

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

This subclass covers non-positive-displacement pumps for liquids, for elastic fluids, or for liquids and elastic fluids whether rotary or not having pure rotation.

This subclass does not cover combinations of non-positive-displacement pumps with other pumps, which are covered by subclass F04B, except that the use of such other pumps for priming or boosting non-positive-displacement is covered by this subclass.

Attention is drawn to the Notes preceding class F01, especially as regards the definition of "pump".

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 [5/00R](#))}

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

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

- F04D 25/064 { Details of the rotor}
- F04D 25/0646 { Details of the stator}
- F04D 25/0653 {the motor having a plane air gap, e.g. disc-type}
- F04D 25/066 { Linear Motors}
- F04D 25/0666 { a sensor is integrated into the pump/motor design}
- F04D 25/0673 ... { Battery powered}
- F04D 25/068 ... { Mechanical details of the pump control unit (pump control details F04D27)}
- F04D 25/0686 ... { specially adapted for submerged use}
- F04D 25/0693 ... { Details or arrangements of the wiring}
- F04D 25/08 .. the working fluid being air, e.g. for ventilation
- F04D 25/082 ... {the unit having provision for cooling the motor}
- F04D 25/084 ... {hand fans}
- F04D 25/086 {hand operated}
- F04D 25/088 ... {Ceiling fans}
- F04D 25/10 ... the unit having provisions for automatically changing direction of output air
- F04D 25/105 {by changing rotor axis direction, e.g. oscillating fans (interconnecting rotary motion and oscillating motion F16H)}
- F04D 25/12 ... the unit being adapted for mounting in apertures
- F04D 25/14 and having shutters, e.g. automatically closed when not in use

- F04D 25/16 . Combinations of two or more pumps {Producing two or more separate gas flows}
- F04D 25/163 .. {driven by a common gearing arrangement}
- F04D 25/166 .. {using fans}

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

[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

[F04D 27/02C](#)

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

WARNING

[F04D 27/02D](#))

- F04D 27/004 . { by varying driving speed}
- WARNING**
- [F04D 27/02F](#)
- F04D 27/005 . { by changing flow path between different stages or between a plurality of compressors; Load distribution between compressors}
- WARNING**
- [F04D 27/02G](#)
- F04D 27/006 . { by influencing fluid temperatures}
- WARNING**
- [F04D 27/02K](#)
- F04D 27/007 . { Conjoint control of two or more different functions}
- WARNING**
- [F04D 27/02L](#)
- F04D 27/008 . { Stop safety or alarm devices, e.g. stop-and-go control; Disposition of check-valves}
- WARNING**
- [F04D 27/0292](#)
- F04D 27/009 . { by bleeding, by passing or recycling fluid}
- WARNING**
- [F04D 27/02B](#)
- 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	.....	{especially adapted for elastic fluid pumps}
F04D 29/566	.....	{especially 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](#))**