CPC  COOPERATIVE PATENT CLASSIFICATION

F  MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING

(NOTE omitted)

LIGHTING; HEATING

F25  REFRIGERATION OR COOLING; COMBINED HEATING AND REFRIGERATION SYSTEMS; HEAT PUMP SYSTEMS; MANUFACTURE OR STORAGE OF ICE; LIQUEFACTION SOLIDIFICATION OF GASES

F25B  REFRIGERATION MACHINES, PLANTS OR SYSTEMS; COMBINED HEATING AND REFRIGERATION SYSTEMS; HEAT-PUMP SYSTEMS (evaporation or evaporation apparatus for physical or chemical purposes, e.g. evaporation of liquids for gas phase reactions B01B 1/005); heat-transfer, heat-exchange or heat-storage materials, e.g. refrigerants, or materials for the production of heat or cold by chemical reactions other than by combustion C09K 5/00; pumps, compressors F04; use of heat-pumps for domestic- or space-heating or for domestic hot-water supply F24D; air-conditioning, air-humidification F24F; fluid heaters using heat pumps F24H)

NOTES
1. Attention is drawn to Note (2) following the title of subclass F24F.
2. When classifying heat pump circuits or systems, groups F25B 1/00 - F25B 25/00 and F25B 29/00 take precedence over group F25B 30/00.

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.

Compression machines, plant, or systems

1/00 Compression machines, plant, or systems with non-reversible cycle (F25B 3/00, F25B 5/00, F25B 6/00, F25B 7/00, F25B 9/00 take precedence)

1/005 . (of the single unit type (F25B 1/10 takes precedence))

1/02 . with compressor of reciprocating-piston type (F25B 1/005, F25B 1/10 take precedence)

1/04 . with compressor of rotary type (F25B 1/005, F25B 1/10 take precedence)

1/047 . . of screw type

1/053 . . of turbine type

1/06 . with compressor of jet type, e.g. using liquid under pressure (F25B 1/005, F25B 1/10 take precedence)

1/08 . . using vapour under pressure

1/10 . with multi-stage compression (with cascade operation F25B 7/00)

3/00 Self-contained rotary compression machines, i.e. with compressor, condenser, and evaporator rotating as a single unit

5/00 Compression machines, plant, or systems, with several evaporator circuits, e.g. for varying refrigerating capacity (with cascade operation F25B 7/00)

5/02 . arranged in parallel

5/04 . arranged in series

6/00 Compression machines, plant, or systems, with several condenser circuits

6/02 . arranged in parallel

6/04 . arranged in series

7/00 Compression machines, plant, or systems, with cascade operation, i.e. with two or more circuits, the heat from the condenser of one circuit being absorbed by the evaporator of the next circuit (F25B 9/00 takes precedence)

9/00 Compression machines, plant, or systems, in which the refrigerant is air or other gas of low boiling point

9/002 . [characterised by the refrigerant]

9/004 . [the refrigerant being air (air conditioning F24F)]

9/006 . [the refrigerant containing more than one component (F25B 9/004 takes precedence; refrigerant materials per se C09K 5/00)]

9/008 . [the refrigerant being carbon dioxide]

9/02 . using Joule-Thompson effect; using vortex effect

9/04 . using vortex effect

9/06 . using expanders (F25B 9/10 takes precedence)

9/065 . [using pressurised gas jets]

9/08 . using ejectors (F25B 9/10 takes precedence)

9/10 . with several cooling stages

9/12 . using 3He-4He dilution
Compression machines, plant, or systems

11/00 Compression machines, plant, or systems, using turbines, e.g., gas turbines
- 17/10 as expanders (F25B 9/06 takes precedence)
- 17/04 centrifugal type

13/00 Compression machines, plant or systems with reversible cycle (defrosting cycles F25B 47/02)

Sorption machines, plant, or systems

15/00 Sorption machines, plant, or systems, operating continuously, e.g., absorption type
- 15/002 using the endothermic solution of salt
- 15/004 [of rotary type]
- 15/006 [with cascade operation]
- 15/008 [with multi-stage operation (F25B 15/006 takes precedence)]
- 15/02 without inert gas ([F25B 15/004, F25B 15/006, F25B 15/008], F25B 15/12, F25B 15/14, F25B 15/16 take precedence)
- 15/025 [Liquid transfer means]
- 15/04 the refrigerant being ammonia evaporated from aqueous solution (F25B 15/025 takes precedence)
- 15/06 the refrigerant being water vapour evaporated from a salt solution, e.g., lithium bromide (F25B 15/025 takes precedence)
- 15/08 the refrigerant being sulfuric acid (F25B 15/025 takes precedence)
- 15/09 the refrigerant being hydrogen desorbed from a hydride (F25B 15/025 takes precedence)
- 15/10 with inert gas ([F25B 15/004, F25B 15/006, F25B 15/008], F25B 15/12, F25B 15/14, F25B 15/16 take precedence)
- 15/12 with resorber ([F25B 15/004, F25B 15/006, F25B 15/008], F25B 15/14 take precedence)
- 15/14 using osmosis ([F25B 15/004, F25B 15/006, F25B 15/008 take precedence])
- 15/16 using desorption cycle ([F25B 15/004, F25B 15/006, F25B 15/008 take precedence])

17/00 Sorption machines, plant, or systems, operating intermitently, e.g., absorption or adsorption type
- 17/02 the absorbent or adsorbent being a liquid, e.g., brine (F25B 17/10 takes precedence)
- 17/04 with two or more boilers operating alternately
- 17/06 with the boiler and evaporator built-up as a unit in a tiltable or revolving arrangement
- 17/08 the absorbent or adsorbent being a solid, e.g., salt (F25B 17/12 takes precedence)
- 17/083 [with two or more boiler-sorbers operating alternately]
- 17/086 [with two or more boiler-sorber/evaporator units]
- 17/10 using the endothermic solution of salt
- 17/12 using desorption of hydrogen from a hydride

Machines, plant, or systems, with a single mode of operation, not covered by groups F25B 1/00 - F25B 17/00

19/00 Machines, plant, or systems, using evaporation of a refrigerant but without recovery of the vapour
- 19/005 [the refrigerant being a liquefied gas]
- 19/02 using fluid jet, e.g., of steam (F25B 19/005 takes precedence)
- 19/04 using liquid jet, e.g., of water

21/00 Machines, plant, or systems, using electric or magnetic effects ([magnetic refrigerating material H01F 1/012 and H01F 1/017)]
- 21/02 using Peltier effect; using Nernst-Ettinghausen effect (thermoelectric elements H01L 35/00, H01L 37/00)

23/00 Machines, plant, or systems, with a single mode of operation not covered by groups F25B 1/00 - F25B 21/00, e.g., using selective radiation effect
- 23/003 using selective radiation effect
- 23/006 [boiling cooling systems]

25/00 Machines, plant, or systems, using a combination of modes of operation covered by two or more of the groups F25B 1/00 - F25B 23/00 (combinations of two or more modes of operation covered by a single main group, see the relevant group)
- 25/005 [using primary and secondary systems]
- 25/02 Compression-sorption machines, plants, or systems

27/00 Machines, plant, or systems, using particular sources of energy (F25B 30/06 takes precedence)
- 27/002 using solar energy (solar heat collectors F24S)
- 27/005 [in compression type systems]
- 27/007 [in sorption type systems]
- 27/02 using waste heat, e.g., from internal-combustion engines

29/00 Combined heating and refrigeration systems, e.g., operating alternately or simultaneously
- 29/003 [of the compression type system]
- 29/006 [of the sorption type system]

30/00 Heat pumps
- 30/02 [of the compression type]
- 30/04 [of the sorption type]
- 30/06 characterised by the source of low potential heat

Component parts or details

31/00 Compressor arrangements (compressors per se F04)
- 31/002 [lubrication (of compressors per se F04B, of machines or engines in general F01MJ)]
- 31/004 [oil recirculating arrangements]
- 31/006 [cooling of compressor or motor (of compressors per se F04B 39/06)]
- 31/008 [by injecting a liquid (for compressors in general F04B 39/062)]
- 31/02 [of motor-compressor units]
- 31/023 [with compressor of reciprocating-piston type]
- 31/026 [with compressor of rotary type]

33/00 Boilers; Analysers; Rectifiers (boiler-absorbers F25B 35/00)
- 35/00 Boiler-absorbers, i.e., boilers usable for absorption or adsorption
- 35/02 using a liquid as sorbent, e.g., brine
- 35/04 using a solid as sorbent
Component parts or details

37/00 Absorbers; Adsorbers (boiler-absorbers F25B 35/00; separating processes involving the treatment of liquids with adsorbents B01D 15/00; separation of gases or vapours by adsorption B01D 53/02; separation of gases or vapours by absorption B01D 53/14; investigating using adsorption or absorption G01N 30/00; {absorption or adsorption in general B01J 20/00})

39/00 Evaporators; Condensers
39/02 . Evaporators
39/022 . . {with plate-like or laminated elements}
39/024 . . {with elements constructed in the shape of a hollow panel (for heat exchange in general F28F 3/12)}
39/026 . . {specially adapted for sorption type systems}
39/028 . . {having distributing means}
39/04 . Condensers

40/00 Subcoolers, desuperheaters or superheaters
40/02 . Subcoolers
40/04 . Desuperheaters
40/06 . Superheaters

41/00 Fluid-circulation arrangements, e.g. for transferring liquid from evaporator to boiler (pumps per se, sealings thereof F04)
41/003 . {fluid line arrangements}
41/006 . {optical fluid control arrangements}
41/02 . using electro-osmosis
41/04 . Disposition of valves (valves per se F16K)
41/043 . . {in the circuit between evaporator and compressor}
41/046 . . {of fluid flow reversing valves}
41/06 . Flow restrictors, e.g. capillary tubes;Disposition thereof
41/062 . . {Expansion valves (regulating valves per se G05D)}
41/065 . . . {Float control valves}
41/067 . . . {capillary tubes}

43/00 Arrangements for separating or purifying gases or liquids (in analysers or rectifiers F25B 33/00); Arrangements for vapourising the residuum of liquid refrigerant, e.g. by heat (F25B 40/00 takes precedence)
43/003 . {filters (in general B01D)}
43/006 . {accumulators}
43/02 . for separating lubricants from the refrigerant
43/04 . for withdrawing non-condensible gases
43/043 . . {for compression type systems}
43/046 . . {for sorption type systems}

45/00 Arrangements for charging or discharging refrigerant

47/00 Arrangements for preventing or removing deposits or corrosion, not provided for in another subclass
47/003 . . {for preventing corrosion}
47/006 . . {for preventing frost}
47/02 . Defrosting cycles
47/022 . . {hot gas defrosting}
47/025 . . . {by reversing the cycle}
47/027 . . . {for defrosting sorption type systems}

49/00 Arrangement or mounting of control or safety devices (testing refrigerators G01M; control in general G05)
49/005 . . {of safety devices (F25B 49/02 and F25B 49/04 take precedence)}
49/02 . for compression type machines, plant or systems
49/022 . . {Compressor control arrangements (in general F04B)}
49/025 . . {Motor control arrangements (motors per se H02K)}
49/027 . . {Condenser control arrangements}
49/04 . for sorption type machines, plant or systems
49/043 . . {Operating continuously}
49/046 . . {Operating intermittently}

2300/00 Special arrangements or features for refrigeration machines, plants or systems, combined heating and refrigeration systems or heat-pump systems

2309/00 Gas cycle refrigeration machines
2309/001 . with a linear configuration or a linear motor
2309/002 . with parallel working cold producing expansion devices in one circuit
2309/003 . characterised by construction or composition of the regenerator
2309/004 . using a compressor of the rotary type
2309/005 . using an expander of the rotary type
2309/006 . using a distributing valve of the rotary type
2309/002 . using the Joule-Thompson effect
2309/021 . . with a cryosurgical probe tip having a specific construction
2309/022 . . characterised by the expansion element
2309/023 . . with two stage expansion
2309/06 . Compression machines, plant or systems characterised by the refrigerant being carbon dioxide
2309/061 . . with cycle highest pressure above the supercritical pressure
2309/14 . Compression machines, plant or systems characterised by the cycle used
2309/1401 . . Ericsson or Ericson cycles
2309/1402 . . Pulse-tube cycles with acoustic driver
2309/1403 . . Pulse-tube cycles with heat input into acoustic driver
2309/1404 . . Pulse-tube cycles with loudspeaker driven acoustic driver
2309/1405 . . Pulse-tube cycles with travelling waves
2309/1406 . . Pulse-tube cycles with pulse tube in co-axial or concentric geometrical arrangements
2309/1407 . . Pulse-tube cycles with pulse tube having in-line geometrical arrangements
2309/1408 . . Pulse-tube cycles with pulse tube having U-turn or L-turn type geometrical arrangements
2309/1409 . . Pulse-tube cycles with pulse tube having special type of geometrical arrangements not being a coaxial, in-line or U-turn type
2309/1411 . . Pulse-tube cycles characterised by control details, e.g. tuning, phase shifting or general control
2309/1412 . . Pulse-tube cycles characterised by heat exchanger details
2309/1413 . . Pulse-tube cycles characterised by performance, geometry or theory
2313/0215 . . the auxiliary heat exchanger being used parallel to the outdoor heat exchanger during heating operation
2313/023 . . using multiple indoor units
2313/0231 . . with simultaneous cooling and heating
2313/0232 . . with bypasses
2313/02321 . . during cooling
2313/02322 . . during defrosting
2313/02323 . . during heating
2313/0233 . . in parallel arrangements
2313/02331 . . during cooling
2313/02332 . . during defrosting
2313/02333 . . during dehumidification
2313/02334 . . during heating
2313/0234 . . in series arrangements
2313/02341 . . during cooling
2313/02342 . . during defrosting
2313/02343 . . during dehumidification
2313/02344 . . during heating
2313/025 . . using multiple outdoor units
2313/0251 . . being defrosted alternately
2313/0252 . . with bypasses
2313/02521 . . during cooling
2313/02522 . . during defrosting
2313/02523 . . during heating
2313/0253 . . in parallel arrangements
2313/02531 . . during cooling
2313/02532 . . during defrosting
2313/02533 . . during heating
2313/0254 . . in series arrangements
2313/02541 . . during cooling
2313/02542 . . during defrosting
2313/02543 . . during heating
2313/027 . . characterised by the reversing means
2313/0271 . . the compressor allows rotation in reverse direction
2313/0272 . . using bridge circuits of one-way valves
2313/02731 . . using one three-way valve
2313/02732 . . using two three-way valves
2313/02741 . . using one four-way valve
2313/02742 . . using two four-way valves
2313/02743 . . using three four-way valves
2313/0276 . . using six-way valves
2313/0279 . . using nine-way valves
2313/02791 . . using shut-off valves
2313/02792 . . using reversing valve changing the refrigerant flow direction due to pressure differences of the refrigerant and not by external actuation
2313/029 . . Control issues
2313/0291 . . related to the pressure of the indoor unit
2313/0292 . . related to reversing valves
2313/0293 . . related to the indoor fan, e.g. controlling speed
2313/0294 . . related to the outdoor fan, e.g. controlling speed
2313/031 . . Sensor arrangements
2313/0311 . . Pressure sensors near the expansion valve
2313/0312 . . Pressure sensors near the indoor heat exchanger
2313/0313 . . Pressure sensors near the outdoor heat exchanger
2313/0314 . . Temperature sensors near the indoor heat exchanger
2313/0315 . . Temperature sensors near the outdoor heat exchanger
2339/022 . . . of evaporative condensers
2339/042 . . . of pcm condensers
2339/043 . . . Condensers made by assembling plate-like or laminated elements
2339/044 . . . Condensers with an integrated receiver
2339/0441 . . . containing a drier or a filter
2339/0442 . . . characterised by the mechanical fixation of the receiver to the header
2339/0443 . . . the receiver being positioned horizontally
2339/0444 . . . where the flow of refrigerant through the condenser receiver is split into two or more flows, each flow following a different path through the condenser receiver
2339/0445 . . . with throttle portions
2339/0446 . . . characterised by the refrigerant tubes connecting the header of the condenser to the receiver; Inlet or outlet connections to receiver
2339/045 . . . Condensers made by assembling a tube on a plate-like element or between plate-like elements
2339/046 . . . Condensers with refrigerant heat exchange tubes positioned inside or around a vessel containing water or pcm to cool the refrigerant gas
2339/047 . . . Water-cooled condensers

2341/00 Details of ejectors not being used as compression device; Details of flow restrictors or expansion valves
2341/001 . . . Ejectors not being used as compression device
2341/0011 . . . Ejectors with the cooled primary flow at reduced or low pressure
2341/0012 . . . Ejectors with the cooled primary flow at high pressure
2341/0013 . . . Ejector control arrangements
2341/0014 . . . Ejectors with a high pressure hot primary flow from a compressor discharge
2341/0015 . . . using two or more ejectors
2341/0016 . . . Ejectors for creating an oil recirculation
2341/006 . . . Details of flow restrictors or expansion valves
2341/0061 . . . Bidirectional expansion restrictors
2341/0062 . . . Capillary expansion valves
2341/0063 . . . Feed forward expansion valves
2341/0064 . . . Superheater expansion valves
2341/0065 . . . Electric expansion valves
2341/00651 . . . actuated by electric heating means, e.g. a heated bimetallic element
2341/00652 . . . being opened and closed cyclically, e.g. with pulse width modulation
2341/00653 . . . actuated by an electric motor
2341/0066 . . . Refrigeration circuits using more than one expansion valve
2341/00661 . . . arranged in parallel
2341/00662 . . . arranged in series
2341/0067 . . . Expansion valves having a pilot valve
2341/00671 . . . the pilot valve is electrically actuated
2341/0068 . . . Expansion valves combined with a sensor
2341/00681 . . . the sensor is heated
2341/00682 . . . the sensor contains sorbent materials
2341/00683 . . . the sensor is disposed in the suction line and influenced by the temperature or the pressure of the suction gas
Details for charging or discharging refrigerants; Service stations therefor

- Charging refrigerant to a cycle
- Collecting refrigerant from a cycle
- Control issues for charging or collecting refrigerant to or from a cycle
- with several tanks to collect or charge a cycle
- Service stations therefor
- having a carrying handle
- having wheels
- characterised by charging or discharging valves
- characterised by the weighing of refrigerant or oil

Details for preventing or removing deposits or corrosion

- Details of defrosting cycles
- Alternate defrosting
- Cool gas defrosting
- Set point defrosting

General features or devices for refrigeration machines, plants or systems, combined heating and refrigeration systems or heat-pump systems, i.e. not limited to a particular subgroup of F25B

- Heaters
- Centrifugal separation of gas, liquid or oil
- Suction accumulators with deflectors
- Refrigeration circuit bypassing means
- for the compressor
- for the condenser
- for the desuperheater
- for the ejector
- for the evaporator
- for the expansion valve or capillary tube
- for the filter or drier
- for the receiver
- for the subcooler
- for the superheater
- Compression system with heat exchange between particular parts of the system
- between the accumulator and another part of the cycle
- between the capillary tube and another part of the refrigeration cycle
- between the storage receiver and another part of the system
- between the suction tube of the compressor and another part of the cycle
- Several compression cycles arranged in parallel
- the capacity of the first system being different from the second
- Details of compressors or related parts
- Compressor mounted in a housing in which a condenser is integrated
- Intercoolers therefor
- Linear compressors
- with multiple cylinders
- with parallel compressors
- the compressors having different capacities
- having multiple cylinders driven by a rotating swash plate

Problems to be solved

- Geometry problems, e.g. for reducing size
- Increasing the heating capacity of a reversible cycle during cold outdoor conditions
- Cavitations
- Clogging
- Cost reduction
- Damage
- Exceeding a certain pressure value in a refrigeration component or cycle
- Exceeding a certain temperature value in a refrigeration component or cycle
- Improving heat transfers
- Reducing heat transfers
- Sound
- Vibrations
- the presence of moisture in a refrigeration component or cycle
- Hunting, i.e. oscillation of controlled refrigeration variables reaching undesirable values
- Lubrication
- Size reduction
- Optimization, e.g. high integration of refrigeration components
- Calculation of parameters
- Reduction of parts
- Preventing, detecting or repairing leaks of refrigeration fluids
- Preventing leaks from developing
- Detecting refrigerant leaks
Sensing or detecting of parameters; Sensors therefor

2700/01. Sensors determining characteristics of the burner for a generator
2700/02. Humidity
2700/03. Oil level
2700/04. Refrigerant level

2700/05. Load shedding of a compressor
2700/06. Piston positions of a compressor
2700/11. Sensor to detect if defrost is necessary
2700/111. using an emitter and receiver, e.g. sensing by emitting light or other radiation and receiving reflection by a sensor
2700/13. Mass flow of refrigerants
2700/131. at the outlet of a subcooler
2700/133. through the condenser
2700/1331. at the inlet
2700/1332. at the outlet
2700/135. through the evaporator
2700/1351. of the cooled fluid upstream or downstream of the evaporator

2700/15. Power, e.g. by voltage or current
2700/151. of the compressor motor
2700/17. Speeds
2700/171. of the compressor
2700/172. of the condenser fan
2700/173. of the evaporator fan
2700/19. Pressures
2700/191. near an expansion valve
2700/193. of the compressor
2700/1931. Discharge pressures
2700/1932. Oil pressures
2700/1933. Suction pressures
2700/195. of the condenser
2700/197. of the evaporator
2700/21. Temperatures
2700/2101. in a bypass
2700/2102. at the outlet of the gas cooler
2700/2103. near a heat exchanger
2700/2104. of an indoor room or compartment
2700/2105. Oil temperatures
2700/2106. of fresh outdoor air
2700/2107. of a Peltier element
2700/2108. of a receiver
2700/2109. of a separator
2700/2111. of a heat storage receiver
2700/2113. of a suction accumulator
2700/2115. of a compressor or the drive means therefor
2700/21151. at the suction side of the compressor
2700/21152. at the discharge side of the compressor
2700/21153. of electronic components
2700/21154. of an inverter
2700/21155. of the oil
2700/21156. of the motor
2700/21157. at the coil or rotor
2700/2116. of a condenser
2700/21161. the fluid cooled by the condenser
2700/21162. of the refrigerant at the inlet of the condenser
2700/21163. of the refrigerant at the outlet of the condenser
2700/2117. of an evaporator
2700/21171. of the fluid cooled by the evaporator
2700/21172. at the inlet
2700/21173. at the outlet
2700/21174. of the refrigerant at the outlet of the evaporator
2700/21175. of the refrigerant at the outlet of the evaporator