SEWAGE TREATMENT DEVICE

SBT

U. S. C. G Recognition Numbers
SBT-15 159.015/3228/0
SBT-25 159.015/3229/0
SBT-40 159.015/3230/0
SBT-65 159.015/3231/0
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FOREWORD

This instruction manual describes matters to be observed in the operation and maintenance of "TAIKO MARINE SEWAGE TREATMENT DEVICE".

We hope this device will be used by customers for a long time under the correct operation and sufficient maintenance and inspection according to this manual. Also for any obscure points in this manual, please readily refer to our business office or plant.

Caution: No part of this manual can be reproduced or reprinted in any form.
SAFETY INSTRUCTIONS

⚠️ CAUTIONS FOR YOUR SAFETY

- Before installing, operating, maintaining and examining equipments, be sure to read well this instruction on safety, the instruction manual and all other attached documents, so that you will be able to use the equipments properly. Also, understand well the information on the equipments and their safety and all of the matters that demand special attention.

- In this instruction, safety is classified into two ranks, “Warning” and “Caution”.
- Even the items which are included in the safety rank, “Caution”, may lead to serious accidents in certain cases. In any case, all of the instructions are very important. So, please be sure to observe them.

⚠️ WARNING

- When the sewage treatment device is stopped to use, empty it after cleaning the inside of the sewage treatment tank. If sewage has been left in the tank, the sewage will go bad, resulting in the production of a poisonous gas. The inhalation of the gas may cause death.
- When the inside of the sewage treatment tank is inspected, check the concentration of the gas, then carry out the work after safety has been verified.
- A place where the sewage treatment device has been installed must be well ventilated. Since a large quantity of air is fed to the device, there is a possibility that the surrounding area falls into a hypoxia state.
- In handling a disinfectant, follow the disinfectant handling standards. The wrong handling of the disinfectant may cause the accidents involving a human life.
- When the discharge pump, the aeration blower or the level switch is examined, turn off the control panel breaker. Also, turn the control switch off. In addition, tag the control panel as “Energizing Is Prohibited”, so that the switch is not turned on by mistake.
- When the discharge pump, the sewage pipe and valve, are overhauled, carry out the work under ventilation, since sewage may contain a poisonous gas.
- In climbing on the sewage treatment tank, wear a helmet and the gloves and shoes with a slide stop function. Also, when the work is carried out at a high place, wear a safety belt. A fall from the place may occur, result in the accidents involving a human life.
- The work for maintaining and checking the inside of the control panel should be carried out by electrician with expert knowledge. The accidental contact with the high-voltage current may cause the death by an electric shock.

⚠️ CAUTION

- Do not use chemicals for cleaning of toilet. The chemicals will affect and kill the microorganisms in the tank. This will cause loss of the purification ability, resulting in the production of a poisonous gas or a bad smell. Use a cleaner which does not give damage to the microorganisms.
- The aeration blower should be run continuously. The interruption of its continuous running will kill the microorganisms within the sewage treatment tank. This will cause loss of the purification ability, resulting in the production of a poisonous gas or a bad smell. Also, there is a possibility that the air discharge nozzle clogs.
- Do not put fingers or objects into the rotary parts of the discharge pump and the aeration blower. There is a possibility of injury.
- Sewage may leak out from the shaft seal part of discharge pump due to the termination of its service life. The sewage that leaked out will go bad and then produce a poisonous gas, resulting in the accidents involving a human life, or in corrosion or failure of implements. Clean the area under ventilation, and stop the leak by replacing parts with new ones.
- The inner surface of the sewage treatment tank has been coated with tar-epoxy. Do not bring fire close to the tank, or the coating will be damaged, thereby causing sewage to leak out from damaged portions of the tank.
- Close the manhole of the sewage treatment tank so securely that sewage or odor will not leak out.
- Check the air vent pipe for the clogging because of sewage or dewing. If the pipe clogs in this way, the toilet seal water trap will be broken by the back pressure of the aeration blower, thereby causing the toilet water to splash and at the same time resulting in the emission of a poisonous bad smell. Also, the splashes dirty your clothes and the surrounding area.
- The paper to be used in the toilet should be soluble in water. Stuffs which are insoluble in water, such as sanitary product, should not be thrown into the toilet but be thrown into a waste-basket placed in the toilet. These stuffs may cause the clogging or failure of the pump.
1. Summary

The Taiko Ship Clean "SBT Series" are compact sized sewage treatment systems with superior performance capabilities, designed exclusively for marine installations.

They are the result of considerable research and include the latest technology to prevent water pollution.

The use of a "Submerged Bio-Filter Treatment System" and the transposition of the sterilization compartment to the center of the device enables it to be more compact. These state of the art devices are thereby more stable under conditions of pitch and roll and are sized for vessels of 200 or more gross tons, or accommodating 10 or more persons as described in the Annex IV of MARPOL TREATY 73/78.

Another remarkable feature of these devices is the ease of operation and maintenance compared with conventional systems.

Furthermore, the quality of effluent exceeds the requirements specified for Type II MSD (Marine Sanitation Devices) contained in Regulation (33CFR159) enforced by the U.S. Coast Guard and also those of the MEPC 2 (VI). (MARPOL TREATY)

Test result verify the following performance characteristics.
BOD<sub>5</sub>: less than 50 ppm
SS: less than 50 ppm
Coliform bacteria (MPN): less than 200/100 mL

2. Construction (Refer to Fig 1.)

2.1 General of "Bio-Filter Method"

The Bio-Filter Method is a method of processing sewage by utilizing a biological film. Packing media are placed in the tank and liquid sewage is circulated around it by means of aeration.

The sewage contacts the biological film causing growth of bacteria on the surface of packing media and organic matter (BOD source) is treated by biochemical oxidation.

2.2 Construction

a. Bio Filter Tank
Sewage from toilets in the ship flows into the Bio-filter Tank. Foreign objects which could obstruct operation of the device are held by a screen. Air from a blower causes circulation of the liquid and breaks up the solids. It also supplies oxygen to the microorganisms attached to the packing media.

b. Sterilization compartment
The sewage treated in the bio-filter tank flows into the sterilization compartment. This liquid is thoroughly disinfected as it washes against the chemical sterilizing tubes in the sterilization compartment. The treated water is collected in the sterilization compartment then discharged overboard by automatic operation of the discharge pump.

![Internal Construction Of SBT Series](image-url)
3. Design

3.1 These devices have been designed to comply with the US Regulation 33CFR Part 159 and may be installed in an uninspected vessel, (as defined by the USCG).

They have also been designed to comply with MARPOL TREATY, MEPC2(VI).

3.2 Model Designation Coad

Example:

\[ \text{SBT - 40} \]

- design capacity of persons
- Submerged Bio-filter Treatment system

3.3 Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
<th>SBT-15</th>
<th>SBT-25</th>
<th>SBT-40</th>
<th>SBT-65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of persons</td>
<td>persons/day</td>
<td>15</td>
<td>25</td>
<td>40</td>
<td>65</td>
</tr>
<tr>
<td>Average of sewage processed</td>
<td>L/day</td>
<td>900</td>
<td>1500</td>
<td>2400</td>
<td>3900</td>
</tr>
<tr>
<td>Processed amount of sewage</td>
<td>L/h×Times/day</td>
<td>94×3</td>
<td>156×3</td>
<td>250×3</td>
<td>406×3</td>
</tr>
<tr>
<td>BOD amount</td>
<td>g/day</td>
<td>202.5</td>
<td>337.5</td>
<td>540</td>
<td>877.5</td>
</tr>
<tr>
<td>Blower</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air flow</td>
<td>m³/min</td>
<td>0.22</td>
<td>0.37</td>
<td>0.60</td>
<td>0.98</td>
</tr>
<tr>
<td>Pressure</td>
<td>MPa</td>
<td>0.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Power Input</td>
<td>kW</td>
<td>0.4</td>
<td>0.4</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Discharge Pump</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>m³/h</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>m</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor Power Input</td>
<td>kW</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Current Draw</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>440VAC×60Hz</td>
<td>A</td>
<td>4.1</td>
<td>4.1</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>220VAC×60Hz</td>
<td>A</td>
<td>8.1</td>
<td>8.1</td>
<td>9.4</td>
<td>9.4</td>
</tr>
</tbody>
</table>

*The maximum operation electric power is reduced to 110V by a transformer which has been installed in a control panel and is used as an operation electric source.
(Reference for rating...Quantity of sewage : 60L/man-day)
(Quantity of BOD : 13.5 g/man-day)

3.4 Features

a. This device performs well during vessel movement, up to a maximum 15 degrees of roll and pitch.

b. This device has been designed to withstand an internal pressure 0.25MPa.

c. This device operates satisfactorily with fresh, brackish, or sea water. However, mixing them should be avoided.

d. Materials; Tar-epoxy coatings have been applied to all portions of the steel plate contact with sewage. Corrosion resistance was considered in the selection of all materials.

e. This device has been designed to stop in the event of a power interruption and to automatically continue its operation when power is resumed.

f. Discharge pump motor and blower motor are rated for operation at 50°C ambient.
4. Installation

4.1 Main Unit

a. The device should be installed as close as possible to the toilet bowls.

b. Maintain clear space of at least 450mm on all sides and above the device. (There is need the space of 1000mm (SBT-15,25) Or 1215mm (SBT-40,65) to pull out Level Prove and Earth rod on the top side of equipment.) However 550mm of clearance at the control panel allows full swing of the door. The mounting base should be attached to the deck using the proper size bolts (shown in table below) through the holes provided.

<table>
<thead>
<tr>
<th>Model</th>
<th>SBT-15</th>
<th>SBT-25</th>
<th>SBT-40</th>
<th>SBT-65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size x Qty</td>
<td>M24 x 4</td>
<td>M24 x 6</td>
<td>M24 x 8</td>
<td>M24 x 10</td>
</tr>
</tbody>
</table>

c. The main unit must not be installed in an area exposed to flammable liquids or gases.

d. The main unit should not be exposed to the weather.

e. The main unit and its piping must be installed below any toilet discharge.

f. The capacity of discharge pump is $4 \text{m}^3 / \text{h} \times 20 \text{m}(\text{water head})$, connection is JIS 5K 40A FF. This head pressure should be set lower than 20m(water head) including the actual head and piping resistance.

4.2 Piping (Refer to FINISHED DWG.)

a. More than three degrees of inclination should be provided for all sewage and air vent piping to prevent collection of sewage or condensation.

b. Piping for sewage should be routed as directly as possible. Appropriate cleaning ports should be provided.

c. Direct overboard discharge piping must be equipped with a valve that can be sealed in the closed position, so that the system may be used restricted waters. (Direct overboard discharge is permissible in unrestricted waters.)

d. Discharge piping must be made higher than the L. W. L.

e. Discharge piping must be made higher than the top of the device.

f. The overflow piping must terminate in the bilge with a connecting U-trap.

g. A storm valve which meets the regulation of the Ship-Classification Society must be used. Its outlet must be 200 to 300 mm below the L. W. L.

h. Consideration must be given to routing of piping so that sea water doesn't flow back into the device.

i. The size of the air vent must be in accordance with the following table or larger throughout its entire length. The vent must be constructed to minimize clogging by climatic conditions such as ice or snow. The outlet should terminate well above the weather deck and be turned downward.

Minimum Vent Size

<table>
<thead>
<tr>
<th>Model</th>
<th>SBT-15</th>
<th>SBT-25</th>
<th>SBT-40</th>
<th>SBT-65</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Diameter (\text{in})</td>
<td>$1\frac{1}{2}$</td>
<td>2</td>
<td>$2\frac{1}{2}$</td>
<td>3</td>
</tr>
</tbody>
</table>

j. A cleaning water supply pipe should be connected to the device at the fitting provided. A screw-down check valve must be provided in the cleaning water supply pipe at the device.

k. If required, the deck discharge from the outlet of discharge pump should have a pipe diameter of $1\frac{1}{2}$" or 4".

l. All piping to the device should be supported in accordance with good marine practice.

4.3 Wiring (Refer to FINISHED DWG.)

a. Wiring from the power source and to the external alarm shall be provided by the installer. The determination of proper size and type of Support for wiring is to be made by the installer, in accordance with good marine practice.

b. Cable supports should be spaced no more than 10 inches apart.

c. Floor wiring shall be protected by a guard cover or guard tube cable cover.

d. Gland connectors shall be completely sealed by tightening the rubber gland. Water-proof putty should also be used.

e. Terminal connectors of ring type or captive spade ends shall be used and shall be installed so that there is no movement.
4.4 Others

a. Toilet bowls shall be of the trap type.
b. The pressure of water in the toilet bowls should be adequate to provide complete cleaning.
c. Galley discharge water shall not empty into this device.

5. Starting (Refer To Fig.7.8)

a. Confirm that all piping is correct by referring to piping diagram.
b. Apply power to control panel (9), and confirm "SOURCE" lamp is lit.
c. Confirm the direction of rotation of the discharge pump (10) by instantaneous use of pump switch. After making sure the pump is rotating correctly, turn the switch to "MANUAL" and "STOP".
d. Shut stop valve (4) and open drain valve for bio-filter tank (5).
e. Introduce cleaning water into the device at (6) by opening cleaning water inlet valve (Not supplied).
f. When the indicator lamp marked "HIGH WATER LEVEL" on the control panel lights, immediately close the cleaning water inlet valve. (If external alarms is installed, confirm alarm operation at the same time).
g. Open treatment water outlet valve (3), discharge pump outlet valve at (H) and all valves to storm valve (Not supplied).
h. Turn the discharge pump switch to "AUTO". Confirm that discharge pump starts automatically and "HIGH WATER LEVEL" lamp goes out as water level drops. Confirm that the discharge pump stops automatically.
i. Check the quantity of oil in blower by sighting the oil level indicator of aeration blower (11). Add oil if necessary.
j. Open air lift valve (7) (right side) and shut air scour valve (6).
k. Confirm the direction of rotation of the aeration blower (11) by turning the select switch to "RUN". Model SBT-15 & 25 are clockwise rotation and Model SBT-40 & 65 are counter clockwise as viewed from the V-pulley side.
l. Open the manhole (15).
m. Confirm that the water is activated by looking inside the sewage treatment device.
n. Close the manhole (15).
o. Check the supply of disinfectant by removing the cap of the sterilizer(14). Refer to 8.2.3 for filling instructions.
p. If an auxiliary device (such as a collecting tank, etc.) has been installed, confirm its automatic operation and alarm in the same way as the sewage treatment device.
q. Open the valve at (C) on the sewage supply pipe so that sewage may enter the treatment device.
r. Confirm the quantity of flush water for each toilet bowl(approximately 10 to 12L/flush) and for urinals (2 to 3L/flush).

The sewage Treatment Plant have a static capacitance type level switch. The level switch is applied sensor with timer for starting and stopping the discharge pump. The timer is set at 12 seconds when we send out the equipment. However, if it is not adjusted, please regulate the adjusting switch that is fitted in front of Level Switch Unit (LSU) in the control panel. (Refer to Fig.6)

However, if the set time of timer is longer than is necessary time, the pump is operated at dry condition so that the pump will be damaged. Therefore, please takes care this matter.
6. Cautions for toilet usage

a. Do not turn off the power source for the aeration blower under any circumstances. If this happens, the microorganism will die and thereby reduce the effectiveness of this Device.
b. Be careful not to throw any foreign substances into the toilet fixtures.
c. Do not use paper containing vinyl components.
d. Be sure to flush after each use of toilet bowl.
e. Chemicals for cleaning toilet bowl (hydrochloric acid, bowl cleaners and deodorizers etc.) should be used sparingly. When used, they should be directly discharged overboard. (Only in unrestricted waters). Additionally after chemicals are used, rinse with water. If chemicals enter into the treatment device, operation may be hindered.
f. In the case of general stains, clean bowls in the following way:
   Wipe with a cloth which is soaked in soapy tepid water.
   If stains don't come off, wipe with a sponge containing a little neutral detergent. Don’t use polishing power containing rough particles because they can scratch crockery and metal fittings, and cause permanent stains.

7. Stoppage

When the device must be shut down for inspection, failure of equipment, or part replacement, the following procedures should be taken.

a. Prohibit the use of toilets, or open direct overboard discharge valve (When only vessel's in unrestricted waters).
b. Turn off "AERATION BLOWER" switch.
c. Turn off "DISCHARGE PUMP" switch.
d. Turn off "POWER SOURCE" by turning off the main circuit breakers.
e. To reactivate the device, reverse items (2) - (4) above and allow sewage to flow into the device. Close direct overboard discharge valves.
8. Maintenance (Refer to fig.7.8)

8.1 Important

Sewage treatment devices utilizing biological systems must have periodic maintenance.

Microorganisms on packing media (17) will die and performance will be reduced, if it is not carefully maintained or if it allowed to get out of balance.

Flush water for the toilet bowl should be sea water, brackish water or fresh water.

But mixtures are not recommended. Using different waters alternately will have an adverse effect on the microorganisms. The incubation period (period in which the microorganisms are generated and stabilized) is approximately one week, irrespective of the type of water used. The following maintenance must be carried out regularly to retain normal operation and performance. Maintenance and inspection of accessory equipment should comply with their instructions.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly</td>
<td>(1) Check the supply of disinfectant (Hypochlorite).</td>
</tr>
<tr>
<td>Biweekly</td>
<td>(2) Check the quantity of oil and clean the air filter (aeration blower).</td>
</tr>
<tr>
<td></td>
<td>(3) Check condition of V-belt.</td>
</tr>
<tr>
<td>Monthly</td>
<td>(4) Clean the bio-filter tank screen (See 8-2(3)).</td>
</tr>
<tr>
<td></td>
<td>(5) Back flush and remove sludge (See 8-2(4)).</td>
</tr>
<tr>
<td>Biyearly</td>
<td>(6) Check the inside coating Fix corroded part.</td>
</tr>
</tbody>
</table>

8.2 Disinfectant

8.2.1 Quantity of disinfectant

a. For normal operation, the required quantity of disinfectant is about 1-2 tablets per month per person (20g per tablet). We recommend the following chemicals be used.

Caution: Handle disinfectant with rubber gloves.

<table>
<thead>
<tr>
<th>manufacturer</th>
<th>Brand Name</th>
<th>Chemical Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nippon Soda Co., Ltd.</td>
<td>Nisso Hicron</td>
<td>Calcium Hypochlorite Ca(ClO)₂·3H₂O</td>
</tr>
<tr>
<td>Nissan Chemical</td>
<td>Hilight Clean</td>
<td>Trichlorisocyanic Acid C₃Cl₂N·O₃</td>
</tr>
<tr>
<td>Industries Co., Ltd.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8.2.2 Caution for storage and use

Both Nisso Hicron and Hilight Clean are very stable tablets, but they are strong oxidizers. The following instructions should be observed for proper storage.

a. Tablets should be stored in a cool and dry place where direct sunlight cannot reach them.

b. Tablets should be kept away from heat, flammables and foreign matter.

c. If chemical contacts skin or cloth, brush off completely and rinse with water.

d. Pay close attention that chemical does not enter eyes or contact mouth or nose.

8.2.3 Filling Instructions

Fig.2 Details Of Sterilization Compartment

a. Remove caps.

b. Look into sterilizers or take them out. If sterilizer is not full, add additional disinfectant tablets.

c. 16 tablets can be accommodated in each sterilizer.

d. Replace each sterilizer in its original position and replace the cap.

<table>
<thead>
<tr>
<th>Model</th>
<th>Number of persons/Person/day</th>
<th>Average Consumption Tablets/week</th>
<th>Number of sterilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBT-15</td>
<td>15</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>SBT-25</td>
<td>25</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>SBT-40</td>
<td>40</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>SBT-65</td>
<td>65</td>
<td>23</td>
<td>2</td>
</tr>
</tbody>
</table>

1.5 tablets/month x person
8.3 Blower Maintenance

8.3.1 Confirmation of the quantity of oil of aeration blowers and cleaning of air filter.

a. Check the quantity of oil in the oil level indicator of aeration blowers (Sight glass). If the level is low, replenish using the recommended lubricating oils (Turbine Oil ISO VG68).

Once every six months (especially when the oil contains dirt and looks black) drain the oil from the drain opening of the oil bath and refill with new oil to proper level.

Turbine Oil ISO VG68

<table>
<thead>
<tr>
<th>Oil Capacity (l)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SBT-15 &amp; 25</td>
<td>0.13</td>
</tr>
<tr>
<td>SBT-40 &amp; 65</td>
<td>0.25</td>
</tr>
</tbody>
</table>

b. Once every six months replenish the grease (Use No.2 grease) by adding grease to threaded caps.

c. Remove the air filter cover of aeration blowers. Take out the filter and wash oil, dust, etc. out of the filter with detergent. After drying completely, reassemble the filter and install as before.

8.3.2 Check the alignment and V-belt

As shown in Fig.3, apply a scale to the end face of the V-pulleys and eliminate vertical and horizontal discrepancies. (The scale should be applied obliquely.)

a. Most proper tension of the V-belt will be obtained when it is loosened up to the maximum before getting to slip on the pulleys.

b. As for a V-belt of general use (A, B, C...type), refer to Fig.4 to obtain its proper tension easily. At the proper tension, the belt is flexible up to an amplitude equivalent to the height of the belt when perpendicularly pressed at the middle of the span.

c. To obtain the proper tension of the belt, adjust it so that its deflection \( \delta = 0.016 \times L \text{(mm)} \) is between the maximum and the minimum of the load values mentioned in Table 1 when it is perpendicularly loaded at the middle of span (distance between the contact points of the belt and the pulleys).

![Fig.4]

![Fig.5]

Table 1

<table>
<thead>
<tr>
<th>Type</th>
<th>Min. of the load values</th>
<th>Max. of the load values</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>9.8 (1.0)</td>
<td>13 (1.3)</td>
</tr>
<tr>
<td>B</td>
<td>18 (1.6)</td>
<td>25 (2.5)</td>
</tr>
<tr>
<td>C</td>
<td>39 (4.0)</td>
<td>54 (5.5)</td>
</tr>
<tr>
<td>D</td>
<td>79 (9.0)</td>
<td>98.1 (10.0)</td>
</tr>
<tr>
<td>E</td>
<td>116 (12.0)</td>
<td>147 (15.0)</td>
</tr>
</tbody>
</table>

d. After adjusting the axes, check the tension of the V-belt once more in the manner as described in a-(i) or a-(ii).

e. Then, tighten the motor-fixing bolts.
8.4 Bio-Filter Tank Screen

Cleaning of the bio-filter tank screen
Open the manhole (15) and remove foreign matter from the screen(2). To prevent foreign matter from entering the system, place an instruction placard near each toilet bowl.

8.5 Bio-Filter Tank

Back flush and sludge removal should be done monthly. Sludge removal should be pumped overboard (only into unrestricted waters) or ashore into a sewage system.

a. Turn the discharge pump switch to "MANUAL" and press red colored "STOP" switch.
b. Turn the blower switch to "STOP".
c. Open air scour valve (6) (left side) and shut air lift valve (7).
d. Turn the blower switch to "RUN". Continue this state about 30 minutes. Fixed sludge on packing media (17) will be removed.
e. Shut air scour valve (6) and open air lift valve (7).
f. Shut treatment water outlet valve (3) and open stop valve (4) and drain valve for bio-filter tank (5).

g. Turn the discharge pump switch to "MANUAL" and press black colored "START" switch. When the sludge has been removed from the tank, turn off discharge pump.
If discharge pump is operated in dry condition, the pump will be damaged so that please pay attention for this matter.
h. Open cleaning water inlet valve (Not supplied) and introduce cleaning water into the treatment device.
Use the same kind of water-sea water, fresh water or brackish water as flush water used in this system before removal of sludge.
i. When "HIGH WATER LEVEL" indicator lamp at the control panel lights. Close the cleaning water inlet valve and the stop valve (4) and drain valve for bio-filter tank (5).
j. Open treatment water outlet valve (3), and turn discharge pump switch to "AUTO".
k. Turn the blower switch to "RUN".

8.6 Check List for Maintenance

Check all of the following items every time maintenance is performed, and take appropriate measures to obtain good results. If this is done, the device will be kept in ideal operating condition.

<table>
<thead>
<tr>
<th>Observation Item</th>
<th>Observation Result</th>
<th>Diagnosis (Countermeasure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recirculation</td>
<td>Uniform</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>Stopped</td>
<td>Aeration blower has stopped</td>
</tr>
<tr>
<td>Tone of color</td>
<td>Light brown</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>Transparency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yellow</td>
<td>Sewage load is too heavy. (The number of persons using exceeds device rating)</td>
</tr>
<tr>
<td>Smell</td>
<td>Little</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>Like sewage</td>
<td>Sewage load is too heavy</td>
</tr>
<tr>
<td></td>
<td>Corrupt</td>
<td>Aeration stop</td>
</tr>
<tr>
<td>Foaming</td>
<td>None</td>
<td>Aeration stop</td>
</tr>
<tr>
<td></td>
<td>A little</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>On all surfaces</td>
<td>Influent contains soap</td>
</tr>
</tbody>
</table>
9. Abnormal Warning Device

(Warning for high water level in the sterilization compartment)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Description</th>
<th>Countermeasure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge pump not operating</td>
<td>Pump trouble</td>
<td>Repair pump</td>
</tr>
<tr>
<td></td>
<td>Burn out of motor</td>
<td>Repair motor</td>
</tr>
<tr>
<td></td>
<td>Overload of motor</td>
<td>Eliminate cause of overload</td>
</tr>
<tr>
<td></td>
<td>Failure in control panel</td>
<td>Repair failed part</td>
</tr>
<tr>
<td>Too much water entering the device</td>
<td>Failure of toilet bowl flush valve</td>
<td>Repair toilet flush valve</td>
</tr>
<tr>
<td></td>
<td>Cleaning water inlet valve open</td>
<td>Close the cleaning water inlet valve</td>
</tr>
</tbody>
</table>

10. Shut Down Instructions

(Winter lay-up)

When the device is not used,

a. Open all drain valves located at the bottom.

b. Discharge all sewage in the device by using the discharge pump.

c. Cleaning water should be used to fill the device after the covers are removed.

d. Flush and drain two or three times, confirming that the inside of the device is clean and empty.

e. Stop all operation by turning off the main circuit breaker in control panel.

If there is a possibility of freezing due to low temperature, open all drains for pump and piping. Any liquids that cannot be drained should be protected by an adequate quantity of antifreeze (This includes piping).
11. Level Probe

11.1 General Scope of Level Probe

This Sewage Treatment Device equips a, capacitance type level probe in the sterilization compartment. This level probe which is series of sensors detects the level of water in the sterilization compartment at each level, gives the signal for starting and stopping the discharge pump, and provides warning for abnormal high water level to the level switch unit. Since the sterilization compartment is isolated, visual check is not possible from the outside. Therefore, the water level can be only checked by the lighting of level indicators on the level switch unit inside of the control panel as shown below.

Timers are incorporated in each sensors for the pump start level and high water level. The former has the function to automatically stop the pump if the sensor in pump stop level fails: it will be adjusted depends on sterilization compartment's size (MAX 20 seconds). The later is designed to avoid any undesirable activation due to water splash: the timer provides warning signal 15 seconds after the sensor was sunken into the water.

11.2 Working Principle

This level probe detects the difference of boundary surface between the water and the air as variation of capacitance and transmits the signal to the level switch unit. The value of dielectric constant significantly changes between the water and the air. This variation is turned into the strong/weak circuit transmit voltage and is applied as on/off signal of the relay circuit in the level switch unit.

11.3 Confirm Operation

- Pump Stop Water Level ~ Lamp "L" Lights
- Pump Start Water Level ~ Lamps "L" "H" Light
- LHM Water Level ~ All Lamps Light

Adjustment Trimmer Off
Timer For Pump Stop (max.20s)

Fig.6 Level Switch Unit (inside Of The Control Panel)

11.4 Abnormal working

If the automatic starting and stopping of pump and high level alarm is not working normally, we suppose that the cause of above is by the problem of Level Probe. In this case, please carry out the following investigation.

a. Open the cap of level probe, and disconnect the wiring of terminal "P" and "E". All LSU operation lamps of "L", "H", and "HH" in control panel are put off at the disconnection of wiring. If above lamps are not put off, the LSU is defected so that there is need to replace it.

b. If there is no defected for the LSU, there is possibility that the level probe is out of order. It is possible to pull out the censer part by take off two (2) screws that is fitted beside of level probe terminal box. Please check whether there is any breaking of wire or others defected part on each censer part or not.

c. Wiring the sensor line under the condition that the sensor part is pulled out. Each sensor line is corresponded to the operating light that is installed on LSU in the control panel. (In order L,H, and HH from bottom side) If you clasp the sensor L, the operating light of L is output. If you grip the sensor H with grasp the sensor L, the operating light of L and H are output. (If you only clasp the sensor H, the operating light is not output.) If you grip the sensor HH more than 15 seconds, the operating light of HH is output. (If you only calsp the sensor HH, the operating light is output.)

d. If you clasp the sensor, and the operating lights are not out put normally, the Level Probe is out of order. Therefore, there is need to replace all of them.

e. If there is no abnormal part on level prove by above inspections, there is possibility that some material is stuck on the level prove pipe so that please remove them by pull out the level prove.

f. Voltage between terminal P and E (Reference Value)
- LED unlighted : DC15V, L
- Lighted : 13.3V, L · H
- Lighted : 11.7V, L · H · HH
- Lighted : 8.4V
12. Parts List (Refer to FINISHED DWG.)

12.1 Sewage Treatment Device

(see Fig.7.8)

Fig.7 Flow Chart

Fig.8 Construction Drawing

<table>
<thead>
<tr>
<th>No.</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>BIO-FILTER TANK</td>
</tr>
<tr>
<td>B</td>
<td>STERILIZATION COMPARTMENT</td>
</tr>
<tr>
<td>C</td>
<td>SEWAGE INLET</td>
</tr>
<tr>
<td>D</td>
<td>SEWAGE INLET</td>
</tr>
<tr>
<td>E</td>
<td>AIR OUTLET</td>
</tr>
<tr>
<td>F</td>
<td>EMERGENCY OVERFLOW</td>
</tr>
<tr>
<td>G</td>
<td>CLEANING WATER INLET</td>
</tr>
<tr>
<td>H</td>
<td>DISCHARGE</td>
</tr>
<tr>
<td>1</td>
<td>TANK</td>
</tr>
<tr>
<td>2</td>
<td>SCREEN</td>
</tr>
<tr>
<td>3</td>
<td>TREATMENT WATER OUTLET VALVE</td>
</tr>
<tr>
<td>4</td>
<td>STOP VALVE</td>
</tr>
<tr>
<td>5</td>
<td>DRAIN VALVE FOR BIO-FILTER TANK</td>
</tr>
<tr>
<td>6</td>
<td>AIR SCOUR VALVE</td>
</tr>
<tr>
<td>7</td>
<td>AIR LIFT VALVE</td>
</tr>
<tr>
<td>8</td>
<td>NON RETURN VALVE</td>
</tr>
<tr>
<td>9</td>
<td>CONTROL PANEL</td>
</tr>
<tr>
<td>10</td>
<td>DISCHARGE PUMP</td>
</tr>
<tr>
<td>11</td>
<td>AERATION BLOWER</td>
</tr>
<tr>
<td>12</td>
<td>MOTOR FOR BLOWER</td>
</tr>
<tr>
<td>13</td>
<td>LEVEL PROBE</td>
</tr>
<tr>
<td>14</td>
<td>STERILIZER</td>
</tr>
<tr>
<td>15</td>
<td>MAN-HOLE</td>
</tr>
<tr>
<td>16</td>
<td>AIR SCOUR PIPE</td>
</tr>
<tr>
<td>17</td>
<td>PACKING MEDIA</td>
</tr>
</tbody>
</table>
12.2 Level Probe

Fig.9 Level Probe

<table>
<thead>
<tr>
<th>NO.</th>
<th>NAME</th>
<th>Qu.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COVER</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>BODY</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>GLAND</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>ELECTRODE</td>
<td>1</td>
</tr>
</tbody>
</table>