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)

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

19/00 Machines, plant, or systems, using evaporation of a refrigerant but without recovery of the vapour

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 F01M))\}

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 39/06))\}

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

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]

2309/00 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 Ericsson 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
Compression machines, plant, or systems with reversible cycle not otherwise provided for

with two or more accumulators

Indoor unit with water as a heat sink or heat source

Outdoor unit with water as a heat sink or heat source

Outdoor unit expansion valves

two pipes connecting the outdoor side to the indoor side with multiple indoor units

three pipes connecting the outdoor side to the indoor side with multiple indoor units

Refrigerant heaters

indoor unit in circulation with outdoor unit in first operation mode, indoor unit in circulation with an other heat exchanger in second operation mode or outdoor unit in circulation with an other heat exchanger in third operation mode

Indoor unit or outdoor unit with auxiliary heat exchanger not forming part of the indoor or outdoor unit

the auxiliary heat exchanger being only used during defrosting

the auxiliary heat exchanger being only used during dehumidifying

the auxiliary heat exchanger being only used during heating

the auxiliary heat exchanger being used parallel to the indoor unit during heating operation

the auxiliary heat exchanger being used parallel to the outdoor heat exchanger during heating operation

using multiple indoor units

with simultaneous cooling and heating

with bypasses

during cooling

during defrosting

during heating

in parallel arrangements

during cooling

during defrosting

during dehumidification

during heating

in series arrangements

during cooling

during defrosting

during dehumidification

during heating

using multiple outdoor units

being defrosted alternately

with bypasses

during cooling

during defrosting

during heating

in parallel arrangements

during cooling

during defrosting

during heating

in series arrangements

during cooling

during defrosting

during heating

characterised by the reversing means

the compressor allows rotation in reverse direction

using bridge circuits of one-way valves

using one three-way valve

using two three-way valves

using one four-way valve

using two four-way valves

using three four-way valves

using six-way valves

using nine-way valves

using shut-off valves

using reversing valve changing the refrigerant flow direction due to pressure differences of the refrigerant and not by external actuation

Control issues

related to the pressure of the indoor unit

related to reversing valves

related to the indoor fan, e.g. controlling speed

related to the outdoor fan, e.g. controlling speed

Sensor arrangements

Pressure sensors near the expansion valve

Pressure sensors near the indoor heat exchanger

Pressure sensors near the outdoor heat exchanger

Temperature sensors near the indoor heat exchanger

Temperature sensors near the outdoor heat exchanger
Temperature sensors near the refrigerant heater

Sorption refrigeration cycles or details thereof

Crystallization prevention
Generator absorber heat exchanger [GAX]
Hydrates for sorption cycles
Inert heat-exchangers
Regeneration
Reversible sorption cycles
Parallel systems therefore

Details of plants, machines, or systems, using electric or magnetic effects

by using electro-caloric effects
by using magneto-caloric effects
with a static fixed magnet
with a rotating or otherwise moving magnet
with modulation, influencing or enhancing an existing magnetic field
by using thermionic electron cooling effects
using Peltier effects; using Nernst-Ettinghausen effects
Control thereof
of fans
of electric power, current or voltage
Mounting details thereof
Removal of heat
by a gas
by liquids or two-phase fluids

Refrigeration system using an engine for driving a compressor

of the internal combustion type

details of condensers
of evaporative condensers
of pcm condensers
Condensers made by assembling plate-like or laminated elements
Condensers with an integrated receiver
containing a drier or a filter
characterised by the mechanical fixation of the receiver to the header
the receiver being positioned horizontally
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
with throttle portions
characterised by the refrigerant tubes connecting the header of the condenser to the receiver; Inlet or outlet connections to receiver
Condensers made by assembling a tube on a plate-like element or between plate-like elements
Condensers with refrigerant heat exchange tubes positioned inside or around a vessel containing water or pcm to cool the refrigerant gas
Water-cooled condensers

Details of ejectors not being used as compression device; Details of flow restrictors or expansion valves

Ejectors not being used as compression device
Ejectors with the cooled primary flow at reduced or low pressure
Ejectors with the cooled primary flow at high pressure
Ejector control arrangements
Ejectors with a high pressure hot primary flow from a compressor discharge
using two or more ejectors
Ejectors for creating an oil recirculation
Details of flow restrictors or expansion valves
Bidirectional expansion restrictors
Capillary expansion valves
Feed forward expansion valves
Superheater expansion valves
Electric expansion valves
actuated by electric heating means, e.g. a heated bimetallic element
being opened and closed cyclically, e.g. with pulse width modulation
actuated by an electric motor
Refrigeration circuits using more than one expansion valve
arranged in parallel
arranged in series
Expansion valves having a pilot valve
the pilot valve is electrically actuated
Expansion valves combined with a sensor
the sensor is heated
the sensor contains sorbent materials
the sensor is disposed in the suction line and influenced by the temperature or the pressure of the suction gas
2347/00 Details for preventing or removing deposits or corrosion
2347/02 . Details of defrosting cycles
2347/021 . Alternate defrosting
2347/022 . Cool gas defrosting
2347/023 . Set point defrosting

2400/00 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

2400/01 . Heaters
2400/02 . Centrifugal separation of gas, liquid or oil
2400/03 . Suction accumulators with deflectors
2400/04 . Refrigeration circuit bypassing means
2400/0401 . for the compressor
2400/0403 . for the condenser
2400/0405 . for the desuperheater
2400/0407 . for the ejector
2400/0409 . for the evaporator
2400/0411 . for the expansion valve or capillary tube
2400/0413 . for the filter or drier
2400/0415 . for the receiver
2400/0417 . for the subcooler
2400/0419 . for the superheater
2400/045 . Compression system with heat exchange between particular parts of the system
2400/051 . between the accumulator and another part of the cycle
2400/052 . between the capillary tube and another part of the refrigeration cycle
2400/053 . between the storage receiver and another part of the system
2400/054 . between the suction tube of the compressor and another part of the cycle
2400/056 . Several compression cycles arranged in parallel
2400/061 . the capacity of the first system being different from the second
2400/07 . Details of compressors or related parts
2400/071 . Compressor mounted in a housing in which a condenser is integrated
2400/072 . Intercoolers therefor
2400/073 . Linear compressors
2400/074 . with multiple cylinders
2400/075 . with parallel compressors
2400/0751 . the compressors having different capacities
2400/076 . having multiple cylinders driven by a rotating swash plate

2400/077 . Compressor control units, e.g. terminal boxes, mounted on the compressor casing wall containing for example starter, protection switches or connector contacts
2400/08 . Refrigeration machines, plants and systems having means for detecting the concentration of a refrigerant
2400/09 . Refrigeration machines, plants and systems having means for detecting the concentration of a sorbent solution
2400/11 . Drop catchers
2400/12 . Inflammable refrigerants
2400/121 ., using R1234
2400/13 . Economisers
2400/14 . Power generation using energy from the expansion of the refrigerant
2400/141 ., the extracted power is not recycled back in the refrigerant circuit
2400/15 . Microelectro-mechanical devices
2400/16 . Receivers
2400/161 ., arranged in parallel
2400/162 ., characterised by the plug or stop
2400/17 . Re-condensers
2400/18 . Refrigerant conversion
2400/19 . Pumping down refrigerant from one part of the cycle to another part of the cycle, e.g. when the cycle is changed from cooling to heating, or before a defrost cycle is started
2400/21 . Modules for refrigeration systems
2400/22 . Refrigeration systems for supermarkets
2400/23 . Separators
2400/24 . Storage receiver heat

2500/00 Problems to be solved
2500/01 . Geometry problems, e.g. for reducing size
2500/02 . Increasing the heating capacity of a reversible cycle during cold outdoor conditions
2500/03 . Cavitations
2500/04 . Clogging
2500/05 . Cost reduction
2500/06 . Damage
2500/07 . Exceeding a certain pressure value in a refrigeration component or cycle
2500/08 . Exceeding a certain temperature value in a refrigeration component or cycle
2500/09 . Improving heat transfers
2500/11 . Reducing heat transfers
2500/12 . Sound
2500/13 . Vibrations
2500/14 . the presence of moisture in a refrigeration component or cycle
2500/15 . Hunting, i.e. oscillation of controlled refrigeration variables reaching undesirable values
2500/16 . Lubrication
2500/17 . Size reduction
2500/18 . Optimization, e.g. high integration of refrigeration components
2500/19 . Calculation of parameters
2500/21 . Reduction of parts
2500/22 . Preventing, detecting or repairing leaks of refrigeration fluids
2500/221 . Preventing leaks from developing
2500/222 . Detecting refrigerant leaks
Sensing or detecting of parameters; Sensors therefore

2700/00 Control issues
2600/00

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

2700/12 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

2700/1352 at the inlet
2700/1353 at the outlet
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 inlet of the evaporator
2700/21175 of the refrigerant at the outlet of the evaporator

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

2600/00 Control issues
2600/01 Timing
2600/02 Compressor control

2600/021 Inverters therefor

2600/022 for multi-stage operation
2600/023 controlling swash plate angles
2600/024 by controlling the electric parameters, e.g. current or voltage

2600/025 by controlling speed
2600/0251 with on-off operation
2600/0252 with two speeds
2600/0253 with variable speed
2600/026 by controlling unloaders
2600/0261 external to the compressor
2600/0262 internal to the compressor
2600/027 by controlling pressure
2600/0271 the discharge pressure
2600/0272 the suction pressure

2600/05 Refrigerant levels
2600/07 Remote controls
2600/11 Fan speed control

2600/111 of condenser fans
2600/112 of evaporator fans

2600/13 Pump speed control
2600/15 during shut down

2600/17 by controlling the pressure of the condenser
2600/19 Refrigerant outlet condenser temperature

2600/21 Refrigerant outlet evaporator temperature

2600/23 Time delays

2600/25 Control of valves
2600/2501 Bypass valves
2600/2503 Condenser exit valves
2600/2505 Fixed-differential control valves

2600/2507 Flow-diverting valves
2600/2509 Economiser valves

2600/2511 Evaporator distribution valves
2600/2513 Expansion valves
2600/2515 Flow valves
2600/2517 Head-pressure valves

2600/2519 On-off valves
2600/2521 On-off valves controlled by pulse signals

2600/2523 Receiver valves
2600/2525 Pressure relief valves

2700/00 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

2500/23 High amount of refrigerant in the system
2500/24 Low amount of refrigerant in the system
2500/25 Standardisation of apparatus or parts
2500/26 characterised by the startup of the refrigeration cycle

2500/27 characterised by the stop of the refrigeration cycle
2500/28 Means for preventing liquid refrigerant entering into the compressor
2500/29 High ambient temperatures
2500/31 Low ambient temperatures
2500/32 Weight

2600/00 Control issues
2600/01 Timing
2600/02 Compressor control

2600/021 Inverters therefor

2600/022 for multi-stage operation
2600/023 controlling swash plate angles
2600/024 by controlling the electric parameters, e.g. current or voltage

2600/025 by controlling speed
2600/0251 with on-off operation
2600/0252 with two speeds
2600/0253 with variable speed
2600/026 by controlling unloaders
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2600/027 by controlling pressure
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