

CPC COOPERATIVE PATENT CLASSIFICATION

F MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING (NOTE omitted)

ENGINES OR PUMPS

F02 COMBUSTION ENGINES (cyclically operating valves therefor, lubricating, exhausting, or silencing engines [F01](#)); HOT-GAS OR COMBUSTION-PRODUCT ENGINE PLANTS

F02B INTERNAL-COMBUSTION PISTON ENGINES; COMBUSTION ENGINES IN GENERAL (plants in which engines use combustion products [F02C](#), [F02G](#); internal-combustion turbines [F02C](#))

NOTES

- In this subclass, the following terms or expressions are used with the meanings indicated:
 - "positive ignition" means ignition by a source external to the working fluid, e.g. by spark or incandescent source;
 - "charging" means forcing air or fuel-air mixture into engine cylinders and thus embraces super-charging;
 - "scavenging" means forcing the combustion residues from the cylinders other than by movement of the working pistons and thus embraces tuned exhaust systems.
- Attention is drawn to the Notes preceding class [F01](#), specially as regards Note (1).
- Engines with specified cycles or number of cylinders are classified in group [F02B 75/02](#) or [F02B 75/16](#), unless other classifying features predominate.

WARNING

In this subclass non-limiting references (in the sense of paragraph 39 of the Guide to the IPC) may still be displayed in the scheme.

Engines characterised by the working fluid to be compressed, or characterised by the type of ignition (with both fuel-air mixture compression and air-compression, or with both positive ignition and compression ignition [F02B 11/00](#); with pre-combustion chambers [F02B 19/00](#); having air storage chambers [F02B 21/00](#); with special shape or construction of other combustion chambers [F02B 23/00](#))

1/00 Engines characterised by fuel-air mixture compression (characterised by both fuel-air mixture compression and air compression, or characterised by both positive ignition and compression ignition [F02B 11/00](#); characterised by precombustion chambers [F02B 19/00](#); characterised by air-storage chambers [F02B 21/00](#); characterised by special shape or construction of combustion chambers [F02B 23/00](#))

NOTE

in this group the following indexing codes are used:

[F02B 2700/02](#) - [F02B 2720/30](#)

- 1/02 . with positive ignition (with non-timed positive ignition [F02B 9/06](#))
- 1/04 . . with fuel-air mixture admission into cylinder
- 1/06 . . . Methods of operating
- 1/08 . . with separate admission of air and fuel into cylinder
- 1/10 . . . Methods of operating
- 1/12 . with compression ignition (with fuel-air charge ignited by compression ignition of an additional fuel [F02B 7/00](#))
- 1/14 . . Methods of operating

3/00 Engines characterised by air compression and subsequent fuel addition (characterised by both fuel-air mixture compression and air compression, or characterised by both positive ignition and compression ignition [F02B 11/00](#); characterised by precombustion chambers [F02B 19/00](#); characterised by air-storage chambers [F02B 21/00](#); characterised by special shape or construction of combustion chambers [F02B 23/00](#))

NOTE

in this group the following indexing codes are used:

[F02B 2700/02](#) - [F02B 2720/30](#)

- 3/02 . with positive ignition (with non-timed positive ignition [F02B 9/06](#))
- 3/04 . . Methods of operating
- 3/06 . with compression ignition ([F02B 13/02](#) takes precedence; with fuel-air charge ignited by compression ignition of an additional fuel [F02B 7/00](#))
- 3/08 . . Methods of operating ([F02B 3/12](#) takes precedence)
- 3/10 . . with intermittent fuel introduction
- 3/12 . . . Methods of operating

19/1066	. . . . {pre-combustion chamber having an inlet and an outlet port and with two distinct intake conduits or with one intake conduit in which the heavier fuel particles are separated from the main stream, e.g. by gravitational forces}	2023/0609	. . . . {the material being a porous medium, e.g. sintered metal}
19/1071	. . . . {pre-combustion chamber having only one orifice,(i.e. an orifice by means of which it communicates with the cylinder); the intake system comprising two distinct intake conduits}	2023/0612	. . . . {the material having a high temperature and pressure resistance, e.g. ceramic}
19/1076	. . . . {pre-combustion chamber being formed within the piston, e.g. two-cycle engines}	2023/0615	. . . . {the combustion space having a volume defined by revolution around an axis inclined relative to the cylinder axis}
19/108	. . . . {with fuel injection at least into pre-combustion chamber, i.e. injector mounted directly in the pre-combustion chamber}	23/0618	. . . . {having in-cylinder means to influence the charge motion}
19/1085	. . . . {controlling fuel injection}	23/0621	. . . . {Squish flow}
19/109	. . . . {with injection of a fuel-air mixture into the pre-combustion chamber by means of a pump, e.g. two-cycle engines}	23/0624	. . . . {Swirl flow}
19/1095	. . . . {with more than one pre-combustion chamber (a stepped form of the main combustion chamber above the piston is to be considered as a pre-combustion chamber if this stepped portion is not a squish area)}	23/0627	. . . . {having additional bores or grooves machined into the piston for guiding air or charge flow to the piston bowl}
19/12	. . . . with positive ignition (F02B 19/02 - F02B 19/10 take precedence)	23/063	. . . . {the combustion space in the piston interacting fluid dynamically with the cylinder head, the injector body or the cylinder wall (F02B 23/04 takes precedence)}
19/14	. . . . with compression ignition (F02B 19/02 - F02B 19/10 take precedence)	23/0633	. . . . {the combustion space being almost completely enclosed in the piston, i.e. having a small inlet in comparison to its volume}
19/16	. . . . Chamber shapes or constructions not specific to sub-groups F02B 19/02 - F02B 19/10	23/0636	. . . . {the combustion space having a substantially flat and horizontal bottom}
19/165	. . . . {The shape or construction of the pre-combustion chambers is specially adapted to be formed, at least in part, of ceramic material (surface coverings of combustion-gas-swept parts F02B 77/02 ; shaped ceramic products characterised by their composition or ceramic compositions C04B 35/00 ; ceramic material for engine casings F02F 7/0087)}	23/0639	. . . . {the combustion space having substantially the shape of a cylinder}
19/18	. . . . Transfer passages between chamber and cylinder	23/0642	. . . . {the depth of the combustion space being much smaller than the diameter of the piston, e.g. the depth being in the order of one tenth of the diameter}
21/00	Engines characterised by air-storage chambers	23/0645	. . . . {Details related to the fuel injector or the fuel spray}
21/02	. . . . Chamber shapes or constructions	23/0648	. . . . {Means or methods to improve the spray dispersion, evaporation or ignition}
23/00	Other engines characterised by special shape or construction of combustion chambers to improve operation (engines with incandescent chambers F02B 9/08)	23/0651	. . . . . {the fuel spray impinging on reflecting surfaces or being specially guided throughout the combustion space}
	NOTE	23/0654	. . . . . {Thermal treatments, e.g. with heating elements or local cooling}
	- in this group the following indexing codes are used:	23/0657	. . . . . {the spray interacting with one or more glow plugs}
	F02B 2700/02 - F02B 2720/30	23/066	. . . . . {the injector being located substantially off-set from the cylinder centre axis}
23/02	. . . . with compression ignition	23/0663	. . . . . {having multiple injectors per combustion chamber}
23/04	. . . . the combustion space being subdivided into two or more chambers (with pre-combustion chambers F02B 19/00)	23/0666	. . . . . {having a single fuel spray jet per injector nozzle}
23/06	. . . . the combustion space being arranged in working piston (F02B 23/04 takes precedence)	23/0669	. . . . . {having multiple fuel spray jets per injector nozzle}
23/0603	. . . . {at least part of the interior volume or the wall of the combustion space being made of material different from the surrounding piston part, e.g. combustion space formed within a ceramic part fixed to a metal piston head}	23/0672	. . . . . {Omega-piston bowl, i.e. the combustion space having a central projection pointing towards the cylinder head and the surrounding wall being inclined towards the cylinder center axis (the surrounding wall being exactly vertical F02B 23/0696)}
2023/0606	. . . . {the material being a catalyst}	23/0675	. . . . . {the combustion space being substantially spherical, hemispherical, ellipsoid or parabolic}
		23/0678	. . . . . {Unconventional, complex or non-rotationally symmetrical shapes of the combustion space, e.g. flower like, having special shapes related to the orientation of the fuel spray jets}
		23/0681	. . . . . {Square, rectangular or the like profiles}
		23/0684	. . . . . {Ring like bowl, e.g. toroidal}

23/0687	. . . . {Multiple bowls in the piston, e.g. one bowl per fuel spray jet}	25/18	. . the charge flowing upward essentially along cylinder wall adjacent the inlet ports, e.g. by means of deflection rib on piston {(F02B 25/145 takes precedence)}
23/069	. . . . {characterised by its eccentricity from the cylinder axis}		
23/0693	. . . . {the combustion space consisting of step-wise widened multiple zones of different depth}	25/20	. Means for reducing the mixing of charge and combustion residues or for preventing escape of fresh charge through outlet ports not provided for in, or of interest apart from, subgroups F02B 25/02 - F02B 25/18
23/0696	. . . . {W-piston bowl, i.e. the combustion space having a central projection pointing towards the cylinder head and the surrounding wall being inclined towards the cylinder wall}	25/22	. . by forming air cushion between charge and combustion residues
23/08	. with positive ignition	25/24	. . Inlet or outlet openings being timed asymmetrically relative to bottom dead-centre
2023/085	. . {using several spark plugs per cylinder}	25/26	. Multi-cylinder engines other than those provided for in, or of interest apart from, groups F02B 25/02 - F02B 25/24 (internal-combustion aspects of rotary engines with movable cylinders F02B 57/00)
23/10	. . with separate admission of air and fuel into cylinder	25/28	. . with V-, fan-, or star-arrangement of cylinders
23/101	. . . {the injector being placed on or close to the cylinder centre axis, e.g. with mixture formation using spray guided concepts}	27/00	Use of kinetic or wave energy of charge in induction systems, or of combustion residues in exhaust systems, for improving quantity of charge or for increasing removal of combustion residues (aspects characterised by provision of driven charging or scavenging pumps F02B 33/00 - F02B 39/00, e.g. use of driven apparatus for immediate conversion of combustion gas pressure into pressure of fresh charge F02B 33/42)
2023/102	. . . {the spark plug being placed offset the cylinder centre axis}	27/001	. {the system having electrically controlled acoustic pulse generating devices, e.g. loudspeakers}
2023/103	. . . {the injector having a multi-hole nozzle for generating multiple sprays}	27/003	. {using check valves}
23/104	. . . {the injector being placed on a side position of the cylinder}	27/005	. {Oscillating pipes with charging achieved by arrangement, dimensions or shapes of intakes pipes or chambers; Ram air pipes}
23/105	. . . . {the fuel is sprayed directly onto or close to the spark plug}	27/006	. . {of intake runners}
2023/106	. . . {Tumble flow, i.e. the axis of rotation of the main charge flow motion is horizontal}	27/008	. {Resonance charging}
2023/107	. . . . {Reverse tumble flow, e.g. having substantially vertical intake ports}	27/02	. the systems having variable, i.e. adjustable, cross-sectional areas, chambers of variable volume, or like variable means (in exhaust systems only F02B 27/06)
2023/108	. . . {Swirl flow, i.e. the axis of rotation of the main charge flow motion is vertical}	27/0205	. . {characterised by the charging effect}
Engines characterised by provisions for charging or scavenging			
(aspects concerned with driven charging or scavenging pumps F02B 33/00 - F02B 39/00)			
25/00	Engines characterised by using fresh charge for scavenging cylinders (aspects characterised by provision of driven charging or scavenging pumps F02B 33/00 - F02B 39/00)	27/021	. . . {Resonance charging (combined with oscillating pipe charging F02B 27/0221)}
	NOTE	27/0215	. . . {Oscillating pipe charging, i.e. variable intake pipe length charging}
	- in this group the following indexing codes are used:	27/0221	. . . . {Resonance charging combined with oscillating pipe charging}
	F02B 2700/02 - F02B 2700/038	27/0226	. . {characterised by the means generating the charging effect}
25/02	. using unidirectional scavenging	27/0231	. . . {Movable ducts, walls or the like (F02B 27/0257 takes precedence)}
25/04	. . Engines having ports both in cylinder head and in cylinder wall near bottom of piston stroke	27/0236	. . . . {with continuously variable adjustment of a length or width}
25/06	. . . the cylinder-head ports being controlled by working pistons, e.g. by sleeve-shaped extensions thereof	27/0242	. . . {Fluid communication passages between intake ducts, runners or chambers}
25/08	. . Engines with oppositely-moving reciprocating working pistons	27/0247	. . . {Plenum chambers; Resonance chambers or resonance pipes}
25/10	. . . with one piston having a smaller diameter or shorter stroke than the other	27/0252	. . . . {Multiple plenum chambers or plenum chambers having inner separation walls, e.g. comprising valves for the same group of cylinders}
25/12	. . Engines with U-shaped cylinders, having ports in each arm	27/0257	. . . . {Rotatable plenum chambers}
25/14	. using reverse-flow scavenging, e.g. with both outlet and inlet ports arranged near bottom of piston stroke		
25/145	. . {with intake and exhaust valves exclusively in the cylinder head}		
25/16	. . the charge flowing upward essentially along cylinder wall opposite the inlet ports (F02B 25/145 takes precedence)}		

- 27/0263 {the plenum chamber and at least one of the intake ducts having a common wall, and the intake ducts wrap partially around the plenum chamber, i.e. snail-type ([F02B 27/0257](#) takes precedence)}
- 27/0268 {Valves}
- 27/0273 {Flap valves}
- 27/0278 {Multi-way valves}
- 27/0284 {Rotary slide valves}
- 27/0289 {Intake runners having multiple intake valves per cylinder}
- 27/0294 . . {Actuators or controllers therefor; Diagnosis; Calibration}
- 27/04 . . in exhaust systems only, e.g. for sucking-off combustion gases
- 27/06 . . the systems having variable, i.e. adjustable, cross-sectional areas, chambers of variable volume, or like variable means
- 29/00 Engines characterised by provision for charging or scavenging not provided for in groups [F02B 25/00](#), [F02B 27/00](#) or [F02B 33/00](#) - [F02B 39/00](#); Details thereof**
- 29/02 . . Other fluid-dynamic features of induction systems for improving quantity of charge (for also imparting a rotation to the charge in the cylinder [F02B 31/00](#); structural features of induction systems [F02M](#))
- 29/04 . . Cooling of air intake supply
- 29/0406 {Layout of the intake air cooling or coolant circuit}
- 29/0412 {Multiple heat exchangers arranged in parallel or in series}
- 29/0418 {the intake air cooler having a bypass or multiple flow paths within the heat exchanger to vary the effective heat transfer surface}
- 29/0425 {Air cooled heat exchangers}
- 29/0431 {Details or means to guide the ambient air to the heat exchanger, e.g. having a fan, flaps, a bypass or a special location in the engine compartment}
- 29/0437 {Liquid cooled heat exchangers}
- 29/0443 {Layout of the coolant or refrigerant circuit}
- 29/045 {Constructional details of the heat exchangers, e.g. pipes, plates, ribs, insulation, materials, or manufacturing and assembly}
- 29/0456 {Air cooled heat exchangers}
- 29/0462 {Liquid cooled heat exchangers}
- 29/0468 {Water separation or drainage means}
- 29/0475 {the intake air cooler being combined with another device, e.g. heater, valve, compressor, filter or EGR cooler, or being assembled on a special engine location}
- 29/0481 {Intake air cooling by means others than heat exchangers, e.g. by rotating drum regenerators, cooling by expansion or by electrical means}
- 29/0493 {Controlling the air charge temperature}
- 29/06 . . After-charging, i.e. supplementary charging after scavenging
- 29/08 . . Modifying distribution valve timing for charging purposes ([F02B 29/06](#) takes precedence; valve gear therefor [F01L](#))
- 29/083 {Cyclically operated valves disposed upstream of the cylinder intake valve, controlled by external means}

- 29/086 {the engine having two or more inlet valves}
- 31/00 Modifying induction systems for imparting a rotation to the charge in the cylinder (structural features of induction systems [F02M](#))**
- 2031/003 {with an auxiliary intake conduit starting upstream of personally controlled throttle valve and ending upstream of and close to the intake valve, or with an auxiliary intake conduit being an independent passage, e.g. having its own carburettor}
- 2031/006 {having multiple air intake valves}
- 31/02 in engines having inlet valves arranged eccentrically to cylinder axis
- 31/04 by means within the induction channel, e.g. deflectors
- 31/06 Movable means, e.g. butterfly valves
- 31/08 having multiple air inlets {, i.e. having main and auxiliary intake passages}
- 31/082 {the main passage having a helical shape around the intake valve axis; Engines characterised by provision of driven charging or scavenging pumps (introducing fuel into cylinders by air-pressure [F02B 13/00](#); after-charging [F02B 29/06](#); arrangements of such pumps or other auxiliary apparatus on engines [F02B 67/00](#); combined engine pump control, control dependent on variables other than those generic to pump [F02D](#))}
- 31/085 {having two inlet valves}
- 31/087 {having three or more inlet valves}

Engines characterised by provision of driven charging or scavenging pumps (introducing fuel into cylinders by air-pressure [F02B 13/00](#); after-charging [F02B 29/06](#); arrangements of such pumps or other auxiliary apparatus on engines [F02B 67/00](#); combined engine and pump control, control dependent on variables other than those generic to pump [F02D](#) {Details or constructional aspects of turbines [F01D](#); turbochargers [F02C](#); pumps [F04](#)})

33/00 Engines characterised by provision of pumps for charging or scavenging (characterised by the introduction of liquid fuel into cylinders by use of auxiliary fluid [F02B 13/00](#); characterised by after-charging [F02B 29/06](#); characterised by provision of pumps for sucking combustion residues from cylinders [F02B 35/00](#); characterised by provision of exhaust-driven pumps [F02B 37/00](#))

NOTE

- in this group the following indexing code is used: [F02M 2700/33](#)

- 33/02 Engines with reciprocating-piston pumps; Engines with crankcase pumps
- 33/04 with simple crankcase pumps, i.e. with the rear face of a non-stepped working piston acting as sole pumping member in co-operation with the crankcase
- 33/06 with reciprocating-piston pumps other than simple crankcase pumps
- 33/08 with the working-cylinder head arranged between working and pumping cylinders
- 33/10 with the pumping cylinder situated between working cylinder and crankcase, or with the pumping cylinder surrounding working cylinder

- 33/12 the rear face of working piston acting as pumping member and co-operating with a pumping chamber isolated from crankcase, the connecting-rod passing through the chamber and co-operating with movable isolating member
- 33/14 working and pumping pistons forming stepped piston
- 33/16 working and pumping pistons having differing movements
- 33/18 . . . with crankshaft being arranged between working and pumping cylinders
- 33/20 . . . with pumping-cylinder axis arranged at an angle to working-cylinder axis, e.g. at an angle of 90 degrees
- 33/22 . . . with pumping cylinder situated at side of working cylinder, e.g. the cylinders being parallel
- 33/24 . . with crankcase pumps other than with reciprocating pistons only
- 33/26 . . Four-stroke engines characterised by having crankcase pumps
- 33/28 . . Component parts, details or accessories of crankcase pumps, not provided for in, or of interest apart from, subgroups [F02B 33/02](#) - [F02B 33/26](#)
- 33/30 . . . Control of inlet or outlet ports ([controlling only working-cylinder inlets F01L](#))
- 33/32 . Engines with pumps other than of reciprocating-piston type ([with crankcase pumps F02B 33/02](#))
- 33/34 . . with rotary pumps ([with cell-type pressure exchangers or the like F02B 33/42](#))
- 33/36 of positive-displacement type
- 33/38 of Roots type
- 33/40 of non-positive-displacement type
- 33/42 . . with driven apparatus for immediate conversion of combustion gas pressure into pressure of fresh charge, e.g. with cell-type pressure exchangers ([pressure exchangers per se F04F 13/00](#))
- 33/44 . Passages conducting the charge from the pump to the engine inlet, e.g. reservoirs ([cooling of charge after leaving pumps F02B 29/04](#))
- 33/443 . . {[Heating of charging air, e.g. for facilitating the starting](#)}
- 33/446 . . {[having valves for admission of atmospheric air to engine, e.g. at starting](#)}
- 35/00 Engines characterised by provision of pumps for sucking combustion residues from cylinders**
- 35/02 . using rotary pumps
- 37/00 Engines characterised by provision of pumps driven at least for part of the time by exhaust** ([characterised by the introduction of liquid fuel into cylinders by use of auxiliary fluid F02B 13/00](#); [characterised by after-charging F02B 29/06](#); [characterised by passages conducting the charge from the pump to the engine inlet F02B 33/44](#))
- 37/001 . {[using exhaust drives arranged in parallel](#)}
- 37/002 . . {[the exhaust supply to one of the exhaust drives can be interrupted](#)}
- 37/004 . {[with exhaust drives arranged in series](#)}
- 37/005 . {[Exhaust driven pumps being combined with an exhaust driven auxiliary apparatus, e.g. a ventilator](#)}
- 37/007 . with exhaust-driven pumps arranged in parallel {, [e.g. at least one pump supplying alternatively](#)}
- 37/013 . with exhaust-driven pumps arranged in series
- 37/02 . Gas passages between engine outlet and pump drive, e.g. reservoirs
- 37/025 . . {[Multiple scrolls or multiple gas passages guiding the gas to the pump drive](#)}
- 37/04 . Engines with exhaust drive and other drive of pumps, e.g. with exhaust-driven pump and mechanically-driven second pump
- 37/10 . . at least one pump being alternatively {or [simultaneously](#)} driven by exhaust and other drive, {e.g. by pressurised fluid from a reservoir or an engine-driven pump}
- 37/105 . . . {[exhaust drive and pump being both connected through gearing to engine-driven shaft](#)}
- 37/11 . . driven by other drive at starting only
- 37/12 . Control of the pumps
- 2037/122 . . {[Control of rotational speed of the pump](#)}
- 2037/125 . . {[Control for avoiding pump stall or surge](#)}
- 37/127 . . {[by bypassing air from the pump inlet, e.g. to the pump outlet \(bypassing charging air F02B 37/16; valves for admission of atmospheric air to engine F02B 33/446\)](#)}
- 37/14 . . {[Control](#)} of the alternation between {or the operation of} exhaust drive and other drive of a pump, e.g. dependent on speed
- 37/16 . . by bypassing charging air {([bypassing air from the pump inlet, e.g. to the pump outlet F02B 37/127](#))}
- 2037/162 . . . {[by bypassing, e.g. partially, intake air from pump inlet to pump outlet](#)}
- 37/164 . . . {[the bypassed air being used in an auxiliary apparatus, e.g. in an air turbine](#)}
- 37/166 {[the auxiliary apparatus being a combustion chamber, e.g. upstream of turbine](#)}
- 37/168 {[into the exhaust conduit \(F02B 37/186 takes precedence\)](#)}
- 37/18 . . by bypassing exhaust {[from the inlet to the outlet of turbine or to the atmosphere](#)}
- 37/183 . . . {[Arrangements of bypass valves or actuators therefor](#)}
- 37/186 {[Arrangements of actuators or linkage for bypass valves](#)}
- 37/20 . . by increasing exhaust energy, e.g. using combustion chamber {[by after-burning \(using an auxiliary combustion chamber supplied by charging air F02B 37/166\)](#)}
- 37/22 . . by varying cross-section of exhaust passages or air passages, {e.g. by throttling turbine inlets or outlets or by varying effective number of guide conduits ([F02B 37/24 takes precedence](#))}
- 37/225 . . . {[air passages](#)}
- 37/24 . . by using pumps or turbines with adjustable guide vanes
- 39/00 Component parts, details, or accessories relating to, driven charging or scavenging pumps, not provided for in groups [F02B 33/00](#) - [F02B 37/00](#)**
- 39/005 . {[Cooling of pump drives](#)}
- 39/02 . Drives of pumps ([exhaust drives or combined exhaust and other drives F02B 37/00](#)); Varying pump drive gear ratio ([control acting both on engine and on pump drive gear ratio F02D](#))

- 39/04 . . Mechanical drives; Variable-gear-ratio drives
(non-mechanical pump drives having variable gear ratio [F02B 39/08](#))
- 39/06 . . . the engine torque being divided by a differential gear for driving a pump and the engine output shaft
- 39/08 . . Non-mechanical drives, e.g. fluid drives having variable gear ratio
- 39/085 . . . {the fluid drive using expansion of fluids other than exhaust gases, e.g. a Rankine cycle}
- 39/10 . . . electric
- 39/12 . . Drives characterised by use of couplings or clutches therein (using fluid slip couplings for varying gear ratio [F02B 39/08](#))
- 39/14 . Lubrication of pumps; Safety measures therefor
- 39/16 . Other safety measures for, or other control of, pumps
- 2039/162 . . {Control of pump parameters to improve safety thereof}
- 2039/164 . . . {the temperature of the pump, of the pump drive or the pumped fluid being limited}
- 2039/166 . . . {the fluid pressure in the pump or exhaust drive being limited}
- 2039/168 . . . {the rotational speed of pump or exhaust drive being limited}
- 41/00 Engines characterised by special means for improving conversion of heat or pressure energy into mechanical power**
- 41/02 . Engines with prolonged expansion
- 41/04 . . in main cylinders
- 41/06 . . in compound cylinders
- 41/08 . . . Two-stroke compound engines
- 41/10 . . in exhaust turbines (use of exhaust turbines for charging [F02B 37/00](#); turbines constructions [F01D](#); gas turbine plant [F02C](#))
- 2041/12 . . {in jet propulsion apparatus}
- Engines operating on non-liquid fuels; Plants including such engines, i.e. combinations of the engines with fuel-generating apparatus** (engines having gas-air charge ignited by compression-ignition of an additional fuel [F02B 7/06](#); engines convertible from gas to other fuel consumption [F02B 69/04](#); apparatus for generating fuel, e.g. gas, see the relevant classes, e.g. [C10](#))
- 43/00 Engines characterised by operating on gaseous fuels; Plants including such engines** (engines characterised by the gas-air charge being ignited by compression ignition of an additional fuel [F02B 7/06](#); engines convertible from gas to other fuel consumption [F02B 69/04](#))
- NOTE**
- in this group the following indexing codes are used:
[F02B 2700/02](#) - [F02B 2720/30](#)
- 43/02 . Engines characterised by means for increasing operating efficiency
- 43/04 . . for improving efficiency of combustion
- 43/06 . . for enlarging charge
- 43/08 . Plants characterised by the engines using gaseous fuel generated in the plant from solid fuel, e.g. wood
- 43/10 . Engines or plants characterised by use of other specific gases, e.g. acetylene, oxyhydrogen
- 2043/103 . . {Natural gas, e.g. methane or LNG used as a fuel}
- 2043/106 . . {Hydrogen obtained by electrolysis}
- 43/12 . . Methods of operating
- 45/00 Engines characterised by operating on non-liquid fuels other than gas; Plants including such engines** (plants involving generation of gaseous fuel from solid fuel [F02B 43/08](#); engines convertible from gas to other fuel consumption [F02B 69/04](#))
- 45/02 . operating on powdered fuel, e.g. powdered coal (operating on fuel containing oxidant [F02B 45/06](#))
- 45/04 . . Plants, e.g. having coal-grinding apparatus
- 45/06 . operating on fuel containing oxidant
- 45/08 . operating on other solid fuels
- 45/10 . operating on mixtures of liquid and non-liquid fuels, e.g. in pasty or foamed state
- Methods of operating engines involving specific pre-treating of, or adding specific substances to, combustion air, or fuel air-mixture, of the engines and not otherwise provided for** (apparatus for performing such pre-treatment or additions [F02M](#))
- 47/00 Methods of operating engines involving adding non-fuel substances or anti-knock agents to combustion air, fuel, or fuel-air mixtures of engines**
- 47/02 . the substances being water or steam
- 47/04 . the substances being other than water or steam only
- 47/06 . . the substances including non-airborne oxygen ([F02B 47/10](#) takes precedence)
- 47/08 . . the substances including exhaust gas
- 47/10 . . . Circulation of exhaust gas in closed or semi-closed circuits, e.g. with simultaneous addition of oxygen
- 49/00 Methods of operating air-compressing compression-ignition engines involving introduction of small quantities of fuel in the form of a fine mist into the air in the engine's intake**
- 51/00 Other methods of operating engines involving pretreating of, or adding substances to, combustion air, fuel, or fuel-air mixture of the engines**
- 51/02 . involving catalysts
- 51/04 . involving electricity or magnetism
- 51/06 . involving rays or sound waves
- Internal-combustion aspects of rotary-piston or oscillating-piston engines**
- 53/00 Internal-combustion aspects of rotary-piston or oscillating-piston engines** (internal-combustion aspects of rotary pistons or outer members for co-operation therewith [F02B 55/00](#))
- NOTE**
- in this group the following indexing codes are used:
[F02B 2730/01](#) - [F02B 2730/09](#)
- 2053/005 . . {Wankel engines}
- 53/02 . Methods of operating
- 53/04 . Charge admission or combustion-gas discharge
- 53/06 . . Valve control therefor
- 53/08 . . Charging, e.g. by means of rotary-piston pump

53/10	• Fuel supply; Introducing fuel to combustion space	63/00	Adaptations of engines for driving pumps, hand-held tools or electric generators; Portable combinations of engines with engine-driven devices (of rotary-piston or oscillating-piston engines F02B 53/14)
53/12	• Ignition	63/02	• for hand-held tools
53/14	• Adaptations of engines for driving, or engine combinations with, other devices (aspects predominantly concerning such devices, see the relevant classes for the devices)	63/04	• for electric generators
55/00	Internal-combustion aspects of rotary pistons; Outer members for co-operation with rotary pistons	63/041	• • {Linear electric generators}
55/02	• Pistons	63/042	• • {Rotating electric generators}
55/04	• • Cooling thereof	63/043	• • {Electric generators using oscillating movement}
55/06	• • • by air or other gas	63/044	• • {the engine-generator unit being placed on a frame or in an housing}
55/08	• Outer members for co-operation with rotary pistons; Casings	2063/045	• • • {Frames for generator-engine sets}
55/10	• • Cooling thereof	2063/046	• • • {Handles adapted therefor, e.g. handles or grips for movable units}
55/12	• • • by air or other gas	63/047	• • • {Movable engine-generator combinations on wheels}
55/14	• Shapes or constructions of combustion chambers	63/048	• • • {Portable engine-generator combinations}
55/16	• Admission or exhaust passages in pistons or outer members	63/06	• for pumps
<u>Internal-combustion aspects of reciprocating-piston engines with movable cylinders</u>		65/00	Adaptations of engines for special uses not provided for in groups F02B 61/00 or F02B 63/00; Combinations of engines with other devices, e.g. with non-driven apparatus (of rotary-piston or oscillating-piston engines F02B 53/14; combinations of prime-movers consisting of electric motors and internal combustion engines for mutual or common propulsion B60K 6/20)
57/00	Internal-combustion aspects of rotary engines in which the combusted gases displace one or more reciprocating pistons	<u>Engines with pertinent characteristics other than those provided for in or of interest apart from, preceding main groups</u>	
57/02	• Fuel or combustion-air supply (cylinder-charge admission or exhaust control F02B 57/04)	67/00	Engines characterised by the arrangement of auxiliary apparatus not being otherwise provided for, e.g. the apparatus having different functions; Driving auxiliary apparatus from engines, not otherwise provided for
57/04	• Control of cylinder-charge admission or exhaust (peculiar to two-stroke engines or to other engines with working-piston-controlled charge admission or exhaust F02B 57/06)	67/04	• of mechanically-driven auxiliary apparatus
57/06	• Two-stroke engines or other engines with working-piston-controlled cylinder-charge admission or exhaust (with combustion space in centre of star F02B 57/10)	67/06	• • driven by means of chains, belts, or like endless members
57/08	• Engines with star-shaped cylinder arrangements	67/08	• of non-mechanically driven auxiliary apparatus
57/085	• • { having two parallel main shafts }	67/10	• of charging or scavenging apparatus
57/10	• • with combustion space in centre of star	69/00	Internal-combustion engines convertible into other combustion-engine type, not provided for in F02B 11/00; Internal-combustion engines of different types characterised by constructions facilitating use of same main engine-parts in different types
59/00	Internal-combustion aspects of other reciprocating-piston engines with movable, e.g. oscillating, cylinders (with yieldable walls F02B 75/38)	69/02	• for different fuel types, other than engines indifferent to fuel consumed, e.g. convertible from light to heavy fuel
<u>Adaptations of engines for special use; Combinations of engines with devices other than engine parts or auxiliaries (of rotary-piston or oscillating-piston engines F02B 53/14; aspects predominantly concerning such devices, see the relevant classes for the devices)</u>		69/04	• • for gaseous and non-gaseous fuels
61/00	Adaptations of engines for driving vehicles or for driving propellers; Combinations of engines with gearing (the engine torque being divided by a differential gear for driving a scavenging or charging pump and the engine output shaft F02B 39/06; adaptations or combinations of rotary-piston or oscillating-piston engines F02B 53/14; arrangements in vehicles, see the relevant classes for vehicles)	69/06	• for different cycles, e.g. convertible from two-stroke to four stroke
61/02	• for driving cycles	71/00	Free-piston engines; Engines without rotary main shaft
61/04	• for driving propellers	71/02	• Starting
61/045	• • { for outboard marine engines }	71/04	• Adaptations of such engines for special use; Combinations of such engines with apparatus driven thereby (aspects predominantly concerning driven apparatus, see the relevant classes for such apparatus)
61/06	• Combinations of engines with mechanical gearing (F02B 61/02 , F02B 61/04 take precedence)	71/045	• • { with hydrostatic transmission }
		71/06	• • Free-piston combustion gas generators per se

73/00	Combinations of two or more engines, not otherwise provided for	2075/1888	. . . . {thirty-four}
		2075/1892	. . . . {thirty-six}
75/00	Other engines	75/1896	. . . {with two or more pistons connected to one crank and having a common combustion space}
75/002	. {Double acting engines}	75/20	. . . with cylinders all in one line
75/005	. {having horizontal cylinders (F02B 75/007 takes precedence)}	75/22	. . . with cylinders in V, fan, or star arrangement
75/007	. {having vertical crankshafts}	75/221	. . . . {with cylinder banks in narrow V-arrangement, having a single cylinder head}
75/02	. Engines characterised by their cycles, e.g. six-stroke	75/222	. . . . {with cylinders in star arrangement}
75/021	. . {having six or more strokes per cycle}	75/224	. . . . {with cylinders in fan arrangement}
2075/022	. . {having less than six strokes per cycle}	75/225	. . . . {having two or more crankshafts}
2075/023	. . . {one}	75/227	. . . . {with cylinder banks in X-arrangement, e.g. double-V engines}
2075/025	. . . {two}	75/228	. . . . {with cylinders arranged in parallel banks}
2075/026	. . . {three}	75/24	. . . with cylinders arranged oppositely relative to main shaft and of "flat" type
2075/027	. . . {four}	75/243	. . . . {with only one crankshaft of the "boxer" type, e.g. all connecting rods attached to separate crankshaft bearings}
2075/028	. . . {five}	75/246	. . . . {with only one crankshaft of the "pancake" type, e.g. pairs of connecting rods attached to common crankshaft bearing}
75/04	. Engines with variable distances between pistons at top dead-centre positions and cylinder heads	75/26	. Engines with cylinder axes coaxial with, or parallel or inclined to, main-shaft axis; Engines with cylinder axes arranged substantially tangentially to a circle centred on main-shaft axis
75/041	. . {by means of cylinder or cylinderhead positioning}	75/265	. . {Engines with cylinder axes substantially tangentially to a circle centred on main-shaft axis}
75/042	. . . {the cylinderhead comprising a counter-piston}	75/28	. Engines with two or more pistons reciprocating within same cylinder or within essentially coaxial cylinders (arranged oppositely relative to main shaft F02B 75/24)
75/044	. . {by means of an adjustable piston length}	75/282	. . {the pistons having equal strokes}
75/045	. . {by means of a variable connecting rod length}	75/285	. . {comprising a free auxiliary piston}
75/047	. . {by means of variable crankshaft position}	75/287	. . {with several pistons positioned in one cylinder one behind the other}
75/048	. . {by means of a variable crank stroke length}	75/30	. . with one working piston sliding inside another
75/06	. Engines with means for equalising torque (compensations of inertial forces, suppression of vibration in systems F16F)	75/32	. Engines characterised by connections between pistons and main shafts and not specific to preceding main groups
75/065	. . {with double connecting rods or crankshafts}	75/34	. Ultra-small engines, e.g. for driving models
75/08	. Engines with means for preventing corrosion in gas-swept spaces	75/36	. Engines with parts of combustion- or working-chamber walls resiliently yielding under pressure
75/10	. Engines with means for rendering exhaust gases innocuous (apparatus per se F01N)	75/38	. . Reciprocating - piston engines (F02B 75/04 takes precedence; with resiliently-urged auxiliary piston in pre-combustion chamber F02B 19/06)
75/12	. Other methods of operation	75/40	. Other reciprocating-piston engines
2075/125	. . {Direct injection in the combustion chamber for spark ignition engines, i.e. not in pre-combustion chamber}	77/00	Component parts, details or accessories, not otherwise provided for
75/16	. Engines characterised by number of cylinders, e.g. single-cylinder engines (F02B 75/26 takes precedence)	77/005	. {Plugs}
75/18	. . Multi-cylinder engines (scavenging aspects F02B 25/00)	77/02	. Surface coverings of combustion-gas-swept parts (of pistons or cylinders only F02F)
2075/1804	. . . {Number of cylinders}	77/04	. Cleaning of, preventing corrosion or erosion in, or preventing unwanted deposits in, combustion engines (cleaning of fuel injection apparatus F02M 65/00)
2075/1808	. . . . {two}	2077/045	. . {by flushing or rinsing}
2075/1812	. . . . {three}	2077/06	. {Arrangements of purifying apparatus for liquid fuel or lubricant filters}
2075/1816	. . . . {four}		
2075/182	. . . . {five}		
2075/1824	. . . . {six}		
2075/1828	. . . . {seven}		
2075/1832	. . . . {eight}		
2075/1836	. . . . {nine}		
2075/184	. . . . {ten}		
2075/1844	. . . . {eleven}		
2075/1848	. . . . {twelve}		
2075/1852	. . . . {thirteen}		
2075/1856	. . . . {fourteen}		
2075/186	. . . . {fifteen}		
2075/1864	. . . . {sixteen}		
2075/1868	. . . . {twenty}		
2075/1872	. . . . {twenty-two}		
2075/1876	. . . . {twenty-four}		
2075/188	. . . . {thirty}		
2075/1884	. . . . {thirty-two}		

- 77/08 . Safety, indicating or supervising devices ([thermal insulation F02B 77/11](#); {rendering engines inoperative or idling [F02D 17/04](#); dependent on lubricating conditions [F01M 1/22](#); dependent on cooling [F01P 11/14](#)})
- 77/081 . . {relating to endless members (endless members, e.g. belts, for driving auxiliary apparatus [F02B 67/04](#))}
- 77/082 . . {relating to valves}
- 77/083 . . {relating to maintenance, e.g. diagnostic device (relating to lubrication [F01M 11/10](#))}
- 77/084 . . {indicating economy}
- 77/085 . . {with sensors measuring combustion processes, e.g. knocking, pressure, ionization, combustion flame}
- 77/086 . . . {Sensor arrangements in the exhaust, e.g. for temperature, misfire, air/fuel ratio, oxygen sensors}
- 77/087 . . {determining top dead centre or ignition-timing}
- 77/088 . . {relating to tightness}
- 77/089 . . {relating to engine temperature (concerning coolant temperature [F01P 11/16](#))}
- 77/10 . . Safety means relating to crankcase explosions
- 77/11 . Thermal or acoustic insulation
- 77/13 . . Acoustic insulation
- 77/14 . Engine-driven auxiliary devices combined into units
- 79/00** **Running-in of internal-combustion engines** ([lubrication thereof F01M](#))
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- 2201/00** **Fuels**
- 2201/02 . Liquid
- 2201/04 . Gas
- 2201/06 . Dual fuel applications
- 2201/062 . . Liquid and liquid
- 2201/0622 . . . Liquid and liquefied gas
- 2201/064 . . Liquid and gas
- 2201/066 . . Gas and gas
- 2275/00** **Other engines, components or details, not provided for in other groups of this subclass**
- 2275/02 . Attachment or mounting of cylinder heads on cylinders
- 2275/06 . Endless member is a belt
- 2275/08 . Endless member is a chain
- 2275/10 . Diamond configuration of valves in cylinder heads
- 2275/14 . Direct injection into combustion chamber
- 2275/16 . Indirect injection
- 2275/18 . DOHC [Double overhead camshaft]
- 2275/20 . SOHC [Single overhead camshaft]
- 2275/22 . Side valves
- 2275/26 . Flame plate
- 2275/28 . Timing distribution gear
- 2275/30 . Inverted positioning of engines
- 2275/32 . Miller cycle
- 2275/34 . Lateral camshaft position
- 2275/36 . Modified dwell of piston in TDC
- 2275/38 . Square four-cylinder configuration
- 2275/40 . Squish effect
- 2275/42 . Texaco combustion process
- 2275/44 . Tools for engines
- 2275/46 . Total Energy plant
- 2275/48 . Tumble motion in gas movement in cylinder
- 2275/50 . Walking beam arrangement of rockers in valve drive
- 2700/00** **Measures relating to the combustion process without indication of the kind of fuel or with more than one fuel**
- 2700/02 . Four stroke engines
- 2700/021 . . with measures for removing exhaust gases from the cylinder
- 2700/023 . . with measures for charging, increasing the power
- 2700/025 . . with measures for compressing the cylinder charge
- 2700/026 . . with measures for increasing the part of the heat transferred to power, compound engines
- 2700/028 . . double-acting
- 2700/03 . Two stroke engines
- 2700/031 . . with measures for removing exhaust gases from the cylinder
- 2700/032 . . . by means of the exhaust gases
- 2700/034 . . with measures for charging, increasing the power
- 2700/035 . . with reservoir for scavenging or charging air
- 2700/037 . . Scavenging or charging channels or openings
- 2700/038 . . with measures for compressing the cylinder charge
- 2710/00** **Gas engines**
- 2710/02 . Four stroke engines
- 2710/021 . . with measures for removing exhaust gases from the cylinder
- 2710/023 . . with measures for charging, increasing the power
- 2710/025 . . with measures for compressing the cylinder charge
- 2710/026 . . with measures for improving combustion
- 2710/028 . . with measures for increasing the part of the heat transferred to power, compound engines
- 2710/03 . Two stroke engines
- 2710/032 . . with measures for removing exhaust gases from the cylinder
- 2710/034 . . with measures for charging, increasing the power
- 2710/036 . . Scavenging or charging channels or openings
- 2710/038 . . with measures for improving combustion
- 2720/00** **Engines with liquid fuel**
- 2720/10 . Mixture compressing engines for liquid fuel
- 2720/12 . Four stroke engines with ignition device
- 2720/122 . . with measures for removing exhaust gases from the cylinder
- 2720/124 . . with measures for charging, increasing the power
- 2720/126 . . with measures for compressing the cylinder charge
- 2720/128 . . with measures for increasing the part of the heat transferred to power, compound engines
- 2720/13 . Two stroke engines with ignition device
- 2720/131 . . with measures for removing exhaust gases from the cylinder
- 2720/132 . . . by means of exhaust gases
- 2720/133 . . with measures for charging, increasing the power
- 2720/135 . . with reservoir for scavenging or charging air
- 2720/136 . . Scavenging or charging channels or openings
- 2720/137 . . with measures for improving combustion
- 2720/138 . . with measures for increasing the part of the heat transferred to power, compound engines

F02B

- 2720/15 . Mixture compressing engines with ignition device and mixture formation in the cylinder
- 2720/151 . . with fuel supply and pulverisation by air or gas under pressure during the suction or compression stroke
- 2720/152 . . with fuel supply and pulverisation by injecting the fuel under pressure during the suction or compression stroke
- 2720/153 . . with injection of an air-fuel mixture under pressure during the suction or compression stroke
- 2720/155 . . with pulverisation by air sucked into the cylinder
- 2720/156 . . with pulverisation by the compressed air stream
- 2720/157 . . with means for improving the mixture in the cylinder
- 2720/158 . . with an auxiliary cylinder in which an explosion is generated
- 2720/16 . Mixture compressing engines with ignition by compression or other heat
- 2720/20 . Air compressing engines with ignition by the heat of compression
- 2720/22 . Four stroke engines
- 2720/221 . . with measures for removing exhaust gases from the cylinder
- 2720/223 . . with measures for charging, increasing the power
- 2720/225 . . with measures for compressing the cylinder charge
- 2720/226 . . with measures for improving combustion
- 2720/228 . . with measures for increasing the part of the heat transferred to power, compound engines
- 2720/23 . Two stroke engines
- 2720/231 . . with measures for removing exhaust gases from the cylinder
- 2720/232 . . . by means of the exhaust gases
- 2720/233 . . with measures for charging, increasing the power
- 2720/235 . . with reservoir for scavenging or charging air
- 2720/236 . . scavenging or charging channels or openings
- 2720/237 . . with measures for improving combustion
- 2720/238 . . with measures for increasing the part of the heat transferred to power, compound engines
- 2720/25 . Supply of fuel in the cylinder
- 2720/251 . . Fuel supply by high pressure gas
- 2720/252 . . . with air pump fixed to engine cylinder; high pressure air being taken from the atmosphere or from an engine cylinder
- 2720/253 . . . with high pressure air reservoir close to the point of injection; high pressure air taken from the engine cylinder
- 2720/255 . . . with mixture compressing pump; fuel-air mixture being compressed in the pump cylinder without self ignition
- 2720/256 . . . using steam or other gas as high pressure gas
- 2720/257 . . Supply of fuel under pressure in the cylinder without blowing fluid
- 2720/258 . . . with compression and ignition exclusively in the cylinder
- 2720/27 . Air compressing engines with hot-bulb ignition
- 2720/272 . . Supply of all the fuel into the prechamber
- 2720/274 . . . with injection of all the fuel into the prechamber
- 2720/276 . . Supply of only a part of the fuel into the prechamber
- 2720/278 . . . with injection of only a part of the fuel into the prechamber
- 2720/30 . Engines with air compression and ignition device
- 2730/00 Internal combustion engines with pistons rotating or oscillating with relation to the housing**
- 2730/01 . with one or more pistons in the form of a disk or rotor rotating with relation to the housing; with annular working chamber
- 2730/011 . . with vanes sliding in the housing
- 2730/012 . . with vanes sliding in the piston
- 2730/013 . . . Vanes fixed in the centre of the housing; Excentric rotors
- 2730/015 . . with vanes hinged to the housing
- 2730/016 . . with vanes hinged to the piston
- 2730/017 . . with rotating elements fixed to the housing or on the piston
- 2730/018 . . with piston rotating around an axis passing through the gravity centre, this piston or the housing rotating at the same time around an axis parallel to the first axis
- 2730/02 . with piston rotating around its axis and having a reciprocating movement in a cylinder
- 2730/03 . with piston oscillating in a housing or in a space in the form of an annular sector
- 2730/05 . with pistons intermeshing as gear wheels; with helicoidal rotors
- 2730/09 . Arrangements or specially formed elements for engines according to the preceding groups
- 2730/095 . . Hydraulic pistons