

## SECTION F — MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING

### F01 MACHINES OR ENGINES IN GENERAL; ENGINE PLANTS IN GENERAL; STEAM ENGINES

**F01B MACHINES OR ENGINES, IN GENERAL OR OF POSITIVE-DISPLACEMENT TYPE, e.g. STEAM ENGINES** (of rotary-piston or oscillating-piston type F01C; of non-positive-displacement type F01D; combustion engines F02; internal-combustion aspects of reciprocating-piston engines F02B 57/00, F02B 59/00; machines for liquids F03, F04; crankshafts, crossheads, connecting-rods F16C; flywheels F16F; gearings for interconverting rotary motion and reciprocating motion in general F16H; pistons, piston-rods, cylinders, for engines in general F16J)

#### Note(s)

- This subclass covers, with the exception of the matter provided for in subclasses F01C-F01P:
  - engines for elastic fluids, e.g. steam engines;
  - engines for liquids and elastic fluids;
  - machines for elastic fluids;
  - machines for liquids and elastic fluids.
- Attention is drawn to the Notes preceding class F01, especially as regards the definitions of "steam" and "special vapour".

#### Subclass index

##### MACHINES OR ENGINES

With reciprocating pistons characterised by

number or relative disposition of cylinders.....	1/00
disposition of cylinder axes relative to main shaft.....	3/00, 5/00
pistons reciprocating in same or coaxial cylinders; piston-main-shaft connections other than covered above.....	7/00, 1/08, 9/00
no rotary main shaft.....	11/00
rotary or other movement of cylinders.....	13/00, 15/00
uniflow principle.....	17/00

With positive displacement of flexible-wall type.....

COMBINATIONS OR ADAPTATIONS OF MACHINES OR ENGINES.....	21/00, 23/00
REGULATING, CONTROLLING, SAFETY MEANS; STARTING.....	25/00, 27/00
OTHER CHARACTERISTICS; DETAILS, ACCESSORIES.....	29/00, 31/00

<b>1/00</b>	<b>Reciprocating-piston machines or engines characterised by number or relative disposition of cylinders or by being built-up from separate cylinder-crankcase elements</b> (F01B 3/00, F01B 5/00 take precedence) [2]	3/04	• the piston motion being transmitted by curved surfaces
1/01	• with one single cylinder [2]	3/06	• • by multi-turn helical surfaces and automatic reversal
1/02	• with cylinders all in one line	3/08	• • • the helices being arranged on the pistons
1/04	• with cylinders in V-arrangement	3/10	• Control of working-fluid admission or discharge peculiar thereto (suitable for more general application F01L)
1/06	• with cylinders in star or fan arrangement		
1/08	• with cylinders arranged oppositely relative to main shaft and of "flat" type	<b>5/00</b>	<b>Reciprocating-piston machines or engines with cylinder axes arranged substantially tangentially to a circle centred on main shaft axis</b>
1/10	• with more than one main shaft, e.g. coupled to common output shaft (combinations of two or more machines or engines F01B 21/00)	<b>7/00</b>	<b>Machines or engines with two or more pistons reciprocating within same cylinder or within essentially coaxial cylinders</b> (in opposite arrangement relative to main shaft F01B 1/08)
1/12	• Separate cylinder-crankcase elements coupled together to form a unit	7/02	• with oppositely reciprocating pistons
<b>3/00</b>	<b>Reciprocating-piston machines or engines with cylinder axes coaxial with, or parallel or inclined to, main shaft axis</b>	7/04	• • acting on same main shaft
3/02	• with wobble-plate	7/06	• • • using only connecting-rods for conversion of reciprocatory into rotary motion or <u>vice versa</u>
		7/08	• • • • with side rods

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- 7/10 • • • • having piston-rod of one piston passed through other piston
- 7/12 • • • using rockers and connecting-rods
- 7/14 • • acting on different main shafts
- 7/16 • with pistons synchronously moving in tandem arrangement
- 7/18 • with differential piston (F01B 7/20 takes precedence)
- 7/20 • with two or more pistons reciprocating one within another, e.g. one piston forming cylinder of the other
- 9/00 Reciprocating-piston machines or engines characterised by connections between pistons and main shafts and not specific to groups F01B 1/00-F01B 7/00** (connections disengageable during idling F01B 31/24)
- 9/02 • with crankshaft
- 9/04 • with rotary main shaft other than crankshaft
- 9/06 • • the piston motion being transmitted by curved surfaces
- 9/08 • • with ratchet and pawl
- 11/00 Reciprocating-piston machines or engines without rotary main shaft, e.g. of free-piston type**
- 11/02 • Equalising or cushioning devices
- 11/04 • Engines combined with reciprocating driven devices, e.g. hammers (with pumps F01B 23/08; predominating aspects of driven devices, see the relevant classes for the devices)
- 11/06 • • for generating vibration only
- 11/08 • with direct fluid transmission link (F01B 11/02 takes precedence)
- 13/00 Reciprocating-piston machines or engines with rotating cylinders in order to obtain the reciprocating-piston motion** (machines or engines of flexible-wall type F01B 19/00) [2]
- 13/02 • with one cylinder only
- 13/04 • with more than one cylinder
- 13/06 • • in star arrangement
- 15/00 Reciprocating-piston machines or engines with movable cylinders other than provided for in group F01B 13/00** (with movable cylinder sleeves for working-fluid control F01L)
- 15/02 • with reciprocating cylinders (with one piston within another F01B 7/20)
- 15/04 • with oscillating cylinder
- 15/06 • • Control of working-fluid admission or discharge peculiar thereto
- 17/00 Reciprocating-piston machines or engines characterised by use of uniflow principle**
- 17/02 • Engines
- 17/04 • • Steam engines
- 19/00 Positive-displacement machines or engines of flexible-wall type**
- 19/02 • with plate-like flexible members
- 19/04 • with tubular flexible members
- 21/00 Combinations of two or more machines or engines** (F01B 23/00 takes precedence; combinations of two or more pumps F04; fluid gearing F16H; regulating or controlling, see the relevant groups)
- 21/02 • the machines or engines being all of reciprocating-piston type
- 21/04 • the machines or engines being not all of reciprocating-piston type, e.g. of reciprocating steam engine with steam turbine
- 23/00 Adaptations of machines or engines for special use; Combinations of engines with devices driven thereby** (F01B 11/00 takes precedence; fluid gearing F16H; aspects predominantly concerning driven devices, see the relevant classes for these devices; regulating or controlling, see the relevant groups)
- 23/02 • Adaptations for driving vehicles, e.g. locomotives (arrangements in vehicles, see the relevant classes for vehicles)
- 23/04 • • the vehicles being waterborne vessels
- 23/06 • Adaptations for driving, or combinations with, hand-held tools or the like
- 23/08 • Adaptations for driving, or combinations with, pumps
- 23/10 • Adaptations for driving, or combinations with, electric generators
- 23/12 • Adaptations for driving rolling mills or other heavy reversing machinery
- 25/00 Regulating, controlling, or safety means** (regulating or controlling in general G05)
- 25/02 • Regulating or controlling by varying working-fluid admission or exhaust, e.g. by varying pressure or quantity (distributing or expansion valve gear F01L)
- 25/04 • • Sensing elements
- 25/06 • • • responsive to speed
- 25/08 • • Final actuators
- 25/10 • • • Arrangements or adaptations of working-fluid admission or discharge valves (valves in general F16K)
- 25/12 • • Devices dealing with sensing elements or final actuators or transmitting means between them, e.g. power-assisted (sensing elements alone F01B 25/04; final actuators alone F01B 25/08)
- 25/14 • • peculiar to particular kinds of machines or engines
- 25/16 • Safety means responsive to specific conditions (against water hammer or the like in steam engines F01B 31/34)
- 25/18 • • preventing rotation in wrong direction
- 25/20 • Checking operation of safety devices
- 25/22 • Braking by redirecting working fluid
- 25/24 • • thereby regenerating energy
- 25/26 • Warning devices
- 27/00 Starting of machines or engines** (starting combustion engines F02N)
- 27/02 • of reciprocating-piston engines
- 27/04 • • by directing working-fluid supply, e.g. by aid of by-pass steam conduits
- 27/06 • • • specially for compound engines
- 27/08 • • Means for moving crank off dead-centre (turning-gear in general F16H)
- 29/00 Machines or engines with pertinent characteristics other than those provided for in main groups F01B 1/00-F01B 27/00**
- 29/02 • Atmospheric engines, i.e. atmosphere acting against vacuum
- 29/04 • characterised by means for converting from one type to a different one
- 29/06 • • from steam engine into combustion engine
- 29/08 • Reciprocating-piston machines or engines not otherwise provided for
- 29/10 • • Engines (refrigeration machines F25B)

- 29/12 • • • Steam engines (toy steam engines A63H 25/00)
- 31/00 Component parts, details, or accessories not provided for in, or of interest apart from, other groups** (machine or engine casings, other than those peculiar to steam engines, F16M)
- 31/02 • De-icing means for engines having icing phenomena
- 31/04 • Means for equalising torque in reciprocating-piston machines or engines (compensation of inertial forces, suppression of vibration in systems F16F)
- 31/06 • Means for compensating relative expansion of component parts
- 31/08 • Cooling of steam engines (cooling of fluid machines or engines in general F01P); Heating; Heat insulation (heat insulation in general F16L 59/00)
- 31/10 • Lubricating arrangements of steam engines (of fluid machines or engines in general F01M)
- 31/12 • Arrangements of measuring or indicating devices (warning apparatus F01B 25/26; measuring instruments or the like per se G01)
- 31/14 • Changing of compression ratio
- 31/16 • Silencers specially adapted for steam engines (arrangements of exhaust pipes or tubes on steam engines F01B 31/30; gas-flow silencers or exhaust silencers for machines or engines in general F01N)
- 31/18 • Draining
- 31/20 • • of cylinders
- 31/22 • Idling devices, e.g. having by-passing valves
- 31/24 • • Disengagement of connections between pistons and main shafts
- 31/26 • Other component parts, details, or accessories, peculiar to steam engines
- 31/28 • • Cylinders or cylinder covers
- 31/30 • • Arrangements of steam conduits
- 31/32 • • Arrangements or adaptations of vacuum breakers
- 31/34 • • Safety means against water hammer or against the penetration of water (steam traps F16T)
- 31/36 • • • automatically cutting-off steam supply

**F01C ROTARY-PISTON OR OSCILLATING-PISTON MACHINES OR ENGINES** (combustion engines F02; internal-combustion aspects F02B 53/00, F02B 55/00; machines for liquids F03, F04)

#### Note(s)

- This subclass covers:
  - rotary-piston or oscillating-piston engines for elastic fluids, e.g. steam;
  - rotary-piston or oscillating-piston engines for liquids and elastic fluids;
  - rotary-piston or oscillating-piston machines for elastic fluids;
  - rotary-piston or oscillating-piston machines for liquids and elastic fluids.
- In this subclass, the following expression is used with the meaning indicated:
  - "rotary-piston machine" includes the German expressions "Drehkolbenmaschinen", "Kreiskolbenmaschinen", and "Umlaufkolbenmaschinen".
- Attention is drawn to the Notes preceding class F01, especially as regards the definitions of "rotary-piston machine", "oscillating-piston machine", "rotary piston", "co-operating members", "movement of co-operating members", "teeth or tooth-equivalents" and "internal-axis".

#### Subclass index

##### MACHINES OR ENGINES

With rotary pistons.....	1/00-7/00
With oscillating pistons.....	9/00
Control; monitoring; safety arrangements.....	20/00
COMBINATIONS OR ADAPTATIONS OF MACHINES OR ENGINES.....	11/00, 13/00
DRIVE OF CO-OPERATING MEMBERS; SEALING ARRANGEMENTS.....	17/00, 19/00
OTHER DETAILS OR ACCESSORIES.....	21/00

- 1/00 Rotary-piston machines or engines** (with axes of co-operating members non-parallel F01C 3/00; with the working-chamber walls at least partly resiliently deformable F01C 5/00; with fluid ring or the like F01C 7/00; rotary-piston machines or engines in which the working fluid is exclusively displaced by, or exclusively displaces, one or more reciprocating pistons F01B 13/00)
- Note(s)**
- Group F01C 1/30 takes precedence over groups F01C 1/02-F01C 1/24.
- 1/02 • 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
- 1/04 • • of internal-axis type
- 1/06 • • of other than internal-axis type (F01C 1/063 takes precedence)
- 1/063 • • with coaxially-mounted members having continuously-changing circumferential spacing between them [3]
- 1/067 • • • having cam-and-follower type drive [3]
- 1/07 • • • having crankshaft-and-connecting-rod type drive [3]
- 1/073 • • • having pawl-and-ratchet type drive [3]
- 1/077 • • • having toothed-gearing type drive [3]
- 1/08 • of intermeshing-engagement type, i.e. with engagement of co-operating members similar to that of toothed gearing
- 1/10 • • of internal-axis type with the outer member having more teeth or tooth-equivalents, e.g. rollers, than the inner member
- 1/107 • • • with helical teeth [3]

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- 1/113 • • • the inner member carrying rollers intermeshing with the outer member [3]
- 1/12 • • of other than internal-axis type
- 1/14 • • • with toothed rotary pistons
- 1/16 • • • • with helical teeth, e.g. chevron-shaped, screw type
- 1/18 • • • • with similar tooth forms (F01C 1/16 takes precedence)
- 1/20 • • • • with dissimilar tooth forms (F01C 1/16 takes precedence)
- 1/22 • 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
- 1/24 • of counter-engagement type, i.e. the movement of co-operating members at the points of engagement being in opposite directions
- 1/26 • • of internal-axis type
- 1/28 • • of other than internal-axis type
- 1/30 • having the characteristics covered by two or more of groups F01C 1/02, F01C 1/08, F01C 1/22, F01C 1/24 or having the characteristics covered by one of these groups together with some other type of movement between co-operating members
- 1/32 • • having both the movement defined in group F01C 1/02 and relative reciprocation between the co-operating members
- 1/324 • • • with vanes hinged to the inner member and reciprocating with respect to the outer member [3]
- 1/328 • • • • and hinged to the outer member [3]
- 1/332 • • • with vanes hinged to the outer member and reciprocating with respect to the inner member [3]
- 1/336 • • • • and hinged to the inner member [3]
- 1/34 • • having the movement defined in group F01C 1/08 or F01C 1/22 and relative reciprocation between the co-operating members
- 1/344 • • • with vanes reciprocating with respect to the inner member [3]
- 1/348 • • • • the vanes positively engaging, with circumferential play, an outer rotatable member [3]
- 1/352 • • • • the vanes being pivoted on the axis of the outer member [3]
- 1/356 • • • with vanes reciprocating with respect to the outer member [3]
- 1/36 • • having both the movements defined in groups F01C 1/22 and F01C 1/24
- 1/38 • • having the movement defined in group F01C 1/02 and having a hinged member (F01C 1/32 takes precedence) [3]
- 1/39 • • • with vanes hinged to the inner as well as to the outer member [3]
- 1/40 • • having the movement defined in group F01C 1/08 or F01C 1/22 and having a hinged member
- 1/44 • • • with vanes hinged to the inner member [3]
- 1/46 • • • with vanes hinged to the outer member [3]
- 3/00 Rotary-piston machines or engines with non-parallel axes of movement of co-operating members (with the working-chamber walls being at least partly resiliently deformable F01C 5/00)**
- 3/02 • the axes being arranged at an angle of 90°
- 3/04 • • with axially-sliding vanes
- 3/06 • the axes being arranged otherwise than at an angle of 90°
- 3/08 • • of intermeshing-engagement type, i.e. with engagement of co-operating members similar to that of toothed gearing
- 5/00 Rotary-piston machines or engines with the working-chamber walls at least partly resiliently deformable**
- 5/02 • the resiliently-deformable wall being part of the inner member, e.g. of a rotary piston
- 5/04 • the resiliently-deformable wall being part of the outer member, e.g. of a housing
- 5/06 • the resiliently-deformable wall being a separate member
- 5/08 • • of tubular form, e.g. hose
- 7/00 Rotary-piston machines or engines with fluid ring or the like**
- 9/00 Oscillating-piston machines or engines**
- 11/00 Combinations of two or more machines or engines, each being of rotary-piston or oscillating-piston type (F01C 13/00 takes precedence; combinations of two or more pumps F04; fluid gearing F16H)**
- 13/00 Adaptations of machines or engines for special use; Combinations of engines with devices driven thereby (aspects predominantly concerning driven devices, see the relevant classes for these devices)**
- 13/02 • for driving hand-held tools or the like
- 13/04 • for driving pumps or compressors
- 17/00 Arrangements for drive of co-operating members, e.g. for rotary piston and casing**
- 17/02 • of toothed-gearing type (F01C 1/077 takes precedence) [3]
- 17/04 • of cam-and-follower type (F01C 1/067 takes precedence) [3]
- 17/06 • using cranks, universal joints, or similar elements (F01C 1/07 takes precedence) [3]
- 19/00 Sealing arrangements in rotary-piston machines or engines (sealings in general F16J)**
- 19/02 • Radially-movable sealings for working fluids
- 19/04 • • of rigid material
- 19/06 • • of resilient material
- 19/08 • Axially-movable sealings for working fluids
- 19/10 • Sealings for working fluids between radially and axially movable parts
- 19/12 • for other than working fluid
- 20/00 Control of, monitoring of, or safety arrangements for, machines or engines [2006.01]**
- 20/02 • specially adapted for several machines or engines connected in series or in parallel [2006.01]
- 20/04 • specially adapted for reversible machines or engines [2006.01]
- 20/06 • specially adapted for stopping, starting, idling or no-load operation [2006.01]
- 20/08 • characterised by varying the rotational speed [2006.01]
- 20/10 • characterised by changing the positions of the inlet or outlet openings with respect to the working chamber [2006.01]
- 20/12 • • using sliding valves [2006.01]
- 20/14 • • using rotating valves [2006.01]
- 20/16 • • using lift valves [2006.01]

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| <p>20/18 • characterised by varying the volume of the working chamber (by changing the positions of inlet or outlet openings F01C 20/10) [2006.01]</p> <p>20/20 • • by changing the form of the inner or outer contour of the working chamber [2006.01]</p> <p>20/22 • • by changing the eccentricity between cooperating members [2006.01]</p> <p>20/24 • characterised by using valves regulating pressure or flow rate, e.g. discharge valves (F01C 20/10 takes precedence) [2006.01]</p> <p>20/26 • • using bypass channels [2006.01]</p> <p>20/28 • Safety arrangements; Monitoring [2006.01]</p> <p><b>21/00 Component parts, details, or accessories, not provided for in groups F01C 1/00-F01C 20/00</b></p> | <p>21/02 • Arrangements of bearings (bearing constructions F16C)</p> <p>21/04 • Lubrication (of machines or engines in general F01M)</p> <p>21/06 • Heating; Cooling (of machines or engines in general F01P); Heat insulation (heat insulation in general F16L)</p> <p>21/08 • Rotary pistons (reciprocating pistons in general F16J)</p> <p>21/10 • Outer members for co-operation with rotary pistons; Casings (casings for rotary engines or machines in general F16M)</p> <p>21/18 • Arrangements for admission or discharge of the working fluid, e.g. constructional features of the inlet or outlet [2006.01]</p> |
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**F01D NON-POSITIVE-DISPLACEMENT MACHINES OR ENGINES, e.g. STEAM TURBINES** (combustion engines F02; machines or engines for liquids F03, F04; non-positive-displacement pumps F04D)

### Note(s)

- This subclass covers:
  - non-positive-displacement engines for elastic fluids, e.g. steam turbines;
  - non-positive-displacement engines for liquids and elastic fluids;
  - non-positive-displacement machines for elastic fluids;
  - non-positive-displacement machines for liquids and elastic fluids.
- Attention is drawn to the Notes preceding class F01, especially as regards the definitions of "reaction type", e.g. with airfoil-like blades, and "impulse type", e.g. bucket turbines.

### Subclass index

#### NON-POSITIVE-DISPLACEMENT MACHINES OR ENGINES

General characteristics; with axial-thrust balancing; with other than pure rotation.....1/00, 3/00, 23/00

#### Component parts

blades and carrying members, protection thereof; rotors with adjustable blades; stators.....5/00, 7/00, 9/00

means against internal leakage.....11/00

COMBINATIONS OR ADAPTATIONS OF MACHINES OR ENGINES.....13/00, 15/00

REGULATION, CONTROLLING, SAFETY MEANS.....17/00, 19/00, 21/00

STARTING; SHUTTING-DOWN.....19/00, 21/00

OTHER DETAILS AND ACCESSORIES.....25/00

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| <p><b>1/00 Non-positive-displacement machines or engines, e.g. steam turbines</b> (with working-fluid flows in opposite axial directions for balancing axial thrust F01D 3/02; with other than pure rotation F01D 23/00; turbines characterised by their use in special steam systems, cycles, or processes, regulating devices therefor F01K)</p> <p>1/02 • with stationary working-fluid guiding means and bladed or like rotor (F01D 1/24 takes precedence; without working-fluid guiding means F01D 1/18) [5]</p> <p>1/04 • • traversed by the working-fluid substantially axially</p> <p>1/06 • • traversed by the working-fluid substantially radially</p> <p>1/08 • • • having inward flow</p> <p>1/10 • • having two or more stages subjected to working-fluid flow without essential intermediate pressure change, i.e. with velocity stages (F01D 1/12 takes precedence)</p> <p>1/12 • • with repeated action on same blade ring</p> <p>1/14 • • • traversed by the working-fluid substantially radially</p> <p>1/16 • • characterised by having both reaction stages and impulse stages</p> | <p>1/18 • without working-fluid guiding means (F01D 1/24, F01D 1/32, F01D 1/34 take precedence) [5]</p> <p>1/20 • • traversed by the working-fluid substantially axially</p> <p>1/22 • • traversed by the working-fluid substantially radially</p> <p>1/24 • characterised by counter-rotating rotors subjected to same working-fluid stream without intermediate stator blades or the like</p> <p>1/26 • • traversed by the working-fluid substantially axially</p> <p>1/28 • • traversed by the working-fluid substantially radially</p> <p>1/30 • characterised by having a single rotor operable in either direction of rotation, e.g. by reversing of blades (combinations of machines or engines F01D 13/00)</p> <p>1/32 • with pressure/velocity transformation exclusively in rotor, e.g. the rotor rotating under the influence of jets issuing from the rotor</p> <p>1/34 • characterised by non-bladed rotor, e.g. with drilled holes (F01D 1/32 takes precedence; sirens G10K 7/00) [5]</p> <p>1/36 • • using fluid friction</p> |
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## F01D

- 1/38 • • of the screw type [5]
- 3/00 Machines or engines with axial-thrust balancing effected by working fluid**
- 3/02 • characterised by having one fluid flow in one axial direction and another fluid flow in the opposite direction
- 3/04 • axial thrust being compensated by thrust-balancing dummy piston or the like
- 5/00 Blades; Blade-carrying members (nozzle boxes F01D 9/02); Heating, heat-insulating, cooling, or antivibration means on the blades or the members**
- 5/02 • Blade-carrying members, e.g. rotors (rotors of non-bladed type F01D 1/34; stators F01D 9/00)
- 5/03 • • Annular blade-carrying members having blades on the inner periphery of the annulus and extending inwardly radially, i.e. inverted rotors [6]
- 5/04 • • for radial-flow machines or engines
- 5/06 • • Rotors for more than one axial stage, e.g. of drum or multiple-disc type; Details thereof, e.g. shafts, shaft connections
- 5/08 • • Heating, heat-insulating, or cooling means
- 5/10 • • Antivibration means
- 5/12 • Blades (blade roots F01D 5/30; rotors with blades adjustable in operation F01D 7/00; stator blades F01D 9/02)
- 5/14 • • Form or construction (selecting particular materials, measures against erosion or corrosion F01D 5/28)
- 5/16 • • • for counteracting blade vibration
- 5/18 • • • Hollow blades; Heating, heat-insulating, or cooling means on blades
- 5/20 • • • Specially-shaped blade tips to seal space between tips and stator
- 5/22 • • Blade-to-blade connections, e.g. by shrouding
- 5/24 • • • using wire or the like
- 5/26 • • Antivibration means not restricted to blade form or construction or to blade-to-blade connections
- 5/28 • • Selecting particular materials; Measures against erosion or corrosion
- 5/30 • Fixing blades to rotors; Blade roots
- 5/32 • • Locking, e.g. by final locking-blades or keys
- 5/34 • Rotor-blade aggregates of unitary construction
- 7/00 Rotors with blades adjustable in operation; Control thereof (for reversing F01D 1/30)**
- 7/02 • having adjustment responsive to speed
- 9/00 Stators (non-fluid guiding aspects of casings, regulating, controlling, or safety aspects, see the relevant groups)**
- 9/02 • Nozzles; Nozzle boxes; Stator blades; Guide conduits
- 9/04 • • forming ring or sector
- 9/06 • Fluid supply conduits to nozzles or the like
- 11/00 Preventing or minimising internal leakage of working fluid, e.g. between stages (sealings in general F16J)**
- 11/02 • by non-contact sealings, e.g. of labyrinth type (for sealing space between rotor blade tips and stator F01D 11/08)
- 11/04 • • using sealing fluid, e.g. steam
- 11/06 • • • Control thereof
- 11/08 • for sealing space between rotor blade tips and stator (specially-shaped blade tips therefor F01D 5/20)
- 11/10 • • using sealing fluid, e.g. steam
- 11/12 • • using a rubstrip, e.g. erodible, deformable or resiliently biased part [6]
- 11/14 • • Adjusting or regulating tip-clearance, i.e. distance between rotor-blade tips and stator casing (rotors with blades adjustable in operation F01D 7/00) [6]
- 11/16 • • • by self-adjusting means (F01D 11/12 takes precedence) [6]
- 11/18 • • • • using stator or rotor components with predetermined thermal response, e.g. selective insulation, thermal inertia, differential expansion [6]
- 11/20 • • • Actively adjusting tip-clearance [6]
- 11/22 • • • • by mechanically actuating the stator or rotor components, e.g. moving shroud sections relative to the rotor [6]
- 11/24 • • • • by selectively cooling or heating stator or rotor components [6]
- 13/00 Combinations of two or more machines or engines (F01D 15/00 takes precedence; combinations of two or more pumps F04; fluid gearing F16H; regulating or controlling, see the relevant groups)**
- 13/02 • Working-fluid interconnection of machines or engines
- 15/00 Adaptations of machines or engines for special use; Combinations of engines with devices driven thereby (regulating or controlling, see the relevant groups; aspects predominantly concerning driven devices, see the relevant classes for the devices)**
- 15/02 • Adaptations for driving vehicles, e.g. locomotives (arrangement in vehicles, see the relevant vehicle classes)
- 15/04 • • the vehicles being waterborne vessels
- 15/06 • Adaptations for driving, or combinations with, hand-held tools or the like
- 15/08 • Adaptations for driving, or combinations with, pumps
- 15/10 • Adaptations for driving, or combinations with, electric generators
- 15/12 • Combinations with mechanical gearing (driven by multiple engines F01D 13/00)
- 17/00 Regulating or controlling by varying flow (for reversing F01D 1/30; by varying rotor blade position F01D 7/00; specially for starting F01D 19/00; shutting-down F01D 21/00; regulating or controlling in general G05)**
- 17/02 • Arrangement of sensing elements (sensing elements per se, see the relevant subclasses)
- 17/04 • • responsive to load
- 17/06 • • responsive to speed
- 17/08 • • responsive to condition of working fluid, e.g. pressure
- 17/10 • Final actuators (valves in general F16K)
- 17/12 • • arranged in stator parts
- 17/14 • • • varying effective cross-sectional area of nozzles or guide conduits
- 17/16 • • • • by means of nozzle vanes
- 17/18 • • • varying effective number of nozzles or guide conduits
- 17/20 • Devices dealing with sensing elements or final actuators or transmitting means between them, e.g. power-assisted (sensing elements alone F01D 17/02; final actuators alone F01D 17/10)
- 17/22 • • the operation or power assistance being predominantly non-mechanical
- 17/24 • • • electrical
- 17/26 • • • fluid, e.g. hydraulic

19/00	<b>Starting of machines or engines; Regulating, controlling, or safety means in connection therewith</b> (warming-up before starting F01D 25/10; turning or inching gear F01D 25/34)	25/02	• De-icing means for engines having icing phenomena
		25/04	• Antivibration arrangements
		25/06	• • for preventing blade vibration (means on blade-carrying members or blades F01D 5/00)
19/02	• dependent on temperature of component parts, e.g. of turbine casing	25/08	• Cooling (of machines or engines in general F01P); Heating; Heat insulation (of blade-carrying members, of blades F01D 5/00)
21/00	<b>Shutting-down of machines or engines, e.g. in emergency; Regulating, controlling, or safety means not otherwise provided for</b>	25/10	• • Heating, e.g. warming-up before starting
		25/12	• • Cooling
21/02	• Shutting-down responsive to overspeed	25/14	• • Casings modified therefor (double casings F01D 25/26)
21/04	• responsive to undesired position of rotor relative to stator, e.g. indicating such position	25/16	• Arrangement of bearings; Supporting or mounting bearings in casings (bearings <i>per se</i> F16C)
21/06	• • Shutting-down	25/18	• Lubricating arrangements (of machines or engines in general F01M)
21/08	• • Restoring position	25/20	• • using lubrication pumps
21/10	• responsive to unwanted deposits on blades, in working-fluid conduits, or the like	25/22	• • using working fluid or other gaseous fluid as lubricant
21/12	• responsive to temperature	25/24	• Casings (modified for heating or cooling F01D 25/14); Casing parts, e.g. diaphragms, casing fastenings (casings for rotary machines or engines in general F16M)
21/14	• responsive to other specific conditions		
21/16	• Trip gear	25/26	• • Double casings; Measures against temperature strain in casings
21/18	• • involving hydraulic means	25/28	• Supporting or mounting arrangements, e.g. for turbine casing
21/20	• Checking operation of shut-down devices	25/30	• Exhaust heads, chambers, or the like
23/00	<b>Non-positive-displacement machines or engines with movement other than pure rotation, e.g. of endless-chain type</b>	25/32	• Collecting of condensation water; Drainage
25/00	<b>Component parts, details, or accessories, not provided for in, or of interest apart from, other groups</b>	25/34	• Turning or inching gear
		25/36	• • using electric motors
<b>F01K</b>	<b>STEAM ENGINE PLANTS; STEAM ACCUMULATORS; ENGINE PLANTS NOT OTHERWISE PROVIDED FOR; ENGINES USING SPECIAL WORKING FLUIDS OR CYCLES</b> (gas-turbine or jet-propulsion plants F02; steam generation F22; nuclear power plants, engine arrangements therein G21D)		

**Note(s)**

Attention is drawn to the Notes preceding class F01, especially as regards the definitions of "steam" and "special vapour".

**Subclass index**

## STEAM ENGINE PLANTS

Characterised by the use of

accumulators or heaters; storing means in alkali; specific types of engines.....3/00, 5/00, 7/00

special steam systems, cycles, or processes.....7/00

Characterised by the disposition of

condenser; structural combination of engine and boiler or condenser.....9/00, 11/00

Not otherwise provided for.....21/00

General layout or operation; adaptations for special use.....13/00, 15/00

Utilisation of steam

for feed-water heating; in the regeneration or other treating; for other purposes.....7/34, 19/00, 17/00

## ENGINE PLANTS NOT RESTRICTED TO STEAM UTILISATION

With several engines driven by different fluids.....23/00

Not otherwise provided for, other types with special working fluids or working with enclosed cycles.....25/00, 27/00

## STEAM ACCUMULATORS.....1/00

## SPECIAL TYPES OF ENGINES

Steam engines.....7/00

Other than steam.....25/00

1/00	<b>Steam accumulators</b> (use of accumulators in steam engine plants F01K 3/00)	1/04	• for storing steam in a liquid, e.g. Ruth type (in alkali to increase steam pressure F22B 1/20)
1/02	• for storing steam otherwise than in a liquid		

## F01K

- 1/06 • • Internal fittings facilitating steam distribution, steam formation, or circulation (acting during charging or discharging F01K 1/08; fittings facilitating circulation through multiple accumulators F01K 1/14)
- 1/08 • Charging or discharging of accumulators with steam (peculiar to multiple accumulators F01K 1/12)
- 1/10 • specially adapted for superheated steam
- 1/12 • Multiple accumulators; Charging, discharging, or regulating peculiar thereto
- 1/14 • • Circulation
- 1/16 • Other safety or regulating means
- 1/18 • • for steam pressure
- 1/20 • Other steam-accumulator parts, details, or accessories

### Steam engine plants

#### 3/00 Plants characterised by the use of steam or heat accumulators, or intermediate steam heaters, therein (regenerating exhaust steam F01K 19/00)

- 3/02 • Use of accumulators and specific engine types; Regulating thereof
- 3/04 • • the engine being of multiple-inlet-pressure type
- 3/06 • • the engine being of extraction or non-condensing type
- 3/08 • Use of accumulators, the plant being specially adapted for a specific use
- 3/10 • • for vehicle drive, e.g. for accumulator locomotives
- 3/12 • having two or more accumulators
- 3/14 • having both steam accumulator and heater, e.g. superheating accumulator (steam superheaters per se F22G)
- 3/16 • • Mutual arrangement of accumulator and heater
- 3/18 • having heaters (having both steam accumulator and heater F01K 3/14; steam heaters per se F22)
- 3/20 • • with heating by combustion gases of main boiler
- 3/22 • • • Controlling, e.g. starting, stopping
- 3/24 • • with heating by separately-fired heaters
- 3/26 • • with heating by steam

#### 5/00 Plants characterised by use of means for storing steam in an alkali to increase steam pressure, e.g. of Honigmann or Koenemann type

- 5/02 • used in regenerative installation

#### 7/00 Steam engine plants characterised by the use of specific types of engine (F01K 3/02 takes precedence); Plants or engines characterised by their use of special steam systems, cycles, or processes (reciprocating-piston engines using uniflow principle F01B 17/04); Regulating means peculiar to such systems, cycles, or processes; Use of withdrawn or exhaust steam for feed-water heating

- 7/02 • the engines being of multiple-expansion type (the engines being only of turbine type F01K 7/16; the engines using steam of critical or over-critical pressure F01K 7/32; the engines being of extraction or non-condensing type F01K 7/34)
- 7/04 • • Regulating means peculiar thereto
- 7/06 • the engines being of multiple-inlet-pressure type (F01K 7/02 takes precedence; the engines being only of turbine type F01K 7/16; the engines using steam of critical or over-critical pressure F01K 7/32; the engines being of extraction or non-condensing type F01K 7/34)
- 7/08 • • Regulating means peculiar thereto

- 7/10 • characterised by the engine exhaust pressure (the engines being only of turbine type F01K 7/16; the engines using steam of critical or over-critical pressure F01K 7/32; the engines being of extraction or non-condensing type F01K 7/34)
- 7/12 • • of condensing type
- 7/14 • • • Regulating means peculiar thereto
- 7/16 • the engines being only of turbine type (the engines using steam of critical or over-critical pressure F01K 7/32; the engines being of extraction or non-condensing type F01K 7/34)
- 7/18 • • the turbine being of multiple-inlet-pressure type
- 7/20 • • • Regulating means peculiar thereto
- 7/22 • • the turbines having inter-stage steam heating
- 7/24 • • • Regulating or safety means peculiar thereto
- 7/26 • • the turbines having inter-stage steam accumulation
- 7/28 • • • Regulating means peculiar thereto
- 7/30 • • the turbines using exhaust steam only
- 7/32 • the engines using steam of critical or over-critical pressure
- 7/34 • the engines being of extraction or non-condensing type; Use of steam for feed-water heating (feed-water heaters in general F22D)
- 7/36 • • the engines being of positive-displacement type
- 7/38 • • the engines being of turbine type
- 7/40 • • Use of two or more feed-water heaters in series
- 7/42 • • Use of desuperheaters for feed-water heating
- 7/44 • • Use of steam for feed-water heating and another purpose

#### 9/00 Steam engine plants characterised by condensers arranged or modified to co-operate with the engines (by condensers structurally combined with engines F01K 11/00; steam condensers per se F28B)

- 9/02 • Arrangements or modifications of condensate or air pumps
- 9/04 • with dump valves to by-pass stages

#### 11/00 Steam engine plants characterised by the engines being structurally combined with boilers or condensers

- 11/02 • the engines being turbines
- 11/04 • the boilers or condensers being rotated in use

#### 13/00 General layout or general methods of operation, of complete steam engine plants

- 13/02 • Regulating, e.g. stopping or starting

#### 15/00 Adaptations of steam engine plants for special use

- 15/02 • for driving vehicles, e.g. locomotives (arrangements in vehicles, see the relevant vehicle classes)
- 15/04 • • the vehicles being waterborne vessels

#### 17/00 Use of steam or condensate extracted or exhausted from steam engine plant (for heating feed-water F01K 7/34; returning condensate to boiler F22D)

- 17/02 • for heating purposes, e.g. industrial, domestic (F01K 17/06 takes precedence; domestic- or space-heating systems, e.g. central-heating systems, in general F24D 1/00, F24D 3/00, F24D 9/00) [3]
- 17/04 • for specific purposes other than heating (F01K 17/06 takes precedence)
- 17/06 • Returning energy of steam, in exchanged form, to process, e.g. use of exhaust steam for drying solid fuel of plant

19/00	<b>Regenerating or otherwise treating steam exhaust from steam engine plant</b> (plants characterised by use of means for storing steam in an alkali to increase steam pressure F01K 5/00; returning condensate to boiler F22D)	23/06	• • combustion heat from one cycle heating the fluid in another cycle
19/02	• Regenerating by compression	23/08	• • • with working fluid of one cycle heating the fluid in another cycle
19/04	• • in combination with cooling or heating	23/10	• • • with exhaust fluid of one cycle heating the fluid in another cycle
19/06	• • in engine cylinder	23/12	• the engines being mechanically coupled (F01K 23/02 takes precedence)
19/08	• • compression done by injection apparatus, jet blower, or the like	23/14	• • including at least one combustion engine
19/10	• Cooling exhaust steam other than by condenser; Rendering exhaust steam invisible	23/16	• • all the engines being turbines (F01K 23/14 takes precedence)
		23/18	• characterised by adaptation for specific use
21/00	<b>Steam engine plants not otherwise provided for</b>	25/00	<b>Plants or engines characterised by use of special working fluids, not otherwise provided for; Plants operating in closed cycles and not otherwise provided for</b>
21/02	• with steam generation in engine cylinders	25/02	• the fluid remaining in the liquid phase
21/04	• using mixtures of steam and gas; Plants generating or heating steam by bringing water or steam into direct contact with hot gas (direct-contact steam generators in general F22B)	25/04	• the fluid being in different phases, e.g. foamed
21/06	• Treating live steam, other than thermodynamically, e.g. for fighting deposits in engine	25/06	• using mixtures of different fluids (plants using mixtures of steam and gas F01K 21/04)
		25/08	• using special vapours
		25/10	• • the vapours being cold, e.g. ammonia, carbon dioxide, ether
		25/12	• • the vapours being metallic, e.g. mercury
		25/14	• • using industrial or other waste gases
23/00	<b>Plants characterised by more than one engine delivering power external to the plant, the engines being driven by different fluids</b>	27/00	<b>Plants for converting heat or fluid energy into mechanical energy, not otherwise provided for</b>
23/02	• the engine cycles being thermally coupled	27/02	• Plants modified to use their waste heat, other than that of exhaust, e.g. engine-friction heat
23/04	• • condensation heat from one cycle heating the fluid in another cycle		

## F01L CYCLICALLY OPERATING VALVES FOR MACHINES OR ENGINES (valves in general F16K)

### Note(s)

- Groups F01L 1/00-F01L 13/00 cover only valve-gear or valve arrangements without provision for variable fluid distribution.
- Valve gear or valve arrangements specially adapted for steam engines are covered by groups F01L 15/00-F01L 35/00.
- Valve-gear or valve arrangements specially adapted for machines or engines with variable working-fluid distribution are covered by groups F01L 15/00-F01L 35/00.
- Attention is drawn to the Notes preceding class F01, especially Note (3).
- As regards the above-mentioned Note (3), attention is drawn to F01B 3/10, F01B 15/06, F01C 20/20, F01C 21/18, F02B 53/06, F03C 1/08, F04B 1/18, F04B 7/00, F04B 39/08, F04B 39/10, F04C 14/00, F04C 15/06, F04C 28/00 and F04C 29/12.

### Subclass index

#### VALVE-GEAR OR VALVE ARRANGEMENTS IN GENERAL

General features.....	1/00
Operation	
mechanical.....	1/00
non-mechanical.....	9/00
Lift valves.....	3/00
Slide valves.....	5/00, 7/00
Arrangements in piston or piston-rod.....	11/00
Modified to facilitate engine operations.....	13/00

#### VALVE-GEAR OR VALVE ARRANGEMENTS FOR VARIABLE WORKING-FLUID DISTRIBUTION

General features.....	1/00
With slide valves	
surrounding cylinder or piston.....	17/00
with rotary or oscillatory motion; combined.....	33/00, 19/00
other features.....	15/00
With lift valves.....	35/00
Arrangements with particular characteristics; reversing gear.....	21/00-27/00, 29/00
Other valve-gear or valve arrangements.....	15/00
Drive, control, or adjustment.....	25/00, 31/00

**Valve-gear or valve arrangements for positive-displacement machines or engines other than steam engines, e.g. for internal-combustion piston engines, without provision for variable fluid distribution**

- 1/00** Valve-gear or valve arrangements, e.g. lift-valve gear (lift valve and valve seat assemblies *per se* F01L 3/00; slide-valve gear F01L 5/00; actuated non-mechanically F01L 9/00; valve arrangements in working piston or piston-rod F01L 11/00; modifications of valve-gear to facilitate reversing, braking, starting, changing compression ratio, or other specific operations F01L 13/00)
- 1/02 • Valve drive (transmitting-gear between valve drive and valve F01L 1/12)
- 1/04 • • by means of cams, camshafts, cam discs, eccentrics, or the like (F01L 1/10 takes precedence)
- 1/047 • • • Camshafts [6]
- 1/053 • • • • overhead type [6]
- 1/06 • • • the cams, or the like, rotating at a higher speed than that corresponding to the valve cycle, e.g. operating four-stroke engine valves directly from crankshaft
- 1/08 • • • Shape of cams
- 1/10 • • by means of crank- or eccentric-driven rods
- 1/12 • Transmitting-gear between valve drive and valve (simultaneously operating two or more valves F01L 1/26)
- 1/14 • • Tappets; Push-rods
- 1/16 • • • Silencing impact; Reducing wear
- 1/18 • • Rocking arms or levers
- 1/20 • Adjusting or compensating clearance, i.e. lash adjustment
- 1/22 • • automatically
- 1/24 • • • by fluid means, e.g. hydraulically
- 1/245 • • • • Hydraulic tappets [6]
- 1/25 • • • • • between cam and valve stem [6]
- 1/255 • • • • • between cam and rocker arm [6]
- 1/26 • characterised by the provision of two or more valves operated simultaneously by same transmitting-gear; peculiar to machines or engines with more than two lift valves per cylinder (with coaxial valves F01L 1/28)
- 1/28 • characterised by the provision of coaxial valves; characterised by the provision of valves co-operating with both intake and exhaust ports
- 1/30 • characterised by the provision of positively opened and closed valves, i.e. desmodromic valves
- 1/32 • characterised by the provision of means for rotating lift valves, e.g. to diminish wear
- 1/34 • characterised by the provision of means for changing the timing of the valves without changing the duration of opening
- 1/344 • • changing the angular relationship between crankshaft and camshaft, e.g. using helicoidal gear [6]
- 1/348 • • • by means acting on timing belts or chains [6]
- 1/352 • • • using bevel or epicyclic gear [6]
- 1/356 • • • making the angular relationship oscillate [6]
- 1/36 • peculiar to machines or engines of specific type other than four-stroke cycle
- 1/38 • • for engines with other than four-stroke cycle, e.g. with two-stroke cycle (F01L 1/26, F01L 1/28 take precedence)

- 1/40 • • for engines with scavenging charge near top dead-centre position, e.g. by overlapping inlet and exhaust time (scavenging aspects F02B)
- 1/42 • • for machines or engines characterised by cylinder arrangement, e.g. star or fan
- 1/44 • Multiple-valve gear or arrangements, not provided for in preceding subgroups, e.g. with lift and different valves
- 1/46 • Component parts, details, or accessories, not provided for in preceding subgroups
- 3/00** Lift valves, i.e. cut-off apparatus with closure members having at least a component of their opening and closing motion perpendicular to the closing faces; Parts or accessories thereof
- 3/02 • Selecting particular materials for valve members or valve seats; Valve members or valve seats composed of two or more materials
- 3/04 • • Coated valve members or valve seats
- 3/06 • Valve members or valve seats with means for guiding or deflecting the medium controlled thereby, e.g. producing a rotary motion of the drawn-in cylinder charge (for rotating lift valves F01L 1/32)
- 3/08 • Valve guides; Sealing of valve stem, e.g. sealing by lubricant
- 3/10 • Connecting springs to valve members
- 3/12 • Cooling of valves
- 3/14 • • by means of a liquid or solid coolant, e.g. sodium, in a closed chamber in a valve
- 3/16 • • by means of a fluid flowing through or along valve, e.g. air (for sealing only F01L 3/08)
- 3/18 • • • Liquid cooling of valve
- 3/20 • Shapes or constructions of valve members, not provided for in preceding subgroups of this group
- 3/22 • Valve seats not provided for in preceding subgroups of this group; Fixing of valve seats
- 3/24 • Safety means or accessories, not provided for in preceding subgroups of this group
- 5/00** Slide-valve gear or valve arrangements (with pure rotary or oscillatory movement F01L 7/00)
- 5/02 • with other than cylindrical, sleeve, or part-annularly-shaped valves, e.g. with flat-type valves
- 5/04 • with cylindrical, sleeve, or part-annularly-shaped valves
- 5/06 • • surrounding working cylinder or piston
- 5/08 • • • Arrangements with several movements or several valves, e.g. one valve inside the other (with part-annularly-shaped valves F01L 5/12)
- 5/10 • • • • with reciprocating and other movement of same valve
- 5/12 • • • Arrangements with part-annularly-shaped valves
- 5/14 • characterised by the provision of valves with reciprocating and other movements (surrounding working cylinder or piston F01L 5/06)
- 5/16 • • with reciprocating and other movement of same valve, e.g. longitudinally and in cross direction of working cylinder
- 5/18 • • with reciprocating valve and other slide valve
- 5/20 • specially for two-stroke engines (F01L 5/06, F01L 5/14 take precedence)
- 5/22 • Multiple-valve arrangements (with valves surrounding working cylinder or piston F01L 5/06; with reciprocating and other slide valves F01L 5/18; specially for two-stroke engines F01L 5/20)
- 5/24 • Component parts, details, or accessories, not provided for in preceding subgroups of this group

7/00	<b>Rotary or oscillatory slide-valve gear or valve arrangements</b> (slide valves with combined rotary and non-rotary movements, combinations of rotary and non-rotary slide valves F01L 5/00)	15/06	• • • of Meyer or Rider type, i.e. in which the expansion is varied at the expansion valve itself
7/02	• with cylindrical, sleeve, or part-annularly-shaped valves (of disc type F01L 7/06; of conical type F01L 7/08)	15/08	• with cylindrical, sleeve, or part-annularly-shaped valves; Such main valves combined with auxiliary valves
7/04	• • surrounding working cylinder or piston	15/10	• with main slide valve and auxiliary valve dragged thereby
7/06	• with disc-type valves	15/12	• characterised by having means for effecting pressure equilibrium between two different cylinder spaces at idling
7/08	• with conically- or frusto-conically-shaped valves	15/14	• Arrangements with several co-operating main valves, e.g. reciprocatory and rotary
7/10	• with valves of other specific shape, e.g. spherical	15/16	• • with reciprocatory slide valves only
7/12	• specially for two-stroke engines (F01L 7/04 takes precedence)	15/18	• Valve arrangements not provided for in preceding subgroups of this group
7/14	• Multiple-valve arrangements (with valves surrounding working cylinder or piston F01L 7/04; specially for two-stroke engines F01L 7/12)	15/20	• Component parts, details, or accessories, not provided for in preceding subgroups of this group
7/16	• Sealing or packing arrangements specially therefor	<b>17/00</b>	<b>Slide-valve gear or valve arrangements with cylindrical, sleeve, or part-annularly-shaped valves surrounding working cylinder or piston</b>
7/18	• Component parts, details, or accessories, not provided for in preceding subgroups of this group	17/02	• Drive, or adjustment during operation, peculiar thereto, e.g. for reciprocating and oscillating movements or for several valves one inside the other
<b>9/00</b>	<b>Valve-gear or valve arrangements actuated non-mechanically</b>	<b>19/00</b>	<b>Slide-valve gear or valve arrangements with reciprocatory and other movement of same valve, other than provided for in group F01L 17/00, e.g. longitudinally and in cross direction of working cylinder</b>
9/02	• by fluid means, e.g. hydraulic	19/02	• Drive, or adjustment during operation, peculiar thereto
9/04	• by electric means	<b>21/00</b>	<b>Use of working pistons or piston-rods as fluid-distributing valves or as valve-supporting elements, e.g. in free-piston machines</b>
<b>11/00</b>	<b>Valve arrangements in working piston or piston-rod</b>	21/02	• Piston or piston-rod used as valve member
11/02	• in piston	21/04	• Valves arranged in or on piston or piston-rod
11/04	• • operated by movement of connecting-rod	<b>23/00</b>	<b>Valves controlled by impact of piston, e.g. in free-piston machines</b>
11/06	• • • operating oscillatory valve	<b>25/00</b>	<b>Drive, or adjustment during operation, of distribution or expansion valves by non-mechanical means</b>
<b>13/00</b>	<b>Modifications of valve-gear to facilitate reversing, braking, starting, changing compression ratio, or other specific operations</b>	25/02	• by fluid means
13/02	• for reversing	25/04	• • by working fluid of machine or engine, e.g. free-piston machine
13/04	• for starting by means of fluid pressure	25/06	• • • Arrangements with main and auxiliary valves, at least one of them being fluid-driven
13/06	• for braking	25/08	• by electric or magnetic means
13/08	• for decompression, e.g. during starting; for changing compression ratio	<b>27/00</b>	<b>Distribution or expansion-valve gear peculiar to free-piston machines or engines and not provided for in groups F01L 21/00-F01L 25/00</b>
<b><u>Valve-gear or valve arrangements specially adapted for steam engines, or specially adapted for other positive-displacement machines or engines with variable working-fluid distribution</u></b>		27/02	• the machine or engine having rotary or oscillatory valves
<b><u>Note(s)</u></b>		27/04	• Delayed-action controls, e.g. of cataract- or dash-pot-type
1.	Groups F01L 15/00-F01L 31/00cover:	<b>29/00</b>	<b>Reversing-gear</b> (equally usable for control of degree of working fluid admission, and reversing being of secondary importance F01L 31/00)
	• valve drive or means external to valves for adjustment during operation;	29/02	• by displacing eccentric
	• tripping-gear;	29/04	• by links or guide rods
	• reversing-gear;	29/06	• by interchanging inlet and exhaust ports
	• use of pistons or piston-rods as valves or as valve-supporting elements;	29/08	• specially for rotary or oscillatory valves
	• valve-gear or valve arrangements peculiar to free-piston machines or engines.	29/10	• Details, e.g. drive
2.	Groups F01L 15/00-F01L 31/00do not fully cover subject matter restricted to rotary, oscillatory, or lift-valve gear or valve arrangements, which is covered by group F01L 33/00 or F01L 35/00.	29/12	• • Powered reverse gear
<b>15/00</b>	<b>Valve-gear or valve arrangements, e.g. with reciprocatory slide valves, other than provided for in groups F01L 17/00-F01L 29/00</b> (valve drive or external valve-adjustment during operation, see the relevant groups, e.g. F01L 31/00; tripping-gear or tripping of valves F01L 31/00)		
15/02	• with valves other than cylindrical, sleeve, or part-annularly-shaped, e.g. flat D-valves		
15/04	• • main valve being combined with auxiliary valve (of drag-valve type F01L 15/10)		

**F01L**

- 31/00 Valve drive, valve adjustment during operation, or other valve control, not provided for in groups F01L 15/00-F01L 29/00** (sensing elements measuring the variable or condition to be controlled or regulated F01B)
- 31/02 • with tripping-gear (for oscillatory valves F01L 31/06); Tripping of valves
  - 31/04 • • with positively-driven trip levers
  - 31/06 • with tripping-gear specially for oscillatory valves; Oscillatory tripping-valves, e.g. of Corliss type
  - 31/08 • Valve drive or valve adjustment, apart from tripping aspects; Positively-driven gear
  - 31/10 • • the drive being effected by eccentrics (F01L 31/14 takes precedence)
  - 31/12 • • • Valve adjustment by displacing eccentric
  - 31/14 • • Valve adjustment by links or guide rods, e.g. in valve-gears with eccentric drive
  - 31/16 • • the drive being effected by specific means other than eccentric, e.g. cams; Valve adjustment in connection with such drives
  - 31/18 • • specially for rotary or oscillatory valves
  - 31/20 • • • Valve adjustment
  - 31/22 • • specially for lift valves
  - 31/24 • • • Valve adjustment

**Rotary or oscillatory slide-valve gear or lift-valve gear or such valve arrangements specially adapted for steam engines, or specially adapted for other positive-displacement machines or engines with variable working-fluid distribution**

- 33/00 Rotary or oscillatory slide-valve gear or valve arrangements, specially adapted for machines or engines with variable fluid distribution** (drive, adjustment during operation, tripping-gear, reversing-gear, use of working pistons or piston-rods as valves or as valve-supporting elements, valve-gear or valve arrangements peculiar to free-piston machines or engines F01L 15/00-F01L 31/00)
- 33/02 • rotary
  - 33/04 • oscillatory
- 35/00 Lift-valve gear or valve arrangements specially adapted for machines or engines with variable fluid distribution** (drive, adjustment during operation, tripping-gear, reversing-gear, use of working pistons or piston-rods as valves or as valve-supporting elements, valve-gear or valve arrangements peculiar to free-piston machines or engines F01L 15/00-F01L 31/00)
- 35/02 • Valves
  - 35/04 • Arrangements of valves in the machine or engine, e.g. relative to working cylinder

**F01M LUBRICATING OF MACHINES OR ENGINES IN GENERAL; LUBRICATING INTERNAL-COMBUSTION ENGINES; CRANKCASE VENTILATING [2]**

**Note(s)**

1. Attention is drawn to the Notes preceding class F01, especially as regards Note (3).
2. Attention is drawn to the following places, which cover lubrication of specific machines or engines:
  - F01B 31/10.....Steam engines
  - F01C 21/04.....Rotary-piston or oscillating-piston machines or engines
  - F01D 25/18.....Non-positive-displacement machines
  - F02C 7/06.....Gas-turbine plants
  - F02F 1/20.....Cylinders of combustion engines
  - F04B 39/02.....Pumps for elastic fluids
  - F04C 29/02.....Rotary-piston or oscillating-piston pumps for liquids
  - F04D 29/04.....Non-positive-displacement pumps

**Subclass index**

PRESSURE LUBRICATION.....	1/00
SPECIAL LUBRICATION.....	3/00, 7/00, 9/00
LUBRICANT CONDITIONING.....	5/00
DETAILS, ACCESSORIES.....	11/00
CRANKCASE VENTILATION.....	13/00

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|--|--|
| <b>1/00 Pressure lubrication</b>   | 1/12 • Closed-circuit lubricating systems not provided for in groups F01M 1/02-F01M 1/10 |
| 1/02 • using lubricating pumps   | 1/14 • Timed lubrication (F01M 1/08 takes precedence)                                    |
| 1/04 • using pressure in working cylinder or crankcase to operate lubricant-feeding devices  | 1/16 • Controlling lubricant pressure or quantity  |
| 1/06 • Lubricating systems characterised by the provision therein of crankshafts or connecting-rods with lubricant passageways, e.g. bores   | 1/18 • Indicating or safety devices (concerning lubricant level F01M 11/06, F01M 11/12)  |
| 1/08 • Lubricating systems characterised by the provision therein of lubricant-jetting means   | 1/20 • • concerning lubricant pressure   |
| 1/10 • Lubricating systems characterised by the provision therein of lubricant venting or purifying means, e.g. of filters (mounting of, connecting of, or constructional details of lubricant purifying means F01M 11/03) | 1/22 • • • rendering machines or engines inoperative or idling on pressure failure       |
|  | 1/24 • • • acting on engine fuel system  |
|  | 1/26 • • • acting on engine ignition system  |
|  | 1/28 • • • acting on engine combustion-air supply  |

3/00	<b>Lubrication specially adapted for engines with crankcase compression of fuel-air mixture, or for other engines in which lubricant is contained in fuel, combustion air, or fuel-air mixture</b> (separating lubricant from air or fuel-air mixture before entry into cylinder F01M 11/08)	9/10	• Lubrication of valve gear or auxiliaries
3/02	• with variable proportion of lubricant to fuel, lubricant to air, or lubricant to fuel-air mixture	9/12	• Non-pressurised lubrication, or non-closed-circuit lubrication, not otherwise provided for
3/04	• for upper cylinder lubrication only	11/00	<b>Component parts, details, or accessories, not provided for in, or of interest apart from, groups F01M 1/00-F01M 9/00</b>
5/00	<b>Heating, cooling, or controlling temperature of lubricant</b> (arrangement of lubricant coolers in engine cooling system F01P 11/08); <b>Lubrication means facilitating engine starting</b>	11/02	• Arrangements of lubricant conduits
5/02	• Conditioning lubricant for aiding engine starting, e.g. heating	11/03	• Mounting or connecting of lubricant purifying means relative to the machine or engine; Details of lubricant purifying means [3]
5/04	• • Diluting, e.g. with fuel	11/04	• Filling or draining lubricant of or from machines or engines
7/00	<b>Lubrication means specially adapted for machine or engine running-in</b>	11/06	• Means for keeping lubricant level constant or for accommodating movement or position of machines or engines
9/00	<b>Lubrication means having pertinent characteristics not provided for in, or of interest apart from, groups F01M 1/00-F01M 7/00</b>	11/08	• Separating lubricant from air or fuel-air mixture before entry into cylinder
9/02	• having means for introducing additives to lubricant	11/10	• Indicating devices; Other safety devices
9/04	• Use of fuel as lubricant	11/12	• • concerning lubricant level
9/06	• Dip or splash lubrication	13/00	<b>Crankcase ventilating or breathing [2]</b>
9/08	• Drip lubrication	13/02	• by means of additional source of positive or negative pressure [2]
		13/04	• having means for purifying air before leaving crankcase, e.g. removing oil [2]
		13/06	• specially adapted for submersible engines, e.g. of armoured vehicles [2]
<b>F01N</b>	<b>GAS-FLOW SILENCERS OR EXHAUST APPARATUS FOR MACHINES OR ENGINES IN GENERAL; GAS-FLOW SILENCERS OR EXHAUST APPARATUS FOR INTERNAL-COMBUSTION ENGINES</b> (arrangements in connection with gas exhaust of propulsion units in vehicles B60K 13/00; combustion-air intake silencers specially adapted for, or arranged on, internal-combustion engines F02M 35/00; protecting against, or damping, noise in general G10K 11/16)		

**Note(s)**

Attention is drawn to the Notes preceding class F01, especially as regards Note (3).

1/00	<b>Silencing apparatus characterised by method of silencing</b>	3/02	• for cooling, or for removing solid constituents of, exhaust (by means of electric or electrostatic separators F01N 3/01) [1, 7]
1/02	• by using resonance	3/021	• • by means of filters [7]
1/04	• • having sound-absorbing materials in resonance chambers	3/022	• • • characterised by specially adapted filtering structure, e.g. honeycomb, mesh or fibrous [7]
1/06	• by using interference effect	3/023	• • • using means for regenerating the filters, e.g. by burning trapped particles [7]
1/08	• by reducing exhaust energy by throttling or whirling	3/025	• • • • using fuel burner or by adding fuel to exhaust [7]
1/10	• • in combination with sound-absorbing materials	3/027	• • • • using electric or magnetic heating [7]
1/12	• • using spirally- or helically-shaped channels (F01N 1/10 takes precedence; cyclones B04C)	3/028	• • • • • using microwaves [7]
1/14	• by adding air to exhaust gases	3/029	• • • • by adding non-fuel substances to exhaust [7]
1/16	• by using movable parts	3/031	• • • • having means for by-passing filters, e.g. when clogged or during cold engine start [7]
1/18	• • having rotary movement	3/032	• • • • during filter regeneration only [7]
1/20	• • having oscillating or vibrating movement (the parts being resilient walls F01N 1/22)	3/033	• • • • in combination with other devices [7]
1/22	• • the parts being resilient walls	3/035	• • • • with catalytic reactors [7]
1/24	• by using sound-absorbing materials (F01N 1/04, F01N 1/06, F01N 1/10, F01N 1/14, F01N 1/16 take precedence)	3/037	• • by means of inertial or centrifugal separators, e.g. associated with agglomerators [7]
3/00	<b>Exhaust or silencing apparatus having means for purifying, rendering innocuous, or otherwise treating exhaust</b> (electric control F01N 9/00; monitoring or diagnostic devices for exhaust-gas treatment apparatus F01N 11/00) [4]	3/038	• • by means of perforated plates defining expansion chambers associated with condensation and collection chambers [7]
3/01	• by means of electric or electrostatic separators [7]	3/04	• • by means of liquids

## F01N

- 3/05 • • by means of air, e.g. by mixing exhaust with air (silencers working by addition of air to exhaust F01N 1/14; arrangements for the supply of additional air for the thermal or catalytic conversion of noxious components of exhaust F01N 3/30) [7]
- 3/06 • for extinguishing sparks
- 3/08 • for rendering innocuous (using electric or electrostatic separators F01N 3/01; chemical aspects B01D 53/92) [1, 7]
- 3/10 • • by thermal or catalytic conversion of noxious components of exhaust [3]
- 3/18 • • • characterised by methods of operation; Regulation [3]
- 3/20 • • • • specially adapted for catalytic conversion (F01N 3/22 takes precedence) [3]
- 3/22 • • • • Regulation of additional air supply only, e.g. using by-passes or variable air pump drives [3]
- 3/24 • • • characterised by constructional aspects of converting apparatus (filtering in combination with catalytic reactors F01N 3/035) [3, 7]
- 3/26 • • • • Construction of thermal reactors [3]
- 3/28 • • • • Construction of catalytic reactors [3]
- 3/30 • • • • Arrangements for supply of additional air (regulation, e.g. using by-passes or variable air pump drives, F01N 3/22) [3]
- 3/32 • • • • • using air pumps (using jet air pumps F01N 3/34; pumps in general F04) [3]
- 3/34 • • • • • using air conduits or jet air pumps, e.g. near the engine exhaust port [3]
- 3/36 • • • • Arrangements for supply of additional fuel [3]
- 3/38 • • • • Arrangements for igniting [3]
- 5/00 **Exhaust or silencing apparatus combined or associated with devices profiting by exhaust energy** (using kinetic or wave energy of exhaust gases in exhaust systems for charging F02B; predominant aspects of such devices, see the relevant classes for the devices)
- 5/02 • the devices using heat
- 5/04 • the devices using kinetic energy
- 9/00 **Electrical control of exhaust gas treating apparatus** (monitoring or diagnostic devices for exhaust-gas treatment apparatus F01N 11/00; conjoint electrical control of two or more combustion engine functions F02D 43/00) [4]
- 11/00 **Monitoring or diagnostic devices for exhaust-gas treatment apparatus** [7]
- 13/00 **Exhaust or silencing apparatus characterised by constructional features** [2010.01]
- 13/02 • having two or more separate silencers in series [2010.01]
- 13/04 • having two or more silencers in parallel, e.g. having interconnections for multi-cylinder engines [2010.01]
- 13/06 • specially adapted for star-arrangement of cylinders, e.g. exhaust manifolds [2010.01]
- 13/08 • Other arrangements or adaptations of exhaust conduits [2010.01]
- 13/10 • • of exhaust manifolds [2010.01]
- 13/12 • specially adapted for submerged exhausting [2010.01]
- 13/14 • having thermal insulation [2010.01]
- 13/16 • Selection of particular materials [2010.01]
- 13/18 • Construction facilitating manufacture, assembly or disassembly [2010.01]
- 13/20 • having flared outlets, e.g. of fish-tail shape [2010.01]
- 99/00 **Subject matter not provided for in other groups of this subclass** [2010.01]

## F01P COOLING OF MACHINES OR ENGINES IN GENERAL; COOLING OF INTERNAL-COMBUSTION ENGINES (arrangements in connection with cooling of propulsion units in vehicles B60K 11/00; heat-transfer, heat-exchange or heat-storage materials C09K 5/00; heat-exchange in general, radiators F28)

### Note(s)

- In this subclass, the following terms or expressions are used with the meanings indicated:
  - "air" also includes other gaseous cooling fluids;
  - "liquid cooling" also includes cooling where liquid is used as the heat-transferring fluid between parts to be cooled and the air, e.g. using radiators;
  - "air cooling" means direct air cooling and thus excludes indirect air cooling occurring in liquid cooling systems as explained under liquid cooling above;
  - "cooling-air" includes directly- or indirectly-acting cooling-air.
- Attention is drawn to the Notes preceding class F01, especially as regards Note (3).
- Cooling by lubricant is classified in subclass F01M when the lubrication aspect predominates, and in subclass F01P when the cooling aspect predominates.

### Air cooling: Liquid cooling

- 1/00 **Air cooling** (propelling cooling-air or liquid coolants F01P 5/00; controlling supply or circulation of coolants F01P 7/00)
- 1/02 • Arrangements for cooling cylinders or cylinder heads, e.g. ducting cooling-air from its pressure source to cylinders or along cylinders
- 1/04 • Arrangements for cooling pistons
- 1/06 • Arrangements for cooling other engine or machine parts
- 1/08 • • for cooling intake or exhaust valves
- 1/10 • • for cooling fuel injectors or sparking-plugs
- 3/00 **Liquid cooling** (propelling cooling-air or liquid coolants F01P 5/00; controlling supply or circulation of coolants F01P 7/00)
- 3/02 • Arrangements for cooling cylinders or cylinder heads

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|---|---|
| <p>3/04 • • Liquid-to-air heat-exchangers combined with, or arranged on, cylinders or cylinder heads</p> <p>3/06 • Arrangements for cooling pistons</p> <p>3/08 • • Cooling of piston exterior only, e.g. by jets</p> <p>3/10 • • Cooling by flow of coolant through pistons</p> <p>3/12 • Arrangements for cooling other engine or machine parts</p> <p>3/14 • • for cooling intake or exhaust valves</p> <p>3/16 • • for cooling fuel injectors or sparking-plugs</p> <p>3/18 • Arrangement or mounting of liquid-to-air heat-exchangers (such arrangements on cylinders or cylinder heads F01P 3/04; relative to vehicles B60K 11/04)</p> <p>3/20 • Cooling circuits not specific to a single part of engine or machine (F01P 3/22 takes precedence)</p> <p>3/22 • characterised by evaporation and condensation of coolant in closed cycles (other cooling by evaporation F01P 9/02); characterised by the coolant reaching higher temperatures than normal atmospheric boiling-point</p> | <p>7/06 • • by varying blade pitch</p> <p>7/08 • • by cutting in or out of pumps</p> <p>7/10 • • by throttling amount of air flowing through liquid-to-air heat-exchangers</p> <p>7/12 • • • by thermostatic control</p> <p>7/14 • the coolant being liquid</p> <p>7/16 • • by thermostatic control</p> |
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- 9/00 Cooling having pertinent characteristics not provided for in, or of interest apart from, groups F01P 1/00-F01P 7/00** (profiting from waste heat of combustion-engine cooling F02G 5/00)
- 9/02 • Cooling by evaporation, e.g. by spraying water on to cylinders (evaporation and condensation of liquid coolant in closed cycles F01P 3/22)
- 9/04 • by simultaneous or alternative use of direct air cooling and liquid cooling (F01P 9/02 takes precedence)
- 9/06 • by use of refrigerating apparatus, e.g. of compressor or absorber type
- 11/00 Component parts, details, or accessories, not provided for in, or of interest apart from, groups F01P 1/00-F01P 9/00**
- 11/02 • Liquid-coolant overflow, venting, or draining devices (automatic draining during freezing conditions F01P 11/20)
- 11/04 • Arrangements of liquid pipes or hoses
- 11/06 • Cleaning (in general B08B); Combating corrosion (in general C23F)
- 11/08 • Arrangements of lubricant coolers (in lubrication apparatus F01M)
- 11/10 • Guiding or ducting cooling-air to or from liquid-to-air heat-exchangers
- 11/12 • Filtering, cooling, or silencing cooling-air
- 11/14 • Indicating devices; Other safety devices
- 11/16 • • concerning coolant temperature (F01P 11/20 takes precedence)
- 11/18 • • concerning coolant pressure, coolant flow, or liquid-coolant level
- 11/20 • • concerning atmospheric freezing conditions, e.g. automatically draining or heating during frosty weather
- Pumping cooling-air or liquid coolants; Controlling circulation or supply of coolants**
- 5/00 Pumping cooling-air or liquid coolants** (controlling circulation or supply of coolants by influencing drive of pumps F01P 7/00)
- 5/02 • Pumping cooling-air; Arrangements of cooling-air pumps, e.g. fans or blowers
- 5/04 • • Pump-driving arrangements
- 5/06 • • Guiding or ducting air to or from ducted fans
- 5/08 • • Use of engine exhaust gases for pumping cooling-air
- 5/10 • Pumping liquid coolant; Arrangements of coolant pumps
- 5/12 • • Pump-driving arrangements
- 5/14 • Safety means against, or active at, failure of coolant-pump drives, e.g. shutting engine down; Means for indicating functioning of coolant pumps
- 7/00 Controlling of coolant flow**
- 7/02 • the coolant being cooling-air
- 7/04 • • by varying pump speed, e.g. by changing pump-drive gear ratio