

ECLA**EUROPEAN CLASSIFICATION****F04D****NON-POSITIVE DISPLACEMENT PUMPS****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".

Guide heading:

Pumping liquids, or liquids and elastic fluids, by rotary pumps ([pumping liquids and elastic fluids at the same time F04D31/00](#))

F04D1/00

Radial-flow pumps, e.g. centrifugal pumps; Helico-centrifugal pumps ([adapted for pumping specific fluids F04D7/00](#); [priming or boosting F04D9/00](#))

F04D1/00B

- . [N: Having contrarotating parts]

F04D1/00C

- . [N: double suction pumps]

F04D1/02

- . having non-centrifugal stages, e.g. centripetal

F04D1/02B

- . . [N: Comprising axial and radial stages]

F04D1/04

- . Helico-centrifugal pumps

F04D1/06

- . Multi-stage pumps ([F04D1/02](#), [F04D13/10](#) take precedence)

F04D1/06B

- . . [N: of the vertically split casing type]

F04D1/06B2

- . . . [N: the casing consisting of a plurality of annuli bolted together]

F04D1/08

- . . the stages being situated concentrically

F04D1/10

- . . with means for changing the flow-path through the stages, e.g. series-parallel, e.g. side loads

F04D1/12

- . Pumps with scoops or like paring members protruding in the fluid circulating in a bowl

F04D1/14

- . Pumps raising fluids by centrifugal force within a conical rotary bowl with vertical axis

F04D3/00

Axial-flow pumps ([priming or boosting F04D9/00](#))

F04D3/00B

- . [N: with a conventional single stage rotor]

F04D3/02

- . of screw type

F04D5/00

Pumps with circumferential or transverse flow [N: (control thereof [F04D15/00C6](#))]

- F04D5/00B . [N: Shear force pumps]
- F04D5/00R . [N: Regenerative pumps (for elastic fluids [F04D23/00R](#))]
- F04D5/00R2 . . [N: of multistage type]
- F04D5/00R2B . . . [N: the stages being radially offset]
- F04D5/00R2D . . . [N: the stages being axially offset]
- F04D5/00R4 . . [N: Details of the inlet or outlet] [N1111]
- F04D5/00R6 . . [N: Details of the stator, e.g. channel shape] [N1111]

F04D7/00 **Pumps adapted for handling specific fluids, e.g. by selection of specific materials for pumps or pump parts ([F04D11/00B](#), [F04D29/22](#) take precedence)**

- F04D7/02 . of centrifugal type
- F04D7/04 . . the fluids being viscous or non-homogenous
- F04D7/04B . . . [N: with means for comminuting, mixing stirring or otherwise treating]
- F04D7/06 . . the fluids being hot or corrosive, e.g. liquid metals [C1111]
- F04D7/06B . . . [N: for liquid metal]
- F04D7/08 . . the fluids being radioactive

F04D9/00 **Priming; Preventing vapour lock**

- F04D9/00B . [N: Preventing vapour lock ([F04D9/04B](#) takes precedence)]
- F04D9/00B2 . . [N: by means in the very pump ([F04D9/04B](#) takes precedence)]
- F04D9/00B2B . . . [N: separating and removing the vapour]
- F04D9/00C . [N: Priming of not self-priming pumps]
- F04D9/00C2 . . [N: by adducting or recycling liquid ([F04D9/00C3](#) takes precedence)]
- F04D9/00C3 . . [N: by venting gas or using gas valves]
- F04D9/00D . [N: Preventing loss of prime, siphon breakers (stopping of pumps [F04D15/02](#))]
- F04D9/00D2 . . [N: by means in the suction mouth, e.g. foot valves]
- F04D9/02 . Self-priming pumps
- F04D9/04 . Using priming pumps; Using booster pumps to prevent vapour-lock
- F04D9/04B . . [N: the priming pump having evacuating action ([F04D9/04C](#) and [F04D9/06](#) take precedence)]
- F04D9/04B2 . . . [N: and means for rendering its in operative]
- F04D9/04C . . [N: the priming pump being hand operated or of the reciprocating type]
- F04D9/04E . . [N: Means for rendering the priming pump inoperative] [N1111]
- F04D9/04E2 . . . [N: the means being liquid level sensors] [N1111]
- F04D9/04E2B [N: the means being floats] [N1111]
- F04D9/04E4 . . . [N: the means being flow sensors] [N1111]
- F04D9/04E6 . . . [N: the means being outlet pressure sensors] [N1111]

- F04D9/04E8 . . . [N: by operator interventions] [N1111]
- F04D9/06 . . of jet type
- F04D9/06B . . . [N: the driving fluid being a gas or vapour, e.g. exhaust of a combustion engine]

- F04D11/00** **Other rotary non-positive-displacement pumps** (pumping installations or systems [F04D13/00](#))

- F04D11/00B . [N: Swash-type impeller pumps]

- F04D13/00** **Pumping installations or systems** (controlling [F04D15/00](#))

- F04D13/02 . Units comprising pumps and their driving means (predominant aspects of the driving means, see the relevant classes for such means)
- F04D13/02B . . [N: containing a coupling]
- F04D13/02B2 . . . [N: a coupling allowing slip, e.g. torque converter]
- F04D13/02B2B [N: for reducing start torque] [N1111]
- F04D13/02B3 . . . [N: a magnetic coupling]
- F04D13/02B3B [N: Details of the can separating the pump and drive area] [N1111]
- F04D13/02B3D [N: Details of the bearings] [N1111]
- F04D13/02B3F [N: Details of the magnetic circuit] [N1111]
- F04D13/02C . . [N: the driving means being a planetary gear]
- F04D13/04 . . the pump being fluid driven
- F04D13/04B . . . [N: the pump wheel carrying the fluid driving means]
- F04D13/04C . . . [N: the fluid driving means being a hydraulic motor of the positive displacement type]

- F04D13/06 . . the pump being electrically driven
- F04D13/06B . . . [N: Canned motor pumps]
- F04D13/06B2 [N: Special connection between the rotor compartments]
- F04D13/06B3 [N: pressure compensation between motor- and pump- compartment]
- F04D13/06B5 [N: Details of the can] [N1111]
- F04D13/06B7 [N: Details of the bearings] [N1111]
- F04D13/06B9 [N: Details of the magnetic circuit] [N1111]
- F04D13/06C . . . [N: the hollow pump or motor shaft being the conduit for the working fluid]
- F04D13/06D . . . [N: the motor being flooded]
- F04D13/06F . . . [N: Floating-units]
- F04D13/06G . . . [N: the motor being of the plane gap type]
- F04D13/06J . . . [N: the motor being of the inside-out type]
- F04D13/06L . . . [N: Battery powered] [N1111]
- F04D13/06N . . . [N: Mechanical details of the pump control unit (pump control [F04D15/00](#))] [N1111]
- F04D13/06W . . . [N: Details or arrangements of the wiring] [N1111]
- F04D13/08 . . . for submerged use
- F04D13/08B [N: and protected by a gas-bell]
- F04D13/08D [N: the pump and drive motor are both submerged] [N1111]

- F04D13/10 adapted for use in mining bore holes
- F04D13/12 . Combinations of two or more pumps (combinations with priming pumps or booster pumps to counteract vapour-lock F04D9/04)
- F04D13/14 . . the pumps being all of centrifugal type [N: (deviation valves F04D15/00B3)]
- F04D13/16 . with storage reservoirs
- F04D15/00 Control, e.g. regulation, of pumps, pumping installations or systems**
- F04D15/00B . [N: by using valves]
- F04D15/00B2 . . [N: by-pass valves]
- F04D15/00B3 . . [N: mixing-reversing- or deviation valves]
- F04D15/00B4 . . [N: throttling valves or valves varying the pump inlet opening or the outlet opening]
- F04D15/00C . [N: Varying behaviour or the very pump (F04D15/00D and F04D29/46 take precedence)]
- F04D15/00C2 . . [N: By-passing by increasing clearance between impeller and its casing]
- F04D15/00C3 . . [N: by varying the effective cross-sectional area of flow through the rotor]
- F04D15/00C4 . . [N: by introducing a gas]
- F04D15/00C6 . . [N: the pumps being of the circumferential flow type]
- F04D15/00D . [N: Rotors with adjustable blades] [M1111]
- F04D15/00D2 . . [N: responsive to temperature]
- F04D15/00G . [N: by changing the speed, e.g. of the driving engine]
- F04D15/00H . [N: Installation or systems with two or more pumps, wherein the flow path through the stages can be changed, e.g. series-parallel] [M1111]
- F04D15/00K . [N: Safety measures (F04D15/02 takes precedence)] [M1111]
- F04D15/00K2 . . [N: Protection against sudden pressure change, e.g. check valves]
- F04D15/00L . [N: Testing machines] [M1111]
- F04D15/00R . [N: Indicators of rotational movement]
- F04D15/02 . Stopping of pumps, or operating valves, on occurrence of unwanted conditions
- F04D15/02B . . [N: responsive to a condition of the working fluid (F04D15/02F takes precedence)]
- F04D15/02B2 . . . [N: the condition being a liquid level or a lack of liquid supply]
- F04D15/02B2H [N: Lack of liquid level being detected using a flow transducer] [N1111]
- F04D15/02B2J [N: Lack of liquid level being detected by analysing the parameters of the electric drive, e.g. current or power consumption] [N1111]
- F04D15/02C . . [N: responsive to a condition of the pump]
- F04D15/02C2 . . . [N: the condition being speed or load]
- F04D15/02C3 . . . [N: the condition being temperature, ingress of humidity or leakage]
- F04D15/02C4 . . . [N: the condition being wear or a position]

- F04D15/02D . . [N: responsive to a condition not otherwise provided for]
- F04D15/02F . . [N: for pumps operating in parallel] [M1111]

Guide heading: **Pumping elastic fluids by rotary pumps**

F04D17/00 **Radial-flow pumps e.g. centrifugal pumps; Helico-centrifugal pumps** ([F04D21/00](#) takes precedence)

- F04D17/02 . having non-centrifugal stages, e.g. centripetal
- F04D17/02B . . [N: comprising axial flow and radial flow stages]
- F04D17/04 . . of transverse-flow type
- F04D17/06 . Helico-centrifugal pumps
- F04D17/08 . Centrifugal pumps
- F04D17/10 . . for compressing or evacuating
- F04D17/10B . . . [N: with double suction]
- F04D17/12 . . . Multi-stage pumps
- F04D17/12B [N: the individual rotor discs being, one for each stage, on a common shaft and axially spaced, e.g. conventional centrifugal multi- stage compressors]
- F04D17/12B2 [N: the casing being vertically split]
- F04D17/12C [N: with radially spaced stages, e.g. for contrarotating type]
- F04D17/14 with means for changing the flow-path through the stages, e.g. series-parallel, e.g. side-loads, ([surge control F04D27/02](#))
- F04D17/16 . . for displacing without appreciable compression
- F04D17/16B . . . [N: Shear force pumps]
- F04D17/16C . . . [N: Double suction pumps]
- F04D17/16D . . . [N: Multi-stage fans, e.g. for vacuum cleaners]
- F04D17/16F . . . [N: Axial entry and discharge]
- F04D17/16G . . . [N: Operating by means of fibrous or porous elements ([suction filters F04D29/70C](#)); e.g. with sponge rotors]
- F04D17/16H . . . [N: Pumps specially adapted to produce a vacuum]
- F04D17/18 . . characterised by use of centrifugal force of liquids entrained in pumps [N: e.g. by means of an auxiliary liquid; fluid ring compressors [F04C19/00](#)]

F04D19/00 **Axial-flow pumps** ([F04D21/00](#) takes precedence); [N: pump comprising axial flow and radial flow stages [F04D17/02B](#)]

- F04D19/00B . [N: Axial flow fans]
- F04D19/00B2 . . [N: reversible fans]
- F04D19/00C . [N: multistage fans]
- F04D19/02 . Multi-stage pumps
- F04D19/02B . . [N: with concentric rows of vanes;]

- F04D19/02C . . [N: with contrarotating parts]
- F04D19/02D . . [N: with a plurality of shafts rotating at different speeds ([F04D19/02B](#) takes precedence)]
- F04D19/02G . . [N: Layout of fluid flow through the stages]
- F04D19/04 . . specially adapted to the production of a high vacuum, e.g. molecular pumps
- F04D19/04B . . . [N: Turbomolecular vacuum pumps]
- F04D19/04C . . . [N: Holweck-type pumps]
- F04D19/04D . . . [N: Combinations of two or more different types of pumps]
- F04D19/04F . . . [N: comprising magnetic bearings]

F04D21/00 Pump involving supersonic speed of pumped fluids

F04D23/00 Other rotary non-positive-displacement pumps (pumping installations or systems [F04D25/00](#))

- F04D23/00B . [N: Pumps adapted for conveying materials or for handling specific elastic fluids]
- F04D23/00B2 . . [N: of radial-flow type]
- F04D23/00B3 . . [N: of axial-flow type]
- F04D23/00D . [N: Creating a pulsating flow]
- F04D23/00R . [N: Regenerative pumps (for liquids or for liquids and elastic fluids 5/00R)]

F04D25/00 Pumping installations or systems (controlling [F04D27/00](#))

- F04D25/02 . Units comprising pumps and their driving means (predominant aspect of the driving means, see the relevant classes for such means)
- F04D25/02B . . [N: comprising a yielding coupling, e.g. hydraulic (a magnetic coupling 25/02D)]
- F04D25/02C . . [N: the driving means being assisted by a power recovery turbine]
- F04D25/02D . . [N: with a magnetic coupling]
- F04D25/02F . . [N: the driving means being a planetary gear] [N1111]
- F04D25/04 . . the pump being fluid-driven [N: (pumps driven by exhaust gases [F02B37/00](#), [F02B39/00](#); turbochargers [F02C6/12](#))] [C9810]
- F04D25/04B . . . [N: the pump wheel carrying the fluid driving means, e.g. turbine blades]
- F04D25/06 . . the pump being electrically driven ([F04D25/08](#) takes precedence)
- F04D25/06B . . . [N: the electric motor being specially adapted for integration in the pump] [M1111]
- F04D25/06B2 [N: the electric motor being of the inside-out type, i.e. the rotor is arranged radially outside a central stator] [M1111]
- F04D25/06B2B [N: Details of the bearings] [N1111]
- F04D25/06B2D [N: Details of the lubrication] [N1111]
- F04D25/06B2F [N: Details of the magnetic circuit] [N1111]
- F04D25/06B2H [N: Details of the rotor] [N1111]
- F04D25/06B2J [N: Details of the stator] [N1111]
- F04D25/06B3 [N: the motor having a plane air gap, e.g. disc-type]

- F04D25/06B4 [N: Linear Motors] [M1111]
- F04D25/06B6 [N: a sensor is integrated into the pump/motor design] [N1111]
- F04D25/06L [N: Battery powered] [N1111]
- F04D25/06N [N: Mechanical details of the pump control unit (pump control details F04D27)] [N1111]
- F04D25/06S [N: specially adapted for submerged use] [N1111]
- F04D25/06W [N: Details or arrangements of the wiring] [N1111]
- F04D25/08 . . the working fluid being air, e.g. for ventilation
- F04D25/08B [N: the unit having provision for cooling the motor]
- F04D25/08C [N: hand fans]
- F04D25/08C2 [N: hand operated]
- F04D25/08D [N: Ceiling fans]
- F04D25/10 the unit having provisions for automatically changing direction of output air
- F04D25/10C [N: by changing rotor axis direction, e.g. oscillating fans (interconnecting rotary motion and oscillating motion F16H)]
- F04D25/12 the unit being adapted for mounting in apertures
- F04D25/14 and having shutters, e.g. automatically closed when not in use
- F04D25/16 . . Combinations of two or more pumps [N: Producing two or more separate gas flows]
- F04D25/16B [N: driven by a common gearing arrangement]
- F04D25/16C [N: using fans]

F04D27/00 Control, e.g. regulation, of pumps, pumping installations or systems

[N: WARNING

[N1111]This group is not complete pending a reorganisation. See also group [F04D27/02](#) which covers also control in general not focussing on surge control
]

- F04D27/00B . . [N: Testing thereof; Determination or simulation of flow characteristics; Stall or surge detection, e.g. condition monitoring] [M1111]
- F04D27/00C . . [N: by varying geometry within the pumps, e.g. by adjusting vanes] [N1111]
- [N: **WARNING**
[N1111]This group is not complete pending a reorganisation. See also group [F04D27/02C](#)
]
- F04D27/00D . . [N: by throttling ([F04D27/00C](#) takes precedence)] [N1111]
- [N: **WARNING**
[N1111]This group is not complete pending a reorganisation. See also group [F04D27/02D](#)
]
- F04D27/00F . . [N: by varying driving speed] [N1111]
- [N: **WARNING**

- [N1111] This group is not complete pending a reorganisation. See also group [F04D27/02F](#)
]
- F04D27/00G . [N: by changing flow path between different stages or between a plurality of compressors; Load distribution between compressors] [N1111]
- [N: **WARNING**
[N1111] This group is not complete pending a reorganisation. See also group [F04D27/02G](#)
]
- F04D27/00K . [N: by influencing fluid temperatures] [N1111]
- [N: **WARNING**
[N1111] This group is not complete pending a reorganisation. See also group [F04D27/02K](#)
]
- F04D27/00L . [N: Conjoint control of two or more different functions] [N1111]
- [N: **WARNING**
[N1111] This group is not complete pending a reorganisation. See also group [F04D27/02L](#)
]
- F04D27/00P . [N: Stop safety or alarm devices, e.g. stop-and-go control; Disposition of check-valves] [N1111]
- [N: **WARNING**
[N1111] This group is not complete pending a reorganisation. See also group [F04D27/02P](#)
]
- F04D27/00R . [N: by bleeding, by passing or recycling fluid] [N1111]
- [N: **WARNING**
[N1111] This group is not complete pending a reorganisation. See also group [F04D27/02B](#)
]
- F04D27/02 . Surge control [N: (surge detection [F04D27/00B](#))] [C1111]
- F04D27/02B . . [N: by bleeding, bypassing or recycling fluids] (influencing the boundary layer by an uncontrolled bleeding of the working fluid [F04D29/68C](#)) [C1111]
- F04D27/02B2 . . . [N: Arrangements therefor, e.g. bleed or by-pass valves] [C1111]
- F04D27/02B4 . . . [N: Control schemes therefor] [N1111]
- F04D27/02B6 . . . [N: Details or means for fluid extraction] [N1111]
- F04D27/02B8 . . . [N: Details or means for fluid reinjection] [N1111]
- F04D27/02C . . [N: by varying geometry within the pumps, e.g. by adjusting vanes]
- F04D27/02D . . [N: by throttling ([F04D27/02C](#) takes precedence)]
- F04D27/02F . . [N: by varying driving speed]

- F04D27/02G . . [N: by changing flow path between different stages or between a plurality of compressors; load distribution between compressors]
- F04D27/02K . . [N: by influencing fluid temperature]
- F04D27/02L . . [N: Conjoint control of two or more different functions] [C1111]
- F04D27/02P . . [N: Stop safety or alarm devices, e.g. stop-and-go control; Disposition of check-valves]

- F04D29/00** **Details, component parts, or accessories (machine elements in general [F16](#))**

- F04D29/00C . [N: especially adapted for elastic fluid pumps]
- F04D29/00E . [N: Decorative aspects, i.e. features which have no effect on the functioning of the pump] [N1111]
- F04D29/00P . [N: especially adapted for liquid pumps]
- F04D29/02 . Selection of particular materials (for handling specific liquids [F04D7/00](#) [N: [F04D23/00B](#)])
- F04D29/02C . . [N: especially adapted for elastic fluid pumps]
- F04D29/02P . . [N: especially adapted for liquid pumps]
- F04D29/04 . Shafts or bearings, or assemblies thereof (specially adapted for elastic fluid pumps [F04D29/05](#)) [[C0706](#)]
- F04D29/04B . . [N: joining shafts, e.g. rigid couplings, quill shafts] [N: WARNING: The group [F04D29/04B](#) 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 [F04D29/044](#) and [F04D29/054](#)] [[C0706](#)]
- F04D29/041 . . Axial thrust balancing [[N0706](#)]
- F04D29/041B . . . [N: hydrostatic; hydrodynamic thrust bearings] [[N0706](#)]
- F04D29/041D . . . [N: balancing pistons] [[N0706](#)]
- F04D29/042 . . Axially shiftable rotors [F04D29/041](#) takes precedence [N: control by creating a by-pass [F04D15/00C](#)] [[N0706](#)]
- F04D29/043 . . Shafts [[N0706](#)]
- F04D29/044 . . . Arrangements for joining or assembling shafts [[N0706](#)]
- F04D29/046 . . Bearings [[N0706](#)]
- F04D29/046B . . . [N: Bearing cartridges] [[N0706](#)]
- F04D29/046D . . . [N: Ceramic bearing designs] [[N0706](#)]
- F04D29/046F . . . [N: Spherical bearings] [[N0706](#)]
- F04D29/047 . . . hydrostatic; hydrodynamic [[N0706](#)]
- F04D29/047B [N: for radial pumps] [[N0706](#)]
- F04D29/047D [N: for axial pumps] [[N0706](#)]
- F04D29/048 . . . magnetic; electromagnetic [[N0706](#)]
- F04D29/049 . . . Roller bearings [[N0706](#)]

- F04D29/05 . Shafts or bearings, or assemblies thereof, specially adapted for elastic fluid pumps [[N0706](#)]
- F04D29/051 . . Axial thrust balancing [[N0706](#)]

F04D29/051B	. . . [N: hydrostatic; hydrodynamic thrust bearings] [N0706]
F04D29/051D	. . . [N: balancing pistons] [N0706]
F04D29/052	. . Axially shiftable rotors F04D29/051 takes precedence [N: control by creating a by-pass F04D27/02C] [N0706]
F04D29/053	. . Shafts [N0706]
F04D29/054	. . . Arrangements for joining or assembling shafts [N0706]
F04D29/056	. . Bearings [N0706]
F04D29/056B	. . . [N: Bearings cartridges] [N0706]
F04D29/056D	. . . [N: Ceramic bearing designs] [N0706]
F04D29/057	. . . hydrostatic; hydrodynamic [N0706]
F04D29/058	. . . magnetic; electromagnetic [N0706]
F04D29/059	. . . Roller bearings [N0706]
F04D29/06	. Lubrication [N: (F04D13/06B, F04D13/06C, F04D13/06D take precedence)] [C0706]
F04D29/06P	. . [N: especially adapted for liquid pumps] [C0706]
F04D29/063	. . especially adapted for elastic fluid pumps [N0706] [C1111]
F04D29/08	. Sealings
F04D29/08C	. . [N: especially adapted for elastic fluid pumps]
F04D29/08P	. . [N: especially adapted for liquid pumps]
F04D29/10	. . Shaft sealings
F04D29/10C	. . . [N: especially adapted for elastic fluid pumps]
F04D29/10C2	. . . . [N: the sealing fluid being other than the working fluid or being the working fluid treated]
F04D29/10P	. . . [N: especially adapted for liquid pumps]
F04D29/10P2	. . . . [N: the sealing fluid being other than the working liquid or being the working liquid treated]
F04D29/12	. . . using sealing-rings
F04D29/12C	. . . . [N: especially adapted for elastic fluid pumps]
F04D29/12C2	. . . . . [N: with special means for adducting cooling or sealing fluid]
F04D29/12P	. . . . [N: especially adapted for liquid pumps]
F04D29/12P2	. . . . . [N: with special means for adducting cooling or sealing fluid]
F04D29/14	. . . operative only when pump is inoperative
F04D29/14C	. . . . [N: especially adapted for elastic fluid pumps]
F04D29/14P	. . . . [N: especially adapted for liquid pumps]
F04D29/16	. . between pressure and suction sides
F04D29/16C	. . . [N: especially adapted for elastic fluid pumps]
F04D29/16C2	. . . . [N: of a centrifugal flow wheel]
F04D29/16C3	. . . . [N: of an axial flow wheel]
F04D29/16P	. . . [N: especially adapted for liquid pumps]
F04D29/16P2	. . . . [N: of a centrifugal flow wheel]
F04D29/16P3	. . . . [N: of an axial flow wheel]
F04D29/18	. Rotors (specially for elastic fluids F04D29/26)

F04D29/18A	. . [N: Axial flow rotors (F04D29/18B take precedence)]
F04D29/18A2	. . . [N: Semi axial flow rotors]
F04D29/18B	. . [N: Rotors consisting of a plurality of wheels]
F04D29/18C	. . [N: Shaftless rotors (F04D13/02B3 takes precedence)]
F04D29/18R	. . [N: specially for regenerative pumps]
F04D29/20	. . Mounting rotors on shafts
F04D29/22	. . specially for centrifugal pumps
F04D29/22B	. . . [N: Conventional flow pattern (F04D29/18 takes precedence)]
F04D29/22B2	. . . . [N: More than one set of flow passages]
F04D29/22B3	. . . . [N: Shape, geometry (F04D29/22B2 takes precedence)]
F04D29/22B4	. . . . [N: Construction and assembly (F04D29/22B2 takes precedence)]
F04D29/22B4B	. . . . . [N: for special materials]
F04D29/22B4C	. . . . . [N: entirely open or stamped from one sheet]
F04D29/22C	. . . [N: Special flow patterns (F04D11/00B takes precedence)]
F04D29/22C2	. . . . [N: Free vortex]
F04D29/22C3	. . . . [N: Channel wheels, e.g. one blade or one flow channel]
F04D29/22C4	. . . . [N: flow-channels with a special cross-section contour, e.g. ejecting, throttling or diffusing effect]
F04D29/22D	. . . [N: with special measures]
F04D29/22D2	. . . . [N: for sealing or thrust balance (F04D29/04 and F04D29/16 take precedence)]
F04D29/22D3	. . . . [N: for influencing flow or boundary layer]
F04D29/22D4	. . . . [N: for increasing NPSH or dealing with liquids near boiling-point]
F04D29/22D5	. . . . [N: for reverse pumping action]
F04D29/22D6	. . . . [N: for comminuting, mixing or separating]
F04D29/22D7	. . . . [N: for protection, e.g. against abrasion]
F04D29/24	. . . Vanes
F04D29/24A	. . . . [N: Geometry, shape]
F04D29/24A2	. . . . . [N: for special effects]
F04D29/24B	. . . . [N: elastic or self-adjusting]
F04D29/26	. Rotors specially for elastic fluids
F04D29/26B	. . [N: mounting fan or blower rotors on shafts]
F04D29/26D	. . [N: mounting compressor rotors on shafts]
F04D29/28	. . for centrifugal or helico-centrifugal pumps [N: for radial-flow or helico-centrifugal pumps]
F04D29/28B	. . . [N: for fans or blowers]
F04D29/28B2	. . . . [N: the leading edge of each vane being substantially parallel to the rotation axis]
F04D29/28B2B	. . . . . [N: rotors of the squirrel-cage type]
F04D29/28C	. . . [N: for compressors]
F04D29/28C2	. . . . [N: the compressor wheel comprising a pair of rotatable bladed hub portions axially aligned and clamped together]
F04D29/28C3	. . . . [N: multi-stage rotors]

F04D29/28D	. . .	[N: with adjusting means]
F04D29/28F	. . .	[N: Part of the wheel having an ejecting effect e.g. being bladeless diffuser]
F04D29/28G	. . .	[N: having provision against erosion or for dust-separation]
F04D29/30	. . .	Vanes
F04D29/30B	. . .	[N: Flexible vanes]
F04D29/32	. .	for axial flow pumps [N: multistage rotors F01D5/00]
F04D29/32B	. . .	[N: for axial flow compressors]
F04D29/32B2	. . .	[N: blade mountings (F01D5/30 takes precedence)]
F04D29/32B2B	. . .	[N: adjustable]
F04D29/32B3	. . .	[N: blades (F01D5/28B takes precedence)]
F04D29/32K	. . .	[N: for axial flow fans (blade mountings F04D29/34 , blades F04D29/38)]
F04D29/32K2	. . .	[N: comprising a rotating shroud]
F04D29/32K4	. . .	[N: with non identical blades]
F04D29/32K6	. . .	[N: with unequal distribution of blades around the hub]
F04D29/32K8	. . .	[N: Details of the hub]
F04D29/34	. . .	Blade mountings [N: for axial flow compressors F04D29/32B2]
F04D29/36	. . .	adjustable [N: flexible blades F04D29/38B]
F04D29/36B	. . .	[N: during rotation]
F04D29/36B2	. . .	[N: The blades having only a predetermined number of possible positions]
F04D29/36B3	. . .	[N: Adjustment by interaction of inertia and lift]
F04D29/36B4	. . .	[N: Adjustment by differences of temperature]
F04D29/38	. . .	Blades [N: (for axial flow compressors F04D29/32B3)]
F04D29/38B	. . .	[N: Flexible blades]
F04D29/38C	. . .	[N: characterised by form]
F04D29/38C2	. . .	[N: Skewed blades]
F04D29/38D	. . .	[N: characterised by construction]
F04D29/40	. .	Casings; Connections of working fluid [N: bleed or by-pass valves F04D15/00B2 , F04D27/02B2]
F04D29/40C	. .	[N: especially adapted for elastic fluid pumps]
F04D29/40P	. .	[N: especially adapted for liquid pumps]
F04D29/42	. .	for radial or helico-centrifugal pumps
F04D29/42C	. . .	[N: especially adapted for elastic fluid pumps]
F04D29/42C2	. . .	[N: suction ports]
F04D29/42C3	. . .	[N: Discharge tongues (F04D17/04 takes precedence)]
F04D29/42C4	. . .	[N: Fan casings]
F04D29/42C4B	. . .	[N: with volutes extending mainly in axial or radially inward direction]
F04D29/42C4C	. . .	[N: Double entry casings]
F04D29/42C4D	. . .	[N: comprising more than one outlet]
F04D29/42C4F	. . .	[N: with axial entry and discharge]
F04D29/42P	. . .	[N: especially adapted for liquid pumps]
F04D29/42P1	. . .	[N: made of sheet metal]

F04D29/42P2	. . . .	[N: suction eyes]
F04D29/42P3	. . . .	[N: Discharge tongues (F04D17/04 takes precedence)]
F04D29/42P4	. . . .	[N: inside lining e.g. rubber]
F04D29/42P6	. . . .	[N: Details of fluid inlet or outlet] [N1111]
F04D29/44	. . .	Fluid-guiding means, e.g. diffusers
F04D29/44C	. . . .	[N: especially adapted for elastic fluid pumps]
F04D29/44C2	. . . . .	[N: rotating diffusers]
F04D29/44C3	. . . . .	[N: Bladed diffusers]
F04D29/44P	. . . .	[N: especially adapted for liquid pumps]
F04D29/44P2	. . . . .	[N: rotating diffusers]
F04D29/44P3	. . . . .	[N: bladed diffusers]
F04D29/46	. . . .	adjustable
F04D29/46C	. . . . .	[N: especially adapted for elastic fluid pumps]
F04D29/46C2	. . . . .	[N: adjusting flow cross-section, otherwise than by using adjustable stator blades]
F04D29/46P	. . . . .	[N: especially adapted for liquid fluid pumps]
F04D29/46P2	. . . . .	[N: adjusting flow cross-section, otherwise than by using adjustable stator blades]
F04D29/48	. . . . .	for unidirectional fluid flow in reversible pumps [N: rotors for reverse action F04D29/22D5]
F04D29/48C	. . . . .	[N: especially adapted for elastic fluid pumps]
F04D29/48P	. . . . .	[N: especially adapted for liquid pumps]
F04D29/50	. . . . .	for reversing fluid flow [N: rotors for reverse action F04D29/22D5]
F04D29/50C	. . . . .	[N: especially adapted for elastic fluid pumps]
F04D29/50P	. . . . .	[N: especially adapted for liquid pumps]
F04D29/52	. .	for axial pumps
F04D29/52C	. . .	[N: especially adapted for elastic fluid pumps]
F04D29/52C2	. . . .	[N: shiftable members for obturating part of the flow path]
F04D29/52C4	. . . .	[N: Details of the casing section radially opposing blade tips (ducts F04D29/54C3)] [C1111]
F04D29/52P	. . .	[N: especially adapted for liquid pumps]
F04D29/54	. . .	Fluid-guiding means, e.g. diffusers
F04D29/54C	. . . .	[N: Specially adapted for elastic fluid pumps (F04D29/56 takes precedence)]
F04D29/54C2	. . . . .	[N: Bladed diffusers (fixing blades to stators F01D9/04C)]
F04D29/54C2B	. . . . .	[N: Blade shapes] [N1111]
F04D29/54C3	. . . . .	[N: Ducts] [C1111]
F04D29/54C3C	. . . . .	[N: having a special shape in order to influence fluid flow]
F04D29/54P	. . . .	[N: Specially adapted for liquid pumps (F04D29/56 takes precedence)]
F04D29/56	. . . .	adjustable
F04D29/56C	. . . . .	[N: specially adapted for elastic fluid pumps]
F04D29/56P	. . . . .	[N: specially adapted for liquid pumps]
F04D29/58	. .	Cooling (of machines or engines in general F01P); Heating; Diminishing heat transfer [N: for the motor of air-pump units F04D25/08B ; cooling of shafts or bearings F04D29/04]

- F04D29/58A . . [N: Cooling the drive system] [N1111]
- F04D29/58B . . [N: Cooling the control unit] [N1111]
- F04D29/58C . . [N: specially adapted for elastic fluid pumps]
- F04D29/58C2 . . . [N: Cooling at least part of the working fluid in a heat exchanger]
- F04D29/58C2B [N: flow schemes and regulation thereto]
- F04D29/58C3 . . . [N: cooling or heating the machine ([F04D29/58C4](#), [F04D29/58C6](#) take precedence)]
- F04D29/58C4 . . . [N: cooling by injection]
- F04D29/58C6 . . . [N: heat insulation or conduction]
- F04D29/58P . . [N: specially adapted for liquid pumps]
- F04D29/58P2 . . . [N: Cooling at last part of the working fluid in a heat exchanger]
- F04D29/58P2B [N: flow schemes and regulation thereto]
- F04D29/58P3 . . . [N: cooling or heating the machine ([F04D29/58P4](#), [F04D29/58P6](#) take precedence)]
- F04D29/58P4 . . . [N: cooling by injection]
- F04D29/58P6 . . . [N: heat insulation or conduction]

- F04D29/60 . Mounting; Assembling; Disassembling [N: [F04D13/10](#) takes precedence]
- F04D29/60C . . [N: specially adapted for elastic fluid pumps]
- F04D29/60C2 . . . [N: Mounting in cavities]
- F04D29/60C2B [N: means for positioning from outside]
- F04D29/60C2D [N: means for removing without depressurising the cavity]
- F04D29/60P . . [N: specially adapted for liquid pumps]
- F04D29/60P2 . . . [N: Mounting in cavities]
- F04D29/60P2B [N: means for positioning from outside]
- F04D29/60P2D [N: means for removing without depressurizing the cavity]
- F04D29/62 . . of radial or helico-centrifugal pumps
- F04D29/62A . . . [N: Adjusting the clearances between rotary and stationary parts] [N1111]
- F04D29/62C . . . [N: especially adapted for elastic fluid pumps]
- F04D29/62C2 [N: Mounting or removal of fans] [M1111]
- F04D29/62P . . . [N: especially adapted for liquid pumps]
- F04D29/64 . . of axial pumps
- F04D29/64A . . . [N: by adjusting the clearances between rotary and stationary parts] [N1111]
- F04D29/64C . . . [N: especially adapted for elastic fluid pumps]
- F04D29/64C2 [N: Mounting or removal of fans] [M1111]
- F04D29/64P . . . [N: especially adapted for liquid pumps]

- F04D29/66 . Combating cavitation, whirls, noise, vibration or the like (gas-flow silencers for machines or engines in general [F01N](#)); Balancing (surge control [F04D27/02](#))
- F04D29/66C . . [N: especially adapted for elastic fluid pumps]
- F04D29/66C2 . . . [N: Balancing of rotors (compensating unbalance [G01M1/36](#))]
- F04D29/66C4 . . . [N: Sound attenuation]
- F04D29/66C4B [N: by means of sound absorbing material]
- F04D29/66C4C [N: by means of resonance chambers or interference]

- F04D29/66C6 . . . [N: by means of rotor construction or layout, e.g. unequal distribution of blades or vanes]
- F04D29/66C7 . . . [N: by influencing the flow pattern, e.g. suppression of turbulence]
- F04D29/66C8 . . . [N: damping or preventing mechanical vibrations]
- F04D29/66P . . [N: especially adapted for liquid pumps ([F04D29/18](#) takes precedence)]
- F04D29/68 . . by influencing boundary layers [N: ([by bleeding elastic fluid F04D27/02B2](#))]
- F04D29/68C . . . [N: especially adapted for elastic fluid pumps]
- F04D29/68C2 [N: by fluid extraction] [N1111]
- F04D29/68C4 [N: by fluid injection] [N1111]
- F04D29/68C6 [N: Inducing localised fluid recirculation in the stator-rotor interface] [N1111]
- F04D29/68C8 [N: Plasma actuators therefore] [N1111]
- F04D29/68P . . . [N: especially adapted for liquid pumps]

- F04D29/70 . Suction grids; Strainers; Dust separation; Cleaning
- F04D29/70C . . [N: especially adapted for elastic fluid pumps] [C1111]
- F04D29/70C2 . . . [N: specially for fans, e.g. fan guards]
- F04D29/70C3 . . . [N: Adding liquids]
- F04D29/70C4 . . . [N: Humidity separation] [N1111]
- F04D29/70P . . [N: specially for liquid pumps]

Guide heading: **Other non-positive-displacement pumps**

F04D31/00 **Pumping liquids and elastic fluids at the same time**

F04D33/00 **Non-positive-displacement pumps with other than pure rotation, e.g. of oscillating type** ([F04D35/00](#) takes precedence; hand-held fans [A45B](#))

F04D35/00 **Pumps producing waves in liquids, i.e. wave.producers** (for bath tubs [A47K3/10](#))