

**CPC****COOPERATIVE PATENT CLASSIFICATION****F02B**

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

**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 embraces super-charging;
  - "scavenging" means forcing the combustion residues from the cylinders other than by movement of the working pistons and thus embraces tuned exhaust systems.
2. Attention is drawn to the Notes preceding class [F01](#), specially 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** (with both fuel-air mixture compression and air-compression, or with both positive ignition and compression ignition [F02B 11/00](#); with pre-combustion chambers [F02B 19/00](#); having air storage chambers [F02B 21/00](#); with special shape or construction of other combustion chambers [F02B 23/00](#))

**F02B 1/00**

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

**NOTE**

in this group the following indexing codes are used:  
[F02B 2700/02](#) to [F02B 2720/30](#)

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

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

**NOTE**

in this group the following indexing codes are used:  
[F02B 2700/02](#) to [F02B 2720/30](#)

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

**F02B 5/00** **Engines characterised by positive ignition** ([F02B 1/02](#), [F02B 3/02](#) take precedence; 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](#); characterised by precombustion chambers [F02B 19/00](#); characterised by air-storage chambers [F02B 21/00](#); characterised by special shape or construction of combustion chambers [F02B 23/00](#))

- [F02B 5/02](#) . Methods of operating

**F02B 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](#); characterised by precombustion chambers [F02B 19/00](#); characterised by air-storage chambers [F02B 21/00](#); characterised by special shape or construction of combustion chambers [F02B 23/00](#))

- [F02B 7/02](#) . the fuel in the charge being liquid
- [F02B 7/04](#) . . Methods of operating
- [F02B 7/06](#) . the fuel in the charge being gaseous
- [F02B 7/08](#) . . Methods of operating

**F02B 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](#); characterised by precombustion chambers [F02B 19/00](#); characterised by air-storage chambers [F02B 21/00](#); characterised by special shape or construction of combustion chambers [F02B 23/00](#))

**NOTE**

- in this group the following indexing codes are used:  
[F02B 2700/02](#) to [F02B 2720/30](#)

- F02B 9/02
  - with compression ignition ([F02B 1/12](#), [F02B 3/06](#) take precedence)
- F02B 9/04
  - . Methods of operating
- F02B 9/06
  - with non-timed positive ignition, e.g. with hot-spots
- F02B 9/08
  - . with incandescent chambers
- F02B 9/10
  - . . Chamber shapes or constructions
- F02B 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** (characterised by recombustion chambers [F02B 19/00](#); characterised by air-storage chambers [F02B 21/00](#); characterised by special shape or construction of combustion chambers [F02B 23/00](#))
- F02B 11/02
  - convertible from fuel-air mixture compression to air compression or vice-versa

**Engines characterised by the method of introducing fuel into cylinders** (characterised by use of gaseous or solid fuels [F02B 43/00](#), [F02B 45/00](#); carburettors, fuel-injection apparatus [F02M](#))

- F02B 13/00** **Engines characterised by the introduction of liquid fuel into cylinders by use of auxiliary fluid**
- F02B 13/02
  - Compression ignition engines using air or gas for blowing fuel into compressed air in cylinder
- F02B 13/04
  - . Arrangements or adaptations of pumps
- F02B 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
- F02B 13/08
  - . Arrangements or adaptations of pumps
- F02B 13/10
  - Use of specific auxiliary fluids, e.g. steam, combustion gas
- F02B 15/00** **Engines characterised by the method of introducing liquid fuel into cylinders and not otherwise provided for**
- F02B 15/02
  - having means for sucking fuel directly into cylinder
- F02B 17/00** **Engines characterised by means for effecting stratification of charge in cylinders**
- F02B 17/005
  - {having direct injection in the combustion chamber}

**Engines characterised by having pre-combustion chambers or air storage chambers, or characterised by shape or construction of combustion chambers to improve operation** (engines with incandescent chambers [F02B 9/08](#))

- F02B 19/00** **Engines characterised by precombustion chambers** (engines with incandescent chambers [F02B 9/08](#))
- F02B 2019/002
  - {with electric heater fitted to at least part of prechamber-wall or transfer passage}
- F02B 2019/004
  - . {with heater control}
- F02B 2019/006
  - {with thermal insulation}
- F02B 2019/008
  - . {variable}
- F02B 19/02
  - the chamber being periodically isolated from its cylinder

- F02B 19/04 . . the isolation being effected by a protuberance on piston or cylinder head
- F02B 19/06 . with auxiliary piston in chamber for transferring ignited charge to cylinder space
- F02B 19/08 . the chamber being of air-swirl type
- F02B 19/10 . with fuel introduced partly into pre-combustion chamber, and partly into cylinder  
([F02B 19/02](#) to [F02B 19/08](#) take precedence)
- F02B 19/1004 . . {details of combustion chamber, e.g. mounting arrangements}
- F02B 19/1009 . . . {heating, cooling}
- F02B 19/1014 . . . {design parameters, e.g. volume, torch passage cross sectional area, length, orientation, or the like}
- F02B 19/1019 . . {with only one pre-combustion chamber ([F02B 19/1004](#) take precedence)}
- F02B 19/1023 . . . {pre-combustion chamber and cylinder being fed with fuel-air mixture(s)}
- F02B 19/1028 . . . . {pre-combustion chamber and cylinder having both intake ports or valves, e.g. HONDS CVCC}
- F02B 19/1033 . . . . . {specially adapted valves, e.g. rotary valves, pre-combustion chamber being part of a valve}
- F02B 19/1038 . . . . . {timing of valves}
- F02B 19/1042 . . . . . {auxiliary intake, valve drive}
- F02B 19/1047 . . . . . {means for varying the size of the torch passage}
- F02B 19/1052 . . . . . {controlling, e.g. varying fuel-air ratio, quantity of charge}
- F02B 19/1057 . . . . . {with fuel injectors disposed upstream of intake valves}
- F02B 19/1061 . . . . . {with residuel gas chamber e.g. containing spark plug}
- F02B 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}
- F02B 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}
- F02B 19/1076 . . . . {pre-combustion chamber being formed within the piston, e.g. two-cycle engines}
- F02B 19/108 . . . {with fuel injection at least into pre-combustion chamber, i.e. injector mounted directly in the pre-combustion chamber}
- F02B 19/1085 . . . . {controlling fuel injection}
- F02B 19/109 . . . {with injection of a fuel-air mixture into the pre-combustion chamber by means of a pump, e.g. two-cycle engines}
- F02B 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)}
- F02B 19/12 . with positive ignition ([F02B 19/02](#) to [F02B 19/10](#) take precedence)
- F02B 19/14 . with compression ignition ([F02B 19/02](#) to [F02B 19/10](#) take precedence)
- F02B 19/16 . Chamber shapes or constructions not specific to sub-groups [F02B 19/02](#) to [F02B 19/10](#)

- F02B 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](#))}

- F02B 19/18 . . Transfer passages between chamber and cylinder

## **F02B 21/00 Engines characterised by air-storage chambers**

- F02B 21/02 . Chamber shapes or constructions

## **F02B 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](#) to [F02B 2720/30](#)

- F02B 23/02 . with compression ignition
- F02B 23/04 . . the combustion space being subdivided into two or more chambers (with pre-combustion chambers [F02B 19/00](#))
- F02B 23/06 . . the combustion space being arranged in working piston ([F02B 23/04](#) takes precedence)
- F02B 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}
- F02B 2023/0606 . . . . {the material being a catalyst}
- F02B 2023/0609 . . . . {the material being a porous medium, e.g. sintered metal}
- F02B 2023/0612 . . . . {the material having a high temperature and pressure resistance, e.g. ceramic}
- F02B 2023/0615 . . . {the combustion space having a volume defined by revolution around an axis inclined relative to the cylinder axis}
- F02B 23/0618 . . . {having in-cylinder means to influence the charge motion}
- F02B 23/0621 . . . . {Squish flow}
- F02B 23/0624 . . . . {Swirl flow}
- F02B 23/0627 . . . . {having additional bores or grooves machined into the piston for guiding air or charge flow to the piston bowl}
- F02B 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)}
- F02B 23/0633 . . . {the combustion space being almost completely enclosed in the piston, i.e. having a small inlet in comparison to its volume}
- F02B 23/0636 . . . {the combustion space having a substantially flat and horizontal bottom}
- F02B 23/0639 . . . . {the combustion space having substantially the shape of a cylinder}
- F02B 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}

- F02B 23/0645 . . . {Details related to the fuel injector or the fuel spray}
- F02B 23/0648 . . . . {Means or methods to improve the spray dispersion, evaporation or ignition}
- F02B 23/0651 . . . . . {the fuel spray impinging on reflecting surfaces or being specially guided throughout the combustion space}
- F02B 23/0654 . . . . . {Thermal treatments, e.g. with heating elements or local cooling}
- F02B 23/0657 . . . . . {the spray interacting with one or more glow plugs}
- F02B 23/066 . . . . . {the injector being located substantially off-set from the cylinder centre axis}
- F02B 23/0663 . . . . . {having multiple injectors per combustion chamber}
- F02B 23/0666 . . . . . {having a single fuel spray jet per injector nozzle}
- F02B 23/0669 . . . . . {having multiple fuel spray jets per injector nozzle}
- F02B 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](#))}
- F02B 23/0675 . . . . {the combustion space being sunstantially spherical, hemispherical, ellipsoid or parabolic}
- F02B 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}
- F02B 23/0681 . . . . . {Square, rectangular or the like profiles}
- F02B 23/0684 . . . . . {Ring like bowl, e.g. toroidal}
- F02B 23/0687 . . . . . {Multiple bowls in the piston, e.g. one bowl per fuel spray jet}
- F02B 23/069 . . . . . {characterised by its eccentricity from the cylinder axis}
- F02B 23/0693 . . . . . {the combustion space consisting of step-wise widened multiple zones of different depth}
- F02B 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}
- F02B 23/08 . . with positive ignition
- F02B 2023/085 . . {using several spark plugs per cylinder}
- F02B 23/10 . . with separate admission of air and fuel into cylinder
- F02B 23/101 . . . . {the injector being placed on or close to the cylinder centre axis, e.g. with mixture formation using spray guided concepts}
- F02B 2023/102 . . . . {the spark plug being placed offset the cylinder centre axis}
- F02B 2023/103 . . . . {the injector having a multi-hole nozzle for generating multiple sprays}
- F02B 23/104 . . . . {the injector being placed on a side position of the cylinder}
- F02B 23/105 . . . . . {the fuel is sprayed directly onto or close to the spark plug}
- F02B 2023/106 . . . . {Tumble flow, i.e. the axis of rotation of the main charge flow motion is horizontal}
- F02B 2023/107 . . . . . {Reverse tumble flow, e.g. having substantially vertical intake ports}
- F02B 2023/108 . . . . {Swirl flow, i.e. the axis of rotation of the main charge flow motion is vertical}

**Engines characterised by provisions for charging or scavenging** (aspects concerned with driven charging or scavenging pumps [F02B 33/00](#) to [F02B 39/00](#))

## **F02B 25/00**

**Engines characterised by using fresh charge for scavenging cylinders** (aspects characterised by provision of driven charging or scavenging pumps [F02B 33/00](#) to [F02B 39/00](#))

### **NOTE**

- in this group the following indexing codes are used:  
[F02B 2700/02](#) to [F02B 2700/038](#)

- [F02B 25/02](#) . using unidirectional scavenging
- [F02B 25/04](#) . . Engines having ports both in cylinder head and in cylinder wall near bottom of piston stroke
- [F02B 25/06](#) . . . the cylinder-head ports being controlled by working pistons, e.g. by sleeve-shaped extensions thereof
- [F02B 25/08](#) . . Engines with oppositely-moving reciprocating working pistons
- [F02B 25/10](#) . . . with one piston having a smaller diameter or shorter stroke than the other
- [F02B 25/12](#) . . Engines with U-shaped cylinders, having ports in each arm
- [F02B 25/14](#) . using reverse-flow scavenging, e.g. with both outlet and inlet ports arranged near bottom of piston stroke
- [F02B 25/145](#) . . {with intake and exhaust valves exclusively in the cylinder head}
- [F02B 25/16](#) . . the charge flowing upward essentially along cylinder wall opposite the inlet ports {([F02B 25/145](#) takes precedence)}
- [F02B 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)}
- [F02B 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](#) to [F02B 25/18](#)
- [F02B 25/22](#) . . by forming air cushion between charge and combustion residues
- [F02B 25/24](#) . . Inlet or outlet openings being timed asymmetrically relative to bottom dead-centre
- [F02B 25/26](#) . Multi-cylinder engines other than those provided for in, or of interest apart from, groups [F02B 25/02](#) to [F02B 25/24](#) (internal-combustion aspects of rotary engines with movable cylinders [F02B 57/00](#))
- [F02B 25/28](#) . . with V-, fan-, or star-arrangement of cylinders

## **F02B 27/00**

**Use of kinetic or wave energy of charge in induction systems, or of combustion residues in exhaust systems, for improving quantity of charge or for increasing removal of combustion residues** (aspects characterised by provision of driven charging or scavenging pumps [F02B 33/00](#) to [F02B 39/00](#), e.g. use of driven apparatus for immediate conversion of combustion gas pressure into pressure of fresh charge [F02B 33/42](#))

- [F02B 27/001](#) . {the system having electrically controlled acoustic pulse generating devices, e.g. loudspeakers}
- [F02B 27/003](#) . {using check valves}



- F02B 27/005 . {Oscillating pipes with charging achieved by arrangement, dimensions or shapes of intakes pipes or chambers; Ram air pipes}
- F02B 27/006 . . {of intake runners}
- F02B 27/008 . {Resonance charging}
- F02B 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](#))
- F02B 27/0205 . . {characterised by the charging effect}
- F02B 27/021 . . . {Resonance charging (combined with oscillating pipe charging [F02B 27/0221](#))}
- F02B 27/0215 . . . {Oscillating pipe charging, i.e. variable intake pipe length charging}
- F02B 27/0221 . . . . {Resonance charging combined with oscillating pipe charging}
- F02B 27/0226 . . {characterised by the means generating the charging effect}
- F02B 27/0231 . . . {Movable ducts, walls or the like ([F02B 27/0257](#) takes precedence)}
- F02B 27/0236 . . . . {with continuously variable adjustment of a length or width}
- F02B 27/0242 . . . {Fluid communication passages between intake ducts, runners or chambers}
- F02B 27/0247 . . . {Plenum chambers; Resonance chambers or resonance pipes}
- F02B 27/0252 . . . . {Multiple plenum chambers or plenum chambers having inner separation walls, e.g. comprising valves for the same group of cylinders}
- F02B 27/0257 . . . . {Rotatable plenum chambers}
- F02B 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)}
- F02B 27/0268 . . . {Valves}
- F02B 27/0273 . . . . {Flap valves}
- F02B 27/0278 . . . . {Multi-way valves}
- F02B 27/0284 . . . . {Rotary slide valves}
- F02B 27/0289 . . . {Intake runners having multiple intake valves per cylinder}
- F02B 27/0294 . . {Actuators or controllers therefor; Diagnosis; Calibration}
- F02B 27/04 . in exhaust systems only, e.g. for sucking-off combustion gases
- F02B 27/06 . . the systems having variable, i.e. adjustable, cross-sectional areas, chambers of variable volume, or like variable means

**F02B 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](#) to [F02B 39/00](#); Details thereof**

- F02B 29/02 . Other fluid-dynamic features of induction systems for improving quantity of charge (for also imparting a rotation to the charge in the cylinder [F02B 31/00](#); structural features of induction systems [F02M](#))
- F02B 29/04 . Cooling of air intake supply
- F02B 29/0406 . . {Layout of the intake air cooling or coolant circuit}
- F02B 29/0412 . . . {Multiple heat exchangers arranged in parallel or in series}



- F02B 29/0418 . . . {the intake air cooler having a bypass or multiple flow paths within the heat exchanger to vary the effective heat transfer surface}
- F02B 29/0425 . . . {Air cooled heat exchangers}
- F02B 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}
- F02B 29/0437 . . . {Liquid cooled heat exchangers}
- F02B 29/0443 . . . . {Layout of the coolant or refrigerant circuit}
- F02B 29/045 . . {Constructional details of the heat exchangers, e.g. pipes, plates, ribs, insulation, materials, or manufacturing and assembly}
- F02B 29/0456 . . . {Air cooled heat exchangers}
- F02B 29/0462 . . . {Liquid cooled heat exchangers}
- F02B 29/0468 . . . {Water separation or drainage means}
- F02B 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}
- F02B 29/0481 . . {Intake air cooling by means others than heat exchangers, e.g. by rotating drum regenerators, cooling by expansion or by electrical means}
- F02B 29/0493 . . {Controlling the air charge temperature}
- F02B 29/06 . After-charging, i.e. supplementary charging after scavenging
- F02B 29/08 . Modifying distribution valve timing for charging purposes ([F02B 29/06](#) takes precedence; valve gear therefor [F01L](#))
- F02B 29/083 . . {Cyclically operated valves disposed upstream of the cylinder intake valve, controlled by external means}
- F02B 29/086 . . {the engine having two or more inlet valves}
- F02B 31/00** **Modifying induction systems for imparting a rotation to the charge in the cylinder** (structural features of induction systems [F02M](#))
- F02B 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}
- F02B 2031/006 . {having multiple air intake valves}
- F02B 31/02 . in engines having inlet valves arranged eccentrically to cylinder axis
- F02B 31/04 . by means within the induction channel, e.g. deflectors
- F02B 31/06 . . Movable means, e.g. butterfly valves
- F02B 31/08 . . . having multiple air inlets, {i.e. having main and auxiliary intake passages}
- F02B 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](#))}
- F02B 31/085 . . . . {having two inlet valves}
- F02B 31/087 . . . . {having three or more inlet valves}

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

## **F02B 33/00**

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

### **NOTE**

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

- [F02B 33/02](#) . Engines with reciprocating-piston pumps; Engines with crankcase pumps
- [F02B 33/04](#) . . with simple crankcase pump, i.e. with the rear face of a non-stepped working piston acting as sole pumping member in co-operation with the crankcase
- [F02B 33/06](#) . . with reciprocating-piston pumps other than simple crankcase pumps
- [F02B 33/08](#) . . . with the working-cylinder head arranged between working and pumping cylinders
- [F02B 33/10](#) . . . with the pumping cylinder situated between working cylinder and crankcase, or with the pumping cylinder surrounding working cylinder
- [F02B 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
- [F02B 33/14](#) . . . . working and pumping pistons forming stepped piston
- [F02B 33/16](#) . . . . working and pumping pistons having differing movements
- [F02B 33/18](#) . . . with crankshaft being arranged between working and pumping cylinders
- [F02B 33/20](#) . . . with pumping-cylinder axis arranged at an angle to working-cylinder axis, e.g. at an angle of 90 degrees
- [F02B 33/22](#) . . . with pumping cylinder situated at side of working cylinder, e.g. the cylinders being parallel
- [F02B 33/24](#) . . with crankcase pumps other than with reciprocating pistons only
- [F02B 33/26](#) . . Four-stroke engines characterised by having crankcase pumps
- [F02B 33/28](#) . . Component parts, details or accessories of crankcase pumps, not provided for in, or of interest apart from, subgroups [F02B 33/02](#) to [F02B 33/26](#)
- [F02B 33/30](#) . . . Control of inlet or outlet ports (controlling only working-cylinder inlets [F01L](#))
- [F02B 33/32](#) . Engines with pumps other than of reciprocating-piston type (with crankcase pumps [F02B 33/02](#))
- [F02B 33/34](#) . . with rotary pumps (with cell-type pressure exchangers or the like [F02B 33/42](#))
- [F02B 33/36](#) . . . of positive-displacement type
- [F02B 33/38](#) . . . . of Roots type

- F02B 33/40
  - • • of non-positive-displacement type
- F02B 33/42
  - • with driven apparatus for immediate conversion of combustion gas pressure into pressure of fresh charge, e.g. with cell-type pressure exchangers (pressure exchangers per se [F04F 13/00](#))
- F02B 33/44
  - Passages conducting the charge from the pump to the engine inlet, e.g. reservoirs (cooling of charge after leaving pumps [F02B 29/04](#))
- F02B 33/443
  - • {Heating of charging air, e.g. for facilitating the starting}
- F02B 33/446
  - • {having valves for admission of atmospheric air to engine, e.g. at starting}
- F02B 35/00**

**Engines characterised by provision of pumps for sucking combustion residues from cylinders**
- F02B 35/02
  - using rotary pumps
- F02B 37/00**

**Engines characterised by provision of pumps driven at least for part of the time by exhaust** (characterised by the introduction of liquid fuel into cylinders by use of auxiliary fluid [F02B 13/00](#); characterised by after-charging [F02B 29/06](#); characterised by passages conducting the charge from the pump to the engine inlet [F02B 33/44](#))
- F02B 37/001
  - {using exhaust drives arranged in parallel}
- F02B 37/002
  - • {the exhaust supply to one of the exhaust drives can be interrupted}
- F02B 37/004
  - {with exhaust drives arranged in series}
- F02B 37/005
  - {Exhaust driven pumps being combined with an exhaust driven auxiliary apparatus, e.g. a ventilator}
- F02B 37/007
  - with exhaust-driven pumps arranged in parallel, {e.g. at least one pump supplying alternatively}
- F02B 37/013
  - with exhaust-driven pumps arranged in series
- F02B 37/02
  - Gas passages between engine outlet and pump drive, e.g. reservoirs
- F02B 37/025
  - • {Multiple scrolls or multiple gas passages guiding the gas to the pump drive}
- F02B 37/04
  - Engines with exhaust drive and other drive of pumps, e.g. with exhaust-driven pump and mechanically-driven second pump
- F02B 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}
- F02B 37/105
  - • • {exhaust drive and pump being both connected through gearing to engine-driven shaft}
- F02B 37/11
  - • driven by other drive at starting only
- F02B 37/12
  - Control of the pumps
- F02B 2037/122
  - • {Control of rotational speed of the pump}
- F02B 2037/125
  - • {Control for avoiding pump stall or surge}
- F02B 37/127
  - • {by bypassing air from the pump inlet, e.g. to the pump outlet (bypassing charging air [F02B 37/16](#); valves for admission of atmospheric air to engine [F02B 33/446](#))}
- F02B 37/14
  - • {Control} of the alternation between {or the operation of} exhaust drive and other drive of a pump, e.g. dependent on speed
- F02B 37/16
  - • by bypassing charging air {(bypassing air from the pump inlet, e.g. to the pump outlet [F02B 37/127](#))}

- F02B 2037/162 . . . {by bypassing, e.g. partially, intake air from pump inlet to pump outlet}
- F02B 37/164 . . . {the bypassed air being used in an auxiliary apparatus, e.g. in an air turbine}
- F02B 37/166 . . . . {the auxiliary apparatus being a combustion chamber, e.g. upstream of turbine}
- F02B 37/168 . . . {into the exhaust conduit (F02B 37/186 takes precedence)}
- F02B 37/18 . . by bypassing exhaust {from the inlet to the outlet of turbine or to the atmosphere}
- F02B 37/183 . . . {Arrangements of bypass valves or actuators therefor}
- F02B 37/186 . . . . {Arrangements of actuators or linkage for bypass valves}
- F02B 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)}
- F02B 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)}
- F02B 37/225 . . . {air passages}
- F02B 37/24 . . by using pumps or turbines with adjustable guide vanes

#### F02B 39/00

**Component parts, details, or accessories relating to, driven charging or scavenging pumps, not provided for in groups F02B 33/00 to F02B 37/00**

- F02B 39/005 . {Cooling of pump drives}
- F02B 39/02 . Drives of pumps (exhaust drives or combined exhaust and other drives F02B 37/00); Varying pump drive gear ratio (control acting both on engine and on pump drive gear ratio F02D)
- F02B 39/04 . . Mechanical drives; Variable-gear-ratio drives (non-mechanical pump drives having variable gear ratio F02B 39/08)
- F02B 39/06 . . . the engine torque being divided by a differential gear for driving a pump and the engine output shaft
- F02B 39/08 . . Non-mechanical drives, e.g. fluid drives having variable gear ratio
- F02B 39/085 . . . {the fluid drive using expansion of fluids other than exhaust gases, e.g. a Rankine cycle}
- F02B 39/10 . . . electric
- F02B 39/12 . . Drives characterised by use of couplings or clutches therein (using fluid slip couplings for varying gear ratio F02B 39/08)
- F02B 39/14 . Lubrication of pumps; Safety measures therefor
- F02B 39/16 . Other safety measures for, or other control of, pumps
- F02B 2039/162 . . {Control of pump parameters to improve safety thereof}
- F02B 2039/164 . . . {the temperature of the pump, of the pump drive or the pumped fluid being limited}
- F02B 2039/166 . . . {the fluid pressure in the pump or exhaust drive being limited}
- F02B 2039/168 . . . {the rotational speed of pump or exhaust drive being limited}

#### F02B 41/00

**Engines characterised by special means for improving conversion of heat or pressure energy into mechanical power**

- F02B 41/02
  - Engines with prolonged expansion
- F02B 41/04
  - . in main cylinders
- F02B 41/06
  - . in compound cylinders
- F02B 41/08
  - . . Two-stroke compound engines
- F02B 41/10
  - . in exhaust turbines (use of exhaust turbines for charging [F02B 37/00](#); turbines constructions [F01D](#); gas turbine plant [F02C](#))
- F02B 2041/12
  - . {in jet propulsion apparatus}

**Engines operating on non-liquid fuels; Plants including such engines, i.e. combinations of the engines with fuel-generating apparatus** (engines having gas-air charge ignited by compression-ignition of an additional fuel [F02B 7/06](#); engines convertible from gas to other fuel consumption [F02B 69/04](#); apparatus for generating fuel, e.g. gas, see the relevant classes, e.g. [C10](#))

**F02B 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](#) to [F02B 2720/30](#)

- F02B 43/02
  - Engines characterised by means for increasing operating efficiency
- F02B 43/04
  - . for improving efficiency of combustion
- F02B 43/06
  - . for enlarging charge
- F02B 43/08
  - Plants characterised by the engines using gaseous fuel generated in the plant from solid fuel, e.g. wood
- F02B 43/10
  - Engines or plants characterised by use of other specific gases, e.g. acetylene, oxyhydrogen
- F02B 2043/103
  - . {Natural gas, e.g. methane or LNG used as a fuel}
- F02B 2043/106
  - . {Hydrogen obtained by electrolysis}
- F02B 43/12
  - . Methods of operating

**F02B 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](#))

- F02B 45/02
  - operating on powdered fuel e.g. powdered coal (operating on fuel containing oxidant [F02B 45/06](#))
- F02B 45/04
  - . Plants, e.g. having coal-grinding apparatus
- F02B 45/06
  - operating on fuel containing oxidant
- F02B 45/08
  - operating on other solid fuels
- F02B 45/10
  - operating on mixtures of liquid and non-liquid fuels, e.g. in pasty or foamed state

**Methods of operating engines involving specific pre-treating of, or adding specific substances to, combustion air, or fuel air-mixture, of the engines and not otherwise provided for (apparatus for performing such pre-treatment or additions [F02M](#))**

**F02B 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**

- [F02B 47/02](#)      . the substances being water or steam
- [F02B 47/04](#)      . the substances being other than water or steam only
- [F02B 47/06](#)      . . the substance including non-airborne oxygen ([F02B 47/10](#) takes precedence)
- [F02B 47/08](#)      . . the substances including exhaust gas
- [F02B 47/10](#)      . . . Circulation of exhaust gas in closed or semi-closed circuits, e.g. with simultaneous addition of oxygen

**F02B 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**

**F02B 51/00**      **Other methods of operating engines involving pretreating of, or adding substances to, combustion air, fuel, or fuel-air mixture of the engines**

- [F02B 51/02](#)      . involving catalysts
- [F02B 51/04](#)      . involving electricity or magnetism
- [F02B 51/06](#)      . involving rays or sound waves

#### **Internal-combustion aspects of rotary-piston or oscillating-piston engines**

**F02B 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](#) to [F02B 2730/09](#)

- [F02B 2053/005](#)      . {Wankel engines}
- [F02B 53/02](#)      . Methods of operating
- [F02B 53/04](#)      . Charge admission or combustion-gas discharge
- [F02B 53/06](#)      . . Valve control therefor
- [F02B 53/08](#)      . . Charging, e.g. by means of rotary-piston pump
- [F02B 53/10](#)      . Fuel supply; Introducing fuel to combustion space
- [F02B 53/12](#)      . Ignition
- [F02B 53/14](#)      . Adaptations of engines for driving, or engine combinations with, other devices (aspects predominantly concerning such devices, see the relevant classes for the devices)

**F02B 55/00**                    **Internal-combustion aspects of rotary pistons; Outer members for co-operation with rotary pistons**

- F02B 55/02                    .    Pistons
- F02B 55/04                    .    .    Cooling thereof
- F02B 55/06                    .    .    .    by air or other gas
- F02B 55/08                    .    Outer members for co-operation with rotary pistons; Casings
- F02B 55/10                    .    .    Cooling thereof
- F02B 55/12                    .    .    .    by air or other gas
- F02B 55/14                    .    Shapes or constructions of combustion chambers
- F02B 55/16                    .    Admission or exhaust passages in pistons or outer members

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

**F02B 57/00**                    **Internal-combustion aspects of rotary engines in which the combusted gases displace one or more reciprocating pistons**

- F02B 57/02                    .    Fuel or combustion-air supply ([cylinder-charge admission or exhaust control F02B 57/04](#))
- F02B 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](#))
- F02B 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](#))
- F02B 57/08                    .    Engines with star-shaped cylinder arrangements
- F02B 57/085                    .    .    {[having two parallel main shafts](#)}
- F02B 57/10                    .    .    with combustion space in centre of star

**F02B 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** ([of rotary-piston or oscillating-piston engines F02B 53/14](#); aspects predominantly concerning such devices, see the relevant classes for the devices)

**F02B 61/00**                    **Adaptations of engines for driving vehicles or for driving propellers; Combinations of engines with gearing** ([the engine torque being divided by a differential gear for driving a scavenging or charging pump and the engine output shaft F02B 39/06](#); adaptations or combinations of rotary-piston or oscillating-piston engines [F02B 53/14](#); arrangements in vehicles, see the relevant classes for vehicles)

- F02B 61/02                    .    for driving cycles
- F02B 61/04                    .    for driving propellers
- F02B 61/045                    .    .    {[for outboard marine engines](#)}
- F02B 61/06                    .    Combinations of engines with mechanical gearing ([F02B 61/02](#), [F02B 61/04 take precedence](#))



**F02B 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](#))**

- [F02B 63/02](#)      .    for hand-held tools
- [F02B 63/04](#)      .    for electric generators
- [F02B 63/041](#)    . .    {Linear electric generators}
- [F02B 63/042](#)    . .    {Rotating electric generators}
- [F02B 63/043](#)    . .    {Electric generators using oscillating movement}
- [F02B 63/044](#)    . .    {the engine-generator unit being placed on a frame or in an housing}
- [F02B 2063/045](#) . . .    {Frames for generator-engine sets}
- [F02B 2063/046](#) . . .    {Handles adapted therefor, e.g. handles or grips for movable units}
- [F02B 63/047](#)    . . .    {Movable engine-generator combinations on wheels}
- [F02B 63/048](#)    . . .    {Portable engine-generator combinations}
- [F02B 63/06](#)      .    for pumps

**F02B 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**

**F02B 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**

- [F02B 67/04](#)      .    of mechanically-driven auxiliary apparatus
- [F02B 67/06](#)      . .    driven by means of chains, belts, or like endless members
- [F02B 67/08](#)      .    of non-mechanically driven auxiliary apparatus
- [F02B 67/10](#)      .    of charging or scavenging apparatus

**F02B 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**

- [F02B 69/02](#)      .    for different fuel types, other than engines indifferent to fuel consumed, e.g. convertible from light to heavy fuel
- [F02B 69/04](#)      . .    for gaseous and non-gaseous fuels
- [F02B 69/06](#)      .    for different cycles, e.g. convertible from two-stroke to four stroke

**F02B 71/00**      **Free-piston engines; Engines without rotary main shaft**

- [F02B 71/02](#)      .    Starting

F02B 71/04 . Adaptations of such engines for special use; Combinations of such engines with apparatus driven thereby (aspects predominantly concerning driven apparatus, see the relevant classes for such apparatus)

F02B 71/045 . . {with hydrostatic transmission}

F02B 71/06 . . Free-piston combustion gas generators per se

**F02B 73/00 Combinations of two or more engines, not otherwise provided for**

**F02B 75/00 Other engines**

F02B 75/002 . {Double acting engines}

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

F02B 75/007 . {having vertical crankshafts}

F02B 75/02 . Engines characterised by their cycles, e.g. six-stroke

F02B 75/021 . . {having six or more strokes per cycle}

F02B 2075/022 . . {having less than six strokes per cycle}

F02B 2075/023 . . . {one}

F02B 2075/025 . . . {two}

F02B 2075/026 . . . {three}

F02B 2075/027 . . . {four}

F02B 2075/028 . . . {five}

F02B 75/04 . Engines with variable distances between pistons at top dead-centre positions and cylinder heads

F02B 75/041 . . {by means of cylinder or cylinderhead positioning}

F02B 75/042 . . . {the cylinderhead comprising a counter-piston}

F02B 75/044 . . {by means of an adjustable piston length}

F02B 75/045 . . {by means of a variable connecting rod length}

F02B 75/047 . . {by means of variable crankshaft position}

F02B 75/048 . . {by means of a variable crank stroke length}

F02B 75/06 . Engines with means for equalising torque (compensation of inertial forces, suppression of vibration in systems F16F)

F02B 75/065 . . {with double connecting rods or crankshafts}

F02B 75/08 . Engines with means for preventing corrosion in gas-swept spaces

F02B 75/10 . Engines with means for rendering exhaust gases innocuous (apparatus per se F01N)

F02B 75/12 . Other methods of operation

F02B 2075/125 . . {Direct injection in the combustion chamber for spark ignition engines, i.e. not in pre-combustion chamber}

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

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

F02B 2075/1804 . . . {Number of cylinders}

F02B 2075/1808 . . . . {two}

F02B 2075/1812 . . . . {three}

F02B 2075/1816	. . . . {four}
F02B 2075/182	. . . . {five}
F02B 2075/1824	. . . . {six}
F02B 2075/1828	. . . . {seven}
F02B 2075/1832	. . . . {eight}
F02B 2075/1836	. . . . {nine}
F02B 2075/184	. . . . {ten}
F02B 2075/1844	. . . . {eleven}
F02B 2075/1848	. . . . {twelve}
F02B 2075/1852	. . . . {thirteen}
F02B 2075/1856	. . . . {fourteen}
F02B 2075/186	. . . . {fifteen}
F02B 2075/1864	. . . . {sixteen}
F02B 2075/1868	. . . . {twenty}
F02B 2075/1872	. . . . {twenty-two}
F02B 2075/1876	. . . . {twenty-four}
F02B 2075/188	. . . . {thirty}
F02B 2075/1884	. . . . {thirty-two}
F02B 2075/1888	. . . . {thirty-four}
F02B 2075/1892	. . . . {thirty-six}
F02B 75/1896	. . . {with two or more pistons connected to one crank and having a common combustion space}
F02B 75/20	. . . with cylinders all in one line
F02B 75/22	. . . with cylinders in V, fan, or star arrangement
F02B 75/221	. . . . {with cylinder banks in narrow V-arrangement, having a single cylinder head}
F02B 75/222	. . . . {with cylinders in star arrangement}
F02B 75/224	. . . . {with cylinders in fan arrangement}
F02B 75/225	. . . . {having two or more crankshafts}
F02B 75/227	. . . . {with cylinder banks in X-arrangement, e.g. double-V engines}
F02B 75/228	. . . . {with cylinders arranged in parallel banks}
F02B 75/24	. . . with cylinders arranged oppositely relative to main shaft and of "flat" type
F02B 75/243	. . . . {with only one crankshaft of the "boxer" type, e.g. all connecting rods attached to separate crankshaft bearings}
F02B 75/246	. . . . {with only one crankshaft of the "pancake" type, e.g. pairs of connecting rods attached to common crankshaft bearing}
F02B 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
F02B 75/265	. . {Engines with cylinder axes substantially tangentially to a circle centred on main-shaft axis}

- F02B 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](#))
- F02B 75/282
  - . {the pistons having equal strokes}
- F02B 75/285
  - . {comprising a free auxiliary piston}
- F02B 75/287
  - . {with several pistons positioned in one cylinder one behind the other}
- F02B 75/30
  - . with one working piston sliding inside another
- F02B 75/32
  - Engines characterised by connections between pistons and main shafts and not specific to preceding main groups
- F02B 75/34
  - Ultra-small engines, e.g. for driving models
- F02B 75/36
  - Engines with parts of combustion- or working-chamber walls resiliently yielding under pressure
- F02B 75/38
  - . Reciprocating - piston engines ([F02B 75/04 takes precedence; with resiliently-urged auxiliary piston in pre-combustion chamber F02B 19/06](#))
- F02B 75/40
  - Other reciprocating-piston engines
- F02B 77/00**
  - **Component parts, details or accessories, not otherwise provided for**
- F02B 77/005
  - {Plugs}
- F02B 77/02
  - Surface coverings of combustion-gas-swept parts ([of pistons or cylinders only F02F](#))
- F02B 77/04
  - Cleaning of, preventing corrosion or erosion in, or preventing unwanted deposits in, combustion engines ({[cleaning of fuel injection apparatus F02M 65/00](#)})
- F02B 2077/045
  - . {by flushing or rinsing}
- F02B 2077/06
  - {Arrangements of purifying apparatus for liquid fuel or lubricant filters}
- F02B 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](#))
- F02B 77/081
  - . {relating to endless members (endless members, e.g. belts, for driving auxiliary apparatus [F02B 67/04](#))}
- F02B 77/082
  - . {relating to valves}
- F02B 77/083
  - . {relating to maintenance, e.g. diagnostic device ([relating to lubrication F01M 11/10](#))}
- F02B 77/084
  - . {indicating economy}
- F02B 77/085
  - . {with sensors measuring combustion processes, e.g. knocking, pressure, ionization, combustion flame}
- F02B 77/086
  - . . {Sensor arrangements in the exhaust, e.g. for temperature, misfire, air/fuel ratio, oxygen sensors}
- F02B 77/087
  - . {determining top dead centre or ignition-timing}
- F02B 77/088
  - . {relating to tightness}
- F02B 77/089
  - . {relating to engine temperature ([concerning coolant temperature F01P 11/16](#))}
- F02B 77/10
  - . Safety means relating to crankcase explosions
- F02B 77/11
  - Thermal or acoustic insulation
- F02B 77/13
  - . Acoustic insulation

[F02B 77/14](#) . Engine-driven auxiliary devices combined into units

**[F02B 79/00](#) Running-in of internal-combustion engines (lubrication thereof [F01M](#))**

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**[F02B 2201/00](#) Fuels**

- [F02B 2201/02](#) . Liquid
- [F02B 2201/04](#) . Gas
- [F02B 2201/06](#) . Dual fuel applications
- [F02B 2201/062](#) . . Liquid and liquid
- [F02B 2201/0622](#) . . . Liquid and liquefied gas
- [F02B 2201/064](#) . . Liquid and gas
- [F02B 2201/066](#) . . Gas and gas

**[F02B 2275/00](#) {Other engines, components or details, not provided for in other groups of this subclass}**

- [F02B 2275/02](#) . Attachment or mounting of cylinder heads on cylinders
- [F02B 2275/06](#) . Endless member is a belt
- [F02B 2275/08](#) . Endless member is a chain
- [F02B 2275/10](#) . Diamond configuration of valves in cylinder heads
- [F02B 2275/14](#) . Direct injection into combustion chamber
- [F02B 2275/16](#) . Indirect injection
- [F02B 2275/18](#) . DOHC [Double overhead camshaft]
- [F02B 2275/20](#) . SOHC [Single overhead camshaft]
- [F02B 2275/22](#) . Side valves
- [F02B 2275/26](#) . Flame plate
- [F02B 2275/28](#) . Timing distribution gear
- [F02B 2275/30](#) . Inverted positioning of engines
- [F02B 2275/32](#) . Miller cycle
- [F02B 2275/34](#) . Lateral camshaft position
- [F02B 2275/36](#) . Modified dwell of piston in TDC
- [F02B 2275/38](#) . Square four-cylinder configuration
- [F02B 2275/40](#) . Squish effect
- [F02B 2275/42](#) . Texaco combustion process
- [F02B 2275/44](#) . Tools for engines
- [F02B 2275/46](#) . Total Energy plant
- [F02B 2275/48](#) . Tumble motion in gas movement in cylinder
- [F02B 2275/50](#) . Walking beam arrangement of rockers in valve drive

**[F02B 2700/00](#) Measures relating to the combustion process without indication of the kind of fuel or with more than one fuel**

- [F02B 2700/02](#) . Four stroke engines
- [F02B 2700/021](#) . . with measures for removing exhaust gases from the cylinder

- F02B 2700/023 . . with measures for charging, increasing the power
- F02B 2700/025 . . with measures for compressing the cylinder charge
- F02B 2700/026 . . with measures for increasing the part of the heat transferred to power, compound engines
- F02B 2700/028 . . double-acting
- F02B 2700/03 . Two stroke engines
- F02B 2700/031 . . with measures for removing exhaust gases from the cylinder
- F02B 2700/032 . . . by means of the exhaust gases
- F02B 2700/034 . . with measures for charging, increasing the power
- F02B 2700/035 . . with reservoir for scavenging or charging air
- F02B 2700/037 . . Scavenging or charging channels or openings
- F02B 2700/038 . . with measures for compressing the cylinder charge

**F02B 2710/00****Gas engines**

- F02B 2710/02 . Four stroke engines
- F02B 2710/021 . . with measures for removing exhaust gases from the cylinder
- F02B 2710/023 . . with measures for charging, increasing the power
- F02B 2710/025 . . with measures for compressing the cylinder charge
- F02B 2710/026 . . with measures for improving combustion
- F02B 2710/028 . . with measures for increasing the part of the heat transferred to power, compound engines
- F02B 2710/03 . Two stroke engines
- F02B 2710/032 . . with measures for removing exhaust gases from the cylinder
- F02B 2710/034 . . with measures for charging, increasing the power
- F02B 2710/036 . . Scavenging or charging channels or openings
- F02B 2710/038 . . with measures for improving combustion

**F02B 2720/00****Engines with liquid fuel**

- F02B 2720/10 . Mixture compressing engines for liquid fuel
- F02B 2720/12 . Four stroke engines with ignition device
- F02B 2720/122 . . with measures for removing exhaust gases from the cylinder
- F02B 2720/124 . . with measures for charging, increasing the power
- F02B 2720/126 . . with measures for compressing the cylinder charge
- F02B 2720/128 . . with measures for increasing the part of the heat transferred to power, compound engines
- F02B 2720/13 . Two stroke engines with ignition device
- F02B 2720/131 . . with measures for removing exhaust gases from the cylinder
- F02B 2720/132 . . . by means of exhaust gases
- F02B 2720/133 . . with measures for charging, increasing the power
- F02B 2720/135 . . with reservoir for scavenging or charging air
- F02B 2720/136 . . Scavenging or charging channels or openings
- F02B 2720/137 . . with measures for improving combustion

- F02B 2720/138 . . with measures for increasing the part of the heat transferred to power, compound engines
- F02B 2720/15 . Mixture compressing engines with ignition device and mixture formation in the cylinder
- F02B 2720/151 . . with fuel supply and pulverisation by air or gas under pressure during the suction or compression stroke
- F02B 2720/152 . . with fuel supply and pulverisation by injecting the fuel under pressure during the suction or compression stroke
- F02B 2720/153 . . with injection of an air-fuel mixture under pressure during the suction or compression stroke
- F02B 2720/155 . . with pulverisation by air sucked into the cylinder
- F02B 2720/156 . . with pulverisation by the compressed air stream
- F02B 2720/157 . . with means for improving the mixture in the cylinder
- F02B 2720/158 . . with an auxiliary cylinder in which an explosion is generated
- F02B 2720/16 . Mixture compressing engines with ignition by compression or other heat
- F02B 2720/20 . Air compressing engines with ignition by the heat of compression
- F02B 2720/22 . Four stroke engines
- F02B 2720/221 . . with measures for removing exhaust gases from the cylinder
- F02B 2720/223 . . with measures for charging, increasing the power
- F02B 2720/225 . . with measures for compressing the cylinder charge
- F02B 2720/226 . . with measures for improving combustion
- F02B 2720/228 . . with measures for increasing the part of the heat transferred to power, compound engines
- F02B 2720/23 . Two stroke engines
- F02B 2720/231 . . with measures for removing exhaust gases from the cylinder
- F02B 2720/232 . . . by means of the exhaust gases
- F02B 2720/233 . . with measures for charging, increasing the power
- F02B 2720/235 . . with reservoir for scavenging or charging air
- F02B 2720/236 . . scavenging or charging channels or openings
- F02B 2720/237 . . with measures for improving combustion
- F02B 2720/238 . . with measures for increasing the part of the heat transferred to power, compound engines
- F02B 2720/25 . Supply of fuel in the cylinder
- F02B 2720/251 . . Fuel supply by high pressure gas
- F02B 2720/252 . . . with air pump fixed to engine cylinder; high pressure air being taken from the atmosphere or from an engine cylinder
- F02B 2720/253 . . . with high pressure air reservoir close to the point of injection; high pressure air taken from the engine cylinder
- F02B 2720/255 . . . with mixture compressing pump; fuel-air mixture being compressed in the pump cylinder without self ignition
- F02B 2720/256 . . . using steam or other gas as high pressure gas
- F02B 2720/257 . . Supply of fuel under pressure in the cylinder without blowing fluid
- F02B 2720/258 . . . with compression and ignition exclusively in the cylinder



F02B 2720/27	<ul style="list-style-type: none"> <li>• Air compressing engines with hot-bulb ignition</li> </ul>
F02B 2720/272	<ul style="list-style-type: none"> <li>• • Supply of all the fuel into the prechamber</li> </ul>
F02B 2720/274	<ul style="list-style-type: none"> <li>• • • with injection of all the fuel into the prechamber</li> </ul>
F02B 2720/276	<ul style="list-style-type: none"> <li>• • Supply of only a part of the fuel into the prechamber</li> </ul>
F02B 2720/278	<ul style="list-style-type: none"> <li>• • • with injection of only a part of the fuel into the prechamber</li> </ul>
F02B 2720/30	<ul style="list-style-type: none"> <li>• Engines with air compression and ignition device</li> </ul>
<b>F02B 2730/00</b>	<b>Internal combustion engines with pistons rotating or oscillating with relation to the housing</b>
F02B 2730/01	<ul style="list-style-type: none"> <li>• with one or more pistons in the form of a disk or rotor rotating with relation to the housing; with annular working chamber</li> </ul>
F02B 2730/011	<ul style="list-style-type: none"> <li>• • with vanes sliding in the housing</li> </ul>
F02B 2730/012	<ul style="list-style-type: none"> <li>• • with vanes sliding in the piston</li> </ul>
F02B 2730/013	<ul style="list-style-type: none"> <li>• • • Vanes fixed in the centre of the housing; Excentric rotors</li> </ul>
F02B 2730/015	<ul style="list-style-type: none"> <li>• • with vanes hinged to the housing</li> </ul>
F02B 2730/016	<ul style="list-style-type: none"> <li>• • with vanes hinged to the piston</li> </ul>
F02B 2730/017	<ul style="list-style-type: none"> <li>• • with rotating elements fixed to the housing or on the piston</li> </ul>
F02B 2730/018	<ul style="list-style-type: none"> <li>• • 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</li> </ul>
F02B 2730/02	<ul style="list-style-type: none"> <li>• with piston rotating around its axis and having a reciprocating movement in a cylinder</li> </ul>
F02B 2730/03	<ul style="list-style-type: none"> <li>• with piston oscillating in a housing or in a space in the form of an annular sector</li> </ul>
F02B 2730/05	<ul style="list-style-type: none"> <li>• with pistons intermeshing as gear wheels; with helicoidal rotors</li> </ul>
F02B 2730/09	<ul style="list-style-type: none"> <li>• Arrangements or specially formed elements for engines according to the preceeding groups</li> </ul>
F02B 2730/095	<ul style="list-style-type: none"> <li>• • Hydraulic pistons</li> </ul>