Alfa Laval

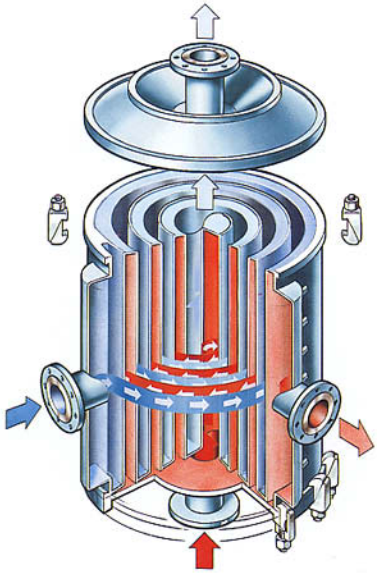
Alfa Laval Thermal

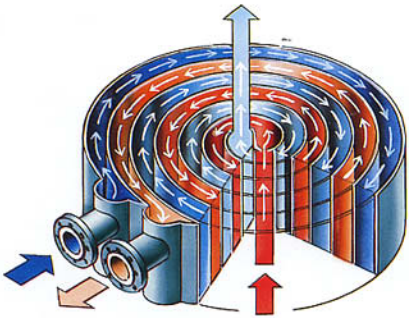
Spiral Heat Exchangers

The spiral heat exchanger

The spiral heat exchanger approaches the ideal in heat transfer equipment. The single channel passage for each side virtually eliminates distribution problems and diminishes fouling tendencies. The curving channel induces turbulence which increases efficiency and keeps solids in suspension. True countercurrent flow permits close temperature approaches and temperature crosses. Radiation losses are negligible. The compact spiral heat exchanger, (SHE) requires less installation and servicing space than conventional heat exchangers of equivalent surface. Essentially, the unit consists of an assembly of two long strips of plate wrapped to form a pair of concentric spiral passages. Alternate edges of the passages are closed so that media flow through continuous, leakproof channels. Covers are fitted for each side of the spiral assembly to enclose the unit.

Alfa Laval is the world's largest supplier of spiral heat exchangers, furnishing thousands of installations worldwide in a variety of services. Sizes range from 5 to 3500 sq. ft. with design pressures up to 400 PSI. The spiral heat exchanger is particularly effective in handling sludges, slurries, and a wide range of fouling and viscous fluids. There are also numerous installations where cleanliness, temperature crosses and sterility are prime requirements.





Operation of the spiral heat exchanger

The hot fluid enters at the center of the unit and flows from the inside outward. The cold fluids enter at the periphery and flows towards the center. Thus, true countercurrent flow is achieved.

Spiral flow both sides

Type I
The Type I spiral has media in full countercurrent flow and may be mounted horizontally or vertically. With a horizontal mounting arrangement the turbulent action of the fluid maintains any solids in suspension. During stand-by, any solids settling that occurs will be at the lowest point of each spiral turn. Upon resumption of normal flow, the restriction formed by the deposited solids causes a proportionate increase in velocity which tends to scrub away the solids and sweep them out of the exchanger.

When one medium is a vapor, the unit is mounted vertically and provided with an additional outlet for condensate removal. For fluids that are toxic or difficult to gasket, such as Dowtherms, the passage for such a medium may be welded shut on both sides. The opposite channel may be accessed by either one or both covers, depending upon preference.

Usage
Liquid-to-liquid, slurries, condensers and gas coolers.

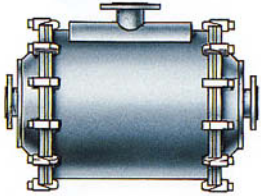
Advantages of the spiral heat exchanger

High Turbulence
At a velocity that would be marginal and approaching laminar flow in straight tubes, good turbulence is obtained in the spiral heat exchanger owing to secondary flow effects caused by the continuously curving channel. Heavily solid laden fluids are easily handled at velocities of 3 feet per second.

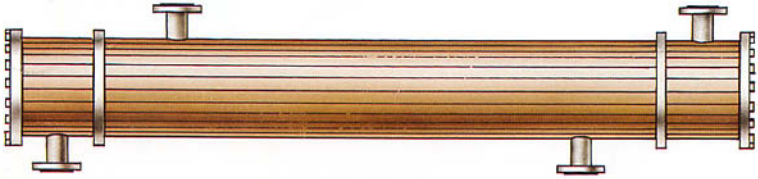
Scrubbing Action
The single flow path spiral heat exchanger tends to flush away scale as it forms. The formation of scale diminishes the cross-section of the passage and thereby increases the velocity and scrubbing effect of the fluid at the exact location affected. The spiral heat exchanger is excellent for use with fluids that tend to sludge or contain solids in suspension.

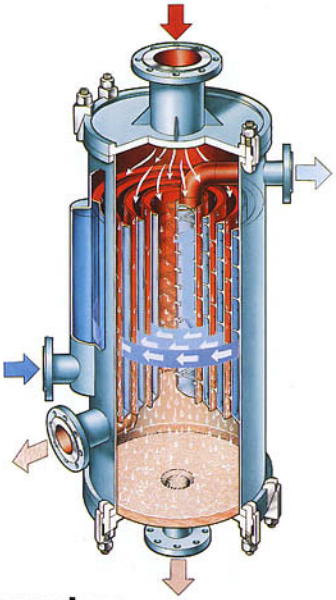
Identical Passage Conformation
Due to its unique geometry, flow characteristics in each passage correspond to flow on the tube side of a conventional heat exchanger allowing the spiral heat exchanger to obtain a higher heat transfer coefficient than conventional heat exchangers. The rectangular cross-section of each passage of the spiral can be dimensioned independently to specifically obtain the desired flow characteristic for each medium.

Easy Access
By removing the covers of the spiral heat exchanger, the entire lengths of the passages are easily accessible for inspection and cleaning. The covers may be hinged to faciliate this. Due to the single passage design and induced turbulance, the spiral can be readily cleaned in place with cleaning solutions without opening the unit.



Small Space Requirements
The wrapped circular arrangement of the heating surfaces in the spiral heat exchanger makes an extremely compact unit; e.g. 2400 sq. ft. of effective surface can be contained in a spiral element 66 inches in diameter by 72 inches long. The only servicing space required is for removal of the covers.





Vaporizer

Type II
The Type II spiral is also a highly effective vaporizer, particularly as a thermosiphon reboiler for distillation processes.

For vaporization duties in a Type II, the liquid feed from the bottom of the distillation column is fed into the lower shell extension. On entering the spiral body in cross-flow the liquid will start to boil, reaching the predetermined vapor fraction at the top of the spiral element. The vapor-liquid mixture is discharged from the connection in the upper shell extension. The heating medium (vapor in liquid) enters the spiral channel via the connection passing through the upper shell extension, flows spirally towards the periphery of the body, and is withdrawn via the outer connection as shown.

The spiral Type II is particularly well suited for reboiling duties at low operating pressures or under vacuum, due to the boiling side channel having a large cross-sectional area with a short flow path. This has two effects:

1. Vapor-phase velocities are maintained at reasonable levels despite the relatively large volumes involved. Friction and momentum pressure drops are minimized.
2. The low height reduces static head loss to a minimum.

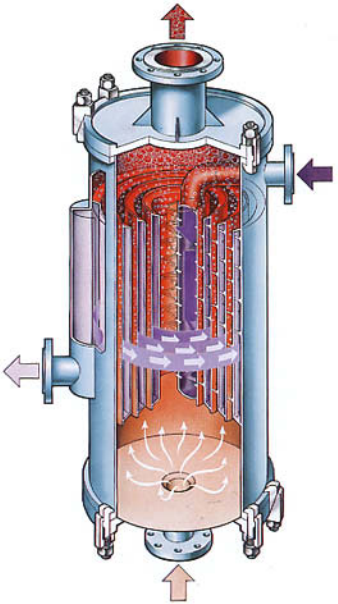
Both these features result in a minimal increase in boiling temperature within the exchanger which is important when vaporizing a liquid at low pressure.

Spiral flow — cross flow

Type II
The Type II spiral has one medium in spiral flow, the other in cross flow parallel to the axis of the spiral element. The passage with the medium in spiral flow is welded on each side and the medium in cross flow passes through the open spiral annulus.

This type is generally used where a very large volume of vapor or vapor/liquid, vapor/gas, mixture is to be handled. This arrangement makes it possible to combine high liquid velocity in the closed spiral channel with very low pressure drop on the vapor mixture side. This type of design is particularly effective for use as low pressure or vacuum condensers. Occasionally this type is furnished for liquid-liquid service where the quantity of one liquid is much greater than the other.

Usage
Condensers, reboilers, gas heaters and coolers.



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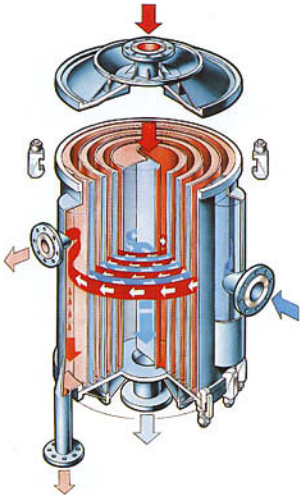


Spiral flow—combination cross & spiral flows

Type III

The Type III spiral is a condenser which combines subcooling of both condensate and non-condensables. The inherent and controllable sub-cooling feature makes it particularly effective for condensing under vacuum.

The coolant enters at the periphery and flows in a spiral path inward to the center where it is discharged at a nozzle at the top of the vapor inlet extension. Removal of the bottom cover exposes the coolant passage for cleaning. The vapor enters the upper distribution extension and is distributed uniformly into the open spiral annulus. This open annulus comprises the condensing zone. Several of the outermost turns are welded closed at the top of the vapor passage. Non-condensables enter this relatively small passage and flow in a spiral path outward and in a pattern fully countercurrent to the coolant. The non-condensable's outlet temperature approaches the coolant inlet temperature.

A separate nozzle is provided for the condensate and for the non-condensables. The nozzles are located at the extreme ends of the peripheral header to minimize entrainment of the condensate.

Usage

Condensers (with built-in after-coolers), vaporizers.

Tower top condenser

Type G

Type G condensers are designed for vertical mounting directly on columns, reactors or kettles thereby eliminating the need for large piping for the vapor.

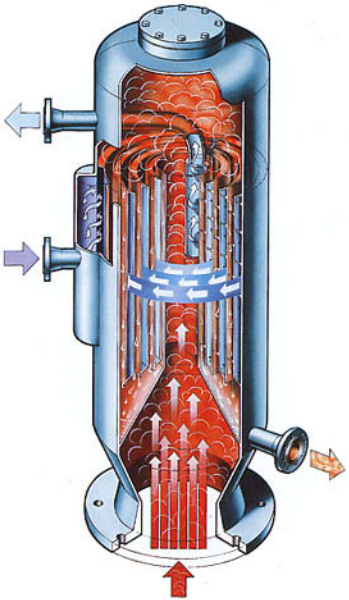
Vapor enters through a central tube in full spiral flow (Type I), cross flow (Type II), or a combination of both (Type III). The cooling medium enters at the periphery, spirals to the center and is discharged at the top.

For minimum subcooling, the vapor flows across the spiral element only, and drops into the condensate chamber. The non-condensables can be subcooled by leading them back into outer turns of the spiral and out through a peripheral nozzle. For substantial subcooling of condensate (and non-condensables) flow from the center tube is in spiral flow as in Type I, or in combination as in Type III.

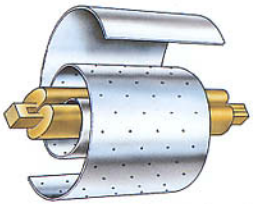
Condensate may be taken directly from the spiral element or collected in a retention chamber under the spiral element.

Usage

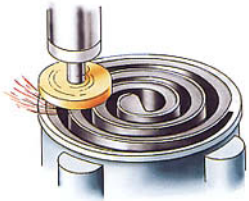
Overhead condensers, vent condensers.



Simplicity of design

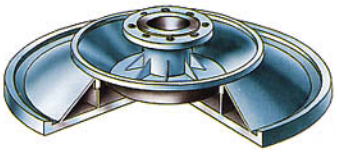


The spiral heat exchanger is a simple design. Using a specially designed machine, spacer studs are flash welded to the upper side of the two strips that comprise the heating surface. These strips are then joined by welding at the center of a retractable mandrel. By rotating the mandrel in a rolling machine, the strips are wrapped to form the basic spiral element.

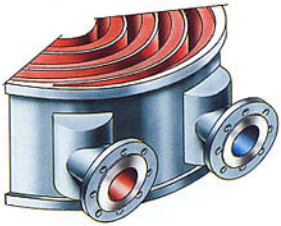


To assure a positive seal, each side of the spiral element as well as the cover surfaces, are machined to a true plane.

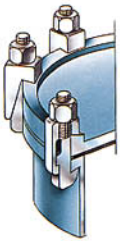
During the rolling process, one edge of each strip is flanged to form the closing or, in some cases, a bar is rolled in at the edges of the strips. When the rolling is completed, the flange or bar is welded to the plates to seal one side of each passage.



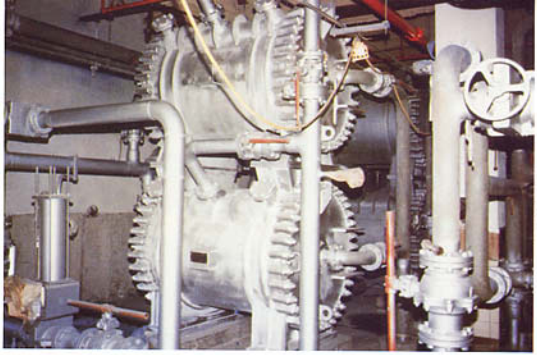
Covers are cut from flat steel and machined true. For large diameter units the covers are a welded assembly, comprising a flat plate with a double cone reinforcement to provide a stiff cover of relatively light weight. Covers may be machined with a very slight conical face so that when bolted in place the cover is prestressed to eliminate deflection when the unit is pressurized. A nozzle is fitted at the center of each cover.



To form a flange for attaching the covers, a bar with a beveled profile is attached to the periphery on each side of the spiral element. A header is welded on the outer end of each passage to accommodate the respective peripheral nozzles.

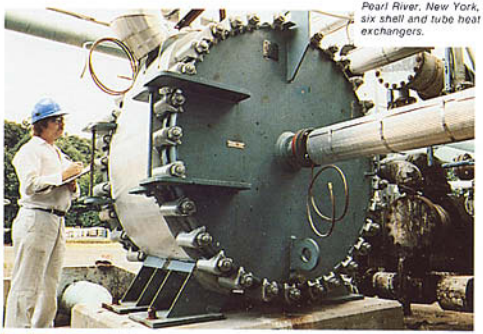


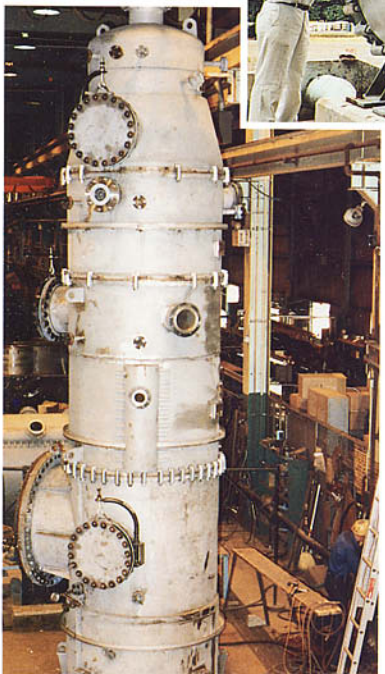
A full-face gasket is compressed between the spiral element and cover. The covers are attached to the spiral by means of forged hook bolts and adapters. Standard gasket material is a non-asbestos fiber gasket, however, gylon, goretex or elastomer gaskets are available.



Four spiral heat exchangers at the Carver-Greenfield sludge dehydration plant at Los Angles, California, recover heat in an oil slurry interchange between evaporative stages.

The spiral heat exchanger installed in a solvent recovery plant at Lederle Laboratories, Pearl River, New York, replaced six shell and tube heat exchangers.

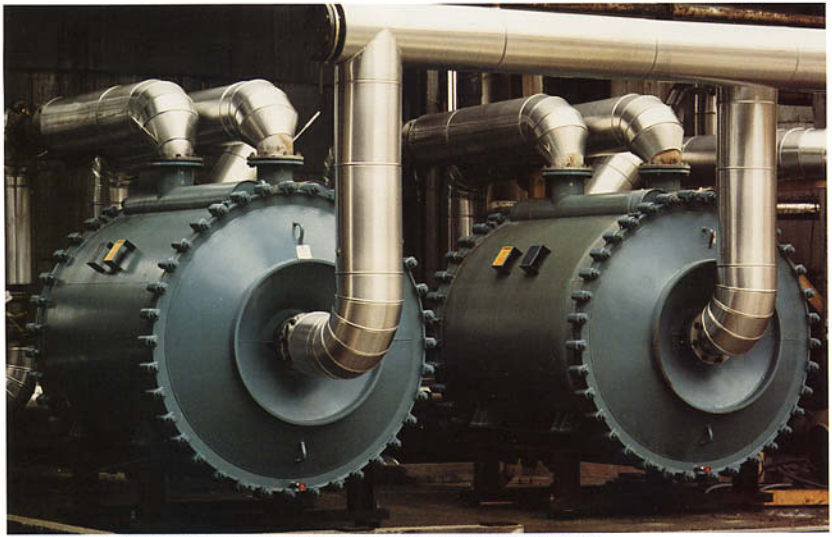




Two spiral heat exchangers cool fibrous raw juice at Amalgamated Sugar in Nyssa, Oregon.

The three stage spiral heat exchanger at Lever Brothers Company, Hammond, Indiana, will perform as an upflow condenser with the condensate being removed between each stage.

Alfa Laval – a worldwide thermal engineering company



Two Type I spiral heat exchangers recover heat from an effluent stream in a paper mill.

Alfa Laval Thermal Inc. is the world's largest supplier of heat transfer equipment with a reputation for excellence in engineering and quality manufacturing. Spiral heat exchangers have been manufactured in Alfa Laval's AHRCO™ facility in Lykens, Pennsylvania plant for over 50 years. Behind our experience the Alfa Laval group has a worldwide organization consisting of 17,000 employees in 70 companies in 30 countries.

A far reaching network of engineers and sales representatives handle the Alfa Laval Thermal Inc. spiral and plate heat exchanger line. This technical support extends worldwide.

Originally designed to handle the highly fouling fluids in the pulp and paper industry, the spiral customer base reaches industries as varied as steel, chemical, pharmaceutical, refineries, laundry and waste water treatment. The spiral can handle applications from coal tar and asphalt to the sterile media of the biotech industry.

The spiral heat exchanger is an excellent alternative for all heat transfer applications.

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