

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

- 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 (F28F 9/0236 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 (F28F 9/0221 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 [F28F 9/0248](#)}
- 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 ([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 9/0246}](#))
- 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 . {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 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