

**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 <a href="#">F04D 5/002</a> )}
<b>F04D 25/00</b>	<b>Pumping installations or systems (controlling <a href="#">F04D 27/00</a>)</b>
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 <a href="#">F04D 25/026</a> )}
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 <a href="#">F02B 37/00</a> , <a href="#">F02B 39/00</a> ; turbochargers <a href="#">F02C 6/12</a> )}
F04D 25/045	... {the pump wheel carrying the fluid driving means, e.g. turbine blades}
F04D 25/06	.. the pump being electrically driven ( <a href="#">F04D 25/08</a> 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 <a href="#">F04D 27/00</a> )}
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 <a href="#">F16H</a> )}
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**

F04D 27/007

(continued)

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 ( <a href="#">specially for elastic fluids F04D 29/26</a> )
F04D 29/181	..	{Axial flow rotors ( <a href="#">F04D 29/185</a> take precedence)}
F04D 29/183	...	{Semi axial flow rotors}
F04D 29/185	..	{Rotors consisting of a plurality of wheels}
F04D 29/186	..	{Shaftless rotors ( <a href="#">F04D 13/024</a> 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 ( <a href="#">F04D 29/18</a> takes precedence)}
F04D 29/2211	....	{More than one set of flow passages}
F04D 29/2216	....	{Shape, geometry ( <a href="#">F04D 29/2211</a> takes precedence)}
F04D 29/2222	....	{Construction and assembly ( <a href="#">F04D 29/2211</a> takes precedence)}
F04D 29/2227	.....	{for special materials}
F04D 29/2233	.....	{entirely open or stamped from one sheet}
F04D 29/2238	...	{Special flow patterns ( <a href="#">F04D 11/005</a> 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 ( <a href="#">F04D 29/04</a> and <a href="#">F04D 29/16</a> 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 <a href="#">F01D 5/00</a> }
F04D 29/321	...	{for axial flow compressors}
F04D 29/322	....	{blade mountings ( <a href="#">F01D 5/30</a> takes precedence)}
F04D 29/323	.....	{adjustable}
F04D 29/324	....	{blades ( <a href="#">F01D 5/282</a> takes precedence)}
F04D 29/325	...	{for axial flow fans (blade mountings <a href="#">F04D 29/34</a> , blades <a href="#">F04D 29/38</a> )}
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 <a href="#">F04D 29/322</a> }
F04D 29/36	....	adjustable{ flexible blades <a href="#">F04D 29/382</a> }

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 <a href="#">F04D 29/324</a> )}
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 <a href="#">F04D 15/0011</a> , <a href="#">F04D 27/0215</a> }
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 ( <a href="#">F04D 17/04</a> 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 ( <a href="#">F04D 17/04</a> 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 <a href="#">F04D 29/2283</a> }
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 <a href="#">F04D 29/2283</a> }
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 <a href="#">F04D 29/545</a> )}
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 ( <a href="#">F04D 29/56</a> takes precedence)}
F04D 29/542	.....	{Bladed diffusers (fixing blades to stators <a href="#">F01D 9/042</a> )}
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 ( <a href="#">F04D 29/56</a> 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 <a href="#">F01P</a> ); Heating; Diminishing heat transfer{ for the motor of air-pump units <a href="#">F04D 25/082</a> ; cooling of shafts or bearings <a href="#">F04D 29/04</a> }
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 ( <a href="#">F04D 29/5846</a> , <a href="#">F04D 29/5853</a> 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 ( <a href="#">F04D 29/5886</a> , <a href="#">F04D 29/5893</a> take precedence)}

F04D 29/5886	...	{cooling by injection}
F04D 29/5893	...	{heat insulation or conduction}
F04D 29/60	.	Mounting; Assembling; Disassembling{ <a href="#">F04D 13/10</a> 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 <a href="#">F01N</a> ); Balancing (surge control <a href="#">F04D 27/02</a> )
F04D 29/661	..	{especially adapted for elastic fluid pumps}
F04D 29/662	...	{Balancing of rotors (compensating unbalance <a href="#">G01M 1/36</a> )}
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 ( <a href="#">F04D 29/18</a> takes precedence)}
F04D 29/68	..	by influencing boundary layers {(by bleeding elastic fluid <a href="#">F04D 27/0215</a> )}
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](#))