CPC COOPERATIVE PATENT CLASSIFICATION

F01P COOLING OF MACHINES OR ENGINES IN GENERAL; COOLING OF INTERNAL-COMBUSTION ENGINES (arrangements in connection with cooling of propulsion units in vehicles B60K 11/00; heat-transfer, heat-exchange or heat-storage materials C09K 5/00; {cooling of gas-turbine engines F02C 7/12}; heat exchange in general, radiators F28)

NOTE

1. In this subclass, the following terms or expressions are used with the meanings indicated:
   - "air" also includes other gaseous cooling fluids;
   - "liquid cooling" also includes cooling where liquid is used as the heat transferring fluid between parts to be cooled and the air, e.g. using radiators;
   - "air cooling" means direct air cooling and thus excludes indirect air cooling occurring in liquid cooling systems as explained herefore;
   - "cooling-air" includes directly or indirectly acting cooling-air.
2. Attention is drawn to the notes preceding class F01, especially as regards Note (3).
3. Cooling by lubricant is classified in subclass F01M when the lubrication aspect predominates and in subclass F01P when the cooling aspect predominates.

Air cooling; Liquid cooling (propelling cooling-air or liquid coolants F01P 5/00; controlling supply or circulation of coolants F01P 7/00; cylinders, pistons, valves, fuel injectors, sparking-plugs, or other engine or machine parts, modified to facilitate cooling, see the relevant classes for such parts)

F01P 1/00 **Air cooling**

F01P 2001/005 . {Cooling engine rooms}

F01P 1/02 . Arrangements for cooling cylinders or cylinder heads, e.g. ducting cooling-air from its pressure source to cylinders or along cylinders

F01P 2001/023 . . {Cooling cylinders (F01P 2003/022 takes precedence)}

F01P 2001/026 . . {Cooling cylinder heads (F01P 2003/025 takes precedence)}

F01P 1/04 . Arrangements for cooling pistons

F01P 1/06 . Arrangements for cooling other engine or machine parts

F01P 1/08 . . for cooling intake or exhaust valves

F01P 1/10 . . for cooling fuel injectors or sparking-plugs

F01P 3/00 **Liquid cooling**

F01P 2003/001 . {Cooling liquid}

F01P 2003/003 . . {having boiling-point higher than 100°C}

F01P 2003/005 . {the liquid being fuel}

F01P 2003/006 . {the liquid being oil}

F01P 2003/008 . {the liquid being water and oil}

F01P 3/02 . Arrangements for cooling cylinders or cylinder heads

F01P 2003/021 . . {Cooling cylinders}

F01P 2003/022 . . . {combined with air cooling}

F01P 2003/024 . . {Cooling cylinder heads}

F01P 2003/025 . . . {combined with air cooling}

F01P 2003/027 . . {Cooling cylinders and cylinder heads in parallel}

F01P 2003/028 . . {Cooling cylinders and cylinder heads in series}

F01P 3/04 . . Liquid-to-air heat-exchangers combined with, or arranged on, cylinders or cylinder heads

F01P 3/06 . Arrangements for cooling pistons

F01P 3/08 . . Cooling of piston exterior only, e.g. by jets

F01P 3/10 . . Cooling by flow of coolant through pistons

F01P 3/12 . Arrangements for cooling other engine or machine parts

F01P 3/14 . . for cooling intake or exhaust valves

F01P 3/16 . . for cooling fuel injectors or sparking-plugs

F01P 3/18 . Arrangements or mounting of liquid-to-air heat-exchangers (such arrangements on cylinders or cylinder heads F01P 3/04; relative to vehicles B60K 11/04)

F01P 2003/182 . . {with multiple heat-exchangers}

F01P 2003/185 . . {arranged in parallel}

F01P 2003/187 . . {arranged in series}

F01P 3/20 . Cooling circuits not specific to a single part of engine or machine (F01P 3/22 takes precedence)

F01P 3/202 . . {for outboard marine engines}

F01P 3/205 . . . {Flushing}

F01P 3/207 . . {liquid-to-liquid heat-exchanging relative to marine vessels}

F01P 3/22 . characterised by evaporation and condensation of coolant in closed cycles (other cooling by evaporation F01P 9/02); characterised by the coolant reaching higher temperatures than normal atmospheric boiling-point

F01P 3/2207 . . {characterised by the coolant reaching temperatures higher than the normal atmospheric boiling point}

F01P 2003/2214 . . {Condensers}

F01P 2003/2221 . . . {of the horizontal type}

F01P 2003/2228 . . . {of the upflow type}

F01P 2003/2235 . . . {of the downflow type}

F01P 2003/2242 . . . {Steam-to-steam condensers}

F01P 2003/225 . . . {Steam-to-liquid condensers}

F01P 2003/2257 . . . {Rotating condensers}

F01P 2003/2264 . . . {Separators}

F01P 3/2271 . . {Closed cycles with separator and liquid return}

F01P 2003/2278 . . {Heat pipes}

F01P 3/2285 . . {Closed cycles with condenser and feed pump}

F01P 2003/2292 . . {with thermostatically controlled by-pass}

Pumping cooling-air or liquid coolants; Controlling circulation or supply of coolants

F01P 5/00 **Pumping cooling-air or liquid coolants** (controlling circulation or supply of coolants by influencing drive of pumps F01P 7/00)

F01P 5/02 . Pumping cooling-air; Arrangements of cooling-air pumps, e.g. fans or blowers

F01P 2005/025 . . {using two or more air pumps}

F01P 5/04 . . Pump-driving arrangements

F01P 5/043 . . . {Pump reversing arrangements}

F01P 2005/046 . . . {with electrical pump drive}

F01P 5/06 . . Guiding or ducting air to, or from, ducted fans

F01P 5/08 . . Use of engine exhaust gases for pumping cooling-air

F01P 5/10 . Pumping liquid coolant; Arrangements of coolant pumps

F01P 2005/105 . . {Using two or more pumps}

F01P 5/12 . . Pump-driving arrangements

F01P 2005/125 . . . {Driving auxiliary pumps electrically}

F01P 5/14 . Safety means against, or active at, failure of coolant-pump drives, e.g. shutting engine down; Means for indicating functioning of coolant pump

F01P 7/00 **Controlling of coolant flow**

F01P 7/02 . the coolant being cooling-air

F01P 7/023 . . {Cowlings for airplane engines}

F01P 7/026 . . {Thermostatic control}

F01P 7/04 . . by varying pump speed, e.g. by changing pump-drive gear ratio

F01P 7/042 . . . {using fluid couplings (couplings or clutches of this type per se F16D 35/00)}

F01P 7/044 . . . {using hydraulic drives}

F01P 7/046 . . . {using mechanical drives}

F01P 7/048 . . . {using electrical drives}

F01P 7/06 . . by varying blade pitch

F01P 7/08 . . by cutting in or out of pumps

F01P 7/081 . . . {using clutches, e.g. electro-magnetic or induction clutches}

F01P 7/082 . . . . {using friction clutches}

F01P 7/084 . . . . . {actuated electromagnetically}

F01P 7/085 . . . . . {actuated by fluid pressure}

F01P 7/087 . . . . . {actuated directly by deformation of a thermostatic device}

F01P 7/088 . . . . . {actuated in response to driving speed, e.g. by centrifugal devices}

F01P 7/10 . . by throttling amount of air flowing through liquid-to-air heat exchangers

F01P 7/12 . . . by thermostatic control

F01P 7/14 . the coolant being liquid

F01P 2007/143 .. {using restrictions}

F01P 2007/146 .. {using valves}

F01P 7/16 .. by thermostatic control

F01P 7/161 ... {by bypassing pumps}

F01P 7/162 ... {by cutting in and out of pumps}

F01P 7/164 ... {by varying pump speed}

F01P 7/165 ... {characterised by systems with two or more loops}

F01P 7/167 ... {by adjusting the pre-set temperature according to engine parameters, e.g. engine load, engine speed}

F01P 2007/168 ... {By varying the cooling capacity of a liquid-to-air heat-exchanger}

F01P 9/00 **Cooling having pertinent characteristics not provided for in, or of interest apart from, groups F01P 1/00 to F01P 7/00** (profiting from waste heat of combustion-engine cooling F02G 5/00)

F01P 2009/005 . {Cooling with melting solids}

F01P 9/02 . Cooling by evaporation, e.g. by spraying water on to cylinders (evaporation and condensation of liquid coolant in closed cycles F01P 3/22; {evaporation or evaporation apparatus for physical or chemical purposes, e.g. evaporation of liquids for gas phase reactions B01B 1/005})

F01P 9/04 . by simultaneous or alternative use of direct air-cooling and liquid cooling (F01P 9/02 takes precedence)

F01P 9/06 . by use of refrigerating apparatus, e.g. of compressor or absorber type

F01P 11/00 **Component parts, details, or accessories not provided for in, or of interest apart from, groups F01P 1/00 to F01P 9/00**

F01P 11/02 . Liquid-coolant {filling}, overflow, venting, or draining devices (automatic draining during freezing conditions F01P 11/20)

F01P 11/0204 .. {Filling}

F01P 11/0209 ... {Closure caps}

F01P 11/0214 .... {Mounting}

F01P 2011/0219 ..... {using bayonet connections}

F01P 2011/0223 ..... {Decoration}

F01P 2011/0228 ..... {Sealing}

F01P 2011/0233 ..... {Venting}

F01P 11/0238 .... {with overpressure valves or vent valves}

F01P 2011/0242 ..... {setting the pressure valve}

F01P 11/0247 .... {Safety; Locking against opening}

F01P 2011/0252 ..... {Venting before opening}

F01P 2011/0257 ..... {with theft preventing means}

F01P 2011/0261 ..... {activated by temperature}

F01P 2011/0266 ..... {activated by pressure}

F01P 2011/0271 .... {Semi-permeable, e.g. using Gore-Tex c fibres}

F01P 11/0276 .. {Draining or purging}

F01P 11/028 .. {Deaeration devices}
F01P 11/0285 .. {Venting devices}
F01P 11/029 .. {Expansion reservoirs}
F01P 11/0295 .. {Condensers for radiators}
F01P 11/04 . Arrangements of liquid pipes or hoses
F01P 11/06 . Cleaning (in general B08B); Combating corrosion (in general C23F)
F01P 2011/061 .. {Cleaning or combatting corrosion using filters}
F01P 2011/063 .. {Cleaning (F01P 2011/061 takes precedence)}
F01P 2011/065 .. {Flushing}
F01P 2011/066 .. {Combatting corrosion (F01P 2011/061 takes precedence)}
F01P 2011/068 ... {chemically}
F01P 11/08 . Arrangements of lubricant coolers (in lubrication apparatus F01M)
F01P 11/10 . Guiding or ducting cooling-air, to, or from, liquid-to-air heat exchangers
F01P 11/12 . Filtering, cooling, or silencing cooling-air
F01P 11/14 . Indicating devices; Other safety devices
F01P 11/16 .. concerning coolant temperature (F01P 11/20 takes precedence)
F01P 11/18 .. concerning coolant pressure, coolant flow, or liquid-coolant level
F01P 11/20 .. concerning atmospheric freezing conditions, e.g. automatically draining or heating during frosty weather
F01P 2011/205 .. {using heat-accumulators}

F01P 2023/00 **Signal processing; Details thereof**
F01P 2023/08 . Microprocessor; Microcomputer

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F01P 2025/00 **Measuring**
F01P 2025/04 . Pressure
F01P 2025/06 .. for determining flow
F01P 2025/08 . Temperature
F01P 2025/12 .. Cabin temperature
F01P 2025/13 .. Ambient temperature
F01P 2025/30 .. Engine incoming fluid temperature
F01P 2025/31 .. Cylinder temperature
F01P 2025/32 .. Engine outcoming fluid temperature
F01P 2025/33 .. Cylinder head temperature
F01P 2025/34 .. Heat exchanger incoming fluid temperature
F01P 2025/36 .. Heat exchanger mixed fluid temperature
F01P 2025/40 .. Oil temperature

F01P 2025/42 . . Intake manifold temperature
F01P 2025/44 . . Outlet manifold temperature
F01P 2025/46 . . Engine parts temperature
F01P 2025/48 . . Engine room temperature
F01P 2025/50 . . using two or more temperature sensors
F01P 2025/52 . . Heat exchanger temperature
F01P 2025/60 . Operating parameters
F01P 2025/62 . . Load
F01P 2025/64 . . Number of revolutions
F01P 2025/66 . . Vehicle speed
F01P 2025/70 . Level
F01P 2025/80 . Concentration anti-freeze

F01P 2031/00 Fail safe
F01P 2031/16 . using melting materials
F01P 2031/18 . Detecting fluid leaks
F01P 2031/20 . Warning devices
F01P 2031/22 . using warning lamps
F01P 2031/24 . for freezing
F01P 2031/30 . Cooling after the engine is stopped
F01P 2031/32 . Deblocking of damaged thermostat
F01P 2031/34 . Limping home
F01P 2031/36 . Failure of coolant pump

F01P 2037/00 Controlling
F01P 2037/02 . starting

F01P 2050/00 Applications
F01P 2050/02 . Marine engines
F01P 2050/04 . . using direct cooling
F01P 2050/06 . . using liquid-to-liquid heat exchangers
F01P 2050/08 . . Engine room
F01P 2050/10 . . Z-type engine
F01P 2050/12 . . Outboard engine
F01P 2050/16 . Motor-cycles
F01P 2050/20 . Aircraft engines
F01P 2050/22 . Motor-cars
F01P 2050/24 . Hybrid vehicles
F01P 2050/30 . Circuit boards

F01P 2060/00 Cooling circuits using auxiliaries

F01P 2060/02 . Intercooler
F01P 2060/04 . Lubricant cooler
F01P 2060/045 . . for transmissions
F01P 2060/06 . Retarder
F01P 2060/08 . Cabin heater
F01P 2060/10 . Fuel manifold
F01P 2060/12 . Turbo charger
F01P 2060/14 . Condenser
F01P 2060/16 . Outlet manifold
F01P 2060/18 . Heater
F01P 2060/185 . . for alternators or generators

F01P 2070/00 **Details**
F01P 2070/02 . using shape memory alloys
F01P 2070/04 . using electrical heating elements
F01P 2070/06 . Using intake pressure as actuating fluid
F01P 2070/08 . Using lubricant pressure as actuating fluid
F01P 2070/10 . using electrical or electromechanical means
F01P 2070/30 . Rotating radiators
F01P 2070/32 . Ring-shaped heat exchangers
F01P 2070/50 . mounting fans to heat-exchangers
F01P 2070/52 . mounting heat-exchangers