K U R O S E

Spiral Type Heat Exchanger

User Guide

Type

KSH-1 KSH-2 KSH-3

In detail contact us (KUROSE) or our local partner with our products serial number.

This guideline is not including the guarantee matter, if you have questions about guarantee, please contact KUROSE or local our partner.

KUROSE CHEMICAL EQUIPMENT CO., LTD.

We have Japanese craftsmanship mind. KUROSE SPIRAL

Contents

1. **Specifications**

The specifications and outline of Spiral Type Heat Exchanger were provided from us (KUROSE).
If you cannot find out it, contact us (KUROSE) or our local partner with our products serial number.

2. **Structure**

The Spiral Type Heat Exchanger is formed by winding two metallic plates in the form of a swirl (spiral shape) forming two flow paths. Each flow is a rectangular flow path of excellent heat transfer efficiency, and the ends are sealed by welding.
For each fluid, individual flow paths are provided, and choking is difficult to occur in the flow path, and compared to shell & tube heat exchangers, fouling is several magnitudes lower, and highly efficient heat exchange is achieved.
Spiral Type Heat Exchangers are classified into three types, namely KSH-1 type, KSH-2 type, and KSH-3 type.

2.1 **KSH-1 Type (spiral flow –spiral flow)**

The representative form of Spiral Type Heat Exchanger KSH-1 type is shown in Fig. 1 and Fig. 2.
Usually, the high temperature fluid enters at the center section, and reaches the periphery by traveling spirally along the flow pass, and flows out of the heat exchanger. On the other hand, the low temperature fluid enters at the periphery, at where the hot fluid flows out, and flows by traveling spirally in a reverse of the hot side while getting heated, and flows out at the center. This pattern is a complete counter current that utilizes the temperature gradient, which is the driving force for heat transfer, most efficiently.
Generally, a alternate edge seals are adopted as seals for both fluids as shown in Fig. 1 and Fig. 2, it is possible to inspect each flow path by removing the both side covers.
Regarding the method of fitting the main body and the cover, there is the “Stud Bolt Type” as shown in Fig. 3, and “Hook Bolt Type” as shown in Fig. 4. The “Stud Bolt Type” is the usual flange fixing type. In contrast to this, in the “Hook Bolt Type”, the fixing and removal of bolts and nuts can be done very easily.
Usually, KSH-1 Type is used for liquid-liquid heat exchange, it is also possible to be used for gas-gas, and gas-liquid (condenser, vaporizer, gas cooling, gas heating) exchange depending on a use conditions such as flow rate etc.
Regarding the method of fitting the main body and the frame, there is the “Fixed Type” shown in Fig. 5, and “Rotary Type” shown in Fig. 6.
In the “Rotary Type”, in terms of maintenance and safety, the main body can be rotated by removing connecting piping.

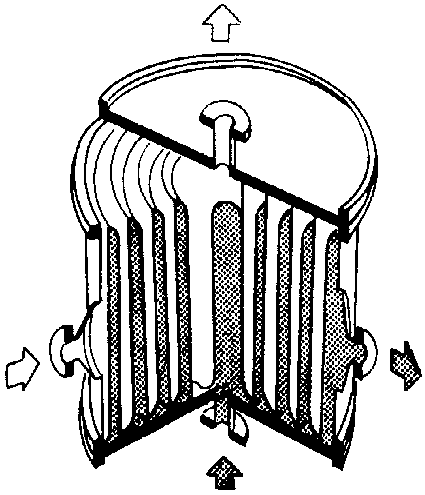

Fig. 1 KSH-1V type

This is the usual type in which the axis of the heat transfer section is vertical, and the fluid discharge is easy.

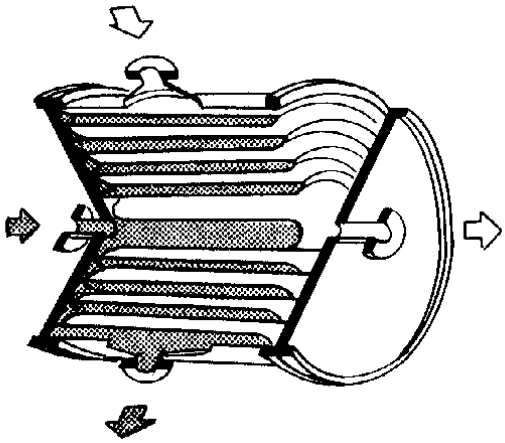

Fig. 2 KSH-1H type

The axis of the heat transfer section is horizontal and can be employed for fluids of severe fouling or for slurries having solids content.

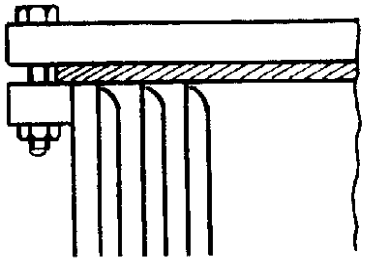

Fig. 3 Stud Bolt Type

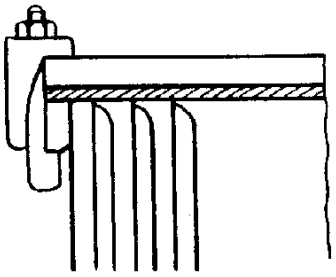

Fig. 4 Hook Bolt Type

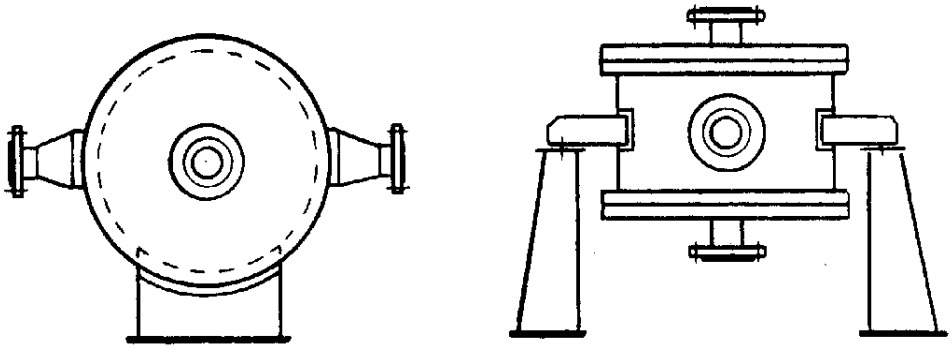

Fig. 5 Fixed Type

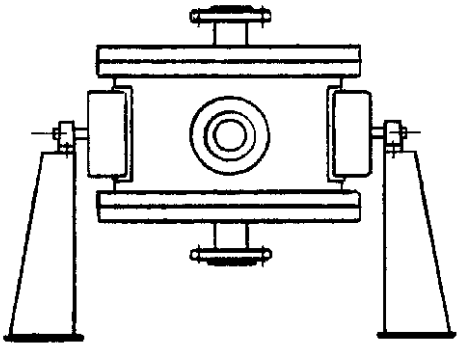

Fig. 6 Rotary Type

2.2

KSH-2 type (spiral flow/axial direction flow)

With KSH-2 type, either the hot or the low temperature fluid flows spirally along the flow pass of the heat transfer while the other fluid flows in the axial direction. The cross sectional area of the axial flow path is much large than the spiral flow path, and can be employed for heat exchange of vapor-liquid or gas-liquid where the fluctuations in volume flow rate are large or for fluids of high viscosity.

Fig. 7 shows the example of flowing vapor to hot fluid and liquid to low temperature fluid. The vapor enters from the top, and flows via the heat transfer section in the axial direction and condenses. The condensed liquid is discharged from the bottom, and the inert gas or un-condensed vapor is discharged from the bottom barrel. On the other hand, the liquid of the low temperature fluid enters from the periphery of the heat transfer section, flows spirally to the center, and exits from the top.

If the fluid does not change the phase, for example “gas-liquid” or “liquid-liquid”, the outlet and inlet on high temperature side and low temperature side are decided taking into consideration the variation in the density or viscosity due to fluid temperature change.

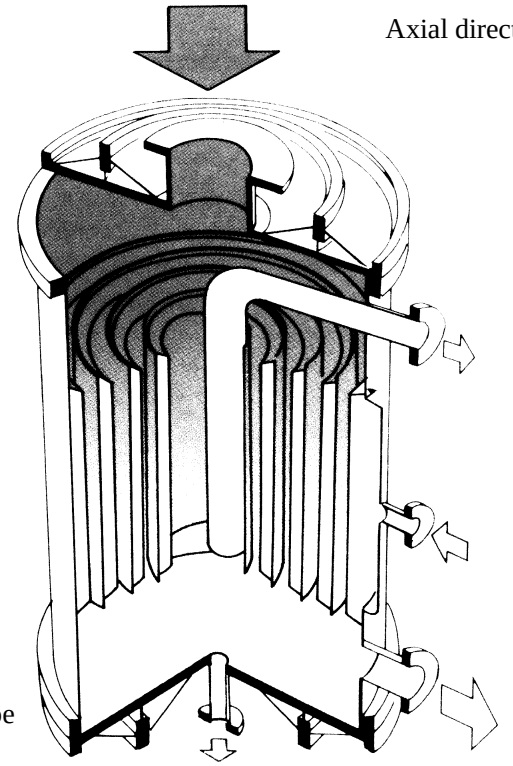

Fig. 7 KSH-2 type

2.3

KSH-3 type (spiral flow/axial flow+spiral flow)

KSH-3 type is mainly used as a condenser for vapors containing inert gas.
The vapor entering from the top flows in the axial direction through the middle section, and condenses. The residual vapor containing inert gas flows through the sealed periphery spirally flow pass, and is thoroughly cooled.
The condensed liquid is discharged from bottom, and a small residual uncondensed vapor which contain a inert gas are discharged out of the device from the periphery of the heat transfer section.
On the other hand, the liquid of the low temperature fluid enters from the periphery of the heat transfer section, flows to the center spirally in a direction opposite to that of high temperature, and flows out from the top.
The Spiral Type Heat Exchanger of type KSH-3 has the combined advantages of having a large flow path cross sectional area at the vapor inlet which is a feature in type KSH-2, along with achieving a high heat transfer efficiency and large temperature gradient by spiral flow at the periphery which is a feature in type KSH-1.
Due to these features, it can be used as a condenser for large volumes as well as for difficult-to-condense vapors containing inert gas.

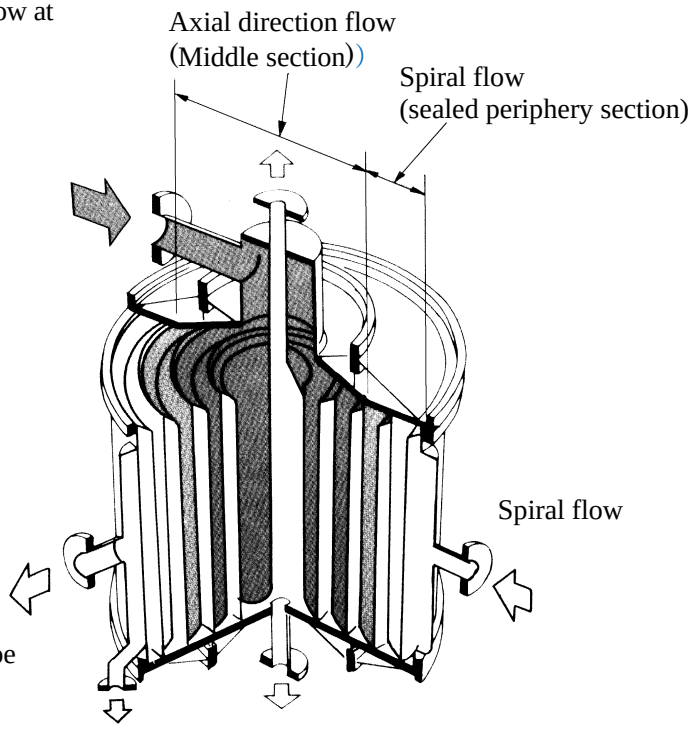

Fig. 8 KSH-3 type

3. **Installation**

(1) Do not lift the heat exchanger with the lifting lug provided on the cover. Otherwise, it is extremely dangerous since Spiral Type Heat Exchanger may fall. Please lift using the main body lifting lug or fitting directly using wire rope.
(2) In the installation of the rotary Spiral Type Heat Exchanger, securely support the heat exchanger to avoid accidents due to rotation. The fitting section for the supplied pillow block is in the form of a long hole. Confirm the passing tool of rotation-preventing bolt provided on the frame leg or the short leg and fix the pillow block.
(3) Ensure that the set bolts or anchor bolts are not loose.
(4) Confirm a level degree of the Spiral Type Heat Exchanger.

4. **Piping**

(1) Carry out piping work on high temperature side and low temperature side as per the labels provided to various nozzles of the Spiral Type Heat Exchanger.
(2) Ensure that there is no excess load (static as well as dynamic) from piping to Spiral Type Heat Exchanger due to vibration or thermal expansion.
(3) Ensure that the fluid flowing through the Spiral Type Heat Exchanger is free from foreign matter (wastepaper, sand, mud, plastic, etc.).
If there is any possibility of the foreign matter contamination in the liquid, please install a strainer.
(4) During piping work, please do not apply external force to nozzles.
(5) As there is danger of heat burn or cold bite if the liquid temperature is high or very low, after piping work, carry out heat insulation or cold insulation jobs before operation.

Recommended items

(1) Install thermometers and pressure gages on the nearby piping of all fluid outlets and inlets.
(2) Install flow meters for various fluids in the nearby pipings.
(3) Install air vents and drain vents in nearby pipings.

5. **Operation**

Do not use exceeding the design temperature and design pressure. Otherwise, it is extremely dangerous since the body may rupture and the fluid may spew out.
As the Spiral Type Heat Exchanger is designed and manufactured mainly based on the intensity of static internal pressure assuming the frequency of repetitive load during use period to be low, please operate ensuring that repetitive dynamic load is not applied onto this equipment.

(1) Carry out leak test of the entire equipment including piping before operation.
(2) Before starting the operation, ensure that the bolts and nuts are in tightened condition. They may have become loose during transport and piping work.
(3) To prevent thermal shock during operation startup, please circulate the liquid in the vicinity side of room temperature.
(4) To prevent rapid or frequent pressure fluctuations in the equipment, the opening and closing of the outlet and inlet valves must be done gently.
(5) If the temperature of the liquid exceeds the boiling point, please operate such that the sudden boiling will not happen within the heat exchanger.
(6) Before starting the operation, flush the pipings to remove any foreign matter in the pipings.
(7) During startup of operation, ensure that the drain valve is closed.
(8) During startup of operation, after ensuring that the air vent valve is open, flow in the fluid.
After the inflow, and after ensuring absence of air accumulation in the flow path, close the air vent valve.
If air inflow is possible during operation, ensure thorough venting with the air vent valve.

6. **Maintenance and Safety**

6.1 **Washing**

In case of occurrence of scale and subsequent washing, adopt the following procedure.

(1) Water wash
Water with pressure below the design pressure is flowed at a stretch.

(2) Chemical wash
Sample the scale, and taking into consideration the washability and the nature of the Spiral Type Heat Exchanger material, the washing reagent, its concentration, wash duration and temperature are determined, and cyclic wash is carried out. After washing, immediately neutralize and wash with water.

6.2 **Stop**

(1) In case of fluid leak though flange during operation, reduce the fluid pressure, tighten the bolts and nuts.
If the leak does not stop, replace the gasket.

(2) Take care and check constantly, including during operation, to ensure there is no damage to the Spiral Type Heat Exchanger due to such as corrosion etc.

(3) If the operation is stopped for prolonged periods, wash with water and dry, and preserve to prevent corrosion or scaling due to concentration.

(4) If the operation is stopped for prolonged periods, pay attention particularly to corrosion of the gasket surface.

7. **Dismantling and Assembling**

The internal parts of the Spiral Type Heat Exchanger including the heat transfer surface can be inspected by removing the cover.

(1) During dismantling and assembling works of the rotary Spiral Type Heat Exchanger, securely support the heat exchanger to avoid accidents due to rotation.

(2) In case of fluids that are toxic, corrosive or flammable, please ensure complete removal of the residual liquid prior to dismantling and assembling.

(3) In dismantling and assembling, do not drop the cover or bolt and nuts of the Spiral Type Heat Exchanger.

(4) When dismantling the cover, take care not to damage the gasket faces.

(5) If the cover is assembled by “Hook Bolt System”, align the hook bolt with the matching mark “→” on the cover, and tighten.

(6) After dismantling, please replace with new gasket during assembling work of the cover.
Otherwise, there may be possibility of leak.

(7) Before dismantling and assembling jobs, in case of extended use periods, there may be occurrence of seizure of cover-use bolts and nuts. Please keep about 10% of all bolts and nuts in reserve.

8. Pressure and airtight test

8.1 Pressure (hydraulic pressure) test

The pressure (hydraulic pressure) test is carried out to check for external leak after dismantling and assembling of the Spiral Type Heat Exchanger. Carry out the pressure (hydraulic pressure) test as per the following guidelines.

(1) As shown in right Fig. 9, fix closed flange and pressure gage to each flow path.

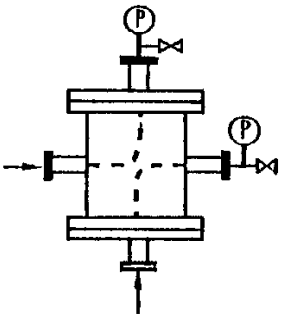

Fig. 9

8.2 Airtight (penumatic) test

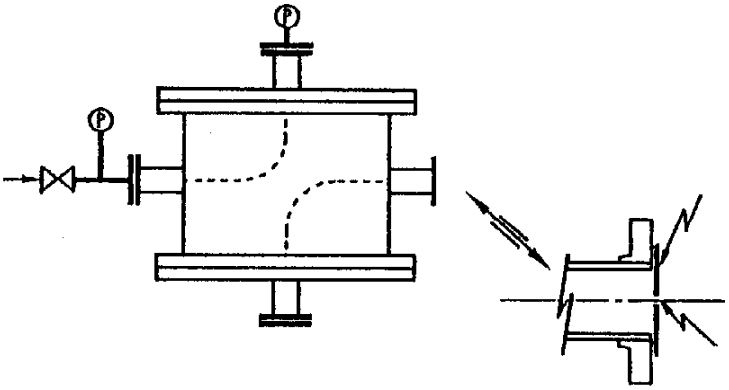

Fig. 10

The airtight (penumatic) test is carried out for examining the internal leak due to damage of heat transfer plate.
Carry out the airtight (penumatic) test as per the following guidelines.

(1) As shown in following Fig. 10, fix pressure gage inside the flow path on one side.
(2) Gradually inlet the air up to the inspection pressure.
(3) On the other inlet of the flow path, fix closed flange, paste adhesive tape etc. at the outlet, open a small hole at the centre, and form a film in that hole with soap water.
If this film does not expand, there is no internal leak.
The heat transfer plate has the shape like that of the spiral-shaped Bourdon-tube, and when pressurized, slightly expands with pressure.
Therefore, allow to stand for more than 30 minutes after pressure rise to confirm the internal leak, and then perform the check.

Warning

(1) Do not carry out pressure and airtight test exceeding the pressure mentioned in the TEST PRESSURE on the assembly drawing or name plate of the Spiral Type Heat Exchanger. Otherwise, it is extremely dangerous since the heat transfer plate may deform and get damaged.

(2) Do not open the both side covers when carrying out pressure and airtight test.
With Spiral Heat Exchangers of alternate edge seal (KSH-1 type, and KSH-3 type), the heat transfer plate may be badly deformed and damaged which may be very dangerous.

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