

CPC**COOPERATIVE PATENT 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".

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}

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 [F04D 5/002](#))}

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 [F04D 25/026](#))}
- 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 [F04D 27/00](#))}
- 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 27/0246](#)

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

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/0253](#))

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

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/0261](#)

- 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 27/0269](#)]

- F04D 27/006
 - {by influencing fluid temperatures}

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/0276](#)

- F04D 27/007
 - {Conjoint control of two or more different functions}

WARNING

This group is not complete pending a reorganisation. See also group [F04D 27/0284](#)

- 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 27/0207](#)
- 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}

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](#))