

CPC**COOPERATIVE PATENT CLASSIFICATION****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](#))

NOTE

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

- "piston" also covers a plunger.

Attention is drawn to the notes preceding class [F01](#) , especially as regards the definitions of "machines", "pumps", and "positive-displacement".

WARNING

The following IPC groups are not used in the CPC scheme. Subject matter covered by these groups is classified in the following CPC groups:

[F04B 35/02](#) covered by [F04B 9/08](#)

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

F04B 1/00

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

F04B 1/005

. { Pumps with cylinder axis arranged substantially tangentially to a circle centred on main shaft axis }

F04B 1/02

. having two cylinders (in V-arrangement [F04B 1/04](#))

F04B 1/04

. having cylinders in star- or fan-arrangement

F04B 1/0404

.. { Details, component parts specially adapted for such pumps }

F04B 1/0408

... { Pistons }

F04B 1/0413

... { Cams }

F04B 1/0417

.... { consisting of several cylindrical elements, e.g. rollers }

F04B 1/0421

... { Cylinders }

F04B 1/0426

... { Arrangements for pressing or connecting the pistons against the actuated cam }

F04B 1/043

.... { hydraulically }

F04B 1/0435

... { Disconnecting the pistons from the actuated cam (in general [F01B 31/24](#)) }

F04B 1/0439	...	{ Supporting and guiding means for the pistons }
F04B 1/0443	...	{ Draining of the engine housing; arrangements dealing with leakage fluid }
F04B 1/0448	...	{ Sealing, e.g. seals for shafts or housings (F04B 1/0408 , F04B 53/164 take precedence) }
F04B 1/0452	...	{ Particularities relating to the distribution members (F04B 1/0472 , F04B 1/0531 and F04B 1/0535 take precedence) }
F04B 1/0456	....	{ to cylindrical distribution members }
F04B 1/0461	....	{ to conical distribution members }
F04B 1/0465	....	{ to plate-like distribution members }
F04B 1/047	..	with an actuating or actuated element at the outer ends of the cylinders
F04B 1/0472	...	{ with cam-actuated distribution members }
F04B 1/0474	...	{ with two or more series radial piston-cylinder units }
F04B 1/0476	....	{ directly located side-by-side }
F04B 1/0478	....	{ Coupling of several cylinder-barrels }
F04B 1/053	..	with an actuating or actuated element at the inner ends of the cylinders
F04B 1/0531	...	{ with cam-actuated distribution members }
F04B 1/0533	....	{ each machine piston being provided with channels which are coacting with the cylinder and are used as a distribution member for another piston-cylinder unit }
F04B 1/0535	...	{ the piston-driving cam being provided with an inlet and an outlet }
F04B 1/0536	...	{ with two or more series radial piston-cylinder units }
F04B 1/0538	....	{ directly located side-by-side }
F04B 1/06	..	Control { (F04B 49/12 , F04B 49/18 take precedence) }
F04B 1/063	...	{ by using a valve in a system with several pumping chambers wherein the flow-path through the chambers can be changed, e.g. series-parallel }
F04B 1/066	...	{ by changing the phase relationship between the actuating cam and the distributing means }
F04B 1/07	...	by varying the relative eccentricity between two members, e.g. a cam and a drive shaft
F04B 1/08	...	regulated by delivery pressure
F04B 1/10	..	the cylinders being movable, e.g. rotary { (F04B 1/20 and F04B 3/006 take precedence) }
F04B 1/107	...	with an actuating or actuated element at the outer ends of the cylinders
F04B 1/1071	....	{ with rotary cylinder block }
F04B 1/1072	....	{ with cylinder block and actuating cam rotating together (F04B 1/1075 and F04B 1/1078 take precedence) }
F04B 1/1074	....	{ with two or more series radial piston-cylinder units }
F04B 1/1075	.....	{ with cylinder block and actuating cam both rotating (F04B 1/1078 takes precedence) }
F04B 1/1077	.....	{ directly located side-by-side }
F04B 1/1078	.....	{ with cylinder block and actuating cam both rotating }
F04B 1/113	...	with an actuating or actuated element at the inner ends of the cylinders
F04B 1/1133	....	{ with rotary cylinder block }
F04B 1/1136	....	{ the rotary cylinder being provided with only one piston, reciprocating within the cylinder }

F04B 1/12	. having cylinder axes coaxial with, or parallel or inclined to main shaft axis
F04B 1/122	.. { Component parts, details, e.g. valves, sealing, lubrication (F04B 1/2014 takes precedence) }
F04B 1/124	... { Pistons }
F04B 1/126	.... { Piston shoe retaining means }
F04B 1/128	.. { Driving means }
F04B 1/14	.. { having stationary cylinders }
F04B 1/141	... { Component parts }
F04B 1/143	.... { Cylinders }
F04B 1/145	.... { Housings }
F04B 1/146	.... { Swash plates or actuating elements }
F04B 1/148	..... { Swash plate or actuating element bearing means or driving axis bearing means }
F04B 1/16	... having two or more sets of cylinders or pistons
F04B 1/18	... having self-acting distribution members, i.e. actuated by working fluid
F04B 1/182	.... { Check valves }
F04B 1/184	.... { Cylindrical distribution members }
F04B 1/186	.... { Conical distribution members }
F04B 1/188	.... { Plate-like distribution members }
F04B 1/20	.. having rotary cylinder block
F04B 1/2007	... { Arrangements for pressing the cylinder barrel against the valve plate, e.g. by fluid pressure }
F04B 1/2014	... { Component parts }
F04B 1/2021	.... { Particularities in the contacting area between cylinder barrel or valve plate }
F04B 1/2028	..... { Bearing means }
F04B 1/2035	.... { Cylinder barrel }
F04B 1/2042	.... { Valve means }
F04B 1/205	..... { Cylindrical valve means }
F04B 1/2057	..... { Conical valve means }
F04B 1/2064	.... { Pumphousing }
F04B 1/2071	..... { Cylinder barrel bearing means }
F04B 1/2078	.... { Swash plate }
F04B 1/2085	..... { Swash plate bearing means or driving axis bearing means }
F04B 1/2092	... { Connection between rotating cylinder barrel and rotating inclined swash plate }
F04B 1/22	... having two or more sets of cylinders or pistons
F04B 1/24	.... inclined to main shaft axis
F04B 1/26	.. Control
F04B 1/28	... for machines or pumps with stationary cylinders
F04B 1/29	.... by varying the relative positions of a swash plate and a cylinder block
F04B 1/295	..... { by changing the inclination of the swash plate }
F04B 1/30	... for machines or pumps with rotary cylinder block
F04B 1/303	.... { by turning the valve plate }

- F04B 1/306 { by turning the swash plate (with fixed inclination) }
- F04B 1/32 by varying the relative positions of a swash plate and a cylinder block
- F04B 1/322 { by moving the swash plate in a direction perpendicular to the axis of rotation of the cylinder barrel }
- F04B 1/324 { by changing the inclination of the swash plate }
- F04B 1/326 { using wedges }
- F04B 1/328 { by changing the inclination of the axis of the cylinder barrel relative to the swash plate ([F04B 1/30](#) takes precedence) }

- F04B 1/34 Control not provided for in a single group of groups [F04B 1/02](#) to [F04B 1/32](#)

- F04B 3/00** **Machines or pumps with pistons coaxing within one cylinder e.g. multi-stage**

- F04B 3/003 . . { with two or more pistons reciprocating one within another, e.g. one piston forming cylinder of the other }
- F04B 3/006 . . { with rotating cylinder block }

- F04B 5/00** **Machines or pumps with differential surface pistons**

- F04B 5/02 . . with double-acting pistons

- F04B 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](#))**

- F04B 7/0003 . . { the distribution member forming both the inlet and discharge distributor for one single pumping chamber ([F04B 7/0208](#) takes precedence) }
- F04B 7/0007 . . { and having a rotating movement }
- F04B 7/0011 . . { and having an oscillating movement }
- F04B 7/0015 . . { and having a slidable movement }

- F04B 7/0019 . . { a common distribution member forming a single discharge distributor for a plurality of pumping chambers ([F04B 7/0233](#) takes precedence) }
- F04B 7/0023 . . { and having a rotating movement }
- F04B 7/0026 . . { and having an oscillating movement }
- F04B 7/003 . . { and having a slidable movement }
- F04B 7/0034 . . { and having an orbital movement, e.g. elbow-pipe type members }

- F04B 7/0038 . . { the distribution member forming a single inlet for a plurality of pumping chambers or a multiple discharge for one single pumping chamber }

- F04B 7/0042 . . { with specific kinematics of the distribution member ([F04B 7/0003](#), [F04B 7/0019](#) take precedence) }
- F04B 7/0046 . . { for rotating distribution members }
- F04B 7/0049 . . { for oscillating distribution members }
- F04B 7/0053 . . { for reciprocating distribution members }

WARNING

Groups [F04B 7/0057](#) to [F04B 7/0069](#) are not used for classification. The documents are in the process of being reclassified to subclass [F01L](#)

- [F04B 7/0057](#) . { Mechanical driving means therefor, e.g. cams }
- [F04B 7/0061](#) .. { for a rotating member }
- [F04B 7/0065](#) ... { being mounted on the main shaft }
- [F04B 7/0069](#) .. { for a sliding member }

- [F04B 7/0073](#) . { the member being of the lost-motion type, e.g. friction-actuated members, or having means for pushing it against or pulling it from its seat }

- [F04B 7/0076](#) . { the members being actuated by electro-magnetic means }

- [F04B 7/008](#) . { the distribution being realised by moving the cylinder itself, e.g. by sliding or swinging ([F04B 7/0291](#) takes precedence) }

- [F04B 7/0084](#) . { Component parts or details specially adapted therefor }
- [F04B 7/0088](#) .. { Sealing arrangements between the distribution members and the housing }
- [F04B 7/0092](#) ... { for oscillating distribution members }
- [F04B 7/0096](#) ... { for pipe-type distribution members }

- [F04B 7/02](#) . the valving being fluid-actuated
- [F04B 7/0208](#) .. { the distribution member forming both the inlet and discharge distributor for one single pumping chamber }
- [F04B 7/0216](#) ... { and having an oscillating movement }
- [F04B 7/0225](#) ... { and having a slidable movement }
- [F04B 7/0233](#) .. { a common distribution member forming a single discharge distributor for a plurality of pumping chambers }
- [F04B 7/0241](#) ... { and having an oscillating movement }
- [F04B 7/025](#) ... { and having a slidable movement }
- [F04B 7/0258](#) ... { and having an orbital movement, e.g. elbow-pipe type members }
- [F04B 7/0266](#) .. { the inlet and discharge means being separate members }
- [F04B 7/0275](#) ... { and being deformable, e.g. membranes }
- [F04B 7/0283](#) ... { and having a rotating movement }
- [F04B 7/0291](#) .. { the distribution being realised by moving the cylinder itself, e.g. by sliding or swinging }

- [F04B 7/04](#) . in which the valving is performed by pistons and cylinders coacting to open and close intake or outlet ports
- [F04B 7/045](#) .. { Two pistons coacting within one cylinder }
- [F04B 7/06](#) .. the pistons and cylinders being relatively reciprocated and rotated

- [F04B 9/00](#) **Piston machines or pumps characterised by the driving or driven means to or from their working members****

- F04B 9/02 . the means being mechanical
- F04B 9/025 .. { Driving of pistons coacting within one cylinder }
- F04B 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](#))
- F04B 9/042 ... { the means being cams }
- F04B 9/045 ... { the means being eccentrics }
- F04B 9/047 ... { the means being pin-and-slot mechanisms }
- F04B 9/06 .. the means including spring- or weight-loaded lost-motion devices

- F04B 9/08 . the means being fluid
- F04B 9/10 .. the fluid being liquid
- F04B 9/103 ... having only one pumping chamber
- F04B 9/1035 { the movement of the pump piston in the two directions being obtained by two single-acting liquid motors each acting in one direction }
- F04B 9/105 reciprocating movement of the pumping member being obtained by a double-acting liquid motor
- F04B 9/1053 { one side of the double-acting liquid motor being always under the influence of the liquid under pressure }
- F04B 9/1056 { with fluid-actuated inlet or outlet valve (mechanically controlled [F04B 7/00](#)) }
- F04B 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
- F04B 9/1073 { with actuation in the other direction by gravity }
- F04B 9/1076 { with fluid-actuated inlet or outlet valve (mechanically controlled [F04B 7/00](#)) }
- F04B 9/109 ... having plural pumping chambers
- F04B 9/1095 { having two or more pumping chambers in series }
- F04B 9/111 with two mechanically connected pumping members
- F04B 9/1115 { the movement of the pumping pistons in only one direction being obtained by a single-acting piston liquid motor, e.g. actuation in the other direction by spring means }
- F04B 9/113 reciprocating movement of the pumping members being obtained by a double-acting liquid motor
- F04B 9/115 reciprocating movement of the pumping members being obtained by two single-acting liquid motors, each acting in one direction
- F04B 9/117 the pumping members not being mechanically connected to each other
- F04B 9/1172 { the movement of each pump piston in the two directions being obtained by a double-acting piston liquid motor }
- F04B 9/1174 { with fluid-actuated inlet or outlet valve (mechanically controlled [F04B 7/00](#)) }
- F04B 9/1176 { the movement of each piston in one direction being obtained by a single-acting piston liquid motor }
- F04B 9/1178 { the movement in the other direction being obtained by a hydraulic connection between the liquid motor cylinders }
- F04B 9/12 .. the fluid being elastic, e.g. steam or air
- F04B 9/1207 ... { using a source of partial vacuum or sub-atmospheric pressure }

F04B 9/1215	....	{ the return stroke being obtained by a spring }
F04B 9/1222	....	{ the return stroke being obtained by an elastic fluid under pressure }
F04B 9/123	...	having only one pumping chamber
F04B 9/1235	....	{ the movement of the pump piston in the two directions being obtained by two single-acting piston fluid motors, each acting in one direction }
F04B 9/125	....	reciprocating movement of the pumping member being obtained by a double-acting elastic-fluid motor
F04B 9/1253	.....	{ one side of the double-acting piston fluid motor being always under the influence of the fluid under pressure }
F04B 9/1256	.....	{ with fluid-actuated inlet or outlet valve (mechanically controlled F04B 7/00) }
F04B 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
F04B 9/1273	.....	{ with actuation in the other direction by gravity }
F04B 9/1276	.....	{ with fluid-actuated inlet or outlet valve (mechanically controlled F04B 7/00) }
F04B 9/129	...	having plural pumping chambers
F04B 9/1295	....	{ having two or more pumping chambers in series }
F04B 9/131	....	with two mechanically connected pumping members
F04B 9/1315	.....	{ the movement of the pumping pistons in only one direction being obtained by a single-acting piston fluid motor, e.g. actuation in the other direction by spring means }
F04B 9/133	.....	reciprocating movement of the pumping members being obtained by a double-acting elastic-fluid motor
F04B 9/135	.....	reciprocating movement of the pumping members being obtained by two single-acting elastic-fluid motors, each acting in one direction
F04B 9/137	....	the pumping members not being mechanically connected to each other
F04B 9/1372	.....	{ the movement of each pump piston in the two directions is obtained by a double-acting piston fluid motor }
F04B 9/1374	.....	{ with fluid-actuated inlet or outlet valve (mechanically controlled F04B 7/00) }
F04B 9/1376	.....	{ the movement of each piston in one direction being obtained by a single-acting piston fluid motor }
F04B 9/1378	.....	{ the movement in the other direction being obtained by an hydraulic connection between the fluid motor cylinders }
F04B 9/14	.	Pumps characterised by muscle-power operation { hand-held spraying or dispensing apparatus using pumps or bulbs B05B 11/00 }

F04B 11/00 Equalisation of pulses, e.g. by use of air vessels; Counteracting cavitation

F04B 11/0008	.	{ using accumulators }
F04B 11/0016	..	{ with a fluid spring }
F04B 11/0025	...	{ the spring fluid being in direct contact with the pumped fluid }
F04B 11/0033	..	{ with a mechanical spring }
F04B 11/0041	.	{ by piston speed control (F04B 11/0058 takes precedence) }

- F04B 11/005 . { using two or more pumping pistons }
- F04B 11/0058 .. { with piston speed control }
- F04B 11/0066 ... { with special shape of the actuating element }
- F04B 11/0075 .. { connected in series }
- F04B 11/0083 ... { the pistons having different cross-sections }
- F04B 11/0091 . { using a special shape of fluid pass, e.g. throttles, ducts }

- F04B 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](#))**
- F04B 13/02 . of two or more fluids at the same time

- F04B 15/00** **Pumps adapted to handle specific fluids, e.g. by selection of specific materials for pumps or pump parts**
- F04B 15/02 . the fluids being viscous or non-homogeneous
- F04B 15/023 .. { supply of fluid to the pump by gravity through a hopper, e.g. without intake valve }
- F04B 2015/026 .. with a priming plunger or piston ahead of the pumping piston and connected on the same piston rod
- F04B 15/04 . the fluids being hot or corrosive ([F04B 15/06](#) takes precedence)
- F04B 15/06 . for liquids near their boiling point, e.g. under subnormal pressure
- F04B 15/08 .. the liquids having low boiling points
- F04B 2015/081 ... Liquified gases
- F04B 2015/0812 Air
- F04B 2015/0814 Argon
- F04B 2015/0816 Carbon monoxide
- F04B 2015/0818 Carbon dioxide
- F04B 2015/082 Helium
- F04B 2015/0822 Hydrogen
- F04B 2015/0824 Nitrogen
- F04B 2015/0826 Oxygen

- F04B 17/00** **Pumps characterised by combination with, or adaptation to, specific driving engines or motors**
- F04B 17/003 . { driven by piezo-electric means ([F04B 43/046](#) and [F04B 43/095](#) take precedence) }
- F04B 17/006 . { Solar operated }
- F04B 17/02 . driven by wind motors
- F04B 17/03 . driven by electric motors

- F04B 17/04 . . . using solenoids
- F04B 17/042 . . . { the solenoid motor being separated from the fluid flow }
- F04B 17/044 { using solenoids directly actuating the piston }
- F04B 17/046 . . . { the fluid flowing through the moving part of the motor }
- F04B 17/048 . . . { the fluid flowing around the moving part of the motor }

- F04B 17/05 . driven by internal-combustion engines
- F04B 17/06 . Mobile combinations

- F04B 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](#)**

- F04B 19/003 . { free-piston type pumps }
- F04B 19/006 . { Micro pumps ([F04B 43/043](#) and [F04B 43/095](#) take precedence) }

- F04B 19/02 . having movable cylinders
- F04B 19/022 . . { reciprocating cylinders }
- F04B 19/025 . . { cylinders rotating around their own axis }
- F04B 19/027 . . { cylinders oscillating around an axis perpendicular to their own axis }

- F04B 19/04 . Pumps for special use (for transferring liquids from bulk storage containers or reservoirs into vehicles or into portable containers [B67D 5/40](#))
- F04B 19/06 . . Pumps for delivery of both liquid and elastic fluid at the same time (wet gas pumps [F04B 37/20](#))

- F04B 19/08 . Scoop devices
- F04B 19/10 . . of wheel type
- F04B 19/12 . . of helical or screw-type
- F04B 19/14 . . of endless-chain type, e.g. with the chains carrying pistons co-operating with open-ended cylinders

- F04B 19/16 . Adhesion-type liquid-lifting devices
- F04B 19/18 . . Adhesion members therefor

- F04B 19/20 . Other positive-displacement pumps
- F04B 19/22 . . of reciprocating-piston type
- F04B 19/24 . . Pumping by heat expansion of pumped fluid

- F04B 23/00** **Pumping installations or systems ([F04B 17/00](#) takes precedence)**

- F04B 23/02 . having reservoirs
- F04B 23/021 . . { the pump being immersed in the reservoir }
- F04B 23/023 . . . { only the pump-part being immersed, the driving-part being outside the reservoir }
- F04B 23/025 . . { the pump being located directly adjacent the reservoir }

- F04B 23/026 . . . { a pump-side forming a wall of the reservoir }
- F04B 23/028 . . . { the pump being mounted on top of the reservoir }
- F04B 23/04 . Combinations of two or more pumps
- F04B 23/06 . . the pumps being all of reciprocating positive-displacement type
- F04B 23/08 . . the pumps being of different types
- F04B 23/10 . . . at least one pump being of the reciprocating positive-displacement type
- F04B 23/103 { being a radial piston pump }
- F04B 23/106 { being an axial piston pump }
- F04B 23/12 . . . at least one pump being of the rotary-piston positive-displacement type
([F04B 23/10](#) takes precedence)
- F04B 23/14 . . . at least one pump being of the non-positive-displacement type ([F04B 23/10](#),
[F04B 23/12](#) take precedence)

Guidance heading: **Pumps specially adapted for elastic fluids** (having a flexible working member [F04B 45/00](#); for raising fluid from great depths [F04B 47/00](#))

F04B 25/00 Multi-stage pumps

- F04B 25/005 . { with two cylinders }
- F04B 25/02 . of stepped piston type
- F04B 25/04 . having cylinders coaxial with, or parallel or inclined to, main shaft axis

F04B 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](#))

- F04B 27/005 . { with two cylinders }
- F04B 27/02 . having cylinders arranged oppositely relative to main shaft
- F04B 27/04 . having cylinders in star- or fan-arrangement
- F04B 27/0404 . . { Details, component parts specially adapted for such pumps }
- F04B 27/0409 . . . { Pistons }
- F04B 27/0414 . . . { Cams }
- F04B 27/0418 { consisting of several cylindrical elements, e.g. rollers }
- F04B 27/0423 . . . { Cylinders }
- F04B 27/0428 . . . { Arrangements for pressing or connecting the pistons against the actuated cam }
- F04B 27/0432 { hydraulically }
- F04B 27/0437 . . . { Disconnecting the pistons from the actuated cam (in general [F01B 31/24](#)) }
- F04B 27/0442 . . . { Supporting and guiding means for the pistons }
- F04B 27/0446 . . . { Draining of the engine housing; Arrangements dealing with leakage fluid }

F04B 27/0451	...	{ Particularities relating to the distribution members (F04B 27/0472 , F04B 27/0531 and F04B 27/0535 take precedence) }
F04B 27/0456	....	{ to cylindrical distribution members }
F04B 27/046	....	{ to conical distribution members }
F04B 27/0465	....	{ to plate like distribution members }
F04B 27/047	..	with an actuating element at the outer ends of the cylinders
F04B 27/0472	...	{ with cam-actuated distribution members }
F04B 27/0474	...	{ with two or more series radial piston-cylinder units }
F04B 27/0476	....	{ directly located side-by-side }
F04B 27/0478	....	{ Coupling of several cylinder-barrels }
F04B 27/053	..	with an actuating element at the inner ends of the cylinders
F04B 27/0531	...	{ with cam-actuated distribution members }
F04B 27/0533	....	{ each machine piston being provided with channels, which are coaxing with the cylinder and are used as a distribution member for another piston-cylinder unit }
F04B 27/0535	...	{ the piston-driving cam being provided with an inlet or an outlet }
F04B 27/0536	...	{ with two or more series radial piston-cylinder units }
F04B 27/0538	....	{ directly located side-by-side }
F04B 27/06	..	the cylinders being movable, e.g. rotary { (F04B 27/08 takes precedence) }
F04B 27/0606	...	{ having cylinders in star- or fan-arrangement, the connection of the pistons with an actuating element being at the outer ends of the cylinders }
F04B 27/0612	....	{ rotary cylinder block }
F04B 27/0619	.....	{ cylinder block and actuating cam rotating together (F04B 27/0631 and F04B 27/0644 take precedence) }
F04B 27/0625	.....	{ with two or more series radial piston cylinder units }
F04B 27/0631	.....	{ cylinder block and actuating cam both rotating (F04B 27/0644 takes precedence) }
F04B 27/0638	.....	{ directly located side by side }
F04B 27/0644	.....	{ cylinder block and actuating cam both rotating }
F04B 27/065	...	{ having cylinders in star- or fan-arrangement, the connection of the pistons with an actuating element being at the inner ends of the cylinders }
F04B 27/0657	....	{ rotary cylinder block }
F04B 27/0663	.....	{ the rotary cylinder being provided with only one piston, reciprocating within this cylinder }
F04B 27/067	..	Control
F04B 27/0673	...	{ by using a valve in a system with several pumping chambers, wherein the flow-path through the chambers can be changed, e.g. series-parallel }
F04B 27/0676	...	{ by changing the phase relationship between the actuating cam and the distribution means }
F04B 27/073	...	by varying the relative eccentricity between two members, e.g. a cam and a drive shaft
F04B 27/08	.	having cylinders coaxial with, or parallel or inclined to, main shaft axis
F04B 27/0804	..	{ having rotary cylinder block (see F01B 3/0032 , F03C 1/0636 , F03C 1/20) }
F04B 27/0808	...	{ having two or more sets of cylinders or pistons }
F04B 27/0813	....	{ inclined to main shaft axis }

F04B 27/0817	...	{ arrangements for pressing the cylinder barrel against the valve plate e.g. by fluid pressure }
F04B 27/0821	...	{ component parts, details, e.g. valves, sealings, lubrication }
F04B 27/0826	....	{ particularities in the contacting area between cylinder barrel and valve plate }
F04B 27/083	.....	{ bearing means }
F04B 27/0834	....	{ cylinder barrel }
F04B 27/0839	....	{ valve means, e.g. valve plate }
F04B 27/0843	.....	{ cylindrical valve means }
F04B 27/0847	.....	{ conical valve means }
F04B 27/0852	....	{ machine housing }
F04B 27/0856	.....	{ cylinder barrel bearing means }
F04B 27/086	....	{ swash plate }
F04B 27/0865	.....	{ swash plate bearing means or driving axis bearing means }
F04B 27/0869	...	{ connection between rotating cylinder barrel and rotating inclined swash plate }
F04B 27/0873	..	{ Component parts, e.g. sealings; Manufacturing or assembly thereof }
F04B 27/0878	...	{ Pistons }
F04B 27/0882	....	{ piston shoe retaining means }
F04B 27/0886	....	{ Piston shoes }
F04B 27/0891	...	{ casings, housings }
F04B 27/0895	...	{ driving means }
F04B 27/10	..	having stationary cylinders
F04B 27/1009	...	{ Distribution members }
F04B 27/1018	....	{ Cylindrical distribution members }
F04B 27/1027	....	{ Conical distribution members }
F04B 27/1036	...	{ Component parts, details, e.g. sealings, lubrication }
F04B 27/1045	....	{ Cylinders }
F04B 27/1054	....	{ Actuating elements }
F04B 27/1063	.....	{ Actuating-element bearing means or driving-axis bearing means }
F04B 27/1072	.....	{ Pivot mechanisms }
F04B 27/1081	....	{ Casings, housings }
F04B 27/109	....	{ Lubrication }
F04B 27/12	...	having plural sets of cylinders or pistons
F04B 27/14	..	Control
F04B 27/16	...	of pumps with stationary cylinders
F04B 27/18	....	by varying the relative positions of a swash plate and a cylinder block
F04B 27/1804	.....	{ Controlled by crankcase pressure }
F04B 2027/1809	.....	Controlled pressure
F04B 2027/1813	.....	Crankcase pressure
F04B 2027/1818	.....	Suction pressure
F04B 2027/1822	.....	Valve-controlled fluid connection
F04B 2027/1827	.....	between crankcase and discharge chamber
F04B 2027/1831	.....	between crankcase and suction chamber

F04B 2027/1836	.....	between crankcase and working chamber
F04B 2027/184	.....	Valve controlling parameter
F04B 2027/1845	.....	Crankcase pressure
F04B 2027/185	.....	Discharge pressure
F04B 2027/1854	.....	External parameters
F04B 2027/1859	.....	Suction pressure
F04B 2027/1863	.....	with an auxiliary valve, controlled by
F04B 2027/1868	.....	Crankcase pressure
F04B 2027/1872	.....	Discharge pressure
F04B 2027/1877	.....	External parameters
F04B 2027/1881	.....	Suction pressure
F04B 2027/1886	.....	Open (not controlling) fluid passage
F04B 2027/189	.....	between crankcase and discharge chamber
F04B 2027/1895	.....	between crankcase and suction chamber
F04B 27/20	...	of pumps with rotary cylinder block
F04B 27/22	....	by varying the relative positions of a swash plate and a cylinder block
F04B 27/24	.	Control not provided for in a single group of groups F04B 27/02 to F04B 27/22

F04B 29/00 **Other pumps with movable, e.g. rotatable cylinders**

F04B 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 classes for the prime mover)

F04B 33/00 **Pumps actuated by muscle power, e.g. for inflating**

- F04B 33/005 . { [specially adapted for inflating tyres of non-motorised vehicles, e.g. cycles, tricycles](#) }
- F04B 33/02 . with intermediate gearing

F04B 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](#))

- F04B 35/002 . { [driven by internal combustion engines](#) }
- F04B 35/004 . { [driven by floating elements](#) }
- F04B 35/006 . { [driven by steam engines](#) }
- F04B 35/008 . { [the means being a fluid transmission link](#) }
- F04B 35/01 . the means being mechanical

- F04B 35/04 . the means being electric
- F04B 35/045 .. { using solenoids }
- F04B 35/06 . Mobile combinations
- F04B 37/00** **Pumps having pertinent characteristics not provided for in, or of interest apart from, groups [F04B 25/00](#) to [F04B 35/00](#)**
- F04B 37/02 . for evacuating by absorption or adsorption (absorption or adsorption in general [B01J](#) ; { for gas-filled discharge tubes see [H01J 17/24](#) })
- F04B 37/04 .. Selection of specific absorption or adsorption materials
- F04B 37/06 . for evacuating by thermal means
- F04B 37/08 .. by condensing or freezing, e.g. cryogenic pumps (cold traps [B01D 8/00](#))
- F04B 37/085 ... { Regeneration of cyro-pumps }
- F04B 37/10 . for special use ([F04B 37/02](#), [F04B 37/06](#) take precedence)
- F04B 37/12 .. to obtain high pressure
- F04B 37/14 .. to obtain high vacuum
- F04B 37/16 ... Means for nullifying unswept space
- F04B 37/18 .. for specific elastic fluid
- F04B 37/20 ... for wet gases, e.g. wet air
- F04B 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](#))**
- F04B 39/0005 . { adaptations of pistons }
- F04B 39/0011 .. { liquid pistons }
- F04B 39/0016 .. { with valve arranged in the piston }
- F04B 39/0022 .. { piston rods }
- F04B 39/0027 . { Pulsation and noise damping means }
- F04B 39/0033 .. { with encapsulations }
- F04B 39/0038 ... { of inlet or outlet channels }
- F04B 39/0044 .. { with vibration damping supports }
- F04B 39/005 .. { with direct action on the fluid flow using absorptive materials }
- F04B 39/0055 .. { with a special shape of fluid passage, e.g. bends, throttles, diameter changes, pipes }
- F04B 39/0061 ... { using muffler volumes }
- F04B 39/0066 ... { using sidebranch resonators, e.g. Helmholtz resonators }
- F04B 39/0072 ... { characterised by assembly or mounting }
- F04B 39/0077 .. { by generating oil foam }
- F04B 39/0083 .. { using blow off silencers }
- F04B 39/0088 .. { using mechanical tuned resonators }

- F04B 39/0094 . { crankshaft }
- F04B 39/02 . Lubrication (of machines or engines in general [F01M](#))
- F04B 39/0207 .. { with lubrication control systems }
- F04B 39/0215 .. { characterised by the use of a special lubricant }
- F04B 39/0223 .. { characterised by the compressor type (swash-plate compressors [F04B 27/109](#)) }
- F04B 39/023 ... { Hermetic compressors }
- F04B 39/0238 { with oil distribution channels }
- F04B 39/0246 { in the rotating shaft }
- F04B 39/0253 { using centrifugal force for transporting the oil }
- F04B 39/0261 { with an auxiliary oil pump }
- F04B 39/0269 { with device for spraying lubricant or with mist lubrication }
- F04B 39/0276 ... { the pump being of the reciprocating piston type, e.g. oscillating, free-piston compressors }
- F04B 39/0284 .. { Constructional details, e.g. reservoirs in the casing (swash-plate compressors [F04B 27/0878](#), [F04B 27/109](#)) }
- F04B 39/0292 ... { Lubrication of pistons or cylinders }
- F04B 39/04 . Measures to avoid lubricant contaminating the pumped fluid
- F04B 39/041 .. { sealing for a reciprocating rod (sealing in general [F16J](#)) }
- F04B 39/042 ... { sealing being provided on the piston }
- F04B 39/044 ... { sealing with a rolling diaphragm between piston and cylinder }
- F04B 39/045 ... { Labyrinth-sealing between piston and cylinder }
- F04B 39/047 ... { Sealing between piston and carter being provided by a bellow }
- F04B 39/048 ... { Sealing between piston and carter being provided by a diaphragm }
- F04B 39/06 . Cooling (of machines or engines in general [F01P](#)); Heating; Prevention of freezing
- F04B 39/062 .. { Cooling by injecting a liquid in the gas to be compressed }
- F04B 39/064 .. { Cooling by a cooling jacket in the pump casing }
- F04B 39/066 .. { Cooling by ventilation }
- F04B 39/068 .. { prevention of freezing }
- F04B 39/08 . Actuation of distribution members
- F04B 39/10 . Adaptations or arrangements of distribution members
- F04B 39/1006 .. { the members being ball valves }
- F04B 39/1013 .. { the members being of the poppet valve type }
- F04B 39/102 .. { the members being disc valves }
- F04B 39/1026 ... { without spring ([F04B 39/1033](#) takes precedence) }
- F04B 39/1033 ... { annular disc valves }
- F04B 39/104 .. { the members being parallel flexible strips }
- F04B 39/1046 .. { Combination of in- and outlet valve }
- F04B 39/1053 .. { the members being Hoerbigen valves }
- F04B 39/106 .. { the members being parallel non-flexible strips }

- F04B 39/1066 . . { Valve plates }
- F04B 39/1073 . . { the members being reed valves }
- F04B 39/108 . . . { circular reed valves }
- F04B 39/1086 . . . { flat annular reed valves }
- F04B 39/1093 . . { the members being low-resistance valves allowing free streaming }

- F04B 39/12 . Casings (casings for machines or engines in general [F16M](#)); Cylinders; Cylinders heads; Fluid connections
- F04B 39/121 . . { Casings }
- F04B 39/122 . . { Cylinder block }
- F04B 39/123 . . { Fluid connections }
- F04B 39/125 . . { Cylinder heads }
- F04B 39/126 . . { Cylinder liners }
- F04B 39/127 . . { Mounting of a cylinder block in a casing }
- F04B 39/128 . . { Crankcases }

- F04B 39/14 . Provisions for readily assembling or disassembling

- F04B 39/16 . Filtration; Moisture separation

- F04B 41/00** **Pumping installations or systems ([F04B 31/00](#), [F04B 35/00](#) take precedence)**

- F04B 41/02 . having reservoirs

- F04B 41/04 . Conversion of internal-combustion engine cylinder units to pumps

- F04B 41/06 . Combinations of two or more pumps

Guidance heading: Machines or pumps having flexible working members

- F04B 43/00** **Machines, pumps, or pumping installations having flexible working members (pumps or pumping installations specially adapted for elastic fluids [F04B 45/00](#))**

- F04B 43/0009 . { Special features }
- F04B 43/0018 . . { the periphery of the flexible member being not fixed to the pump-casing, but acting as a valve }
- F04B 43/0027 . . { without valves }
- F04B 43/0036 . . { the flexible member being formed as an O-ring }
- F04B 43/0045 . . { with a number of independent working chambers which are actuated successively by one mechanism }
- F04B 43/0054 . . { particularities of the flexible members }
- F04B 43/0063 . . . { bell-shaped flexible members }
- F04B 43/0072 . . . { of tubular flexible members }
- F04B 43/0081 . . { systems, control, safety measures }
- F04B 43/009 . . . { leakage control; pump systems with two flexible members; between the actuating element and the pumped fluid }

- F04B 43/02 . having plate-like flexible members, e.g. diaphragms
- F04B 43/021 .. { the plate-like flexible member is pressed against a wall by a number of elements, each having an alternating movement in a direction perpendicular to the plane of the plate-like flexible member and each having its own driving mechanism }
- F04B 43/023 .. { double acting plate-like flexible member }
- F04B 43/025 .. { two or more plate-like pumping members in parallel }
- F04B 43/026 ... { each plate-like pumping flexible member working in its own pumping chamber }
- F04B 43/028 .. { with in- or outlet valve arranged in the plate-like flexible member (valve arranged in the piston [F04B 53/12](#)) }
- F04B 43/04 .. Pumps having electric drive
- F04B 43/043 ... { Micro pumps }
- F04B 43/046 { with piezo-electric drive }
- F04B 43/06 .. Pumps having fluid drive
- F04B 43/067 ... the fluid being actuated directly by a piston
- F04B 43/073 ... the actuating fluid being controlled by at least one valve
- F04B 43/0733 { with fluid-actuated pump inlet or outlet valves; with two or more pumping chambers in series }
- F04B 43/0736 { with two or more pumping chambers in parallel }
- F04B 43/08 . having tubular flexible members ([F04B 43/12](#) takes precedence)
- F04B 43/082 .. { the tubular flexible member being pressed against a wall by a number of elements, each having an alternating movement in a direction perpendicular to the axes of the tubular member and each having its own driving mechanism }
- F04B 43/084 .. { the tubular member being deformed by stretching ou distersion }
- F04B 43/086 .. { with two or more tubular flexible members in parallel ([F04B 43/1136](#) takes precedence) }
- F04B 43/088 .. { with two or more tubular flexible members in series ([F04B 43/1133](#) takes precedence) }
- F04B 43/09 .. Pumps having electric drive
- F04B 43/095 ... { Piezo-electric drive }
- F04B 43/10 .. Pumps having fluid drive
- F04B 43/107 ... the fluid being actuated directly by a piston
- F04B 43/113 ... the actuating fluid being controlled by at least one valve
- F04B 43/1133 { with fluid-actuated pump inlet or outlet valves; with two or more pumping chambers in series }
- F04B 43/1136 { with two or more pumping chambers in parallel }
- F04B 43/12 . having peristaltic action
- F04B 43/1207 .. { the actuating element being a swash plate }
- F04B 43/1215 .. { having no backing plate (deforming of the tube only by rollers) }
- F04B 43/1223 .. { the actuating elements, e.g. rollers, moving in a straight line during squeezing }
- F04B 43/123 .. { using an excenter as the squeezing element }
- F04B 43/1238 .. { using only one roller as the squeezing element, the roller moving on an arc of a circle during squeezing }
- F04B 43/1246 ... { the roller being placed at the outside of the tubular flexible member }

- F04B 43/1253 .. { by using two or more rollers as squeezing elements, the rollers moving on an arc of a circle during squeezing }
- F04B 43/1261 ... { the rollers being placed at the outside of the tubular flexible member }
- F04B 43/1269 ... { the rotary axes of the rollers lying in a plane perpendicular to the rotary axis of the driving motor }
- F04B 43/1276 ... { Means for pushing the rollers against the tubular flexible member }
- F04B 43/1284 ... { Means for pushing the backing-plate against the tubular flexible member }
- F04B 43/1292 ... { Pumps specially adapted for several tubular flexible members }
- F04B 43/14 .. having plate-like flexible members

F04B 45/00**Pumps or pumping installations having flexible working members and specially adapted for elastic fluids**

- F04B 45/02 . having bellows
- F04B 45/022 .. { with two or more bellows in parallel }
- F04B 45/024 .. { with two or more bellows in series }
- F04B 45/027 .. having electric drive
- F04B 45/033 .. having fluid drive
- F04B 45/0333 ... { the fluid being actuated directly by a piston }
- F04B 45/0336 ... { the actuating fluid being controlled by one or more valves }
- F04B 45/04 . having plate-like flexible members, e.g. diaphragms
- F04B 45/041 .. { double acting plate-like flexible pumping member }
- F04B 45/043 .. { two or more plate-like pumping flexible members in parallel }
- F04B 45/045 .. { with in- or outlet valve arranged in the plate-like pumping flexible members }
- F04B 45/047 .. Pumps having electric drive
- F04B 45/053 .. Pumps having fluid drive
- F04B 45/0533 ... { the fluid being actuated directly by a piston }
- F04B 45/0536 ... { the actuating fluid being controlled by one or more valves }
- F04B 45/06 . having tubular flexible members ([F04B 45/02](#) takes precedence)
- F04B 45/061 .. { with fluid drive }
- F04B 45/062 ... { the fluid being actuated directly by a piston }
- F04B 45/064 ... { the actuating fluid being controlled by one or more valves }
- F04B 45/065 .. { with electric drive }
- F04B 45/067 .. Pumps having electric drive
- F04B 45/073 .. Pumps having fluid drive
- F04B 45/0733 ... { the fluid being actuated directly by a piston }
- F04B 45/0736 ... { the actuating fluid being controlled by one or more valves }
- F04B 45/08 .. having peristaltic action
- F04B 45/085 ... { the actuating element being a swash plate }
- F04B 45/10 .. having plate-like flexible members

F04B 47/00**Pumps or pumping installation 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](#))

- F04B 47/005 . { Sand trap arrangements }
- F04B 47/02 . the driving mechanisms being situated at ground level ([F04B 47/12](#) takes precedence)
- F04B 47/022 .. { driving of the walking beam }
- F04B 47/024 .. { actuated by muscle power }
- F04B 47/026 .. { Pull rods, full rod component parts }
- F04B 47/028 .. { details of the walking beam }
- F04B 47/04 .. the driving means incorporating fluid means
- F04B 47/06 . having motor-pump units situated at great depth
- F04B 47/08 .. the motor being actuated by fluid
- F04B 47/10 ... the units or parts thereof being liftable to ground level by fluid pressure
- F04B 47/12 . having free plunger lifting the fluid to the surface
- F04B 47/14 . Counterbalancing
- F04B 47/145 .. with fluid means

F04B 49/00 **Control { e.g. of pump delivery, or pump pressure } of, or safety measures for, machines, pumps, or pumping installations, not otherwise provided for, or of interest apart from, groups [F04B 1/00](#) to [F04B 47/00](#)**

NOTE

The classification symbols in group [F04B 49/00](#) and subgroups can be followed by additional symbols preceded by the sign "+". The symbols are applied in subgroups [F04B 49/06](#), [F04B 49/08](#), [F04B 49/16](#) and [F04B 49/225](#). The symbols have the meanings as listed below:

+C specially adapted for pumps for elastic fluids,
e.g. compressors
+P specially adapted for pumps for liquids

- F04B 49/002 . { Hydraulic systems to change the pump delivery }
- F04B 49/005 . { changing the phase relationship of two working pistons in one working chamber or the phase-relationship of a piston and a driven distribution member }
- F04B 49/007 . { Installations or systems with two or more pumps or pump cylinders, wherein the flow-path through the stages can be changed, e.g. from series to parallel (centrifugal pumps [F04D 15/0072](#)) }
- F04B 49/02 . Stopping, starting, unloading or idling control (controlled electrically [F04B 49/06](#))
- F04B 49/022 .. { by means of pressure }
- F04B 49/025 .. by means of floats
- F04B 49/03 .. by means of valves

- F04B 49/035 . . . Bypassing
- F04B 49/04 . Regulating by means of floats ([F04B 49/025](#) takes precedence)
- F04B 49/06 . Control using electricity ([regulating by means of floats actuating electric switches F04B 49/04](#))
- F04B 49/065 . . { [and making use of computers](#) }
- F04B 49/08 . Regulating by delivery pressure
- F04B 49/10 . Other safety measures
- F04B 49/103 . . { [Responsive to speed](#) }
- F04B 49/106 . . { [Responsive to pumped volume](#) }
- F04B 49/12 . by varying the length of stroke of the working members
- F04B 49/121 . . { [Lost-motion device in the driving mechanism](#) }
- F04B 49/123 . . { [by changing the eccentricity of one element relative to another element](#) }
- F04B 49/125 . . . { [by changing the eccentricity of the actuation means, e.g. cams or cranks, relative to the driving means, e.g. driving shafts \(\[F04B 49/128\]\(#\) takes precedence \)](#) }
- F04B 49/126 { [with a double eccenter mechanism](#) }
- F04B 49/128 . . . { [by changing the eccentricity of the cylinders, e.g. by moving a cylinder block](#) }
- F04B 49/14 . . Adjusting abutments located in the path of reciprocation
- F04B 49/16 . by adjusting the capacity of dead spaces of working chambers
- F04B 49/18 . by changing the effective cross-section of the working surface of the piston
- F04B 49/20 . by changing the driving speed ([controlled electrically F04B 49/06](#))
- F04B 49/22 . by means of valves ([F04B 49/03](#) takes precedence)
- F04B 49/225 . . { [with throttling valves or valves varying the pump inlet opening or the outlet opening](#) }
- F04B 49/24 . . Bypassing
- F04B 49/243 . . . { [by keeping open the inlet valve](#) }
- F04B 49/246 . . . { [by keeping open the outlet valve](#) }

F04B 51/00 Testing machines, pumps, or pumping installations

F04B 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](#)

- F04B 53/001 . { [Noise damping](#) }

WARNING

[Group F04B 53/001](#) and subgroups are not complete, see [F04B 11/00](#), [F04B 53/16](#)

F04B 53/002	.. { by encapsulation }
F04B 53/003	.. { by damping supports }
F04B 53/004	.. { by mechanical resonators }
F04B 53/005	. { Adaptations or arrangements of valves used as foot valves, of suction strainers, or of mud-boxes }
F04B 53/006	. { Crankshafts }
F04B 53/007	. { Cylinder heads }
F04B 53/008	. { Spacing or clearance between cylinder and piston }
F04B 53/02	. Packing the free space between cylinders and pistons
F04B 53/04	. Draining
F04B 53/06	. Venting
F04B 53/08	. Cooling (of machines or engines in general F01P); Heating; Preventing freezing
F04B 53/10	. Valves; Arrangement of valves
F04B 53/1002	.. { Ball valves }
F04B 53/1005	... { being formed by two closure members working in series }
F04B 53/1007	... { having means for guiding the closure member }
F04B 53/101	... { having means for limiting the opening height }
F04B 53/1012	.... { and means for controlling the opening height }
F04B 53/1015	... { Combinations of ball valves working in parallel }
F04B 53/1017	... { Semi-spherical ball valves }
F04B 53/102	.. { Disc valves }
F04B 53/1022	... { having means for guiding the closure member axially }
F04B 53/1025	.... { the guiding means being provided within the valve opening }
F04B 53/1027	.... { the guiding means being provided at both sides of the disc }
F04B 53/103	... { Flat-annular type disc valves }
F04B 53/1032	... { Spring-actuated disc valves (F04B 53/1022 , F04B 53/103 take precedence) }
F04B 53/1035	... { with means for limiting the opening height }
F04B 53/1037	.. { Flap valves }
F04B 53/104	... { the closure member being a rigid element oscillating around a fixed point }
F04B 53/1042	.... { by means of a flexible connection }
F04B 53/1045	.... { the valve being formed by two elements }
F04B 53/1047	... { the valve being formed by one or more flexible elements }
F04B 53/105	.... { one flexible element oscillating around a fixed point }
F04B 53/1052	.... { two flexible elements oscillating around a fixed point }
F04B 53/1055	.... { more than two flexible elements oscillating around a fixed point }
F04B 53/1057	.... { the valve being a tube, e.g. normally closed at one end }
F04B 53/106	.... { the valve being a membrane }

F04B 53/1062	.....	{ fixed at two or more points at its periphery }
F04B 53/1065	.....	{ fixed at its centre }
F04B 53/1067	.....	{ fixed at its whole periphery and with an opening at its centre }
F04B 53/107	.....	{ the opening normally being closed by a fixed element }
F04B 53/1072	..	{ the valve being an elastic body, the length thereof changing in the opening direction }
F04B 53/1075	..	{ the valve being a flexible annular ring }
F04B 53/1077	..	{ Flow resistance valves, e.g. without moving parts }
F04B 53/108	..	{ Valves characterised by the material }
F04B 53/1082	...	{ magnetic }
F04B 53/1085	..	{ having means for limiting the opening height (F04B 53/101 and F04B 53/1035 take precedence) }
F04B 53/1087	..	{ Valve seats }
F04B 53/109	..	{ inlet and outlet valve forming one unit }
F04B 53/1092	...	{ and one single element forming both the inlet and outlet closure member }
F04B 53/1095	..	{ Valves linked to another valve of another pumping chamber }
F04B 53/1097	..	{ with means for lifting the closure member for pump cleaning purposes }
F04B 53/12	..	arranged in or on pistons
F04B 53/121	...	{ the valve being an annular ring surrounding the piston, e.g. an O-ring }
F04B 53/122	...	{ the piston being free-floating, e.g. the valve being formed between the actuating rod and the piston }
F04B 53/123	...	{ Flexible valves }
F04B 53/124	...	{ Oscillating valves }
F04B 53/125	...	{ Reciprocating valves }
F04B 53/126	....	{ Ball valves }
F04B 53/127	....	{ Disc valves }
F04B 53/128	.....	{ Annular disc valves }
F04B 53/129	....	{ Poppet valves }
F04B 53/14	.	Pistons, piston-rods or piston-rod connections
F04B 53/141	..	{ Intermediate liquid piston between the driving piston and the pumped liquid (F04B 43/06 and F04B 43/10 take precedence) }
F04B 53/142	..	{ Intermediate liquid-piston between a driving piston and a driven piston (F04B 9/10 , F04B 43/06 , F04B 43/10 and F04B 53/141 take precedence) }
F04B 53/143	..	{ Sealing provided on the piston }
F04B 53/144	..	{ Adaptation of piston-rods }
F04B 53/145	...	{ Rod shock absorber }
F04B 53/146	...	{ Piston-rod guiding arrangements }
F04B 53/147	...	{ Mounting or detaching of piston rod }
F04B 53/148	..	{ the piston being provided with channels which are coacting with the cylinder and are used as a distribution member for another piston-cylinder unit }
F04B 53/16	.	Casings; Cylinders; Cylinder liners or heads; Fluid connections
F04B 53/162	..	{ Adaptations of cylinders }
F04B 53/164	...	{ Stuffing boxes }

- F04B 53/166 . . . { Cylinder liners }
- F04B 53/168 { Mounting of cylinder liners in cylinders }
- F04B 53/18 . Lubricating (of machines or engines in general [F01M](#))
- F04B 53/20 . Filtering
- F04B 53/22 . Arrangements for enabling ready assembly or disassembly

F04B 2201/00 Pump parameters

- F04B 2201/02 . Piston parameters
- F04B 2201/0201 . . Position of the piston
- F04B 2201/02011 . . . Angular position of a piston rotating around its own axis
- F04B 2201/0202 . . Linear speed of the piston
- F04B 2201/0203 . . Acceleration of the piston
- F04B 2201/0204 . . Power on the piston
- F04B 2201/0205 . . Piston ring wear
- F04B 2201/0206 . . Length of piston stroke
- F04B 2201/0207 . . Number of pumping strokes in unit time
- F04B 2201/02071 . . . Total number of pumping strokes
- F04B 2201/0208 . . Leakage across the piston
- F04B 2201/0209 . . Duration of piston stroke
- F04B 2201/021 . . Rotational speed of a piston rotating around its own axis ([F04B 7/06](#))
- F04B 2201/04 . Carter parameters
- F04B 2201/0401 . . Carter pressure
- F04B 2201/0402 . . Lubricating oil temperature
- F04B 2201/0403 . . Carter housing temperature
- F04B 2201/0404 . . Lubricating oil condition
- F04B 2201/0405 . . Leakage
- F04B 2201/0406 . . Pressure change across an oil filter
- F04B 2201/06 . Valve parameters
- F04B 2201/0601 . . Opening times
- F04B 2201/06011 . . . of the inlet valve only
- F04B 2201/06012 . . . of the outlet valve only
- F04B 2201/0602 . . Valve acceleration
- F04B 2201/0603 . . Valve wear
- F04B 2201/0604 . . Valve noise
- F04B 2201/0605 . . Leakage over a valve
- F04B 2201/0606 . . Opening width or height
- F04B 2201/06061 . . . of the inlet valve
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F04B 2201/08	. Cylinder or housing parameters
F04B 2201/0801	.. Temperature
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F04B 2201/0803	.. Leakage
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F04B 2201/0805	.. Rotational speed of a rotating cylinder block
F04B 2201/0806	.. Resonant frequency
F04B 2201/0807	.. Number of working cylinders
F04B 2201/0808	.. Size of the dead volume

F04B 2201/12	. Parameters of driving or driven means
F04B 2201/1201	.. Rotational speed of the axis
F04B 2201/1202	.. Torque on the axis
F04B 2201/1203	.. Power on the axis
F04B 2201/1204	.. Position of a rotating inclined plate
F04B 2201/12041	... Angular position
F04B 2201/1205	.. Position of a non-rotating inclined plate
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F04B 2201/1206	.. Rotational speed of a rotating inclined plate
F04B 2201/1207	.. Wear of the bearings
F04B 2201/1208	.. Angular position of the shaft
F04B 2201/1209	.. Radial force on the bearings
F04B 2201/121	.. Load on the sucker rod
F04B 2201/1211	.. Position of the walking beam
F04B 2201/1212	.. Oil pressure in the bearings
F04B 2201/1213	.. Eccentricity of an outer annular cam
F04B 2201/124	.. Coupling parameters
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F04B 2203/00 Motor parameters

F04B 2203/02	. of rotating electric motors
F04B 2203/0201	.. Current
F04B 2203/0202	.. Voltage
F04B 2203/0203	.. Magnetic flux
F04B 2203/0204	.. Frequency of the electric current
F04B 2203/0205	.. Temperature
F04B 2203/0206	.. Vibration
F04B 2203/0207	.. Torque
F04B 2203/0208	.. Power
F04B 2203/0209	.. Rotational speed

F04B 2203/021	..	Lubricating-oil temperature
F04B 2203/0211	..	Noise
F04B 2203/0212	..	Amplitude of the electric current
F04B 2203/0213	..	Pulses per unit of time (pulse motor)
F04B 2203/0214	..	Number of working motor-pump units
F04B 2203/04	.	of linear electric motors
F04B 2203/0401	..	Current
F04B 2203/0402	..	Voltage
F04B 2203/0403	..	Magnetic flux
F04B 2203/0404	..	Frequency of the electric current
F04B 2203/0405	..	Temperature
F04B 2203/0406	..	Vibration
F04B 2203/0407	..	Force
F04B 2203/0408	..	Power
F04B 2203/0409	..	Linear speed
F04B 2203/041	..	Lubricating-oil temperature
F04B 2203/0411	..	Noise
F04B 2203/06	.	of internal combustion engines
F04B 2203/0601	..	Temperature
F04B 2203/0602	..	Vibration
F04B 2203/0603	..	Torque
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F04B 2203/0605	..	Rotational speed
F04B 2203/0606	..	Lubricating-oil temperature
F04B 2203/0607	..	Fuel consumption
F04B 2203/06071	...	position of the carburettor valve
F04B 2203/09	.	of linear hydraulic motors
F04B 2203/0901	..	Opening time of the valves
F04B 2203/0902	..	Liquid pressure in a working chamber
F04B 2203/0903	..	Position of the driving piston
F04B 2203/091	...	Opening time of the valves
F04B 2203/10	.	of linear elastic fluid motors
F04B 2203/1001	..	Opening time of the valves
F04B 2203/11	.	of a gas turbine
F04B 2203/1101	..	Rotational speed of the turbine
F04B 2203/1102	..	Flow rate of the driving fluid
F04B 2203/1103	..	Rotation sense of the turbine
F04B 2203/12	.	of rotating hydraulic motors

F04B 2203/1201	. .	Rotational speed
F04B 2203/1202	. .	Pressure at the motor inlet
F04B 2205/00		Fluid parameters
F04B 2205/01	.	Pressure before the pump inlet
F04B 2205/02	.	Pressure in the inlet chamber
F04B 2205/03	.	Pressure in the compression chamber
F04B 2205/04	.	Pressure in the outlet chamber
F04B 2205/05	.	Pressure after the pump outlet
F04B 2205/06	.	Pressure in a (hydraulic) circuit
F04B 2205/061	. .	after a throttle
F04B 2205/062	. .	before a throttle
F04B 2205/063	. .	in a reservoir linked to the pump outlet
F04B 2205/064	. .	in a reservoir linked to the pump inlet
F04B 2205/065	. .	between two stages in a multi-stage pump
F04B 2205/07	.	Pressure difference over the pump
F04B 2205/08	.	Pressure difference over a throttle
F04B 2205/0801	. .	the throttle being a filter
F04B 2205/09	.	Flow through the pump
F04B 2205/10	.	Inlet temperature
F04B 2205/11	.	Outlet temperature
F04B 2205/111	. .	after a throttle
F04B 2205/112	. .	between two stages in a multi-stage pump
F04B 2205/12	.	Pressure pulsations before the pump
F04B 2205/13	.	Pressure pulsations after the pump
F04B 2205/14	.	Viscosity
F04B 2205/15	.	By-passing over the pump
F04B 2205/151	. .	Opening width of a bypass valve
F04B 2205/16	.	Opening or closing of a valve in a circuit
F04B 2205/17	.	Opening width of a throttling device
F04B 2205/171	. .	before the pump inlet

- F04B 2205/172 . . after the pump outlet
- F04B 2205/173 . . in a circuit
- F04B 2205/18 . Pressure in a control cylinder/piston unit
- F04B 2205/50 . Presence of foreign matter in the fluid
- F04B 2205/501 . . of solid particles
- F04B 2205/503 . . of gas in a liquid flow, e.g. gas bubbles

F04B 2207/00 External parameters

- F04B 2207/01 . Load in general
- F04B 2207/02 . External pressure
- F04B 2207/03 . External temperature
- F04B 2207/04 . Settings
 - F04B 2207/041 . . of flow
 - F04B 2207/0411 . . . maximum
 - F04B 2207/0412 . . . minimum
 - F04B 2207/0413 . . . medium
 - F04B 2207/042 . . of pressure
 - F04B 2207/0421 . . . maximum
 - F04B 2207/0422 . . . minimum
 - F04B 2207/0423 . . . medium
 - F04B 2207/043 . . of time
 - F04B 2207/044 . . of the rotational speed of the driving motor
 - F04B 2207/0441 . . . maximum
 - F04B 2207/0442 . . . minimum
 - F04B 2207/045 . . of the resonant frequency of the unit motor-pump
 - F04B 2207/046 . . of length of piston stroke
 - F04B 2207/047 . . of the nominal power of the driving motor
 - F04B 2207/048 . . of a reference voltage of the driving motor
- F04B 2207/70 . Warnings
 - F04B 2207/701 . . Sound
 - F04B 2207/702 . . Light
 - F04B 2207/703 . . Stopping
 - F04B 2207/704 . . Idling