CPC  COOPERATIVE PATENT CLASSIFICATION

F  MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING
   (NOTE omitted)

LIGHTING; HEATING

F28  HEAT EXCHANGE IN GENERAL
    (NOTES omitted)

F28F  DETAILS OF HEAT-EXCHANGE AND HEAT-TRANSFER APPARATUS, OF
      GENERAL APPLICATION (water and air traps, air venting F16)

WARNING

In this subclass non-limiting references (in the sense of paragraph 39 of the Guide to the IPC) may still be displayed in the scheme.

1/00  Tubular elements; Assemblies of tubular elements
      (specially adapted for movement F28F 5/00)
   1/003  .  [Multiple wall conduits, e.g. for leak detection
            (leak-detection in metal cooled nuclear reactor
            steam generators F22B 1/066)]
   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)]
   1/02  .  Tubular elements of cross-section which is non-
            circular (F28F 1/08, F28F 1/10 take precedence)
   1/022  .  {with multiple channels}
   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)}
2001/027  .  {with dimples}
   1/04  .  polygonal, e.g. rectangular ((F28F 1/022 takes
            precedence))
   1/045  .  .  {with assemblies of stacked elements}
   1/06  .  .  crimped or corrugated in cross-section
   1/08  .  Tubular elements crimped or corrugated in
            longitudinal section
   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)
   1/105  .  {the means being corrugated elements extending
            around the tubular elements}
   1/12  .  the means being only outside the tubular element
   1/122  .  .  [and being formed of wires]
   1/124  .  .  [and being formed of pins]
   1/126  .  .  {consisting of zig-zag shaped fins (F28F 1/105
            takes precedence)}
   1/128  .  .  {Fins with openings, e.g. louvered fins
            (F28F 1/105 takes precedence)}
   1/14  .  .  and extending longitudinally (F28F 1/38 takes
            precedence)
   1/16  .  .  the means being integral with the element,
            e.g. formed by extrusion (F28F 1/22 takes
            precedence)
   1/18  .  .  the element being built-up from finned
            sections
   1/20  .  .  .  the means being attachable to the element
            (F28F 1/22 takes precedence)
   1/22  .  .  .  the means having portions engaging further
            tubular elements
   1/24  .  .  .  and extending transversely (F28F 1/38 takes
            precedence)
   1/26  .  .  .  the means being integral with the element
            (F28F 1/32 takes precedence)
   1/28  .  .  .  the element being built-up from finned
            sections
   1/30  .  .  .  the means being attachable to the element
            (F28F 1/32 takes precedence)
   1/32  .  .  .  the means having portions engaging further
            tubular elements
   1/325  .  .  .  {Fins with openings}
   1/34  .  .  .  and extending obliquely (F28F 1/38 takes
            precedence)
   1/36  .  .  .  the means being helically wound fins or wire
            spirals
   1/38  .  .  .  and being staggered to form tortuous fluid
            passages
   1/40  .  .  .  the means being only inside the tubular element
   1/405  .  .  .  [and being formed of wires]
   1/42  .  .  .  the means being both outside and inside the
            tubular element
   1/422  .  .  .  [with outside means integral with the
            tubular element and inside means integral
            with the tubular element (F28F 1/424 takes
            precedence)]
   1/424  .  .  .  [Means comprising outside portions integral
            with inside portions]
   1/426  .  .  .  {the outside portions and the inside portions
            forming parts of complementary shape, e.g.
            concave and convex}
2001/428  .  .  .  {Particular methods for manufacturing outside
            or inside fins}
   1/44  .  .  .  and being formed of wire mesh
3/00  Plate-like or laminated elements; Assemblies of
       plate-like or laminated elements (specially adapted
       for movement F28F 5/00)
   3/005  .  [Arrangements for preventing direct contact
            between different heat-exchange media (F28F 3/10
            takes precedence)]
Elements or assemblies thereof with means for increasing heat-transfer area, e.g. with fins, with recesses, with corrugations (F28F 3/008 takes precedence)

[the means being wires or pins]

[the means being corrugated, plate-like elements]

[with openings, e.g. louvered corrugated fins; Assemblies of corrugated strips]

[the means being integral with the element]

[in the form of local deformations of the element]

[the deformations being punctual, e.g. dimples]

[the deformations being linear, e.g. corrugations]

[in the form of ribs integral with the element or local variations in thickness of the element, e.g. grooves, microchannels]

[the means being attachable to the element]

[Elements constructed for building-up into stacks, e.g. capable of being taken apart for cleaning]

[capable of being taken apart]

[having one or more openings therein forming tubular heat-exchange passages]

[Arrangements for sealing the margins]

[Elements constructed in the shape of a hollow panel, e.g. with channels [(F28D 1/02, F28D 1/03 take precedence)]

[by separating portions of a pair of joined sheets to form channels, e.g. by inflation (manufacture thereof B23P)]

Elements specially adapted for movement (arrangements for moving the elements, see the appropriate subclass for the apparatus concerned)

Rotary drums or rollers

Hollow impellers, e.g. stirring vane

Hollow screw conveyors

Elements not covered by group F28F 1/00, F28F 3/00 or F28F 5/00

Blocks traversed by passages for heat-exchange media (F28D 7/0008 takes precedence)

Casings; Header boxes; Auxiliary supports for elements; Auxiliary members within casings

[Casings in the form of plate-like arrangements; Frames enclosing a heat exchange core]

[with fastening means for other structures]

[Common frame elements for multiple cores]

[normal auxiliary members within casings, e.g. internal filling means or sealing means]

[Auxiliary supports for elements]

[Supports for plates or plate assemblies]

[for tubes or tube-assemblies]

[formed by plates (F28F 9/0138 takes precedence)]

[formed by slats, tie-rods, articulated or expandable rods]

[formed by concentric strips]

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

[formed by intersecting strips]
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}

2009/0285 . . .  {Other particular headers or end plates}

2009/0287 . . .  {having passages for different heat exchange media}

2009/0289 . . .  {with increasing or decreasing cross-section, e.g. having conical shape}

2009/0292 . . .  {with fins}

2009/0295 . . .  {comprising cooling circuits}

2009/0297 . . .  {Side headers, e.g. for radiators having conduits laterally connected to common header}

9/04 . . .  Arrangements for sealing elements into header boxes or end plates  {(arrangements for sealing flow lines connectors to header boxes F28F 9/0248)}

9/06 . . .  by dismountable joints

9/08 . . .  by wedge-type connections, e.g. taper ferrule

9/10 . . .  by screw-type connections, e.g. gland

9/12 . . .  by flap-type connections

9/14 . . .  by force-joining

9/16 . . .  by permanent joints, e.g. by rolling  (metalworking procedures in general B21, B32; particularly B21D 39/06, B23K)

9/162 . . .  . . .  {by using bonding or sealing substances, e.g. adhesives (F28F 9/18 takes precedence)}

9/165 . . .  . . .  {by using additional preformed parts, e.g. sleeves, gaskets (F28F 9/185 takes precedence)}

9/167 . . .  . . .  {the parts being inserted in the heat-exchange conduits}

9/18 . . .  by welding

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}

9/185 . . .  . . .  {with additional preformed parts}

9/187 . . .  . . .  {at least one of the parts being non-metallic, e.g. heat-sealing plastic elements}

9/20 . .  Arrangements of heat reflectors, e.g. separately-insertible reflecting walls

9/22 . .  Arrangements for directing heat-exchange media into successive compartments, e.g. arrangements of guide plates

2009/222 . . .  . .  {Particular guide plates, baffles or deflectors, e.g. having particular orientation relative to an elongated casing or conduit}

2009/224 . . .  . .  {Longitudinal partitions}

2009/226 . . .  . .  {Transversal partitions}

2009/228 . . .  . .  {Oblique partitions}

9/24 . .  Arrangements for promoting turbulent flow of heat-exchange media, e.g. by plates  (F28F 1/08 takes precedence; in general F15D)

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)}

9/262 . . .  . .  {for radiators (F28D 1/0408 takes precedence)}

9/264 . . .  . .  {by sleeves, nipples}

9/266 . . .  . .  {by screw-type connections}

9/268 . . .  . .  {by permanent joints, e.g. by welding}

11/00  Arrangements for sealing leaky tubes and conduits  {stopping flow from or in pipes in general F16L 55/10}

11/02 . .  . .  {using obturating elements, e.g. washers, inserted and operated independently of each other (F28F 11/06 takes precedence)}

11/04 . .  . .  {using pairs of obturating elements, e.g. washers, mounted upon central operating rods (F28F 11/06 takes precedence)}

11/06 . .  . .  {using automatic tube obturating appliances}

13/00  Arrangements for modifying heat-transfer, e.g. increasing, decreasing  (F28F 1/00 - F28F 11/00 take precedence)

2013/001 . .  . .  {Particular heat conductive materials, e.g. superconductive elements  (for thermal joints F28E 2013/006)}

13/003 . .  . .  {by using permeable mass, perforated or porous materials (F28F 13/18 takes precedence)}

2013/005 . .  . .  {Thermal joints}

2013/006 . .  . .  {Heat conductive materials}

2013/008 . .  . .  {Variable conductance materials; Thermal switches}

13/02 . .  . .  {by influencing fluid boundary  (boundary-layer control in general F15D)}

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})

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])

13/08 . .  . .  . .  {by varying the cross-section of the flow channels}

13/10 . .  . .  . .  {by imparting a pulsating motion to the flow, e.g. by sonic vibration}

13/12 . .  . .  . .  {by creating turbulence, e.g. by stirring, by increasing the force of circulation (F28F 13/08 takes precedence)}

13/125 . .  . .  . .  {by stirring}

13/14 . .  . .  . .  {by endowing the walls of conduits with zones of different degrees of conduction of heat}

13/16 . .  . .  . .  {by applying an electrostatic field to the body of the heat-exchange medium}

13/18 . .  . .  . .  {by applying coatings, e.g. radiation-absorbing, radiation-reflecting; by surface treatment, e.g. polishing}

13/182 . .  . .  . .  {especially adapted for evaporator or condenser surfaces (F28F 13/187 takes precedence)}

13/185 . .  . .  . .  {Heat-exchange surfaces provided with microstructures or with porous coatings}

13/187 . .  . .  . .  {especially adapted for evaporator surfaces or condenser surfaces, e.g. with nucleation sites}

17/00  Removing ice or water from heat-exchange apparatus

17/005 . .  . .  {Means for draining condensates from heat exchangers, e.g. from evaporators  (F28B 9/08 takes precedence)}

19/00  Preventing the formation of deposits or corrosion, e.g. by using filters  {or scrapers}

19/002 . .  . .  {by using inserts or attachments}
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)]

Features relating to the use of intermediate heat-exchange materials, e.g. selection of compositions (heat-transfer, heat-exchange or heat-storage materials)

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

Subject matter not provided for in other groups of this subclass

Prediction; Simulation; Testing (measuring quantity of heat conveyed by flowing mediums)

Heat exchange conduits

Fins

Closure means, e.g. end caps on header boxes or plugs on conduits

Reinforcing means

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

- Flexible elements
- comprising shape memory alloys or bimetallic elements
- composite, e.g. polymers with fillers or fibres
- pressed; stamped; deep-drawn
- made by hydroforming
- expanded or perforated metal plate
- molded
- injection molded
- overlapped
- extruded
- sintered
- with nanostructures

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

- having microchannels

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

- in the form of screens or covers (heat shields F28F 2265/10)
- by using means for draining heat exchange media from heat exchangers
- for preventing overheating, e.g. heat shields (thermal insulation F28F 2270/00)
- for preventing overpressure
- for preventing damage by freezing, e.g. for accommodating volume expansion
- for preventing leakage
- for removing contaminants, e.g. for degassing
- for preventing development of microorganisms
- for draining

2265/24 . for electrical insulation
2265/26 . for allowing differential expansion between elements (floating header box elements F28F 9/0236)
2265/28 . for preventing noise (by preventing vibrations F28F 2265/30)
2265/32 . for limiting movements, e.g. stops, locking means

2270/00 Thermal insulation; Thermal decoupling

- by using blind conduits

2275/00 Fastening; Joining

- by using bonding materials (braze F28F 2275/04);
- by embedding elements in particular materials
- . by using adhesives
- . by brazing (braze heat exchangers B23K 1/0012)
- . with particular processing steps, e.g. by allowing displacement of parts during brazing or by using a reservoir for storing brazing material
- . by welding (welding heat exchangers B23K 2101/14)
- . by diffusion bonding
- . by impact pressure or friction welding
- . by induction welding or by using microwaves
- . by ultrasonic or vibration welding
- . by laser welding
- . by explosive welding
- . by clamping or clipping
- . with snap connection
- . by force joining
- . by methods involving deformation of the elements
- . by crimping, caulking or clinching
- . by bringing elements together and expanding
- . by shrinking
- . by using form fitting connection, e.g. with tongue and groove
- . with pin and hole connections
- . with bayonet connections
- . with toothed elements, e.g. with serrations
- . by using wedge effect
- . with threaded elements
- . with tie-rods
- . by using magnetic effect

2280/00 Mounting arrangements; Arrangements for facilitating assembling or disassembling of heat exchanger parts

- Removable elements
- Means for preventing wrong assembling of parts
- Adapter frames, e.g. for mounting heat exchanger cores on other structure and for allowing fluidic connections
- Tolerance compensating means
- Moveable elements, e.g. being pivotal (elements specially adapted for movements F28F 5/00)
- with hinged connections