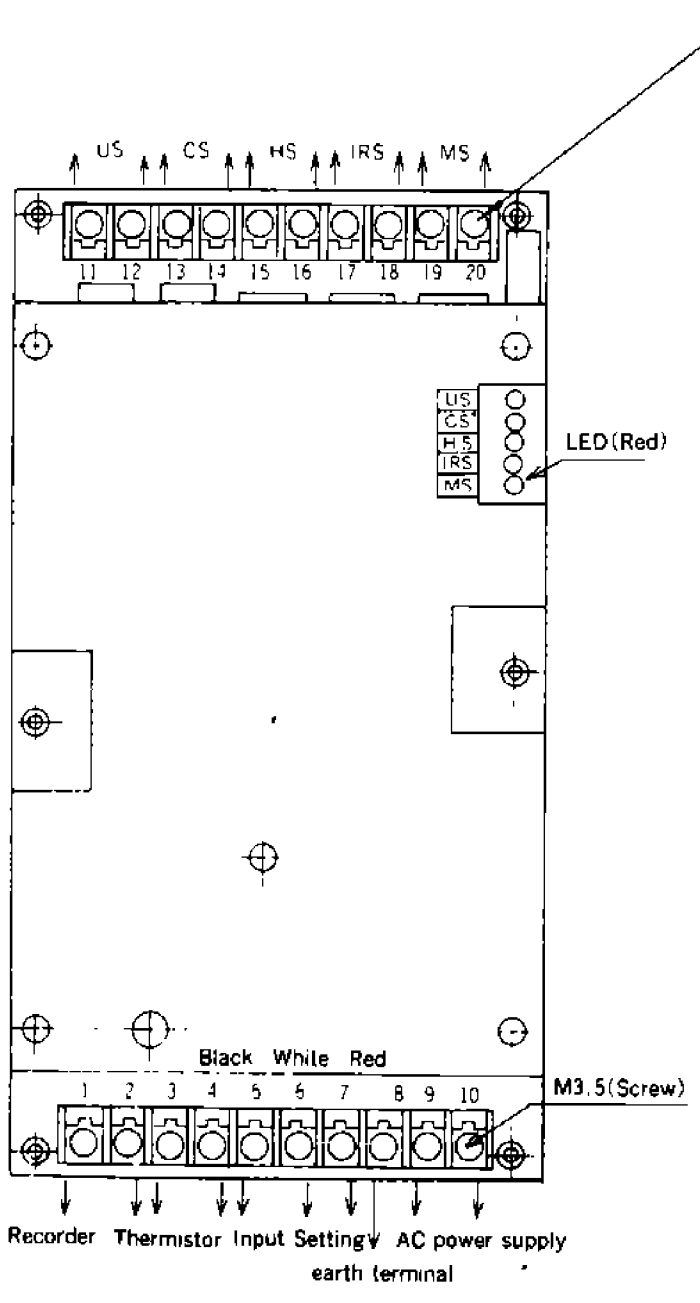
① **Specifications**

- Model: P-CONTR
- Power supply: AC24V 50/60Hz
- Temperature control range: −25°C~+25°C
- Sensor: Thermistor
- Numbers of output: 5 ea (US, CS, HS, IRS, MS)
- Operation characteristics of switches (In case setting is 0°C)



- Insulation resistance: DC500V megger 50MΩ or more
  Note: Do not impress the input terminals from 1 to 8
- Dielectric pressure: AC500V for one minute
  Note: Do not impress the input terminals from 1 to 8.

●External wiring



② **Check points**

a. Check points of thermistor

1) Operate the unit, setting the thermostat knob to 0°C.

2) When inside temperature becomes even after repeating ON/OFF operation two or three times by the CS compressor thermostat, start checking the thermistor.

3) Remove the thermistor from the terminals, 03 and 04 and measure its resistance with a digital voltmeter, and at the same time measure inside temperature with a thermistor thermometer. Then, check that error is within 0±1.0°C, using the attached table for thermistor resistance.
In addition, prepare water, in which ice cubes are put and put a mercury thermometer and thermistor in it and check that error is with 0±1.0°C by use of the table for thermistor resistance.

4) If such error differs largely with that in the table, replace the thermistor, as it must be faulty.

b. Check points of printed circuit board

1) Connect the dial resistor to the thermistor terminals, 03 and 04 and check the printed circuit board.

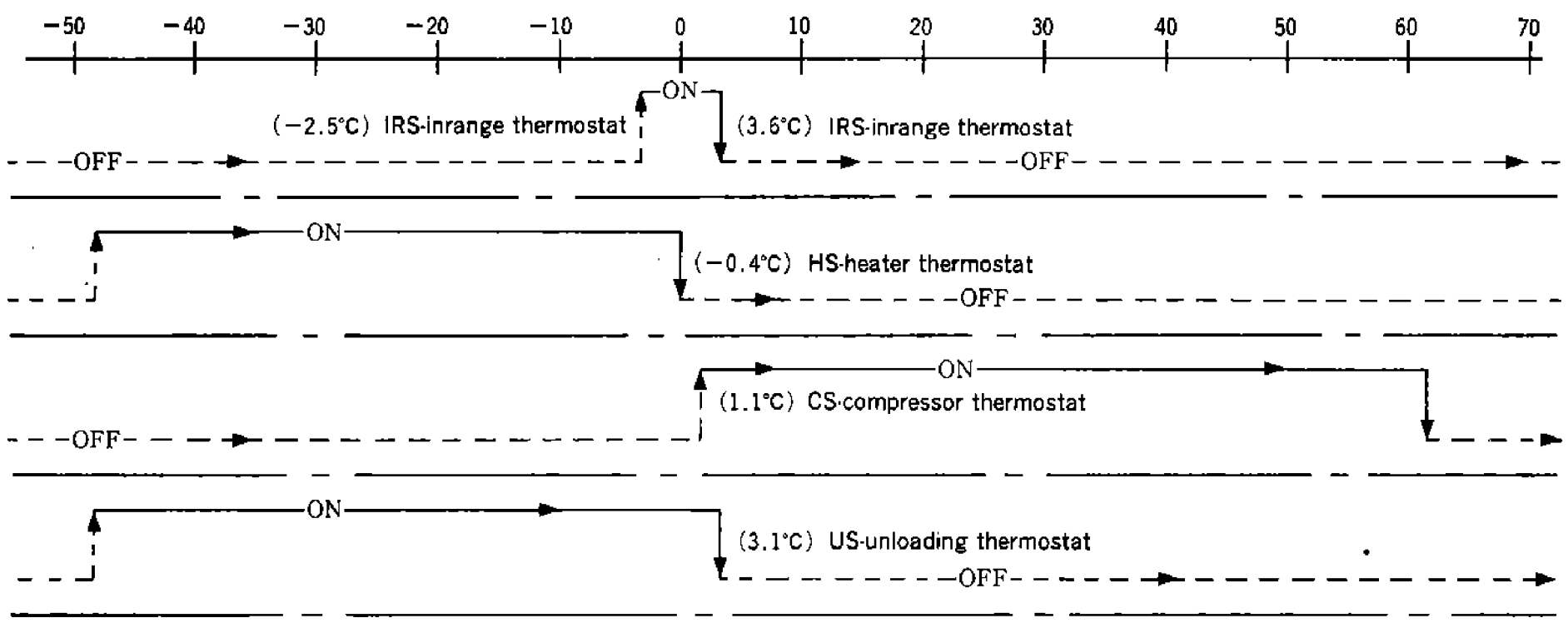
2) Set the setter to 0°C.

3) Raise temperature of the dial resistor gradually from −50°C (77.5810kΩ) to 70°C and then make it drop down to −50°C again. (Refe to table for thermistor resistance.)

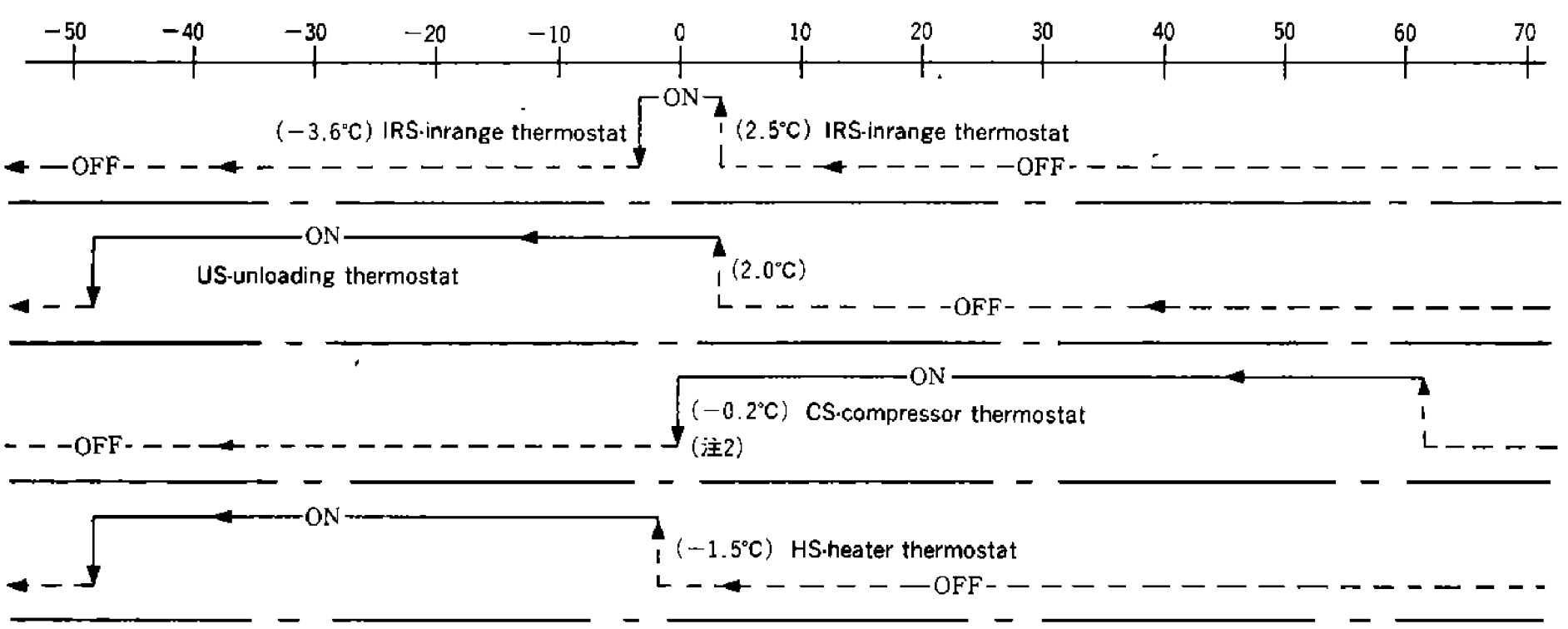
4) Temperature of the dial resistor falls to −50°C again, next time raise it to 2°C.
And then make it drop to −50°C again.

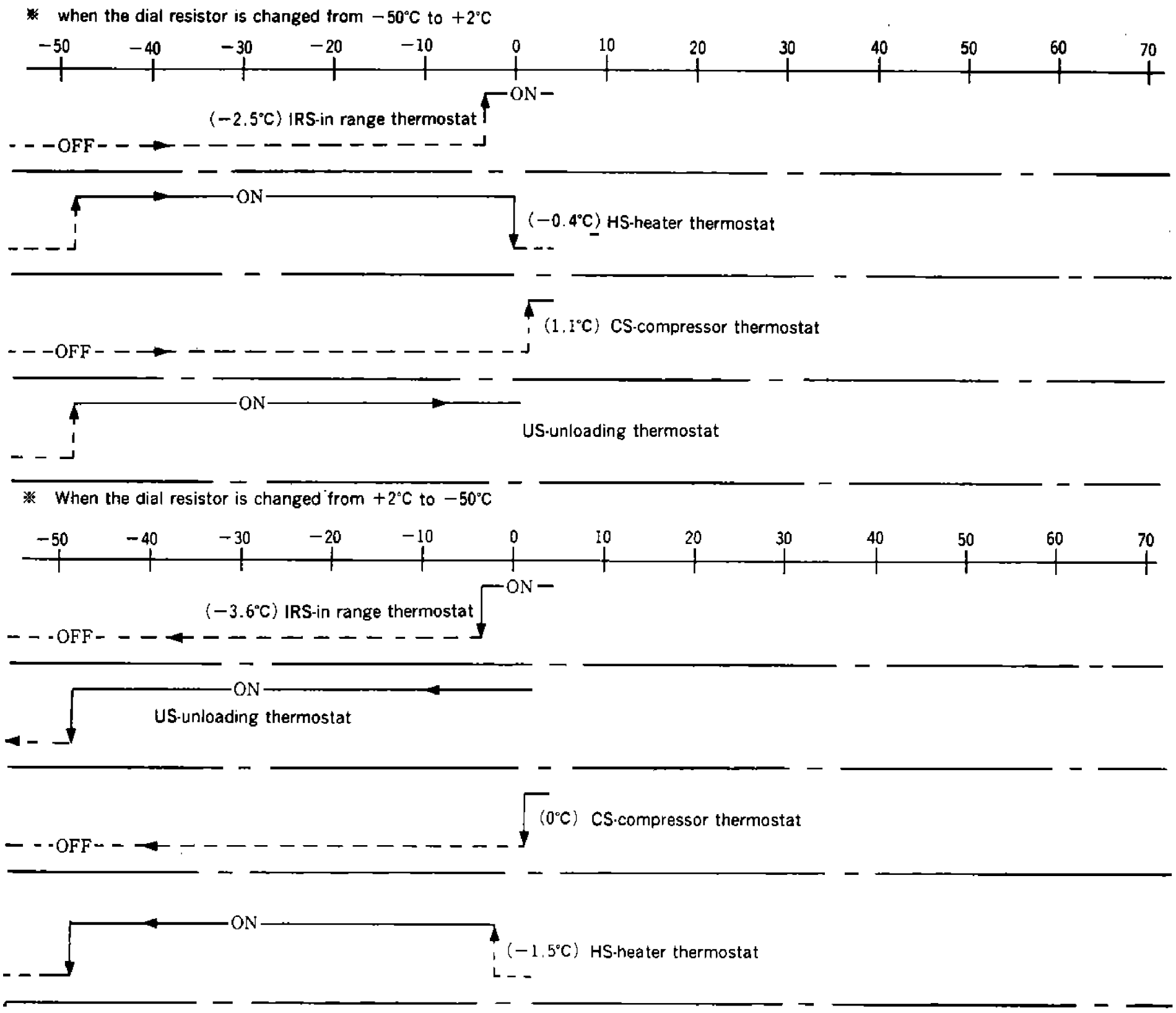
5) Check that functioning points of the thermostat accord with the points shown in the following diagrams during operation.

※ When the dial resistor is changed from −50°C to +70°C



※ When the dial resister is changed from +70°C to −50°C





Notes:

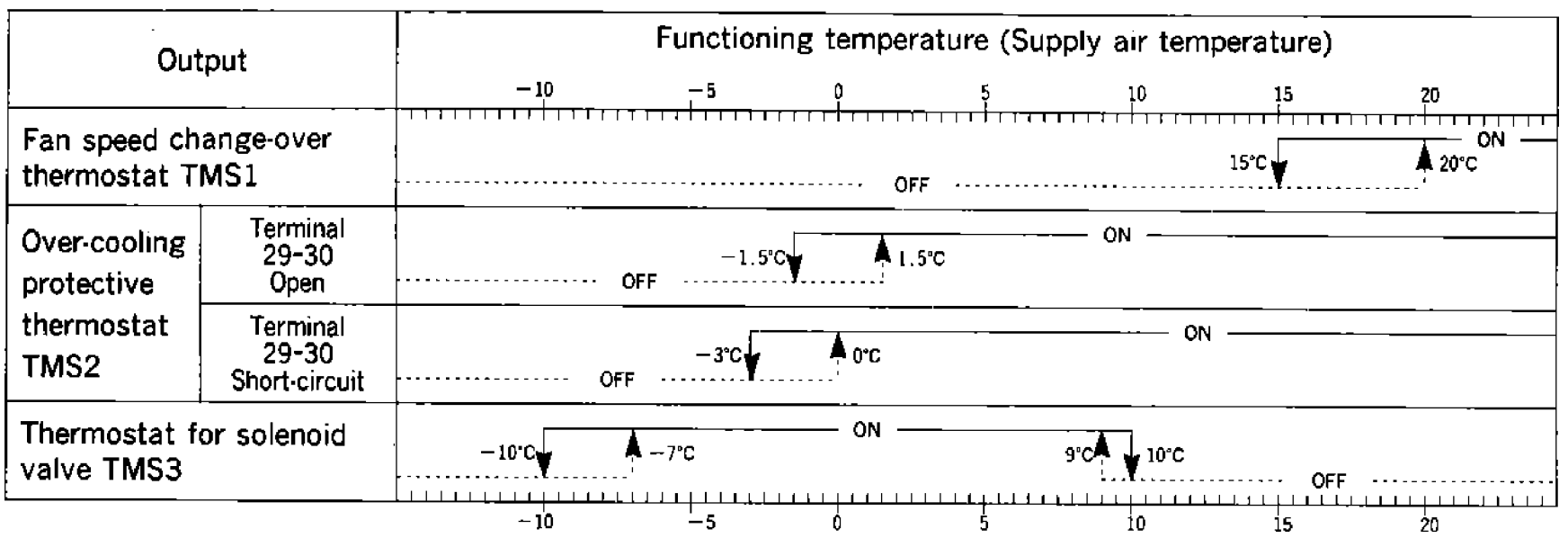
1. Move the dial resistor slowly at the functioning point, and do not return it.
2. In case inside temperature is higher than the in range, functioning point of the CS-thermostat is from −0.2 to +1.1°C. If inside temperature is within the in range and the CS thermostat is turned off, functioning point of CS is from 0 to + 1.1°C.
3. Confirm the output functions with indication lamp (LED) on controller.
4. When controller function is checked by set point selector simply during unit operation, check the function of controller after several cycling operation of compressor and getting uniform inside temperature.

- After finishing the checks stated above, check MS (manual switch). Set the thermistor input to −10°C with the dial resistor. After that, turn the setting knob.
  When setting is lowered : From ON to OFF at −6.5°C ± 1.0°C
  When setting is raised : From OFF to ON at −4.5°C ± 1.0°C
- After checking, if accuracy of the printed circuit board is insufficient, replace it.

5.3.10 Electronic controller (23A2)

① **Specifications**

- Model : P-TIMER
- Power supply : AC24V 50/60Hz
- Sensor : Thermistor
- Thermostat output



●Timer output

Output		Setting timer
Fan delay timer 2F1		60 seconds
Fan delay timer 2F2		10 seconds
Defrost initiation timer (Short) 2D1	Factory setting	4 hours
	Switch change-over	3 hours
Defrost initiation timer (Long) 2D2	Factory setting	12 hours
	Switch change-over	24 hours
Defrost delay timer 2D3		20 seconds
Defrost back-up timer 2D4		90 minutes

- Insulation resistance: DC500V megger 50MΩ or more
  Note: Do not impress the input terminals 32~33
- Dielectric pressure: AC500V for one minute
  Note: Do not impress the input terminals 32~33

② **Checking method for operation**

a. Checking thermostats for their outputs

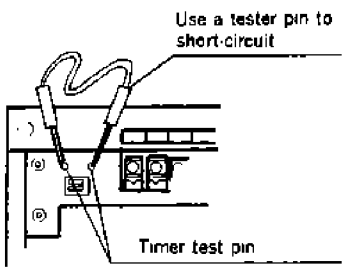
- Set the set point selector to 0°C, and make pull-down start at supply air temperature above +25°C. Compare output functioning point of each thermostat with supply air temperature to check the difference between them is within ±2°C. Note that the thermistor does not follow speed of pull-down if it is very quick.
  In order to check the functioning point on the low temperature side of the solenoid valve thermostat (TMS3) at −10/−7°C, set the unit to −18°C.
- When dial resistance is used for the check, refer to the conversion table for "Resistance VS. Temperature".

1) Connect the dial resistor to the thermistor terminals, 32 and 33 and check the printed circuit board.
2) Raise temperature of the dial resistor gradually from −50°C (77.5810kΩ) to 70°C and then make it drop down to −50°C again. (Refe to table for thermistor resistance.)
3) Check that functioning points of the thermostat accord with the points are thermostat temperature setting.

b. Checking timers for their outputs

● 2D1, 2D2, 2D4

Check the defrost initiation timers, 2D1, 2D2 and 2D4 by use of the timer test pin.



When the timer test pin is short-circuit, the following timer countings are shortened.

2D1 4 hours → 4 seconds

2D2 12 hours →12 seconds

2D4 90 minutes → 9 seconds

● Set the set point selector to the temperature at which the unit starts and the lamp for IN RANGE goes off. When the timer pin is short-circuit, timer counting is shortened and defrosting starts. Defrosting will start by 2D1 4 seconds later after turning on the test switch, and the pilot lamps for DEFROST and IN RANGE will light up. So measure such a time lag. After initiation of defrosting, the lamp for IN RANGE will go off 9 seconds later by 2D4, so measure such a time lag.

● Regarding 2D2, operate the unit in the same manner and set the set point selector to the temperature at which the lamp for IN RANGE lights up. The lamp for DEFROST will light up 12 seconds later by 2D2 after short-circuit.

● 2D3

Operate the unit and turn on the manual defrost switch to start defrosting, and pump-down operation will start soon. When pump-down operation is finished, the compressor will stop for 20 seconds by 2D3 and then will restart.

● 2F1

When the operation switch is turned on at inside temperature above 25°C the fan is delayed in starting by 10 seconds by 2F1, and then will run in low speed.

● 2F2

After finishing defrosting (after the lamp for DEFROST going off), the fan is delayed in starting by one minute by 2F2, and will run.

c. Check points of thermistor

Remove the thermistor from the terminals, 32 and 33,and measure its resistance with a digital voltmeter, and at the same time measure inside temperature with a thermistor thermometer. Then, check that error is within ±1.0°C using the attached table for thermistor resistance.

In addition, prepare water, in which ice cubes are put and put a mercury thermometer and thermistor in it and check that error is within ±1.0°C by use of the table for thermistor resistance.

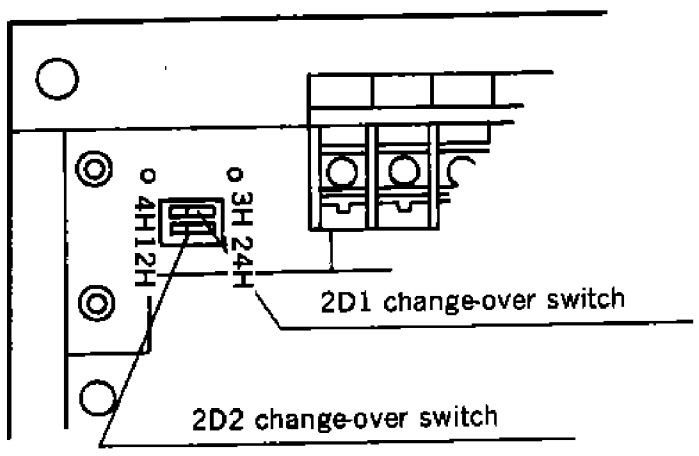
If such error differs largely with that in the table, replace the thermistor, as it must be faulty.

③ **Timer change-over switch**

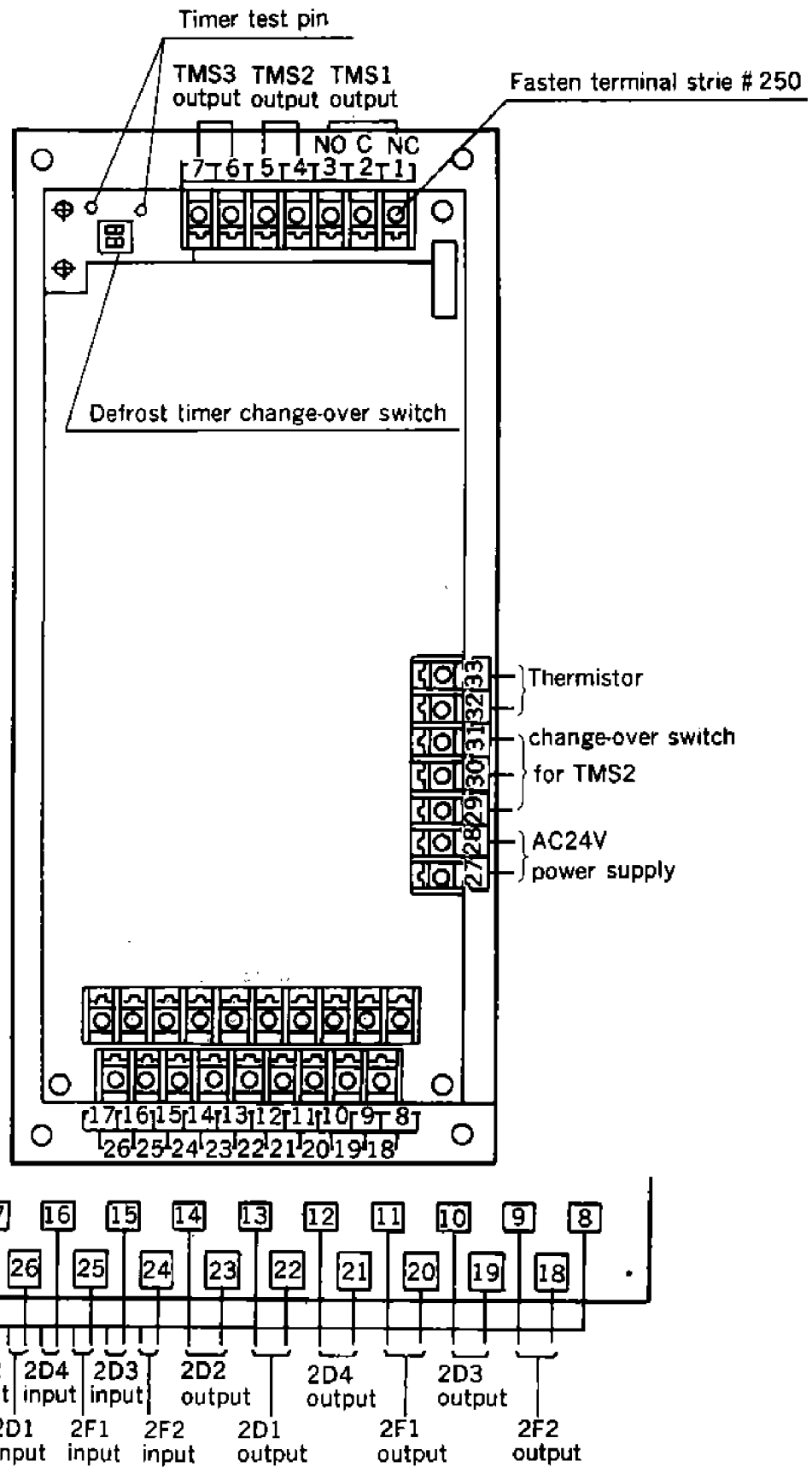
The defrost initiation timers, 2D1 and 2D2 can be changed in timer settings by the timer changer-over switch.

Use a small screwdriver to change timer settings.

	Factory setting	Switch change-over
2D1	4H(hr)	3H(hr)
2D2	12H(hr)	24H(hr)



④ **External wiring**



⑤ Sensor characteristics

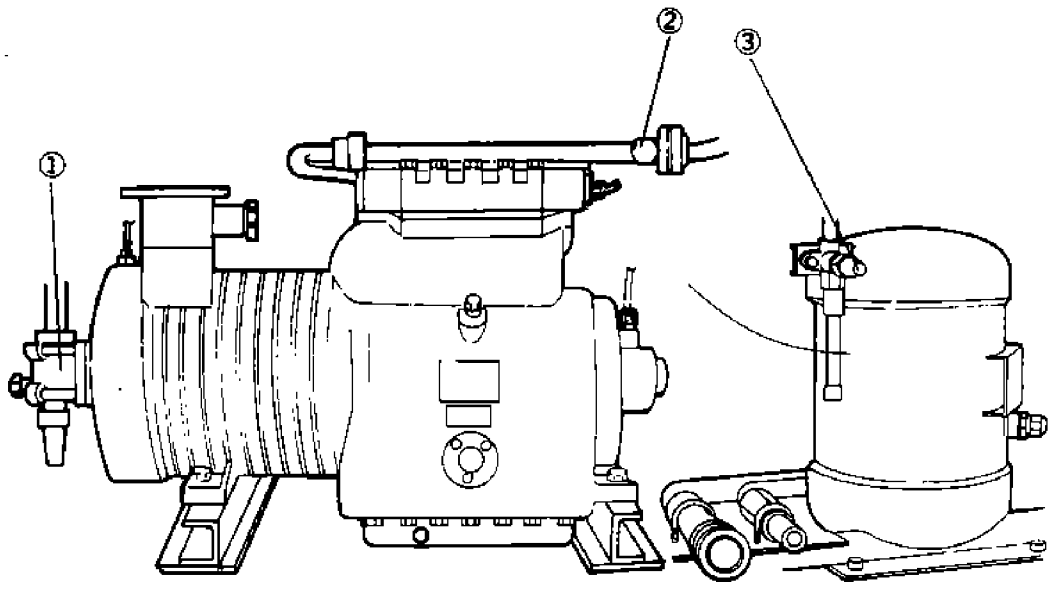
(Resistance-temperature conversion table)

Temperature °C	Resistance KΩ	Temperature °C	Resistance KΩ	Temperature °C	Resistance KΩ	Temperature °C	Resistance KΩ	Temperature °C	Resistance KΩ
−50.0	77.5810	−27.5	22.0854	−5.0	7.4810	17.5	2.9140	40.0	1.2740
−49.5	75.2718	−27.0	21.5230	−4.5	7.3151	18.0	2.8575	40.5	1.2522
−49.0	73.0412	−26.5	20.9770	−4.0	7.1534	18.5	2.8023	41.0	1.2309
−48.5	70.8862	−26.0	20.4471	−3.5	6.9959	19.0	2.7483	41.5	1.2100
−48.0	68.8039	−25.5	19.9326	−3.0	6.8422	19.5	2.6956	42.0	1.1896
−47.5	66.7917	−25.0	19.4330	−2.5	6.6929	20.0	2.6440	42.5	1.1695
−47.0	64.8468	−24.5	18.9443	−2.0	6.5471	20.5	2.5934	43.0	1.1498
−46.5	62.9667	−24.0	18.4698	−1.5	6.4051	21.0	2.5440	43.5	1.1306
−46.0	61.1491	−23.5	18.0090	−1.0	6.2666	21.5	2.4957	44.0	1.1117
−45.5	59.3916	−23.0	17.5615	−0.5	6.1316	22.0	2.4484	44.5	1.0932
−45.0	57.6920	−22.5	17.1268	0	6.0000	22.5	2.4022	45.0	1.0750
−44.5	56.0336	−22.0	16.7045	0.5	5.8709	23.0	2.3570	45.5	1.0571
−44.0	54.4298	−21.5	16.2943	1.0	5.7450	23.5	2.3128	46.0	1.0396
−43.5	52.8785	−21.0	15.8957	1.5	5.6223	24.0	2.2696	46.5	1.0224
−43.0	51.3779	−20.5	15.5084	2.0	5.5026	24.5	2.2273	47.0	1.0055
−42.5	49.9262	−20.0	15.1320	2.5	5.3859	25.0	2.1860	47.5	0.9890
−42.0	48.5215	−19.5	14.7634	3.0	5.2720	25.5	2.1454	48.0	0.9728
−41.5	47.1621	−19.0	14.4052	3.5	5.1610	26.0	2.1056	48.5	0.9569
−41.0	45.8465	−18.5	14.0571	4.0	5.0527	26.5	2.0667	49.0	0.9413
−40.5	44.5729	−18.0	13.7186	4.5	4.9471	27.0	2.0287	49.5	0.9260
−40.0	43.3400	−17.5	13.3896	5.0	4.8440	27.5	1.9915	50.0	0.9110
−39.5	42.1361	−17.0	13.0698	5.5	4.7428	28.0	1.9550	50.5	0.8962
−39.0	40.9705	−16.5	12.7587	6.0	4.6440	28.5	1.9194	51.0	0.8817
−38.5	39.8420	−16.0	12.4563	6.5	4.5477	29.0	1.8845	51.5	0.8674
−38.0	38.7491	−15.5	12.1621	7.0	4.4536	29.5	1.8504	52.0	0.8534
−37.5	37.6907	−15.0	11.8760	7.5	4.3619	30.0	1.8170	52.5	0.8397
−37.0	36.6654	−14.5	11.5958	8.0	4.2723	30.5	1.7842	53.0	0.8263
−36.5	35.6722	−14.0	11.3233	8.5	4.1849	31.0	1.7520	53.5	0.8131
−36.0	34.7100	−13.5	11.0582	9.0	4.0996	31.5	1.7205	54.0	0.8002
−35.5	33.7776	−13.0	10.8003	9.5	4.0163	32.0	1.6897	54.5	0.7875
−35.0	32.8740	−12.5	10.5493	10.0	3.9350	32.5	1.6596	55.0	0.7750
−34.5	31.9911	−12.0	10.3051	10.5	3.8553	33.0	1.6300	55.5	0.7627
−34.0	31.1355	−11.5	10.0675	11.0	3.7775	33.5	1.6011	56.0	0.7507
−33.5	30.3063	−11.0	9.8363	11.5	3.7015	34.0	1.5728	56.5	0.7388
−33.0	29.5024	−10.5	9.6111	12.0	3.6273	34.5	1.5451	57.0	0.7272
−32.5	28.7230	−10.0	9.3920	12.5	3.5548	35.0	1.5180	57.5	0.7158
−32.0	27.9674	−9.5	9.1772	13.0	3.4840	35.5	1.4913	58.0	0.7047
−31.5	27.2346	−9.0	8.9681	13.5	3.4149	36.0	1.4651	58.5	0.6937
−31.0	26.5239	−8.5	8.7645	14.0	3.3474	36.5	1.4394	59.0	0.6829
−30.5	25.8347	−8.0	8.5663	14.5	3.2814	37.0	1.4143	59.5	0.6724
−30.0	25.1660	−7.5	8.3732	15.0	3.2170	37.5	1.3897	60.0	0.6620
−29.5	24.5121	−7.0	8.1853	15.5	3.1536	38.0	1.3656		
−29.0	23.8776	−6.5	8.0022	16.0	3.0916	38.5	1.3420		
−28.5	23.2621	−6.0	7.8239	16.5	3.0310	39.0	1.3189		
−28.0	22.6649	−5.5	7.6502	17.0	2.9718	39.5	1.2962		

6. Maintenance

6.1 Handling method of the stop valves

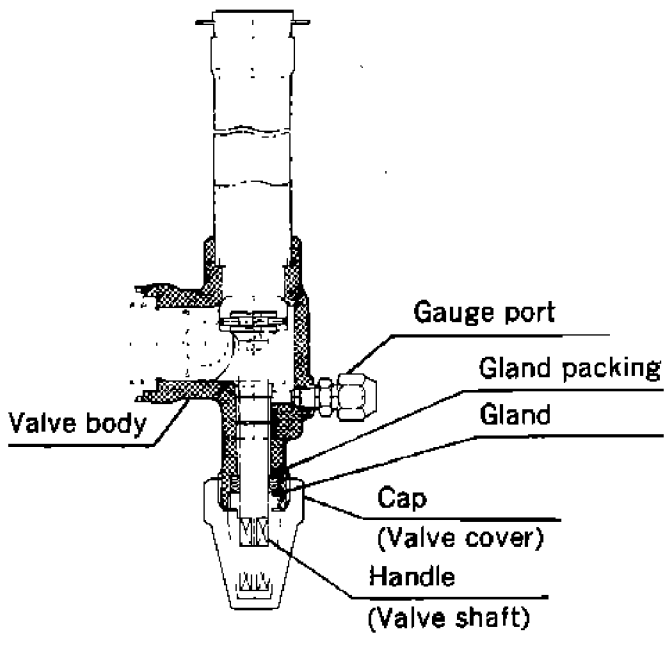
(1) Place of the stop valve and its kind



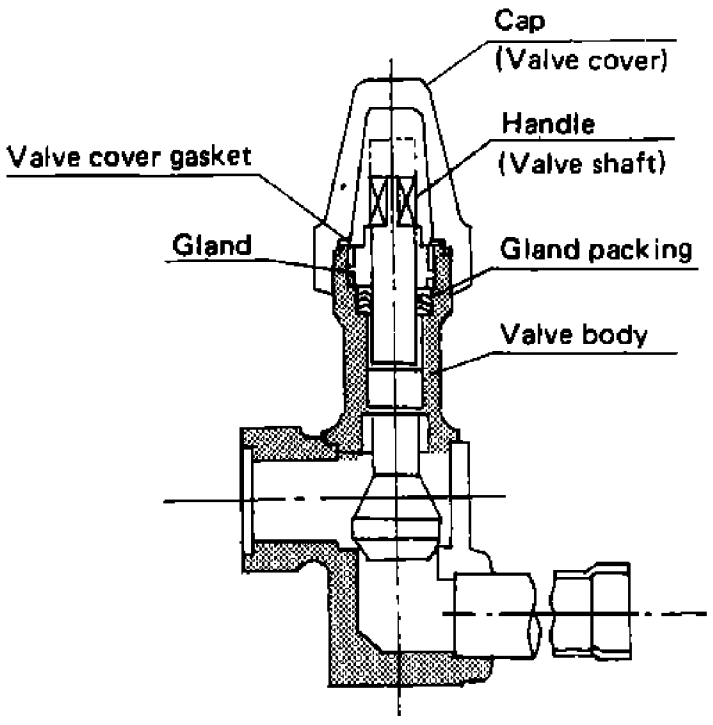
① Stop valve at compressor suction side
② Stop valve at compressor discharge side
③ Stop valve at water cooled condenser (or receiver) outlet side

(2) Structure of stop valve

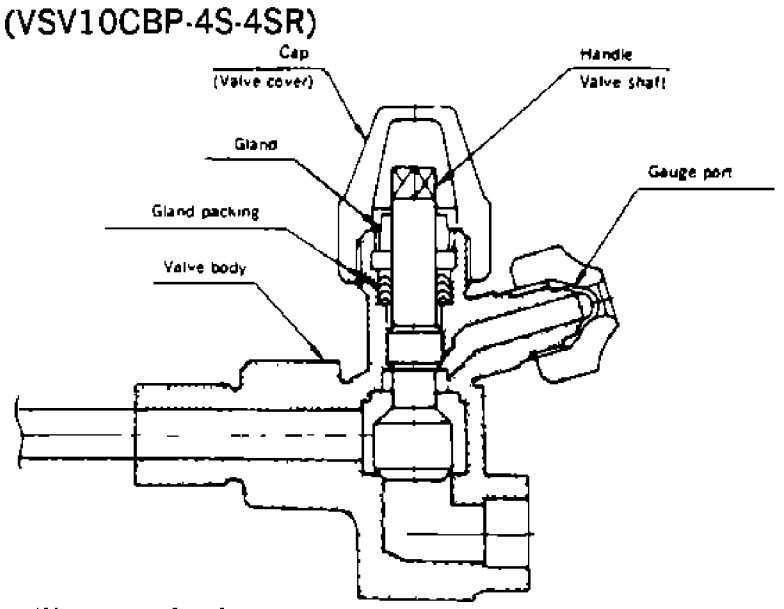
1 Stop valve at compressor suction side
(VSH26C-10S)



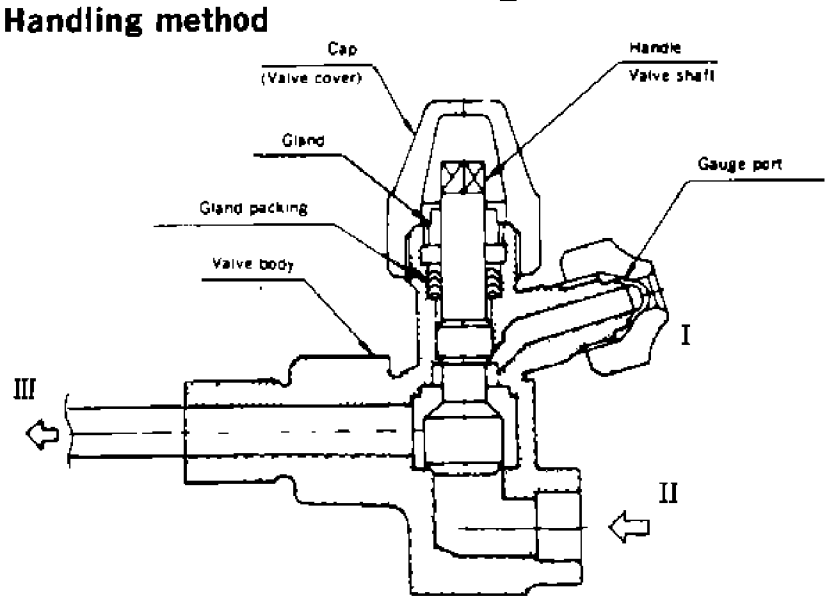
2 Stop valve at compressor discharge side
(VSV22CR-7S-7F)



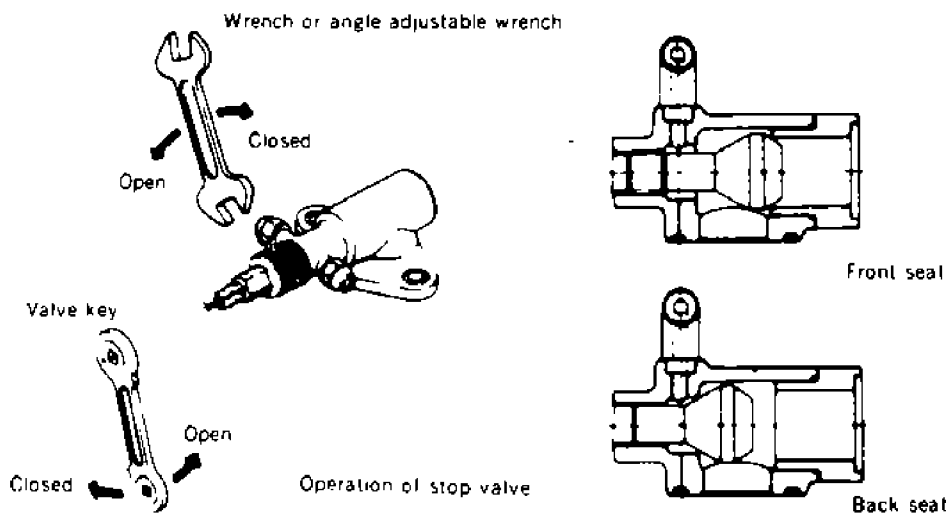
3 Stop valve at water cooled condenser (or receiver) outlet side
(VSV10CBP-4S-4SR)



(3) Handling method



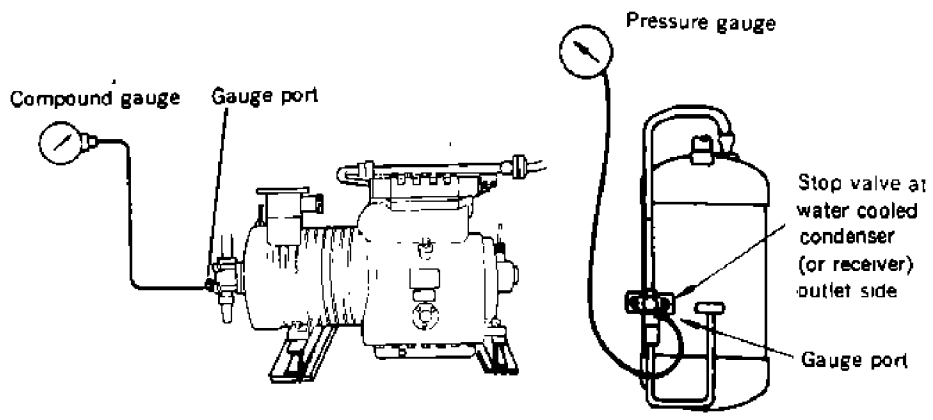
1) Remove the valve cap. At this time, be careful not to lose the gasket.
2) Loosen the gland in a way the refrigerant is not extracted.
3) Fully close the handle ·····The refrigerant passage I is connected to III (Front seat)
4) Fully release the handle·····The refrigerant passage II is connected to III (Back seat)
5) Set the handle at the neutral position
·····The refrigerant passage I is connected to II and III.
6) The refrigerant passage differs with the procedure mentioned in 3, 4, or 5. So select the best passage by necessity.
7) Operate the handle, tighten the gland and place the valve cap as it was after completion of the work. At this time, do not forget to attach the gasket.



6.2 Attaching or removing points of pressure gauges

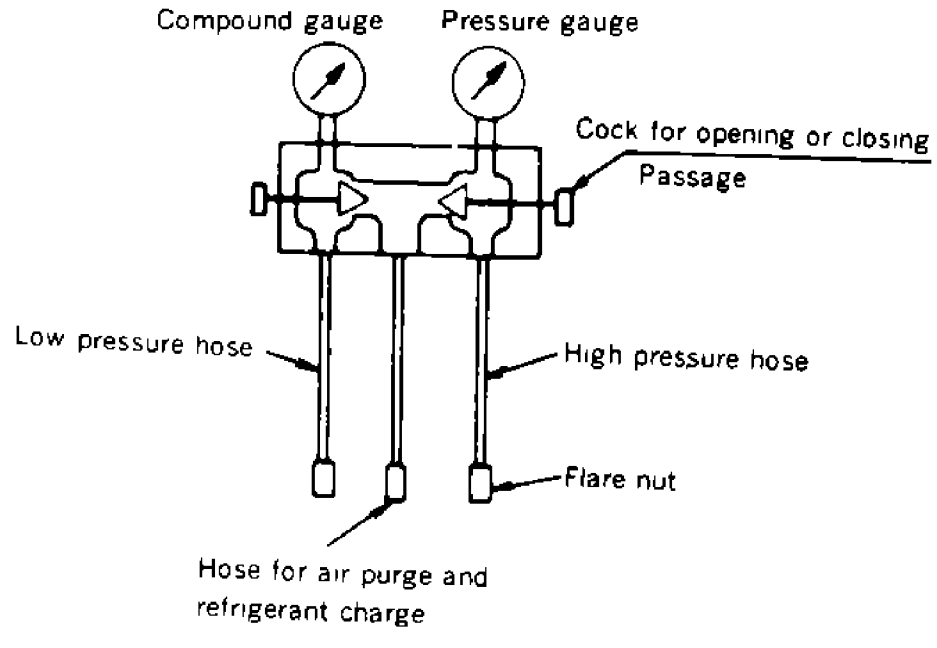
(1) Attaching a general pressure gauge

1) After closing the stop valve for charging refrigerant fully and opening the stop valve on the outlet of the water cooled condenser (or receiver) fully (back seat), connect the gauge piping to the gauge port.
2) Loosen a little the flare nut on the pressure gauge side and turn the handle of the stop valve a little (Middle seat) and return it at once. Thus the air is purged.
3) After purging the air, accurately tighten up the flare nut on the pressure gauge side.
4) Turn the handle of the stop valve a little, and confirm that the needle of the gauge rises.
5) Be certain that the needle of the pressure gauge does not oscillate during the operation of the unit. If it oscillates, do not close the gauge port fully and open the handle of the stop valve a little.
6) In case the pressure gauge is attached to the low pressure side, if the low pressure is lower than the atmospheric pressure, the air is drawn in the piping during the air purging. So install the pressure gauge after confirming that low pressure is higher than the atmospheric pressure.
7) Operate the unit and confirm that unit is stopped without pump down.

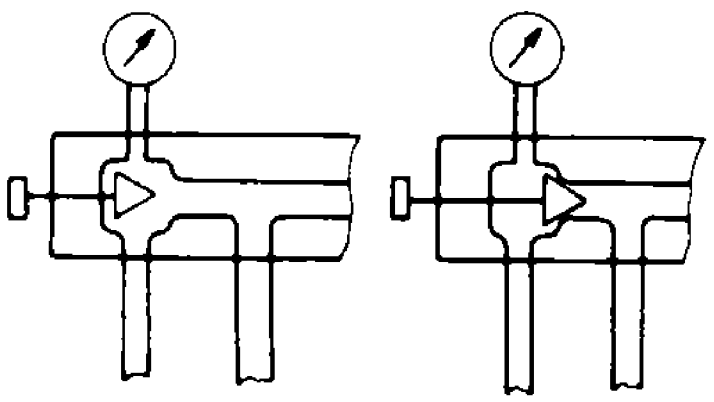


(2) Attaching the gauge manifold

1) With regard to mounting points, note the same caution as that for general pressure gauges.
2) Open the cocks which are attached to the both sides of the gauge manifold when mounting, Loosen the blind cover of the centre hose, and close the gauge port for the stop valve for charging refrigerant and the water cooled condenser (or receiver) outlet valve.
3) Attach the flare nut of the hose of the manifold on the high pressure side tightly and on the low pressure side loosely.
4) Loosen the water cooled condenser (or receiver) outlet valve and vent the air from the hose on the low pressure side and the centre hose and then once again keep the stop valve in the back seat state. After that, tighten up the flare nut on the low pressure side.
5) After closing the cocks of the gauge manifold, keep the cock of the stop valve for charging refrigerant and water cooled condenser (or receiver) outlet valve at the neutral seat and measure pressure.



Structure of gauge manifold



Opening and closing states of gauge manifold

(3) Removing the pressure gauge and the gauge manifold, as stated below.

When the high pressure hose is removed, note that the liquid refrigerant in the hose may jet out, which is very dangerous.

1) Turn the handle of the stop valve, and close the gauge port.
2) Open the cock (in care of gauge manifolds) or the flare nuts (in case of general pressure gauges) a little to extract the refrigerant from the hose.
   At this time, do not open it suddenly so as not to joint out liquid refrigerant.
3) After extracting the refrigerant from the hose, remove the pipe connection for the gauge piping.
4) Place the blind cover on the gauge port of the stop valve, accurately tighten up the flare nut and confirm no refrigerant leaks.

Note : Since the blind cover is very small, be careful not to loose it.

6.3 Pump down

Pump down means that the refrigerant in the refrigeration circuit is liquidized and collected in the water cooled condenser (or receiver). This work is required to repair the refrigeration circuit for minimizing leaking volume of the refrigerant and risks due to pressure rising.

〈Working procedure〉

1) Install pressure gauges to the high pressure side the low pressure side.
2) Operate the refrigeration unit (either on water cooled or air cooled operation)
3) Close the water cooled condenser (or receiver) outlet valve.
4) Stop the operation when reading of the low pressure gauge becomes 0.1 kg/cm² and close the compressor discharge valve.
5) After a short while, read the low pressure gauge. If pressure rises, open the compressor discharge valve and repeat the same procedure.
6) Repeat the same procedure two or three times, and the refrigerant is collected in the water cooled condenser (or receiver).

6.4 Charging and purging the refrigerant, refrigeration oil

(1) Purging non-condensable gas

If non-condensable gas such as air exsits in the refrigeration circuit, it is collected by the water cooled condenser (or receiver), which raise pressure in the water cooled condenser (or receiver) abnormally high and reduces heat transferring ratio of the condenser surface. If is, therefore, very important to extract non-condensable gas.

If discharge pressure is abnormally high (even though cooling water volume is increased, in case of water cooled operation) and will not return to the normal pressure, inspect if non-condensable gas such as air exsists in the following method.

- Stop the compressor, close the water cooled condenser (or receiver) valve and wait until leaving and entering cooling air (or water) of the air (water) cooled condenser become equal. If there is any difference between saturated pressure corresponding to cooling air (water) and condensing pressure, non-condensable gas exists. In this case, purge non-condensable gas as stated below.

1) Accomplish pump down
2) Condense the refrigerant as much as possible, and then discharge it from the gauge port of the compressor discharge valve.
3) Discharge the condensed refrigerant repeatedly reading the pressure gauge until condensing pressure becomes saturated pressure.

(2) Refrigerant purge

There are two methods of refrigerant purge ; i.e. one is for collecting the the refrigerant extracted in a cylinder and the other is for discharging it to the atomosphere.

(a) Collecting the refrigerant in a cylinder

1) Prepare an empty cylinder which has been dried by forming vacuum inside and weigh it.
2) The cylinder is connected to the gauge port of the water cooled condenser (or receiver) by piping with the cylinder cock closed, and then loosen the flare nut on the cylinder side a little to vent the air from the piping.
3) Operate the refrigeration unit to pump down the refrigerant.
4) After completion of pump down, open the gauge port of the water cooled condenser (or receiver) and then open the cock of the cylinder to collect the liquid refrigerant into the cylinder.
5) After collecting the refrigerant, close the gauge port and the cock and then remove the piping.
6) Be certain that the refrigerant has been collected in the cylinder by weighing it.
7) As for the refrigerant remaining in the refrigeration circuit, extract it to the atmosphere.

(b) Extracting the refrigerant to the atomosphere

1) Open the gauge port of the stop valve for charging refrigerant to extract the gaseous refrigerant to the atmosphere.
2) Do not open the compressor discharge valve or the gauge port of the water cooled condenser (or receiver), otherwise the refrigerant oil and the liquid refrigerant are discharged, which may result in shortage of oil or getting chillblains.
3) Do not extract the refrigerant in a closed room and also confirm there is no fire around it. Although the refrigerant is non-toxic, there may be fear of suffocation. In addition, if the refrigerant contacts with fire, it yields phosgene gas (toxic gas).

(3) Vacuum drying and charging refrigerant and refrigeration oil

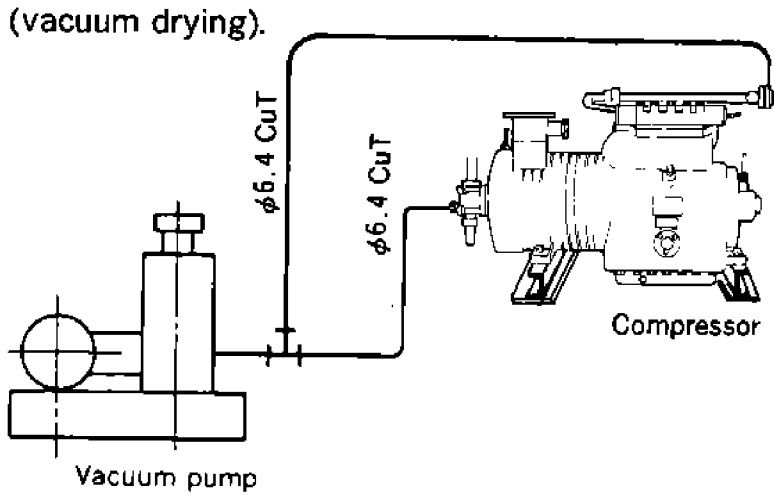
If all the refrigerant has leaked out and the air is intermixed in the refrigeration circuit, repair a cause of trouble and do vacuum drying. Then charge the predesigned volume of refrigerant. In case the refrigerant oil is replaced, do the same.

(Required tools)

1. Refrigerant cylinder (20 kg) for R12 (CC12F2) with mouth piece
2. Refrigeration oil (20 ℓ can) SUNISO 3GS-DI
3. ϕ6.4 CuT (with two flare nuts) } or gauge manifold
4. Pressure gauge (20 kg/cm²), compound gauge (10 kg/cm² × 75 cmHg) } or gauge manifold
5. Weighing scale (Up to 50 kg)
6. Tools
7. Vaccum pump

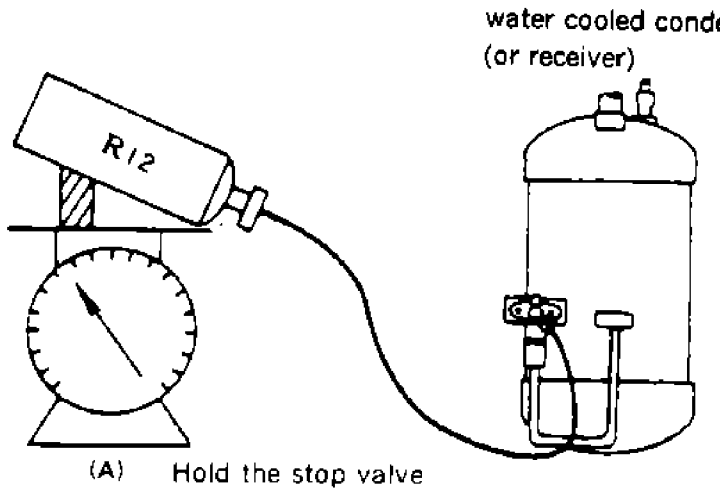
(a) In case the refrigerant is replenished without exchanging the refrigeration oil.

1) Connect the vacuum pump to the gauge ports of the stop valve for charging refrigerant and the compressor discharge valves, form vacuum down to 76 cmHg, hold the stop valve in the back seat state and then remove the vacuum pump, leaving the vacuum state in the refrigeration circuit. However, when air enters in the refrigeration circuit, form the vacuum in the circuit down to 76 cmHg and leave it for more than 2 hours (vacuum drying).

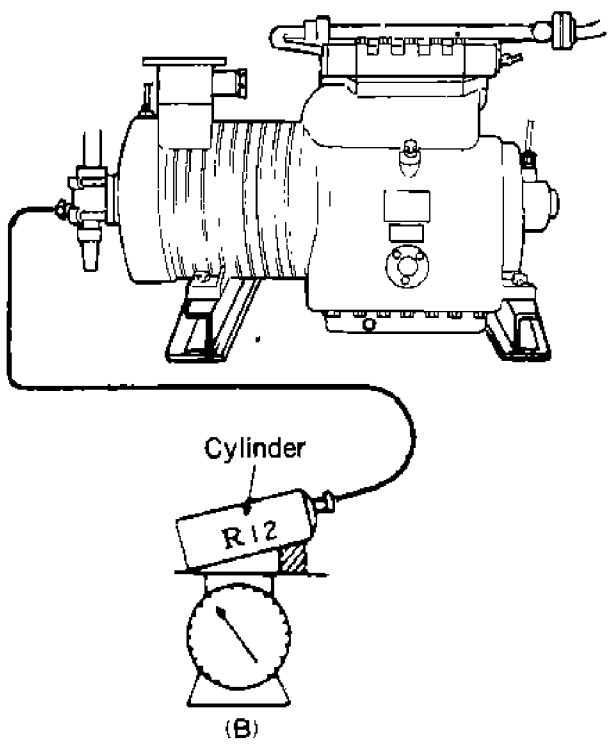


2) Place a refrigerant cylinder on the weighting scale, and record its weight.

3) In case the refrigerant is charged in the liquid state, do it as shown in the below figure (A). Prevent the liquid refrigerant collected in the water cooled condenser (or receiver) from flowing to the low pressure side. If the refrigerant is hardly charged, operate the compressor to charge it.



(A) Hold the stop valve in the front seat



(B)

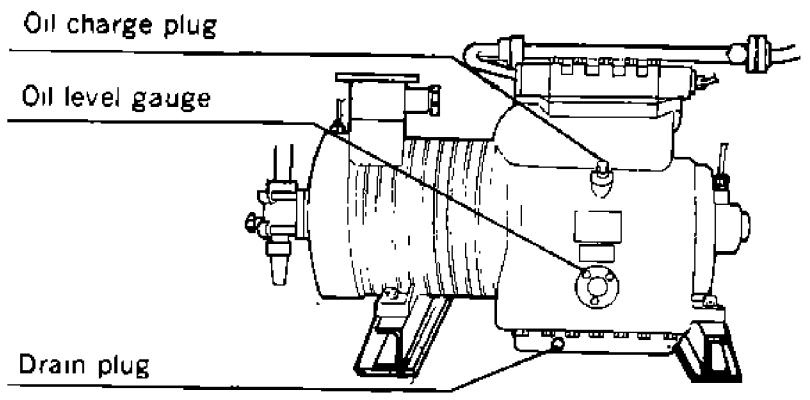
4) In case the refrigerant it charged in the gaseous state, do it as shown in above figure (B). If the refrigerant is hardly charged, operate the compressor to charge it.

5) Charge the predesigned volume of the refrigerant in the above stated methods either in 4 or 5.

6) After completion of refrigerant charge, hold the stop valve in the back seat state and confirm that if the predesigned volume of the refrigerant has been charged by operating the refrigeration unit.

(b) Charging the refrigerant as well after replenishment of refrigerant oil

1) Extract the refrigerant oil.→Firstly discard all the gas so that pressure in the refrigerant circuit becomes 0. Then loosen the drain plug at the bottom of the compressor to extract all the oil. At this time, firstly open the oil charge plug and then the drain plug to prevent the oil from jetting out.



2) Tighten up the drain plug.

3) Charge the predesigned volume of the oil from the charge plug of the compressor.

4) Accomplish vacuum drying and refrigerant charge stated in (1).

5) Be sure to stop the compressor while this work is accomplished.

6) When the refrigeration oil is discarded, be sure to remove the oil level gauge for cleaning.

7) Recommendable refrigeration oil is SUNISO 3GS-DI. SUNISO 3GS—DI is superior to SUNISO 3GS in heat resistance.
Maker of SUNINO 3GS—DI is SUN OIL CO., LTD. (U.S. A.)

8) Do not mix two refrigeration oils.

9) Do not use oil which is left opened to the atomosphere for a long time, as it may contain water. In case oil still remains in the oil can after charging, be sure to cap it.

(c) In case only the refrigeration oil is exchanged.

1) Operate the refrigeration unit to pump down the refrigerant by use of the stop valve at the outlet of the water cooled condenser (or receiver) and stop it when low pressure becomes 0.1 kg/cm².

2) Tighten up the discharge valve of the compressor.

3) Open the gauge port on the suction side to extract the refrigerant on the low pressure side.

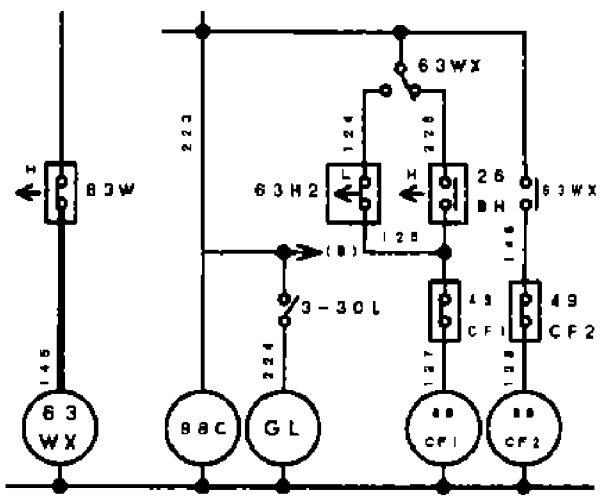
4) Charge the oil from the oil charge plug. At this time, form the vaccum gradually to hasten oil charge.

5) Restore the stop valve to its original state.

6.5 Check points for high pressure switch

Check the high pressure switch for functioning after stopping the condenser fans so as to raise discharge pressure. Remove the lead wire on the strip in the switch box to stop the condenser fans. After finishing the test, provide rewiring accurately as it was.

Air/water cooled type



Air cooled type