

CPC COOPERATIVE PATENT CLASSIFICATION

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

ENGINES OR PUMPS

F02 COMBUSTION ENGINES; HOT-GAS OR COMBUSTION-PRODUCT ENGINE PLANTS

F02B INTERNAL-COMBUSTION PISTON ENGINES; COMBUSTION ENGINES IN GENERAL (gas-turbine plants [F02C](#); hot-gas or combustion-product positive-displacement engine plants [F02G](#))

NOTES

1. 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 includes supercharging;
 - "scavenging" means forcing the combustion residues from the cylinders other than by movement of the working pistons, and thus includes tuned exhaust systems.
2. Attention is drawn to the Notes preceding class [F01](#), especially as regards Note (1).
3. 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

- 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](#))
- 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](#))

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 (compression ignition engines using air or gas for blowing fuel into compressed air in cylinder [F02B 13/02](#))
- 3/08 . . Methods of operating ([F02B 3/12](#) takes precedence)
- 3/10 . . with intermittent fuel introduction
- 3/12 . . . Methods of operating
- 5/00 Engines characterised by positive ignition** (engines characterised by fuel-air mixture compression with positive ignition [F02B 1/02](#); engines characterised by air compression and subsequent fuel addition with positive ignition [F02B 3/02](#); with non-timed positive ignition [F02B 9/06](#); characterised by both fuel-air mixture compression and air compression, or characterised by both positive ignition and compression ignition [F02B 11/00](#))
- 5/02 . Methods of operating

7/00	Engines characterised by the fuel-air charge being ignited by compression ignition of an additional fuel (characterised by both fuel-air mixture compression and air compression, or characterised by both positive ignition and compression ignition F02B 11/00)	2019/002	• {with electric heater fitted to at least part of prechamber-wall or transfer passage}
		2019/004	• • {with heater control}
		2019/006	• {with thermal insulation}
		2019/008	• • {variable}
7/02	• the fuel in the charge being liquid	19/02	• the chamber being periodically isolated from its cylinder
7/04	• • Methods of operating	19/04	• • the isolation being effected by a protuberance on piston or cylinder head
7/06	• the fuel in the charge being gaseous	19/06	• with auxiliary piston in chamber for transferring ignited charge to cylinder space
7/08	• • Methods of operating	19/08	• the chamber being of air-swirl type
9/00	Engines characterised by other types of ignition (characterised by both fuel-air mixture compression and air compression, or characterised by both positive ignition and compression ignition F02B 11/00)	19/10	• with fuel introduced partly into pre-combustion chamber, and partly into cylinder
	NOTE	19/1004	• • {details of combustion chamber, e.g. mounting arrangements}
	- in this group the following indexing codes are used:	19/1009	• • • {heating, cooling}
	F02B 2700/02 - F02B 2720/30	19/1014	• • • {design parameters, e.g. volume, torch passage cross sectional area, length, orientation, or the like}
9/02	• with compression ignition (engines characterised by fuel-air mixture compression with compression ignition F02B 1/12 ; engines characterised by air compression and subsequent fuel addition with compression ignition F02B 3/06)	19/1019	• • {with only one pre-combustion chamber (F02B 19/1004 take precedence)}
		19/1023	• • • {pre-combustion chamber and cylinder being fed with fuel-air mixture(s)}
9/04	• • Methods of operating	19/1028	• • • • {pre-combustion chamber and cylinder having both intake ports or valves, e.g. HONDS CVCC}
9/06	• with non-timed positive ignition, e.g. with hot-spots	19/1033	• • • • • {specially adapted valves, e.g. rotary valves, pre-combustion chamber being part of a valve}
9/08	• • with incandescent chambers	19/1038	• • • • • {timing of valves}
9/10	• • • Chamber shapes or constructions	19/1042	• • • • • {auxiliary intake, valve drive}
11/00	Engines characterised by both fuel-air mixture compression and air compression, or characterised by both positive ignition and compression ignition, e.g. in different cylinders	19/1047	• • • • • {means for varying the size of the torch passage}
11/02	• convertible from fuel-air mixture compression to air compression or <i>vice versa</i>	19/1052	• • • • • {controlling, e.g. varying fuel-air ratio, quantity of charge}
		19/1057	• • • • • {with fuel injectors disposed upstream of intake valves}
Engines characterised by the method of introducing liquid fuel into cylinders		19/1061	• • • • • {with residual gas chamber, e.g. containing spark plug}
13/00	Engines characterised by the introduction of liquid fuel into cylinders by use of auxiliary fluid	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}
13/02	• Compression ignition engines using air or gas for blowing fuel into compressed air in cylinder	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}
13/04	• • Arrangements or adaptations of pumps	19/1076	• • • • • {pre-combustion chamber being formed within the piston, e.g. two-cycle engines}
13/06	• Engines having secondary air mixed with fuel in pump, compressed therein without ignition, and fuel-air mixture being injected into air in cylinder	19/108	• • • {with fuel injection at least into pre-combustion chamber, i.e. injector mounted directly in the pre-combustion chamber}
13/08	• • Arrangements or adaptations of pumps	19/1085	• • • • • {controlling fuel injection}
13/10	• Use of specific auxiliary fluids, e.g. steam, combustion gas	19/109	• • • {with injection of a fuel-air mixture into the pre-combustion chamber by means of a pump, e.g. two-cycle engines}
15/00	Engines characterised by the method of introducing liquid fuel into cylinders and not otherwise provided for		
15/02	• having means for sucking fuel directly into cylinder		
17/00	Engines characterised by means for effecting stratification of charge in cylinders		
17/005	• {having direct injection in the combustion chamber}		
Engines characterised by precombustion chambers or air-storage chambers, or characterised by special shape or construction of combustion chambers to improve operation			
19/00	Engines characterised by precombustion chambers		

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)}	23/0633	. . . {the combustion space being almost completely enclosed in the piston, i.e. having a small inlet in comparison to its volume}
19/12	. with positive ignition (engines with non-timed positive ignition, and with incandescent chambers F02B 9/08)	23/0636	. . . {the combustion space having a substantially flat and horizontal bottom}
19/14	. with compression ignition	23/0639	. . . . {the combustion space having substantially the shape of a cylinder}
19/16	. Chamber shapes or constructions not specific to sub-groups F02B 19/02 - F02B 19/10	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}
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)}	23/0645	. . . {Details related to the fuel injector or the fuel spray}
19/18	. . Transfer passages between chamber and cylinder	23/0648	. . . . {Means or methods to improve the spray dispersion, evaporation or ignition}
21/00	Engines characterised by air-storage chambers	23/0651	. . . . . {the fuel spray impinging on reflecting surfaces or being specially guided throughout the combustion space}
21/02	. Chamber shapes or constructions	23/0654	. . . . {Thermal treatments, e.g. with heating elements or local cooling}
23/00	Other engines characterised by special shape or construction of combustion chambers to improve operation (engines with incandescent chambers F02B 9/08)	23/0657	. . . . . {the spray interacting with one or more glow plugs}
	NOTE	23/066	. . . . {the injector being located substantially off-set from the cylinder centre axis}
	- in this group the following indexing codes are used:	23/0663	. . . . {having multiple injectors per combustion chamber}
	F02B 2700/02 - F02B 2720/30	23/0666	. . . . {having a single fuel spray jet per injector nozzle}
23/02	. with compression ignition	23/0669	. . . . {having multiple fuel spray jets per injector nozzle}
23/04	. . the combustion space being subdivided into two or more chambers (with pre-combustion chambers F02B 19/00)	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)}
23/06	. . the combustion space being arranged in working piston (F02B 23/04 takes precedence)	23/0675	. . . {the combustion space being substantially spherical, hemispherical, ellipsoid or parabolic}
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}	23/0678	. . . {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}
2023/0606	. . . . {the material being a catalyst}	23/0681	. . . . {Square, rectangular or the like profiles}
2023/0609	. . . . {the material being a porous medium, e.g. sintered metal}	23/0684	. . . . {Ring like bowl, e.g. toroidal}
2023/0612	. . . . {the material having a high temperature and pressure resistance, e.g. ceramic}	23/0687	. . . . {Multiple bowls in the piston, e.g. one bowl per fuel spray jet}
2023/0615	. . . {the combustion space having a volume defined by revolution around an axis inclined relative to the cylinder axis}	23/069	. . . . {characterised by its eccentricity from the cylinder axis}
23/0618	. . . {having in-cylinder means to influence the charge motion}	23/0693	. . . . {the combustion space consisting of step-wise widened multiple zones of different depth}
23/0621	. . . . {Squish flow}	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}
23/0624	. . . . {Swirl flow}	23/08	. with positive ignition
23/0627	. . . . {having additional bores or grooves machined into the piston for guiding air or charge flow to the piston bowl}	2023/085	. {using several spark plugs per cylinder}
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)}	23/10	. . with separate admission of air and fuel into cylinder
		23/101	. . . {the injector being placed on or close to the cylinder centre axis, e.g. with mixture formation using spray guided concepts}
		2023/102	. . . {the spark plug being placed offset the cylinder centre axis}

2023/103	. . . {the injector having a multi-hole nozzle for generating multiple sprays}	27/001	. {the system having electrically controlled acoustic pulse generating devices, e.g. loudspeakers}
23/104	. . . {the injector being placed on a side position of the cylinder}	27/003	. {using check valves}
23/105	. . . . {the fuel is sprayed directly onto or close to the spark plug}	27/005	. {Oscillating pipes with charging achieved by arrangement, dimensions or shapes of intakes pipes or chambers; Ram air pipes}
2023/106	. . . . {Tumble flow, i.e. the axis of rotation of the main charge flow motion is horizontal}	27/006	. . {of intake runners}
2023/107	. . . . {Reverse tumble flow, e.g. having substantially vertical intake ports}	27/008	. {Resonance charging}
2023/108	. . . . {Swirl flow, i.e. the axis of rotation of the main charge flow motion is vertical}	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)
Engines characterised by provision for charging or scavenging			
25/00	Engines characterised by using fresh charge for scavenging cylinders		
	NOTE		
	- in this group the following indexing codes are used:		
	F02B 2700/02 - F02B 2700/038		
25/02	. using unidirectional scavenging	27/0205	. . {characterised by the charging effect}
25/04	. . Engines having ports both in cylinder head and in cylinder wall near bottom of piston stroke	27/021	. . . {Resonance charging (combined with oscillating pipe charging F02B 27/0221)}
25/06	. . . the cylinder-head ports being controlled by working pistons, e.g. by sleeve-shaped extensions thereof	27/0215	. . . {Oscillating pipe charging, i.e. variable intake pipe length charging}
25/08	. . Engines with oppositely-moving reciprocating working pistons	27/0221	. . . . {Resonance charging combined with oscillating pipe charging}
25/10	. . . with one piston having a smaller diameter or shorter stroke than the other	27/0226	. . {characterised by the means generating the charging effect}
25/12	. . Engines with U-shaped cylinders, having ports in each arm	27/0231	. . . {Movable ducts, walls or the like (F02B 27/0257 takes precedence)}
25/14	. using reverse-flow scavenging, e.g. with both outlet and inlet ports arranged near bottom of piston stroke	27/0236	. . . . {with continuously variable adjustment of a length or width}
25/145	. . {with intake and exhaust valves exclusively in the cylinder head}	27/0242	. . . {Fluid communication passages between intake ducts, runners or chambers}
25/16	. . the charge flowing upward essentially along cylinder wall opposite the inlet ports (F02B 25/145 takes precedence)}	27/0247	. . . {Plenum chambers; Resonance chambers or resonance pipes}
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)}	27/0252	. . . . {Multiple plenum chambers or plenum chambers having inner separation walls, e.g. comprising valves for the same group of cylinders}
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	27/0257	. . . . {Rotatable plenum chambers}
25/22	. . by forming air cushion between charge and combustion residues	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)}
25/24	. . Inlet or outlet openings being timed asymmetrically relative to bottom dead-centre	27/0268	. . . {Valves}
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 F02B 57/00)	27/0273	. . . . {Flap valves}
25/28	. . with V-, fan-, or star-arrangement of cylinders	27/0278	. . . . {Multi-way valves}
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		
		27/0284	. . . . {Rotary slide valves}
		27/0289	. . . {Intake runners having multiple intake valves per cylinder}
		27/0294	. . {Actuators or controllers thereof; 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)
		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)
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 (air intakes or induction systems for internal-combustion engines F02M 35/10)
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

33/00	Engines characterised by provision of pumps for charging or scavenging
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
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
33/44	. Passages conducting the charge from the pump to the engine inlet, e.g. reservoirs
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	39/02	• Drives of pumps (exhaust drives or combined exhaust and other drives F02B 37/00); Varying pump drive gear ratio
37/00	Engines characterised by provision of pumps driven at least for part of the time by exhaust	39/04	• • Mechanical drives; Variable-gear-ratio drives (non-mechanical pump drives having variable gear ratio F02B 39/08)
37/001	• {using exhaust drives arranged in parallel}	39/06	• • • the engine torque being divided by a differential gear for driving a pump and the engine output shaft
37/002	• • {the exhaust supply to one of the exhaust drives can be interrupted}	39/08	• • Non-mechanical drives, e.g. fluid drives having variable gear ratio
37/004	• {with exhaust drives arranged in series}	39/085	• • • {the fluid drive using expansion of fluids other than exhaust gases, e.g. a Rankine cycle}
37/005	• {Exhaust driven pumps being combined with an exhaust driven auxiliary apparatus, e.g. a ventilator}	39/10	• • • electric
37/007	• with exhaust-driven pumps arranged in parallel {, e.g. at least one pump supplying alternatively}	39/12	• • Drives characterised by use of couplings or clutches therein (using fluid slip couplings for varying gear ratio F02B 39/08)
37/013	• with exhaust-driven pumps arranged in series	39/14	• Lubrication of pumps; Safety measures therefor
37/02	• Gas passages between engine outlet and pump drive, e.g. reservoirs	39/16	• Other safety measures for, or other control of, pumps
37/025	• • {Multiple scrolls or multiple gas passages guiding the gas to the pump drive}	2039/162	• • {Control of pump parameters to improve safety thereof}
37/04	• Engines with exhaust drive and other drive of pumps, e.g. with exhaust-driven pump and mechanically-driven second pump	2039/164	• • • {the temperature of the pump, of the pump drive or the pumped fluid being limited}
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}	2039/166	• • • {the fluid pressure in the pump or exhaust drive being limited}
37/105	• • • {exhaust drive and pump being both connected through gearing to engine-driven shaft}	2039/168	• • • {the rotational speed of pump or exhaust drive being limited}
37/11	• • driven by other drive at starting only	41/00	Engines characterised by special means for improving conversion of heat or pressure energy into mechanical power
37/12	• Control of the pumps	41/02	• Engines with prolonged expansion
2037/122	• • {Control of rotational speed of the pump}	41/04	• • in main cylinders
2037/125	• • {Control for avoiding pump stall or surge}	41/06	• • in compound cylinders
37/14	• • {Control} of the alternation between {or the operation of} exhaust drive and other drive of a pump, e.g. dependent on speed	41/08	• • • Two-stroke compound engines
37/16	• • by bypassing charging air	41/10	• • in exhaust turbines (use of exhaust turbines for charging F02B 37/00)
37/162	• • • {by bypassing, e.g. partially, intake air from pump inlet to pump outlet}	2041/12	• • {in jet propulsion apparatus}
37/164	• • • {the bypassed air being used in an auxiliary apparatus, e.g. in an air turbine}	Engines operating on non-liquid fuels; Plants including such engines, i.e. combinations of the engine with fuel-generating apparatus	
37/166	• • • • {the auxiliary apparatus being a combustion chamber, e.g. upstream of turbine}	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)
37/168	• • • {into the exhaust conduit (F02B 37/166 takes precedence)}		NOTE
37/18	• • by bypassing exhaust {from the inlet to the outlet of turbine or to the atmosphere}		- in this group the following indexing codes are used: F02B 2700/02 - F02B 2720/30
37/183	• • • {Arrangements of bypass valves or actuators therefor}	43/02	• Engines characterised by means for increasing operating efficiency
37/186	• • • • {Arrangements of actuators or linkage for bypass valves}	43/04	• • for improving efficiency of combustion
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)}	43/06	• • for enlarging charge
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)	43/08	• Plants characterised by the engines using gaseous fuel generated in the plant from solid fuel, e.g. wood
37/225	• • • {air passages}	43/10	• Engines or plants characterised by use of other specific gases, e.g. acetylene, oxyhydrogen
37/24	• • by using pumps or turbines with adjustable guide vanes	2043/103	• • {Natural gas, e.g. methane or LNG used as a fuel}
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}		

- 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, fuel or fuel-air mixture of the engines, and not otherwise provided for

- 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
- 53/12 . Ignition

- 53/14 . Adaptations of engines for driving, or engine combinations with, other devices
- 55/00 Internal-combustion aspects of rotary pistons; Outer members for co-operation with rotary pistons**
- 55/02 . Pistons
- 55/04 . . Cooling thereof
- 55/06 . . . by air or other gas
- 55/08 . Outer members for co-operation with rotary pistons; Casings
- 55/10 . . Cooling thereof
- 55/12 . . . by air or other gas
- 55/14 . Shapes or constructions of combustion chambers
- 55/16 . Admission or exhaust passages in pistons or outer members

Internal-combustion aspects of reciprocating-piston engines with movable cylinders

- 57/00 Internal-combustion aspects of rotary engines in which the combusted gases displace one or more reciprocating pistons**
- 57/02 . Fuel or combustion-air supply (cylinder-charge admission or exhaust control F02B 57/04)
- 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)
- 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)
- 57/08 . Engines with star-shaped cylinder arrangements
- 57/085 . . {having two parallel main shafts}
- 57/10 . . with combustion space in centre of star
- 59/00 Internal-combustion aspects of other reciprocating-piston engines with movable, e.g. oscillating, cylinders (with yieldable walls F02B 75/38)**

Adaptations of engines for special use; Combinations of engines with devices other than engine parts or auxiliaries

- 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)**
- 61/02 . for driving cycles
- 61/04 . for driving propellers
- 61/045 . . {for outboard marine engines}
- 61/06 . Combinations of engines with mechanical gearing (F02B 61/02, F02B 61/04 take precedence)
- 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)**
- 63/02 . for hand-held tools
- 63/04 . for electric generators
- 63/041 . . {Linear electric generators}
- 63/042 . . {Rotating electric generators}

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75/227 {with cylinder banks in X-arrangement, e.g. double-V engines}	77/085	. . {with sensors measuring combustion processes, e.g. knocking, pressure, ionization, combustion flame}
75/228	. . . . {with cylinders arranged in parallel banks}	77/086	. . . {Sensor arrangements in the exhaust, e.g. for temperature, misfire, air/fuel ratio, oxygen sensors}
75/24	. . . with cylinders arranged oppositely relative to main shaft and of "flat" type	77/087	. . {determining top dead centre or ignition-timing}
75/243	. . . . {with only one crankshaft of the "boxer" type, e.g. all connecting rods attached to separate crankshaft bearings}	77/088	. . {relating to tightness}
75/246	. . . . {with only one crankshaft of the "pancake" type, e.g. pairs of connecting rods attached to common crankshaft bearing}	77/089	. . {relating to engine temperature (concerning coolant temperature F01P 11/16)}
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	77/10	. . Safety means relating to crankcase explosions
75/265	. . {Engines with cylinder axes substantially tangentially to a circle centred on main-shaft axis}	77/11	. Thermal or acoustic insulation
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)	77/13	. . Acoustic insulation
75/282	. . {the pistons having equal strokes}	77/14	. Engine-driven auxiliary devices combined into units
75/285	. . {comprising a free auxiliary piston}		
75/287	. . {with several pistons positioned in one cylinder one behind the other}	79/00	Running-in of internal-combustion engines (lubrication thereof F01M 7/00)
75/30	. . with one working piston sliding inside another		
75/32	. Engines characterised by connections between pistons and main shafts and not specific to preceding main groups	2201/00	Fuels
75/34	. Ultra-small engines, e.g. for driving models	2201/02	. Liquid
75/36	. Engines with parts of combustion- or working-chamber walls resiliently yielding under pressure	2201/04	. Gas
75/38	. . Reciprocating - piston engines (F02B 75/04 takes precedence; with resiliently-urged auxiliary piston in pre-combustion chamber F02B 19/06)	2201/06	. Dual fuel applications
75/40	. Other reciprocating-piston engines	2201/062	. . Liquid and liquid
77/00	Component parts, details or accessories, not otherwise provided for	2201/0622	. . . Liquid and liquefied gas
77/005	. {Plugs}	2201/064	. . Liquid and gas
77/02	. Surface coverings of combustion-gas-swept parts (of pistons F02F 3/10; of cylinders and cylinder heads F02F 1/00)	2201/066	. . Gas and gas
77/04	. Cleaning of, preventing corrosion or erosion in, or preventing unwanted deposits in, combustion engines ((cleaning of fuel injection apparatus F02M 65/00))	2275/00	Other engines, components or details, not provided for in other groups of this subclass
2077/045	. . {by flushing or rinsing}	2275/02	. Attachment or mounting of cylinder heads on cylinders
2077/06	. {Arrangements of purifying apparatus for liquid fuel or lubricant filters}	2275/06	. Endless member is a belt
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})	2275/08	. Endless member is a chain
77/081	. . {relating to endless members (endless members, e.g. belts, for driving auxiliary apparatus F02B 67/04)}	2275/10	. Diamond configuration of valves in cylinder heads
77/082	. . {relating to valves}	2275/14	. Direct injection into combustion chamber
77/083	. . {relating to maintenance, e.g. diagnostic device (relating to lubrication F01M 11/10)}	2275/16	. Indirect injection
77/084	. . {indicating economy}	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
- 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

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- 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