SECTION F — MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING

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

F02M SUPPLYING COMBUSTION ENGINES IN GENERAL WITH COMBUSTIBLE MIXTURES OR CONSTITUENTS THEREOF (charging such engines F02B)

Note(s)

1. In this subclass, the following terms or expressions 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 includes 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.
2. Attention is drawn to the Notes preceding class F01.

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SUPPLYING WITH LIQUID FUEL
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- Pre-treating fuel, air, or mixture
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Carburettors for liquid fuels

1/00 Carburettors with means for facilitating engine's starting or its idling below operational temperatures [1, 2006.01]

1/02 • the means to facilitate starting or idling being chokes for enriching fuel-air mixture (automatic chokes F02M 1/08) **[1, 2006.01]**

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 **[1, 2006.01]**

1/06 • • having axially-movable valves, e.g. piston-shaped **[1, 2006.01]**

1/08 • the means to facilitate starting or idling becoming operative or inoperative automatically (in connection with auxiliary carburetting apparatus F02M 1/04) **[1, 2006.01]**

1/10 • • dependent on engine temperature, e.g. having thermostat **[1, 2006.01]**

1/12 • • • with means for electrically heating thermostat **[1, 2006.01]**

1/14 • • dependent on pressure in combustion-air- or fuel-air-mixture intake (F02M 1/10 takes precedence) **[1, 2006.01]**

1/16 • Other means for enriching fuel-air mixture during starting; Priming cups; using different fuels for starting and normal operation **[1, 2006.01]**

1/18 • • Enriching fuel-air mixture by depressing float to flood carburettor **[1, 2006.01]**

3/00 Idling devices for carburettors (with means for facilitating idling below operational temperatures F02M 1/00) **[1, 2006.01]**

3/02 • Preventing flow of idling fuel **[1, 2006.01]**

3/04 • • under conditions where engine is driven instead of driving, e.g. driven by vehicle running down hill **[1, 2006.01]**

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 **[4, 2006.01]**

3/05 • • • Pneumatic or mechanical control, e.g. with speed regulation **[4, 2006.01]**

3/055 • • • Fuel flow cut-off by introducing air, e.g. brake air, into the idling fuel system **[4, 2006.01]**

3/06 • Increasing idling speed **[1, 2006.01]**

3/07 • • by positioning the throttle flap stop, or by changing the fuel flow cross-sectional area, by electrical, electromechanical or electropneumatical means, according to engine speed **[4, 2006.01]**

3/08 • Other details of idling devices (fighting ice-formation by heating idling ports F02M 15/02) **[1, 2006.01]**

3/09 • • Valves responsive to engine conditions, e.g. manifold vacuum (F02M 1/00, F02M 5/00-F02M 33/00 take precedence) **[5, 2006.01]**

3/10 • • Fuel metering pins; Nozzles **[4, 2006.01]**

3/12 • • Passage way systems **[4, 2006.01]**

3/14 • • Location of idling system outlet relative to throttle valve **[4, 2006.01]**

5/00 Float-controlled apparatus for maintaining a constant fuel level in carburettors [1, 2006.01]

5/02 • with provisions to meet variations in carburettor position, e.g. upside-down position in aircraft **[1, 2006.01]**

5/04 • • with pivotally or rotatably mounted float chambers **[1, 4, 2006.01]**

5/06 • having adjustable float mechanism, e.g. to meet dissimilarities in specific gravity of different fuels **[1, 2006.01]**

5/08 • having means for venting float chambers **[1, 2006.01]**

5/10 • having means for preventing vapour lock, e.g. insulated float chambers or forced fuel circulation through float chamber with engine stopped **[1, 2006.01]**

5/12 • Other details, e.g. floats, valves, setting devices or tools (floats in general F16K 33/00) **[1, 2006.01]**

5/16 • • Floats **[4, 2006.01]**

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) **[1, 2006.01]**

7/02 • Carburettors having aerated fuel spray nozzles (with valve control for amount of air for aerating fuel F02M 7/24) **[1, 2006.01]**

7/04 • Means for enriching charge at high combustion-air flow **[1, 2006.01]**

7/06 • Means for enriching charge on sudden throttle opening, i.e. at acceleration, e.g. storage means in passage way system **[1, 2006.01]**

7/08 • • using pumps **[1, 2006.01]**

7/087 • • • changing output according to temperature in engine **[4, 2006.01]**

7/093 • • • changing output according to intake vacuum **[4, 2006.01]**

7/10 • Other installations, without moving parts, for influencing fuel/air ratio, e.g. electrical means (F02M 7/23 takes precedence) **[1, 4, 2006.01]**

7/11 • • Altering float-chamber pressure (enriching the fuel-air mixture during starting by depressing float to flood carburettor F02M 1/18) **[5, 2006.01]**

7/12 • Other installations, with moving parts, for influencing fuel/air ratio, e.g. having valves (F02M 7/24 takes precedence) **[1, 4, 2006.01]**

7/127 • • Altering the float-chamber pressure (enriching the fuel-air mixture during starting by depressing float to flood carburettor F02M 1/18) **[5, 2006.01]**

7/133 • • Auxiliary jets, i.e. operating only under certain conditions, e.g. full power (F02M 7/04, F02M 7/06 take precedence) **[5, 2006.01]**

7/14 • • with means for controlling cross-sectional area of fuel spray nozzle (dependent on air-throttle valve position F02M 7/22) **[1, 2006.01]**

7/16 • • • operated automatically, e.g. dependent on exhaust-gas analysis **[1, 2006.01]**

7/17 • • • • by a pneumatically adjustable piston-like element, e.g. constant depression carburettors **[5, 2006.01]**

7/18 • • with means for controlling cross-sectional area of fuel-metering orifice (dependent on air-throttle position F02M 7/22) **[1, 2006.01]**

7/20 • • • operated automatically, e.g. dependent on altitude **[1, 2006.01]**

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) **[1, 2006.01]**

7/23 • Fuel aerating devices **[4, 2006.01]**

7/24 • • Controlling flow of aerating air **[1, 4, 2006.01]**

7/26 • • • dependent on position of optionally operable throttle means **[4, 2006.01]**

7/28 • • • dependent on temperature or pressure **[4, 2006.01]**

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 [1, 2006.01]**

9/02 • having throttling valves, e.g. of piston shape, slidably arranged transversely to the passage **[1, 2006.01]**

9/04 • • with throttling valves sliding in a plane inclined to the passage **[1, 2006.01]**

9/06 • • with means for varying cross-sectional area of fuel spray nozzle dependent on throttle position (F02M 7/17 takes precedence) **[1, 5, 2006.01]**

9/08 • having throttling valves rotatably mounted in the passage **[1, 2006.01]**

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 **[1, 2006.01]**

9/12 • having other specific means for controlling the passage, or for varying cross-sectional area, of fuel-air mixing chambers **[1, 2006.01]**

9/127 • • Axially movable throttle valves concentric with the axis of the mixture passage **[5, 2006.01]**

9/133 • • • the throttle valves having mushroom-shaped bodies **[5, 2006.01]**

9/14 • having venturi and nozzle relatively displaceable essentially along the venturi axis **[1, 2006.01]**

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 [1, 2006.01]**

11/02 • with throttling valve, e.g. of flap or butterfly type, in a later stage opening automatically **[1, 2006.01]**

11/04 • • the later-stage valves having damping means **[1, 2006.01]**

11/06 • Other carburettors with throttling valve of flap or butterfly type **[1, 2006.01]**

11/08 • Register carburettors with throttling valve movable transversally to air passage **[1, 2006.01]**

11/10 • Register carburettors with rotatable throttling valves **[1, 2006.01]**

13/00 **Arrangements of two or more separate carburettors** (apparatus for testing, tuning, or synchronising carburettors F02M 19/01; 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) **[1, 2006.01]**

13/02 • Separate carburettors **[1, 2006.01]**

13/04 • • structurally united **[1, 2006.01]**

13/06 • the carburettors using different fuels **[1, 2006.01]**

13/08 • Carburettors adapted to use liquid and gaseous fuels, e.g. alternatively **[1, 2006.01]**

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) **[1, 2006.01]**

15/02 • with heating means, e.g. to combat ice-formation **[1, 2006.01]**

15/04 • • the means being electrical **[1, 2006.01]**

15/06 • Heat shieldings, e.g. from engine radiations **[1, 2006.01]**

17/00 **Carburettors having pertinent characteristics not provided for in, or of interest apart from, the apparatus of main groups F02M 1/00-F02M 15/00** (apparatus for treating combustion-air, fuel, or fuel-air mixture by catalysts, electric means, magnetism, rays, sonic waves, or the like F02M 27/00; combinations of carburettors and low-pressure fuel-injection apparatus F02M 71/00) **[1, 2006.01]**

17/02 • Floatless carburettors **[1, 2006.01]**

17/04 • • having fuel inlet valve controlled by diaphragm **[1, 2006.01]**

17/06 • • having overflow chamber determining constant fuel level **[1, 2006.01]**

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 **[1, 2006.01]**

17/09 • • the valve being of an eccentrically mounted butterfly type **[5, 2006.01]**

17/10 • Carburettors having one or more fuel passages opening in valve-member of air throttle **[1, 2006.01]**

17/12 • • the valve-member being of butterfly type **[1, 2006.01]**

17/14 • Carburettors with fuel-supply parts opened and closed in synchronism with engine stroke **[1, 2006.01]**

17/16 • Carburettors having continuously-rotating bodies, e.g. surface carburettors (fuel injection by centrifugal forces F02M 69/06) **[1, 2006.01]**

17/18 • Other surface carburettors **[1, 2006.01]**

17/20 • • with fuel bath **[1, 2006.01]**

17/22 • • • with air bubbling through bath **[1, 2006.01]**

17/24 • • with wicks **[1, 2006.01]**

17/26 • • with other wetted bodies **[1, 2006.01]**

17/28 • • • fuel being drawn through a porous body **[1, 2006.01]**

17/30 • Carburettors with fire-protecting devices, e.g. combined with fire-extinguishing apparatus **[1, 2006.01]**

17/32 • • automatically closing fuel conduits on outbreak of fire **[1, 2006.01]**

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) **[1, 2006.01]**

17/36 • Carburettors having fitments facilitating their cleaning **[1, 2006.01]**

17/38 • Controlling of carburettors, not otherwise provided for (external control gear F02M 19/12) **[1, 2006.01]**

17/40 • Selection of particular materials for carburettors, e.g. sheet metal, plastic, or translucent materials **[1, 2006.01]**

17/42 • Float-controlled carburettors not otherwise provided for **[1, 2006.01]**

17/44 • Carburettors characterised by draught direction and not otherwise provided for **[1, 2006.01]**

17/46 • • with down-draught **[1, 2006.01]**

17/48 • • with up-draught **[1, 2006.01]**

17/50 • Carburettors having means for combating ice-formation (thermally F02M 15/02) **[1, 2006.01]**

17/52 • Use of cold, produced by carburettors, for other purposes (apparatus using the cold, see the relevant classes for such apparatus) **[1, 2006.01]**

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) **[1, 2006.01]**

19/01 • Apparatus for testing, tuning, or synchronising carburettors, e.g. carburettor flow stands **[3, 2006.01]**

19/02 • Metering-orifices, e.g. variable in diameter (variable during operation F02M 7/18) **[1, 2006.01]**

19/025 • • Metering orifices not variable in diameter **[4, 2006.01]**

19/03 • Fuel atomising nozzles; Arrangement of emulsifying air conduits (atomising in general B05B) **[4, 2006.01]**

19/035 • • Mushroom-shaped atomising nozzles **[4, 2006.01]**

19/04 • Fuel-metering pins or needles **[1, 2006.01]**

19/06 • Other details of fuel conduits **[1, 2006.01]**

19/08 • Venturis **[1, 2006.01]**

19/10 • • in multiple arrangement **[1, 2006.01]**

19/12 • External control gear, e.g. having dash-pots (dampening means in later stages of multi-stage carburettors F02M 11/04; carburettor control gear in which the carburettor aspects do not predominate, see the relevant classes) **[1, 2006.01]**

21/00 Apparatus for supplying engines with non-liquid fuels, e.g. gaseous fuels stored in liquid form [1, 2006.01]

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) **[1, 2006.01]**

21/04 • • Gas-air mixing apparatus (carburettors adapted to use liquid and gaseous fuels F02M 13/08; carburetting gases in general C10J) **[1, 2006.01]**

21/06 • • Apparatus for de-liquefying, e.g. by heating (discharging liquefied gases in general F17C) **[1, 2006.01]**

21/08 • for non-gaseous fuels (for engines operating on fuel containing oxidants F02B) **[1, 2006.01]**

21/10 • • for fuels with low melting point, e.g. apparatus having heating means **[1, 2006.01]**

21/12 • for fuels in pulverised state (engine plants with fuel-pulverising apparatus F02B) **[1, 2006.01]**

Engine-pertinent apparatus for feeding, or treating before their admission to engine, combustion-air, fuel, or fuel-air mixture

23/00 Apparatus for adding secondary air to fuel-air mixture [1, 2006.01]

23/02 • with personal control **[1, 2006.01]**

23/03 • • the secondary air-valve controlled by main combustion-air throttle **[5, 2006.01]**

23/04 • with automatic control **[1, 2006.01]**

23/06 • • dependent on engine speed **[1, 2006.01]**

23/08 • • dependent on pressure in main combustion-air induction system **[1, 2006.01]**

23/09 • • • using valves directly opened by low pressure **[6, 2006.01]**

23/10 • • dependent on temperature, e.g. engine temperature **[1, 2006.01]**

23/12 • characterised by being combined with device for, or by secondary air effecting, re-atomising of condensed fuel **[1, 2006.01]**

23/14 • characterised by adding hot air **[1, 2006.01]**

25/00 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) **[1, 2006.01]**

25/022 • Adding fuel and water emulsion, water or steam **[6, 2006.01]**

25/025 • • Adding water **[6, 2006.01]**

25/028 • • • into the charge intakes **[6, 2006.01]**

25/03 • • • into the cylinders **[6, 2006.01]**

25/032 • • Producing and adding steam **[6, 2006.01]**

25/035 • • • into the charge intakes **[6, 2006.01]**

25/038 • • • into the cylinders **[6, 2006.01]**

*25/06 • adding lubricant vapours **[1, 2006.01, 2016.01]***

25/08 • adding fuel vapours drawn from engine fuel reservoir **[1, 2006.01]**

25/10 • adding acetylene, non-waterborne hydrogen, non-airborne oxygen, or ozone **[1, 2006.01]**

25/12 • • the apparatus having means for generating such gases (using rays and simultaneously generating ozone F02M 27/06) **[1, 2006.01]**

25/14 • adding anti-knock agents, not provided for in groups F02M 25/022-F02M 25/10 **[1, 2006.01]**

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 [2016.01]

*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 **[2016.01]***

*26/02 • EGR systems specially adapted for supercharged engines **[2016.01]***

*26/03 • • with a single mechanically or electrically driven intake charge compressor **[2016.01]***

*26/04 • • with a single turbocharger **[2016.01]***

*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 **[2016.01]***

*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 **[2016.01]***

*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 **[2016.01]***

*26/08 • • for engines having two or more intake charge compressors or exhaust gas turbines, e.g. a turbocharger combined with an additional compressor **[2016.01]***

*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 **[2016.01]***

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* ***[2016.01]***

26/11 • *Manufacture or assembly of EGR systems; Materials or coatings specially adapted for EGR systems* ***[2016.01]***

26/12 • *characterised by means for attaching parts of an EGR system to each other or to engine parts* ***[2016.01]***

26/13 • *Arrangement or layout of EGR passages, e.g. in relation to specific engine parts or for incorporation of accessories* ***[2016.01]***

26/14 • • *in relation to the exhaust system* ***[2016.01]***

26/15 • • • *in relation to engine exhaust purifying apparatus* ***[2016.01]***

26/16 • • • *with EGR valves located at or near the connection to the exhaust system* ***[2016.01]***

26/17 • • *in relation to the intake system* ***[2016.01]***

26/18 • • • *Thermal insulation or heat protection* ***[2016.01]***

26/19 • • • *Means for improving the mixing of air and recirculated exhaust gases, e.g. venturis or multiple openings to the intake system* ***[2016.01]***

26/20 • • • *Feeding recirculated exhaust gases directly into the combustion chambers or into the intake runners* ***[2016.01]***

26/21 • • • *with EGR valves located at or near the connection to the intake system* ***[2016.01]***

26/22 • • *with coolers in the recirculation passage* ***[2016.01]***

26/23 • • • *Layout, e.g. schematics* ***[2016.01]***

26/24 • • • • *with two or more coolers* ***[2016.01]***

26/25 • • • • *with coolers having bypasses* ***[2016.01]***

26/26 • • • • • *characterised by details of the bypass valve* ***[2016.01]***

26/27 • • • • *with air-cooled heat exchangers* ***[2016.01]***

26/28 • • • • *with liquid-cooled heat exchangers* ***[2016.01]***

26/29 • • • *Constructional details of the coolers, e.g. pipes, plates, ribs, insulation or materials* ***[2016.01]***

26/30 • • • • *Connections of coolers to other devices, e. g. to valves, heaters, compressors or filters; Coolers characterised by their location on the engine* ***[2016.01]***

26/31 • • • • *Air-cooled heat exchangers* ***[2016.01]***

26/32 • • • • *Liquid-cooled heat exchangers* ***[2016.01]***

26/33 • • • *controlling the temperature of the recirculated gases* ***[2016.01]***

26/34 • • *with compressors, turbines or the like in the recirculation passage* ***[2016.01]***

26/35 • • *with means for cleaning or treating the recirculated gases, e.g. catalysts, condensate traps, particle filters or heaters* ***[2016.01]***

26/36 • • *with means for adding fluids other than exhaust gas to the recirculation passage; with reformers* ***[2016.01]***

26/37 • • *with temporary storage of recirculated exhaust gas (internal exhaust gas recirculation F02M 26/01)* ***[2016.01]***

26/38 • • *with two or more EGR valves disposed in parallel* ***[2016.01]***

26/39 • • *with two or more EGR valves disposed in series* ***[2016.01]***

26/40 • • *with timing means in the recirculation passage, e.g. cyclically operating valves or regenerators; with arrangements involving pressure pulsations* ***[2016.01]***

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* ***[2016.01]***

26/42 • • *having two or more EGR passages; EGR systems specially adapted for engines having two or more cylinders* ***[2016.01]***

26/43 • • • *in which exhaust from only one cylinder or only a group of cylinders is directed to the intake of the engine* ***[2016.01]***

26/44 • • • *in which a main EGR passage is branched into multiple passages* ***[2016.01]***

26/45 • *Sensors specially adapted for EGR systems* ***[2016.01]***

26/46 • • *for determining the characteristics of gases, e.g. composition* ***[2016.01]***

26/47 • • • *the characteristics being temperatures, pressures or flow rates* ***[2016.01]***

26/48 • • *EGR valve position sensors (details of the sensor installation in the valve housing F02M 26/71)* ***[2016.01]***

26/49 • *Detecting, diagnosing or indicating an abnormal function of the EGR system* ***[2016.01]***

26/50 • *Arrangements or methods for preventing or reducing deposits, corrosion or wear caused by impurities (F02M 26/35, F02M 26/74 take precedence)* ***[2016.01]***

26/51 • *EGR valves combined with other devices, e.g. with intake valves or compressors (combined with intake air throttles F02M 26/64)* ***[2016.01]***

26/52 • *Systems for actuating EGR valves* ***[2016.01]***

26/53 • • *using electric actuators, e.g. solenoids* ***[2016.01]***

26/54 • • • *Rotary actuators, e.g. step motors* ***[2016.01]***

26/55 • • *using vacuum actuators* ***[2016.01]***

26/56 • • • *having pressure modulation valves* ***[2016.01]***

26/57 • • • • *using electronic means, e.g. electromagnetic valves* ***[2016.01]***

26/58 • • • *Constructional details of the actuator; Mounting thereof* ***[2016.01]***

26/59 • • *using positive pressure actuators; Check valves therefor* ***[2016.01]***

26/60 • • • *in response to air intake pressure* ***[2016.01]***

26/61 • • • *in response to exhaust pressure* ***[2016.01]***

26/62 • • • *in response to fuel pressure* ***[2016.01]***

26/63 • • *the EGR valve being directly controlled by an operator (F02M 26/64 takes precedence)* ***[2016.01]***

26/64 • • *the EGR valve being operated together with an intake air throttle* ***[2016.01]***

26/65 • *Constructional details of EGR valves* ***[2016.01]***

26/66 • • *Lift valves, e.g. poppet valves* ***[2016.01]***

26/67 • • • *Pintles; Spindles; Springs; Bearings; Sealings; Connections to actuators* ***[2016.01]***

26/68 • • • *Closing members; Valve seats; Flow passages* ***[2016.01]***

26/69 • • • *having two or more valve-closing members* ***[2016.01]***

26/70 • • *Flap valves; Rotary valves; Sliding valves; Resilient valves* ***[2016.01]***

26/71 • • *Multi-way valves* ***[2016.01]***

26/72 • • *Housings* ***[2016.01]***

26/73 • • • *with means for heating or cooling the EGR valve **[2016.01]***
26/74 • • *Protection from damage, e.g. shielding means **[2016.01]***

27/00 Apparatus for treating combustion-air, fuel, or fuel-air mixture, by catalysts, electric means, magnetism, rays, sonic waves, or the like [1, 2006.01]
27/02 • by catalysts **[1, 2006.01]**
27/04 • by electric means or magnetism **[1, 2006.01]**
27/06 • by rays **[1, 2006.01]**
27/08 • by sonic or ultrasonic waves **[1, 2006.01]**

29/00 Apparatus for re-atomising condensed fuel or homogenising fuel-air mixture (combined with secondary-air supply F02M 23/12) **[1, 2006.01]**
29/02 • having rotary parts **[1, 2006.01]**
29/04 • having screens, gratings, baffles, or the like (rotary F02M 29/02) **[1, 2006.01]**
29/06 • • generating whirling motion of mixture **[1, 2006.01]**
29/08 • • having spirally-wound wires **[1, 2006.01]**
29/10 • • adjustable **[1, 2006.01]**
29/12 • having homogenising valves held open by mixture current **[1, 2006.01]**
29/14 • re-atomising or homogenising being effected by unevenness of internal surfaces of mixture intake **[1, 2006.01]**

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) **[1, 2006.01]**
31/02 • for heating **[1, 2006.01]**
31/04 • • 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 19/04) **[1, 4, 2006.01]**
31/06 • • • by hot gases, e.g. by mixing cold and hot air **[1, 2006.01]**
31/07 • • • • Temperature-responsive control, e.g. using thermostatically-controlled valves (F02M 31/083 takes precedence) **[6, 2006.01]**
31/08 • • • • the gases being exhaust gases **[1, 2006.01]**
31/083 • • • • • Temperature-responsive control of the amount of exhaust gas or combustion air directed to the heat exchange surface **[6, 2006.01]**
31/087 • • • • • Heat-exchange arrangements between the air intake and exhaust gas passages, e.g. by means of contact between the passages **[5, 2006.01]**
31/093 • • • • • • Air intake passage surrounding the exhaust gas passage; Exhaust gas passage surrounding the air intake passage **[5, 2006.01]**
31/10 • • • by hot liquids, e.g. lubricants **[1, 2006.01]**
31/12 • • electrically **[1, 2006.01]**
31/125 • • • Fuel **[5, 2006.01]**
31/13 • • • Combustion air **[5, 2006.01]**
31/135 • • • Fuel-air mixture **[5, 2006.01]**
31/14 • • by using heat from working cylinders or cylinder heads **[1, 2006.01]**
31/16 • • Other apparatus for heating fuel **[1, 2006.01]**
31/18 • • • to vaporise fuel **[1, 2006.01]**
31/20 • for cooling (cooling of charging-air or of scavenging-air F02B) **[1, 2006.01]**

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) **[1, 2006.01]**
33/02 • for collecting and returning condensed fuel **[1, 2006.01]**
33/04 • • returning to the intake passage **[5, 2006.01]**
33/06 • • • with simultaneous heat supply **[5, 2006.01]**
33/08 • • returning to the fuel tank **[5, 2006.01]**

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) **[1, 2006.01]**
35/02 • Air cleaners **[1, 2006.01]**
35/022 • • acting by gravity, by centrifugal, or by other inertial forces, e.g. with moistened walls **[2, 2006.01]**
35/024 • • using filters, e.g. moistened (F02M 35/026 takes precedence; cleaning of the filtering material F02M 35/08) **[2, 2006.01]**
35/026 • • acting by guiding the air over or through an oil or other liquid bath, e.g. combined with filters **[2, 2006.01]**
35/04 • • specially arranged with respect to engine; Mounting thereon **[1, 2006.01]**
35/06 • • • combined or associated with engine's cooling blower or fan, or with flywheel **[1, 2006.01]**
35/08 • • with means for removing dust from cleaners; with means for indicating clogging; with by-pass means **[1, 2006.01]**
35/09 • • • Clogging indicators **[6, 2006.01]**
35/10 • Air intakes; Induction systems (using kinetic or wave energy of charge in induction systems for improving quantity of charge F02B) **[1, 2006.01]**
35/104 • • Intake manifolds **[6, 2006.01]**
35/108 • • • with primary and secondary intake passages **[6, 2006.01]**
35/112 • • • for engines with cylinders all in one line (F02M 35/108 takes precedence) **[6, 2006.01]**
35/116 • • • for engines with cylinders in V-arrangement or arranged oppositely relative to the main shaft (F02M 35/108 takes precedence) **[6, 2006.01]**
35/12 • Intake silencers **[1, 2006.01]**
35/14 • Combined air cleaners and silencers **[1, 2006.01]**
35/16 • characterised by use in vehicles (predominant vehicle aspects, see the relevant classes for the vehicles) **[1, 2006.01]**

37/00 Apparatus or systems for feeding liquid fuel from storage containers to carburettors or fuel-injection apparatus (F02M 69/00 takes precedence; 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) **[1, 5, 2006.01]**
37/02 • Feeding by means of suction apparatus, e.g. by air flow through carburettors (by driven pumps F02M 37/04) **[1, 2006.01]**
37/04 • Feeding by means of driven pumps (pump construction F04) **[1, 2006.01]**

37/06 • • mechanically driven **[1, 2006.01]**
37/08 • • electrically driven **[1, 2006.01]**
37/10 • • • submerged in fuel, e.g. in reservoir **[1, 2006.01]**
37/12 • • fluid-driven, e.g. by compressed combustion-air **[1, 2006.01]**
37/14 • • the pumps being combined with other apparatus **[1, 2006.01]**
37/16 • • characterised by provision of personally-, e.g. manually-, operated pumps **[1, 2006.01]**
37/18 • • characterised by provision of main and auxiliary pumps **[1, 2006.01]**
37/20 • characterised by means for preventing vapour lock **[1, 2006.01]**
37/22 • Arrangements for purifying liquid fuel specially adapted for, or arranged on, internal-combustion engines, e.g. arrangement in the feeding system **[3, 2006.01]**

Fuel-injection apparatus

Note(s) [2009.01]

Low-pressure fuel injection is classified in groups F02M 51/00, F02M 69/00 or F02M 71/00.

39/00 Arrangements of fuel-injection apparatus with respect to engines; Pump drives adapted to such arrangements (F02M 49/00 takes precedence; arrangements of injectors F02M 61/14) **[1, 2006.01]**
39/02 • Arrangements of fuel-injection apparatus to facilitate the driving of pumps; Arrangements of fuel-injection pumps; Pump drives **[1, 2006.01]**

41/00 Fuel-injection apparatus with two or more injectors fed from a common pressure-source sequentially by means of a distributor [1, 2006.01]
41/02 • the distributor being spaced from pumping elements **[1, 2006.01]**
41/04 • • the distributor reciprocating **[1, 2006.01]**
41/06 • • the distributor rotating **[1, 2006.01]**
41/08 • the distributor and pumping elements being combined **[1, 2006.01]**
41/10 • • pump pistons acting as the distributor **[1, 2006.01]**
41/12 • • • the pistons rotating to act as the distributor **[1, 2006.01]**
41/14 • • rotary distributor supporting pump pistons **[1, 2006.01]**
41/16 • characterised by the distributor being fed from a constant-pressure source, e.g. accumulator **[1, 2006.01]**

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 [1, 2006.01]
43/02 • Pumps peculiar thereto **[1, 2006.01]**
43/04 • Injectors peculiar thereto **[1, 2006.01]**

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) **[1, 2006.01]**
45/02 • with each cyclic delivery being separated into two or more parts **[1, 2006.01]**
45/04 • • with a small initial part **[1, 2006.01]**
45/06 • • • Pumps peculiar thereto **[1, 2006.01]**
45/08 • • • Injectors peculiar thereto **[1, 2006.01]**
45/10 • • Other injectors with multiple-part delivery, e.g. with vibrating valves **[1, 2006.01]**
45/12 • providing a continuous delivery with variable pressure **[1, 2006.01]**

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) **[1, 2006.01]**
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 **[1, 2006.01]**
47/04 • using fluid, other than fuel, for injection-valve actuation **[1, 2006.01]**
47/06 • Other fuel injectors peculiar thereto **[1, 2006.01]**

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 [1, 2006.01]
49/02 • using the cylinder pressure, e.g. compression end pressure **[1, 2006.01]**
49/04 • using the piston impact **[1, 2006.01]**

51/00 Fuel-injection apparatus characterised by being operated electrically [1, 2006.01]
51/02 • specially for low-pressure fuel-injection (pumps per se F02M 51/04; injectors per se F02M 51/08) **[1, 2006.01]**
51/04 • Pumps peculiar thereto **[1, 2006.01]**
51/06 • Injectors peculiar thereto **[1, 2006.01]**
51/08 • • specially for low-pressure fuel-injection **[1, 2006.01]**

53/00 Fuel-injection apparatus characterised by having heating, cooling, or thermally-insulating means [1, 2006.01]
53/02 • with fuel-heating means, e.g. for vaporising **[1, 2006.01]**
53/04 • Injectors with heating, cooling, or thermally-insulating means **[1, 2006.01]**
53/06 • • with fuel-heating means, e.g. for vaporising **[1, 2006.01]**
53/08 • • with air cooling **[1, 2006.01]**

55/00 Fuel-injection apparatus characterised by their fuel conduits or their venting means [1, 2006.01]
55/02 • Conduits between injection pumps and injectors **[1, 2006.01]**
55/04 • Means for damping vibrations in injection-pump inlets **[1, 2006.01]**

57/00 Fuel injectors combined or associated with other devices [1, 2006.01]
57/02 • Injectors structurally combined with fuel-injection pumps **[1, 2006.01]**
57/04 • the devices being combustion-air intake or exhaust valves **[1, 2006.01]**
57/06 • the devices being sparking-plugs **[1, 2006.01]**

59/00 Pumps specially adapted for fuel-injection and not provided for in groups F02M 39/00-F02M 57/00 (general features of pumps F04) **[1, 2006.01]**
59/02 • of reciprocating-piston type **[1, 2006.01]**

59/04 • • characterised by special arrangement of cylinders with respect to piston-driving shaft, e.g. arranged parallel to that shaft **[1, 2006.01]**
59/06 • • • with cylinders arranged radially to driving shaft, e.g. in V- or star-arrangement **[1, 2006.01]**
59/08 • • characterised by two or more pumping elements with conjoint outlet **[1, 2006.01]**
59/10 • • characterised by the piston drive **[1, 2006.01]**
59/12 • having other positive-displacement pumping elements, e.g. rotary **[1, 2006.01]**
59/14 • • of elastic-wall type **[1, 2006.01]**
59/16 • characterised by having multi-stage compression of fuel **[1, 2006.01]**
59/18 • characterised by the pumping action being achieved through release of pre-compressed springs **[1, 2006.01]**
59/20 • Varying fuel delivery in quantity or timing **[1, 2006.01]**
59/22 • • Varying quantity by adjusting cylinder-head space **[1, 2006.01]**
59/24 • • with constant-length-stroke pistons having variable effective portion of stroke **[1, 2006.01]**
59/26 • • • caused by movements of pistons relative to their cylinders **[1, 2006.01]**
59/28 • • • • Mechanisms therefor **[1, 2006.01]**
59/30 • • with variable-length-stroke pistons **[1, 2006.01]**
59/32 • • fuel delivery being controlled by means of fuel-displaced auxiliary pistons, which effect injection **[1, 2006.01]**
59/34 • • by throttling of passages to pumping elements or of overflow passages **[1, 2006.01]**
59/36 • • by variably-timed valves controlling fuel passages **[1, 2006.01]**
59/38 • Pumps characterised by adaptations to special uses or conditions **[1, 2006.01]**
59/40 • • for reversible engines **[1, 2006.01]**
59/42 • • for starting of engines **[1, 2006.01]**
59/44 • Details, component parts, or accessories not provided for in, or of interest apart from, the apparatus of groups F02M 59/02-F02M 59/42 **[1, 2006.01]**
59/46 • • Valves (in general F16K) **[1, 2006.01]**
59/48 • • Assembling; Disassembling; Replacing **[1, 2006.01]**

61/00 Fuel injectors not provided for in groups F02M 39/00-F02M 57/00 or F02M 67/00 [1, 2006.01]
61/02 • of valveless type **[1, 2006.01]**
61/04 • having valves (valves in general F16K) **[1, 2006.01]**
61/06 • • the valves being furnished at seated ends with pintle- or plug-shaped extensions **[1, 2006.01]**
61/08 • • the valves opening in direction of fuel flow **[1, 2006.01]**
61/10 • • Other injectors with elongated valve bodies, i.e. of needle-valve type **[1, 2006.01]**
61/12 • • • characterised by the provision of guiding or centring means for valve bodies **[1, 2006.01]**
61/14 • Arrangements of injectors with respect to engines; Mounting of injectors **[1, 2006.01]**
61/16 • Details not provided for in, or of interest apart from, the apparatus of groups F02M 61/02-F02M 61/14 **[1, 2006.01]**
61/18 • • Injection nozzles, e.g. having valve-seats **[1, 2006.01]**
61/20 • • Closing valves mechanically, e.g. arrangements of springs or weights **[1, 2006.01]**

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 [1, 2006.01]
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 provisions for cutting-out pumps, pumping elements, or injectors; Fuel-injection apparatus having provisions for variably interconnecting pumping elements and injectors alternatively **[1, 2006.01]**
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. of constant-pressure pump or accumulator, when that mechanism releases the valve **[1, 2006.01]**
63/06 • Use of pressure wave generated by fuel inertia to open injection valves **[1, 2006.01]**

65/00 Testing fuel-injection apparatus, e.g. testing injection timing [1, 2006.01]

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) **[1, 2006.01]**
67/02 • the gas being compressed air, e.g. compressed in pumps (arrangements or adaptations of such pumps F02B) **[1, 2006.01]**
67/04 • • the air being extracted from working cylinders of the engine **[1, 2006.01]**
67/06 • the gas being other than air, e.g. steam, combustion gas **[1, 2006.01]**
67/08 • • the gas being generated by combustion of part of fuel other than in engine working cylinders **[1, 2006.01]**
67/10 • Injectors peculiar thereto, e.g. of valveless type **[1, 2006.01]**
67/12 • • having valves **[1, 2006.01]**
67/14 • characterised by provisions for injecting different fuels, e.g. main fuel and readily self-igniting starting-fuel **[1, 2006.01]**

69/00 Low-pressure fuel-injection apparatus (electrically-operated F02M 51/00) **[1, 2006.01]**
69/02 • Pumps peculiar thereto **[1, 2006.01]**
69/04 • Injectors peculiar thereto **[1, 2006.01]**
69/06 • characterised by the pressurisation of the fuel being caused by centrifugal force acting on the fuel **[1, 2006.01]**
69/08 • characterised by the fuel being carried by compressed air into main stream of combustion-air **[1, 2006.01]**
69/10 • peculiar to scavenged two-stroke engines, e.g. injecting into crankcase-pump chamber **[1, 2006.01]**
69/12 • comprising a fuel-displaced free piston for intermittently metering and supplying fuel to injection nozzles **[5, 2006.01]**
69/14 • having cyclically-operated valves connecting injection nozzles to a source of fuel under pressure during the injection period **[5, 2006.01]**

69/16 • characterised by means for metering continuous fuel flow to injectors or means for varying fuel pressure upstream of injectors **[5, 2006.01]**

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) **[5, 2006.01]**

69/20 • • • the device being a servo-motor, e.g. using engine intake air pressure or vacuum (F02M 69/22 takes precedence) **[5, 2006.01]**

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 **[5, 2006.01]**

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 **[5, 2006.01]**

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 **[5, 2006.01]**

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 **[5, 2006.01]**

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) **[5, 2006.01]**

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 **[5, 2006.01]**

69/34 • • with an auxiliary fuel circuit supplying fuel to the engine, e.g. with the fuel pump outlet being directly connected to the injection nozzles **[5, 2006.01]**

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 **[5, 2006.01]**

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) **[5, 2006.01]**

69/40 • • • using variably controlled air pressure, e.g. by modifying the intake air vacuum signal acting on the fuel metering device **[5, 2006.01]**

69/42 • • • using other means than variable fluid pressure, e.g. acting on the fuel metering device mechanically or electrically **[5, 2006.01]**

69/44 • characterised by means for supplying extra fuel to the engine on sudden air throttle opening, e.g at acceleration **[5, 2006.01]**

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 **[5, 2006.01]**

69/48 • • Arrangement of air sensors **[5, 2006.01]**

69/50 • • Arrangement of fuel distributors **[5, 2006.01]**

69/52 • • Arrangement of fuel metering devices **[5, 2006.01]**

69/54 • • Arrangement of fuel pressure regulators **[5, 2006.01]**

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) **[1, 2006.01]**

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) **[1, 2006.01]**

71/04 • with carburettor being used at starting or idling only and injection apparatus being used during normal operation of engine **[1, 2006.01]**

99/00 Subject matter not provided for in other groups of this subclass [2006.01]