

**CPC****COOPERATIVE PATENT CLASSIFICATION****F28F****DETAILS OF HEAT-EXCHANGE AND HEAT-TRANSFER APPARATUS,  
OF GENERAL APPLICATION** ([water and air traps](#), [air venting F16](#) )**F28F 1/00****Tubular elements; Assemblies of tubular elements** ([specially adapted for movement F28F 5/00](#))

## F28F 1/003

- . { [Multiple wall conduits, e.g. for leak detection](#) ([leak-detection in metal cooled nuclear reactor steam generators F22B 1/066](#)) }

## F28F 1/006

- . {[with variable shape, e.g. with modified tube ends, with different geometrical features](#) ([F28F 1/025](#), [F28F 1/06](#), [F28F 1/08](#), [F28F 9/16](#), [F28F 9/18](#) take precedence) }

## F28F 1/02

- . Tubular elements of cross-section which is non-circular ([F28F 1/08](#), [F28F 1/10](#) take precedence)

## F28F 1/022

- .. {[with multiple channels](#) }

## F28F 1/025

- .. {[with variable shape, e.g. with modified tube ends, with different geometrical features](#) ([F28F 1/06](#), [F28F 1/08](#), [F28F 9/16](#), [F28F 9/18](#) take precedence) }

## F28F 2001/027

- .. with dimples

## F28F 1/04

- .. polygonal, e.g. rectangular { ([F28F 1/022](#) takes precedence) }

## F28F 1/045

- ... {[with assemblies of stacked elements](#) }

## F28F 1/06

- .. crimped or corrugated in cross-section

## F28F 1/08

- . Tubular elements crimped or corrugated in longitudinal section

## F28F 1/10

- . Tubular elements and assemblies thereof with means for increasing heat-transfer area, e.g. with fins, with projections, with recesses ([crimped or corrugated elements F28F 1/06](#), [F28F 1/08](#))

## F28F 1/105

- .. {[the means being corrugated elements extending around the tubular elements](#) }

## F28F 1/12

- .. the means being only outside the tubular element

## F28F 1/122

- ... {[and being formed of wires](#) }

## F28F 1/124

- ... {[and being formed of pins](#) }

## F28F 1/126

- ... {[consisting of zig-zag shaped fins](#) ([F28F 1/105](#) takes precedence) }

## F28F 1/128

- .... {[Fins with openings, e.g. louvered fins](#) }

## F28F 1/14

- ... and extending longitudinally ([F28F 1/38](#) takes precedence)

## F28F 1/16

- .... the means being integral with the element, e.g. formed by extrusion ([F28F 1/22](#) takes precedence)

## F28F 1/18

- ..... the element being built-up from finned sections

## F28F 1/20

- .... the means being attachable to the element ([F28F 1/22](#) takes precedence)

## F28F 1/22

- .... the means having portions engaging further tubular elements

## F28F 1/24

- ... and extending transversely ([F28F 1/38](#) takes precedence)

## F28F 1/26

- .... the means being integral with the element ([F28F 1/32](#) takes precedence)

## F28F 1/28

- ..... the element being built-up from finned sections

## F28F 1/30

- .... the means being attachable to the element ([F28F 1/32](#) takes precedence)

- F28F 1/32 . . . . the means having portions engaging further tubular elements
- F28F 1/325 . . . . . {Fins with openings }
- F28F 1/34 . . . and extending obliquely ([F28F 1/38 takes precedence](#))
- F28F 1/36 . . . . the means being helically wound fins or wire spirals
- F28F 1/38 . . . and being staggered to form tortuous fluid passages
- F28F 1/40 . . the means being only inside the tubular element
- F28F 1/405 . . . {and being formed of wires }
- F28F 1/42 . . the means being both outside and inside the tubular element
- F28F 1/422 . . . { with outside means integral with the tubular element and inside means integral with the tubular element ([F28F 1/424 takes precedence](#)) }
- F28F 1/424 . . . { Means comprising outside portions integral with inside portions }
- F28F 1/426 . . . . { the outside portions and the inside portions forming parts of complementary shape, e.g. concave and convex }
- F28F 2001/428 . . . Particular methods for manufacturing outside or inside fins
- F28F 1/44 . . . and being formed of wire mesh

**F28F 3/00** **Plate-like or laminated elements; Assemblies of plate-like or laminated elements**  
(specially adapted for movement [F28F 5/00](#))

- F28F 3/005 . {Arrangements for preventing direct contact between different heat-exchange media ([F28F 3/10 takes precedence](#)) }
- F28F 3/02 . Elements or assemblies thereof with means for increasing heat-transfer area, e.g. with fins, with recesses, with corrugations ([F28F 3/08](#) {[F28F 3/08D](#) } takes precedence)
- F28F 3/022 . . {the means being wires or pins }
- F28F 3/025 . . {the means being corrugated, plate-like elements }
- F28F 3/027 . . . {with openings, e.g. louvered corrugated fins; Assemblies of corrugated strips }
- F28F 3/04 . . the means being integral with the element
- F28F 3/042 . . . { in the form of local deformations of the element }
- F28F 3/044 . . . . { the deformations being pontual, e.g. dimples }
- F28F 3/046 . . . . { the deformations being linear, e.g. corrugations }
- F28F 3/048 . . . { in the form of ribs integral with the element or local variations in thickness of the element, e.g. grooves, microchannels }
- F28F 3/06 . . the means being attachable to the element
- F28F 3/08 . Elements constructed for building-up into stacks, e.g. capable of being taken apart for cleaning
- F28F 3/083 . . {capable of being taken apart }
- F28F 3/086 . . {having one or more openings therein forming tubular heat-exchange passages }
- F28F 3/10 . . Arrangements for sealing the margins
- F28F 3/12 . Elements constructed in the shape of a hollow panel, e.g. with channels { ([F28D 1/02](#), [F28D 1/03 take precedence](#)) }
- F28F 3/14 . . by separating portions of a pair of joined sheets to form channels, e.g. by inflation ([manufacture thereof B23P](#) )

**F28F 5/00** **Elements specially adapted for movement** ([arrangements for moving the elements](#),

see the appropriate subclass for the apparatus concerned)

F28F 5/02 . Rotary drums or rollers

F28F 5/04 . Hollow impellers, e.g. stirring vane

F28F 5/06 . Hollow screw conveyers

**F28F 7/00 Elements not covered by group [F28F 1/00](#), [F28F 3/00](#) or [F28F 5/00](#)**

F28F 7/02 . Blocks traversed by passages for heat-exchange media { ([F28D 7/0008](#) takes precedence) }

**F28F 9/00 Casings; Header boxes; Auxiliary supports for elements; Auxiliary members within casings**

F28F 9/001 . { Casings in the form of plate-like arrangements; Frames enclosing a heat exchange core }

F28F 9/002 .. {with fastening means for other structures }

F28F 2009/004 .. Common frame elements for multiple cores

F28F 9/005 . { Other auxiliary members within casings, e.g. internal filling means or sealing means }

F28F 9/007 . Auxiliary supports for elements

F28F 9/0075 .. {Supports for plates or plate assemblies }

F28F 9/013 .. for tubes or tube-assemblies

F28F 9/0131 ... { formed by plates ([F28F 9/0138](#) takes precedence) }

F28F 9/0132 ... {formed by slats, tie-rods, articulated or expandable rods }

F28F 9/0133 ... {formed by concentric strips }

F28F 9/0135 ... {formed by grids having only one tube per closed grid opening ([F28F 9/0132](#) and [F28F 9/0133](#) take precedence) }

F28F 9/0136 .... {formed by intersecting strips }

F28F 9/0137 ... {formed by wires, e.g. helically coiled ([F28F 9/0135](#) takes precedence) }

F28F 9/0138 ... { formed by sleeves for finned tubes }

F28F 9/02 . Header boxes; End plates

F28F 9/0202 .. {Header boxes having their inner space divided by partitions }

F28F 9/0204 ... {for elongated header box, e.g. with transversal and longitudinal partitions }

F28F 9/0207 .... { the longitudinal or transversal partitions being separate elements attached to header boxes ([F28F 9/0212](#), [F28F 9/0217](#) take precedence) }

F28F 9/0209 .... {having only transversal partitions }

F28F 9/0212 ..... {the partitions being separate elements attached to header boxes }

F28F 9/0214 .... {having only longitudinal partitions }

F28F 9/0217 ..... {the partitions being separate elements attached to header boxes }

F28F 9/0219 .. {Arrangements for sealing end plates into casing or header box; Header box

		sub-elements ( <a href="#">F28F 9/0236</a> takes precedence) }
<a href="#">F28F 9/0221</a>	...	{Header boxes or end plates formed by stacked elements }
<a href="#">F28F 9/0224</a>	...	{Header boxes formed by sealing end plates into covers ( <a href="#">F28F 9/0221</a> takes precedence) }
<a href="#">F28F 9/0226</a>	....	{with resilient gaskets }
<a href="#">F28F 9/0229</a>	..	{Double end plates; Single end plates with hollow spaces }
<a href="#">F28F 9/0231</a>	..	{Header boxes having an expansion chamber }
<a href="#">F28F 9/0234</a>	..	{having a second heat exchanger disposed there within, e.g. oil cooler }
<a href="#">F28F 9/0236</a>	..	{floating elements }
<a href="#">F28F 9/0239</a>	...	{floating header boxes }
<a href="#">F28F 9/0241</a>	...	{floating end plates }
<a href="#">F28F 9/0243</a>	..	{Header boxes having a circular cross-section }
<a href="#">F28F 9/0246</a>	..	{ Arrangements for connecting header boxes with flow lines }
<a href="#">F28F 9/0248</a>	...	{ Arrangements for sealing connectors to header boxes }
<a href="#">F28F 9/0251</a>	...	{ Massive connectors, e.g. blocks; Plate-like connectors }
<a href="#">F28F 9/0253</a>	....	{ with multiple channels, e.g. with combined inflow and outflow channels }
<a href="#">F28F 9/0256</a>	...	{ Arrangements for coupling connectors with flow lines }
<a href="#">F28F 9/0258</a>	....	{ of quick acting type, e.g. with snap action }
<a href="#">F28F 9/026</a>	..	{ with static flow control means, e.g. with means for uniformly distributing heat exchange media into conduits }
<a href="#">F28F 9/0263</a>	...	{ by varying the geometry or cross-section of header box }
<a href="#">F28F 9/0265</a>	...	{ by using guiding means or impingement means inside the header box }
<a href="#">F28F 9/0268</a>	....	{ in the form of multiple deflectors for channeling the heat exchange medium }
<a href="#">F28F 9/027</a>	...	{ in the form of distribution pipes }
<a href="#">F28F 9/0273</a>	....	{ with multiple holes }
<a href="#">F28F 9/0275</a>	....	{ with multiple branch pipes }
<a href="#">F28F 9/0278</a>	...	{ in the form of stacked distribution plates or perforated plates arranged over end plates }
<a href="#">F28F 9/028</a>	...	{ by using inserts for modifying the pattern of flow inside the header box, e.g. by using flow restrictors or permeable bodies or blocks with channels }
<a href="#">F28F 9/0282</a>	...	{ by varying the geometry of conduit ends, e.g. by using inserts or attachments for modifying the pattern of flow at the conduit inlet or outlet }
<a href="#">F28F 2009/0285</a>	..	Other particular headers or end plates
<a href="#">F28F 2009/0287</a>	...	having passages for different heat exchange media
<a href="#">F28F 2009/029</a>	...	with increasing or decreasing cross-section, e.g. having conical shape
<a href="#">F28F 2009/0292</a>	...	with fins
<a href="#">F28F 2009/0295</a>	...	comprising cooling circuits
<a href="#">F28F 2009/0297</a>	...	Side headers, e.g. for radiators having conduits laterally connected to common header
<a href="#">F28F 9/04</a>	..	Arrangements for sealing elements into header boxes or end plates { arrangements for sealing flow lines connectors to header boxes <a href="#">F28F 9/0248</a> }
<a href="#">F28F 9/06</a>	...	by dismountable joints
<a href="#">F28F 9/08</a>	....	by wedge-type connections, e.g. taper ferrule

- F28F 9/10 . . . . by screw-type connections, e.g. gland
- F28F 9/12 . . . . by flange-type connections
- F28F 9/14 . . . . by force-joining
- F28F 9/16 . . . by permanent joints, e.g. by rolling ([metal-working procedures in general B21](#) , [B32](#) ; particularly [B21D 39/06](#), [B23K](#) )
- F28F 9/162 . . . . {by using bonding or sealing substances, e.g. adhesives ([F28F 9/18](#) takes precedence) }
- F28F 9/165 . . . . {by using additional preformed parts, e.g. sleeves, gaskets ([F28F 9/185](#) takes precedence) }
- F28F 9/167 . . . . . {the parts being inserted in the heat-exchange conduits }
- F28F 9/18 . . . . by welding
- F28F 9/182 . . . . . {the heat-exchange conduits having ends with a particular shape, e.g. deformed; the heat-exchange conduits or end plates having supplementary joining means, e.g. abutments }
- F28F 9/185 . . . . . {with additional preformed parts }
- F28F 9/187 . . . . . {at least one of the parts being non-metallic, e.g. heat-sealing plastic elements }
  
- F28F 9/20 . Arrangements of heat reflectors, e.g. separately-insertible reflecting walls
  
- F28F 9/22 . Arrangements for directing heat-exchange media into successive compartments, e.g. arrangements of guide plates
  
- F28F 2009/222 . . Particular guide plates, baffles or deflectors, e.g. having particular orientation relative to an elongated casing or conduit
- F28F 2009/224 . . . Longitudinal partitions
- F28F 2009/226 . . . Transversal partitions
- F28F 2009/228 . . . Oblique partitions
  
- F28F 9/24 . Arrangements for promoting turbulent flow of heat-exchange media, e.g. by plates ([F28F 1/38](#) takes precedence; in general [F15D](#) )
  
- F28F 9/26 . Arrangements for connecting different sections of heat-exchange elements, e.g. of radiators ([connecting different sections in water heaters F24H 9/14](#), {[connecting headers with inlet or outlet fittings F28F 9/04B](#) })
- F28F 9/262 . . { for radiators ([F28D 1/0408](#) takes precedence) }
- F28F 9/264 . . . {by sleeves, nipples }
- F28F 9/266 . . . {by screw-type connections }
- F28F 9/268 . . . {by permanent joints, e.g. by welding }
  
- F28F 11/00** **Arrangements for sealing leaky tubes and conduits** ([stopping flow from or in pipes in general F16L 55/10](#))
  
- F28F 11/02 . using obturating elements, e.g. washers, inserted and operated independently of each other ([F28F 11/06](#) takes precedence)
  
- F28F 11/04 . using pairs of obturating elements, e.g. washers, mounted upon central operating rods ([F28F 11/06](#) takes precedence)
  
- F28F 11/06 . using automatic tube obturating appliances

<b>F28F 13/00</b>	<b>Arrangements for modifying heat-transfer, e.g. increasing, decreasing (<a href="#">F28F 1/00</a> to <a href="#">F28F 11/00</a> take precedence)</b>
<a href="#">F28F 2013/001</a>	. Particular heat conductive materials, e.g. superconductive elements ( <a href="#">for thermal joints F28F 2013/006</a> )
<a href="#">F28F 13/003</a>	. { <a href="#">by using permeable mass, perforated or porous materials (F28F 13/18 takes precedence)</a> }
<a href="#">F28F 2013/005</a>	. Thermal joints
<a href="#">F28F 2013/006</a>	. . Heat conductive materials
<a href="#">F28F 2013/008</a>	. . Variable conductance materials; Thermal switches
<a href="#">F28F 13/02</a>	. by influencing fluid boundary ( <a href="#">boundary-layer control in general F15D</a> )
<a href="#">F28F 13/04</a>	. by preventing the formation of continuous films of condensate on heat-exchange surfaces, e.g. by promoting droplet formation { <a href="#">F28F 13/18 takes precedence</a> }
<a href="#">F28F 13/06</a>	. by affecting the pattern of flow of the heat-exchange media { ( <a href="#">F28F 13/003 takes precedence</a> ; <a href="#">static flow control means in header boxes F28F 9/026</a> ) }
<a href="#">F28F 13/08</a>	. . by varying the cross-section of the flow channels
<a href="#">F28F 13/10</a>	. . by imparting a pulsating motion to the flow, e.g. by sonic vibration
<a href="#">F28F 13/12</a>	. . by creating turbulence, e.g. by stirring, by increasing the force of circulation ( <a href="#">F28F 13/08 takes precedence</a> )
<a href="#">F28F 13/125</a>	. . . { <a href="#">by stirring</a> }
<a href="#">F28F 13/14</a>	. by endowing the walls of conduits with zones of different degrees of conduction of heat
<a href="#">F28F 13/16</a>	. by applying an electrostatic field to the body of the heat-exchange medium
<a href="#">F28F 13/18</a>	. by applying coatings, e.g. radiation-absorbing, radiation-reflecting; by surface treatment, e.g. polishing
<a href="#">F28F 13/182</a>	. . { <a href="#">especially adapted for evaporator or condenser surfaces (F28F 13/187 takes precedence)</a> }
<a href="#">F28F 13/185</a>	. . { <a href="#">Heat-exchange surfaces provided with microstructures or with porous coatings</a> }
<a href="#">F28F 13/187</a>	. . . { <a href="#">especially adapted for evaporator surfaces or condenser surfaces, e.g. with nucleation sites</a> }
<b>F28F 17/00</b>	<b>Removing ice or water from heat-exchange apparatus</b>
<a href="#">F28F 17/005</a>	. { <a href="#">Means for draining condensates from heat exchangers, e.g. from evaporators (F28B 9/08 takes precedence)</a> }
<b>F28F 19/00</b>	<b>Preventing the formation of deposits or corrosion, e.g. by using filters {or scrapers }</b>
<a href="#">F28F 19/002</a>	. { <a href="#">by using inserts or attachments</a> }
<a href="#">F28F 19/004</a>	. { <a href="#">by using protective electric currents, voltages, cathodes, anodes, electric</a>

short-circuits }

- F28F 19/006 . {Preventing deposits of ice }
- F28F 19/008 . {by using scrapers }
- F28F 19/01 . by using means for separating solid materials from heat-exchange fluids, e.g. filters
- F28F 19/02 . by using coatings, e.g. vitreous or enamel coatings
- F28F 19/04 . . of rubber; of plastics material; of varnish
- F28F 19/06 . . of metal

**F28F 21/00** **Constructions of heat-exchange apparatus characterised by the selection of particular materials** { (coatings for modifying heat-transfer [F28F 13/18](#); coatings for preventing the formation of deposits or corrosion [F28F 19/02](#)) }

- F28F 21/003 . {for domestic or space-heating systems }
- F28F 21/006 . {of glass }
- F28F 21/02 . of carbon, e.g. graphite
- F28F 21/04 . of ceramic; of concrete; of natural stone
- F28F 21/045 . . {for domestic or space-heating systems }
- F28F 21/06 . of plastics material
- F28F 21/061 . . {for domestic or space-heating systems }
- F28F 21/062 . . {the heat-exchange apparatus employing tubular conduits }
- F28F 21/063 . . . {for domestic or space-heating systems }
- F28F 21/065 . . {the heat-exchange apparatus employing plate-like or laminated conduits }
- F28F 21/066 . . . {for domestic or space-heating systems }
- F28F 21/067 . . {Details }
- F28F 21/068 . . . {for domestic or space-heating systems }
- F28F 21/08 . of metal
- F28F 21/081 . . { Heat exchange elements made from metals or metal alloys }
- F28F 21/082 . . . { from steel or ferrous alloys }
- F28F 21/083 . . . . { from stainless steel }
- F28F 21/084 . . . { from aluminium or aluminium alloys }
- F28F 21/085 . . . { from copper or copper alloys }
- F28F 21/086 . . . { from titanium or titanium alloys }
- F28F 21/087 . . . { from nickel or nickel alloys }
- F28F 21/088 . . {for domestic or space-heating systems }
- F28F 21/089 . . { Coatings, claddings or bonding layers made from metals or metal alloys ([F28F 19/06](#) takes precedence) }

**F28F 23/00** **Features relating to the use of intermediate heat-exchange materials, e.g. selection**



**of compositions** (heat-transfer, heat-exchange or heat-storage materials [C09K 5/00](#))

[F28F 23/02](#)

- . Arrangements for obtaining or maintaining same in a liquid state

**[F28F 25/00](#)**

**Component parts of trickle coolers** (arrangements for increasing heat transfer [F28F 13/00](#); controlling arrangements [F28F 27/00](#))

[F28F 2025/005](#)

- . Liquid collection; Liquid treatment; Liquid recirculation; Addition of make-up liquid

[F28F 25/02](#)

- . for distributing, circulating, and accumulating liquid ([spraying or atomising in general B05B](#) , [B05D](#) )

[F28F 25/04](#)

- . . Distributing or accumulator troughs

[F28F 25/06](#)

- . . Spray nozzles or spray pipes

[F28F 25/08](#)

- . . Splashing boards or grids, e.g. for converting liquid sprays into liquid films; Elements or beds for increasing the area of the contact surface ([packing elements per se B01J 19/30](#), [B01J 19/32](#))

[F28F 25/082](#)

- . . . {Spaced elongated bars, laths; Supports therefor }

[F28F 25/085](#)

- . . . {Substantially horizontal grids; Blocks }

[F28F 25/087](#)

- . . . {Vertical or inclined sheets; Supports or spacers }

[F28F 25/10](#)

- . for feeding gas or vapour

[F28F 25/12](#)

- . . Ducts; Guide vanes, e.g. for carrying currents to distinct zones

**[F28F 27/00](#)**

**Control arrangements or safety devices specially adapted for heat-exchange or heat-transfer apparatus** ([control arrangements in general G05](#) )

[F28F 27/003](#)

- . {specially adapted for cooling towers }

[F28F 27/006](#)

- . {specially adapted for regenerative heat-exchange apparatus }

[F28F 27/02](#)

- . for controlling the distribution of heat-exchange media between different channels ( { [static flow control means in header boxes F28F 9/026](#) }; [arrangements of guide plates or guide vanes F28F 9/22](#), [F28F 25/12](#))

**[F28F 99/00](#)**

**Subject matter not provided for in other groups of this subclass**

**[F28F 2200/00](#)**

**Prediction; Simulation; Testing** ([measuring quantity of heat conveyed by flowing mediums G01K 17/06](#))

[F28F 2200/005](#)

- . Testing heat pipes

**[F28F 2210/00](#)**

**Heat exchange conduits**

[F28F 2210/02](#)

- . with particular branching, e.g. fractal conduit arrangements

[F28F 2210/04](#)

- . Arrangements of conduits common to different heat exchange sections, the conduits having channels for different circuits



- F28F 2210/06 . having walls comprising obliquely extending corrugations, e.g. in the form of threads
- F28F 2210/08 . Assemblies of conduits having different features
- F28F 2210/10 . Particular layout, e.g. for uniform temperature distribution

#### **F28F 2215/00 Fins**

- F28F 2215/02 . Arrangements of fins common to different heat exchange sections, the fins being in contact with different heat exchange media
- F28F 2215/04 . Assemblies of fins having different features, e.g. with different fin densities
- F28F 2215/06 . Hollow fins; fins with internal circuits
- F28F 2215/08 . with openings, e.g. louvers ([zig-zag fins with openings F28F 1/128](#), [common transversal fins with openings F28F 1/325](#), [corrugated fins with openings F28F 3/027](#))
- F28F 2215/10 . Secondary fins, e.g. projections or recesses on main fins
- F28F 2215/12 . with U-shaped slots for laterally inserting conduits
- F28F 2215/14 . in the form of movable or loose fins

#### **F28F 2220/00 Closure means, e.g. end caps on header boxes or plugs on conduits**

#### **F28F 2225/00 Reinforcing means**

- F28F 2225/02 . for casings
- F28F 2225/04 . for conduits
- F28F 2225/06 . for fins
- F28F 2225/08 . for header boxes

#### **F28F 2230/00 Sealing means**

#### **F28F 2235/00 Means for filling gaps between elements, e.g. between conduits within casings**

#### **F28F 2240/00 Spacing means**

#### **F28F 2245/00 Coatings; Surface treatments**

- F28F 2245/02 . hydrophilic
- F28F 2245/04 . hydrophobic

F28F 2245/06 . having particular radiating, reflecting or absorbing features, e.g. for improving heat transfer by radiation

F28F 2245/08 . self-cleaning

**F28F 2250/00 Arrangements for modifying the flow of the heat exchange media (in general [F28F 13/06](#)) , e.g. flow guiding means (in casings [F28F 9/22](#)) ; Particular flow patterns**

F28F 2250/02 . Streamline-shaped elements

F28F 2250/04 . Communication passages between channels

F28F 2250/06 . Derivation channels, e.g. bypass

F28F 2250/08 . Fluid driving means, e.g. pumps, fans

F28F 2250/10 . Particular pattern of flow of the heat exchange media

F28F 2250/102 . . with change of flow direction

F28F 2250/104 . . with parallel flow

F28F 2250/106 . . with cross flow

F28F 2250/108 . . with combined cross flow and parallel flow

**F28F 2255/00 Heat exchanger elements made of materials having special features or resulting from particular manufacturing processes**

F28F 2255/02 . Flexible elements

F28F 2255/04 . comprising shape memory alloys or bimetallic elements

F28F 2255/06 . composite, e.g. polymers with fillers or fibres

F28F 2255/08 . pressed; stamped; deep-drawn

F28F 2255/10 . made by hydroforming

F28F 2255/12 . expanded or perforated metal plate

F28F 2255/14 . molded

F28F 2255/143 . . injection molded

F28F 2255/146 . . overmolded

F28F 2255/16 . extruded

F28F 2255/18 . sintered

F28F 2255/20 . with nanostructures

**F28F 2260/00 Heat exchangers or heat exchange elements having special size, e.g. microstructures (micro heat pipes [F28D 2015/0225](#); nanostructures [F28F 2255/20](#))**

F28F 2260/02 . having microchannels

**F28F 2265/00** **Safety or protection arrangements; Arrangements for preventing malfunction**  
(control or monitoring devices [F28F 27/00](#))

F28F 2265/02 . in the form of screens or covers ([heat shields F28F 2265/10](#))

F28F 2265/06 . by using means for draining heat exchange media from heat exchangers

F28F 2265/10 . for preventing overheating, e.g. heat shields ([thermal insulation F28F 2270/00](#))

F28F 2265/12 . for preventing overpressure

F28F 2265/14 . for preventing damage by freezing, e.g. for accommodating volume expansion

F28F 2265/16 . for preventing leakage

F28F 2265/18 . for removing contaminants, e.g. for degassing

F28F 2265/20 . for preventing development of microorganisms

F28F 2265/22 . for draining

F28F 2265/24 . for electrical insulation

F28F 2265/26 . for allowing differential expansion between elements ([floating header box elements F28F 9/0236](#))

F28F 2265/28 . for preventing noise ([by preventing vibrations F28F 2265/30](#))

F28F 2265/30 . for preventing vibrations

F28F 2265/32 . for limiting movements, e.g. stops, locking means

**F28F 2270/00** **Thermal insulation; Thermal decoupling**

F28F 2270/02 . by using blind conduits

**F28F 2275/00** **Fastening; Joining**

F28F 2275/02 . by using bonding materials ([brazing F28F 2275/04](#)) ; by embedding elements in particular materials

F28F 2275/025 . . by using adhesives

F28F 2275/04 . by brazing ([brazing heat exchangers B23K 1/0012](#))

F28F 2275/045 . . with particular processing steps, e.g. by allowing displacement of parts during brazing or by using a reservoir for storing brazing material

F28F 2275/06 . by welding ([welding heat exchangers L23K 101/14](#))

F28F 2275/061	..	by diffusion bonding
F28F 2275/062	..	by impact pressure or friction welding
F28F 2275/064	..	by induction welding or by using microwaves
F28F 2275/065	..	by ultrasonic or vibration welding
F28F 2275/067	..	by laser welding
F28F 2275/068	..	by explosive welding
F28F 2275/08	.	by clamping or clipping
F28F 2275/085	..	with snap connection
F28F 2275/10	.	by force joining
F28F 2275/12	.	by methods involving deformation of the elements
F28F 2275/122	..	by crimping, caulking or clinching
F28F 2275/125	..	by bringing elements together and expanding
F28F 2275/127	..	by shrinking
F28F 2275/14	.	by using form fitting connection, e.g. with tongue and groove
F28F 2275/143	..	with pin and hole connections
F28F 2275/146	..	with bayonet connections
F28F 2275/16	.	with toothed elements, e.g. with serrations
F28F 2275/18	.	by using wedge effect
F28F 2275/20	.	with threaded elements
F28F 2275/205	..	with of tie-rods
F28F 2275/22	.	by using magnetic effect
<b>F28F 2280/00</b>		<b>Mounting arrangements; Arrangements for facilitating assembling or disassembling of heat exchanger parts</b>
F28F 2280/02	.	Removable elements
F28F 2280/04	.	Means for preventing wrong assembling of parts
F28F 2280/06	.	Adapter frames, e.g. for mounting heat exchanger cores on other structure and for allowing fluidic connections
F28F 2280/08	.	Tolerance compensating means
F28F 2280/10	.	Movable elements, e.g. being pivotable ( <a href="#">elements specially adapted for movements F28F 5/00</a> )
F28F 2280/105	..	with hinged connections