

**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 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
<b>F28F 7/00</b>	<b>Elements not covered by group <a href="#">F28F 1/00</a>, <a href="#">F28F 3/00</a> or <a href="#">F28F 5/00</a></b>
F28F 7/02	. Blocks traversed by passages for heat-exchange media {( <a href="#">F28D 7/0008</a> takes precedence)}
<b>F28F 9/00</b>	<b>Casings; Header boxes; Auxiliary supports for elements; Auxiliary members within casings</b>
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 ( <a href="#">F28F 9/0138</a> 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 ( <a href="#">F28F 9/0132</a> and <a href="#">F28F 9/0133</a> take precedence)}
F28F 9/0136	.... {formed by intersecting strips}
F28F 9/0137	... {formed by wires, e.g. helically coiled ( <a href="#">F28F 9/0135</a> 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 ( <a href="#">F28F 9/0212</a> , <a href="#">F28F 9/0217</a> 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)}
F28F 9/0221	... {Header boxes or end plates formed by stacked elements}
F28F 9/0224	... {Header boxes formed by sealing end plates into covers ( <a href="#">F28F 9/0221</a> takes precedence)}
F28F 9/0226	.... {with resilient gaskets}
F28F 9/0229	.. {Double end plates; Single end plates with hollow spaces}
F28F 9/0231	.. {Header boxes having an expansion chamber}
F28F 9/0234	.. {having a second heat exchanger disposed there within, e.g. oil cooler}
F28F 9/0236	.. {floating elements}

F28F 9/0239	...	{floating header boxes}
F28F 9/0241	...	{floating end plates}
F28F 9/0243	..	{Header boxes having a circular cross-section}
F28F 9/0246	..	{ Arrangements for connecting header boxes with flow lines}
F28F 9/0248	...	{ Arrangements for sealing connectors to header boxes}
F28F 9/0251	...	{ Massive connectors, e.g. blocks; Plate-like connectors}
F28F 9/0253	....	{ with multiple channels, e.g. with combined inflow and outflow channels}
F28F 9/0256	...	{ Arrangements for coupling connectors with flow lines}
F28F 9/0258	....	{ of quick acting type, e.g. with snap action}
F28F 9/026	..	{ with static flow control means, e.g. with means for uniformly distributing heat exchange media into conduits}
F28F 9/0263	...	{ by varying the geometry or cross-section of header box}
F28F 9/0265	...	{ by using guiding means or impingement means inside the header box}
F28F 9/0268	....	{ in the form of multiple deflectors for channeling the heat exchange medium}
F28F 9/027	...	{ in the form of distribution pipes}
F28F 9/0273	....	{ with multiple holes}
F28F 9/0275	....	{ with multiple branch pipes}
F28F 9/0278	...	{ in the form of stacked distribution plates or perforated plates arranged over end plates}
F28F 9/028	...	{ 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}
F28F 9/0282	...	{ 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}
F28F 2009/0285	..	{Other particular headers or end plates }
F28F 2009/0287	...	{having passages for different heat exchange media }
F28F 2009/029	...	{with increasing or decreasing cross-section, e.g. having conical shape }
F28F 2009/0292	...	{with fins }
F28F 2009/0295	...	{comprising cooling circuits }
F28F 2009/0297	...	{Side headers, e.g. for radiators having conduits laterally connected to common header }
F28F 9/04	..	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> }
F28F 9/06	...	by dismountable joints
F28F 9/08	....	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 ( <a href="#">metal-working procedures in general B21, B32; particularly B21D 39/06, B23K</a> )
F28F 9/162	....	{by using bonding or sealing substances, e.g. adhesives ( <a href="#">F28F 9/18 takes precedence</a> )}

- 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 9/0246](#)})
- 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
- F28F 13/00** **Arrangements for modifying heat-transfer, e.g. increasing, decreasing ([F28F 1/00 to F28F 11/00 take precedence](#))**
- F28F 2013/001 . . {Particular heat conductive materials, e.g. superconductive elements ([for thermal joints F28F 2013/006](#))}
- F28F 13/003 . . {by using permeable mass, perforated or porous materials ([F28F 13/18 takes precedence](#))}
- F28F 2013/005 . . {Thermal joints }
- F28F 2013/006 . . {Heat conductive materials }
- F28F 2013/008 . . {Variable conductance materials; Thermal switches }

- F28F 13/02 . by influencing fluid boundary ([boundary-layer control in general F15D](#))
- F28F 13/04 . by preventing the formation of continuous films of condensate on heat-exchange surfaces, e.g. by promoting droplet formation {[F28F 13/18 takes precedence](#)}
- F28F 13/06 . by affecting the pattern of flow of the heat-exchange media {(F28F 13/003 takes precedence; static flow control means in header boxes F28F 9/026 )}
- F28F 13/08 .. by varying the cross-section of the flow channels
- F28F 13/10 .. by imparting a pulsating motion to the flow, e.g. by sonic vibration
- F28F 13/12 .. by creating turbulence, e.g. by stirring, by increasing the force of circulation ([F28F 13/08 takes precedence](#))
- F28F 13/125 ... {by stirring}
- F28F 13/14 . by endowing the walls of conduits with zones of different degrees of conduction of heat
- F28F 13/16 . by applying an electrostatic field to the body of the heat-exchange medium
- F28F 13/18 . by applying coatings, e.g. radiation-absorbing, radiation-reflecting; by surface treatment, e.g. polishing
- F28F 13/182 .. {especially adapted for evaporator or condenser surfaces ([F28F 13/187 takes precedence](#))}
- F28F 13/185 .. {Heat-exchange surfaces provided with microstructures or with porous coatings}
- F28F 13/187 ... {especially adapted for evaporator surfaces or condenser surfaces, e.g. with nucleation sites}
  
- F28F 17/00** **Removing ice or water from heat-exchange apparatus**
- F28F 17/005 . {Means for draining condensates from heat exchangers, e.g. from evaporators ([F28B 9/08 takes precedence](#))}
  
- F28F 19/00** **Preventing the formation of deposits or corrosion, e.g. by using filters {or scrapers}**
- F28F 19/002 . {by using inserts or attachments}
- F28F 19/004 . {by using protective electric currents, voltages, cathodes, anodes, electric 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	<ul style="list-style-type: none"> <li>· {specially adapted for regenerative heat-exchange apparatus}</li> </ul>
F28F 27/02	<ul style="list-style-type: none"> <li>· for controlling the distribution of heat-exchange media between different channels ({ static flow control means in header boxes <a href="#">F28F 9/026</a>}; arrangements of guide plates or guide vanes <a href="#">F28F 9/22</a>, <a href="#">F28F 25/12</a>)</li> </ul>
<b>F28F 99/00</b>	<b>Subject matter not provided for in other groups of this subclass</b>
<b>F28F 2200/00</b>	<b>Prediction; Simulation; Testing</b> (measuring quantity of heat conveyed by flowing mediums <a href="#">G01K 17/06</a> )
F28F 2200/005	<ul style="list-style-type: none"> <li>· Testing heat pipes</li> </ul>
<b>F28F 2210/00</b>	<b>Heat exchange conduits</b>
F28F 2210/02	<ul style="list-style-type: none"> <li>· with particular branching, e.g. fractal conduit arrangements</li> </ul>
F28F 2210/04	<ul style="list-style-type: none"> <li>· Arrangements of conduits common to different heat exchange sections, the conduits having channels for different circuits</li> </ul>
F28F 2210/06	<ul style="list-style-type: none"> <li>· having walls comprising obliquely extending corrugations, e.g. in the form of threads</li> </ul>
F28F 2210/08	<ul style="list-style-type: none"> <li>· Assemblies of conduits having different features</li> </ul>
F28F 2210/10	<ul style="list-style-type: none"> <li>· Particular layout, e.g. for uniform temperature distribution</li> </ul>
<b>F28F 2215/00</b>	<b>Fins</b>
F28F 2215/02	<ul style="list-style-type: none"> <li>· Arrangements of fins common to different heat exchange sections, the fins being in contact with different heat exchange media</li> </ul>
F28F 2215/04	<ul style="list-style-type: none"> <li>· Assemblies of fins having different features, e.g. with different fin densities</li> </ul>
F28F 2215/06	<ul style="list-style-type: none"> <li>· Hollow fins; fins with internal circuits</li> </ul>
F28F 2215/08	<ul style="list-style-type: none"> <li>· with openings, e.g. louvers (zig-zag fins with openings <a href="#">F28F 1/128</a>, common transversal fins with openings <a href="#">F28F 1/325</a>, corrugated fins with openings <a href="#">F28F 3/027</a>)</li> </ul>
F28F 2215/10	<ul style="list-style-type: none"> <li>· Secondary fins, e.g. projections or recesses on main fins</li> </ul>
F28F 2215/12	<ul style="list-style-type: none"> <li>· with U-shaped slots for laterally inserting conduits</li> </ul>
F28F 2215/14	<ul style="list-style-type: none"> <li>· in the form of movable or loose fins</li> </ul>
<b>F28F 2220/00</b>	<b>Closure means, e.g. end caps on header boxes or plugs on conduits</b>
<b>F28F 2225/00</b>	<b>Reinforcing means</b>
F28F 2225/02	<ul style="list-style-type: none"> <li>· for casings</li> </ul>
F28F 2225/04	<ul style="list-style-type: none"> <li>· for conduits</li> </ul>
F28F 2225/06	<ul style="list-style-type: none"> <li>· for fins</li> </ul>
F28F 2225/08	<ul style="list-style-type: none"> <li>· for header boxes</li> </ul>
<b>F28F 2230/00</b>	<b>Sealing means</b>
<b>F28F 2235/00</b>	<b>Means for filling gaps between elements, e.g. between conduits within casings</b>
<b>F28F 2240/00</b>	<b>Spacing means</b>
<b>F28F 2245/00</b>	<b>Coatings; Surface treatments</b>
F28F 2245/02	<ul style="list-style-type: none"> <li>· hydrophilic</li> </ul>



F28F 2245/04	<ul style="list-style-type: none"> <li>hydrophobic</li> </ul>
F28F 2245/06	<ul style="list-style-type: none"> <li>having particular radiating, reflecting or absorbing features, e.g. for improving heat transfer by radiation</li> </ul>
F28F 2245/08	<ul style="list-style-type: none"> <li>self-cleaning</li> </ul>
<b>F28F 2250/00</b>	<b>Arrangements for modifying the flow of the heat exchange media (in general <a href="#">F28F 13/06</a>), e.g. flow guiding means (in casings <a href="#">F28F 9/22</a>); Particular flow patterns</b>
F28F 2250/02	<ul style="list-style-type: none"> <li>Streamline-shaped elements</li> </ul>
F28F 2250/04	<ul style="list-style-type: none"> <li>Communication passages between channels</li> </ul>
F28F 2250/06	<ul style="list-style-type: none"> <li>Derivation channels, e.g. bypass</li> </ul>
F28F 2250/08	<ul style="list-style-type: none"> <li>Fluid driving means, e.g. pumps, fans</li> </ul>
F28F 2250/10	<ul style="list-style-type: none"> <li>Particular pattern of flow of the heat exchange media</li> </ul>
F28F 2250/102	<ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>with change of flow direction</li> </ul> </li> </ul>
F28F 2250/104	<ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>with parallel flow</li> </ul> </li> </ul>
F28F 2250/106	<ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>with cross flow</li> </ul> </li> </ul>
F28F 2250/108	<ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>with combined cross flow and parallel flow</li> </ul> </li> </ul>
<b>F28F 2255/00</b>	<b>Heat exchanger elements made of materials having special features or resulting from particular manufacturing processes</b>
F28F 2255/02	<ul style="list-style-type: none"> <li>Flexible elements</li> </ul>
F28F 2255/04	<ul style="list-style-type: none"> <li>comprising shape memory alloys or bimetallic elements</li> </ul>
F28F 2255/06	<ul style="list-style-type: none"> <li>composite, e.g. polymers with fillers or fibres</li> </ul>
F28F 2255/08	<ul style="list-style-type: none"> <li>pressed; stamped; deep-drawn</li> </ul>
F28F 2255/10	<ul style="list-style-type: none"> <li>made by hydroforming</li> </ul>
F28F 2255/12	<ul style="list-style-type: none"> <li>expanded or perforated metal plate</li> </ul>
F28F 2255/14	<ul style="list-style-type: none"> <li>molded</li> </ul>
F28F 2255/143	<ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>injection molded</li> </ul> </li> </ul>
F28F 2255/146	<ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>overmolded</li> </ul> </li> </ul>
F28F 2255/16	<ul style="list-style-type: none"> <li>extruded</li> </ul>
F28F 2255/18	<ul style="list-style-type: none"> <li>sintered</li> </ul>
F28F 2255/20	<ul style="list-style-type: none"> <li>with nanostructures</li> </ul>
<b>F28F 2260/00</b>	<b>Heat exchangers or heat exchange elements having special size, e.g. microstructures (micro heat pipes <a href="#">F28D 2015/0225</a>; nanostructures <a href="#">F28F 2255/20</a>)</b>
F28F 2260/02	<ul style="list-style-type: none"> <li>having microchannels</li> </ul>
<b>F28F 2265/00</b>	<b>Safety or protection arrangements; Arrangements for preventing malfunction (control or monitoring devices <a href="#">F28F 27/00</a>)</b>
F28F 2265/02	<ul style="list-style-type: none"> <li>in the form of screens or covers (<a href="#">heat shields F28F 2265/10</a>)</li> </ul>
F28F 2265/06	<ul style="list-style-type: none"> <li>by using means for draining heat exchange media from heat exchangers</li> </ul>
F28F 2265/10	<ul style="list-style-type: none"> <li>for preventing overheating, e.g. heat shields (<a href="#">thermal insulation F28F 2270/00</a>)</li> </ul>
F28F 2265/12	<ul style="list-style-type: none"> <li>for preventing overpressure</li> </ul>
F28F 2265/14	<ul style="list-style-type: none"> <li>for preventing damage by freezing, e.g. for accommodating volume expansion</li> </ul>

- 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 B23K 2201/14](#))
- 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
- F28F 2280/00**
  - Mounting arrangements; Arrangements for facilitating assembling or disassembling of heat exchanger parts**
- 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 ([elements specially adapted for movements F28F 5/00](#))
- F28F 2280/105
  - . . with hinged connections