SMC

IDX-OM-G033-A

# OPERATION MANUAL

REFRIGERATED TYPE AIR DRYER

## IDF370B

SMC CORPORATION

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The SMC Refrigerated Type Air Dryers will produce a plenty of dried air although they are compact because of a higher heat-exchange efficiency. Fully automatic operation capability makes the long-period continuous operation possible and thus requires less time for maintenance. Furthermore, they have several features such as, becuase of the peculiar refrigeration capacity control method, the cooled-down air temperature can be maintained at constant regardless of reduction in load, no freezing of humidity takes place, etc.

To ensure the most satisfactory performance forever, operators are requested to read this manual, before operating the unit.

## 1. SPECIFICATIONS

| Item \ Model | IDF370B−603 |
|---|---|
| ※Air flow rate (50/60Hz) Nm³/min | 54／65 |
| Applicable air compressor kw | 370 |
| Operating pressure kgf/cm² {kPa} | 1.5 ～ 9.8 {150 ～ 980} |
| Power source | 3phase, AC200V, 50／60Hz |
| Fuse breaker capacity A | 80 |
| Transformer capacity kVA | 15／17 |
| Power consumption (50/60Hz) W | 8100／9500 |
| Compressor starting current (50/60Hz) | 230／200 |
| Compressor running current (50/60Hz) | 28／31 |
| Condenser cooling method | Shell and tube type |
| Refrigerant control system | Thermos. auto expansion valve, hot gas bypass valve |
| Refrigerant used | R22 |
| Connection flange | 6B |
| Weight kgf | 1100 |
| ※※ Amount of cooling water ℓ／min | 100 |
| Press drop on cooling water side kgf／cm² | 0.5 |

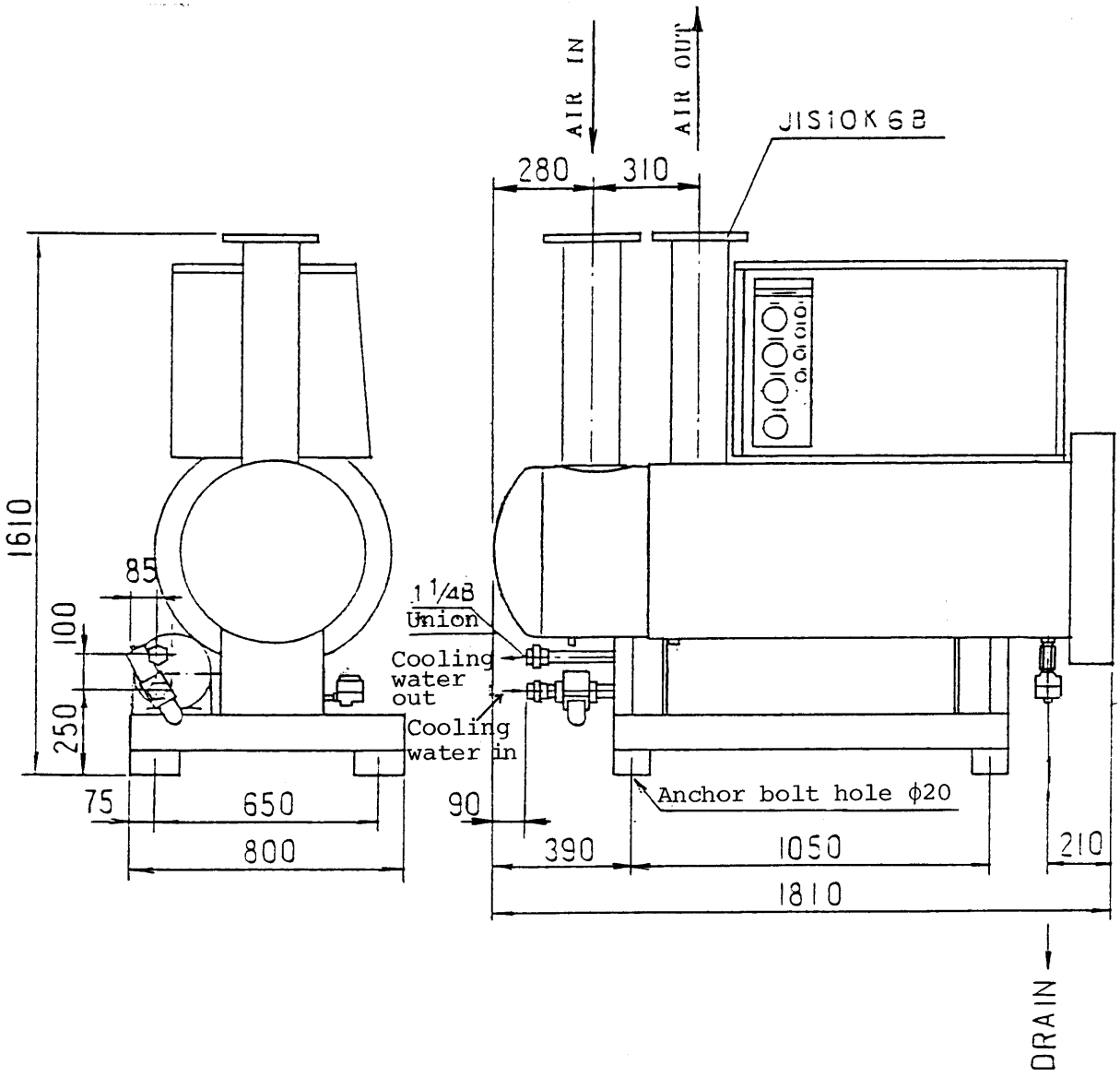
※ Note : Inlet air conditions : Pressure 7 kgf/cm² {700 kPa} ,
saturated temp 35℃

Ambient temperature : 32℃

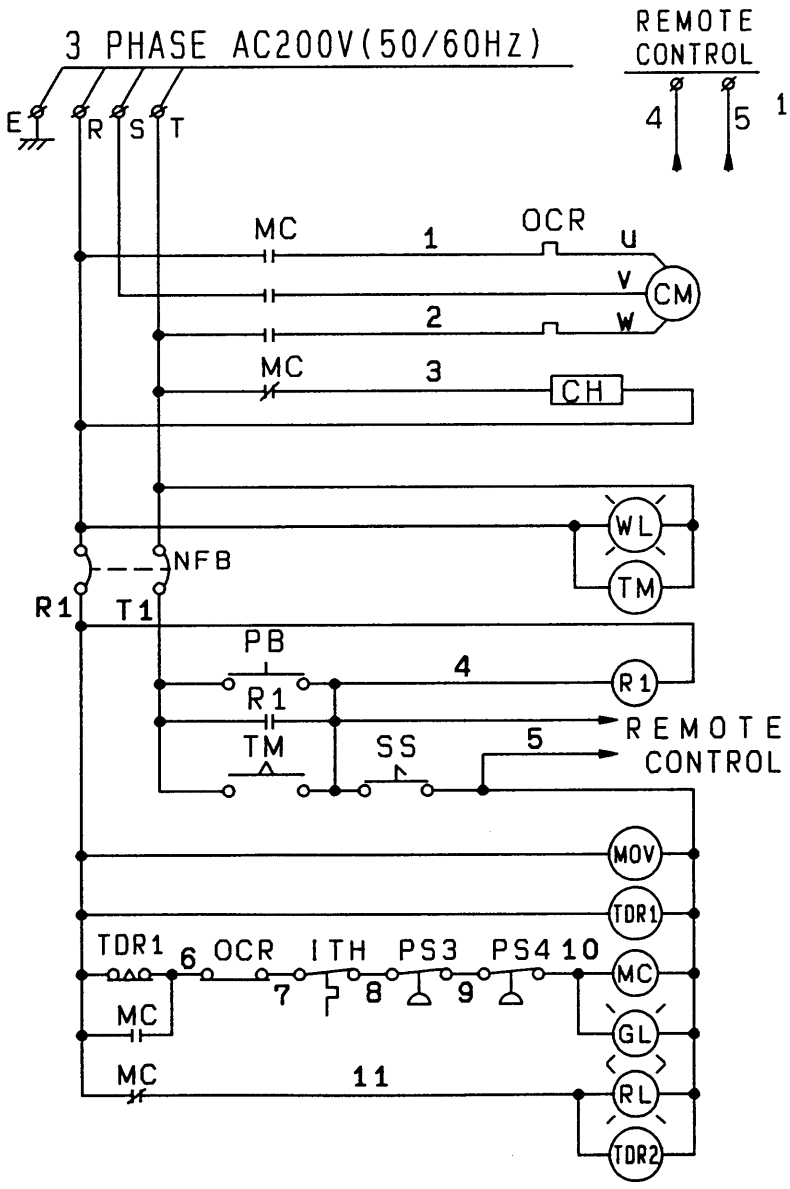
Outlet air dew point : 10℃ (at 7 kgf/cm² {700 kPa} )

※※ Value under the rated load at a cooling water inlet temperature of 32 ℃.

## 2. EXTERNAL DIMENSIONS



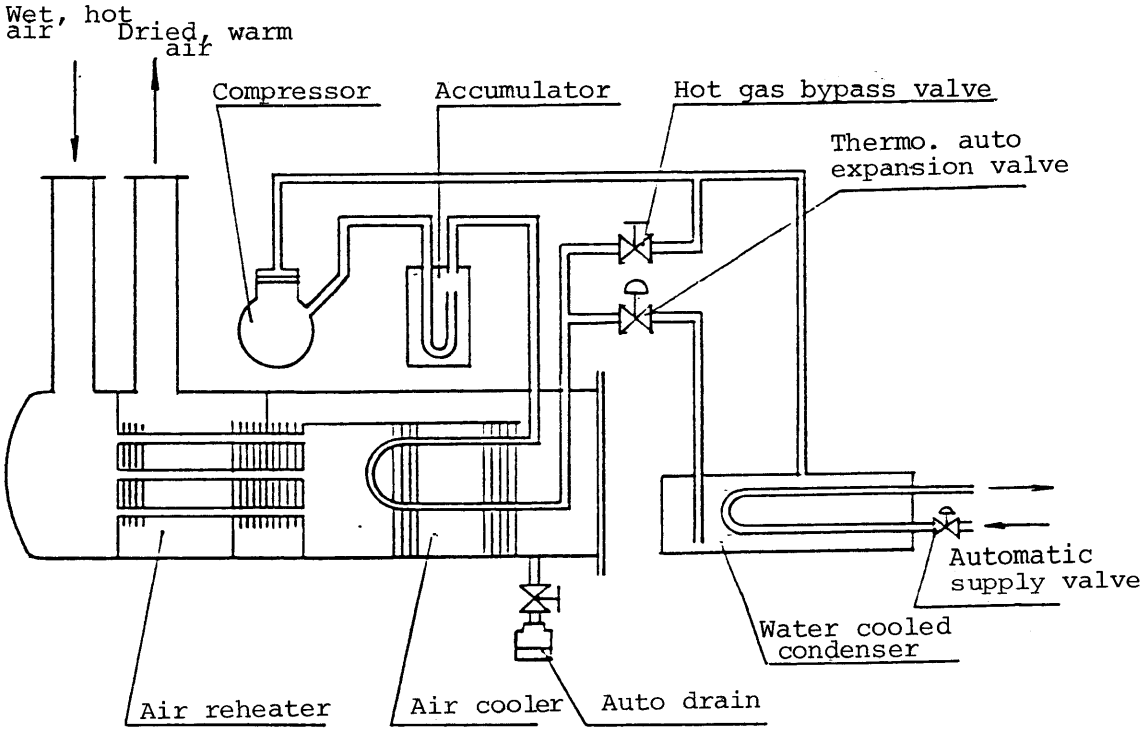
3. WIRING DIAGRAM




| SYMBOL | DEVICE NAME |
|---|---|
| MC | MAGNETIC CONTACTOR |
| OCR | OVER CURRENT RELAY |
| CM | COMPRESSOR MOTOR |
| CH | CRANK CASE HEATER |
| TM | TIMER (12H) |
| PB | RESET SWITCH |
| R1 | RELAY |
| SS | START-STOP SWITCH |
| MOV | MOTOR OPERATED VALVE |
| TDR1,2 | TIME DELAY RELAY |
| ITH | INTERNAL THEMOSTAT |
| PS3 | HI-LO PRESS. SWICH |
| PS4 | PRESS. SWITH |
| WL | POWER LAMP |
| GL | RUN LAMP |
| RL | ALARM LAMP |
| NFB | NO FUSE BREAKER |

## 4. PRINCIPLE OF OPERATION

Damp, hot air which enters the air dryer is first pre-cooled in an air-to-air heat exchanger by cold dehumidified air which comes out of the air-to-refrigerant heat exchanger. It then enters the air-to-refrigerant heat exchanger where it is additionally cooled by flon gas which absorbs heat from it. At this stage, water and oil vapor contained in the air condense forming water and oil droplets which are collected in the auto-drain and automatically ejected. The air which is thoroughly cooled and dehumidified by the air-to-refrigerant heat exchanger once again passes through the air-to-air heat exchanger where it is heat exchanged with damp, hot air to become clean, dry air which does not cause sweating of the pipes in the system.



(1) Hot gas bypass valve is designed to prevent excessive cooling (freezing) of the air when the inlet air conditions fall below the rated load specifications, by maintaining the evaporation temperature of the refrigerant at a constant value.

(2) The amount of air which can be handled increases in inverse proportion to the temperature of the air at the inlet, and in direct proportion to the pressure.

If the system is operated with the cooling at a higher temperature, it is possible to handle a larger volume of air. If, however, the system is operated at a temperature in excess of 15°C, the freezer will become overloaded, leading to a possible fault.

(3) A crankcase heater is provided in order to prevent lubrication problems due to foaming during startup.

The crankcase heater maintains the bottom of the freezer at a constant temperature in order to prevent the refrigerant mixing with the freezer oil in the freezer proper. It is energized when the power is switched on. It is not energized, however, when the system is running. Consequently, it is necessary to leave the power switch ON even when the system is not running. Be sure to turn on the

power 12 hours before the first run after installing the system or before starting it up after it has been shut down for a considerable period of time.

The timer is set so that model IDF370B will not start up unless the power supply has been turned on 12 hours previously.

## 5. AIR PIPING

(1) As for detailed piping examples for each application, refer to the separate catalog, "Equipment for Purifying Compressed Air."

(2) To ensure the most satisfactory performance of the unit forever, it is recommended to install a main line filter (AFF series) in an inlet air piping.

The filter will lessen cooling load of the unit and contamination of the heat exchangers.

(3) INSTALL a bypass piping to facilitate maintenance. (See Fig. 1.)

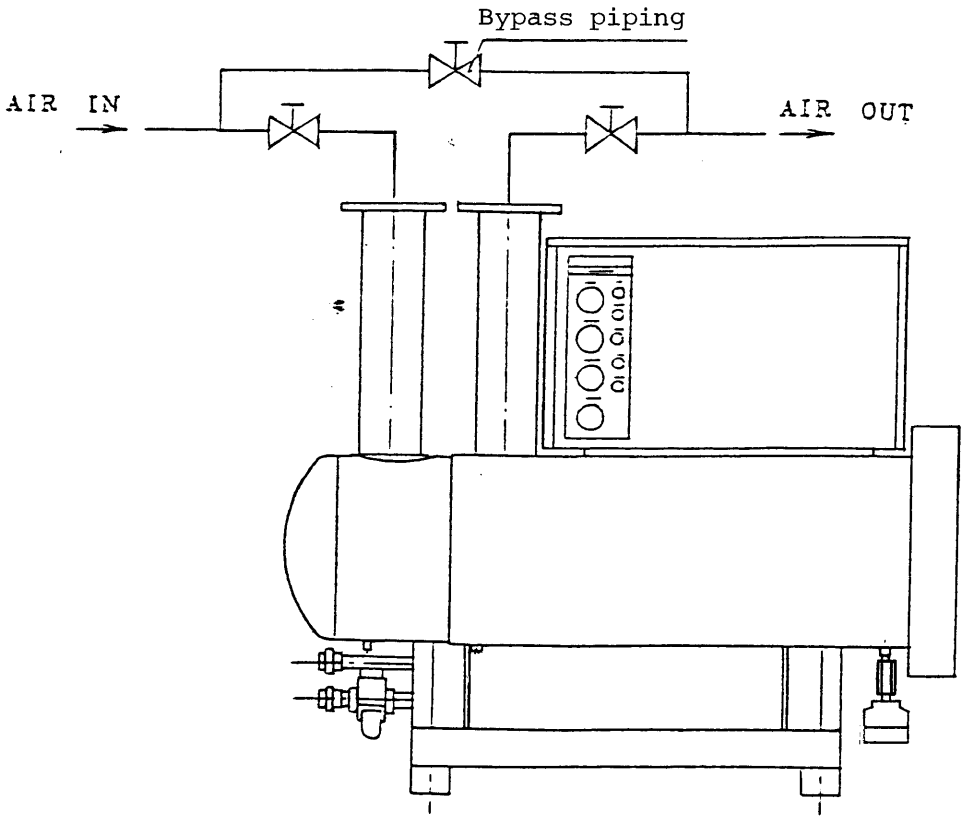



Fig. 1

(4) As far as possible , operate the system with the inlet air temperature at or below 40°C. If the temperature is likely to exceed 40°C, it is recommended that an after cooler (HAW series: Water-cooled type) be installed.

(5) The most efficient and economical method of dehumidifying hot, compressed air is to first cool and dehumidify it to below 40°C using an after-cooler, then further cool and dehumidify it using a freezing type air drier.

## 6. INSTALLATION

(1) Model IDF370B air-to-refrigerant heat exchanger and air-to-air heat exchangers are Class 2 pressure vessels. It is therefore necessary to make notification to your local Manager of the Labor Standards Office. (See item 11.)

(2) Install the equipment on a relatively vibration-free, stable, level floor surface (shall not deviate from the horizontal by more than 5°C).

(3) Maintain the equipment at least 1 m away from walls or other equipment, etc., both front and rear and left and right, in order to provide an unobstructed flow of air and also to facilitate maintenance.

(4) Install the equipment inside in a well ventilated, dust-free area of low humidity. If it is installed outside, make sure that it is not directly exposed to rain or wind.

(5) When installing or transporting the equipment, on no account turn it on its side or drop it. This will damage the equipment.

(6) The equipment cannot be used in an atmosphere containing corrosive gases such as sulfur dioxide, hydrogen sulfide, etc. It is necessary to first treat such air before drawing it into the equipment.

(7) When installing the model IDF370B, be sure to apply the warning sticker "R22 freezing equipment" provided, on an easily visible part of the equipment. (Clauses 14 and 15 of rules relating to freezing safety)

## 7. ELECTRICAL WIRING

(1) The rated voltage of the equipment is 200 V 3-phase, and the permissible voltage fluctuation is ±10%. Ensure that the voltage imbalance between phases is no more than 3%.

(2) Remove the front panel, then take off the cover of the electrical box located on the left side of the equipment and connect up the power wires (3-phase 200 V 50/60 Hz) to the R, S and T terminals on the terminal block and also the earth wire to the E terminal.

(3) Be sure to install the main switch and a suitable fuse on the power supply side.

(4) The power wires and earth wire shall have the capacities shown in the table below.

| Item \ Model | IDF370B |
|---|---|
| Power wires ($mm^2$) | 8.0 |
| Fuse capacity (A) | 80 |

## 8. OPERATION

(1) Reconfirm that the installation site, air piping, electrical wiring, supply voltage and fuse capacity, etc., are suitable.

(2) Because this equipment employs a crankcase heater, set it so that it starts up 12 hours after the power is switched on. In the case of model IDF370B, a 12-hour timer is contained in the equipment.

In the event of a short-term power failure, open the small window in the left side panel (panel on drain port side) and press the pushbutton switch. This will enable the equipment to operate independently of the set time on the timer. In such a case, however, start up the equipment after energizing the crankcase heater for the same length of time as the duration of the power failure (max. 12 hours.)

(3) As a general rule, start and stop the equipment using the switch on the equipment. While the equipment is running, the run lamp will be alight.

(4) After shutting down the equipment, wait for at least 5 minutes before switching it on again. It is possible to run the equipment continuously even without passing air through it.

(5) If air is passed through the equipment after running it for 5 to 10 minutes on load (i.e. without passing air through it), no humid air will appear at the secondary side.

(6) The specified cooling temperature will be indicated on the cooling temperature gauge for about 10 to 20 minutes after passing air through the system. If the air flow drops to below 1/10 of the rated value, the cooling temperature indication may become inaccurate.

(7) Use the cooling temperature gauge within the temperature range 2°C to 15°C.

(8) If the system shuts down due to a fault, the run lamp will go out and the fault lamp will light up.

In such a case, turn off the switch of the equipment and after removing the cause of the fault restart the system. (See item on troubleshooting.)

(9) The auto drain of this equipment is a motor operated type. Its operating cycle is shown on the next page.

| Item \ Model | IDF370B |
|---|---|
| 1 cycle time (min) | 1 |
| Valve opening time (sec) | 8 |
| Valve closing time (sec) | 52 |

## 9. MAINTENANCE CONTROL

(1) Check to see whether or not the cooling temperature conforms to the value specified in item (7) of "Operation."

(2) Check to see if the lamps light up, as well as the air pressure and the operation of the auto drain.

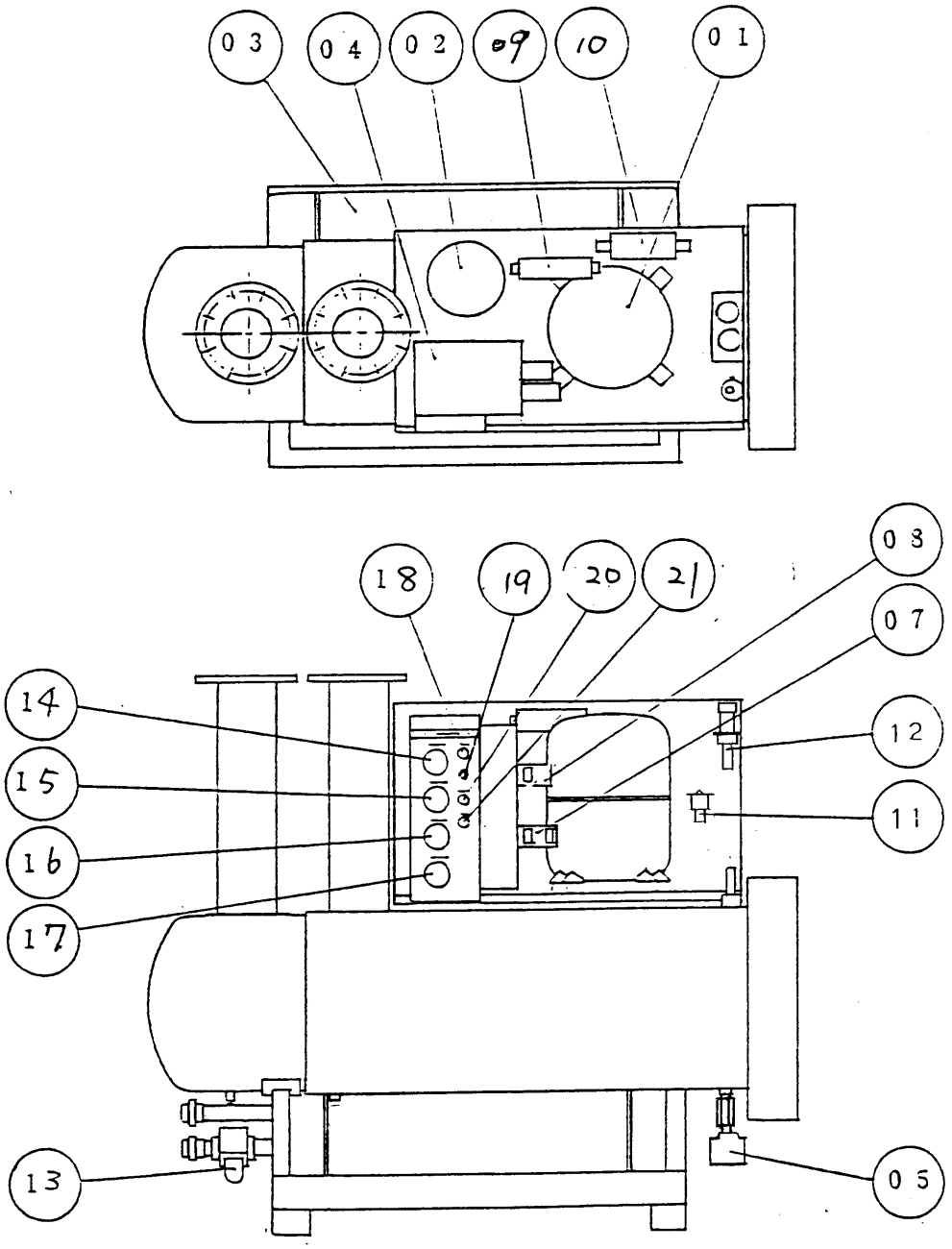
(3) The reading on the refrigerant pressure gauge in the freezing cycle air dryer is normal if the readings on the condensation pressure gauge and the evaporation pressure gauge are within the range shown in the table below.

| Conditions | | During Operation | | During Shut-down | | |
|---|---|---|---|---|---|---|
| | | | | Ambient Temperature | | |
| | | No Load | Load | Approx. 10°C | Approx. 20°C | Approx. 30°C |
| Refrigerant Pressure kgf/cm$^2$ | Condensation Pressure | 15 - 19 | 15 - 19 | 5.0 min | 7.5 min | 10 min |
| | Evaporation Pressure | Approx. 3.5 | Approx. 3.5 - 5.5 | | | |

(4) Since it is essential for the water-cooled condenser to keep contact with high quality cooling water as much as possible, control the quality of cooling water in accordance with the description in 13. MAINTENANCE OF WATER-COOLED CONDENSER.

10. NAME OF PARTS

Name of parts are shown below.



| No. | Name | No. | Name |
|---|---|---|---|
| 01 | Compressor | 12 | Hot gas bypass valve |
| 02 | Accumulator | 13 | Automatic supply valve |
| 03 | Water cooled condenser | 14 | Air pressure gauge |
| 04 | Relay box | 15 | Air cooling thermometer |
| 05 | Auto drain | 16 | Refrigerant evaporating pressure gauge |
| 06 | Pressure switch | 17 | Refrigerant condensing pressure gauge |
| 07 | Hi·lo Pressure switch | 18 | Power lamp |
| 08 | Differential pressure switch | 19 | Running lamp |
| 09 | Strainer | 20 | Alarm lamp |
| 10 | Refrigerant dryer | 21 | Run·stop switch |
| 11 | Thermos. auto expansion valve | | |

## 11. TROUBLESHOOTING

### (1) Lamp does not light on.

| Symptom | Cause | Remedy |
|---|---|---|
| Compressor runs. | Defective lamp | Replace lamp. |
| Compressor does not run. | Trouble in power source<br>· Blown fuse<br>· Abnormal voltage, etc. | Locate trouble and eliminate it. |
| | Loose or slipping terminal. | Secure connection |
| | Faulty compressor, overcurrent relay, electromagnetic contactor, HI·LO pressure switch, differential pressure switch, and command switch., etc. | Replace faulty component |

(2) Equipment stops operating after some time.

| Symptom | Cause | Remedy |
|---|---|---|
| Equipment operated by passing air through it (lamp lights up) - evaporation pressure too high. | Contaminated cooling water side of water-cooled condenser | Clean cooling water side |
| | Inlet temperature of cooling water too high | Restudy cooling tower |
| | Intake air conditions too stringent<br>·Too high temperature<br>·Too large air volume<br>·Too low pressure | Restudy specifications (install after-cooler, etc.) |
| Lamp lights up but compressor does not operate. | Faulty compressor, over-current relay, solenoid contactor, etc. | Replace faulty part. |
| Equipment operated without passing air through it (lamp lights up) - evaporation pressure too low. ($3.0\ kgf/cm^2$ 300 kpa or less). | Gas leakage | Repair. |
| | Improperly set capacity adjusting valve | Set valve correctly. |
| | Improperly set automatic water supply valve | Set valve correctly |

(3) Water appear at secondary side

| Cause | Remedy |
|---|---|
| Insufficient cooling | See item 4. |
| Faulty operation of auto drain. | Repair or replace. |
| Bypass pipe valve is open. | Close it. |
| Piping not connected to dryer is fitted at secondary side. | Restudy piping. |
| Drain stop valve is closed. | Open it. |

(4) Insufficient cooling

| Symptom | Cause | Remedy |
|---|---|---|
| Evaporation pressure is high. | Contaminated cooling water side of water-cooled condenser | Clean cooling water side |
| | Inlet temperature of cooling water too high | Restudy cooling tower |
| | Intake air conditions stringent.<br>· Temperature is high.<br>· Air volume is too large.<br>· Pressure is low. | Restudy specifications (install after-cooler, etc.) |
| | Ambient temperature is high. | Restudy installation location (install dust, ventillator, etc.) |
| Evaporation pressure is low. | Gas leakage | Repair |

## 12. MAINTENANCE OF WATER-COOLED CONDENSER

When a water-cooled air drier is used for a certain period of time, dirt at the cooling water side of the water-cooled condenser may cause the condensation performance to drop and the condensation pressure to become abnormally high, so that the high-pressure pressure switch on the air drier operates to turn off the air drier. Consequently, when operating the air drier, read the following thoroughly and carry out maintenance and inspection of the water-cooled condenser.

(1) Cooling water

Generally, subterrainean water or supply water is used for the cooling water of a water-cooled condenser. Depending upon the cooling method employed, water-cooled condensers are divided into single-pass and circulating types. A single-pass type is one in which the suberrainean water or supply water is continually fed to the condenser and the water which is heated in the condenser is discharged outside. This method is used where water is plentiful. A circulating type is one in which the water after absorbing heat from the condenser and becoming hot is cooled in a cooling tower and reused.

Loss of performance of a water-cooled condenser is almost invariably due to corrosion or scale formation at the cooling water side. Table 1 shows the properties of foreign matter in cooling water and appropriate counter-measures.

Table 1

| | Cause of Formation of Foreign Matter | Trouble | Countermeasure |
|---|---|---|---|
| Scale | ° When using hard cooling water.<br>° If calcium or magnesium are contained in the cooling water, insoluble carbonates, silicates and sulfates will form on the walls of the condenser. | ° Reduced cooling performance.<br>° Cooling water flow passages become blocked up, preventing flow of water. | ° Change water source.<br>° Periodically clean or perform chemical cleaning.<br>° Use treated water. |
| Slime | ° Polluted seawater or cooling water such as factory waste water or domestic drainage is particularly nutritious and microorganisms proliferate in it. If such water also contains sand, soil and rust, a viscous muddy cake will be formed. | ° Reduction of cooling performance.<br>° Cooling water passages become blocked up, preventing flow of water. | ° Change water source.<br>° Periodically clean or perform chemical cleaning.<br>° Use treated water. |
| Dirt and dust . Sand and soil | ° When using the circulating method in dirty and dusty locations, dirt and dust becomes mixed with the cooling water, promoting the formation of scale and slime. | ° Reduction of cooling performance<br>° Cooling water passages become blocked up, preventing flow of water. | ° Fit a filter at the cooling water intake of the pump.<br>° Periodically clean the condenser. |

(2) Quality standards pertaining to cooling water

(a) Water quality standards

Quality standards pertaining to cooling water (Note 1) used in water-cooled condenser are defined in the standards of the Japan Refrigeration and Air Conditioning Industry Association. Numerical values are shown in Table 2.

Table 2

| Item | Reference Value | Tendency | |
|---|---|---|---|
| | | Corrosion | Scale Formation |
| P H (25°C) | 6.0 - 8.0 | ○ | ○ |
| Conductivity (25°C)[μ℧/cm] | 500 max. | ○ | |
| Chlorine ions $C\ell^-$ [PPM] | 200 max. | ○ | |
| Sulfate ions $SO_4^{2-}$ [PPM] | 200 max. | ○ | |
| Total iron content Fe[PPM] | 1.0 (0.5) max. | ○ | ○ |
| Alkalinity $CaCO_3$ [PPM] | 100 max. | | ○ |
| Total hardness $CaCO_3$ [PPM] | 200 max. | | ○ |
| Sulfur ions $S^{2-}$ [PPM] | Shall be undetectable | ○ | |
| Ammonium ions $NH_4^+$ [PPM] | Shall be undetectable | ○ | |
| Silica $SiO_2$ [PPM] | 50 max. | | ○ |

Note 1. Cooling water is defined as water which passes through a water-cooled condenser of either the one-pass type or circulating type.

2. The sumbol ○ in the columns in the table above indicate a factor which is related to a tendency to either corrosion or scale formation.

(b) Water quality inspection

When using industrial water or subterranean water (well water) as cooling water for a heat exchanger, test the water in respect of the items shown in Table 2 using the method given in JIS K0101 (Industrial Water Test Method) or a method based thereon, and determine whether or not the water is suitable on the basis of the reference values given in Table 2.

If the water deviates from the reference values, it is necessary to take the following action.

① Change the water source, for example use supply water instead of subterranean water.

② Change the cooling method from a one-pass method to a circulating method using cooling water which can be used with the one-pass method.

③ Determine a suitable method of treatment by contacting a water treatment consultant.

When using the circulating method employing a cooling tower, or the like, atmospheric pollution will bring about corrosion of the heat transfer pipes due to sulfur dioxide gas in the air dissolving in the cooling water and forming sulfuric

acid, even if the water quality initially satisfies the water quality standards. It is therefore important to periodically check the water quality of the cooling water in the heat exchanger and also to control the water quality by replacing the cooling water, etc.

Fig. 1 shows trouble due to poor water quality and preventive measures.

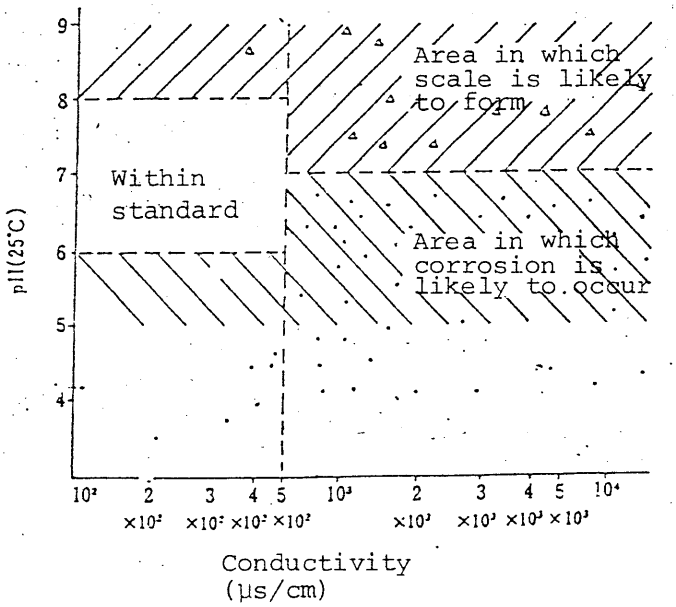



Fig. 1 Relationship between PH and Conductivity

(3) Method of washing cooling water side of water-cooled condenser

Despite carrying out adequate control of the cooling water quality, scale will form on the walls of the cooling pipes, causing performance to be reduced. Accordingly, periodically clean the inside of the cooling pipes as outlined below. The methods of

cleaning can be broadly divided into mechanical cleaning and chemical cleaning. The advantages and disadvantages of the respective methods are shown in the Table 3.

Table 3

| | Mechanical Cleaning Method | *1 Chemical Cleaning Method |
|---|---|---|
| Advantages | ° Can be performed partially.<br>° Cleaning is possible regardless of size of heat exchanger. | ° Work can be carried out without disassembling heat exchanger.<br>° All parts of condenser which can be reached by cleaning fluid can be cleaned, including parts which are normally difficult to clean mechanically (center part of tube bundles and inside of U-bends).<br>° Provided that scale, etc., can be dissolved by the cleaning fluid, condenser can be cleaned with virtually no damage to metal surfaces, regardless of whether water is hard, soft or rubbery.<br>° No cleaning equipment is necessary. |
| Disadvantages | ° Heat transfer pipes may become damaged depending on cleaning method used.<br>° Cleaning equipment is necessary. | ° Heat transfer pipes may become corroded due to residual cleaning fluid depending on type of cleaning fluid used.<br>*2 ° Heat transfer pipes will be eroded and corroded to a certain extent depending upon cleaning fluid used.<br>*3 ° Waste water resulting from cleaning may give rise to pollution problems. |

Note: *1 Unless the constituents of the impurities in the cooling water are known and a suitable cleaning fluid used, it will be necessary to perform cleaning all over again.

*2 Anti-erosion and corrosion agents are marketed together with the cleaning fluid. (See Table 5.)

*3 Marketed together with agent for treating waste water.

(a) Mechanical cleaning method

Mechanical cleaning methods generally employed include fitting a brush, or the like, on the end of a long thin shaft and mainpulating it by hand, a power-driven cleaning device, or a high-pressure fluid injection method in which high-pressure fluid is injected from a fine nozzle (jet cleaning). The following two methods are described below, in view of the construction of the heat exchanger, cost and effectiveness.

(i) Exampleof power-driven cleaning device

Hard scale adhering to the inside of straight parts of the heat transfer tubes is removed by means of a tool powered by compressed air.

(1) Maker: Sugino Machine Manufacturing Co.

(2) Name: Compressed-air-driven external motor cleaner

(3) Type: MK-K and specifications

Table 4 Main Specifications

| Specifications / Construction | I.D. of Pipe | Air Working Pressure | Air Consumption | No-load Rotating Speed | Max. Shaft Length | I.D. of Hose | | Weight |
|---|---|---|---|---|---|---|---|---|
| | $\phi$mm | kg/cm$^2$G | m$^3$/min | R.P.M | cm | Air | Water | kg |
| HM-K | $6.3 - 36.5$ | 6 | 1.0 | 2,800 | 6.0 | 16 | 6.5 | 4 |

Application: Removal of hard scale from heat exchanger, condenser, and equipment with small diameter tubes
(It is possible to perform cleaning work in safety even in places where there is a danger of explosion.)

Rotation: The air motor incorporates a planetary gear speed reduction unit to produce a high rotational torque.

Air motor proper: The air motor is made of light alloy for weight reduction/

Hollow shaft: The shaft is a thick-walled pipe made of special steel in order to provide sufficient strength against twisting forces. It is also possible to freely extend the length of the shaft. In particular, because water is passed through the inside of the shaft to be sprayed from the end tool, ejection of the removed scale outside the tube and cooling of the end tool take place simultaneously.

Handling method: This cleaning device can be operated by simply connecting up the air hose and water hose and gripping the grip valve.

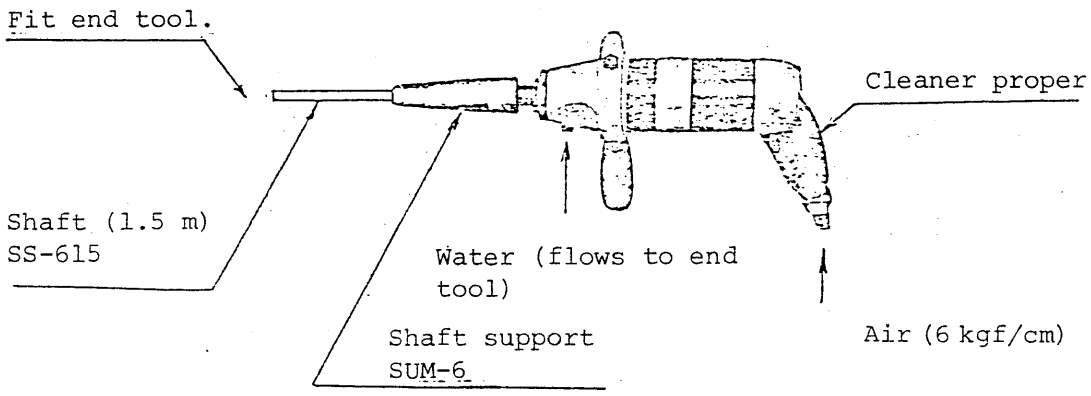



Fig. 2 Cleaner Proper, Shaft Support, and Shaft

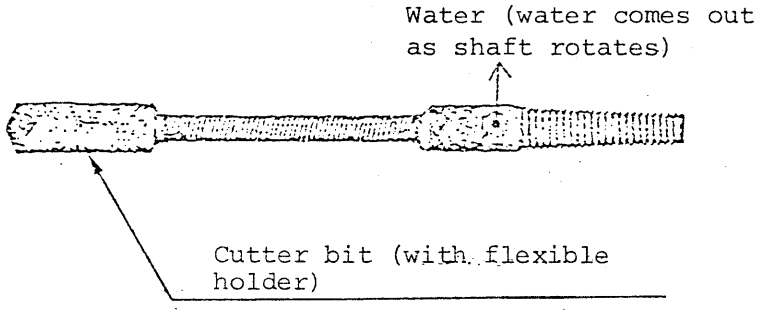



Fig. 3 End Tool

(4) Cleaning method

As shown in the figure, the inside of the tubes of the heat exchanger are cleaned at the rate of one heat transfer tube every 10 to 15 seconds by means of a tube cleaner, while passing water through the tube cleaner.

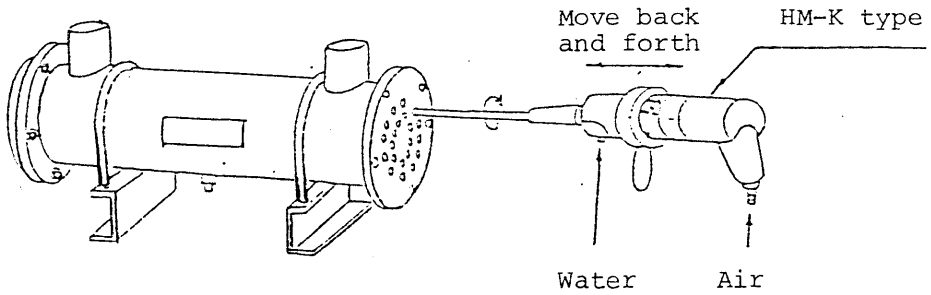



Fig. 4 Example of Use of Tube Cleaner

5) Note

The tube cleaner is used to clean straight portions of the heat transfer tubes. The inside of the tubes may become damaged when the cutter bit (Fig. 3) is inserted into U-bends.

The shaft O.D. and cutter bit dimensions (Figs. 2 and 3) will differ depending upon the I.D. of the heat transfer tubes. For detains, refer to the maker's catalog. (For contact address see Table 5.)

(ii) Cleaning using brush

Soft scale is removed from the inside surface of the heat transfer tubes using an easy-to-clean inexpensive brush.

1) Example of brush dimensions and material

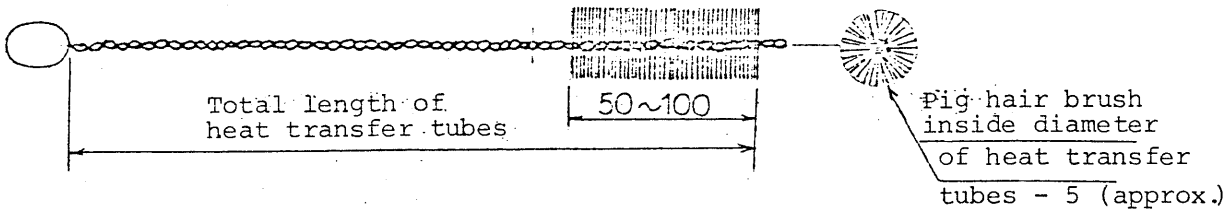



Fig. 5 Brush

2) Cleaning method

Remove the cover from the water chamber and insert the brush into the tubes. Move the brush back and forth inside each tube three times. Before inserting the brush, wet the inside of the tubes.

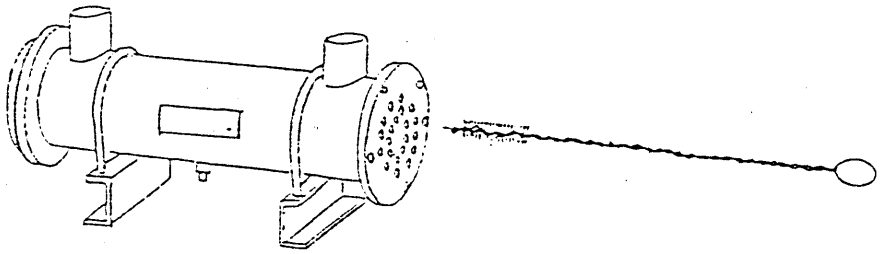


Fig. 6 Outline of Cleaning Method

3) Note

Scale and slime which adheres to the inside of the heat transfer tubes will gradually become hard. It is therefore necessary to clean it off with a brush before this happens. Although the optimum cleaning frequency will vary depending on the water quality, it is recommended that it be cleaned once a year (May or June).

(b) Chemical cleaning method

Chemical cleaning methods include static and circulatory methods. Of these, the latter is more effective. Also, in the case of the one-pass method, use the method shown in Fig. 7 or 8, while if a cooling tower is employed, use the method of Fig. 9.

When carrying out cleaning, take adequate measures to prevent corrosion due to the formation of harmful gas in the washing fluid itself.

(i) Example of chemical method (static method)

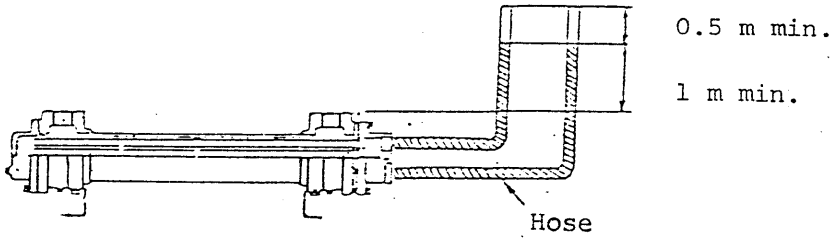



Fig. 7

1) Working procedure

1)-1 Remove the connection from the cooling water inlet and outlet pipes of the heat exchanger and connect up hoses (rubber or vinyl) instead.

1)-2 Lift up and fix the hoses, then pour in fluid until it comes at leas 1 m above the top of the water chamber cover and leave it for the specified length of time.

1)-3 Discharge the washing fluid and flush the pipes out with water (for at least 20 minutes) to ensure that there is no residual washing fluid.

(ii) Example of chemical cleaning method (circulating method)

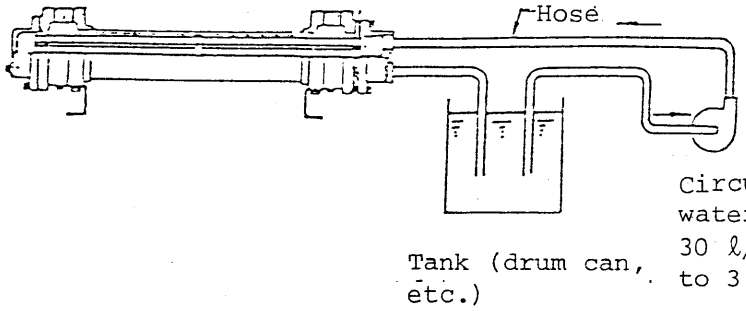



Fig. 8

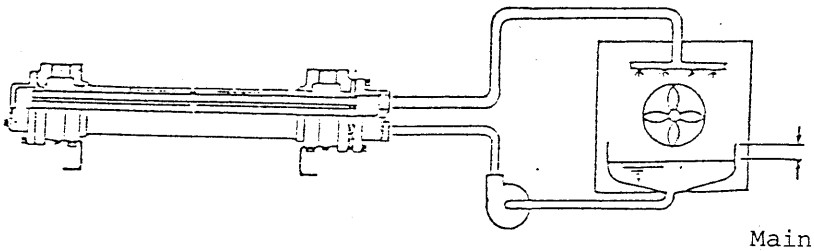



Fig. 9

1) Working procedure for case of Fig. 8

1)-1 Connect up the washing circulation pump (acid-proof pump, if necessary) and the cooling water inlet/outlet of the heat exchanger by means of a hose.

1)-2 Pour washing fluid into the tank and circulate it for a fixed period of time.

1)-3 Discharge the washing fluid and flush out the tank properly (at least 20 minutes) to ensure that there is no residual washing fluid.

2) Work procedure in case of Fig. 9

2)-1 When using a cooling tower, pour washing fluid into it and wash the tower by circulating the washing fluid through it for a fixed period of time.

2)-2 Discharge the washing fluid and thoroughly flush out the cooling tower (replace water three or four times at intervals of five minutes) to ensure that no traces of washing fluid remain.

3) Note

3)-1 When cleaning by means of a circulating method, thoroughly check the pump for leakage and also confirm that the pressure is normal, before operating it.

3)-2 When using a chemical cleaning method, the amount of fluid, washing time and treatment, etc., will vary depending upon the kind of washing fluid used. Accordingly, perform washing in accordance with the instructions provided with the washing fluid. In particular, be very careful when disposing the waste liquid.

3)-3 Check the results of washing, as follows:

- Observe the water during washing to see if dirt gradually disappears.
- Check changes (reductions) in pressure drop on the cooling water system by observing the discharge pressure of the pump, and so on.

(c) Makers of cooling water monitoring equipment and treating agents

Table 6 shows the main makers of cleaning tools, water quality measuring instruments, washing agents and water treating agents. Before taking action, consult with the makers concerned.

Table 5 Makers of Cooling Water Monitoring Equipment and Treating Agents

| Measuring Instrument, Tool, and Treating Agent | Maker | TEL | Product Name |
|---|---|---|---|
| Cleaning tool | Sugino Machine Ltd. | (0765) 24 5111 | Tube cleaner |
| PH Measuring Instrument<br><br>Electrical conductivity meter | Denki Kagaku Keiki Co., Ltd. | (0422) 53 5111 | PH checker HK-2<br>Water quality meter |
| | Showa Industries Co., Ltd. | (0582) 32 1131<br>(03) 750 6068 | Water quality checker WQC-2A |
| | Kurita Water Industries Ltd. | (03) 347 3381 | PH meter KP-3<br>Electric conductivity meter |

| Measuring Instrument, Tool, and Treating Agent | Maker | TEL | Product Name |
|---|---|---|---|
| Chemical Washing Agent | Kurita Water Industries Ltd. | (06) 203 1141 | Curinstar HP<br>Curinstar B-111<br>Curinstar B-114<br>Curinstar SP<br>Curinstar EP |
| | Mitsubishi Gas Chemical Co. | (03) 283 4759 | Deslime<br>Diaflush |
| | Koyo Kasei Co., Ltd. | (0797) 31 7122 | |
| Water Treating Agent | Kurita Water Industries Ltd. | | Kurisour-pack<br>Kurisour IT<br>Kurisour A600 |
| | Showa Industries Co., Ltd. | (0582) 32 1131<br>(03) 750 6068 | Joso |