

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	<ul style="list-style-type: none"> . {specially adapted for cooling towers}
F28F 27/006	<ul style="list-style-type: none"> . {specially adapted for regenerative heat-exchange apparatus}
F28F 27/02	<ul style="list-style-type: none"> . 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	<ul style="list-style-type: none"> . Testing heat pipes
F28F 2210/00	Heat exchange conduits
F28F 2210/02	<ul style="list-style-type: none"> . with particular branching, e.g. fractal conduit arrangements
F28F 2210/04	<ul style="list-style-type: none"> . Arrangements of conduits common to different heat exchange sections, the conduits having channels for different circuits
F28F 2210/06	<ul style="list-style-type: none"> . having walls comprising obliquely extending corrugations, e.g. in the form of threads
F28F 2210/08	<ul style="list-style-type: none"> . Assemblies of conduits having different features
F28F 2210/10	<ul style="list-style-type: none"> . Particular layout, e.g. for uniform temperature distribution
F28F 2215/00	Fins
F28F 2215/02	<ul style="list-style-type: none"> . Arrangements of fins common to different heat exchange sections, the fins being in contact with different heat exchange media
F28F 2215/04	<ul style="list-style-type: none"> . Assemblies of fins having different features, e.g. with different fin densities
F28F 2215/06	<ul style="list-style-type: none"> . Hollow fins; fins with internal circuits
F28F 2215/08	<ul style="list-style-type: none"> . 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	<ul style="list-style-type: none"> . Secondary fins, e.g. projections or recesses on main fins
F28F 2215/12	<ul style="list-style-type: none"> . with U-shaped slots for laterally inserting conduits
F28F 2215/14	<ul style="list-style-type: none"> . 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	<ul style="list-style-type: none"> . for casings
F28F 2225/04	<ul style="list-style-type: none"> . for conduits
F28F 2225/06	<ul style="list-style-type: none"> . for fins
F28F 2225/08	<ul style="list-style-type: none"> . 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