### CPC - COOPERATIVE PATENT CLASSIFICATION

#### F

**MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING**

*(NOTE omitted)*

#### ENGINES OR PUMPS

**F04**

**POSITIVE - DISPLACEMENT MACHINES FOR LIQUIDS; PUMPS FOR LIQUIDS OR ELASTIC FLUIDS**

*(NOTE omitted)*

**F04D**

**NON-POSITIVE-DISPLACEMENT PUMPS** *(engine fuel-injection pumps F02M; ion pumps H01J 41/12; electrodynamic pumps H02K 44/02)*

### NOTES

1. This subclass covers non-positive-displacement pumps for liquids, for elastic fluids, or for liquids and elastic fluids whether rotary or not having pure rotation.
2. This subclass does not cover combinations of non-positive-displacement pumps with other pumps, which are covered by subclass F04B, except that the use of such other pumps for priming or boosting non-positive-displacement is covered by this subclass.
3. Attention is drawn to the Notes preceding class F01, especially as regards the definition of "pump".

### 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.

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<td>9/041</td>
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<td>{the priming pump having evacuating action (F04D 9/043 and F04D 9/06 take precedence)}</td>
<td></td>
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</table>
Pumping liquids, or liquids and elastic fluids, by rotary pumps

Pumping liquids, or liquids and elastic fluids, by rotary pumps

| 9/042 | . . . [and means for rendering its in operative] |
| 9/043 | . . . [the priming pump being hand operated or of the reciprocating type] |
| 9/044 | . . . [Means for rendering the priming pump inoperative] |
| 9/045 | . . . [the means being liquid level sensors] |
| 9/046 | . . . . . [the means being floats] |
| 9/047 | . . . [the means being flow sensors] |
| 9/048 | . . . [the means being outlet pressure sensors] |
| 9/049 | . . . by operator interventions |
| 9/06 | . . . of jet type |
| 9/065 | . . . [the driving fluid being a gas or vapour, e.g. exhaust of a combustion engine] |

11/00 Other rotary non-positive-displacement pumps
(pumping installations or systems F04D 13/00)

11/005 . . . [Swash-type impeller pumps] |

13/00 Pumping installations or systems (controlling F04D 15/00)

13/02 . . . Units comprising pumps and their driving means (predominant aspects of the driving means, see the relevant classes for such means)

13/021 . . . [containing a coupling] |

13/022 . . . [a coupling allowing slip, e.g. torque converter] |

13/023 . . . . . [for reducing start torque] |

13/024 . . . . [a magnetic coupling] |

13/025 . . . . . [Details of the can separating the pump and drive area] |

13/026 . . . . . [Details of the bearings] |

13/027 . . . . . [Details of the magnetic circuit] |

13/028 . . . . . [the driving means being a planetary gear] |

13/04 . . . . . [the pump being fluid driven] |

13/043 . . . . . [the pump wheel carrying the fluid driving means] |

13/046 . . . . . [the fluid driving means being a hydraulic motor of the positive displacement type] |

13/06 . . . . . [the pump being electrically driven] |

13/066 . . . . . [Canned motor pumps] |

13/0613 . . . . . [Special connection between the rotor compartments] |

13/062 . . . . . [pressure compensation between motor- and pump- compartment] |

13/0626 . . . . . [Details of the can] |

13/0633 . . . . . [Details of the bearings] |

13/064 . . . . . [Details of the magnetic circuit] |

13/0646 . . . . . [the hollow pump or motor shaft being the conduit for the working fluid] |

13/0653 . . . . . [the motor being flooded] |

13/066 . . . . . [Floating-units] |

13/0666 . . . . . [the motor being of the plane gap type] |

13/0673 . . . . . [the motor being of the inside-out type] |

13/068 . . . . . [Battery powered] |

13/0686 . . . . . [Mechanical details of the pump control unit (pump control F04D 15/00)] |

13/0693 . . . . . [Details or arrangements of the wiring] |

13/08 . . . . . for submerged use |

13/083 . . . . . [and protected by a gas-bell] |

13/086 . . . . . [the pump and drive motor are both submerged] |

13/10 . . . . . adapted for use in mining bore holes |

13/12 . . . Combinations of two or more pumps (combinations with priming pumps or booster pumps to counteract vapour-lock F04D 9/04) |

13/14 . . . the pumps being all of centrifugal type (deviation valves F04D 15/0016) |

13/16 . . . with storage reservoirs |

15/00 Control, e.g. regulation, of pumps, pumping installations or systems

15/0005 . . . [by using valves] |

15/0011 . . . [by-pass valves] |

15/0016 . . . [mixing-reversing- or deviation valves] |

15/0022 . . . [throttling valves or valves varying the pump inlet opening or the outlet opening] |

15/0027 . . . [Varying behaviour of the very pump (F04D 15/0055 and F04D 29/46 take precedence)] |

15/0033 . . . [By-passing by increasing clearance between impeller and its casing] |

15/0038 . . . [by varying the effective cross-sectional area of flow through the rotor] |

15/0044 . . . [by introducing a gas] |

15/005 . . . . . [the pumps being of the circumferential flow type] |

15/0055 . . . [Rotors with adjustable blades] |

15/0061 . . . [responsive to temperature] |

15/0066 . . . [by changing the speed, e.g. of the driving engine] |

15/0072 . . . [Installation or systems with two or more pumps, wherein the flow path through the stages can be changed, e.g. series-parallel] |

15/0077 . . . [Safety measures (F04D 15/02 takes precedence)] |

15/0083 . . . [Protection against sudden pressure change, e.g. check valves] |

15/0088 . . . [Testing machines] |

15/0094 . . . [Indicators of rotational movement] |

15/02 . . . . . Stopping of pumps, or operating valves, on occurrence of unwanted conditions |

15/0209 . . . . . [responsive to a condition of the working fluid (F04D 15/029 takes precedence)] |

15/0218 . . . . . [the condition being a liquid level or a lack of liquid supply] |

15/0227 . . . . . [Lack of liquid level being detected using a flow transducer] |

15/0236 . . . . . [Lack of liquid level being detected by analysing the parameters of the electric drive, e.g. current or power consumption] |

15/0245 . . . . . [responsive to a condition of the pump] |

15/0254 . . . . . [the condition being speed or load] |

15/0263 . . . . . [the condition being temperature, ingress of humidity or leakage] |

15/0272 . . . . . [the condition being wear or a position] |

15/0281 . . . . . [responsive to a condition not otherwise provided for] |

15/029 . . . . . [for pumps operating in parallel] |

Pumping elastic fluids by rotary pumps

17/00 Radial-flow pumps, e.g. centrifugal pumps; Helico-centrifugal pumps (F04D 21/00 takes precedence)

17/02 . . . having non-centrifugal stages, e.g. centripetal |

17/025 . . . [comprising axial flow and radial flow stages] |

17/04 . . . . . of transverse-flow type |

17/06 . . . Helico-centrifugal pumps |

17/08 . . . Centrifugal pumps |

17/10 . . . . . for compressing or evacuating
Pumping elastic fluids by rotary pumps

F04D

... [with double suction]
17/12  . . . Multi-stage pumps
17/122 . . . [the individual rotor discs being, one for each stage, on a common shaft and axially spaced, e.g. conventional centrifugal multi-stage compressors]
17/125 . . . [the casing being vertically split]
17/127 . . . [with radially spaced stages, e.g. for contrarotating type]
17/14 . . . [with means for changing the flow-path through the stages, e.g. series-parallel, e.g. side-loads, (surge control F04D 27/02)]
17/16 . . . for displacing without appreciable compression
17/161 . . . [Shear force pumps]
17/162 . . . [Double suction pumps]
17/164 . . . [Multi-stage fans, e.g. for vacuum cleaners]
17/165 . . . [Axial entry and discharge]
17/167 . . . [Operating by means of fibrous or porous elements (suction filters F04D 29/701), e.g. with sponge rotors]
17/168 . . . [Pumps specially adapted to produce a vacuum]
17/18 . . . characterised by use of centrifugal force of liquids entrained in pumps (e.g. by means of an auxiliary liquid; fluid ring compressors F04C 19/00)]

19/00 Axial-flow pumps (F04D 21/00) takes precedence; (pump comprising axial flow and radial flow stages F04D 17/0025)

19/002 . . . [Axial flow fans]
19/005 . . . [reversible fans]
19/007 . . . [multistage fans]
19/02 . . . Multi-stage pumps
19/022 . . . [with concentric rows of vanes;]
19/024 . . . [with contrarotating parts]
19/026 . . . [with a plurality of shafts rotating at different speeds (F04D 19/022 takes precedence)]
19/028 . . . [Layout of fluid flow through the stages]
19/04 . . . specially adapted to the production of a high vacuum, e.g. molecular pumps]
19/042 . . . [Turbomolecular vacuum pumps]
19/044 . . . [Holweck-type pumps]
19/046 . . . [Combinations of two or more different types of pumps]
19/048 . . . [comprising magnetic bearings]

21/00 Pump involving supersonic speed of pumped fluids

23/00 Other rotary non-positive-displacement pumps (pumping installations or systems F04D 25/00)
23/001 . . . [Pumps adapted for conveying materials or for handling specific elastic fluids]
23/003 . . . [of radial-flow type]
23/005 . . . [of axial-flow type]
23/006 . . . [Creating a pulsating flow]
23/008 . . . [Regenerative pumps (for liquids or for liquids and elastic fluids F04D 5/002)]

25/00 Pumping installations or systems (controlling F04D 27/00)
25/02 . . . Units comprising pumps and their driving means (predominant aspect of the driving means, see the relevant classes for such means)

25/022 . . . [comprising a yielding coupling, e.g. magnetic coupling F04D 25/026]
25/024 . . . [the driving means being assisted by a power recovery turbine]
25/026 . . . [with a magnetic coupling]
25/028 . . . [the driving means being a planetary gear]
25/04 . . . the pump being fluid-driven (pumps driven by exhaust gases F02B 37/00, F02B 39/00; turbochargers F02C 6/12)]
25/045 . . . [the pump wheel carrying the fluid driving means, e.g. turbine blades]
25/06 . . . the pump being electrically driven (F04D 25/08 takes precedence)
25/0606 . . . [the electric motor being specially adapted for integration in the pump]
25/0613 . . . [the electric motor being of the inside-out type, i.e. the rotor is arranged radically outside a central stator]
25/062 . . . [Details of the bearings]
25/0626 . . . [Details of the lubrication]
25/0633 . . . [Details of the magnetic circuit]
25/064 . . . [Details of the rotor]
25/0646 . . . [Details of the stator]
25/0653 . . . [the motor having a plane air gap, e.g. disc-type]
25/066 . . . [Linear Motors]
25/0666 . . . [a sensor is integrated into the pump/motor design]
25/0673 . . . [Battery powered]
25/068 . . . [Mechanical details of the pump control unit (pump control details F04D 27/00)]
25/0686 . . . [specially adapted for submerged use]
25/0693 . . . [Details or arrangements of the wiring]
25/08 . . . the working fluid being air, e.g. for ventilation
25/082 . . . [the unit having provision for cooling the motor]
25/084 . . . [hand fans]
25/086 . . . [hand operated]
25/088 . . . [Ceiling fans]
25/10 . . . the unit having provisions for automatically changing direction of output air
25/105 . . . [by changing rotor axis direction, e.g. oscillating fans (interconnecting rotary motion and oscillating motion F16H)]
25/12 . . . the unit being adapted for mounting in apertures
25/14 . . . [and having shutters, e.g. automatically closed when not in use]
25/16 . . . Combinations of two or more pumps [Producing two or more separate gas flows]
25/163 . . . [driven by a common gearing arrangement]
25/166 . . . [using fans]

27/00 Control, e.g. regulation, of pumps, pumping installations or systems
27/001 . . . [Testing thereof; Determination or simulation of flow characteristics; Stall or surge detection, e.g. condition monitoring]
27/002 . . . [by varying geometry within the pumps, e.g. by adjusting vanes]
27/003 . . . [by throttling (F04D 27/002 takes precedence)]
27/004 . . . [by varying driving speed]
Pumping elastic fluids by rotary pumps

Details, component parts, or accessories (machine elements in general F16)

- [especially adapted for elastic fluid pumps]
- [especially adapted for liquid pumps]
- Selection of particular materials (for handling specific liquids F04D 7/00 [F04D 23/001])
- [especially adapted for elastic fluid pumps]
- [especially adapted for liquid pumps]
- Shafts or bearings, or assemblies thereof (especially adapted for elastic fluid pumps F04D 29/0405)
- [joining shafts, e.g. rigid couplings, quill shafts]

WARNING

The group F04D 29/0405 is no longer used for the classification of new documents as from July 1st, 2007. The backlog of this group is being continuously reclassified to F04D 29/044 and F04D 29/054.

- Axial thrust balancing
- [hydrostatic; hydrodynamic thrust bearings]
- [balancing pistons]
- Axially shiftable rotors (F04D 29/041 takes precedence; [control by creating a by-pass F04D 15/0027])
- Shafts
- Arrangements for joining or assembling shafts
- Bearings
- [Bearing cartridges]
- [Ceramic bearing designs]

- [Spherical bearings]
- hydrostatic; hydrodynamic
- [for radial pumps]
- [for axial pumps]
- magnetic; electromagnetic
- Roller bearings
- Shafts or bearings, or assemblies thereof, specially adapted for elastic fluid pumps
- Axial thrust balancing
- [hydrostatic; hydrodynamic thrust bearings]
- [balancing pistons]
- Axially shiftable rotors (F04D 29/051 takes precedence; [control by creating a by-pass F04D 27/0246])
- Shafts
- Arrangements for joining or assembling shafts
- Bearings
- [Bearings cartridges]
- [Ceramic bearing designs]
- [especially adapted for liquid pumps]
- [especially adapted for elastic fluid pumps]
- Seals
- [especially adapted for elastic fluid pumps]
- [especially adapted for liquid pumps]
- Shaft sealings
- [especially adapted for elastic fluid pumps]
- [the sealing fluid being other than the working fluid or being the working fluid treated]
- [especially adapted for liquid pumps]
- [the sealing fluid being other than the working liquid or being the working liquid treated]
- using sealing-rings
- [especially adapted for elastic fluid pumps]
- [with special means for adducting cooling or sealing fluid]
- [especially adapted for liquid pumps]
- [with special means for adducting cooling or sealing fluid]
- operative only when pump is inoperative
- [especially adapted for elastic fluid pumps]
- [especially adapted for liquid pumps]
- between pressure and suction sides
- [especially adapted for elastic fluid pumps]
- [of a centrifugal flow wheel]
- [of an axial flow wheel]
- [especially adapted for liquid pumps]
- [of a centrifugal flow wheel]
- [of an axial flow wheel]
- Rotors (specially for elastic fluids F04D 29/26)
- [Axial flow rotors (F04D 29/185 takes precedence)]
- [Semi axial flow rotors]
- [Rotors consisting of a plurality of wheels]
- [Shaftless rotors (F04D 13/024 takes precedence)]
Pumping elastic fluids by rotary pumps

Rotors specially for elastic fluids

for axial flow pumps

for centrifugal or helico-centrifugal pumps { for mounting compressor rotors on shafts }

specially for centrifugal pumps

{ specially for regenerative pumps }

Blades { (for axial flow compressors }

Flexible blades

characterised by form

Skewed blades

characterised by construction

Casing; Connections of working fluid { (bleed or by-pass valves F04D 15/0011, F04D 27/0215) }

especially adapted for liquid pumps

especially adapted for elastic fluid pumps

suction ports

Discharge tongues (F04D 17/04 takes precedence)

Fan casings

with volutes extending mainly in axial or radially inward direction

Double entry casings

comprising more than one outlet

with axial entry and discharge

especially adapted for liquid pumps

made of sheet metal

suction eyes

Discharge tongues (F04D 17/04 takes precedence)

inside lining, e.g. rubber

Details of fluid inlet or outlet

Fluid-guiding means, e.g. diffusers

especially adapted for elastic fluid pumps

rotating diffusers

Bladed diffusers

especially adapted for liquid pumps

rotating diffusers

bladed diffusers

adjustable

especially adapted for elastic fluid pumps

Adjusting flow cross-section, otherwise than by using adjustable stator blades

especially adapted for liquid fluid pumps

Adjusting flow cross-section, otherwise than by using adjustable stator blades

for unidirectional fluid flow in reversible pumps { (rotors for reverse action F04D 29/2283) }

especially adapted for elastic fluid pumps
Pumping elastic fluids by rotary pumps

... {especially adapted for liquid pumps}
29/62 ... of radial or helico-centrifugal pumps
29/622 ... {A45B}
29/64 ... of axial pumps
29/644 ... [by adjusting the clearances between rotary and stationary parts]
29/646 ... {Mounting or removal of fans}
29/648 ... {especially adapted for liquid pumps}
29/66 ... Combating cavitation, whirls, noise, vibration or the like (gas-flow silencers for machines or engines in general F01N); Balancing (surge control F04D 27/02)
29/661 ... {especially adapted for liquid pumps}
29/662 ... {Balancing of rotors (compensating unbalance G01M 1/36)}
29/663 ... {Sound attenuation}
29/664 ... {by means of sound absorbing material}
29/665 ... {by means of resonance chambers or interference}
29/666 ... {by means of rotor construction or layout, e.g. unequal distribution of blades or vanes}
29/667 ... {by influencing the flow pattern, e.g. suppression of turbulence}
29/668 ... {by fluid injection}
29/669 ... (especially adapted for liquid pumps (F04D 29/18 takes precedence))
31/00 Pumping liquids and elastic fluids at the same time
29/68 ... by influencing boundary layers (by bleeding elastic fluid F04D 27/0215)
29/681 ... {especially adapted for elastic fluid pumps}
29/682 ... {by fluid extraction}
29/684 ... {by fluid injection}
29/685 ... {Inducing localised fluid recirculation in the stator-rotor interface}
29/687 ... {Plasma actuators therefore}
29/688 ... {especially adapted for liquid pumps}
29/69 ... Suction grids; Strainers; Dust separation; Cleaning
29/70 ... {especially adapted for elastic fluid pumps}
29/703 ... {specially for fans, e.g. fan guards}
29/705 ... {Adding liquids}
29/706 ... {Humidity separation}
29/708 ... {specially for liquid pumps}

Other non-positive-displacement pumps

33/00 Non-positive-displacement pumps with other than pure rotation, e.g. of oscillating type (F04D 35/00 takes precedence; hand-held fans A45B)
35/00 Pumps producing waves in liquids, i.e. wave-producers (for bath tubs A47K 3/10)