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.

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)

7/02 . the fuel in the charge being liquid
7/04 . . Methods of operating
7/06 . the fuel in the charge being gaseous
7/08 . . Methods of operating

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)

NOTE

- in this group the following indexing codes are used:
F02B 2700/02 - F02B 2720/30

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)

9/04 . . Methods of operating

9/06 . with non-timed positive ignition, e.g. with hot-spots

9/08 . . with incandescent chambers

9/10 . . . Chamber shapes or constructions

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**

11/02 . convertible from fuel-air mixture compression to air compression or vice versa

Engines characterised by the method of introducing liquid fuel into cylinders

13/00 **Engines characterised by the introduction of liquid fuel into cylinders by use of auxiliary fluid**

13/02 . Compression ignition engines using air or gas for blowing fuel into compressed air in cylinder

13/04 . . Arrangements or adaptations of pumps

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

13/08 . . Arrangements or adaptations of pumps

13/10 . Use of specific auxiliary fluids, e.g. steam, combustion gas

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**

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}

19/02 . the chamber being periodically isolated from its cylinder

19/04 . . the isolation being effected by a protuberance on piston or cylinder head

19/06 . with auxiliary piston in chamber for transferring ignited charge to cylinder space

19/08 . the chamber being of air-swirl type

19/10 . with fuel introduced partly into pre-combustion chamber, and partly into cylinder

19/1004 . . {details of combustion chamber, e.g. mounting arrangements}

19/1009 . . . {heating, cooling}

19/1014 . . . {design parameters, e.g. volume, torch passage cross sectional area, length, orientation, or the like}

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)}

19/1028 . . . . {pre-combustion chamber and cylinder having both intake ports or valves, e.g. HONDS CVCC}

19/1033 . . . . . {specially adapted valves, e.g. rotary valves, pre-combustion chamber being part of a valve}

19/1038 . . . . . {timing of valves}

19/1042 . . . . . {auxiliary intake, valve drive}

19/1047 . . . . . {means for varying the size of the torch passage}

19/1052 . . . . . {controlling, e.g. varying fuel-air ratio, quantity of charge}

19/1057 . . . . . {with fuel injectors disposed upstream of intake valves}

19/1061 . . . . . {with residual gas chamber, e.g. containing spark plug}

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}

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}

19/1076 . . . . {pre-combustion chamber being formed within the piston, e.g. two-cycle engines}

19/108 . . . {with fuel injection at least into pre-combustion chamber, i.e. injector mounted directly in the pre-combustion chamber}

19/1085 . . . . {controlling fuel injection}

19/109 . . . {with injection of a fuel-air mixture into the pre-combustion chamber by means of a pump, e.g. two-cycle engines}

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)}

19/12 . with positive ignition (engines with non-timed positive ignition, and with incandescent chambers F02B 9/08)

19/14 . with compression ignition

19/16 . Chamber shapes or constructions not specific to sub-groups F02B 19/02 - F02B 19/10

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)}

19/18 . . Transfer passages between chamber and cylinder

21/00 Engines characterised by air-storage chambers

21/02 . Chamber shapes or constructions

23/00 Other engines characterised by special shape or construction of combustion chambers to improve operation (engines with incandescent chambers F02B 9/08)

NOTE

- in this group the following indexing codes are used:
F02B 2700/02 - F02B 2720/30

23/02 . with compression ignition

23/04 . . the combustion space being subdivided into two or more chambers (with pre-combustion chambers F02B 19/00)

23/06 . . the combustion space being arranged in working piston (F02B 23/04 takes precedence)

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}

2023/0606 . . . . {the material being a catalyst}

2023/0609 . . . . {the material being a porous medium, e.g. sintered metal}

2023/0612 . . . . {the material having a high temperature and pressure resistance, e.g. ceramic}

2023/0615 . . . {the combustion space having a volume defined by revolution around an axis inclined relative to the cylinder axis}

23/0618 . . . {having in-cylinder means to influence the charge motion}

23/0621 . . . . {Squish flow}

23/0624 . . . . {Swirl flow}

23/0627 . . . . {having additional bores or grooves machined into the piston for guiding air or charge flow to the piston bowl}

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)}

23/0633 . . . {the combustion space being almost completely enclosed in the piston, i.e. having a small inlet in comparison to its volume}

23/0636 . . . {the combustion space having a substantially flat and horizontal bottom}

23/0639 . . . . {the combustion space having substantially the shape of a 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}

23/0645 . . . {Details related to the fuel injector or the fuel spray}

23/0648 . . . . {Means or methods to improve the spray dispersion, evaporation or ignition}

23/0651 . . . . . {the fuel spray impinging on reflecting surfaces or being specially guided throughout the combustion space}

23/0654 . . . . {Thermal treatments, e.g. with heating elements or local cooling}

23/0657 . . . . . {the spray interacting with one or more glow plugs}

23/066 . . . . {the injector being located substantially off-set from the cylinder centre axis}

23/0663 . . . . {having multiple injectors per combustion chamber}

23/0666 . . . . {having a single fuel spray jet per injector nozzle}

23/0669 . . . . {having multiple fuel spray jets per injector nozzle}

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)}

23/0675 . . . {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}

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}

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}

23/08 . with positive ignition

2023/085 . . {using several spark plugs per cylinder}

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}

23/104 . . . {the injector being placed on a side position of the cylinder}

23/105 . . . . {the fuel is sprayed directly onto or close to the spark plug}

2023/106 . . . {Tumble flow, i.e. the axis of rotation of the main charge flow motion is horizontal}

2023/107 . . . . {Reverse tumble flow, e.g. having substantially vertical intake ports}

2023/108 . . . {Swirl flow, i.e. the axis of rotation of the main charge flow motion is vertical}

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
25/04 . . Engines having ports both in cylinder head and in cylinder wall near bottom of piston stroke
25/06 . . . the cylinder-head ports being controlled by working pistons, e.g. by sleeve-shaped extensions thereof
25/08 . . Engines with oppositely-moving reciprocating working pistons
25/10 . . . with one piston having a smaller diameter or shorter stroke than the other
25/12 . . Engines with U-shaped cylinders, having ports in each arm
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)}
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)}
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
25/22 . . by forming air cushion between charge and combustion residues
25/24 . . Inlet or outlet openings being timed asymmetrically relative to bottom dead-centre
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)
25/28 . . with V-, fan-, or star-arrangement of cylinders

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**

27/001 . {the system having electrically controlled acoustic pulse generating devices, e.g. loudspeakers}
27/003 . {using check valves}
27/005 . {Oscillating pipes with charging achieved by arrangement, dimensions or shapes of intakes pipes or chambers; Ram air pipes}
27/006 . . {of intake runners}
27/008 . {Resonance charging}
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)
27/0205 . . {characterised by the charging effect}
27/021 . . . {Resonance charging (combined with oscillating pipe charging F02B 27/0221)}
27/0215 . . . {Oscillating pipe charging, i.e. variable intake pipe length charging}
27/0221 . . . . {Resonance charging combined with oscillating pipe charging}
27/0226 . . {characterised by the means generating the charging effect}
27/0231 . . . {Movable ducts, walls or the like (F02B 27/0257 takes precedence)}
27/0236 . . . . {with continuously variable adjustment of a length or width}
27/0242 . . . {Fluid communication passages between intake ducts, runners or chambers}
27/0247 . . . {Plenum chambers; Resonance chambers or resonance pipes}
27/0252 . . . . {Multiple plenum chambers or plenum chambers having inner separation walls, e.g. comprising valves for the same group of cylinders}
27/0257 . . . . {Rotatable plenum chambers}
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)
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)
31/02 . in engines having inlet valves arranged eccentrically to cylinder axis (F02B 31/08 takes precedence)
31/04 . by means within the induction channel, e.g. deflectors
31/042 . . {induction channel having a helical shape around the intake valve axis}
31/06 . . Movable means, e.g. butterfly valves
31/08 . having multiple air inlets
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

37/00 Engines characterised by provision of pumps driven at least for part of the time by exhaust
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}
37/14 . . {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
37/162 . . . {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 37/166 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
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)
2041/12 . . {in jet propulsion apparatus}

Engines operating on non-liquid fuels; Plants including such engines, i.e. combinations of the engine with fuel-generating apparatus

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, 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 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}
63/043 . . {Electric generators using oscillating movement}
63/044 . . {the engine-generator unit being placed on a frame or in an housing}
2063/045 . . . {Frames for generator-engine sets}
2063/046 . . . {Handles adapted therefor, e.g. handles or grips for movable units}
63/047 . . . {Movable engine-generator combinations on wheels}
63/048 . . . {Portable engine-generator combinations}
63/06 . for pumps

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)

Engines with pertinent characteristics other than those provided for in or of interest apart from, preceding main groups

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**

67/04 . of mechanically-driven auxiliary apparatus

67/06 . . driven by means of chains, belts, or like endless members

67/08 . of non-mechanically driven auxiliary apparatus

67/10 . of charging or scavenging apparatus

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**

69/02 . for different fuel types, other than engines indifferent to fuel consumed, e.g. convertible from light to heavy fuel

69/04 . . for gaseous and non-gaseous fuels

69/06 . for different cycles, e.g. convertible from two-stroke to four stroke

71/00 **Free-piston engines; Engines without rotary main shaft**

71/02 . Starting

71/04 . Adaptations of such engines for special use; Combinations of such engines with apparatus driven thereby

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**

75/00 **Other engines**

75/002 . {Double acting engines}

75/005 . {having horizontal cylinders (F02B 75/007 takes precedence)}

75/007 . {having vertical crankshafts}

75/02 . Engines characterised by their cycles, e.g. six-stroke

75/021 . . {having six or more strokes per cycle}

2075/022 . . {having less than six strokes per cycle}

2075/023 . . . {one}

2075/025 . . . {two}

2075/026 . . . {three}

2075/027 . . . {four}

2075/028 . . . {five}

75/04 . Engines with variable distances between pistons at top dead-centre positions and cylinder heads

75/041 . . {by means of cylinder or cylinderhead positioning}

75/042 . . . {the cylinderhead comprising a counter-piston}

75/044 . . {by means of an adjustable piston length}

75/045 . . {by means of a variable connecting rod length}

75/047 . . {by means of variable crankshaft position}

75/048 . . {by means of a variable crank stroke length}

75/06 . Engines with means for equalising torque

75/065 . . {with double connecting rods or crankshafts}

75/08 . Engines with means for preventing corrosion in gas-swept spaces

75/10 . Engines with means for rendering exhaust gases innocuous (apparatus per se F01N 3/00)

75/12 . Other methods of operation

2075/125 . . {Direct injection in the combustion chamber for spark ignition engines, i.e. not in pre-combustion chamber}

75/16 . Engines characterised by number of cylinders, e.g. single-cylinder engines (F02B 75/26 takes precedence)

75/18 . . Multi-cylinder engines (scavenging aspects F02B 25/00)

2075/1804 . . . {Number of cylinders}

2075/1808 . . . . {two}

2075/1812 . . . . {three}

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}

2075/1888 . . . . {thirty-four}

2075/1892 . . . . {thirty-six}

75/1896 . . . {with two or more pistons connected to one crank and having a common combustion space}

75/20 . . . with cylinders all in one line

75/22 . . . with cylinders in V, fan, or star arrangement

75/221 . . . . {with cylinder banks in narrow V-arrangement, having a single cylinder head}

75/222 . . . . {with cylinders in star arrangement}

75/224 . . . . {with cylinders in fan arrangement}

75/225 . . . . {having two or more crankshafts}

75/227 . . . . {with cylinder banks in X-arrangement, e.g. double-V engines}

75/228 . . . . {with cylinders arranged in parallel banks}

75/24 . . . with cylinders arranged oppositely relative to main shaft and of "flat" type

75/243 . . . . {with only one crankshaft of the "boxer" type, e.g. all connecting rods attached to separate crankshaft bearings}

75/246 . . . . {with only one crankshaft of the "pancake" type, e.g. pairs of connecting rods attached to common crankshaft bearing}

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

75/265 . . {Engines with cylinder axes substantially tangentially to a circle centred on main-shaft axis}

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)
75/282 . . {the pistons having equal strokes}
75/285 . . {comprising a free auxiliary piston}
75/287 . . {with several pistons positioned in one cylinder one behind the other}
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
75/34 . Ultra-small engines, e.g. for driving models
75/36 . Engines with parts of combustion- or working-chamber walls resiliently yielding under pressure
75/38 . . Reciprocating - piston engines (F02B 75/04 takes precedence; with resiliently-urged auxiliary piston in pre-combustion chamber F02B 19/06)
75/40 . Other reciprocating-piston engines

77/00 Component parts, details or accessories, not otherwise provided for

77/005 . {Plugs}
77/02 . Surface coverings of combustion-gas-swept parts (of pistons F02F 3/10; of cylinders and cylinder heads F02F 1/00)
77/04 . Cleaning of, preventing corrosion or erosion in, or preventing unwanted deposits in, combustion engines
2077/045 . . {by flushing or rinsing}
2077/06 . {Arrangements of purifying apparatus for liquid fuel or lubricant filters}
77/08 . Safety, indicating, or supervising devices (thermal insulation F02B 77/11; monitoring or diagnostic devices for exhaust-gas treatment apparatus F01N 11/00)
77/081 . . {relating to endless members}
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 7/00)

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
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