

# SECTION F — MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING

## F28 HEAT EXCHANGE IN GENERAL

**F28F DETAILS OF HEAT-EXCHANGE OR HEAT-TRANSFER APPARATUS, OF GENERAL APPLICATION** (heat-transfer, heat-exchange or heat-storage materials C09K 5/00; water or air traps, air venting F16)

### Subclass index

#### DETAILS AND THEIR ARRANGEMENTS

Elements for heat exchange or transfer and assemblies thereof

tubular; plate-like; for movement; others.....1/00, 3/00, 5/00, 7/00

auxiliary supports for elements; sealing.....9/00, 11/00

Casings and header boxes.....9/00

Preventing deposits or corrosion.....17/00, 19/00

Special features of heat-exchange apparatus

characterised by the selection of: constructional material; intermediate heat-exchange material.....21/00, 23/00

component parts of trickle coolers.....25/00

MODIFYING HEAT-TRANSFER; CONTROL OF APPARATUS.....13/00, 27/00

SUBJECT MATTER NOT PROVIDED FOR IN OTHER GROUPS OF THIS SUBCLASS.....99/00

#### **1/00 Tubular elements; Assemblies of tubular elements** (specially adapted for movement F28F 5/00)

1/02 • Tubular elements of cross-section which is non-circular (F28F 1/08, F28F 1/10 take precedence)

1/04 • • polygonal, e.g. rectangular

1/06 • • crimped or corrugated in cross-section

1/08 • Tubular elements crimped or corrugated in longitudinal section

1/10 • Tubular elements or 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)

1/12 • • the means being only outside the tubular element

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

1/34 • • • 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

1/42 • • the means being both outside and inside the tubular element

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)

3/02 • Elements or assemblies thereof with means for increasing heat-transfer area, e.g. with fins, with recesses, with corrugations (F28F 3/08 takes precedence)

3/04 • • the means being integral with the element

3/06 • • the means being attachable to the element

3/08 • Elements constructed for building-up into stacks, e.g. capable of being taken apart for cleaning

3/10 • • Arrangement for sealing the margins

3/12 • Elements constructed in the shape of a hollow panel, e.g. with channels

3/14 • • by separating portions of a pair of joined sheets to form channels, e.g. by inflation (manufacture thereof B23P)

#### **5/00 Elements specially adapted for movement** (arrangements for moving the elements, see the appropriate subclass for the apparatus concerned)

5/02 • Rotary drums or rollers

5/04 • Hollow impellers, e.g. stirring vane

5/06 • Hollow screw conveyers

<b>7/00</b>	<b>Elements not covered by group F28F 1/00, F28F 3/00, or F28F 5/00</b>	13/12	• • by creating turbulence, e.g. by stirring, by increasing the force of circulation (F28F 13/08 takes precedence)
7/02	• Blocks traversed by passages for heat-exchange media	13/14	• by endowing the walls of conduits with zones of different degrees of conduction of heat
<b>9/00</b>	<b>Casings; Header boxes; Auxiliary supports for elements; Auxiliary members within casings</b>	13/16	• by applying an electrostatic field to the body of the heat-exchange medium
9/007	• Auxiliary supports for elements [6]	13/18	• by applying coatings, e.g. radiation-absorbing, radiation-reflecting; by surface treatment, e.g. polishing
9/013	• • for tubes or tube-assemblies [6]	<b>17/00</b>	<b>Removing ice or water from heat-exchange apparatus</b>
9/02	• Header boxes; End plates	<b>19/00</b>	<b>Preventing the formation of deposits or corrosion, e.g. by using filters</b>
9/04	• • Arrangements for sealing elements into header boxes or end plates (joining pipes to walls in general F16L 41/00)	19/01	• by using means for separating solid materials from heat-exchange fluids, e.g. filters [6]
9/06	• • • by dismountable joints	19/02	• by using coatings, e.g. vitreous or enamel coatings
9/08	• • • • by wedge-type connections, e.g. taper ferrule	19/04	• • of rubber; of plastics material; of varnish
9/10	• • • • by screw-type connections, e.g. gland	19/06	• • of metal
9/12	• • • • by flange-type connections	<b>21/00</b>	<b>Constructions of heat-exchange apparatus characterised by the selection of particular materials</b>
9/14	• • • • by force-joining	21/02	• of carbon, e.g. graphite
9/16	• • • by permanent joints, e.g. by rolling (metal-working procedures in general B21, B23, particularly B21D 39/06, B23K)	21/04	• of ceramic; of concrete; of natural stone
9/18	• • • • by welding	21/06	• of plastics material
9/20	• Arrangements of heat reflectors, e.g. separately-insertible reflecting walls	21/08	• of metal
9/22	• Arrangements for directing heat-exchange media into successive compartments, e.g. arrangements of guide plates	<b>23/00</b>	<b>Features relating to the use of intermediate heat-exchange materials, e.g. selection of compositions</b>
9/24	• Arrangements for promoting turbulent flow of heat-exchange media, e.g. by plates (F28F 1/38 takes precedence; in general F15D)	23/02	• Arrangements for obtaining or maintaining same in a liquid state
9/26	• Arrangements for connecting different sections of heat-exchange elements, e.g. of radiators (connecting different sections in water heaters F24H 9/14)	<b>25/00</b>	<b>Component parts of trickle coolers</b> (arrangements for increasing heat transfer F28F 13/00; controlling arrangements F28F 27/00)
<b>11/00</b>	<b>Arrangements for sealing leaky tubes or conduits</b> (stopping flow from or in pipes in general F16L 55/10)	25/02	• for distributing, circulating, or accumulating liquid (spraying or atomising in general B05B, B05D)
11/02	• using obturating elements, e.g. washers, inserted and operated independently of each other (F28F 11/06 takes precedence)	25/04	• • Distributing or accumulator troughs
11/04	• using pairs of obturating elements, e.g. washers, mounted upon central operating rods (F28F 11/06 takes precedence)	25/06	• • Spray nozzles or spray pipes
11/06	• using automatic tube-obturating appliances	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 in general B01J 19/30, B01J 19/32)
<b>13/00</b>	<b>Arrangements for modifying heat transfer, e.g. increasing, decreasing</b> (F28F 1/00-F28F 11/00 take precedence)	25/10	• for feeding gas or vapour
13/02	• by influencing fluid boundary (boundary-layer control in general F15D)	25/12	• • Ducts; Guide vanes, e.g. for carrying currents to distinct zones
13/04	• by preventing the formation of continuous films of condensate on heat-exchange surfaces, e.g. by promoting droplet formation	<b>27/00</b>	<b>Control arrangements or safety devices specially adapted for heat-exchange or heat-transfer apparatus</b>
13/06	• by affecting the pattern of flow of the heat-exchange media	27/02	• for controlling the distribution of heat-exchange media between different channels (arrangements of guide plates or guide vanes F28F 9/22, F28F 25/12)
13/08	• • by varying the cross-section of the flow channels	<b>99/00</b>	<b>Subject matter not provided for in other groups of this subclass [2006.01]</b>
13/10	• • by imparting a pulsating motion to the flow, e.g. by sonic vibration		