F04  POSITIVE-DISPLACEMENT MACHINES FOR LIQUIDS, PUMPS FOR LIQUIDS OR ELASTIC FLUIDS (portable fire extinguishers with manually-operated pumps A62C 11/00, with power-driven pumps A62C 25/00; charging or scavenging combustion engines by pumps F02B; engine fuel-injection pumps F02M; ion pumps H01J 41/12; electrodynamic pumps H02K 44/02)

Note

Combinations of positive-displacement and non-positive-displacement pumps are classified in subclass F04B as a general subclass for pumps, and in subclasses F04C, F04D in respect of matter specific to those subclasses.

F04B  POSITIVE-DISPLACEMENT MACHINES FOR LIQUIDS, PUMPS (machines for liquids, or pumps, of rotary-piston or oscillating-piston type F04C; non-positive-displacement pumps F04D; pumping of fluid by direct contact of another fluid or by using inertia of fluid to be pumped F04F; crankshafts, crossheads, connecting-rods F16C; flywheels F16F; gearings for interconverting rotary motion and reciprocating motion in general F16H; pistons, piston-rods, cylinders, in general F16J)

Notes

(1) In this subclass, the following term is used with the meaning indicated:

– “piston” also covers a plunger.

(2) Attention is drawn to the Notes following the titles of class B81 and subclass B81B relating to “micro-structural devices” and “micro-structural systems”. [7]

(3) Attention is drawn to the Notes preceding class F01, especially as regards the definitions of “machines”, “pumps”, and “positive-displacement”.

Subclass Index

POSITIVE-DISPLACEMENT MACHINES FOR LIQUIDS, PUMPS IN GENERAL

General characteristics of machines and pumps

multiple cylinders; single cylinders, pistons coating in cylinder; differential-surface pistons; flexible working members..................................................1/00; 3/00; 5/00; 43/00

positively-driven distribution members; driving or driven means to or from working members..................................................7/00; 9/00

equalization of pulses, counteracting cavitation ........................................ 11/00

other characteristics.................................................. 19/00

Characteristics peculiar to pumps, their adaptations or combinations

delivering measured quantities; handling specific fluids; pumping from great depths ..........13/00; 15/00;

associated with specific driving engines .................................................. 17/00

Other characteristics .................................................. 19/00

Pumping installations or systems ............... 23/00, 43/00, 47/00

Component parts, details or accessories .................................................. 53/00

PUMPS FOR ELASTIC FLUIDS

General characteristics

multiple stages; multiple cylinders .............................................. 25/00; 27/00

free piston; flexible working member; actuation by muscle power.................................................. 31/00; 45/00;

33/00

driving means .................................................. 35/00

For pumping from great depths ...................... 47/00

Other characteristics; other details or accessories .................................. 37/00; 39/00

Pumping installations or systems ............... 41/00, 45/00, 47/00

CONTROL, SAFETY MEASURES; TESTING .................................................. 49/00; 51/00

COMPONENT PARTS, DETAILS OR ACCESSORIES .................................................. 53/00

Pumps for liquids or for liquid and elastic fluids; Positive-displacement machines for liquids (having flexible working members F04B 43/00; pumps for raising fluids from great depths F04B 47/00)

1/00 Multi-cylinder machines or pumps characterised by number or arrangement of cylinders (F04B 3/00 takes precedence; fluid-driven pumps F04B 9/08; control of reciprocating machines or pumps in general F04B 49/00)

1/02 having two cylinders (in V-arrangement F04B 1/04)

1/04 having cylinders in star- or fan-arrangement [6]

1/047 with an actuating or actuated element at the outer ends of the cylinders [6]

1/053 with an actuating or actuated element at the inner ends of the cylinders [6]

1/06 Control

1/07 by varying the relative eccentricity between two members, e.g. a cam and a drive shaft [6]

1/08 regulated by delivery pressure

1/10 the cylinders being movable, e.g. rotary [6]

1/107 with an actuating or actuated element at the outer ends of the cylinders [6]
Piston machines or pumps characterised by having their cylinder axes coaxial with, or parallel or inclined to, main shaft axis

- 9/113 . . . . with an actuating or actuated element at the inner ends of the cylinders [6]
- 1/12 . . . . having cylinder axes coaxial with, or parallel or inclined to, main shaft axis
- 1/14 . . . . having stationary cylinders
- 1/16 . . . . having two or more sets of cylinders or pistons
- 1/18 . . . . having self-acting distribution members, i.e. actuated by working fluid
- 1/20 . . . . having rotary cylinder block
- 1/22 . . . . having two or more sets of cylinders or pistons
- 1/24 . . . . inclined to main shaft axis
- 1/26 . . . . Control
- 1/28 . . . . for machines or pumps with stationary cylinders
- 1/29 . . . . by varying the relative positions of a swash plate and a cylinder block [6]
- 1/30 . . . . for machines or pumps with rotary cylinder block
- 1/32 . . . . by varying the relative positions of a swash plate and a cylinder block [6]
- 1/34 . . . . Control not provided for in a single group of groups F04B 1/02 to F04B 1/32 [6]

3/00 Machines or pumps having pertinent characteristics

- 5/00 Machines or pumps with differential-surface pistons
  - 5/02 . . . . with double-acting pistons [6]
- 7/00 Piston machines or pumps characterised by having positively-driven valving (with cylinders in star- or fan-arrangement F04B 1/04; with cylinder axes coaxial with, or parallel or inclined to, main shaft axis F04B 1/12)
  - 7/02 . . . . the valving being fluid-actuated
  - 7/04 . . . . in which the valving is performed by pistons and cylinders coacting to open and close intake or outlet ports [3]
  - 7/06 . . . . the pistons and cylinders being relatively reciprocated and rotated [3]
- 9/00 Piston machines or pumps characterised by the driving or driven means to or from their working members
  - 9/02 . . . . the means being mechanical
  - 9/04 . . . . the means being cams, eccentrics, or pin-and-slot mechanisms (with cylinder axes coaxial with, or parallel or inclined to, main shaft axis F04B 1/12)
  - 9/06 . . . . the means including spring- or weight-loaded lost-motion devices
  - 9/08 . . . . the means being fluid
  - 9/10 . . . . the fluid being liquid
  - 9/103 . . . . having only one pumping chamber [6]
  - 9/105 . . . . reciprocating movement of the pumping member being obtained by a double-acting liquid motor [6]
  - 9/107 . . . . rectilinear movement of the pumping member in the working direction being obtained by a single-acting liquid motor, e.g. actuated in the other direction by gravity or a spring [6]
  - 9/111 . . . . with two mechanically connected pumping members [6]
  - 9/113 . . . . reciprocating movement of the pumping members being obtained by a double-acting liquid motor [6]
- 9/115 . . . . reciprocating movement of the pumping members being obtained by two single-acting liquid motors, each acting in one direction [6]
- 9/117 . . . . the pumping members not being mechanically connected to each other [6]
- 9/12 . . . . the fluid being elastic, e.g. steam or air
- 9/123 . . . . having only one pumping chamber [6]
- 9/125 . . . . reciprocating movement of the pumping member being obtained by a double-acting elastic-fluid motor [6]
- 9/127 . . . . rectilinear movement of the pumping member in the working direction being obtained by a single-acting elastic-fluid motor, e.g. actuated in the other direction by gravity or a spring [6]
- 9/129 . . . . having plural pumping chambers [6]
- 9/131 . . . . with two mechanically connected pumping members [6]
- 9/133 . . . . reciprocating movement of the pumping members being obtained by a double-acting elastic-fluid motor [6]
- 9/135 . . . . reciprocating movement of the pumping members being obtained by two single-acting elastic-fluid motors, each acting in one direction [6]
- 9/137 . . . . the pumping members not being mechanically connected to each other [6]
- 9/14 . . . . Pumps characterised by muscle-power operation

11/00 Equalisation of pulses, e.g. by use of air vessels; Counteraacting cavitation

- 13/00 Pumps specially modified to deliver fixed or variable measured quantities (for transferring liquid from bulk storage containers or reservoirs into vehicles or into portable containers B67D 5/40)
  - 13/02 . . . . of two or more fluids at the same time
- 15/00 Pumps adapted to handle specific fluids, e.g. by selection of specific materials for pumps or pump parts
  - 15/02 . . . . the fluids being viscous or non-homogeneous
  - 15/04 . . . . the fluids being hot or corrosive (F04B 15/06 takes precedence)
  - 15/06 . . . . for liquids near their boiling point, e.g. under subnormal pressure
  - 15/08 . . . . the liquids having low boiling points
- 17/00 Pumps characterised by combination with, or adaptation to, specific driving engines or motors
  - 17/02 . . . . driven by wind motors
  - 17/03 . . . . driven by electric motors [6]
  - 17/04 . . . . using solenoids [6]
  - 17/05 . . . . driven by internal-combustion engines [6]
  - 17/06 . . . . Mobile combinations
- 19/00 Machines or pumps having pertinent characteristics not provided for in, or of interest apart from, groups F04B 1/00 to F04B 17/00
  - 19/02 . . . . having movable cylinders
  - 19/04 . . . . Pumps for special use (for transferring liquids from bulk storage containers or reservoirs into vehicles or into portable containers B67D 5/40)
  - 19/06 . . . . Pumps for delivery of both liquid and elastic fluids at the same time (wet gas pumps F04B 37/20) [6]
  - 19/08 . . . . Scoop devices
  - 19/10 . . . . of wheel type
  - 19/12 . . . . of helical or screw type
Pumps specially adapted for elastic fluids (having a flexible working member F04B 45/00; for raising fluid from great depths F04B 47/00)

25/00 Multi-stage pumps
25/02 . of stepped-piston type
25/04 . having cylinders coaxial with, or parallel or inclined to, main shaft axis

27/00 Multi-cylinder pumps characterised by number or arrangement of cylinders (F04B 25/00 takes precedence; control of reciprocating machines or pumps in general F04B 49/00)
27/02 . having cylinders arranged oppositely relative to main shaft
27/04 . having cylinders in star- or fan-arrangement [6]
27/047 . with an actuating element at the outer ends of the cylinders [6]
27/053 . with an actuating element at the inner ends of the cylinders [6]
27/06 . the cylinders being movable, e.g. rotary
27/073 . by varying the relative eccentricity between two members, e.g. a cam and a drive shaft [6]
27/08 . having cylinders coaxial with, or parallel or inclined to, main shaft axis
27/10 . having stationary cylinders [6]
27/12 . having plural sets of cylinders or pistons [6]
27/16 . of pumps with stationary cylinders [6]
27/18 . by varying the relative positions of a swash plate and a cylinder block [6]
27/20 . of pumps with rotary cylinder block [6]
27/22 . by varying the relative positions of a swash plate and a cylinder block [6]
27/24 . Control not provided for in a single group of groups F04B 27/02 to F04B 27/22 [6]

31/00 Free-piston pumps; Systems incorporating such pumps (muscle-driven pumps in which the stroke is not defined by gearing F04B 33/00; free-piston combustion engines, free-piston gas generators F02B 71/00; systems predominated by prime mover aspects, see the relevant class for the prime mover)

33/00 Pumps actuated by muscle power, e.g. for inflating
33/02 . with intermediate gearing

35/00 Piston pumps characterised by the driving means to their working members, or by combination with, or adaptation to, specific driving engines or motors, not otherwise provided for (predominant aspects of the engines or motors, see the relevant classes)
35/01 . the means being mechanical [6]
35/02 . the means being fluid
35/04 . the means being electric
35/06 . Mobile combinations

37/00 Pumps having pertinent characteristics not provided for in, or of interest apart from, groups F04B 25/00 to F04B 35/00
37/02 . for evacuating by absorption or adsorption (absorption or adsorption in general B01J)
37/04 . Selection of specific absorption or adsorption materials
37/06 . for evacuating by thermal means
37/08 . by condensing or freezing, e.g. cryogenic pumps (cold traps B01D 8/00)
37/10 . for special use (F04B 37/02, F04B 37/06 take precedence)
37/12 . to obtain high pressure
37/14 . to obtain high vacuum
37/16 . Means for nullifying unswept space
37/18 . for specific elastic fluids
37/20 . for wet gases, e.g. wet air

39/00 Component parts, details, or accessories, of pumps or pumping systems, not otherwise provided for in, or of interest apart from, groups F04B 25/00 to F04B 37/00 (for controlling F04B 49/00)
39/02 . Lubrication (of machines or engines in general F01M)
39/04 . Measures to avoid lubricant contaminating the pumped fluid
39/06 . Cooling (of machines or engines in general F01P); Heating; Prevention of freezing
39/08 . Actuation of distribution members
39/10 . Adaptation or arrangement of distribution members
39/12 . Casings (casings for machines or engines in general F16M); Cylinders; Cylinder heads; Fluid connections
39/14 . Provisions for readily assembling or disassembling
39/16 . Filtration; Moisture separation

41/00 Pumping installations or systems (F04B 31/00, F04B 35/00 take precedence)
41/02 . having reservoirs
41/04 . Conversion of internal-combustion engine cylinder units to pumps
41/06 . Combinations of two or more pumps

Machines or pumps having flexible working members

43/00 Machines, pumps, or pumping installations having flexible working members (pumps or pumping installations specially adapted for elastic fluids F04B 45/00)
43/02 . having plate-like flexible members, e.g. diaphragms (F04B 43/14 takes precedence) [3]
43/04 . Pumps having electric drive
43/06 . Pumps having fluid drive
43/067 . the fluid being actuated directly by a piston [6]
43/073 . the actuating fluid being controlled by at least one valve [6]
MACHINES OR PUMPS

43/08 . having tubular flexible members (F04B 43/12 takes precedence)
43/09 . Pumps having electric drive [6]
43/10 . Pumps having fluid drive
43/107 . the fluid being actuated directly by a piston [6]
43/113 . the actuating fluid being controlled by at least one valve [6]
43/12 . having peristaltic action
43/14 . having plate-like flexible members [3]

45/00 Pumps or pumping installations having flexible working members and specially adapted for elastic fluids
45/02 . having bellows
45/027 . having electric drive [6]
45/033 . having fluid drive [6]
45/04 . having plate-like flexible members, e.g. diaphragms (F04B 45/10 takes precedence) [3]
45/047 . Pumps having electric drive [6]
45/053 . Pumps having fluid drive [6]
45/06 . having tubular flexible members (F04B 45/02, F04B 45/08 take precedence) [3]
45/067 . Pumps having electric drive [6]
45/08 . having peristaltic action [3]
45/10 . having plate-like flexible members [3]

47/00 Pumps or pumping installations specially adapted for raising fluids from great depths, e.g. well pumps (by using positive or negative pressurised fluid medium acting directly on the liquid to be pumped F04F 1/00)
47/02 . the driving mechanisms being situated at ground level (F04B 47/12 takes precedence)
47/04 . the driving means incorporating fluid means
47/06 . having motor-pump units situated at great depth
47/08 . the motors being actuated by fluid
47/10 . the units or parts thereof being liftable to ground level by fluid pressure
47/12 . having free plunger lifting the fluid to the surface
47/14 . Counterbalancing

49/00 Control of, or safety measures for, machines, pumps, or pumping installations, not otherwise provided for in, or of interest apart from, groups F04B 1/00 to F04B 47/00
49/02 . Stopping, starting, unloading, or idling control (controlled electrically F04B 49/06) [6]

49/025 . by means of floats [6]
49/03 . by means of valves [6]
49/04 . Regulating by means of floats (F04B 49/025 takes precedence) [6]
49/06 . Control using electricity (regulating by means of floats actuating electric switches F04B 49/04)
49/08 . Regulating by delivery pressure
49/10 . Other safety measures
49/12 . by varying the length of stroke of the working members [6]
49/16 . by adjusting the capacity of dead spaces of working chambers [6]
49/18 . by changing the effective cross-section of the working surface of the piston [6]
49/20 . by changing the driving speed (controlled electrically F04B 49/06) [6]
49/22 . by means of valves (F04B 49/03 takes precedence) [6]

51/00 Testing machines, pumps, or pumping installations
53/00 Component parts, details or accessories not provided for in, or of interest apart from, groups F04B 1/00 to F04B 23/00 or F04B 39/00 to F04B 47/00 [6]
53/02 . Packing the free space between cylinders and pistons [6]
53/06 . Venting [6]
53/08 . Cooling (of machines or engines in general F01P); Heating; Preventing freezing [6]
53/10 . Valves; Arrangement of valves [6]
53/12 . arranged in or on pistons [6]
53/16 . Casings; Cylinders; Cylinder liners or heads; Fluid connections [6]
53/18 . Lubricating (of machines or engines in general F01M) [6]
53/22 . Arrangements for enabling ready assembly or disassembly [6]

F04B – F04C

ROTARY-PISTON, OR OSCILLATING-PISTON, POSITIVE-DISPLACEMENT MACHINES FOR LIQUIDS (engines F03C); ROTARY-PISTON, OR OSCILLATING-PISTON, POSITIVE-DISPLACEMENT PUMPS

Note
Attention is drawn to the Notes preceding class F01, especially as regards the definitions of “machines”, “pumps”, “positive displacement”, “rotary-piston machines”, “oscillating-piston machines”, “rotary piston”, “co-operating members”, “movement of co-operating members”, “teeth or tooth-equivalents”, and “internal axis”.

Subclass Index

MACHINES OR PUMPS

Rotary-piston

general characteristics; non-parallel axes of movement of co-operating members .........................2/00; 3/00

resiliently-deformable chamber walls; fluid ring.................................5/00; 7/00

Oscillating-piston.................................................................9/00

Combinations or adaptations ..................................................11/00, 13/00

Pump installations..............................................................11/00
2/00 Rotary-piston machines or pumps (with non-parallel axes of co-operating members F04C 3/00; with the working-chamber walls at least partly resiliently deformable F04C 5/00; with fluid ring or the like F04C 7/00; rotary-piston pumps specially adapted for elastic fluids F04C 18/00, F04C 19/00; rotary-piston machines or pumps in which the working-fluid is exclusively displaced by, or exclusively displaces, one or more reciprocating pistons F04B) [3]

Note

Group F04C 2/30 takes precedence over groups F04C 2/02 to F04C 2/24. [3]

2/02 . of arcuate-engagement type, i.e. with circular translatory movement of co-operating members, each member having the same number of teeth or tooth-equivalents [3]

2/04 . . of internal-axis type [3]

2/06 . . of other than internal-axis type (F04C 2/063 takes precedence) [3]

2/063 . . with coaxially-mounted members having continuously-changing circumferential spacing between them [3]

2/067 . . having cam-and-follower type drive [3]

2/07 . . having crankshaft-and-connecting-rod type drive [3]

2/073 . . having pawl-and-ratchet type drive [3]

2/077 . . having toothed-gearing type drive [3]

2/08 . . of intermeshing-engagement type, i.e. with engagement of co-operating members similar to that of toothed gearing [3]

2/10 . . of internal-axis type with the outer member having more teeth or tooth-equivalents, e.g. rollers, than the inner member [3]

2/107 . . with helical teeth [3]

2/113 . . the inner member carrying rollers intermeshing with the outer member [3]

2/12 . . of other than internal-axis type [3]

2/14 . . with toothed rotary pistons [3]

2/16 . . . with helical teeth, e.g. chevron-shaped, screw type [3]

2/18 . . . with similar tooth forms (F04C 2/16 takes precedence) [3]

2/20 . . . with dissimilar tooth forms (F04C 2/16 takes precedence) [3]

2/22 . . of internal-axis type with equidirectional movement of co-operating members at the points of engagement, or with one of the co-operating members being stationary, the inner member having more teeth or tooth-equivalents than the outer member [3]

2/24 . of counter-engagement type, i.e. the movement of co-operating members at the points of engagement being in opposite directions [3]

2/26 . . of internal-axis type [3]

2/28 . . of other than internal-axis type [3]

2/30 . having the characteristics covered by two or more of groups F04C 2/02, F04C 2/08, F04C 2/22, F04C 2/24 or having the characteristics covered by one of these groups together with some other type of movement between co-operating members [3]

2/32 . . having both the movement defined in group F04C 2/02 and relative reciprocation between the co-operating members [3]

2/324 . . . with vanes hinged to the inner member and reciprocating with respect to the outer member [3]

2/328 . . . and hinged to the outer member [3]

2/332 . . . with vanes hinged to the outer member and reciprocating with respect to the inner member [3]

2/336 . . . and hinged to the inner member [3]

2/34 . . having the movement defined in group F04C 2/08 or F04C 2/22 and relative reciprocation between the co-operating members [3]

2/344 . . . with vanes reciprocating with respect to the inner member [3]

2/348 . . . the vanes positively engaging, with circumferential play, an outer rotatable member [3]

2/352 . . . the vanes being pivoted on the axis of the outer member [3]

2/356 . . . with vanes reciprocating with respect to the outer member [3]

2/36 . . having both the movements defined in groups F04C 2/22 and F04C 2/24 [3]

2/38 . . having the movement defined in group F04C 2/02 and having a hinged member (F04C 2/32 takes precedence) [3]

2/39 . . with vanes hinged to the inner as well as to the outer member [3]

2/40 . . having the movement defined in group F04C 2/08 or F04C 2/22 and having a hinged member [3]

2/44 . . . with vanes hinged to the inner member [3]

2/46 . . . with vanes hinged to the outer member [3]

3/00 Rotary-piston machines or pumps, with non-parallel axes of movement of co-operating members, e.g. of screw type (with the working-chamber walls at least partly resilently deformable F04C 5/00; rotary-piston pumps with non-parallel axes of movement of co-operating members specially adapted for elastic fluids F04C 18/48)

3/02 . the axes being arranged at an angle of 90 degrees [5]
3/04 . . of intermeshing engagement type, i.e. with engagement of co-operating members similar to that of toothed gearing [5]
3/06 . the axes being arranged otherwise than at an angle of 90 degrees [5]
3/08 . . of intermeshing engagement type, i.e. with engagement of co-operating members similar to that of toothed gearing [5]

5/00 Rotary-piston machines or pumps with the working-chamber walls at least partly resiliently deformable (such pumps specially adapted for elastic fluids F04C 18/00)

7/00 Rotary-piston machines or pumps with fluid ring or the like (such pumps specially adapted for elastic fluids F04C 19/00)

9/00 Oscillating-piston machines or pumps (such pumps specially adapted for elastic fluids F04C 21/00)

11/00 Combinations of two or more machines or pumps, each being of rotary-piston or oscillating-piston type (combinations of such pumps specially adapted for elastic fluids F04C 23/00); Pumping installations (F04C 13/00 takes precedence; specially adapted for elastic fluids F04C 23/00; fluid gearing F16H)

13/00 Adaptations of machines or pumps for special use, e.g. for extremely high pressures (of pumps specially adapted for elastic fluids F04C 25/00)

14/00 Control of, monitoring of, or safety arrangements for, machines, pumps or pumping installations (of pumps or pumping installations specially adapted for elastic fluids F04C 28/00) [8]
14/02 . specially adapted for several machines or pumps connected in series or in parallel [8]
14/04 . specially adapted for reversible machines or pumps [8]
14/06 . specially adapted for stopping, starting, idling or no-load operation [8]
14/08 . characterised by varying the rotational speed [8]
14/10 . characterised by changing the positions of the inlet or outlet openings with respect to the working chamber [8]
14/12 . . using sliding valves [8]
14/14 . . using rotating valves [8]
14/16 . . using lift valves [8]
14/18 . characterised by varying the volume of the working chamber (by changing the positions of inlet or outlet openings F04C 14/10) [8]
14/20 . . by changing the form of the inner or outer contour of the working chamber [8]
14/22 . . by changing the eccentricity between cooperating members [8]
14/24 . . characterised by using valves regulating pressure or flow rate, e.g. discharge valves (F04C 14/10 takes precedence) [8]
14/26 . . using bypass channels [8]
14/28 . Safety arrangements; Monitoring [8]

15/00 Component parts, details or accessories of machines, pumps or pumping installations, not provided for in groups F04C 2/00 to F04C 14/00 (of pumps specially adapted for elastic fluids F04C 18/00 to F04C 29/00) [1,8]
15/06 . Arrangements for admission or discharge of the working fluid, e.g. constructional features of the inlet or outlet [8]

Pumps specially adapted for elastic fluids

18/00 Rotary-piston pumps specially adapted for elastic fluids (with fluid ring or the like F04C 19/00; rotary-piston pumps in which the working-fluid is exclusively displaced by one or more reciprocating pistons F04B) [3]

Note

Group F04C 18/30 takes precedence over groups F04C 18/02 to F04C 18/24. [3,5]
18/02 . . of arcuate-engagement type, i.e. with circular transatory movement of co-operating members, each member having the same number of teeth or tooth-equivalents [3]
18/04 . . of internal-axis type [3]
18/06 . . of other than internal-axis type (F04C 18/063 takes precedence) [3]
18/063 . . with coaxially-mounted members having continuously-changing circumferential spacing between them [3]
18/067 . . having cam-and-follower type drive [3]
18/07 . . having crankshaft-and-connecting-rod type drive [3]
18/073 . . having pawl-and-ratchet type drive [3]
18/077 . . having toothed-gearing type drive [3]
18/08 . . of intermeshing-engagement type, i.e. with engagement of co-operating members similar to that of toothed gearing [3]
18/10 . . of internal-axis type with the outer member having more teeth or tooth-equivalents, e.g. rollers, than the inner member [3]
18/107 . . with helical teeth [3]
18/113 . . the inner member carrying rollers intermeshing with the outer member [3]
18/12 . . of other than internal-axis type [3]
18/14 . . with toothed rotary pistons [3]
18/16 . . . with helical teeth, e.g. chevron-shaped, screw type [3]
18/18 . . . with similar tooth forms (F04C 18/16 takes precedence) [3]
18/20 . . . with dissimilar tooth forms (F04C 18/16 takes precedence) [3]
18/22 . . of internal-axis type with equidirectional movement of co-operating members at the points of engagement, or with one of the co-operating members being stationary, the inner member having more teeth or tooth-equivalents than the outer member [3]
18/24 . . of counter-engagement type, i.e. the movement of co-operating members at the points of engagement being in opposite directions [3]
18/26 . . of internal-axis type [3]
18/28 . . of other than internal-axis type [3]
18/30 . having the characteristics covered by two or more of groups F04C 18/02, F04C 18/08, F04C 18/22, F04C 18/24, F04C 18/48, or having the characteristics covered by one of these groups together with some other type of movement between co-operating members [3]
18/32 . having both the movement defined in group F04C 18/02 and relative reciprocation between the co-operating members [3]
18/324 . . with vanes hinged to the inner member and reciprocating with respect to the outer member [3]
23/00 Combinations of two or more pumps, each being of rotary-piston or oscillating-piston type, specially adapted for elastic fluids; Pumping installations specially adapted for elastic fluids; Multi-stage pumps specially adapted for elastic fluids (F04C 25/00 takes precedence)

23/02 . Pumps characterised by combination with, or adaptation to, specific driving engines or motors (predominant aspects of the engines or motors, see the relevant classes)

25/00 Adaptations for special use of pumps for elastic fluids

25/02 . for producing high vacuum (sealing arrangements F04C 27/00; silencing F04C 29/06)

27/00 Sealing arrangements in rotary-piston pumps specially adapted for elastic fluids

27/02 . Liquid sealing for high-vacuum pumps

28/00 Control of, monitoring of, or safety arrangements for, pumps or pumping installations specially adapted for elastic fluids [8]

28/02 . specially adapted for several pumps connected in series or in parallel [8]

28/04 . specially adapted for reversible pumps [8]

28/06 . specially adapted for stopping, starting, idling or no-load operation [8]

28/08 . characterised by varying the rotational speed [8]

28/10 . characterised by changing the positions of the inlet or outlet openings with respect to the working chamber [8]

28/12 . . using sliding valves [8]

28/14 . . using rotating valves [8]

28/16 . . using lift valves [8]

28/18 . . characterised by varying the volume of the working chamber (by changing the positions of inlet or outlet openings F04C 28/10) [8]

28/20 . . by changing the form of the inner or outer contour of the working chamber [8]

28/22 . . by changing the eccentricity between cooperating members [8]

28/24 . . characterised by using valves regulating pressure or flow rate, e.g. discharge valves (F04C 28/10 takes precedence) [8]

28/26 . . using bypass channels [8]

28/28 . . Safety arrangements; Monitoring [8]

29/00 Component parts, details, or accessories, of pumps or pumping installations specially adapted for elastic fluids, not provided for in groups F04C 18/00 to F04C 28/00

29/02 . Lubrication (of machines or engines in general F01M); Lubricant separation (separation in general B01D)

29/04 . Heating; Cooling (of machines or engines in general F01P); Heat insulation (heat insulation in general F16L 59/00)

29/06 . Silencing (gas-flow silencers or exhaust apparatus for machines or engines in general F01N)

29/12 . Arrangements for admission or discharge of the working fluid, e.g. constructional features of the inlet or outlet [8]

Note Group F04C 18/30 takes precedence over group F04C 18/48. [8]
**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”.

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<td>Pumping installations or systems; control ....................... 13/00; 15/00</td>
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<tr>
<td>1/06 Multi-stage pumps (F04D 1/02 takes precedence)</td>
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<tr>
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</tr>
<tr>
<td>1/12 Pumps with scoops or like paring members protruding in the fluid circulating in a bowl</td>
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<tr>
<td>1/14 Pumps raising fluids by centrifugal force within a conical rotary bowl with vertical axis</td>
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| 5/00 Pumps with circumferential or transverse flow |

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<td>7/06 the fluids being hot or corrosive, e.g. liquid metal</td>
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<td>13/06 the pump being electrically driven</td>
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<tr>
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<tr>
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<tr>
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<tr>
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<tr>
<td>17/12 Multi-stage pumps</td>
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<tr>
<td>17/14 with means for changing the flow-path through the stages, e.g. series/parallel (surge control F04D 27/02)</td>
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<tr>
<td>17/16 for displacing without appreciable compression</td>
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<tr>
<td>17/18 characterised by use of centrifugal force of liquids entrained in pumps</td>
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</table>
19/00 Axial-flow pumps (F04D 21/00 takes precedence)
19/02 Multi-stage pumps
19/04 specially adapted to the production of a high vacuum, e.g. molecular pumps
21/00 Pumps involving supersonic speed of pumped fluids
23/00 Other rotary non-positive-displacement pumps (pumping installations or systems F04D 25/00)

25/00 Pumping installations or systems (controlling F04D 27/00)
25/02 Units comprising pumps and their driving means (predominant aspects of the driving means, see the relevant classes for such means)
25/04 the pump being fluid-driven
25/06 the pump being electrically driven (F04D 25/08 takes precedence)
25/08 the working fluid being air, e.g. for ventilation
25/10 the unit having provisions for automatically changing the direction of output air
25/12 the unit being adapted for mounting in apertures
25/14 and having shutters, e.g. automatically closed when not in use
25/16 Combinations of two or more pumps

27/00 Control, e.g., regulation, of pumps, pumping installations, or systems
27/02 Surge control

29/00 Details, component parts, or accessories (machine elements in general F16)
29/02 Selection of particular materials (for handling specific liquids F04D 7/00)
29/04 Shafts or bearings, or assemblies thereof (specially adapted for elastic fluid pumps F04D 29/05) [1,8]
29/041 Axial thrust balancing [8]
29/042 Axially shiftable rotors (F04D 29/041 takes precedence) [8]
29/043 Shafts [8]
29/044 Arrangements for joining or assembling shafts [8]
29/046 Bearings [8]
29/047 Hydrostatic; hydrodynamic [8]
29/048 Magnetic; electromagnetic [8]
29/049 Roller bearings [8]
29/05 Shafts or bearings, or assemblies thereof, specially adapted for elastic fluid pumps [8]
29/051 Axial thrust balancing [8]
29/052 Axially shiftable rotors (F04D 29/051 takes precedence) [8]
29/053 Shafts [8]
29/054 Arrangements for joining or assembling shafts [8]
29/056 Bearings [8]

29/057 Hydrostatic; hydrodynamic [8]
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29/14 Operative only when pump is inoperative
29/16 Between pressure and suction sides
29/18 Rotors (specially adapted for elastic fluids F04D 29/26)
29/20 Mounting rotors on shafts
29/22 Specially for centrifugal pumps
29/24 Vanes
29/26 Rotors specially adapted for elastic fluids
29/28 for centrifugal or helico-centrifugal pumps
29/30 Vanes
29/32 for axial-flow pumps
29/34 Blade mountings
29/36 Adjustable
29/38 Blades
29/40 Casings; Connections for working fluid
29/42 for radial or helico-centrifugal pumps
29/44 Fluid-guiding means, e.g. diffusers
29/46 Adjustable
29/48 for unidirectional fluid flow in reversible pumps
29/50 for reversing fluid flow
29/52 for axial pumps
29/54 Fluid-guiding means, e.g. diffusers
29/56 Adjustable
29/58 Cooling (of machines or engines in general F01P); Heating; Diminishing heat transfer
29/60 Mounting; Assembling; Disassembling
29/62 of radial or helico-centrifugal pumps
29/64 of axial pumps
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)
29/68 by influencing boundary layers
29/70 Suction grids; Strainers; Dust separation; Cleaning

Other non-positive-displacement pumps
31/00 Pumping liquids and elastic fluids at the same time
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) [2]
35/00 Pumps producing waves in liquids, i.e. wave-producers (for bath tubs A47K 3/10) [2]

Notes
(1) Attention is drawn to the Notes preceding class F01.
(2) Combinations of pumps covered by this subclass with other pumps are only classified in this subclass if such other pumps are intended for preliminary pumping for diffusion pumps.

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<td>1/10</td>
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<td>1/18</td>
<td>. . . the fluid medium being mixed with, or generated from, the liquid to be pumped</td>
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