

CPC**COOPERATIVE PATENT CLASSIFICATION****F04D****NON-POSITIVE DISPLACEMENT PUMPS****NOTE**

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.

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.

Attention is drawn to the Notes preceding class [F01](#), especially as regards the definition of "pump".

Guidance heading: **Pumping liquids, or liquids and elastic fluids, by rotary pumps** ([pumping liquids and elastic fluids at the same time F04D 31/00](#))

F04D 1/00 **Radial-flow pumps, e.g. centrifugal pumps ; Helico-centrifugal pumps** ([adapted for pumping specific fluids F04D 7/00](#) ; [priming or boosting F04D 9/00](#))

- F04D 1/003 . { [Having contrarotating parts](#) }
- F04D 1/006 . { [double suction pumps](#) }
- F04D 1/02 . having non-centrifugal stages, e.g. centripetal
- F04D 1/025 . . { [Comprising axial and radial stages](#) }
- F04D 1/04 . Helico-centrifugal pumps
- F04D 1/06 . Multi-stage pumps ([F04D 1/02](#) , [F04D 13/10](#) take precedence)
- F04D 1/063 . . { [of the vertically split casing type](#) }
- F04D 1/066 . . . { [the casing consisting of a plurality of annuli bolted together](#) }
- F04D 1/08 . . the stages being situated concentrically
- F04D 1/10 . . with means for changing the flow-path through the stages, e.g. series-parallel, e.g. side loads
- F04D 1/12 . Pumps with scoops or like paring members protruding in the fluid circulating in a bowl
- F04D 1/14 . Pumps raising fluids by centrifugal force within a conical rotary bowl with vertical axis
- F04D 3/00** **Axial-flow pumps** ([priming or boosting F04D 9/00](#))
- F04D 3/005 . { [with a conventional single stage rotor](#) }
- F04D 3/02 . of screw type

F04D 5/00 **Pumps with circumferential or transverse flow** { (control thereof [F04D 15/005](#)) }

- F04D 5/001
 - { Shear force pumps }
- F04D 5/002
 - { Regenerative pumps (for elastic fluids [F04D 23/008](#)) }
- F04D 5/003
 - .. { of multistage type }
- F04D 5/005
 - ... { the stages being radially offset }
- F04D 5/006
 - ... { the stages being axially offset }
- F04D 5/007
 - .. { Details of the inlet or outlet }
- F04D 5/008
 - .. { Details of the stator, e.g. channel shape }

F04D 7/00 **Pumps adapted for handling specific fluids, e.g. by selection of specific materials for pumps or pump parts (F04D 11/005 , F04D 29/22 take precedence)**

- F04D 7/02
 - of centrifugal type
- F04D 7/04
 - the fluids being viscous or non-homogenous
- F04D 7/045
 - { with means for comminuting, mixing stirring or otherwise treating }
- F04D 7/06
 - the fluids being hot or corrosive, e.g. liquid metals
- F04D 7/065
 - { for liquid metal }
- F04D 7/08
 - the fluids being radioactive

F04D 9/00 Priming ; Preventing vapour lock

- F04D 9/001
 - . { Preventing vapour lock ([F04D 9/041](#) takes precedence) }
- F04D 9/002
 - .. { by means in the very pump ([F04D 9/041](#) takes precedence) }
- F04D 9/003
 - ... { separating and removing the vapour }
- F04D 9/004
 - . { Priming of not self-priming pumps }
- F04D 9/005
 - .. { by adducting or recycling liquid ([F04D 9/006](#) takes precedence) }
- F04D 9/006
 - .. { by venting gas or using gas valves }
- F04D 9/007
 - . { Preventing loss of prime, siphon breakers (stopping of pumps [F04D 15/02](#)) }
- F04D 9/008
 - .. { by means in the suction mouth, e.g. foot valves }
- F04D 9/02
 - . Self-priming pumps
- F04D 9/04
 - . Using priming pumps ; Using booster pumps to prevent vapour-lock
- F04D 9/041
 - .. { the priming pump having evacuating action ([F04D 9/043](#) and [F04D 9/06](#) take precedence) }
- F04D 9/042
 - ... { and means for rendering its in operative }
- F04D 9/043
 - .. { the priming pump being hand operated or of the reciprocating type }
- F04D 9/044
 - .. { Means for rendering the priming pump inoperative }
- F04D 9/045
 - ... { the means being liquid level sensors }
- F04D 9/046
 - { the means being floats }

- F04D 9/047 ... { the means being flow sensors }
- F04D 9/048 ... { the means being outlet pressure sensors }
- F04D 9/049 ... { by operator interventions }
- F04D 9/06 .. of jet type
- F04D 9/065 ... { the driving fluid being a gas or vapour, e.g. exhaust of a combustion engine }

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

- F04D 11/005 . { Swash-type impeller pumps }

F04D 13/00 **Pumping installations or systems (controlling [F04D 15/00](#))**

- F04D 13/02 . Units comprising pumps and their driving means (predominant aspects of the driving means, see the relevant classes for such means)
- F04D 13/021 .. { containing a coupling }
- F04D 13/022 ... { a coupling allowing slip, e.g. torque converter }
- F04D 13/023 { for reducing start torque }
- F04D 13/024 ... { a magnetic coupling }
- F04D 13/025 { Details of the can separating the pump and drive area }
- F04D 13/026 { Details of the bearings }
- F04D 13/027 { Details of the magnetic circuit }
- F04D 13/028 .. { the driving means being a planetary gear }
- F04D 13/04 .. the pump being fluid driven
- F04D 13/043 ... { the pump wheel carrying the fluid driving means }
- F04D 13/046 ... { the fluid driving means being a hydraulic motor of the positive displacement type }
- F04D 13/06 .. the pump being electrically driven
- F04D 13/0606 ... { Canned motor pumps }
- F04D 13/0613 { Special connection between the rotor compartments }
- F04D 13/062 { pressure compensation between motor- and pump- compartment }
- F04D 13/0626 { Details of the can }
- F04D 13/0633 { Details of the bearings }
- F04D 13/064 { Details of the magnetic circuit }
- F04D 13/0646 ... { the hollow pump or motor shaft being the conduit for the working fluid }
- F04D 13/0653 ... { the motor being flooded }
- F04D 13/066 ... { Floating-units }
- F04D 13/0666 ... { the motor being of the plane gap type }
- F04D 13/0673 ... { the motor being of the inside-out type }
- F04D 13/068 ... { Battery powered }
- F04D 13/0686 ... { Mechanical details of the pump control unit (pump control [F04D 15/00](#)) }
- F04D 13/0693 ... { Details or arrangements of the wiring }
- F04D 13/08 ... for submerged use

F04D 13/083	.... { and protected by a gas-bell }
F04D 13/086	.... { the pump and drive motor are both submerged }
F04D 13/10	.... adapted for use in mining bore holes
F04D 13/12	. Combinations of two or more pumps (combinations with priming pumps or booster pumps to counteract vapour-lock F04D 9/04)
F04D 13/14	.. the pumps being all of centrifugal type { (deviation valves F04D 15/0016) }
F04D 13/16	. with storage reservoirs
F04D 15/00	Control, e.g. regulation, of pumps, pumping installations or systems
F04D 15/0005	. { by using valves }
F04D 15/0011	.. { by-pass valves }
F04D 15/0016	.. { mixing-reversing- or deviation valves }
F04D 15/0022	.. { throttling valves or valves varying the pump inlet opening or the outlet opening }
F04D 15/0027	. { Varying behaviour or the very pump (F04D 15/0055 and F04D 29/46 take precedence) }
F04D 15/0033	.. { By-passing by increasing clearance between impeller and its casing }
F04D 15/0038	.. { by varying the effective cross-sectional area of flow through the rotor }
F04D 15/0044	.. { by introducing a gas }
F04D 15/005	.. { the pumps being of the circumferential flow type }
F04D 15/0055	. { Rotors with adjustable blades }
F04D 15/0061	.. { responsive to temperature }
F04D 15/0066	. { by changing the speed, e.g. of the driving engine }
F04D 15/0072	. { Installation or systems with two or more pumps, wherein the flow path through the stages can be changed, e.g. series-parallel }
F04D 15/0077	. { Safety measures (F04D 15/02 takes precedence) }
F04D 15/0083	.. { Protection against sudden pressure change, e.g. check valves }
F04D 15/0088	. { Testing machines }
F04D 15/0094	. { Indicators of rotational movement }
F04D 15/02	. Stopping of pumps, or operating valves, on occurrence of unwanted conditions
F04D 15/0209	.. { responsive to a condition of the working fluid (F04D 15/029 takes precedence) }
F04D 15/0218	... { the condition being a liquid level or a lack of liquid supply }
F04D 15/0227	.... { Lack of liquid level being detected using a flow transducer }
F04D 15/0236	.... { Lack of liquid level being detected by analysing the parameters of the electric drive, e.g. current or power consumption }
F04D 15/0245	.. { responsive to a condition of the pump }
F04D 15/0254	... { the condition being speed or load }

- F04D 15/0263 . . . { the condition being temperature, ingress of humidity or leakage }
- F04D 15/0272 . . . { the condition being wear or a position }
- F04D 15/0281 . . { responsive to a condition not otherwise provided for }
- F04D 15/029 . . { for pumps operating in parallel }

Guidance heading: Pumping elastic fluids by rotary pumps

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

- F04D 17/02 . having non-centrifugal stages, e.g. centripetal
- F04D 17/025 . . { comprising axial flow and radial flow stages }
- F04D 17/04 . . of transverse-flow type
- F04D 17/06 . Helico-centrifugal pumps
- F04D 17/08 . Centrifugal pumps
- F04D 17/10 . . for compressing or evacuating
- F04D 17/105 . . . { with double suction }
- F04D 17/12 . . . Multi-stage pumps
- F04D 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 }
- F04D 17/125 { the casing being vertically split }
- F04D 17/127 { with radially spaced stages, e.g. for contrarotating type }
- F04D 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](#))
- F04D 17/16 . . for displacing without appreciable compression
- F04D 17/161 . . . { Shear force pumps }
- F04D 17/162 . . . { Double suction pumps }
- F04D 17/164 . . . { Multi-stage fans, e.g. for vacuum cleaners }
- F04D 17/165 . . . { Axial entry and discharge }
- F04D 17/167 . . . { Operating by means of fibrous or porous elements ([suction filters F04D 29/701](#)) ; e.g. with sponge rotors }
- F04D 17/168 . . . { Pumps specially adapted to produce a vacuum }
- F04D 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](#) }

F04D 19/00 Axial-flow pumps ([F04D 21/00](#) takes precedence) ; { pump comprising axial flow and radial flow stages [F04D 17/025](#) }

- F04D 19/002 . { Axial flow fans }
- F04D 19/005 . . { reversible fans }
- F04D 19/007 . { multistage fans }
- F04D 19/02 . Multi-stage pumps

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

F04D 21/00 Pump involving supersonic speed of pumped fluids

F04D 23/00 Other rotary non-positive-displacement pumps ([pumping installations or systems F04D 25/00](#))

- F04D 23/001 . { Pumps adapted for conveying materials or for handling specific elastic fluids }
- F04D 23/003 .. { of radial-flow type }
- F04D 23/005 .. { of axial-flow type }
- F04D 23/006 . { Creating a pulsating flow }
- F04D 23/008 . { Regenerative pumps ([for liquids or for liquids and elastic fluids 5/00R](#)) }

F04D 25/00 Pumping installations or systems ([controlling F04D 27/00](#))

- F04D 25/02 . Units comprising pumps and their driving means ([predominant aspect of the driving means, see the relevant classes for such means](#))
- F04D 25/022 .. { comprising a yielding coupling, e.g. hydraulic ([a magnetic coupling 25/02D](#)) }
- F04D 25/024 .. { the driving means being assisted by a power recovery turbine }
- F04D 25/026 .. { with a magnetic coupling }
- F04D 25/028 .. { the driving means being a planetary gear }
- F04D 25/04 .. the pump being fluid-driven { ([pumps driven by exhaust gases F02B 37/00](#) , [F02B 39/00](#) ; [turbochargers F02C 6/12](#)) }
- F04D 25/045 ... { the pump wheel carrying the fluid driving means, e.g. turbine blades }
- F04D 25/06 .. the pump being electrically driven ([F04D 25/08](#) takes precedence)
- F04D 25/0606 ... { the electric motor being specially adapted for integration in the pump }
- F04D 25/0613 { the electric motor being of the inside-out type, i.e. the rotor is arranged radially outside a central stator }
- F04D 25/062 { Details of the bearings }
- F04D 25/0626 { Details of the lubrication }
- F04D 25/0633 { Details of the magnetic circuit }
- F04D 25/064 { Details of the rotor }
- F04D 25/0646 { Details of the stator }

- F04D 25/0653 { the motor having a plane air gap, e.g. disc-type }
- F04D 25/066 { Linear Motors }
- F04D 25/0666 { a sensor is integrated into the pump/motor design }
- F04D 25/0673 . . . { Battery powered }
- F04D 25/068 . . . { Mechanical details of the pump control unit ([pump control details F04D27](#)) }
- F04D 25/0686 . . . { specially adapted for submerged use }
- F04D 25/0693 . . . { Details or arrangements of the wiring }
- F04D 25/08 . . the working fluid being air, e.g. for ventilation
- F04D 25/082 . . . { the unit having provision for cooling the motor }
- F04D 25/084 . . . { hand fans }
- F04D 25/086 { hand operated }
- F04D 25/088 . . . { Ceiling fans }
- F04D 25/10 . . . the unit having provisions for automatically changing direction of output air
- F04D 25/105 { by changing rotor axis direction, e.g. oscillating fans ([interconnecting rotary motion and oscillating motion F16H](#)) }
- F04D 25/12 . . . the unit being adapted for mounting in apertures
- F04D 25/14 and having shutters, e.g. automatically closed when not in use
- F04D 25/16 . . Combinations of two or more pumps { Producing two or more separate gas flows }
- F04D 25/163 . . { driven by a common gearing arrangement }
- F04D 25/166 . . { using fans }

F04D 27/00 Control, e.g. regulation, of pumps, pumping installations or systems

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/02](#) which covers also control in general not focussing on surge control

- F04D 27/001 . { Testing thereof; Determination or simulation of flow characteristics; Stall or surge detection, e.g. condition monitoring }
- F04D 27/002 . { by varying geometry within the pumps, e.g. by adjusting vanes }

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/02 C](#)

- F04D 27/003 . { by throttling ([F04D 27/002](#) takes precedence) }

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/02 D](#))

- F04D 27/004 . { by varying driving speed }

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/02 F](#)

- [F04D 27/005](#) . { by changing flow path between different stages or between a plurality of compressors; Load distribution between compressors }

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/02 G\]](#)

- [F04D 27/006](#) . { by influencing fluid temperatures }

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/02 K](#)

- [F04D 27/007](#) . { Conjoint control of two or more different functions }

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/02 L](#)

- [F04D 27/008](#) . { Stop safety or alarm devices, e.g. stop-and-go control; Disposition of check-valves }

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/0292](#)

- [F04D 27/009](#) . { by bleeding, by passing or recycling fluid }

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/02 B](#)

- [F04D 27/02](#) . Surge control { (surge detection [F04D 27/001](#)) }
- [F04D 27/0207](#) . . { by bleeding, bypassing or recycling fluids } (influencing the boundary layer by an uncontrolled bleeding of the working fluid [F04D 29/681](#))
- [F04D 27/0215](#) . . . { Arrangements therefor, e.g. bleed or by-pass valves }
- [F04D 27/0223](#) . . . { Control schemes therefor }
- [F04D 27/023](#) . . . { Details or means for fluid extraction }
- [F04D 27/0238](#) . . . { Details or means for fluid reinjection }

- F04D 27/0246 .. { by varying geometry within the pumps, e.g. by adjusting vanes }
- F04D 27/0253 .. { by throttling ([F04D 27/0246](#) takes precedence) }
- F04D 27/0261 .. { by varying driving speed }
- F04D 27/0269 .. { by changing flow path between different stages or between a plurality of compressors; load distribution between compressors }
- F04D 27/0276 .. { by influencing fluid temperature }
- F04D 27/0284 .. { Conjoint control of two or more different functions }
- F04D 27/0292 .. { Stop safety or alarm devices, e.g. stop-and-go control; Disposition of check-valves }

F04D 29/00 Details, component parts, or accessories ([machine elements in general F16](#))

- F04D 29/002 . { especially adapted for elastic fluid pumps }
- F04D 29/005 . { Decorative aspects, i.e. features which have no effect on the functioning of the pump }
- F04D 29/007 . { especially adapted for liquid pumps }
- F04D 29/02 . Selection of particular materials ([for handling specific liquids F04D 7/00](#) { [F04D 23/001](#) })
- F04D 29/023 .. { especially adapted for elastic fluid pumps }
- F04D 29/026 .. { especially adapted for liquid pumps }
- F04D 29/04 . Shafts or bearings, or assemblies thereof ([specially adapted for elastic fluid pumps F04D 29/05](#))
- 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](#) }
- F04D 29/041 .. Axial thrust balancing
- F04D 29/0413 ... { hydrostatic; hydrodynamic thrust bearings }
- F04D 29/0416 ... { balancing pistons }
- F04D 29/042 .. Axially shiftable rotors [F04D 29/041](#) takes precedence { [control by creating a by-pass F04D 15/0027](#) }
- F04D 29/043 .. Shafts
- F04D 29/044 ... Arrangements for joining or assembling shafts
- F04D 29/046 .. Bearings
- F04D 29/0462 ... { Bearing cartridges }
- F04D 29/0465 ... { Ceramic bearing designs }
- F04D 29/0467 ... { Spherical bearings }
- F04D 29/047 ... hydrostatic ; hydrodynamic
- F04D 29/0473 { for radial pumps }
- F04D 29/0476 { for axial pumps }
- F04D 29/048 ... magnetic ; electromagnetic
- F04D 29/049 ... Roller bearings

F04D 29/05	. Shafts or bearings, or assemblies thereof, specially adapted for elastic fluid pumps
F04D 29/051	.. Axial thrust balancing
F04D 29/0513	... { hydrostatic; hydrodynamic thrust bearings }
F04D 29/0516	... { balancing pistons }
F04D 29/052	.. Axially shiftable rotors F04D 29/051 takes precedence { control by creating a by-pass F04D 27/0246 }
F04D 29/053	.. Shafts
F04D 29/054	... Arrangements for joining or assembling shafts
F04D 29/056	.. Bearings
F04D 29/0563	... { Bearings cartridges }
F04D 29/0566	... { Ceramic bearing designs }
F04D 29/057	... hydrostatic ; hydrodynamic
F04D 29/058	... magnetic ; electromagnetic
F04D 29/059	... Roller bearings
F04D 29/06	. Lubrication { (F04D 13/0606 , F04D 13/0646 , F04D 13/0653 take precedence) }
F04D 29/061	.. { especially adapted for liquid pumps }
F04D 29/063	.. especially adapted for elastic fluid pumps
F04D 29/08	. Sealings
F04D 29/083	.. { especially adapted for elastic fluid pumps }
F04D 29/086	.. { especially adapted for liquid pumps }
F04D 29/10	.. Shaft sealings
F04D 29/102	... { especially adapted for elastic fluid pumps }
F04D 29/104	.... { the sealing fluid being other than the working fluid or being the working fluid treated }
F04D 29/106	... { especially adapted for liquid pumps }
F04D 29/108	.... { the sealing fluid being other than the working liquid or being the working liquid treated }
F04D 29/12	... using sealing-rings
F04D 29/122	.... { especially adapted for elastic fluid pumps }
F04D 29/124	..... { with special means for adducting cooling or sealing fluid }
F04D 29/126	.... { especially adapted for liquid pumps }
F04D 29/128	..... { with special means for adducting cooling or sealing fluid }
F04D 29/14	... operative only when pump is inoperative
F04D 29/143	.... { especially adapted for elastic fluid pumps }
F04D 29/146	.... { especially adapted for liquid pumps }
F04D 29/16	.. between pressure and suction sides
F04D 29/161	... { especially adapted for elastic fluid pumps }
F04D 29/162	.... { of a centrifugal flow wheel }
F04D 29/164	.... { of an axial flow wheel }
F04D 29/165	... { especially adapted for liquid pumps }
F04D 29/167	.... { of a centrifugal flow wheel }

F04D 29/168	.... { of an axial flow wheel }
F04D 29/18	. Rotors (specially for elastic fluids F04D 29/26)
F04D 29/181	.. { Axial flow rotors (F04D 29/185 take precedence) }
F04D 29/183	... { Semi axial flow rotors }
F04D 29/185	.. { Rotors consisting of a plurality of wheels }
F04D 29/186	.. { Shaftless rotors (F04D 13/024 takes precedence) }
F04D 29/188	.. { specially for regenerative pumps }
F04D 29/20	.. Mounting rotors on shafts
F04D 29/22	.. specially for centrifugal pumps
F04D 29/2205	... { Conventional flow pattern (F04D 29/18 takes precedence) }
F04D 29/2211	.... { More than one set of flow passages }
F04D 29/2216	.... { Shape, geometry (F04D 29/2211 takes precedence) }
F04D 29/2222	.... { Construction and assembly (F04D 29/2211 takes precedence) }
F04D 29/2227	..... { for special materials }
F04D 29/2233	..... { entirely open or stamped from one sheet }
F04D 29/2238	... { Special flow patterns (F04D 11/005 takes precedence) }
F04D 29/2244	.... { Free vortex }
F04D 29/225	.... { Channel wheels, e.g. one blade or one flow channel }
F04D 29/2255	.... { flow-channels with a special cross-section contour, e.g. ejecting, throttling or diffusing effect }
F04D 29/2261	... { with special measures }
F04D 29/2266	.... { for sealing or thrust balance (F04D 29/04 and F04D 29/16 take precedence) }
F04D 29/2272	.... { for influencing flow or boundary layer }
F04D 29/2277	.... { for increasing NPSH or dealing with liquids near boiling-point }
F04D 29/2283	.... { for reverse pumping action }
F04D 29/2288	.... { for comminuting, mixing or separating }
F04D 29/2294	.... { for protection, e.g. against abrasion }
F04D 29/24	... Vanes
F04D 29/242	.... { Geometry, shape }
F04D 29/245	..... { for special effects }
F04D 29/247	.... { elastic or self-adjusting }
F04D 29/26	. Rotors specially for elastic fluids
F04D 29/263	.. { mounting fan or blower rotors on shafts }
F04D 29/266	.. { mounting compressor rotors on shafts }
F04D 29/28	.. for centrifugal or helico-centrifugal pumps { for radial-flow or helico-centrifugal pumps }
F04D 29/281	... { for fans or blowers }
F04D 29/282	.... { the leading edge of each vane being substantially parallel to the rotation axis }
F04D 29/283	..... { rotors of the squirrel-cage type }
F04D 29/284	... { for compressors }

F04D 29/285	....	{ the compressor wheel comprising a pair of rotatable bladed hub portions axially aligned and clamped together }
F04D 29/286	....	{ multi-stage rotors }
F04D 29/287	...	{ with adjusting means }
F04D 29/288	...	{ Part of the wheel having an ejecting effect e.g. being bladeless diffuser }
F04D 29/289	...	{ having provision against erosion or for dust-separation }
F04D 29/30	...	Vanes
F04D 29/305	....	{ Flexible vanes }
F04D 29/32	..	for axial flow pumps { multistage rotors F01D 5/00 }
F04D 29/321	...	{ for axial flow compressors }
F04D 29/322	....	{ blade mountings (F01D 5/30 takes precedence) }
F04D 29/323	.....	{ adjustable }
F04D 29/324	....	{ blades (F01D 5/282 takes precedence) }
F04D 29/325	...	{ for axial flow fans (blade mountings F04D 29/34 , blades F04D 29/38) }
F04D 29/326	....	{ comprising a rotating shroud }
F04D 29/327	....	{ with non identical blades }
F04D 29/328	....	{ with unequal distribution of blades around the hub }
F04D 29/329	....	{ Details of the hub }
F04D 29/34	...	Blade mountings { for axial flow compressors F04D 29/322 }
F04D 29/36	....	adjustable { flexible blades F04D 29/382 }
F04D 29/362	.....	{ during rotation }
F04D 29/364	.....	{ The blades having only a predetermined number of possible positions }
F04D 29/366	.....	{ Adjustment by interaction of inertia and lift }
F04D 29/368	.....	{ Adjustment by differences of temperature }
F04D 29/38	...	Blades { (for axial flow compressors F04D 29/324) }
F04D 29/382	....	{ Flexible blades }
F04D 29/384	....	{ characterised by form }
F04D 29/386	.....	{ Skewed blades }
F04D 29/388	....	{ characterised by construction }
F04D 29/40	.	Casings ; Connections of working fluid { bleed or by-pass valves F04D 15/0011 , F04D 27/0215 }
F04D 29/403	..	{ especially adapted for elastic fluid pumps }
F04D 29/406	..	{ especially adapted for liquid pumps }
F04D 29/42	..	for radial or helico-centrifugal pumps
F04D 29/4206	...	{ especially adapted for elastic fluid pumps }
F04D 29/4213	....	{ suction ports }
F04D 29/422	....	{ Discharge tongues (F04D 17/04 takes precedence) }
F04D 29/4226	....	{ Fan casings }
F04D 29/4233	.....	{ with volutes extending mainly in axial or radially inward direction }
F04D 29/424	.....	{ Double entry casings }
F04D 29/4246	.....	{ comprising more than one outlet }

F04D 29/4253	.....	{ with axial entry and discharge }
F04D 29/426	...	{ especially adapted for liquid pumps }
F04D 29/4266	....	{ made of sheet metal }
F04D 29/4273	....	{ suction eyes }
F04D 29/428	....	{ Discharge tongues (F04D 17/04 takes precedence) }
F04D 29/4286	....	{ inside lining e.g. rubber }
F04D 29/4293	....	{ Details of fluid inlet or outlet }
F04D 29/44	...	Fluid-guiding means, e.g. diffusers
F04D 29/441	....	{ especially adapted for elastic fluid pumps }
F04D 29/442	.....	{ rotating diffusers }
F04D 29/444	.....	{ Bladed diffusers }
F04D 29/445	....	{ especially adapted for liquid pumps }
F04D 29/447	.....	{ rotating diffusers }
F04D 29/448	.....	{ bladed diffusers }
F04D 29/46	....	adjustable
F04D 29/462	.....	{ especially adapted for elastic fluid pumps }
F04D 29/464	.....	{ adjusting flow cross-section, otherwise than by using adjustable stator blades }
F04D 29/466	.....	{ especially adapted for liquid fluid pumps }
F04D 29/468	.....	{ adjusting flow cross-section, otherwise than by using adjustable stator blades }
F04D 29/48	.....	for unidirectional fluid flow in reversible pumps { rotors for reverse action F04D 29/2283 }
F04D 29/483	.....	{ especially adapted for elastic fluid pumps }
F04D 29/486	.....	{ especially adapted for liquid pumps }
F04D 29/50	.....	for reversing fluid flow { rotors for reverse action F04D 29/2283 }
F04D 29/503	.....	{ especially adapted for elastic fluid pumps }
F04D 29/506	.....	{ especially adapted for liquid pumps }
F04D 29/52	..	for axial pumps
F04D 29/522	...	{ especially adapted for elastic fluid pumps }
F04D 29/524	....	{ shiftable members for obturating part of the flow path }
F04D 29/526	....	{ Details of the casing section radially opposing blade tips (ducts F04D 29/545) }
F04D 29/528	...	{ especially adapted for liquid pumps }
F04D 29/54	...	Fluid-guiding means, e.g. diffusers
F04D 29/541	....	{ Specially adapted for elastic fluid pumps (F04D 29/56 takes precedence) }
F04D 29/542	.....	{ Bladed diffusers (fixing blades to stators F01D 9/042) }
F04D 29/544	.....	{ Blade shapes }
F04D 29/545	.....	{ Ducts }
F04D 29/547	.....	{ having a special shape in order to influence fluid flow }
F04D 29/548	....	{ Specially adapted for liquid pumps (F04D 29/56 takes precedence) }
F04D 29/56	....	adjustable
F04D 29/563	.....	{ specially adapted for elastic fluid pumps }

- F04D 29/566 { specially adapted for liquid pumps }
- F04D 29/58 . Cooling (of machines or engines in general [F01P](#)) ; Heating ; Diminishing heat transfer { for the motor of air-pump units [F04D 25/082](#) ; cooling of shafts or bearings [F04D 29/04](#) }
- F04D 29/5806 . . { Cooling the drive system }
- F04D 29/5813 . . { Cooling the control unit }
- F04D 29/582 . . { specially adapted for elastic fluid pumps }
- F04D 29/5826 . . . { Cooling at least part of the working fluid in a heat exchanger }
- F04D 29/5833 { flow schemes and regulation thereto }
- F04D 29/584 . . . { cooling or heating the machine ([F04D 29/5846](#) , [F04D 29/5853](#) take precedence) }
- F04D 29/5846 . . . { cooling by injection }
- F04D 29/5853 . . . { heat insulation or conduction }
- F04D 29/586 . . { specially adapted for liquid pumps }
- F04D 29/5866 . . . { Cooling at last part of the working fluid in a heat exchanger }
- F04D 29/5873 { flow schemes and regulation thereto }
- F04D 29/588 . . . { cooling or heating the machine ([F04D 29/5886](#) , [F04D 29/5893](#) take precedence) }
- F04D 29/5886 . . . { cooling by injection }
- F04D 29/5893 . . . { heat insulation or conduction }
- F04D 29/60 . Mounting ; Assembling ; Disassembling { [F04D 13/10](#) takes precedence }
- F04D 29/601 . . { specially adapted for elastic fluid pumps }
- F04D 29/602 . . . { Mounting in cavities }
- F04D 29/603 { means for positioning from outside }
- F04D 29/604 { means for removing without depressurising the cavity }
- F04D 29/605 . . { specially adapted for liquid pumps }
- F04D 29/606 . . . { Mounting in cavities }
- F04D 29/607 { means for positioning from outside }
- F04D 29/608 { means for removing without depressurizing the cavity }
- F04D 29/62 . . of radial or helico-centrifugal pumps
- F04D 29/622 . . . { Adjusting the clearances between rotary and stationary parts }
- F04D 29/624 . . . { especially adapted for elastic fluid pumps }
- F04D 29/626 { Mounting or removal of fans }
- F04D 29/628 . . . { especially adapted for liquid pumps }
- F04D 29/64 . . of axial pumps
- F04D 29/642 . . . { by adjusting the clearances between rotary and stationary parts }
- F04D 29/644 . . . { especially adapted for elastic fluid pumps }
- F04D 29/646 { Mounting or removal of fans }
- F04D 29/648 . . . { especially adapted for liquid pumps }
- F04D 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](#))
- F04D 29/661 . . { especially adapted for elastic fluid pumps }

F04D 29/662	...	{ Balancing of rotors (compensating unbalance G01M 1/36) }
F04D 29/663	...	{ Sound attenuation }
F04D 29/664	....	{ by means of sound absorbing material }
F04D 29/665	....	{ by means of resonance chambers or interference }
F04D 29/666	...	{ by means of rotor construction or layout, e.g. unequal distribution of blades or vanes }
F04D 29/667	...	{ by influencing the flow pattern, e.g. suppression of turbulence }
F04D 29/668	...	{ damping or preventing mechanical vibrations }
F04D 29/669	..	{ especially adapted for liquid pumps (F04D 29/18 takes precedence) }
F04D 29/68	..	by influencing boundary layers { (by bleeding elastic fluid F04D 27/0215) }
F04D 29/681	...	{ especially adapted for elastic fluid pumps }
F04D 29/682	....	{ by fluid extraction }
F04D 29/684	....	{ by fluid injection }
F04D 29/685	....	{ Inducing localised fluid recirculation in the stator-rotor interface }
F04D 29/687	....	{ Plasma actuators therefore }
F04D 29/688	...	{ especially adapted for liquid pumps }
F04D 29/70	.	Suction grids ; Strainers ; Dust separation ; Cleaning
F04D 29/701	..	{ especially adapted for elastic fluid pumps }
F04D 29/703	...	{ specially for fans, e.g. fan guards }
F04D 29/705	...	{ Adding liquids }
F04D 29/706	...	{ Humidity separation }
F04D 29/708	..	{ specially for liquid pumps }

Guidance heading: Other non-positive-displacement pumps

F04D 31/00	Pumping liquids and elastic fluids at the same time
F04D 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)
F04D 35/00	Pumps producing waves in liquids, i.e. wave.producers (for bath tubs A47K 3/10)