

CPC**COOPERATIVE PATENT CLASSIFICATION****F02M****SUPPLYING COMBUSTION ENGINES IN GENERAL, WITH COMBUSTIBLE MIXTURES OR CONSTITUENTS THEREOF**(charging such engines [F02B](#))**NOTES**

1. Attention is drawn to the notes preceding class [F01](#).
2. In this subclass the following terms are used with the meanings indicated:
 - "Carburettors" means essentially apparatus for mixing fuel with air, the fuel being brought into mixing contact with the air by lowering the air pressure, e.g. in a venturi;
 - "Fuel injection apparatus" means apparatus for introducing fuel into a space, e.g. engine cylinder, by pressurising the fuel, e.g. by a pump acting behind the fuel, and thus embraces the so-called "solid fuel injection" in which liquid fuel is introduced without any admixture of gas;
 - "Low-pressure fuel injection" means fuel injection in which the fuel-air mixture containing fuel thus injected will be substantially compressed in the compression stroke of the engine;
 - "Pumping element" means a single piston-cylinder unit in a reciprocating-piston fuel-injection pump or the equivalent unit in any other type of fuel-injection pump.

WARNING

The following IPC groups are not used in the CPC scheme. Subject matter covered by these groups is classified in the following CPC groups:

F02M 7/23	covered by	F02M 7/103
F02M 51/08	" "	F02M 51/06

Carburettors (for gaseous fuels [F02M 21/00](#); combined with low-pressure fuel-injection apparatus [F02M 71/00](#))

F02M 1/00

Carburettors with means for facilitating engine's starting or its idling below operational temperatures

NOTE

- in this group the following indexing codes are used: [F02M 2700/4302](#)

[F02M 1/005](#)

- {Remote display or control for displaying the operational situation of the starter}

[F02M 1/02](#)

- the means to facilitate starting or idling being chokes for enriching fuel-air mixture (automatic chokes [F02M 1/08](#))

[F02M 1/04](#)

- the means to facilitate starting or idling being auxiliary carburetting apparatus able to be put into, and out of, operation, e.g. having automatically-operated disc valves

[F02M 1/043](#)

- • {Auxiliary carburetting apparatus controlled by rotary sliding valves}

[F02M 1/046](#)

- • {Auxiliary carburetting apparatus controlled by piston valves}

[F02M 1/06](#)

- • having axially-movable valves, e.g. piston-shaped

[F02M 1/08](#)

- the means to facilitate starting or idling becoming operative or inoperative automatically (in connection with auxiliary carburetting apparatus [F02M 1/04](#))

- F02M 1/10
 - . dependent on engine temperature, e.g. having thermostat
- F02M 1/12
 - . . with means for electrically heating thermostat
- F02M 1/14
 - . dependent on pressure in combustion-air or fuel-air-mixture intake
(F02M 1/10 takes precedence)
- F02M 1/16
 - Other means for enriching fuel-air mixture during starting; Priming cups; Using different fuels for starting and normal operation
- F02M 1/165
 - . {Vaporizing light fractions from the fuel and condensing them for use during starting}
- F02M 1/18
 - . Enriching fuel-air mixture by depressing float to flood carburettor
- F02M 1/185
 - . . {Enriching the fuel-air mixture by altering the float chamber level by external means, e.g. by opening the input valve}

- F02M 3/00**
 - Idling devices (with means for facilitating idling below operational temperatures F02M 1/00)**
- F02M 3/005
 - {Idling fuel enrichment with motor driven instead of driving; Switching the fuel supply from the main to idling jet system}
- F02M 3/02
 - Preventing flow of idling fuel
- F02M 3/04
 - . under conditions where engine is driven instead of driving, e.g. driven by vehicle running down hill
- F02M 3/041
 - . . {Removal of the fuel from the main jet system, e.g. by means of a pump}
- F02M 3/042
 - . . {Fuel cut-off by altering the pressure in the float chamber; Arrangement of pneumatic accumulators for pressure equalization}
- F02M 3/043
 - . . {Devices as described in F02M 3/005, F02M 3/041, F02M 3/042, F02M 3/045, F02M 3/05 and F02M 3/055 and also equipped with additional air}
- F02M 3/045
 - . . Control of valves situated in the idling nozzle system, or the passage system, by electrical means or by a combination of electrical means with fluidic or mechanical means
- F02M 3/05
 - . . Pneumatic or mechanical control, e.g. with speed regulation
- F02M 3/055
 - . . Fuel flow cut-off by introducing air, e.g. brake air, into the idling fuel system
- F02M 3/06
 - Increasing idling speed
- F02M 3/062
 - . {by altering as a function of motor r.p.m. the throttle valve stop or the fuel conduit cross-section by means of pneumatic or hydraulic means (external damping elements F02M 19/122)}
- F02M 3/065
 - . {by randomly altering the throttle valve stop}
- F02M 2003/067
 - . {the valve for controlling the cross-section of the conduit being rotatable, but not being a screw-like valve}
- F02M 3/07
 - . by positioning the throttle flap stop, or by changing the fuel flow cross-sectional area, by electrical, electromechanical or electropneumatic means, according to engine speed
- F02M 3/075
 - . . {the valve altering the fuel conduit cross-section being a slidable valve}
- F02M 3/08
 - Other details of idling devices (fighting ice-formation by heating idling ports F02M 15/02)
- F02M 3/09
 - . Valves responsive to engine conditions, e.g. manifold vacuum (F02M 1/00, F02M 5/00 - F02M 33/00 take precedence)

- F02M 3/10
 - . Fuel metering pins; nozzles
- F02M 2003/105
 - . . {Needle adjustment limiter caps}
- F02M 3/12
 - . Passageway systems
- F02M 3/14
 - . Location of idling system outlet relative to throttle valve
- F02M 5/00**

Float-controlled apparatus for maintaining a constant fuel level
- F02M 5/02
 - with provisions to meet variations in carburettor position, e.g. upside-down position in aircraft
- F02M 5/04
 - . with pivotally or rotatably mounted float chambers {(basic adjustment of float chambers having variable position [F02M 5/14](#))}
- F02M 5/06
 - having adjustable float mechanism, e.g. to meet dissimilarities in specific gravity of different fuels
- F02M 5/08
 - having means for venting float chambers
- F02M 5/085
 - . {consisting of an overflow from the float chamber}
- F02M 5/10
 - having means for preventing vapour lock, e.g. insulated float chambers or forced fuel circulation through float chamber with engine stopped
- F02M 5/105
 - . {Auxiliary input valve which can be regulated to obtain an increased fuel supply from the float chamber}
- F02M 5/12
 - Other details, e.g. floats, valves, setting devices or tools (floats in general [F16K 33/00](#))
- F02M 5/125
 - . {Shape of the jet needle}
- F02M 5/14
 - . Float chambers, e.g. adjustable in position {(float chamber with a built-in intermediate reservoir [F02M 7/06](#))}
- F02M 5/16
 - . Floats
- F02M 7/00**

Carburettors with means for influencing, e.g. enriching or keeping constant, fuel/air ratio of charge under varying conditions (choke valves for starting [F02M 1/00](#))
- F02M 7/02
 - Carburettors having aerated fuel spray nozzles (with valve control for amount of air for aerating fuel [F02M 7/24](#))
- F02M 7/025
 - . {Fuel cut-off by introducing brake air in the conduit system leading to the main jet (fuel cut-off by introducing brake air into the idling fuel system [F02M 3/055](#))}
- F02M 7/04
 - Means for enriching charge at high combustion-air flow
- F02M 7/045
 - . {Mechanical adjustment of the spray nozzle cross-section in connection with the choke}
- F02M 7/06
 - Means for enriching charge on sudden {air} throttle opening, i.e. at acceleration, e.g. storage means in passage way system
- F02M 7/08
 - . using pumps
- F02M 7/083
 - . . {a pump sucking fuel from the conduit system leading to the spray nozzle downstream of the metering cross-section during deceleration}
- F02M 7/087
 - . . . changing output according to temperature in engine
- F02M 7/093
 - . . . changing output according to intake vacuum
- F02M 7/10
 - Other installations, without moving parts, for influencing fuel/air ratio, e.g. electrical means

- F02M 7/103 . . {with self-acting equaliser jets}
- F02M 7/106 . . {Fluid amplifier as a device for influencing the fuel-air mixture}
- F02M 7/11 . . Altering float-chamber pressure (enriching the fuel-air mixture during starting by depressing float to flood carburettor F02M 1/18)
- F02M 7/12 . Other installations, with moving parts, for influencing fuel/air ratio, e.g. having valves (F02M 7/24 takes precedence)
- F02M 7/127 . . Altering the float-chamber pressure (enriching the fuel-air mixture during starting by depressing float to flood carburettor F02M 1/18)
- F02M 7/133 . . Auxiliary jets, i.e. operating only under certain conditions, e.g. full power (F02M 7/04, F02M 7/06 take precedence)
- F02M 7/14 . . with means for controlling cross-sectional area of fuel spray nozzle (dependent on air-throttle valve position F02M 7/22)
- F02M 7/16 . . . operated automatically, e.g. dependent on exhaust-gas analysis
- F02M 7/17 by a pneumatically adjustable piston-like element, e.g. constant depression carburettors
- F02M 7/18 . . with means for controlling cross-sectional area of fuel-metering orifice (dependent on air-throttle position F02M 7/22)
- F02M 7/20 . . . operated automatically, e.g. dependent on altitude
- F02M 7/22 . . fuel flow cross-sectional area being controlled dependent on air-throttle-valve position (the throttle valve being slidably arranged transversely to air passage F02M 9/06)
- F02M 7/225 . . . {The fuel orifice opening is controlled by a manually actuatable throttle valve so as to vary the cross-sectional area of the orifice}
- F02M 7/24 . . with means for controlling amount of air for aerating fuel
- F02M 7/245 . . . {Accessories, e.g. sieves, accelerating wheels, whirl generating devices and the like, for the intimate mixing of emulsifying air with fuel}
- F02M 7/26 . . . dependent on position of optionally operable throttle means
- F02M 7/28 . . . dependent on temperature or pressure
- F02M 9/00 Carburettors having air or fuel-air mixture passage throttling valves other than of butterfly type (register-type carburettors F02M 11/00); Carburettors having fuel-air mixing chambers of variable shape or position**
- F02M 9/02 . having throttling valves, e.g. of piston shape, slidably arranged transversely to the passage
- F02M 9/023 . . {General constructional elements}
- F02M 9/026 . . {with plate-like throttle valve}
- F02M 9/04 . . with throttling valves sliding in a plane inclined to the passage
- F02M 9/06 . . with means for varying cross-sectional area of fuel spray nozzle dependent on throttle position
- F02M 9/065 . . . {Automatically and not automatically controlled throttle valves operating mutually}
- F02M 9/08 . having throttling valves rotatably mounted in the passage
- F02M 9/085 . . {Fuel spray nozzles in the throttling valves}
- F02M 9/10 . having valves, or like controls, of elastic-wall type for controlling the passage, or for varying cross-sectional area, of fuel-air mixing chambers {or of the entry passage}

- F02M 9/103 . . {Mechanical control}
- F02M 9/106 . . {Pneumatic or hydraulic control}
- F02M 9/12 . . having other specific means for controlling the passage, or for varying cross-sectional area, of fuel-air mixing chambers
- F02M 9/121 . . {Iris diaphragms}
- F02M 9/122 . . {consisting of lamellae or wires, e.g. a hyperboloid formed by twisting a wire cylinder}
- F02M 9/123 . . {Spiral springs}
- F02M 9/124 . . {Throttle valves with an action corresponding to those in apparatus for re-atomising condensed fuel or homogenising fuel-air mixture (shape of throttle valves [F02M 3/14](#))}
- F02M 9/125 . . {specially shaped throttle valves not otherwise covered in groups [F02M 9/121](#) - [F02M 9/124](#)}
- F02M 9/127 . . Axially movable throttle valves concentric with the axis of the mixture passage
- F02M 9/1275 . . . {Venturi-nozzle shaped type, e.g. a venturi nozzle being moved relative to a fixed mushroom-shaped body}
- F02M 9/133 . . . the throttle valves having mushroom-shaped bodies
- F02M 9/14 . . having venturi and nozzle relatively displaceable essentially along the venture axis

- F02M 11/00** **Multi-stage carburettors, Register-type carburettors, i.e. with slidable or rotatable throttling valves in which a plurality of fuel nozzles, other than only an idling nozzle and a main one, are sequentially exposed to air stream by throttling valve**
- F02M 11/02 . . with throttling valve, e.g. of flap or butterfly type, in a later stage opening automatically
- F02M 11/04 . . the later stage valves having damping means
- F02M 11/06 . . Other carburettors with throttling valve of flap or butterfly type
- F02M 11/08 . . Register carburettors with throttling valve movable transversally to air passage
- F02M 11/10 . . Register carburettors with rotatable throttling valves
- F02M 11/105 . . {Shape of the idling system}

- F02M 13/00** **Arrangements of two or more separate carburettors (re-atomising condensed fuel or homogenising fuel-air mixture [F02M 29/00](#)); Carburettors using more than one fuel (apparatus for adding small quantities of secondary fuel [F02M 25/00](#))**
- F02M 13/02 . . Separate carburettors
- F02M 13/021 . . {Particular constructional measures of the intake conduits between carburettors and cylinder}
- F02M 13/023 . . {Special construction of the control rods}
- F02M 13/025 . . {Equalizing pipes between the carburettors, e.g. between the float chambers}
- F02M 13/026 . . {Common functional groups for several carburettors, e.g. common idling system}
- F02M 13/028 . . {Tuning apparatus for multi-stage carburettors installations (other carburettor tuning apparatus [F02M 19/01](#))}

- F02M 13/04 . . . structurally united
- F02M 13/043 . . . {arranged in series, e.g. initial and main carburettor}
- F02M 13/046 . . . {arranged in parallel, e.g. initial and main carburettor}
- F02M 13/06 . the carburettors using different fuels
- F02M 13/08 . Carburettors adapted to use liquid and gaseous fuels, e.g. alternatively

- F02M 15/00** **Carburettors with heating, cooling, or thermal insulating means for combustion-air, fuel, or fuel-air mixture** (heating, cooling, or thermally insulating float apparatus [F02M 5/00](#); apparatus for thermally treating combustion-air, fuel, or fuel-air mixture not being part of a carburettor [F02M 31/00](#))
 - F02M 15/02 . with heating means, e.g. to combat ice-formation
 - F02M 15/022 . . {near to manually operated throttle valve}
 - F02M 15/025 . . {Fuel preheating}
 - F02M 15/027 . . {Air or air-fuel mixture preheating}
 - F02M 15/04 . . the means being electrical
 - F02M 15/045 . . . {for the fuel system, e.g. built into the fuel conduits or nozzles}
 - F02M 15/06 . Heat shieldings, e.g. from engine radiations

- F02M 17/00** **Carburettors having pertinent characteristics not provided for in, or of interest apart from, the apparatus of preceding main groups** (apparatus for treating combustion-air, fuel, or fuel-air mixture by catalysts, electric means, magnetism, rays, sound waves, or the like [F02M 27/00](#); combinations of carburettors and low-pressure fuel-injection apparatus [F02M 71/00](#))
 - F02M 17/02 . Floatless carburettors
 - F02M 17/04 . . having fuel inlet valve controlled by diaphragm
 - F02M 17/06 . . having overflow chamber determining constant fuel level
 - F02M 17/08 . Carburettors having one or more fuel passages opening in a valve-seat surrounding combustion-air passage, the valve being opened by passing air
 - F02M 17/09 . . the valve being of an eccentrically mounted butterfly type
 - F02M 17/10 . Carburettors having one or more fuel passages opening in valve-member of air throttle
 - F02M 17/12 . . the valve member being of butterfly type
 - F02M 17/14 . Carburettors with fuel-supply parts opened and closed in synchronism with engine stroke {Valve carburettors}
 - F02M 17/142 . . {with the fuel exit nozzles in or near the valve seat or valve}
 - F02M 17/145 . . {the valve being opened by the pressure of the passing fluid}
 - F02M 17/147 . . {Valve carburettor with simultaneous air and fuel control}
 - F02M 17/16 . Carburettors having continuously-rotating bodies, e.g. surface carburettors (fuel injection by centrifugal forces [F02M 69/06](#))
 - F02M 17/18 . Other surface carburettors
 - F02M 17/20 . . with fuel bath
 - F02M 17/22 . . . with air bubbling through bath
 - F02M 17/24 . . with wicks
 - F02M 17/26 . . with other wetted bodies

- F02M 17/28 . . . fuel being drawn through a porous body
- F02M 17/30 . Carburettors with fire-protecting devices, e.g. combined with fire-extinguishing apparatus
- F02M 17/32 . . automatically closing fuel conduits on outbreak of fire [{\(fire protection devices for stopping flow from or in pipes or hoses F16L 55/1026\)}](#)
- F02M 17/34 . Other carburettors combined or associated with other apparatus, e.g. air filters [\(predominant aspects of the apparatus, see the relevant classes for such apparatus\)](#)
- F02M 17/36 . Carburettors having fitments facilitating their cleaning
- F02M 17/38 . Controlling of carburettors, not otherwise provided for [\(external control gear F02M 19/12\)](#)
- F02M 17/40 . Selection of particular materials for carburettors, e.g. sheet metal, plastic, or translucent materials
- F02M 17/42 . Float-controlled carburettors not otherwise provided for
- F02M 17/44 . Carburettors characterised by draught direction and not otherwise provided for [{e.g. for model aeroplanes}](#)
- F02M 17/46 . . with down- draught
- F02M 17/48 . . with up- draught [{and float draught, e.g. for lawnmower and chain saw motors}](#)
- F02M 17/50 . Carburettors having means for combating ice-formation [\(thermally F02M 15/02\)](#)
- F02M 17/52 . Use of cold, produced by carburettors, for other purposes [\(apparatus using the cold, see the relevant classes for such apparatus\)](#)
- F02M 17/525 . . [{Use of the intake conduit vacuum}](#)
- F02M 19/00** **Details, component parts, or accessories of carburettors, not provided for in, or of interest apart from, the apparatus of groups [F02M 1/00](#) - [F02M 17/00](#) (measuring or testing apparatus in general G01)**
- F02M 19/01 . Apparatus for testing, tuning, or synchronising carburettors, e.g. carburettor glow stands
- F02M 19/02 . Metering-orifices, e.g. variable in diameter [\(variable during operation F02M 7/18\)](#)
- F02M 19/0203 . . [{the cross-sectional area being changed pneumatically, e.g. vacuum dependent}](#)
- F02M 19/0207 . . [{the cross-sectional area being changed electrically}](#)
- F02M 19/021 . . [{the cross-sectional area being changed mechanically}](#)
- F02M 19/0214 . . [{Changing the nozzle cross-sectional area as a function of temperature}](#)
- F02M 19/0217 . . [{Movable mushroom-shaped spray nozzles}](#)
- F02M 19/0221 . . [{with a roughened spray stimulating surface or the like, e.g. sieves near to the nozzle orifice}](#)
- F02M 19/0225 . . [{Arrangement of nozzle in the suction passage \(idling nozzles F02M 3/08\)}](#)
- F02M 19/0228 . . [{Ring nozzles}](#)
- F02M 19/0232 . . [{Fuel nozzle with device for return flow of leaked fuel}](#)
- F02M 19/0235 . . [{Arrangements of several spray nozzles not provided for in \[F02M 3/00\]\(#\) or \[F02M 11/00\]\(#\)}](#)
- F02M 19/0239 . . [{in a fixed aerofoil profile}](#)

- F02M 19/0242 . . {with inserts of porous material}
- F02M 19/0246 . . {Nozzle cleaning}
- F02M 19/025 . . Metering orifices not variable in diameter
- F02M 19/03 . . Fuel atomising nozzles; Arrangement of emulsifying air conduits (atomising in general [B05B](#))
- F02M 19/035 . . Mushroom-shaped atomising nozzles
- F02M 19/04 . Fuel-metering pins or needles
- F02M 19/06 . Other details of fuel conduits
- F02M 19/063 . . {Built-in electric heaters}
- F02M 19/066 . . {Built-in cleaning elements, e.g. filters}
- F02M 19/08 . Venturis
- F02M 19/081 . . {Shape of venturis or cross-section of mixture passages being adjustable}
- F02M 19/082 . . {Venturi section being axially slidable in the mixture passages}
- F02M 19/083 . . {Venturi section consisting of a lamellae spring-like structure}
- F02M 19/085 . . {venturi section being made from elastic material, e.g. from rubber-like material}
- F02M 19/086 . . {Venturi suction bypass systems}
- F02M 19/087 . . {Venturi throat consisting of automatically adjusting balls}
- F02M 19/088 . . {Whirl devices and other atomising means in or on the venturi walls}
- F02M 19/10 . . in multiple arrangement {e.g. arranged in series, fixed, arranged radially offset with respect to each other}
- F02M 19/105 . . . {movable axially relative to each other}
- F02M 19/12 . External control gear, e.g. having dashpots (dampening means in later stages of multistage carburettors [F02M 11/04](#); carburettor control gear in which the carburettor aspects do not predominate, see the relevant classes)
- F02M 19/122 . . {Damping elements (pneumatic or hydraulic means for increasing idling speed [F02M 3/062](#))}
- F02M 19/124 . . {Connecting rods between at least two throttle valves ([F02M 1/02](#) takes precedence)}
- F02M 19/126 . . {Connecting rods between at least a throttle valve and an accelerating pump ([F02M 7/08](#) takes precedence)}
- F02M 19/128 . . {Reserve throttle idle return spring, e.g. for use upon failure of the main spring}

- F02M 21/00** **Apparatus for supplying engines with non-liquid fuels, e.g. gaseous fuels stored in liquid form**
NOTE
 - in this group the following indexing codes are used:
[F02M 2700/12](#) - [F02M 2700/13](#)
- F02M 21/02 . for gaseous fuels (apparatus for vaporising liquid fuel by heat [F02M 31/00](#); engines with apparatus generating gas from solid fuel, e.g. from wood, [F02B 43/08](#))
- F02M 21/0203 . . {characterised by the type of gaseous fuel}

F02M 21/0206	. . .	{Non-hydrocarbon fuels, e.g. hydrogen, ammonia or carbon monoxide}
F02M 21/0209	. . .	{Hydrocarbon fuels, e.g. methane or acetylene}
F02M 21/0212	. . . .	{comprising at least 3 C-Atoms, e.g. liquefied petroleum gas [LPG], propane, butane or dimethyl ether [DME]}
F02M 21/0215	. . .	{Mixtures of gaseous fuels; Natural gas; Biogas; Mine gas; Landfill gas}
F02M 21/0218	. .	{Details on the gaseous fuel supply system, e.g. tanks, valves, pipes, pumps, rails, injectors or mixers}
F02M 21/0221	. . .	{Fuel storage reservoirs, e.g. cryogenic tanks}
F02M 21/0224	. . . .	{Secondary gaseous fuel storages}
F02M 21/0227	. . .	{Means to treat or clean gaseous fuels or fuel systems, e.g. removal of tar, cracking, reforming or enriching}
F02M 21/023	. . .	{Valves; Pressure or flow regulators in the fuel supply or return system}
F02M 21/0233	. . . .	{Details of actuators therefor}
F02M 21/0236	. . . .	{Multi-way valves; Multiple valves forming a multi-way valve system}
F02M 21/0239	. . . .	{Pressure or flow regulators therefor}
F02M 21/0242	. . . .	{Shut-off valves; Check valves; Safety valves; Pressure relief valves}
F02M 21/0245	. . .	{High pressure fuel supply systems; Rails; Pumps; Arrangement of valves}
F02M 21/0248	. . .	{Injectors}
F02M 21/0251	. . . .	{Details of actuators therefor}
F02M 21/0254	. . . . .	{Electric actuators, e.g. solenoid or piezoelectric}
F02M 21/0257	. . . .	{Details of the valve closing elements, e.g. valve seats, stems or arrangement of flow passages}
F02M 21/026	. . . . .	{Lift valves, i.e. stem operated valves}
F02M 21/0263	. . . . .	{Inwardly opening single or multi nozzle valves, e.g. needle valves}
F02M 21/0266	. . . . .	{Hollow stem valves; Piston valves; Stems having a spherical tip}
F02M 21/0269	. . . . .	{Outwardly opening valves, e.g. poppet valves}
F02M 21/0272	. . . . .	{Ball valves; Plate valves; Valves having deformable or flexible parts, e.g. membranes; Rotatable valves}
F02M 21/0275	. . . .	{for in-cylinder direct injection, e.g. injector combined with spark plug}
F02M 21/0278	. . . .	{Port fuel injectors for single or multipoint injection into the air intake system}
F02M 21/0281	. . . .	{Adapters, sockets or the like to mount injection valves onto engines; Fuel guiding passages between injectors and the air intake system or the combustion chamber}
F02M 21/0284	. . .	{Arrangement of multiple injectors or fuel-air mixers per combustion chamber}
F02M 21/0287	. . .	{characterised by the transition from liquid to gaseous phase (F02M 21/06 takes precedence); Injection in liquid phase; Cooling and low temperature storage}
F02M 21/029	. . .	{Arrangement on engines or vehicle bodies; Conversion to gaseous fuel supply systems}

- F02M 21/0293 . . . {Safety devices; Fail-safe measures}
- F02M 21/0296 . . . {Manufacturing or assembly; Materials, e.g. coatings}
- F02M 21/04 . . Gas-air mixing apparatus (carburettors adapted to use liquid and gaseous fuels [F02M 13/08](#); carburetting gases in general [C10J](#))
- F02M 21/042 . . . {Mixer comprising a plurality of bores or flow passages}
- F02M 21/045 . . . {Vortex mixer}
- F02M 21/047 . . . {Venturi mixer}
- F02M 21/06 . . Apparatus for de-liquefying, e.g. by heating (discharging liquefied gases in general [F17C](#))
- F02M 21/08 . for non-gaseous fuels (for engines operating on fuel containing oxidants [F02B](#))
- F02M 21/10 . . for fuels with low melting point, e.g. apparatus having heating means
- F02M 21/12 . for fuels in pulverised state (engine plants with fuel-pulverising apparatus [F02B](#))

Engine-pertinent apparatus for feeding, or treating before their admission to engine, combustion-air, fuel, or fuel-air mixture {treatment by admission of activating fluids}

F02M 23/00 Apparatus for adding secondary air to fuel-air mixture

- F02M 23/001 . {built into a flange}
- F02M 23/003 . {Particular shape of air intake}
- F02M 23/005 . {with a damping element in the secondary air control}
- F02M 23/006 . {Valves specially shaped for supplying secondary air}
- F02M 2023/008 . {by injecting compressed air directly into the combustion chamber}
- F02M 23/02 . with personal control, or with secondary-air valve controlled by main combustion-air throttle
- F02M 23/025 . . {Optional operation by means of a hand or foot switch}
- F02M 23/03 . . the secondary air-valve controlled by main combustion-air throttle
- F02M 23/04 . with automatic control
- F02M 23/06 . . dependent on engine speed
- F02M 23/062 . . . {Secondary air flow cut-off at low speed}
- F02M 23/065 . . . {Secondary air flow cut-off at high torque}
- F02M 23/067 . . . {Secondary air admission flow at high speeds and with the main butterfly valve closed, e.g. during deceleration}
- F02M 23/08 . . dependent on pressure in main combustion-air induction system, {e.g. pneumatic-type apparatus}
- F02M 23/085 . . . {specially adapted for secondary air admission during braking or travelling down steep slopes}
- F02M 23/09 . . . using valves directly opened by low pressure
- F02M 23/095 {with balls which are not spring loaded}
- F02M 23/10 . . dependent on temperature, e.g. engine temperature
- F02M 23/12 . characterised by being combined with device for, or by secondary air effecting, re-atomising of condensed fuel
- F02M 23/14 . characterised by adding hot {secondary} air

Engine-pertinent apparatus for adding non-fuel substances or small quantities of secondary fuel to combustion-air, main fuel, or fuel-air mixture (F02M 43/00 takes precedence; adding secondary air to fuel-air mixture F02M 23/00; adding exhaust gases F02M 26/00)

- F02M 26/00**

Engine-pertinent apparatus for adding exhaust gases to combustion-air, main fuel or fuel-air mixture, e.g. by exhaust gas recirculation [EGR] systems

- F02M 2026/001 . {Arrangements; Control features; Details}
- F02M 2026/002 . . {EGR valve being controlled by vacuum or overpressure}

- F02M 2026/0025 . . . {Intake vacuum or overpressure modulating valve}
- F02M 2026/003 . . {EGR valve controlled by air measuring device}
- F02M 2026/004 . . {EGR valve controlled by a temperature signal or an air/fuel ratio (λ) signal}
- F02M 2026/005 . . {EGR valve controlled by an engine speed signal}
- F02M 2026/0055 . . {EGR valve controlled by inertia, e.g. having a pendulum controlling the EGR valve}
- F02M 2026/006 . . {EGR specially adapted for intake systems having two or more fuel injectors per cylinder}
- F02M 2026/007 . . {EGR specially adapted for engines having two or more spark plugs per cylinder}
- F02M 2026/008 . . {EGR specially adapted for engines having a combustion chamber divided by the piston at TDC into two or more sub-chambers}
- F02M 2026/009 . . {EGR combined with means to change air/fuel ratio, ignition timing, charge swirl in the cylinder}
- F02M 26/01 . Internal exhaust gas recirculation, i.e. wherein the residual exhaust gases are trapped in the cylinder or pushed back from the intake or the exhaust manifold into the combustion chamber without the use of additional passages
- F02M 26/02 . EGR systems specially adapted for supercharged engines
- F02M 26/03 . . with a single mechanically or electrically driven intake charge compressor
- F02M 26/04 . . with a single turbocharger
- F02M 26/05 . . . High pressure loops, i.e. wherein recirculated exhaust gas is taken out from the exhaust system upstream of the turbine and reintroduced into the intake system downstream of the compressor
- F02M 26/06 . . . Low pressure loops, i.e. wherein recirculated exhaust gas is taken out from the exhaust downstream of the turbocharger turbine and reintroduced into the intake system upstream of the compressor
- F02M 26/07 . . . Mixed pressure loops, i.e. wherein recirculated exhaust gas is either taken out upstream of the turbine and reintroduced upstream of the compressor, or is taken out downstream of the turbine and reintroduced downstream of the compressor
- F02M 26/08 . . for engines having two or more intake charge compressors or exhaust gas turbines, e.g. a turbocharger combined with an additional compressor
- F02M 26/09 . . Constructional details, e.g. structural combinations of EGR systems and supercharger systems; Arrangement of the EGR and supercharger systems with respect to the engine
- F02M 26/10 . . . having means to increase the pressure difference between the exhaust and intake system, e.g. venturis, variable geometry turbines, check valves using pressure pulsations or throttles in the air intake or exhaust system
- F02M 26/11 . Manufacture or assembly of EGR systems; Materials or coatings specially adapted for EGR systems
- F02M 26/12 . characterised by means for attaching parts of an EGR system to each other or to engine parts
- F02M 26/13 . Arrangement or layout of EGR passages, e.g. in relation to specific engine parts or for incorporation of accessories
- F02M 26/14 . . in relation to the exhaust system

- F02M 26/15
 - . . . in relation to engine exhaust purifying apparatus
- F02M 26/16
 - . . . with EGR valves located at or near the connection to the exhaust system
- F02M 26/17
 - . . in relation to the intake system
- F02M 26/18
 - . . . Thermal insulation or heat protection
- F02M 26/19
 - . . . Means for improving the mixing of air and recirculated exhaust gases, e.g. venturis or multiple openings to the intake system
- F02M 26/20
 - . . . Feeding recirculated exhaust gases directly into the combustion chambers or into the intake runners
- F02M 26/21
 - . . . with EGR valves located at or near the connection to the intake system
- F02M 26/22
 - . . with coolers in the recirculation passage
- F02M 26/23
 - . . . Layout, e.g. schematics
- F02M 26/24
 - with two or more coolers
- F02M 26/25
 - with coolers having bypasses
- F02M 26/26
 - characterised by details of the bypass valve
- F02M 26/27
 - with air-cooled heat exchangers
- F02M 26/28
 - with liquid-cooled heat exchangers
- F02M 26/29
 - . . . Constructional details of the coolers, e.g. pipes, plates, ribs, insulation or materials
- F02M 26/30
 - Connections of coolers to other devices, e. g. to valves, heaters, compressors or filters; Coolers characterised by their location on the engine
- F02M 26/31
 - Air-cooled heat exchangers
- F02M 26/32
 - Liquid-cooled heat exchangers
- F02M 26/33
 - . . . controlling the temperature of the recirculated gases
- F02M 26/34
 - . . with compressors, turbines or the like in the recirculation passage
- F02M 26/35
 - . . with means for cleaning or treating the recirculated gases, e.g. catalysts, condensate traps, particle filters or heaters
- F02M 26/36
 - . . with means for adding fluids other than exhaust gas to the recirculation passage; with reformers
- F02M 26/37
 - . . with temporary storage of recirculated exhaust gas ([internal exhaust gas recirculation F02M 26/01](#))
- F02M 26/38
 - . . with two or more EGR valves disposed in parallel
- F02M 26/39
 - . . with two or more EGR valves disposed in series
- F02M 26/40
 - . . with timing means in the recirculation passage, e.g. cyclically operating valves or regenerators; with arrangements involving pressure pulsations
- F02M 26/41
 - . . characterised by the arrangement of the recirculation passage in relation to the engine, e.g. to cylinder heads, liners, spark plugs or manifolds; characterised by the arrangement of the recirculation passage in relation to specially adapted combustion chambers
- F02M 26/42
 - . . having two or more EGR passages; EGR systems specially adapted for engines having two or more cylinders
- F02M 26/43
 - . . . in which exhaust from only one cylinder or only a group of cylinders is directed to the intake of the engine
- F02M 26/44
 - . . . in which a main EGR passage is branched into multiple passages

- F02M 26/45
 - Sensors specially adapted for EGR systems
- F02M 26/46
 - . for determining the characteristics of gases, e.g. composition
- F02M 26/47
 - . . the characteristics being temperatures, pressures or flow rates
- F02M 26/48
 - . EGR valve position sensors ([details of the sensor installation in the valve housing F02M 26/72](#))
- F02M 26/49
 - Detecting, diagnosing or indicating an abnormal function of the EGR system
- F02M 26/50
 - Arrangements or methods for preventing or reducing deposits, corrosion or wear caused by impurities ([F02M 26/35](#), [F02M 26/74](#) take precedence)
- F02M 26/51
 - EGR valves combined with other devices, e.g. with intake valves or compressors ([combined with intake air throttles F02M 26/64](#))
- F02M 26/52
 - Systems for actuating EGR valves

WARNING

Group [F02M 26/52](#) is impacted by reclassification into groups [F02M 26/53](#)- [F02M 26/64](#).

Groups [F02M 26/52](#) and [F02M 26/53](#)- [F02M 26/64](#) should be considered in order to perform a complete search.

- F02M 26/53
 - . using electric actuators, e.g. solenoids

WARNING

Group [F02M 26/53](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/53](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

- F02M 26/54
 - . . Rotary actuators, e.g. step motors

WARNING

Group [F02M 26/54](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/54](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

- F02M 26/55
 - . using vacuum actuators

WARNING

Group [F02M 26/55](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/55](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

- F02M 26/56
 - . . having pressure modulation valves

WARNING

Group [F02M 26/56](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/56](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

F02M 26/57 using electronic means, e.g. electromagnetic valves

WARNING

Group [F02M 26/57](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/57](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

F02M 26/58 Constructional details of the actuator; Mounting thereof

WARNING

Group [F02M 26/58](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/58](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

F02M 26/59 using positive pressure actuators; Check valves therefor

WARNING

Group [F02M 26/59](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/59](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

F02M 26/60 in response to air intake pressure

WARNING

Group [F02M 26/60](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/60](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

F02M 26/61 in response to exhaust pressure

WARNING

Group [F02M 26/61](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/61](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

F02M 26/615 {the exhaust back pressure}

WARNING

Group [F02M 26/615](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/615](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

F02M 26/62 . . . in response to fuel pressure

WARNING

Group [F02M 26/62](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/62](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

F02M 26/63 . . the EGR valve being directly controlled by an operator ([F02M 26/64](#) takes precedence)

WARNING

Group [F02M 26/63](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/63](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

F02M 26/64 . . the EGR valve being operated together with an intake air throttle

WARNING

Group [F02M 26/64](#) is incomplete pending reclassification of documents from group [F02M 26/52](#).

Groups [F02M 26/64](#) and [F02M 26/52](#) should be considered in order to perform a complete search.

F02M 26/65 . Constructional details of EGR valves

F02M 26/66 . . Lift valves, e.g. poppet valves

F02M 26/67 . . . Pintles; Spindles; Springs; Bearings; Sealings; Connections to actuators

F02M 26/68 . . . Closing members; Valve seats; Flow passages

F02M 26/69 . . . having two or more valve-closing members

F02M 26/70 . . Flap valves; Rotary valves; Sliding valves; Resilient valves

F02M 26/71 . . Multi-way valves

F02M 26/72 . . Housings

F02M 26/73 . . . with means for heating or cooling the EGR valve

F02M 26/74 . . Protection from damage, e.g. shielding means

F02M 27/00 Apparatus for treating combustion-air, fuel, or fuel-air mixture, by catalysts, electric means, magnetism, rays, sound waves, or the like

F02M 27/02 . by catalysts

F02M 27/04 . by electric means, {ionisation, polarisation} or magnetism

F02M 27/042 . . {by plasma}

F02M 27/045 . . {by permanent magnets}

F02M 2027/047 . . {with a pulsating magnetic field}

F02M 27/06 . by rays, {e.g. infra-red and ultra-violet}

F02M 27/065 . . {Radioactive radiation}

F02M 27/08 . by sonic or ultrasonic waves

F02M 29/00	Apparatus for re-atomising condensed fuel or homogenising fuel-air mixture (combined with secondary-air supply F02M 23/12 {; collecting condensed fuel F02M 33/02 })
F02M 29/02	<ul style="list-style-type: none"> having rotary parts, {e.g. fan wheels}
F02M 29/04	<ul style="list-style-type: none"> having screens, gratings, baffles, or the like (rotary F02M 29/02)
F02M 29/06	<ul style="list-style-type: none"> generating whirling motion of mixture
F02M 29/08	<ul style="list-style-type: none"> having spirally-wound wires
F02M 29/10	<ul style="list-style-type: none"> adjustable
F02M 29/12	<ul style="list-style-type: none"> having homogenising valves held open by mixture current
F02M 29/14	<ul style="list-style-type: none"> re-atomising or homogenising being effected by unevenness of internal surfaces of mixture intake
F02M 31/00	Apparatus for thermally treating combustion-air, fuel, or fuel-air mixture (F02M 21/06 , F02M 21/10 take precedence; such apparatus being part of a carburettor or fuel-injection apparatus F02M 15/00 , F02M 53/00 ; adding hot secondary air to fuel-air mixture F02M 23/14)
F02M 31/005	<ul style="list-style-type: none"> {using a heat-pipe (heat-pipe per se F28D)}
F02M 31/02	<ul style="list-style-type: none"> for heating {(F02M 31/005 takes precedence)}
F02M 31/04	<ul style="list-style-type: none"> combustion-air or fuel-air mixture (electrically F02M 31/12; by using heat from working cylinders or cylinder heads F02M 31/14; heating of combustion-air as an engine starting aid F02N 7/04)
F02M 31/042	<ul style="list-style-type: none"> Combustion air
F02M 31/045	<ul style="list-style-type: none"> Fuel-air mixture
F02M 31/047	<ul style="list-style-type: none"> for fuel enriched partial mixture flow path
F02M 31/06	<ul style="list-style-type: none"> by hot gases, e.g. by mixing cold and hot air
F02M 31/062	<ul style="list-style-type: none"> with thermostat and pneumatic actuator both working on the air mixture control valve
F02M 31/064	<ul style="list-style-type: none"> pneumatically controlled (F02M 31/062 takes precedence)
F02M 31/066	<ul style="list-style-type: none"> operated manually, e.g. by means of valves on the air filter
F02M 31/068	<ul style="list-style-type: none"> particular constructional aspects of the switching devices, e.g. connecting linkage between two control valves
F02M 31/07	<ul style="list-style-type: none"> Temperature-responsive control, e.g. using thermostatically-controlled valves (F02M 31/083 takes precedence)
F02M 31/08	<ul style="list-style-type: none"> the gases being exhaust gases {(adding exhaust gases to the air intake passage F02M 26/00)}
F02M 31/0805	<ul style="list-style-type: none"> Pneumatic control of the amount of exhaust gas or combustion air directed to the heat exchange surfaces e.g. as a function of the pressure in the air intake passage
F02M 31/081	<ul style="list-style-type: none"> Manual switching of the fluids directed to the heat exchange surfaces
F02M 31/0815	<ul style="list-style-type: none"> Heat exchange surfaces arranged inside a flange
F02M 31/082	<ul style="list-style-type: none"> Particular shape of air input passage near to the branch
F02M 31/0825	<ul style="list-style-type: none"> Particular constructional characteristics of the heat exchange surfaces, e.g. finned pipes, coiled pipes or the like

- F02M 31/083 Temperature-responsive control of the amount of exhaust gas or combustion air directed to the heat exchange surface
- F02M 31/087 Heat-exchange arrangements between the air intake and exhaust gas passages, e.g. by means of contact between the passages
- F02M 31/093 Air intake passage surrounding the exhaust gas passage;
Exhaust gas passage surrounding the air intake passage
- F02M 31/10 . . . by hot liquids, e.g. lubricants {or cooling water}
- F02M 31/102 {Particular constructional characteristics of the shape of the heat exchange surfaces}
- F02M 31/105 {Particular constructional characteristics of the switching apparatus}
- F02M 31/107 {Controlled or manual switching}
- F02M 31/12 . . electrically
- F02M 31/125 . . . Fuel
- F02M 31/13 . . . Combustion air
- F02M 31/135 . . . Fuel-air mixture
- F02M 31/14 . . by using heat from working cylinders or cylinder heads
- F02M 31/145 . . . {with particular constructional means}
- F02M 31/16 . . Other apparatus for heating fuel
- F02M 31/163 . . . {Preheating by burning an auxiliary mixture}
- F02M 31/166 . . . {with mechanical generation of heat, e.g. by surface friction}
- F02M 31/18 . . . to vaporise fuel
- F02M 31/183 {Control}
- F02M 31/186 {with simultaneous mixing of secondary air}
- F02M 31/20 . for cooling (cooling of charging-air or of scavenging-air [F02B](#) (; Use of cold [F02M 17/52](#); [F02M 31/005](#) takes precedence))
- F02M 31/205 . . {Control}

- F02M 33/00** **Other apparatus for treating combustion-air, fuel, or fuel-air mixture**
(combustion-air cleaners [F02M 35/00](#); arrangements for purifying liquid fuel [F02M 37/22](#))
- F02M 33/02 . for collecting and returning condensed fuel {(apparatus for re-atomising condensed fuel [F02M 29/00](#))}
- F02M 33/025 . . {Means not otherwise provided for}
- F02M 33/04 . . returning to the intake passage
- F02M 33/043 . . . {Coating of the intake passage with a porous material}
- F02M 33/046 . . . {Coating of the intake passage with material preventing the formation of condensation}
- F02M 33/06 . . . with simultaneous heat supply
- F02M 33/08 . . returning to the fuel tank

- F02M 35/00** **Combustion-air cleaners, air intakes, intake silencers, or induction systems specially adapted for, or arranged on, internal-combustion engines (air cleaners in general [B01D](#))**
- F02M 35/02 . Air cleaners

- F02M 35/0201 . . {Housings; Casings; Frame constructions; Lids; Manufacturing or assembling thereof}
- F02M 35/0202 . . . {Manufacturing or assembling; Materials for air cleaner housings}
- F02M 35/0203 {by using clamps, catches, locks or the like, e.g. for disposable plug-in filter cartridges}
- F02M 35/0204 {for connecting or joining to other devices, e.g. pipes}
- F02M 35/0205 {Details, e.g. sensors or measuring devices}
- F02M 35/0207 {on the clean air side}
- F02M 35/0208 {with sensing means on both, the air feeding side and the clean air side}
- F02M 35/0209 . . . {comprising flexible, resilient, movable or rotatable elements, e.g. with vibrating or contracting movements; Springs; Valves; Flaps ([F02M 35/06](#), [F02M 35/08](#) take precedence)}
- F02M 35/021 . . . {Arrangements of air flow meters in or on air cleaner housings}
- F02M 35/0212 . . {Multiple cleaners}
- F02M 35/0214 . . . {arranged concentrically or coaxially}
- F02M 35/0215 . . . {arranged in parallel}
- F02M 35/0216 . . . {arranged in series, e.g. pre- and main filter in series}
- F02M 35/0217 . . {acting by electric discharge; Electrostatic precipitators therefor}
- F02M 35/0218 . . {acting by absorption or adsorption; trapping or removing vapours or liquids, e.g. originating from fuel}
- F02M 35/022 . . acting by gravity, by centrifugal, or by other inertial forces, e.g. with moistened walls
- F02M 35/0223 . . . {by centrifugal forces, e.g. cyclones}
- F02M 35/0226 . . . {by gravity or by mass inertia, e.g. labyrinths, deflectors}
- F02M 35/024 . . using filters, e.g. moistened ([F02M 35/026](#) takes precedence; cleaning of the filtering material [F02M 35/08](#))
- F02M 35/02408 . . . {Manufacturing filter elements}
- F02M 35/02416 . . . {Fixing, mounting, supporting or arranging filter elements; Filter element cartridges}
- F02M 35/02425 {Support structures increasing the stability or stiffness of the filter element}
- F02M 35/02433 {Special alignment with respect to the air intake flow, e.g. angled or in longitudinal flow direction}
- F02M 35/02441 {Materials or structure of filter elements, e.g. foams}
- F02M 35/0245 {Pleated, folded, corrugated filter elements, e.g. made of paper}
- F02M 35/02458 {consisting of multiple layers, e.g. coarse and fine filters; Coatings; Impregnations; Wet or moistened filter elements}
- F02M 35/02466 {Meshes; Grids; Perforated plates}
- F02M 35/02475 {characterised by the shape of the filter element}
- F02M 35/02483 {Cylindrical, conical, oval, spherical or the like filter elements; wounded filter elements}
- F02M 35/02491 {Flat filter elements, e.g. rectangular}

- F02M 35/026
 - . acting by guiding the air over or through an oil or other liquid bath, e.g. combined with filters
- F02M 35/04
 - . specially arranged with respect to engine, {to intake system or specially adapted to vehicle}; Mounting thereon; {Combinations with other devices (combined with silencers F02M 35/14)}
- F02M 35/042
 - . . {combined with other devices, e.g. heaters (F02M 35/021, F02M 35/06, F02M 35/14 take precedence); for use other than engine air intake cleaning, e.g. air intake filters arranged in the fuel vapour recovery system}
- F02M 35/044
 - . . {Special arrangements of cleaners in or with respect to the air intake system, e.g. in the intake plenum, in ducts or with respect to carburettors}
- F02M 35/046
 - . . . {Inline cleaners, i.e. the cleaner being arranged along the length of a wall of a pipe or manifold}
- F02M 35/048
 - . . . {Arranging or mounting on or with respect to engines or vehicle bodies}
- F02M 35/06
 - . . . combined or associated with engine's cooling blower or fan, or with flywheel
- F02M 35/08
 - . with means for removing dust, {particles or liquids} from cleaners; with means for indicating clogging; with by-pass means; {Regeneration of cleaners}
- F02M 35/082
 - . . . {By-pass means}
- F02M 35/084
 - . . . {Dust collection chambers or discharge sockets, e.g. chambers fed by gravity or closed by a valve}
- F02M 35/086
 - . . . {Dust removal by flushing, blasting, pulsating or aspirating flow, washing or the like; Mechanical dust removal, e.g. by using scrapers}
- F02M 35/088
 - . . . {Water, snow or ice proofing; Separation or drainage of water, snow or ice}
- F02M 35/09
 - . . . Clogging indicators; {Diagnosis or testing of air cleaners (sensors therefore F02M 35/10373)}
- F02M 35/10
 - Air intakes; Induction systems (using kinetic or wave energy of charge in induction systems for improving quantity of charge {F02B 27/00})
- F02M 35/10006
 - . {characterised by the position of elements of the air intake system in direction of the air intake flow, i.e. between ambient air inlet and supply to the combustion chamber}
- F02M 35/10013
 - . . . {Means upstream of the air filter; Connection to the ambient air}
- F02M 35/10019
 - . . . {Means upstream of the fuel injection system, carburettor or plenum chamber (F02M 35/10013 takes precedence)}
- F02M 35/10026
 - . . . {Plenum chambers}
- F02M 35/10032
 - {specially shaped or arranged connecting duct between carburettor or air inlet duct and the plenum chamber; specially positioned carburettors or throttle bodies with respect to the plenum chamber}
- F02M 35/10039
 - {Intake ducts situated partly within or on the plenum chamber housing}
- F02M 35/10045
 - {Multiple plenum chambers; Plenum chambers having inner separation walls (for V-engines F02M 35/116; for resonance charging F02B 27/02)}
- F02M 35/10052
 - {special shapes or arrangements of plenum chambers; Constructional details}
- F02M 35/10059
 - {Swirl chamber upstream of the plenum chamber}

F02M 35/10065	. . . . {Valves arranged in the plenum chamber}
F02M 35/10072	. . . {Intake runners}
F02M 35/10078	. . . {Connections of intake systems to the engine}
F02M 35/10085	. . . . {having a connecting piece, e.g. a flange, between the engine and the air intake being foreseen with a throttle valve, fuel injector, mixture ducts or the like}
F02M 35/10091	. . {characterised by details of intake ducts: shapes; connections; arrangements (ducts within or on the plenum chamber F02M 35/10039)}
F02M 35/10098	. . . {Straight ducts}
F02M 35/10104	. . . {Substantially vertically arranged ducts}
F02M 35/10111	. . . {Substantially V-, C- or U-shaped ducts in direction of the flow path}
F02M 35/10118	. . . {with variable cross-sections of intake ducts along their length; Venturis; Diffusors}
F02M 35/10124	. . . {Ducts with special cross-sections, e.g. non-circular cross-section}
F02M 35/10131	. . . {Ducts situated in more than one plane; Ducts of one plane crossing ducts of another plane}
F02M 35/10137	. . . {Flexible ducts, e.g. bellows or hoses}
F02M 35/10144	. . . {Connections of intake ducts to each other or to another device}
F02M 35/1015	. . {characterised by the engine type (engine intake manifolds F02M 35/104)}
F02M 35/10157	. . . {Supercharged engines}
F02M 35/10163	. . . . {having air intakes specially adapted to selectively deliver naturally aspirated fluid or supercharged fluid}
F02M 35/1017	. . . {Small engines, e.g. for handheld tools, or model engines; Single cylinder engines}
F02M 35/10177	. . . {Engines having multiple fuel injectors or carburettors per cylinder}
F02M 35/10183	. . . {Engines having intake ducts fed from a separate carburettor or injector, the idling system being considered as a separate carburettor}
F02M 35/1019	. . . {Two-stroke engines; Reverse-flow scavenged or cross scavenged engines}
F02M 35/10196	. . . {Carburetted engines}
F02M 35/10203	. . . {Rotary, e.g. "Wankel", engines; Engines with cylinders in star arrangement; Radial piston engines; W-engines (F02M 35/112 and F02M 35/116 take precedence)}
F02M 35/10209	. . {Fluid connections to the air intake system; their arrangement of pipes, valves or the like}
F02M 35/10216	. . . {Fuel injectors; Fuel pipes or rails; Fuel pumps or pressure regulators}
F02M 35/10222	. . . {Exhaust gas recirculation [EGR]; Positive crankcase ventilation [PCV]; Additional air admission, lubricant or fuel vapour admission}
F02M 35/10229	. . . {the intake system acting as a vacuum or overpressure source for auxiliary devices; e.g. brake systems; Vacuum chambers (air storage chamber F02B 21/00)}
F02M 35/10236	. . . {Overpressure or vacuum relief means; Burst protection}

- F02M 35/10242 . . {Devices or means connected to or integrated into air intakes; Air intakes combined with other engine or vehicle parts (filters [F02M 35/02](#); silencers [F02M 35/12](#) and [F02M 35/14](#); air coolers [F02B 29/04](#); heaters [F02M 31/00](#); air storage tanks [F02B 21/00](#); compressors [F02B 33/00](#); sensors [F02M 35/10373](#))}
- F02M 35/10249 . . . {Electrical or electronic devices fixed to the intake system; Electric wiring (electric heaters [F02M 31/12](#); sensors [F02M 35/10373](#))}
- F02M 35/10255 . . . {Arrangements of valves; Multi-way valves ([F02M 35/10032](#) takes precedence; valves in the plenum chamber [F02M 35/10065](#); check valves [F02M 35/10275](#))}
- F02M 35/10262 . . . {Flow guides, obstructions, deflectors or the like (for generating a charge motion in the cylinder [F02B 31/00](#); for re-atomising condensed fuel or homogenising fuel-air mixture [F02M 29/00](#))}
- F02M 35/10268 . . . {Heating, cooling or thermal insulating means (air coolers [F02B 29/04](#); thermal treatment of combustion-air, fuel or fuel-air mixture [F02M 31/00](#); details of the throttle valve housing [F02D 9/1035](#))}
- F02M 35/10275 . . . {Means to avoid a change in direction of incoming fluid, e.g. all intake ducts diverging from plenum chamber at acute angles; Check valves; Flame arrestors for backfire prevention}
- F02M 35/10281 . . . {Means to remove, re-atomise or redistribute condensed fuel; Means to avoid fuel particles from separating from the mixture (apparatus for re-atomising condensed fuel or homogenising fuel-air mixture [F02M 29/00](#); other apparatus for treating combustion-air, fuel or fuel-air mixture [F02M 33/00](#))}
- F02M 35/10288 . . . {Air intakes combined with another engine part, e.g. cylinder head cover or being cast in one piece with the exhaust manifold, cylinder head or engine block}
- F02M 35/10295 . . . {Damping means, e.g. tranquillising chamber to dampen air oscillations (intake silencers [F02M 35/12](#))}
- F02M 35/10301 . . . {Flexible, resilient, pivotally or movable parts; Membranes ([F02M 35/10255](#) and [F02M 35/10032](#) take precedence)}
- F02M 35/10308 . . . {Equalizing conduits, e.g. between intake ducts or between plenum chambers}
- F02M 35/10314 . . {Materials for intake systems (for sound damping [F02M 35/12](#); for air cleaners [F02M 35/02](#))}
- F02M 35/10321 . . . {Plastics; Composites; Rubbers}
- F02M 35/10327 . . . {Metals; Alloys (catalysts [F02M 27/02](#))}
- F02M 35/10334 . . . {Foams; Fabrics; Porous media; Laminates; Ceramics; Coatings}
- F02M 35/1034 . . {Manufacturing and assembling intake systems}
- F02M 35/10347 . . . {Moulding, casting or the like}
- F02M 35/10354 . . . {Joining multiple sections together (joining plastic materials together in general [B29C 65/00](#))}
- F02M 35/1036 {by welding, bonding or the like (welding plastic materials together in general [B29C 65/02](#))}
- F02M 35/10367 . . . {Machining, e.g. milling, grinding, punching, sanding; Bending; Surface treatments}
- F02M 35/10373 . . {Sensors for intake systems (throttle position sensors [F02D 9/105](#))}

- F02M 35/1038 . . . {for temperature or pressure}
- F02M 35/10386 . . . {for flow rate (air flow meters in air cleaners [F02M 35/021](#); circuit arrangements for generating control signals by measuring intake air flow [F02D 41/18](#))}
- F02M 35/10393 . . . {for characterising a multi-component mixture, e.g. for the composition such as humidity, density or viscosity}
- F02M 35/104 . . Intake manifolds
- F02M 35/1042 . . . {characterised by provisions to avoid mixture or air supply from one plenum chamber to two successively firing cylinders}
- F02M 35/1045 . . . {characterised by the charge distribution between the cylinders/ combustion chambers or its homogenisation}
- F02M 35/1047 . . . {characterised by some cylinders being fed from one side of engine block and the other cylinders being fed from the other side of engine block}
- F02M 35/108 . . . with primary and secondary intake passages
- F02M 35/1085 {the combustion chamber having multiple intake valves (modifying induction systems for imparting a rotation to the charge in the cylinder and having multiple air inlets [F02B 31/08](#); shape or arrangement of intake or exhaust channels in cylinder heads [F02F 1/42](#))}
- F02M 35/112 . . . for engines with cylinders all in one line ([F02M 35/108](#) takes precedence)
- F02M 35/116 . . . for engines with cylinders in V-arrangement or arranged oppositely relative to the main shaft ([F02M 35/108](#) takes precedence)
- F02M 35/1165 {Boxer or pancake engines}
- F02M 35/12 . . Intake silencers {Sound modulation, transmission or amplification (intake silencers also used as exhaust silencer [F01N 13/007](#); filters for compressors [F04B 39/16](#))}
- F02M 35/1205 . . {Flow throttling or guiding}
- F02M 35/1211 . . . {by using inserts in the air intake flow path, e.g. baffles, throttles or orifices; Flow guides ([F02M 35/1244](#) takes precedence)}
- F02M 35/1216 . . . {by using a plurality of holes, slits, protrusions, perforations, ribs or the like; Surface structures; Turbulence generators}
- F02M 35/1222 . . . {by using adjustable or movable elements, e.g. valves, membranes, bellows, expanding or shrinking elements}
- F02M 35/1227 . . . {by using multiple air intake flow paths, e.g. bypass, honeycomb or pipes opening into an expansion chamber}
- F02M 35/1233 . . . {by using expansion chambers in the air intake flow path}
- F02M 35/1238 . . . {by using secondary connections to the ambient, e.g. covered by a membrane or a porous member}
- F02M 35/1244 . . {using interference; Masking or reflecting sound}
- F02M 35/125 . . . {by using active elements, e.g. speakers}
- F02M 35/1255 . . {using resonance}
- F02M 35/1261 . . . {Helmholtz resonators}
- F02M 35/1266 . . . {comprising multiple chambers or compartments}
- F02M 35/1272 . . {using absorbing, damping, insulating or reflecting materials, e.g. porous foams, fibres, rubbers, fabrics, coatings or membranes}

- F02M 35/1277 . . {Reinforcement of walls, e.g. with ribs or laminates; Walls having air gaps or additional sound damping layers}
- F02M 35/1283 . . {Manufacturing or assembly; Connectors; Fixations}
- F02M 35/1288 . . {combined with or integrated into other devices ([F02M 35/14](#) takes precedence); Plurality of air intake silencers ([F02M 35/1266](#) takes precedence)}
- F02M 35/1294 . . {Amplifying, modulating, tuning or transmitting sound, e.g. directing sound to the passenger cabin; Sound modulation}
- F02M 35/14 . Combined air cleaners and silencers
- F02M 35/16 . characterised by use in vehicles ([predominant vehicle aspects, see the relevant classes for the vehicles](#))
- F02M 35/161 . . {Arrangement of the air intake system in the engine compartment, e.g. with respect to the bonnet or the vehicle front face}
- F02M 35/162 . . {Motorcycles; All-terrain vehicles, e.g. quads, snowmobiles; Small vehicles, e.g. forklifts}
- F02M 35/164 . . {Heavy duty vehicles; e.g. trucks, trains, agricultural or construction machines}
- F02M 35/165 . . {Marine vessels; Ships; Boats}
- F02M 35/167 . . . {having outboard engines; Jet-skis}
- F02M 35/168 {with means, e.g. valves, to prevent water entry}

- F02M 37/00** **Apparatus or systems for feeding liquid fuel from storage containers to carburettors or fuel-injection apparatus** ([F02M 69/00](#) takes precedence {; fuel injection apparatus characterised by their conduits and venting means [F02M 55/00](#); fuel injection apparatus having a common rail [F02M 63/0225](#); control of fuel feeding [F02D 33/003](#)}; feeding liquid fuel to combustion apparatus, in general [F23K 5/00](#); fuel supply to apparatus for generating combustion products of high pressure or high velocity [F23R 3/28](#)); **Arrangements for purifying liquid fuel specially adapted for, or arranged on, internal-combustion engines** (separating apparatus, filters per se [B01D](#); centrifuges [B04B](#))
- F02M 37/0011 . {Constructional details; Manufacturing or assembly of elements of fuel systems; Materials therefor}
- F02M 37/0017 . . {related to fuel pipes or their connections, e.g. joints or sealings ([F02M 55/004](#) takes precedence)}
- F02M 37/0023 . . {Valves in the fuel supply and return system}
- F02M 37/0029 . . . {Pressure regulator in the low pressure fuel system (pressure regulator in low-pressure injection apparatus [F02M 69/54](#))}
- F02M 37/0035 . . . {Thermo sensitive valves}
- F02M 37/0041 . . {Means for damping pressure pulsations (equalisation of pulses in positive displacement pumps [F04B 1/00](#); devices for damping fluid pulsations in pipes [F16L 55/04](#))}
- F02M 37/0047 . {Layout or arrangement of systems for feeding fuel (fuel injection apparatus characterised by their conduits and venting means [F02M 55/00](#); fuel injection apparatus having a common rail [F02M 63/0225](#); arrangement of fuel conduits of low pressure fuel injection apparatus [F02M 69/462](#))}
- F02M 37/0052 . . {Details on the fuel return circuit; Arrangement of pressure regulators}
- F02M 37/0058 . . . {Returnless fuel systems, i.e. the fuel return lines are not entering the fuel tank}

- F02M 37/0064
 - . . {for engines being fed with multiple fuels or fuels having special properties, e.g. bio-fuels; varying the fuel composition (controlling engines working with pluralities of fuels [F02D 19/06](#))}
- F02M 37/007
 - . . {characterised by its use in vehicles, in stationary plants or in small engines, e.g. hand held tools}
- F02M 37/0076
 - . {Details of the fuel feeding system related to the fuel tank (vehicle fuel tanks [B60K 15/03](#))}
- F02M 37/0082
 - . . {Devices inside the fuel tank other than fuel pumps or filters (electrical pumps submerged in fuel tanks [F02M 37/10](#), jet pumps [F02M 37/025](#))}
- F02M 37/0088
 - . . {Multiple separate fuel tanks or tanks being at least partially partitioned}
- F02M 37/0094
 - . . . {Saddle tanks; Tanks having partition walls}
- F02M 37/02
 - . Feeding by means of suction apparatus, e.g. by air flow through carburettors (by driven pumps [F02M 37/04](#))
- F02M 37/025
 - . . {Feeding by means of a liquid fuel-driven jet pump (jet pumps per se [F04F](#))}
- F02M 37/04
 - . Feeding by means of driven pumps (pump construction [F04](#))
- F02M 37/041
 - . . {Arrangements for driving gear-type pumps}
- F02M 37/043
 - . . {Arrangements for driving reciprocating piston-type pumps}
- F02M 37/045
 - . . {Arrangements for driving rotary positive-displacement pumps}
- F02M 37/046
 - . . {Arrangements for driving diaphragm-type pumps}
- F02M 37/048
 - . . {Arrangements for driving regenerative pumps, i.e. side-channel pumps}
- F02M 37/06
 - . . mechanically driven
- F02M 37/08
 - . . electrically driven
- F02M 2037/082
 - . . . {Details of the entry of the current supply lines into the pump housing, e.g. wire connectors, grommets, plugs or sockets}
- F02M 2037/085
 - . . . {Electric circuits therefor}
- F02M 2037/087
 - {Controlling fuel pressure valve}
- F02M 37/10
 - . . . submerged in fuel, e.g. in reservoir
- F02M 37/103
 - {Mounting pumps on fuel tanks}
- F02M 37/106
 - {the pump being installed in a sub-tank}
- F02M 37/12
 - . . fluid-driven, e.g. by compressed combustion-air
- F02M 37/14
 - . . the pumps being combined with other apparatus
- F02M 37/16
 - . . characterised by provision of personally-, e.g. manually-, operated pumps
- F02M 37/18
 - . . characterised by provision of main and auxiliary pumps
- F02M 37/20
 - . characterised by means for preventing vapour lock
- F02M 37/22
 - . Arrangements for purifying liquid fuel specially adapted for, or arranged on, internal-combustion engines, e.g. arrangement in the feeding system
- F02M 37/221
 - . . {having water separator means}
- F02M 37/223
 - . . {having heating means ([F02M 37/221](#) takes precedence)}
- F02M 2037/225
 - . . {having pump means in the filter housing}
- F02M 2037/226
 - . . {having pressure regulator means in the filter housing}
- F02M 2037/228
 - . . {Fuel tank strainers}

Fuel-injection apparatus (carrying the fuel into cylinders by high-pressure gas [F02M 67/00](#); low-pressure fuel-injection [F02M 69/00](#))

F02M 39/00 Arrangements of fuel-injection apparatus with respect to engines; Pump drives adapted to such arrangements (arrangements of injectors [F02M 61/14](#))

NOTE

Low-pressure fuel injection is classified in groups [F02M 51/00](#), [F02M 69/00](#) or [F02M 71/00](#).

[F02M 39/005](#) . {Arrangements of fuel feed-pumps with respect to fuel injection apparatus ([F02M 37/00](#) takes precedence)}

[F02M 39/02](#) . Arrangements of fuel-injection apparatus to facilitate the driving of pumps; Arrangements of fuel-injection pumps; Pump drives ([F02M 49/00](#) takes precedence)

F02M 41/00 Fuel-injection apparatus with two or more injectors fed from a common pressure-source sequentially by means of a distributor

NOTE

- in this group the following indexing codes are used: [F02M 2700/1329](#)

[F02M 41/02](#) . the distributor being spaced from pumping elements

[F02M 41/04](#) . . the distributor reciprocating

[F02M 41/042](#) . . . {by means of mechanical drive}

[F02M 41/045](#) . . . {by means of hydraulic or pneumatic drive}

[F02M 41/047](#) . . . {by means of electric drive}

[F02M 41/06](#) . . the distributor rotating

[F02M 41/063](#) . . . {the distributor and rotary valve controlling fuel passages to pumping elements being combined}

[F02M 41/066](#) {Arrangements for adjusting the rotary valve-distributor}

[F02M 41/08](#) . the distributor and pumping elements being combined

[F02M 41/10](#) . . pump pistons acting as the distributor

[F02M 41/12](#) . . . the pistons rotating to act as the distributor

[F02M 41/121](#) {with piston arranged axially to driving shaft ([F02M 41/123](#) takes precedence)}

[F02M 41/122](#) {with piston arranged radially to driving shaft ([F02M 41/123](#) takes precedence)}

[F02M 41/123](#) {characterised by means for varying fuel delivery or injection timing}

[F02M 41/124](#) {Throttling of fuel passages to or from the pumping chamber}

[F02M 41/125](#) {Variably-timed valves controlling fuel passages}

[F02M 41/126](#) {valves being mechanically or electrically adjustable sleeves slidably mounted on rotary piston}

[F02M 41/127](#) {valves being fluid-actuated slide-valves, e.g. differential rotary-piston pump}

- F02M 41/128 {Varying injection timing by angular adjustment of the face-cam or the rollers support}
- F02M 41/14 . . . rotary distributor supporting pump pistons
- F02M 41/1405 . . . {pistons being disposed radially with respect to rotation axis}
- F02M 41/1411 {characterised by means for varying fuel delivery or injection timing}
- F02M 41/1416 {Devices specially adapted for angular adjustment of annular cam}
- F02M 41/1422 {Injection being effected by means of a free-piston displaced by the pressure of fuel}
- F02M 41/1427 {Arrangements for metering fuel admitted to pumping chambers, e.g. by shuttles or by throttle-valves}
- F02M 41/1433 . . . {pistons being parallel to rotation axis}
- F02M 2041/1438 . . . {Arrangements or details pertaining to the devices classified in [F02M 41/14](#) and subgroups}
- F02M 2041/1444 {Feed-pumps; Arrangements or pressure regulation therefor}
- F02M 2041/145 {Throttle valves for metering fuel to the pumping chamber}
- F02M 2041/1455 {Shuttles per se, or shuttles associated with throttle valve for metering fuel admitted to the pumping chamber}
- F02M 2041/1461 {Axial displacement of rotor for varying piston stroke or for controlling fuel passages}
- F02M 2041/1466 {Piston-stroke variation by other means than axial displacement of rotor}
- F02M 2041/1472 {Devices for limiting maximum delivery or for providing excess fuel for starting or for correcting advance at starting}
- F02M 2041/1477 {Releasing fuel pressure or adjusting quantity-time characteristics of fuel delivery, e.g. by conducting pressurised fuel to a variable volume space, an accumulator or a return conduit}
- F02M 2041/1483 {Variably timed valves controlling fuel passages, e.g. sleeve-valves mounted on the rotor}
- F02M 2041/1488 {Electric actuation of valves or other parts}
- F02M 2041/1494 {Details of cams, tappets, rotors, venting means, specially arranged valves, e.g. in the rotor}
- F02M 41/16 . . . characterised by the distributor being fed from a constant pressure source, e.g. accumulator {or constant pressure positive displacement pumps}
- F02M 43/00** **Fuel-injection apparatus operating simultaneously on two or more fuels or on a liquid fuel and another liquid, e.g. the other liquid being an anti-knock additive**
- F02M 43/02 . . . Pumps peculiar thereto
- F02M 43/04 . . . Injectors peculiar thereto
- F02M 45/00** **Fuel-injection apparatus characterised by having a cyclic delivery of specific time/pressure or time/quantity relationship (fuel-injectors having such deliveries by means of valves furnished at seated ends with pintle- or plug-shaped extensions [F02M 61/06](#) {pumps having such delivery by means of delivery valves [F02M 59/462](#)})**
- F02M 45/02 . . . with each cyclic delivery being separated into two or more parts

- F02M 45/04
 - . with a small initial part, {e.g. initial part for partial load and initial and main part for full load}
- F02M 45/06
 - . . Pumps peculiar thereto
- F02M 45/063
 - . . . {Delivery stroke of piston being divided into two or more parts, e.g. by using specially shaped cams}
- F02M 45/066
 - . . . {Having specially arranged spill port and spill contour on the piston (F02M 45/063 takes precedence)}
- F02M 45/08
 - . . Injectors peculiar thereto
- F02M 45/083
 - . . . {Having two or more closing springs acting on injection-valve}
- F02M 45/086
 - . . . {Having more than one injection-valve controlling discharge orifices}
- F02M 45/10
 - . Other injectors with multiple-part delivery, e.g. with vibrating valves
- F02M 45/12
 - providing a continuous {cyclic} delivery with variable pressure
- F02M 47/00**

Fuel-injection apparatus operated cyclically with fuel-injection valves actuated by fluid pressure (F02M 49/00 takes precedence; apparatus with injection valves opened by fuel pressure and closed by non-fluid means, see the groups providing for other characteristics)
- F02M 47/02
 - of accumulator-injector type, i.e. having fuel pressure of accumulator tending to open, and fuel pressure in other chamber tending to close, injection valves and having means for periodically releasing that closing pressure
- F02M 47/022
 - . {Mechanically actuated valves draining the chamber to release the closing pressure}
- F02M 47/025
 - . {Hydraulically actuated valves draining the chamber to release the closing pressure}
- F02M 47/027
 - . {Electrically actuated valves draining the chamber to release the closing pressure}
- F02M 47/04
 - using fluid, other than fuel, for injection-valve actuation
- F02M 47/043
 - . {Fluid pressure acting on injection-valve in the period of non-injection to keep it closed}
- F02M 47/046
 - . {Fluid pressure acting on injection-valve in the period of injection to open it}
- F02M 47/06
 - Other fuel injectors peculiar thereto
- F02M 49/00**

Fuel-injection apparatus in which injection pumps are driven or injectors are actuated, by the pressure in engine working cylinders, or by impact of engine working piston
- F02M 49/02
 - using the cylinder pressure, e.g. compression end pressure
- F02M 49/04
 - using the piston impact
- F02M 51/00**

Fuel-injection apparatus characterised by being operated electrically
- F02M 51/005
 - {Arrangement of electrical wires and connections, e.g. wire harness, sockets, plugs; Arrangement of electronic control circuits in or on fuel injection apparatus}
- F02M 51/02
 - specially for low-pressure fuel-injection ({F02M 51/005 takes precedence}; pumps per se F02M 51/04)
- F02M 51/04
 - Pumps peculiar thereto
- F02M 51/06
 - Injectors peculiar thereto {with means directly operating the valve needle}

- F02M 51/0603 . . {using piezo-electric or magnetostrictive operating means}
- F02M 51/0607 . . . {the actuator being hollow, e.g. with needle passing through the hollow space}
- F02M 51/061 . . {using electromagnetic operating means}
- F02M 51/0614 . . . {characterised by arrangement of electromagnets or fixed armature}
- F02M 51/0617 {having two or more electromagnets}
- F02M 51/0621 {acting on one mobile armature ([F02M 51/0628](#) takes precedence)}
- F02M 51/0625 . . . {characterised by arrangement of mobile armatures}
- F02M 51/0628 {having a stepped armature}
- F02M 51/0632 {having a spherically or partly spherically shaped armature, e.g. acting as valve body}
- F02M 51/0635 {having a plate-shaped or undulated armature not entering the winding (if entering the winding [F02M 51/0664](#))}
- F02M 51/0639 {the armature acting as a valve}
- F02M 51/0642 {the armature having a valve attached thereto}
- F02M 51/0646 {the valve being a short body, e.g. sphere or cube}
- F02M 51/065 {the valve being spherical or partly spherical}
- F02M 51/0653 {the valve being an elongated body, e.g. a needle valve}
- F02M 51/0657 {the body being hollow and its interior communicating with the fuel flow}
- F02M 51/066 {the armature and the valve being allowed to move relatively to each other or not being attached to each other}
- F02M 51/0664 {having a cylindrically or partly cylindrically shaped armature, e.g. entering the winding; having a plate-shaped or undulated armature entering the winding}
- F02M 51/0667 {the armature acting as a valve or having a short valve body attached thereto}
- F02M 51/0671 {the armature having an elongated valve body attached thereto}
- F02M 51/0675 {the valve body having cylindrical guiding or metering portions, e.g. with fuel passages}
- F02M 51/0678 {all portions having fuel passages, e.g. flats, grooves, diameter reductions}
- F02M 51/0682 {the body being hollow and its interior communicating with the fuel flow ([F02M 51/0675](#) takes precedence)}
- F02M 51/0685 {the armature and the valve being allowed to move relatively to each other or not being attached to each other}
- F02M 51/0689 . . . {and permanent magnets ([F02M 51/0696](#) takes precedence)}
- F02M 51/0692 {as valve or armature return means}
- F02M 51/0696 . . . {characterised by the use of movable windings}
- F02M 2051/08 . . {Specially for low-pressure fuel-injection}

F02M 53/00

Fuel-injection apparatus characterised by having heating, cooling or thermally-insulating means

NOTE

- in this group the following indexing codes are used : [F02M 2700/077](#)

F02M 53/02

- with fuel-heating means, e.g. for vaporising

F02M 53/04

- Injectors with heating, cooling, or thermally-insulating means

F02M 53/043

- . {with cooling means other than air cooling}

F02M 53/046

- . {with thermally-insulating means}

F02M 53/06

- . with fuel-heating means, e.g. for vaporising

F02M 53/08

- . with air cooling

F02M 55/00

Fuel-injection apparatus characterised by their fuel conduits or their venting means; {Arrangements of conduits between fuel tank and pump [F02M 37/00](#) (venting in general [B01D 19/00](#))}

F02M 55/001

- {Pumps with means for preventing erosion on fuel discharge}

F02M 55/002

- {Arrangement of leakage or drain conduits in or from injectors}

F02M 55/004

- {Joints; Sealings}

F02M 55/005

- . {for high pressure conduits, e.g. connected to pump outlet or to injector inlet}

F02M 55/007

- {Venting means}

F02M 55/008

- {Arrangement of fuel passages inside of injectors}

F02M 55/02

- Conduits between injection pumps and injectors, {e.g. conduits between pump and common-rail or conduits between common-rail and injectors}

F02M 55/025

- . {Common rails}

F02M 55/04

- Means for damping vibrations {or pressure fluctuations} in injection pump inlets {or outlets}

F02M 57/00

Fuel-injectors combined or associated with other devices

NOTE

in this group the following indexing codes are used: [F02M 2700/1335](#)

F02M 57/005

- {the devices being sensors}

F02M 57/02

- Injectors structurally combined with fuel-injection pumps

F02M 57/021

- . {the injector being of valveless type, e.g. the pump piston co-operating with a conical seat of an injection nozzle at the end of the pumping stroke}

F02M 57/022

- . {characterised by the pump drive}

F02M 57/023

- . . {mechanical}

F02M 57/024

- . . . {with hydraulic link for varying the piston stroke}

F02M 57/025

- . . . {hydraulic, e.g. with pressure amplification}

F02M 57/026

- {Construction details of pressure amplifiers, e.g. fuel passages or check valves arranged in the intensifier piston or head, particular diameter relationships, stop members, arrangement of ports or conduits}

F02M 57/027

- . . . {electric}

- F02M 57/028 . . . {pneumatic (using engine cylinder pressure [F02M 49/02](#))}
- F02M 57/04 . the devices being combustion-air intake or exhaust valves
- F02M 57/06 . the devices being sparking plugs

F02M 59/00 **Pumps specially adapted for fuel-injection and not provided for in groups [F02M 39/00](#) - [F02M 57/00](#), {e.g. rotary cylinder-block type pumps} (general features of pumps [F04](#))**

NOTE

- in this group the following indexing codes are used: [F02M 2700/1323](#), [F02M 2700/1341](#), [F02M 2700/1352](#), [F02M 2700/1388](#)

- F02M 59/02 . of reciprocating-piston {or reciprocating-cylinder} type
- F02M 59/022 . . {having an accumulator storing pressurised fuel during pumping stroke of the piston for subsequent delivery to the injector}
- F02M 59/025 . . {characterised by a single piston}
- F02M 59/027 . . . {Unit-pumps, i.e. single piston and cylinder pump-units, e.g. for cooperating with a camshaft}
- F02M 59/04 . . characterised by special arrangement of cylinders with respect to piston-driving shaft, e.g. arranged parallel to that shaft {or swash-plate type pumps (with rotary valve [F02M 59/362](#))}
- F02M 59/06 . . . with cylinders arranged radially to driving shaft, e.g. in V or star arrangement
- F02M 59/08 . . characterised by two or more pumping elements with conjoint outlet {or several pumping elements feeding one engine cylinder (feeding common rails [F02M 63/0225](#))}
- F02M 59/10 . . characterised by the piston-drive
- F02M 59/102 . . . {Mechanical drive, e.g. tappets or cams ([F02M 45/063](#) takes precedence)}
- F02M 59/105 . . . {hydraulic drive ([F02M 59/32](#) takes precedence)}
- F02M 59/107 . . . {pneumatic drive, e.g. crankcase pressure drive ([F02M 49/00](#) takes precedence)}
- F02M 59/12 . having other positive-displacement pumping elements, e.g. rotary
- F02M 59/14 . . of elastic-wall type
- F02M 59/16 . characterised by having multi-stage compression of fuel
- F02M 59/18 . characterised by the pumping action being achieved through release of pre-compressed springs
- F02M 59/20 . Varying fuel delivery in quantity or timing (for distributor pumps [F02M 41/123](#), [F02M 41/1411](#))
- F02M 59/205 . . {Quantity of fuel admitted to pumping elements being metered by an auxiliary metering device}
- F02M 59/22 . . Varying quantity {or timing} by adjusting cylinder-head space
- F02M 59/24 . . with constant-length-stroke pistons having variable effective portion of stroke
- F02M 59/243 . . . {caused by movement of cylinders relative to their pistons}
- F02M 59/246 {Mechanisms therefor}
- F02M 59/26 . . . caused by movements of pistons relative to their cylinders

- F02M 59/265 {characterised by the arrangement or form of spill port of spill contour on the piston (F02M 45/066 takes precedence)}
- F02M 59/28 Mechanisms therefor
- F02M 59/30 . . with variable-length-stroke pistons {(swash-plate type pumps F02M 59/04)}
- F02M 59/32 . . fuel delivery being controlled by means of fuel-displaced auxiliary pistons, which effect injection {(combined with rotary distributor supporting pump pistons F02M 41/1422; low pressure fuel-injection F02M 69/12)}
- F02M 59/34 . . by throttling of passages to pumping elements or of overflow passages, {e.g. throttling by means of a pressure-controlled sliding valve having liquid stop or abutment}
- F02M 59/36 . . by variably-timed valves controlling fuel passages {to pumping elements or overflow passages}
- F02M 59/361 . . . {Valves being actuated mechanically}
- F02M 59/362 {valves rotating (combined with rotary fuel distributor F02M 41/063)}
- F02M 59/363 {arrangements for adjusting the rotary valve}
- F02M 59/365 . . . {valves being actuated by the fluid pressure produced in an auxiliary pump, e.g. pumps with differential pistons; Regulated pressure of supply pump actuating a metering valve, e.g. a sleeve surrounding the pump piston}
- F02M 59/366 . . . {Valves being actuated electrically}
- F02M 59/367 {Pump inlet valves of the check valve type being open when actuated}
- F02M 59/368 {Pump inlet valves being closed when actuated}
- F02M 59/38 . Pumps characterised by adaptations to special use or conditions
- F02M 59/40 . . for reversible engines
- F02M 59/42 . . for starting of engines {(supply of excess fuel F02M 59/447)}
- F02M 59/44 . Details, components parts, or accessories not provided for in, or of interest apart from, the apparatus of groups F02M 59/02 - F02M 59/42; {Pumps having transducers, e.g. to measure displacement of pump rack or piston}
- F02M 59/442 . . {means preventing fuel leakage around pump plunger, e.g. fluid barriers}
- F02M 59/445 . . {Selection of particular materials}
- F02M 59/447 . . {means specially adapted to limit fuel delivery or to supply excess of fuel temporarily, e.g. for starting of the engine (combined with fuel pump regulating devices F02D)}
- F02M 59/46 . . Valves (in general F16K)
- F02M 59/462 . . . {Delivery valves}
- F02M 59/464 . . . {Inlet valves of the check valve type}
- F02M 59/466 . . . {Electrically operated valves, e.g. using electromagnetic or piezo-electric operating means}
- F02M 59/468 {using piezo-electric operating means}
- F02M 59/48 . . Assembling; Disassembling; Replacing
- F02M 59/485 . . . {Means for fixing delivery valve casing and barrel to each other or to pump casing}

F02M 61/00 **Fuel-injectors not provided for in groups [F02M 39/00](#) - [F02M 57/00](#) or [F02M 67/00](#)**

NOTE

- in this group the following indexing codes are used: [F02M 2700/07](#),
[F02M 2700/074](#)

- [F02M 61/02](#) . of valveless type
- [F02M 61/04](#) . having valves, {e.g. having a plurality of valves in series} (valves in general [F16K](#))
- [F02M 61/042](#) . . {The valves being provided with fuel passages}
- [F02M 61/045](#) . . . {The valves being provided with fuel discharge orifices}
- [F02M 61/047](#) . . {the valves being formed by deformable nozzle parts, e.g. flexible plates or discs with fuel discharge orifices}
- [F02M 61/06](#) . . the valves being furnished at seated ends with pintle or plug shaped extensions
- [F02M 61/08](#) . . the valves opening in direction of fuel flow {([F02M 61/047](#) takes precedence)}
- [F02M 61/10](#) . . Other injectors with elongated valve bodies, i.e. of needle-valve type
- [F02M 61/12](#) . . . characterised by the provision of guiding or centring means for valve bodies
- [F02M 61/14](#) . Arrangements of injectors with respect to engines; Mounting of injectors
- [F02M 61/145](#) . . {the injection nozzle opening into the air intake conduit}
- [F02M 61/16](#) . Details not provided for in, or of interest apart from, the apparatus of groups [F02M 61/02](#) - [F02M 61/14](#)
- [F02M 61/161](#) . . {Means for adjusting injection-valve lift}
- [F02M 61/162](#) . . {Means to impart a whirling motion to fuel upstream or near discharging orifices}
- [F02M 61/163](#) . . . {Means being injection-valves with helically or spirally shaped grooves}
- [F02M 61/165](#) . . {Filtering elements specially adapted in fuel inlets to injector}
- [F02M 61/166](#) . . {Selection of particular materials}
- [F02M 61/167](#) . . {Means for compensating clearance or thermal expansion}
- [F02M 61/168](#) . . {Assembling; Disassembling; Manufacturing; Adjusting}
- [F02M 61/18](#) . . Injection nozzles, e.g. having valve seats; {Details of valve member seated ends, not otherwise provided for}
- [F02M 61/1806](#) . . . {characterised by the arrangement of discharge orifices, e.g. orientation or size}
- [F02M 61/1813](#) {Discharge orifices having different orientations with respect to valve member direction of movement, e.g. orientations being such that fuel jets emerging from discharge orifices collide with each other}
- [F02M 61/182](#) {Discharge orifices being situated in different transversal planes with respect to valve member direction of movement}
- [F02M 61/1826](#) {Discharge orifices having different sizes}
- [F02M 61/1833](#) {Discharge orifices having changing cross sections, e.g. being divergent}

- F02M 61/184 {Discharge orifices having non circular sections}
- F02M 61/1846 {Dimensional characteristics of discharge orifices}
- F02M 61/1853 {Orifice plates}
- F02M 61/186 {Multi-layered orifice plates}
- F02M 61/1866 {Valve seats or member ends having multiple cones}
- F02M 61/1873 {Valve seats or member ends having circumferential grooves or ridges, e.g. toroidal}
- F02M 61/188 {Spherical or partly spherical shaped valve member ends}
- F02M 61/1886 {Details of valve seats not covered by groups [F02M 61/1866](#) - [F02M 61/188](#)}
- F02M 61/1893 {Details of valve member ends not covered by groups [F02M 61/1866](#) - [F02M 61/188](#)}
- F02M 61/20 . . . Closing valves mechanically, e.g. arrangements of springs or weights {or permanent magnets; Damping of valve lift ([F02M 61/205](#) takes precedence)}
- F02M 61/205 {Means specially adapted for varying the spring tension or assisting the spring force to close the injection-valve, e.g. with damping of valve lift}

F02M 63/00 Other fuel-injection apparatus having pertinent characteristics not provided for in groups [F02M 39/00](#) - [F02M 57/00](#) or [F02M 67/00](#); Details, component parts, or accessories of fuel-injection apparatus, not provided for in, or of interest apart from, the apparatus of groups [F02M 39/00](#) - [F02M 61/00](#) or [F02M 67/00](#); {Combination of fuel pump with other devices, e.g. lubricating oil pump}

NOTE

- in this group the following indexing codes are used: [F02M 2700/05](#), [F02M 2700/072](#)

- F02M 63/0001 . {Fuel-injection apparatus with specially arranged lubricating system, e.g. by fuel oil (lubrication of engines [F01M](#))}
- F02M 63/0003 . {Fuel-injection apparatus having a cyclically-operated valve for connecting a pressure source, e.g. constant pressure pump or accumulator, to an injection valve held closed mechanically, e.g. by springs, and automatically opened by fuel pressure (having a distributor [F02M 41/16](#); low pressure fuel injection [F02M 69/14](#))}
- F02M 63/0005 . . {using valves actuated by fluid pressure}
- F02M 63/0007 . . {using electrically actuated valves (injection valves [F02M 51/06](#))}
- F02M 63/0008 . . {using mechanically actuated valves}
- F02M 63/001 . {Fuel-injection apparatus having injection valves held closed mechanically, e.g. by springs, and opened by a cyclically-operated mechanism for a time ([F02M 67/12](#) takes precedence; operated by fluid pressure [F02M 47/00](#); operated electrically [F02M 51/06](#); opened by fuel pressure [F02M 61/00](#))}
- F02M 63/0012 . {Valves (for fuel metering see the relevant groups, e.g. [F02M 59/34](#); inlet or outlet check valves for fuel injection pumps [F02M 59/46](#); for fuel injectors see the relevant groups, e.g. [F02M 61/00](#))}
- F02M 63/0014 . . {characterised by the valve actuating means}
- F02M 63/0015 . . . {electrical, e.g. using solenoid}
- F02M 63/0017 {using electromagnetic operating means}

F02M 63/0019	. . . . .	{characterised by the arrangement of electromagnets or fixed armatures}
F02M 63/0021	. . . . .	{characterised by the arrangement of mobile armatures}
F02M 63/0022	. . . . .	{the armature and the valve being allowed to move relatively to each other}
F02M 63/0024	. . . . .	{in combination with permanent magnet}
F02M 63/0026	. . . . .	{using piezoelectric or magnetostrictive actuators}
F02M 63/0028	. . . . .	{hydraulic}
F02M 63/0029	. . . . .	{using a pilot valve controlling a hydraulic chamber}
F02M 63/0031	. . . . .	{characterized by the type of valves, e.g. special valve member details, valve seat details, valve housing details}
F02M 63/0033	. . . . .	{Lift valves, i.e. having a valve member that moves perpendicularly to the plane of the valve seat}
F02M 63/0035	. . . . .	{Poppet valves, i.e. having a mushroom-shaped valve member that moves perpendicularly to the plane of the valve seat}
F02M 63/0036	. . . . .	{with spherical or partly spherical shaped valve member ends}
F02M 63/0038	. . . . .	{rotary}
F02M 63/004	. . . . .	{Sliding valves, e.g. spool valves, i.e. whereby the closing member has a sliding movement along a seat for opening and closing}
F02M 63/0042	. . . . .	{combined with valve seats of the lift valve type}
F02M 63/0043	. . . . .	{Two-way valves}
F02M 63/0045	. . . . .	{Three-way valves}
F02M 63/0047	. . . . .	{Four-way valves or valves with more than four ways}
F02M 63/0049	. . . . .	{Combined valve units, e.g. for controlling pumping chamber and injection valve}
F02M 63/005	. . . . .	{Pressure relief valves}
F02M 63/0052	. . . . .	{with means for adjusting the opening pressure, e.g. electrically controlled}
F02M 63/0054	. . . . .	{Check valves (F02M 59/462 , F02M 59/464 take precedence)}
F02M 63/0056	. . . . .	{Throttling valves, e.g. having variable opening positions throttling the flow}
F02M 63/0057	. . . . .	{Means for avoiding fuel contact with valve actuator, e.g. isolating actuators by using bellows or diaphragms}
F02M 63/0059	. . . . .	{Arrangements of valve actuators}
F02M 63/0061	. . . . .	{Single actuator acting on two or more valve bodies}
F02M 63/0063	. . . . .	{Two or more actuators acting on a single valve body}
F02M 63/0064	. . . . .	{Two or more actuators acting on two or more valve bodies}
F02M 63/0066	. . . . .	{Combination of electromagnetic and piezoelectric or magnetostrictive actuators}
F02M 63/0068	. . . . .	{Actuators specially adapted for partial and full opening of the valves}
F02M 63/007	. . . . .	{Details not provided for in, or of interest apart from, the apparatus of the groups F02M 63/0014 - F02M 63/0059 }
F02M 63/0071	. . . . .	{characterised by guiding or centering means in valves including the absence of any guiding means, e.g. "flying arrangements"}

- F02M 63/0073 . . . {Pressure balanced valves}
- F02M 63/0075 . . . {Stop members in valves, e.g. plates or disks limiting the movement of armature, valve or spring}
- F02M 63/0077 . . . {Valve seat details}
- F02M 63/0078 . . . {Valve member details, e.g. special shape, hollow or fuel passages in the valve member}
- F02M 63/008 {Hollow valve members, e.g. members internally guided}
- F02M 63/02 . . Fuel-injection apparatus having several injectors fed by a common pumping element, or having several pumping elements feeding a common injector; Fuel-injection apparatus having provision for cutting-out pumps, pumping elements, or injectors; Fuel-injection apparatus having provisions for variably interconnecting pumping elements and injectors alternatively
- F02M 63/0205 . . {for cutting-out pumps or injectors in case of abnormal operation of the engine or the injection apparatus, e.g. over-speed, break-down of fuel pumps or injectors (safety devices acting on engine fuel system on lubricant pressure failure [F01M 1/24](#)); for cutting-out pumps for stopping the engine}
- F02M 63/021 . . . {by locking pump pistons}
- F02M 63/0215 . . . {by draining or closing fuel conduits}
- F02M 63/022 . . . {by acting on fuel control mechanism}
- F02M 63/0225 . . {Fuel-injection apparatus having a common rail feeding several injectors ([F02M 63/0003](#) takes precedence); Means for varying pressure in common rails; Pumps feeding common rails}
- F02M 63/023 . . . {Means for varying pressure in common rails (pressure control [F02D 41/3845](#))}
- F02M 63/0235 {by bleeding fuel pressure}
- F02M 63/024 {between the low pressure pump and the high pressure pump}
- F02M 63/0245 {between the high pressure pump and the common rail}
- F02M 63/025 {from the common rail}
- F02M 63/026 {Means for reducing the pressure in common rails at power off (pressure control [F02D 41/3845](#))}
- F02M 63/0265 . . . {Pumps feeding common rails}
- F02M 63/027 {More than one high pressure pump feeding a single common rail}
- F02M 63/0275 . . . {Arrangement of common rails}
- F02M 63/028 {Returnless common rail system}
- F02M 63/0285 {having more than one common rail}
- F02M 63/029 {per cylinder bank; e.g. storing different fuels or fuels at different pressure levels per cylinder bank}
- F02M 63/0295 {for V- or star- or boxer-engines}
- F02M 63/04 . . Fuel-injection apparatus having injection valves held closed by a cyclically-operated mechanism for a time and automatically opened by fuel pressure, e.g. constant-pressure pump or accumulator, when that mechanism releases the valve
- F02M 63/06 . . Use of pressure wave generated by fuel inertia to open injection valves

F02M 65/00 **Testing fuel-injection apparatus, e.g. testing injection timing** {(testing of ignition [F02P 17/00](#); measuring fuel consumption [G01F 9/00](#)); **Cleaning of fuel-injection apparatus**}

- [F02M 65/001](#) . {Measuring fuel delivery of a fuel injector}
- [F02M 65/002](#) . {Measuring fuel delivery of multi-cylinder injection pumps}
- [F02M 65/003](#) . {Measuring variation of fuel pressure in high pressure line}
- [F02M 65/005](#) . {Measuring or detecting injection-valve lift, e.g. to determine injection timing}
- [F02M 65/006](#) . {Measuring or detecting fuel leakage of fuel injection apparatus}
- [F02M 65/007](#) . {Cleaning}
- [F02M 65/008](#) . . {of injectors only}

Fuel-injection by high-pressure gas carrying the fuel into engine working cylinders; Low-pressure fuel-injection

F02M 67/00 **Apparatus in which fuel-injection is effected by means of high-pressure gas, the gas carrying the fuel into working cylinders of the engine, e.g. air-injection type** (using compressed air for low-pressure fuel-injection apparatus [F02M 69/08](#))

NOTE

- in this group the following indexing codes are used: [F02B 2720/25](#)

- [F02M 67/005](#) . {fuel-gas mixture being compressed in a pump for subsequent injection into the engine}
- [F02M 67/02](#) . the gas being compressed air, e.g. compressed in pumps ([arrangements or adaptation of such pumps F02B](#))
- [F02M 67/04](#) . . the air being extracted from working cylinders of the engine
- [F02M 67/06](#) . the gas being other than air, e.g. steam, combustion gas
- [F02M 67/08](#) . . the gas being generated by combustion of part of fuel other than in engine working cylinders
- [F02M 67/10](#) . Injectors peculiar thereto, e.g. valve less type
- [F02M 67/12](#) . . having valves
- [F02M 67/14](#) . characterised by provisions for injecting different fuels, e.g. main fuel and readily self-igniting starting fuel

F02M 69/00 **Low-pressure fuel-injection apparatus** (electrically operated [F02M 51/00](#)); **{Apparatus with both continuous and intermittent injection; Apparatus injecting different types of fuel}**

NOTE

- in this group the following indexing codes are used: [F02B 2720/15](#)

- [F02M 69/002](#) . {characterised by means for intermittently metering the portion of fuel injected ([F02M 69/12](#), [F02M 69/14](#) take precedence)}
- [F02M 69/005](#) . {characterised by control of air admission to the engine according to the fuel injected}

- F02M 69/007
 - {by means of devices using fuel pressure deviated from main fuel circuit acting on air throttle valve}
- F02M 69/02
 - Pumps peculiar thereto {(elastic wall type pumps [F02M 59/14](#))}
- F02M 69/04
 - Injectors peculiar thereto
- F02M 69/041
 - {having vibrating means for atomizing the fuel, e.g. with sonic or ultrasonic vibrations}
- F02M 69/042
 - {Positioning of injectors with respect to engine, e.g. in the air intake conduit (mounting of injectors [F02M 61/14](#))}
- F02M 69/043
 - {for injecting into the intake conduit upstream of an air throttle valve}
- F02M 69/044
 - {for injecting into the intake conduit downstream of an air throttle valve}
- F02M 69/045
 - {for injecting into the combustion chamber ([F02M 69/046](#) takes precedence)}
- F02M 69/046
 - {for injecting into both the combustion chamber and the intake conduit}
- F02M 69/047
 - {injectors with air chambers, e.g. communicating with atmosphere for aerating the nozzles ([F02M 69/325](#) takes precedence)}
- F02M 69/048
 - {having variable fuel outlets, e.g. controlled by a valve actuated by operator}
- F02M 69/06
 - characterised by the pressurisation of the fuel being caused by centrifugal force acting on the fuel
- F02M 69/08
 - characterised by the fuel being carried by compressed air into main stream of combustion-air
- F02M 69/10
 - peculiar to scavenged two-stroke engines, e.g. injecting into crankcase-pump chamber
- F02M 69/12
 - comprising a fuel-displaced free-piston for intermittently metering and supplying fuel to injection nozzles {(high-pressure fuel-injection with fuel-displaced auxiliary pistons [F02M 59/32](#))}
- F02M 69/125
 - {Means for varying the stroke of the free-piston}
- F02M 69/14
 - having cyclically-operated valves connecting injection nozzles to a source of fuel under pressure during the injection period {(high-pressure fuel injection apparatus [F02M 63/0003](#))}
- F02M 69/142
 - {the valves being operated by fluid impulses, e.g. using bistable fluid operated valves}
- F02M 69/145
 - {the valves being actuated electrically (electrically-operated injectors [F02M 51/06](#))}
- F02M 69/147
 - {the valves being actuated mechanically, e.g. rotating}
- F02M 69/16
 - characterised by means for metering continuous fuel flow to injectors or means for varying fuel pressure upstream of {continuously or intermittently operated} injectors
- F02M 69/18
 - the means being metering valves throttling fuel passages to injectors or by-pass valves throttling overflow passages, the metering valves being actuated by a device responsive to the engine working parameters, e.g. engine load, speed, temperature or quantity of air ([F02M 69/26](#) takes precedence)
- F02M 69/20
 - the device being a servo-motor, e.g. using engine intake air pressure or vacuum ([F02M 69/22](#) takes precedence)
- F02M 69/22
 - the device comprising a member movably mounted in the air intake conduit and displaced according to the quantity of air admitted to the engine

- F02M 69/24
 - • • the device comprising a member for transmitting the movement of the air throttle valve actuated by the operator to the valves controlling fuel passages
- F02M 69/26
 - • the means varying fuel pressure in a fuel by-pass passage, the pressure acting on a throttle valve against the action of metered or throttled fuel pressure for variably throttling fuel flow to injection nozzles, e.g. to keep constant the pressure differential at the metering valve
- F02M 69/28
 - characterised by means for cutting-out the fuel supply to the engine or to main injectors during certain operating periods, e.g. deceleration
- F02M 69/30
 - characterised by means for facilitating the starting-up or idling of engines or by means for enriching fuel charge, e.g. below operational temperatures or upon high power demand of engines ([at acceleration F02M 69/44](#))
- F02M 69/32
 - • with an air by-pass around the air throttle valve or with an auxiliary air passage, e.g. with a variably controlled valve therein
- F02M 69/325
 - • • {with an auxiliary injection nozzle therein ([F02M 69/34](#) takes precedence)}
- F02M 69/34
 - • with an auxiliary fuel circuit supplying fuel to the engine, e.g. with the fuel pump outlet being directly connected to injection nozzles
- F02M 69/36
 - • having an enrichment mechanism modifying fuel flow to injectors, e.g. by acting on the fuel metering device or on the valves throttling fuel passages to injection nozzles or overflow passages {(at [acceleration F02M 69/44](#))}
- F02M 69/38
 - • • using fuel pressure, e.g. by varying fuel pressure in the control chambers of the fuel metering device ([F02M 69/26](#) takes precedence)
- F02M 69/383
 - • • • {the fuel passing through different passages to injectors or to a drain, the pressure of fuel acting on valves to close or open selectively these passages}
- F02M 69/386
 - • • • {variably controlling the pressure of the fuel by-passing the metering valves, e.g. by valves responsive to signals of temperature or oxygen sensors}
- F02M 69/40
 - • • using variably controlled air pressure, e.g. by modifying the intake air vacuum signal acting on the fuel metering device
- F02M 69/42
 - • • using other means than variable fluid pressure, e.g. acting on the fuel metering device mechanically or electrically
- F02M 69/44
 - characterised by means for supplying extra fuel to the engine on sudden air throttle opening, e.g. at acceleration
- F02M 69/46
 - Details, component parts or accessories not provided for in, or of interest apart from, the apparatus covered by groups [F02M 69/02](#) - [F02M 69/44](#)
- F02M 69/462
 - • {Arrangement of fuel conduits, e.g. with valves for maintaining pressure in the pipes after the engine being shut-down}
- F02M 69/465
 - • • {of fuel rails}
- F02M 69/467
 - • {Devices using intake air for generating a control signal acting on fuel delivery ([F02M 69/125](#), [F02M 69/20](#), [F02M 69/40](#) take precedence)}
- F02M 69/48
 - • Arrangement of air sensors {([F02M 69/22](#) takes precedence)}
- F02M 69/50
 - • Arrangement of fuel distributors, {e.g. with means for supplying equal portion of metered fuel to injectors ([F02M 69/147](#) takes precedence)}
- F02M 69/52
 - • Arrangement of fuel metering devices {([F02M 69/18](#) takes precedence)}
- F02M 69/54
 - • Arrangement of fuel pressure regulators

F02M 71/00 **Combinations of carburettors and low-pressure fuel-injection apparatus**
(means for enriching charge on sudden air throttle opening of carburettors
[F02M 7/06](#))

NOTE

- in this group the following indexing codes are used: [F02M 2700/1347](#)

[F02M 71/02](#) . with fuel-air mixture being produced by the carburettor and being compressed
by a pump for subsequent injection into main combustion-air ([adaptations or
arrangements of such pumps F02B](#))

[F02M 71/04](#) . with carburettor being used at starting or idling only and injection apparatus
being used during normal operation of engine {or [vice-versa](#)}

F02M 99/00 **Subject matter not provided for in other groups of this subclass**

F02M 2200/00 **Details of fuel-injection apparatus, not otherwise provided for**

[F02M 2200/02](#) . Fuel-injection apparatus having means for reducing wear

[F02M 2200/03](#) . Fuel-injection apparatus having means for reducing or avoiding stress, e.g.
the stress caused by mechanical force, by fluid pressure or by temperature
variations

[F02M 2200/04](#) . Fuel-injection apparatus having means for avoiding effect of cavitation, e.g.
erosion

[F02M 2200/05](#) . Fuel-injection apparatus having means for preventing corrosion

[F02M 2200/06](#) . Fuel-injection apparatus having means for preventing coking, e.g. of fuel
injector discharge orifices or valve needles

[F02M 2200/07](#) . Fuel-injection apparatus having means for avoiding sticking of valve or
armature, e.g. preventing hydraulic or magnetic sticking of parts

[F02M 2200/08](#) . Fuel-injection apparatus having special means for influencing magnetic flux,
e.g. for shielding or guiding magnetic flux

[F02M 2200/09](#) . Fuel-injection apparatus having means for reducing noise

[F02M 2200/16](#) . Sealing of fuel injection apparatus not otherwise provided for

[F02M 2200/18](#) . Fuel-injection apparatus having means for maintaining safety not otherwise
provided for

[F02M 2200/185](#) . . means for improving crash safety

[F02M 2200/20](#) . Fuel-injection apparatus with permanent magnets

[F02M 2200/21](#) . Fuel-injection apparatus with piezo-electric or magnetostrictive elements

[F02M 2200/215](#) . . Piezo-electric or magnetostrictive elements being able to tilt in its housing

[F02M 2200/22](#) . Fuel-injection apparatus with bimetallic or memory shape alloy elements

[F02M 2200/24](#) . Fuel-injection apparatus with sensors

[F02M 2200/241](#) . . Acceleration or vibration sensors

[F02M 2200/242](#) . . Displacement sensors

[F02M 2200/244](#) . . Force sensors

[F02M 2200/245](#) . . Position sensors, e.g. Hall sensors

[F02M 2200/247](#) . . Pressure sensors

[F02M 2200/248](#) . . Temperature sensors

- F02M 2200/25 . Fuel-injection apparatus with heat-expansible elements
- F02M 2200/26 . Fuel-injection apparatus with elastically deformable elements other than coil springs
- F02M 2200/27 . Fuel-injection apparatus with filters
- F02M 2200/28 . Details of throttles in fuel-injection apparatus
- F02M 2200/29 . Fuel-injection apparatus having rotating means ([rotary valves F02M 63/0038](#))
- F02M 2200/30 . Fuel-injection apparatus having mechanical parts, the movement of which is damped
 - F02M 2200/302 . . using electrical means
 - F02M 2200/304 . . using hydraulic means
 - F02M 2200/306 . . using mechanical means
 - F02M 2200/308 . . using pneumatic means
- F02M 2200/31 . Fuel-injection apparatus having hydraulic pressure fluctuations damping elements
 - F02M 2200/315 . . for damping fuel pressure fluctuations
- F02M 2200/40 . Fuel-injection apparatus with fuel accumulators, e.g. a fuel injector having an integrated fuel accumulator
- F02M 2200/44 . Valves, e.g. injectors, with valve bodies arranged side-by-side
- F02M 2200/46 . Valves, e.g. injectors, with concentric valve bodies
- F02M 2200/50 . Arrangements of springs for valves used in fuel injectors or fuel injection pumps
 - F02M 2200/502 . . Springs biasing the valve member to the open position
 - F02M 2200/505 . . Adjusting spring tension by sliding spring seats
 - F02M 2200/507 . . Adjusting spring tension by screwing spring seats
- F02M 2200/60 . Fuel-injection apparatus having means for facilitating the starting of engines, e.g. with valves or fuel passages for keeping residual pressure in common rails
- F02M 2200/70 . Linkage between actuator and actuated element, e.g. between piezoelectric actuator and needle valve or pump plunger
 - F02M 2200/701 . . mechanical
 - F02M 2200/702 . . . with actuator and actuated element moving in different directions, e.g. in opposite directions
 - F02M 2200/703 . . hydraulic
 - F02M 2200/704 . . . with actuator and actuated element moving in different directions, e.g. in opposite directions
 - F02M 2200/705 . . . with means for filling or emptying hydraulic chamber, e.g. for compensating clearance or thermal expansion
 - F02M 2200/706 Valves for filling or emptying hydraulic chamber
 - F02M 2200/707 . . . with means for avoiding fuel contact with actuators, e.g. isolating actuators by using bellows or diaphragms
 - F02M 2200/708 . . . with hydraulic chambers formed by a movable sleeve
- F02M 2200/80 . Fuel injection apparatus manufacture, repair or assembly
- F02M 2200/8007 . . Storing data on fuel injection apparatus, e.g. by printing, by using bar codes or EPROMs

- F02M 2200/8015 . . Provisions for assembly of fuel injection apparatus in a certain orientation, e.g. markings, notches or specially shaped sleeves other than a clip
- F02M 2200/8023 . . the assembly involving use of quick-acting mechanisms, e.g. clips
- F02M 2200/803 . . using clamp elements and fastening means; e.g. bolts or screws
- F02M 2200/8038 . . the assembly involving use of adhesives, glue or the like
- F02M 2200/8046 . . the manufacture involving injection moulding, e.g. of plastic or metal
- F02M 2200/8053 . . involving mechanical deformation of the apparatus or parts thereof
- F02M 2200/8061 . . involving press-fit, i.e. interference or friction fit
- F02M 2200/8069 . . involving removal of material from the fuel apparatus, e.g. by punching, hydro-erosion or mechanical operation
- F02M 2200/8076 . . involving threaded members
- F02M 2200/8084 . . involving welding or soldering
- F02M 2200/8092 . . adjusting or calibration
- F02M 2200/85 . Mounting of fuel injection apparatus
- F02M 2200/851 . . provisions for adjusting the angular, rotational or axial position of injectors
- F02M 2200/852 . . provisions for mounting the fuel injection apparatus in a certain orientation, e.g. markings or notches
- F02M 2200/853 . . involving use of quick-acting mechanism, e.g. clips
- F02M 2200/855 . . using clamp elements or fastening means, e.g. bolts or screws
- F02M 2200/856 . . characterised by mounting injector to fuel or common rail, or vice versa
- F02M 2200/857 . . characterised by mounting fuel or common rail to engine
- F02M 2200/858 . . sealing arrangements between injector and engine
- F02M 2200/90 . Selection of particular materials
- F02M 2200/9007 . . Ceramic materials
- F02M 2200/9015 . . Elastomeric or plastic materials
- F02M 2200/9023 . . Fibrous materials
- F02M 2200/903 . . Glass
- F02M 2200/9038 . . Coatings
- F02M 2200/9046 . . Multi-layered materials
- F02M 2200/9053 . . Metals
- F02M 2200/9061 . . . Special treatments for modifying the properties of metals used for fuel injection apparatus, e.g. modifying mechanical or electromagnetic properties
- F02M 2200/9069 . . . Non-magnetic metals
- F02M 2200/9076 . . . Non-ferrous metals
- F02M 2200/9084 . . Rheological fluids
- F02M 2200/9092 . . Sintered materials
- F02M 2200/95 . Fuel injection apparatus operating on particular fuels, e.g. biodiesel, ethanol, mixed fuels
- F02M 2200/953 . . Dimethyl ether, DME
- F02M 2200/956 . . Ethanol

F02M 2547/00**Special features for fuel-injection valves actuated by fluid pressure**

F02M 2547/001

- Control chambers formed by movable sleeves

F02M 2547/003

- Valve inserts containing control chamber and valve piston

F02M 2547/005

- Fuel injectors without fuel return, i.e. the pressure in the control chamber is released into the combustion chamber with fluid flow only in one direction

F02M 2547/006

- Springs assisting hydraulic closing force

F02M 2547/008

- Means for influencing the flow rate out of or into a control chamber, e.g. depending on the position of the needle

F02M 2700/00**Supplying, feeding or preparing air, fuel, fuel air mixtures or auxiliary fluids for a combustion engine; Use of exhaust gas; Compressors for piston engines****WARNING**

Groups [F02M 2700/00](#) –[F02M 2700/4397](#) are no longer used for the classification of documents as of January 1, 1975.

F02M 2700/05

- Miscellaneous constructional elements; Leakage detection

F02M 2700/055

- • Fuel distribution among injection nozzles

F02M 2700/07

- Nozzles and injectors with controllable fuel supply

F02M 2700/071

- • Injectors having valves

F02M 2700/072

- • Injection valve actuated by engine for supply of pressurised fuel; Electrically or electromagnetically actuated injectors

F02M 2700/074

- • Injection valve actuated by fuel pressure for pressurised fuel supply

F02M 2700/075

- • Injection valve actuated by cylinder pressure or other air pressure for pressurised fuel supply

F02M 2700/077

- • Injectors having cooling or heating means

F02M 2700/078

- • Injectors combined with fuel injection pump

F02M 2700/12

- Devices or methods for making a gas mixture for a combustion engine

F02M 2700/123

- • Fuel supply devices

F02M 2700/126

- • Devices for the supply or mixing of air and gas

F02M 2700/13

- Special devices for making an explosive mixture; Fuel pumps

F02M 2700/1305

- • Auxiliary air supply devices for carburettors

F02M 2700/1311

- • Devices for controlling register carburettors or for carburettors disposed in parallel

F02M 2700/1317

- • Fuel pump for internal combustion engines

F02M 2700/1323

- • • Controlled diaphragm type fuel pump

F02M 2700/1329

- • • Controlled rotary fuel pump with parallel pistons or with a single piston in the extension of the driving shaft

F02M 2700/1335

- • • Fuel pump combined with the fuel injector

F02M 2700/1341

- • • Fuel pump driven by the differential pressure of a gas

F02M 2700/1347

- • • Fuel pump acting on a carburettor; Acceleration pumps

F02M 2700/1352

- • • Fuel pump with a constant stroke piston without control means

F02M 2700/1358

- • • Fuel pump with control of fuel inlet to the pumping chamber

- F02M 2700/1364 . . . Fuel pump controlled by means of a fuel return valve
- F02M 2700/137 . . . Fuel pump with control of fuel outlet of pumping chamber to delivery pipe
- F02M 2700/1376 . . . Fuel pump with control of the pump piston stroke
- F02M 2700/1382 . . . Fuel pump with control of the cylinder relative to non-rotary piston
- F02M 2700/1388 . . . Fuel pump with control of the piston relative to a fixed cylinder
- F02M 2700/1394 . . Knock sensors
- F02M 2700/31 . Use of exhaust gas of combustion engines
- F02M 2700/33 . Compressors for piston combustion engines
- F02M 2700/331 . . Charging and scavenging compressors
- F02M 2700/333 . . . Drive thereof
- F02M 2700/335 . . . Control therefor
- F02M 2700/336 . . . Arrangements thereof on the engine
- F02M 2700/338 . . Injection air compressors
- F02M 2700/34 . Measures, also constructive measures, for avoiding the generation of nixious products such as CO in the exhaust gases
- F02M 2700/43 . Arrangements for supplying air, fuel or auxiliary fluids to a combustion space of mixture compressing engines working with liquid fuel
- F02M 2700/4302 . . whereby air and fuel are sucked into the mixture conduit
- F02M 2700/4304 . . . working only with one fuel
- F02M 2700/4307 without mixing chambers disposed in parallel
- F02M 2700/4309 specially adapted for motorcycles
- F02M 2700/4311 with mixing chambers disposed in parallel
- F02M 2700/4314 . . . with mixing chambers disposed in parallel
- F02M 2700/4316 without mixing chambers disposed in parallel
- F02M 2700/4319 with mixing chambers disposed in parallel
- F02M 2700/4321 . . . working with fuel and admission of auxiliary fluids such as water, anti-knock agents, hydrogen, ozone or the like
- F02M 2700/4323 . . . Throttling devices (not control systems thereof)
- F02M 2700/4326 Means for preventing back-fire
- F02M 2700/4328 . . . Reservoirs
- F02M 2700/433 without limitation of the liquid level
- F02M 2700/4333 with limitation of the liquid level
- F02M 2700/4335 . . . Transport devices
- F02M 2700/4338 Acceleration pumps
- F02M 2700/434 . . . Heating or cooling devices
- F02M 2700/4342 Heating devices
- F02M 2700/4345 by means of exhaust gases
- F02M 2700/4347 by means of water
- F02M 2700/435 by means of electricity
- F02M 2700/4352 by means of hot air
- F02M 2700/4354 by means of heat radiated from the engine

- F02M 2700/4357 by other means
- F02M 2700/4359 Cooling devices
- F02M 2700/4361 Mixing chambers
- F02M 2700/4364 with fuel atomization
- F02M 2700/4366 with fuel atomization by a valve
- F02M 2700/4369 with fuel atomization from an open fuel surface
- F02M 2700/4371 with fuel atomization from a fuel film dispersed over a surface
- F02M 2700/4373 Mixture improving devices
- F02M 2700/4376 Mechanical devices
- F02M 2700/4378 Other devices
- F02M 2700/438 Supply of liquid to a carburettor reservoir with limitation of the liquid level;
Aerating devices; Mounting of fuel filters
- F02M 2700/4383 with fuel displacement by gas pressure working on the fuel
- F02M 2700/4385 the pressure being an overpressure
- F02M 2700/4388 with fuel displacement by a pump
- F02M 2700/439 the pump being a membrane pump
- F02M 2700/4392 Conduits, manifolds, as far as heating and cooling if not concerned;
Arrangements for removing condensed fuel
- F02M 2700/4395 Other details
- F02M 2700/4397 whereby air or fuel are admitted in the mixture conduit by means other than
vacuum or an acceleration pump