

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

F04D 29/0405

(continued)

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](#))