

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 ([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 9/04B](#) })

- 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

- 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 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
- 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