

# CPC COOPERATIVE PATENT CLASSIFICATION

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

### ENGINES OR PUMPS

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

**F02D CONTROLLING COMBUSTION ENGINES** (cyclically operating valves for combustion engines [F01L](#); controlling combustion engine lubrication [F01M](#); cooling internal combustion engines [F01P](#); supplying combustion engines with combustible mixtures or constituents thereof, e.g. carburettors, injection pumps [F02M](#); starting of combustion engines [F02N](#); controlling of ignition [F02P](#); controlling gas-turbine plants, jet-propulsion plants, or combustion-product engine plants, [see the relevant subclasses for these plants](#))

#### NOTES

1. Attention is drawn to the notes preceding class [F01](#).
2. In this subclass, the following words are used with the meanings indicated:
  - "Fuel injection" means the introduction of a combustible substance into a space, e.g. cylinder, by means of a pressure source, e.g. a pump, continuously or cyclically acting behind the substance;
  - "Supercharging" means supplying to the working space, e.g. cylinder, combustion-air pressurised by means of a pressure source, e.g. a pump.

#### WARNING

In this subclass non-limiting references (in the sense of paragraph 39 of the Guide to the IPC) may still be displayed in the scheme.

**Controlling, e.g. regulating, fuel injection** (peculiar to engines characterised by their use of non-liquid fuels, pluralities of fuels, or non-fuel substances added to the combustible mixtures [F02D 19/00](#); peculiar to supercharged engines [F02D 23/00](#); automatic controllers for prime movers, in general [G05D](#))

**1/00 Controlling fuel-injection pumps, e.g. of high pressure injection type** ([F02D 3/00](#) takes precedence; controlling fuel-injection electrically [F02D 41/30](#) {pumping elements on fuel pressure acting for varying fuel delivery in quantity or timing [F02M](#)})

#### NOTE

- in this subclass the following indexing codes are used:

[F02D 2700/0282](#) and [F02D 2700/10](#)

- |           |   |           |   |
|-----------|---|-----------|---|
| 2001/0005 | . {Details, component parts or accessories of centrifugal governors}  | 2001/004  | . . {Arrangement of linkages between governor sleeve and pump control}  |
| 2001/001  | . . {Arrangement of centrifugal weights}  | 2001/0045 | . . {Arrangement of means for influencing governor characteristics by operator}   |
| 2001/0015 | . . . {the weights being cup-shaped and carrying governor springs}  | 2001/005  | . . . {varying main spring tension}   |
| 2001/002  | . . {Arrangement of governor springs}   | 2001/0055 | . . . {varying pivotal point of linkages between governor sleeve and pump control}  |
| 2001/0025 | . . . {having at least two springs, one of them being idling spring}  | 2001/006  | . . {Assembling; Disassembling; Replacing}  |
| 2001/003  | . . . {the main spring being active at maximum speed only}  | 2001/0065 | . . {Selection of particular materials}   |
| 2001/0035 | . . . {the main spring being active at all speeds, e.g. its tension varying with the load, i.e. the position of pump control} | 2001/007  | . {Means for adjusting stops for minimum and maximum fuel delivery}   |
|           |   | 2001/0075 | . . {using engine temperature, e.g. to adjust the idling speed at cold start}   |
|           |   | 2001/008  | . . {using intake air pressure, e.g. adjusting full load stop at high supercharging pressures}                                    |
|           |   | 2001/0085 | . {Arrangements using fuel pressure for controlling fuel delivery in quantity or timing}  |
|           |   | 2001/009  | . . {Means for varying the pressure of fuel supply pump according to engine working parameters}                                   |
|           |   | 2001/0095 | . {Mounting of control means with respect to injection apparatus or the engine}   |
|           |   | 1/02      | . not restricted to adjustment of injection timing, e.g. varying amount of fuel delivered   |
|           |   | 1/025     | . . {by means dependent on engine working temperature ( <a href="#">F02D 1/08</a> takes precedence)}                              |
|           |   | 1/04      | . . by mechanical means dependent on engine speed, e.g. using centrifugal governors ( <a href="#">F02D 1/08</a> takes precedence) |
|           |   | 1/045     | . . . {characterised by arrangement of springs or weights}  |

- 1/06 . . by means dependent on pressure of engine working fluid ([F02D 1/08 takes precedence](#))
- 1/065 . . . {of intake of air}
- 1/08 . . Transmission of control impulse to pump control, e.g. with power drive or power assistance
  - 2001/082 . . . {electric}
  - 2001/085 . . . . {using solenoids}
  - 2001/087 . . . . {using step motors}
  - 1/10 . . . mechanical
  - 1/12 . . . non-mechanical, e.g. hydraulic
  - 1/122 . . . . {control impulse depending only on engine speed}
  - 1/125 . . . . . {using a centrifugal governor}
  - 1/127 . . . . . {using the pressure developed in a pump}
  - 1/14 . . . . pneumatic
  - 1/16 . Adjustment of injection timing ([F02D 1/02 takes precedence](#) {rotary distributor pumps [F02M 41/00](#); by adjustment of pumping elements [F02M 59/20](#)})
  - 1/162 . . {by mechanical means dependent on engine speed for angular adjustment of driving and driven shafts}
  - 2001/165 . . {by means dependent on engine load}
  - 2001/167 . . {by means dependent on engine working temperature, e.g. at cold start}
  - 1/18 . . with non-mechanical means for transmitting control impulse; with amplification of control impulse
    - 1/183 . . . {hydraulic}
    - 2001/186 . . . . {using a pressure-actuated piston for adjustment of a stationary cam or roller support}

**3/00 Controlling low-pressure fuel injection, i.e. where the air-fuel mixture containing fuel thus injected will be substantially compressed by the compression stroke of the engine, by means other than controlling only an injection pump (controlling fuel-injection electrically [F02D 41/30](#); {controlling the feeding of liquid fuel from storage containers to carburettors or fuel-injection apparatus [F02D 33/003](#); } carburettors [F02M](#))**

#### NOTE

When the control apparatus or system forms part of the low-pressure fuel-injection apparatus it is classified in group [F02M 69/00](#).

- 3/02 . with continuous injection or continuous flow upstream of the injection nozzle
- 3/04 . Controlling fuel-injection and carburation, e.g. of alternative systems
- 7/00 Other fuel-injection control**
- 7/002 . {Throttling of fuel passages between pumps and injectors or overflow passages (low-pressure fuel injection [F02M 69/00](#))}
- 7/005 . . {by mechanical means, e.g. using a centrifugal governor}
- 7/007 . . {by fluid actuated means, e.g. slide valves}
- 7/02 . Controlling fuel injection where fuel is injected by compressed air
- 2007/025 . . {Controlling compressed air quantity or pressure}

#### NOTES

1. accelerator lever means a lever actuated by foot or hand (e.g. pedal).

2. throttle lever means a lever connected to the accelerator lever via a force transmitting element (e.g. cable, link) and mounted on the throttle axis.

#### 9/00 Controlling engines by throttling air or fuel-and-air induction conduits or exhaust conduits

##### NOTE

- in this group the following indexing codes are used: [F02D 2700/00](#), [F02D 2700/02](#), [F02D 2700/04](#), [F02D 2700/09](#)

- 9/02 . concerning induction conduits (throttle valves, or arrangements thereof in conduits [F02D 9/08](#))
- 2009/0201 . . {Arrangements; Control features; Details thereof}
- 2009/0203 . . . {Mechanical governor}
- 2009/0205 . . . {working on the throttle valve and another valve, e.g. choke}
- 2009/0206 . . . {specially positioned with relation to engine or engine housing}
- 2009/0208 . . . {for small engines}
- 2009/021 . . . {combined with an electromechanical governor, e.g. centrifuged governor and electric governor acting on the governor lever}
- 2009/0211 . . . {combined with another mechanical or pneumatic governor}
- 2009/0213 . . . {Electronic or electric governor}
- 2009/0215 . . . {Pneumatic governor}
- 2009/0216 . . . {of the air-vane type}
- 2009/0218 . . . {Details of governor springs}
- 2009/022 . . . {Throttle control function parameters}
- 2009/0222 . . . {Exhaust gas temperature}
- 2009/0223 . . . {Cooling water temperature}
- 2009/0225 . . . {Intake air or mixture temperature}
- 2009/0227 . . . {Atmospheric pressure}
- 2009/0228 . . . {Manifold pressure}
- 2009/023 . . . {Engine speed}
- 2009/0232 . . . {Fuel pump rack position}
- 2009/0233 . . . {Engine vibration}
- 2009/0235 . . . {Throttle control functions}
- 2009/0237 . . . {Increasing combustion chamber gas temperature}
- 2009/0238 . . . {Increasing ignition delay}
- 2009/024 . . . {Increasing intake vacuum}
- 2009/0242 . . . {Increasing exhaust brake effect}
- 2009/0244 . . . {Choking air flow at low speed and load}
- 2009/0245 . . . {Shutting down engine, e.g. working together with fuel cut-off}
- 2009/0247 . . . {Opening the throttle a little on engine shutdown}
- 2009/0249 . . . {Starting engine, e.g. closing throttle in Diesel engine to reduce starting torque}
- 2009/025 . . . {Opening the throttle a little during starting}
- 2009/0252 . . . {Opening a special valve-controlled intake passage (by-pass) during starting}
- 2009/0254 . . . {Mechanical control linkage between accelerator lever and throttle valve}
- 2009/0255 . . . {with means for correcting throttle position, e.g. throttle cable of variable length}
- 2009/0257 . . . {having a pin and slob connection ("Leerweg")}

2009/0259	. . . {having a dashpot, e.g. working in the throttle opening and closing directions}	9/08	. Throttle valves specially adapted therefor; Arrangements of such valves in conduits (throttle valves modified for use in or arranged in carburettors F02M; throttle valves in general F16K)
2009/0261	. . . {having a specially shaped transmission member, e.g. a cam, specially toothed gears, with a clutch}	9/10	. . having pivotally-mounted flaps
2009/0262	. . . {having two or more levers on the throttle shaft}	9/1005	. . . {Details of the flap}
2009/0264	. . . {in which movement is transmitted through a spring}	9/101	. . . . {Special flap shapes, ribs, bores or the like}
2009/0266	. . . {in which movement is transmitted through a vacuum motor}	9/1015	. . . . . {Details of the edge of the flap, e.g. for lowering flow noise or improving flow sealing in closed flap position}
2009/0267	. . . {for simultaneous action of a governor and an accelerator lever on the throttle}	9/102	. . . . {the flap having movable parts fixed onto it}
2009/0269	. . . {Throttle closing springs; Acting of throttle closing springs on the throttle shaft}	9/1025	. . . . {the rotation axis of the flap being off-set from the flap center axis}
2009/0271	. . . {with means for closing the throttle other than throttle closing springs}	9/103	. . . . . {the rotation axis being located at an edge}
2009/0272	. . . {Two or more throttles disposed in series}	9/1035	. . . {Details of the valve housing}
2009/0274	. . . {one being controlled by pressure in intake conduit, e.g. for slowly opening the throttle as the other valve is suddenly opened}	9/104	. . . . {Shaping of the flow path in the vicinity of the flap, e.g. having inserts in the housing}
2009/0276	. . . {Throttle and EGR-valve operated together}	9/1045	. . . . . {for sealing of the flow in closed flap position, e.g. the housing forming a valve seat}
2009/0277	. . . {Fail-safe mechanisms, e.g. with limp-home feature, to close throttle if actuator fails, or if control cable sticks or breaks}	9/105	. . . . {having a throttle position sensor (detection of actuation F02D 11/106)}
2009/0279	. . . {Throttle valve control for intake system with two parallel air flow paths, each controlled by a throttle, e.g. a resilient flap disposed on a throttle}	9/1055	. . . . {having a fluid by-pass}
2009/0281	. . . {with means for detecting malfunction of one throttle and actuating only the correctly working throttle}	9/106	. . . . {Sealing of the valve shaft in the housing, e.g. details of the bearings}
2009/0283	. . . {Throttle in the form of an expander}	9/1065	. . . {Mechanical control linkage between an actuator and the flap, e.g. including levers, gears, springs, clutches, limit stops of the like}
2009/0284	. . . {Throttle control device with means for signalling a certain throttle opening, e.g. by a steplike increase of throttle closing spring force}	9/107	. . . {Manufacturing or mounting details}
2009/0286	. . . {Throttle control device with accelerator lever defining a stop for opening the throttle, e.g. the throttle itself being opened by air flow, a spring}	9/1075	. . . {Materials, e.g. composites}
2009/0288	. . . {Throttle control device specially adapted for spark-assisted compression-ignition engine (Diesel engine)}	9/108	. . . . {Plastics}
2009/0289	. . . {Throttle control device with means for establishing a variable resistance torque during throttle opening}	9/1085	. . . . {Non-organic materials, e.g. metals, alloys, ceramics}
2009/0291	. . . {Throttle control device for throttle being disposed in a two-stroke engine transfer passage}	9/109	. . . {having two or more flaps}
2009/0293	. . . {Throttle control device adapted to limit power development at low attitude}	9/1095	. . . . {Rotating on a common axis, e.g. having a common shaft}
2009/0294	. . . {Throttle control device with provisions for actuating electric or electronic sensors}	9/12	. . having slidably-mounted valve members; having valve members movable longitudinally of conduit
2009/0296	. . . {Throttle control device with stops for limiting throttle opening or closing beyond a certain position during certain periods of operation}	9/14	. . . the members being slidable transversely of conduit
2009/0298	. . . {Throttle control device with holding devices, i.e. to hold throttle in a predetermined position}	9/16	. . . the members being rotatable
9/04	. concerning exhaust conduits (throttle valves, or arrangements thereof in conduits F02D 9/08)	9/18	. . having elastic-wall valve members
9/06	. . Exhaust brakes	11/00	<b>Arrangements for, or adaptations to, non-automatic engine control initiation means, e.g. operator initiated (specially for reversing F02D 27/00; arrangement or mounting of prime-mover control devices in vehicles B60K 26/00)</b>
		11/02	. characterised by hand, foot, or like operator controlled initiation means
		11/04	. characterised by mechanical control linkages (with power drive or assistance F02D 11/06)
		11/06	. characterised by non-mechanical control linkages, e.g. fluid control linkages or by control linkages with power drive or assistance
		11/08	. . of the pneumatic type
		11/10	. . of the electric type
		2011/101	. . . {characterised by the means for actuating the throttles}
		2011/102	. . . . {at least one throttle being moved only by an electric actuator}
		2011/103	. . . . {at least one throttle being alternatively mechanically linked to the pedal or moved by an electric actuator}

- 2011/104 . . . . {using electric step motors}
- 11/105 . . . {characterised by the function converting demand to actuation, e.g. a map indicating relations between an accelerator pedal position and throttle valve opening or target engine torque}
- 11/106 . . . {Detection of demand or actuation}
- 11/107 . . . {Safety-related aspects}
- 2011/108 . . . {with means for detecting or resolving a stuck throttle, e.g. when being frozen in a position}
- 13/00 Controlling the engine output power by varying inlet or exhaust valve operating characteristics, e.g. timing (modifying valve gear F01L)**
  - 2013/005 . {of throttleless spark ignited engines}
  - 13/02 . during engine operation
  - 13/0203 . . {Variable control of intake and exhaust valves}
  - 13/0207 . . . {changing valve lift or valve lift and timing}
  - 13/0211 . . . . {the change of valve timing is caused by the change in valve lift, i.e. both valve lift and timing are functionally related}
  - 13/0215 . . . {changing the valve timing only}
  - 13/0219 . . . . {by shifting the phase, i.e. the opening periods of the valves are constant}
  - 13/0223 . . {Variable control of the intake valves only}
  - 13/0226 . . . {changing valve lift or valve lift and timing}
  - 13/023 . . . . {the change of valve timing is caused by the change in valve lift, i.e. both valve lift and timing are functionally related}
  - 13/0234 . . . {changing the valve timing only}
  - 13/0238 . . . . {by shifting the phase, i.e. the opening periods of the valves are constant}
  - 13/0242 . . {Variable control of the exhaust valves only}
  - 13/0246 . . . {changing valve lift or valve lift and timing}
  - 13/0249 . . . {changing the valve timing only}
  - 13/0253 . . {Fully variable control of valve lift and timing using camless actuation systems such as hydraulic, pneumatic or electromagnetic actuators, e.g. solenoid valves}
  - 13/0257 . . {Independent control of two or more intake or exhaust valves respectively, i.e. one of two intake valves remains closed or is opened partially while the other is fully opened}
  - 13/0261 . . {Controlling the valve overlap}
  - 13/0265 . . . {Negative valve overlap for temporarily storing residual gas in the cylinder}
  - 13/0269 . . {Controlling the valves to perform a Miller-Atkinson cycle}
  - 13/0273 . . {Multiple actuations of a valve within an engine cycle}
  - 13/0276 . . {Actuation of an additional valve for a special application, e.g. for decompression, exhaust gas recirculation or cylinder scavenging}
  - 13/028 . . {for two-stroke engines}
  - 13/0284 . . . {Variable control of exhaust valves only}
  - 2013/0288 . . . . {for cleaning the valves}
  - 2013/0292 . . {in the start-up phase, e.g. for warming-up cold engine or catalyst}
  - 2013/0296 . . {Changing the valve lift only}
  - 13/04 . . using engine as brake
  - 13/06 . . Cutting-out cylinders
  - 13/08 . . for rendering engine inoperative or idling

## 15/00 Varying compression ratio (modifying valve gear F01L)

### NOTE

- in this group the following indexing codes are used:

[F02D 2700/03](#)

15/02 . by alteration or displacement of piston stroke

15/04 . by alteration of volume of compression space without changing piston stroke

## 17/00 Controlling engines by cutting out individual cylinders; Rendering engines inoperative or idling (controlling or rendering inoperative by varying inlet or exhaust valve operating characteristics F02D 13/00)

### NOTE

- in this group the following indexing codes are used:

[F02D 2700/05](#)

17/02 . Cutting-out (cutting-out engines in multiple engine arrangements [F02D 25/04](#))

17/023 . . {the inactive cylinders acting as compressor other than for pumping air into the exhaust system}

17/026 . . . {delivering compressed fluid, e.g. air, reformed gas, to the active cylinders other than during starting}

17/04 . rendering engines inoperative or idling, e.g. caused by abnormal conditions (dependent on lubricating conditions [F01M 1/22](#); dependent on cooling [F01P 5/14](#))

## Controlling peculiar to specified types or adaptations of engines

## 19/00 Controlling engines characterised by their use of non-liquid fuels, pluralities of fuels, or non-fuel substances added to the combustible mixtures (the non-fuel substances being gaseous F02D 21/00)

19/02 . peculiar to engines working with gaseous fuels (apparatus, or control parts thereof, for mixing gas and air [F02M](#))

19/021 . . {Control of components of the fuel supply system}

19/022 . . . {to adjust the fuel pressure, temperature or composition}

19/023 . . . {to adjust the fuel mass or volume flow}

19/024 . . . . {by controlling fuel injectors}

19/025 . . {Failure diagnosis or prevention; Safety measures; Testing}

19/026 . . {Measuring or estimating parameters related to the fuel supply system}

19/027 . . . {Determining the fuel pressure, temperature or volume flow, the fuel tank fill level or a valve position}

19/028 . . . . {by estimation, i.e. without using direct measured parameter of a corresponding sensor}

19/029 . . . {Determining density, viscosity, concentration or composition}

19/04 . peculiar to engines working with solid fuels, e.g. pulverised coal

19/06 . peculiar to engines working with pluralities of fuels, e.g. alternatively with light and heavy fuel oil, other than engines indifferent to the fuel consumed



- 19/0602 . . {Control of components of the fuel supply system}
- 19/0605 . . . {to adjust the fuel pressure or temperature}
- 19/0607 . . . {to adjust the fuel mass or volume flow}
- 19/061 . . . . {by controlling fuel injectors}
- 19/0613 . . . {Switch-over from one fuel to another ([F02D 19/081 takes precedence](#))}
- 19/0615 . . . . {being initiated by automatic means, e.g. based on engine or vehicle operating conditions}
- 19/0618 . . . . {depending on the engine's or vehicle's position, e.g. on/off road or proximity to a harbor}
- 19/0621 . . . . {Purging of the fuel system}
- 19/0623 . . {Failure diagnosis or prevention; Safety measures; Testing}
- 19/0626 . . {Measuring or estimating parameters related to the fuel supply system}
- 19/0628 . . . {Determining the fuel pressure, temperature or flow, the fuel tank fill level or a valve position}
- 19/0631 . . . . {by estimation, i.e. without using direct measurements of a corresponding sensor}
- 19/0634 . . . {Determining a density, viscosity, composition or concentration ([F02D 19/087 takes precedence](#))}
- 19/0636 . . . . {by estimation, i.e. without using direct measurements of a corresponding sensor}
- 19/0639 . . {characterised by the type of fuels}
- 19/0642 . . . {at least one fuel being gaseous, the other fuels being gaseous or liquid at standard conditions}
- 19/0644 . . . . {the gaseous fuel being hydrogen, ammonia or carbon monoxide}
- 19/0647 . . . . {the gaseous fuel being liquefied petroleum gas [LPG], liquefied natural gas [LNG], compressed natural gas [CNG] or dimethyl ether [DME]}
- 19/0649 . . . {Liquid fuels having different boiling temperatures, volatilities, densities, viscosities, cetane or octane numbers}
- 19/0652 . . . . {Biofuels, e.g. plant oils}
- 19/0655 . . . . . {at least one fuel being an alcohol, e.g. ethanol ([F02D 19/084 takes precedence](#))}
- 19/0657 . . . . {Heavy or light fuel oils; Fuels characterised by their impurities such as sulfur content or differences in grade, e.g. for ships}
- 19/066 . . {Retrofit of secondary fuel supply systems; Conversion of engines to operate on multiple fuels}
- 19/0663 . . {Details on the fuel supply system, e.g. tanks, valves, pipes, pumps, rails, injectors or mixers}
- 19/0665 . . . {Tanks, e.g. multiple tanks}
- 19/0668 . . . {Treating or cleaning means; Fuel filters}
- 19/0671 . . . . {Means to generate or modify a fuel, e.g. reformers, electrolytic cells or membranes}
- 19/0673 . . . {Valves; Pressure or flow regulators; Mixers}
- 19/0676 . . . . {Multi-way valves; Switch-over valves}
- 19/0678 . . . . {Pressure or flow regulators therefor; Fuel metering valves therefor}
- 19/0681 . . . . {Shut-off valves; Check valves; Safety valves; Pressure relief valves}
- 19/0684 . . . {High pressure fuel injection systems; Details on pumps, rails or the arrangement of valves in the fuel supply and return systems}
- 19/0686 . . . {Injectors}
- 19/0689 . . . . {for in-cylinder direct injection}
- 19/0692 . . . . {Arrangement of multiple injectors per combustion chamber}
- 19/0694 . . . . {operating with a plurality of fuels}
- 19/0697 . . . {Arrangement of fuel supply systems on engines or vehicle bodies; Components of the fuel supply system being combined with another device}
- 19/08 . . simultaneously using pluralities of fuels ([F02D 19/12 takes precedence](#))
- 19/081 . . . {Adjusting the fuel composition or mixing ratio; Transitioning from one fuel to the other}
- 19/082 . . . {Premixed fuels, i.e. emulsions or blends}
- 19/084 . . . . {Blends of gasoline and alcohols, e.g. E85}
- 19/085 . . . . {Control based on the fuel type or composition}
- 19/087 . . . . . {with determination of densities, viscosities, composition, concentration or mixture ratios of fuels}
- 19/088 . . . . . {by estimation, i.e. without using direct measurements of a corresponding sensor}
- 19/10 . . . peculiar to compression-ignition engines in which the main fuel is gaseous
- 19/105 . . . . {operating in a special mode, e.g. in a liquid fuel only mode for starting}
- 19/12 . . peculiar to engines working with non-fuel substances or with anti-knock agents, e.g. with anti-knock fuel ([apparatus, or control parts thereof for delivering such substances or agents F02M](#))
- 21/00 Controlling engines characterised by their being supplied with non-airborne oxygen or other non-fuel gas**
- 21/02 . . peculiar to oxygen-fed engines
- 21/04 . . with circulation of exhaust gases in closed or semi-closed circuits
- 21/06 . . peculiar to engines having other non-fuel gas added to combustion air
- 21/08 . . the other gas being the exhaust gas of engine ([circulation of exhaust gas in oxygen-fed engines F02D 21/04](#))
- 2021/083 . . . {controlling exhaust gas recirculation electronically}
- 2021/086 . . . {the exhaust gas recirculation valve being controlled by fuel pressure, e.g. indirectly}
- 21/10 . . having secondary air added to the fuel-air mixture ([apparatus, or control parts thereof, for delivering secondary air F02M](#))
- 23/00 Controlling engines characterised by their being supercharged**
- 23/005 . . {with the supercharger being mechanically driven by the engine ([supercharger drives F02B 39/00](#))}
- 23/02 . . the engines being of fuel-injection type
- 25/00 Controlling two or more co-operating engines**
- 25/02 . . to synchronise speed
- 25/04 . . by cutting-out engines
- 27/00 Controlling engines characterised by their being reversible**
- 27/02 . . by performing a programme

**28/00** Programme-control of engines (programme-control specific to a type or purpose covered by one of the groups of this subclass except groups [F02D 29/00](#), [F02D 39/00](#), or by one group of another subclass, e.g. [F01L](#), see that group; programme-control in general [G05B 19/00](#))

**29/00** Controlling engines, such controlling being peculiar to the devices driven thereby, the devices being other than parts or accessories essential to engine operation, e.g. controlling of engines by signals external thereto

**NOTE**

- in this group the following indexing codes are used: [F02D 2700/07](#)

- 29/02 . peculiar to engines driving vehicles; peculiar to engines driving variable pitch propellers
- 29/04 . peculiar to engines driving pumps
- 29/06 . peculiar to engines driving electric generators

**Other controlling of engines**

**31/00** Use of speed-sensing governors to control combustion engines, not otherwise provided for

- 31/001 . {Electric control of rotation speed}
- 31/002 . . {controlling air supply}
- 31/003 . . . {for idle speed control}
- 31/004 . . . . {by controlling a throttle stop}
- 31/005 . . . . {by controlling a throttle by-pass}
- 31/006 . . . {for maximum speed control}
- 31/007 . . {controlling fuel supply}
- 31/008 . . . {for idle speed control}
- 31/009 . . . {for maximum speed control}

**33/00** Controlling delivery of fuel or combustion-air, not otherwise provided for {(using exhaust gas sensors [F02D 35/0023](#), [F02D 35/0046](#))}

- 33/003 . {Controlling the feeding of liquid fuel from storage containers to carburettors or fuel-injection apparatus (control of electrical fuel pumps [F02D 41/3082](#), controlling fuel flow to a common rail [F02D 41/3845](#)); Failure or leakage prevention; Diagnosis or detection of failure; Arrangement of sensors in the fuel system; Electric wiring; Electrostatic discharge}
- 33/006 . . {depending on engine operating conditions, e.g. start, stop or ambient conditions}
- 33/02 . of combustion-air

**35/00** Controlling engines, dependent on conditions exterior or interior to engines, not otherwise provided for

- 35/0007 . {using electrical feedback ([F02D 35/0015](#) takes precedence)}

**NOTE**

Attention is drawn to the note preceding [F02D 41/00](#).

- 35/0015 . {using exhaust gas sensors ([F02D 41/14](#) takes precedence)}
- 35/0023 . . {Controlling air supply}
- 35/003 . . . {by means of by-pass passages}
- 35/0038 . . . {by means of air pumps}
- 35/0046 . . {Controlling fuel supply}

- 35/0053 . . . {by means of a carburettor}
- 35/0061 . . . . {Controlling the emulsifying air only ([F02D 35/0076](#), [F02D 35/0084](#) take precedence)}
- 35/0069 . . . . {Controlling the fuel flow only ([F02D 35/0076](#), [F02D 35/0084](#) take precedence)}
- 35/0076 . . . . {using variable venturi carburettors}
- 35/0084 . . . . {using two barrel carburettors}
- 35/0092 . . . {by means of fuel injection}
- 35/02 . on interior conditions
- 35/021 . . {using an ionic current sensor}
- 35/022 . . {using an optical sensor, e.g. in-cylinder light probe}
- 35/023 . . {by determining the cylinder pressure}
- 35/024 . . . {using an estimation}
- 35/025 . . {by determining temperatures inside the cylinder, e.g. combustion temperatures}
- 35/026 . . . {using an estimation}
- 35/027 . . {using knock sensors}
- 35/028 . . {by determining the combustion timing or phasing}

**37/00** Controlling conjointly two or more functions of engines, not otherwise provided for

- 37/02 . one of the functions being ignition (ignition control per se [F02P](#) {, automatically advancing or retarding ignition combined with electronic control of other engine functions, e.g. fuel injection [F02P 5/045](#)})

**39/00** Other non-electrical control

- 39/02 . for four-stroke engines
- 39/04 . for engines with other cycles than four-stroke, e.g. two-stroke
- 39/06 . for engines adding the fuel substantially at the end of compression stroke
- 39/08 . for engines adding the fuel substantially before compression stroke
- 39/10 . for free-piston engines; for engines without rotary main shaft

**Electrical control of combustion engines**

**NOTES**

1. Groups [F02D 41/00](#) - [F02D 45/00](#) cover electrical aspects of electrically controlled devices.
2. Groups [F02D 41/00](#) - [F02D 45/00](#) do not cover
  - non-electrical aspects of electrically controlled devices, which are covered by groups [F02D 1/00](#) - [F02D 39/00](#) or by subclass [F02M](#);
  - both electrical and non-electrical aspects of electrically controlled devices, which are covered by groups [F02D 1/00](#) - [F02D 39/00](#) or by subclass [F02M](#)

**41/00** Electrical control of supply of combustible mixture or its constituents ([F02D 43/00](#) takes precedence {; control of engine starters [F02N 11/08](#), electrical control of engine ignition timing [F02P 5/145](#)})

- 41/0002 . {Controlling intake air}
- 41/0005 . . {during deceleration}
- 41/0007 . . {for control of turbo-charged or super-charged engines (control of the pumps per se [F02B 37/12](#))}
- 2041/001 . . {for engines with variable valve actuation}
- 2041/0012 . . . {with selective deactivation of cylinders}

- 2041/0015 . . {for engines with means for controlling swirl or tumble flow, e.g. by using swirl valves}
- 2041/0017 . . {by simultaneous control of throttle and exhaust gas recirculation}
- 2041/002 . . {by simultaneous control of throttle and variable valve actuation}
- 2041/0022 . . {for diesel engines by throttle control}
- 41/0025 . {Controlling engines characterised by use of non-liquid fuels, pluralities of fuels, or non-fuel substances added to the combustible mixtures}
- 41/0027 . . {the fuel being gaseous (non-electrical control [F02D 19/02](#))}
- 41/003 . . {Adding fuel vapours, e.g. drawn from engine fuel reservoir}
- 41/0032 . . . {Controlling the purging of the canister as a function of the engine operating conditions}
- 41/0035 . . . . {to achieve a special effect, e.g. to warm up the catalyst}
- 41/0037 . . . . {for diagnosing the engine (diagnosis of purge control systems [F02M 25/0809](#))}
- 41/004 . . . . {Control of the valve or purge actuator, e.g. duty cycle, closed loop control of position}
- 41/0042 . . . {Controlling the combustible mixture as a function of the canister purging, e.g. control of injected fuel to compensate for deviation of air fuel ratio when purging}
- 41/0045 . . . {Estimating, calculating or determining the purging rate, amount, flow or concentration}
- 41/0047 . . {Controlling exhaust gas recirculation [EGR] (temperature control with cooler in recirculation circuit [F02M 26/33](#))}
- 41/005 . . . {according to engine operating conditions}
- 41/0052 . . . . {Feedback control of engine parameters, e.g. for control of air/fuel ratio or intake air amount}
- 41/0055 . . . . {Special engine operating conditions, e.g. for regeneration of exhaust gas treatment apparatus}
- 41/0057 . . . . {Specific combustion modes (combustion modes [per se F02D 41/3017](#))}
- 41/006 . . . {using internal EGR (control of valve overlap for internal EGR [F02D 13/0261](#); arrangements for internal EGR [F02M 26/01](#))}
- 41/0062 . . . . {Estimating, calculating or determining the internal EGR rate, amount or flow}
- 41/0065 . . . {Specific aspects of external EGR control (constructional details of EGR system [F02M 26/00](#))}
- 2041/0067 . . . . {Determining the EGR temperature}
- 2041/007 . . . . {by estimation}
- 41/0072 . . . . {Estimating, calculating or determining the EGR rate, amount or flow (sensors in EGR systems [F02M 26/45](#))}
- 2041/0075 . . . . . {by using flow sensors}
- 41/0077 . . . {Control of the EGR valve or actuator, e.g. duty cycle, closed loop control of position (EGR valve position sensor [F02M 26/48](#))}
- 41/008 . {Controlling each cylinder individually}
- 41/0082 . . {per groups or banks ([F02D 41/0087](#) takes precedence)}
- 41/0085 . . {Balancing of cylinder outputs, e.g. speed, torque or air-fuel ratio}
- 41/0087 . . {Selective cylinder activation, i.e. partial cylinder operation (deceleration cut-off [F02D 41/123](#))}
- 41/009 . {using means for generating position or synchronisation signals}
- 2041/0092 . . {Synchronisation of the cylinders at engine start}
- 2041/0095 . . {Synchronisation of the cylinders during engine shutdown}
- 41/0097 . {using means for generating speed signals}
- 41/02 . Circuit arrangements for generating control signals
- 41/0205 . . {using an auxiliary engine speed control ([engine speed control per se F02D 31/00](#))}
- 41/021 . . {Introducing corrections for particular conditions exterior to the engine (conjoint control of vehicle sub-units for propelling the vehicle [B60W 30/18](#))}
- 41/0215 . . . . {in relation with elements of the transmission}
- 41/022 . . . . {in relation with the clutch status}
- 41/0225 . . . . {in relation with the gear ratio or shift lever position}
- 41/023 . . . . {in relation with the gear ratio shifting (conjoint control for improving gear change [B60W 30/19](#))}
- 41/0235 . . . {in relation with the state of the exhaust gas treating apparatus ([control of exhaust gas treating apparatus per se F01N](#))}
- 41/024 . . . . {to increase temperature of the exhaust gas treating apparatus}
- 41/0245 . . . . . {by increasing temperature of the exhaust gas leaving the engine}
- 41/025 . . . . . {by changing the composition of the exhaust gas, e.g. for exothermic reaction on exhaust gas treating apparatus}
- 41/0255 . . . . . {to accelerate the warming-up of the exhaust gas treating apparatus at engine start}
- 2041/026 . . . . . {using an external load, e.g. by increasing generator load or by changing the gear ratio}
- 2041/0265 . . . . . {to decrease temperature of the exhaust gas treating apparatus}
- 41/027 . . . . {to purge or regenerate the exhaust gas treating apparatus}
- 41/0275 . . . . . {the exhaust gas treating apparatus being a NOx trap or adsorbent}
- 41/028 . . . . . {Desulfurisation of NOx traps or adsorbent}
- 41/0285 . . . . . {the exhaust gas treating apparatus being a SOx trap or adsorbent}
- 41/029 . . . . . {the exhaust gas treating apparatus being a particulate filter}
- 41/0295 . . . . {Control according to the amount of oxygen that is stored on the exhaust gas treating apparatus}
- 41/04 . . Introducing corrections for particular operating conditions ([F02D 41/14](#) takes precedence)
- 41/042 . . . {for stopping the engine}
- 41/045 . . . {Detection of accelerating or decelerating state (detection thereof in general [G01P](#))}
- 41/047 . . . {Taking into account fuel evaporation or wall wetting; (special correction after fuel cut-off [F02D 41/126](#))}
- 41/06 . . . for engine starting or warming up ({[F02D 41/0255](#) takes precedence})
- 41/061 . . . . {the corrections being time dependent}
- 41/062 . . . . {for starting ([F02D 41/061](#) takes precedence)}

41/064	. . . . .	{ at cold start ( <a href="#">F02D 41/067</a> takes precedence)}	2041/1429	. . . . .	{Linearisation, i.e. using a feedback law such that the system evolves as a linear one}
41/065	. . . . .	{ at hot start or restart ( <a href="#">F02D 41/067</a> takes precedence)}	2041/143	. . . . .	{the control loop including a non-linear model or compensator}
41/067	. . . . .	{ with control of the choke (non electronic control of choke see <a href="#">F02M 1/10</a> )}	2041/1431	. . . . .	{the system including an input-output delay}
41/068	. . . . .	{for warming-up}	2041/1432	. . . . .	{the system including a filter, e.g. a low pass or high pass filter}
41/08	. . .	for idling ( <a href="#">F02D 41/06</a> , <a href="#">F02D 41/16</a> take precedence)	2041/1433	. . . . .	{using a model or simulation of the system}
41/083	. . . . .	{taking into account engine load variation, e.g. air-conditioning}	2041/1434	. . . . .	{Inverse model}
41/086	. . . . .	{taking into account the temperature of the engine}	2041/1436	. . . . .	{Hybrid model}
41/10	. . .	for acceleration	2041/1437	. . . . .	{Simulation}
41/102	. . . . .	{Switching from sequential injection to simultaneous injection}	41/1438	. . .	{using means for determining characteristics of the combustion gases; Sensors therefor}
41/105	. . . . .	{using asynchronous injection}	41/1439	. . . . .	{characterised by the position of the sensor}
41/107	. . . . .	{and deceleration}	41/144	. . . . .	{Sensor in intake manifold}
41/12	. . .	for deceleration { ( <a href="#">F02D 41/0005</a> , <a href="#">F02D 41/107</a> take precedence)}	41/1441	. . . . .	{Plural sensors}
41/123	. . . . .	{the fuel injection being cut-off}	41/1443	. . . . .	{with one sensor per cylinder or group of cylinders}
41/126	. . . . .	{transitional corrections at the end of the cut-off period}	41/1444	. . . . .	{characterised by the characteristics of the combustion gases}
41/14	. .	Introducing closed-loop corrections	41/1445	. . . . .	{the characteristics being related to the exhaust flow}
41/1401	. . .	{characterised by the control or regulation method ( <a href="#">F02D 41/1473</a> , <a href="#">F02D 41/1477</a> take precedence)}	41/1446	. . . . .	{the characteristics being exhaust temperatures}
41/1402	. . . . .	{Adaptive control}	41/1447	. . . . .	{with determination means using an estimation}
41/1403	. . . . .	{Sliding mode control}	41/1448	. . . . .	{the characteristics being an exhaust gas pressure}
41/1404	. . . . .	{Fuzzy logic control}	41/145	. . . . .	{with determination means using an estimation}
41/1405	. . . . .	{Neural network control}	41/1451	. . . . .	{the sensor being an optical sensor}
41/1406	. . . . .	{with use of a optimisation method, e.g. iteration}	41/1452	. . . . .	{the characteristics being a CO <sub>x</sub> content or concentration}
41/1408	. . . . .	{Dithering techniques}	41/1453	. . . . .	{the characteristics being a CO content or concentration}
2041/1409	. . . . .	{using at least a proportional, integral or derivative controller}	41/1454	. . . . .	{the characteristics being an oxygen content or concentration or the air-fuel ratio}
2041/141	. . . . .	{using a feed-forward control element}	41/1455	. . . . .	{with sensor resistivity varying with oxygen concentration ( <a href="#">F02D 41/1456</a> takes precedence)}
2041/1411	. . . . .	{using a finite or infinite state machine, automaton or state graph for controlling or modelling}	41/1456	. . . . .	{with sensor output signal being linear or quasi-linear with the concentration of oxygen}
2041/1412	. . . . .	{using a predictive controller}	41/1458	. . . . .	{with determination means using an estimation}
2041/1413	. . . . .	{Controller structures or design}	41/1459	. . . . .	{the characteristics being a hydrocarbon content or concentration}
2041/1415	. . . . .	{using a state feedback or a state space representation}	41/146	. . . . .	{the characteristics being an NO <sub>x</sub> content or concentration}
2041/1416	. . . . .	{Observer}	41/1461	. . . . .	{of the exhaust gases emitted by the engine}
2041/1417	. . . . .	{Kalman filter}	41/1462	. . . . .	{with determination means using an estimation}
2041/1418	. . . . .	{Several control loops, either as alternatives or simultaneous}	41/1463	. . . . .	{of the exhaust gases downstream of exhaust gas treatment apparatus}
2041/1419	. . . . .	{the control loops being cascaded, i.e. being placed in series or nested}	41/1465	. . . . .	{with determination means using an estimation}
2041/142	. . . . .	{using different types of control law in combination, e.g. adaptive combined with PID and sliding mode}	41/1466	. . . . .	{the characteristics being a soot concentration or content}
2041/1422	. . . . .	{Variable gain or coefficients}	41/1467	. . . . .	{with determination means using an estimation}
2041/1423	. . . . .	{Identification of model or controller parameters}			
2041/1424	. . . . .	{Pole-zero cancellation}			
2041/1425	. . . . .	{using a bond graph model or models with nodes}			
2041/1426	. . . . .	{taking into account control stability}			
2041/1427	. . . . .	{Decoupling, i.e. using a feedback such that one output is controlled by only one input}			



2041/1468	. . . . .	{the characteristics being an ammonia content or concentration of the exhaust gases}	2041/202	. .	{characterised by the control of the circuit}
2041/1469	. . . . .	{with determination means using an estimation}	2041/2024	. . .	{the control switching a load after time-on and time-off pulses}
2041/147	. . . . .	{the characteristics being a hydrogen content or concentration of the exhaust gases}	2041/2027	. . . .	{Control of the current by pulse width modulation or duty cycle control}
2041/1472	. . . . .	{the characteristics being a humidity or water content of the exhaust gases}	2041/2031	. . .	{Control of the current by means of delays or monostable multivibrators}
41/1473	. . . .	{characterised by the regulation method}	2041/2034	. . .	{Control of the current gradient}
41/1474	. . . . .	{by detecting the commutation time of the sensor}	2041/2037	. . .	{for preventing bouncing of the valve needle}
41/1475	. . . . .	{Regulating the air fuel ratio at a value other than stoichiometry}	2041/2041	. . .	{for controlling the current in the free-wheeling phase}
41/1476	. . . . .	{Biasing of the sensor}	2041/2044	. . .	{using pre-magnetisation or post-magnetisation of the coils}
41/1477	. . . .	{characterised by the regulation circuit or part of it,(e.g. comparator, PI regulator, output)}	2041/2048	. . .	{said control involving a limitation, e.g. applying current or voltage limits}
41/1479	. . . . .	{Using a comparator with variable reference}	2041/2051	. . .	{using voltage control}
41/148	. . . . .	{Using a plurality of comparators}	2041/2055	. . .	{with means for determining actual opening or closing time}
41/1481	. . . . .	{Using a delaying circuit}	2041/2058	. . .	{using information of the actual current value}
41/1482	. . . . .	{Integrator, i.e. variable slope}	2041/2062	. . . .	{the current value is determined by simulation or estimation}
41/1483	. . . . .	{Proportional component}	2041/2065	. . .	{the control being related to the coil temperature}
41/1484	. . . . .	{Output circuit}	2041/2068	. .	{characterised by the circuit design or special circuit elements}
41/1486	. . . .	{with correction for particular operating conditions}	2041/2072	. . .	{Bridge circuits, i.e. the load being placed in the diagonal of a bridge to be controlled in both directions}
41/1487	. . . . .	{Correcting the instantaneous control value}	2041/2075	. . .	{Type of transistors or particular use thereof}
41/1488	. . . . .	{Inhibiting the regulation}	2041/2079	. . .	{the circuit having several coils acting on the same anchor}
41/1489	. . . . .	{Replacing of the control value by a constant}	2041/2082	. . .	{the circuit being adapted to distribute current between different actuators or recuperate energy from actuators}
41/149	. . . . .	{Replacing of the control value by an other parameter}	2041/2086	. . .	{with means for detecting circuit failures}
41/1491	. . . . .	{Replacing of the control value by a mean value}	2041/2089	. . .	{detecting open circuits}
41/1493	. . . .	{Details}	2041/2093	. . .	{detecting short circuits}
41/1494	. . . . .	{Control of sensor heater}	41/2096	. .	{for controlling piezo-electric injectors (drive and control circuit for piezo-electric devices in general <a href="#">H01L 41/042</a> )}
41/1495	. . . . .	{Detection of abnormalities in the air/fuel ratio feedback system}	41/22	. .	Safety or indicating devices for abnormal conditions {(in air/fuel ratio feedback systems <a href="#">F02D 41/1495</a> , in electric control linkage <a href="#">F02D 11/107</a> , in purge control systems <a href="#">F02M 25/0809</a> )}
41/1496	. . . . .	{Measurement of the conductivity of a sensor ( <a href="#">F02D 41/1455</a> takes precedence)}	41/221	. .	{relating to the failure of actuators or electrically driven elements}
41/1497	. . .	{With detection of the mechanical response of the engine}	41/222	. .	{relating to the failure of sensors or parameter detection devices}
41/1498	. . . .	{measuring engine roughness}	2041/223	. . .	{Diagnosis of fuel pressure sensors}
41/16	. . .	for idling	2041/224	. .	{Diagnosis of the fuel system}
41/18	. .	by measuring intake air flow (measuring flow in general <a href="#">G01F</a> )	2041/225	. . .	{Leakage detection}
41/182	. . .	{for the control of a fuel injection device}	2041/226	. . .	{Fail safe control for fuel injection pump}
41/185	. . .	{using a vortex flow sensor}	2041/227	. .	{Limping Home, i.e. taking specific engine control measures at abnormal conditions}
41/187	. . .	{using a hot wire flow sensor}	2041/228	. .	{Warning displays}
41/20	. .	Output circuits, e.g. for controlling currents in command coils (current control in inductive loads in general <a href="#">H03K 17/64</a> )	41/24	. .	characterised by the use of digital means
2041/2003	. .	{using means for creating a boost voltage, i.e. generation or use of a voltage higher than the battery voltage, e.g. to speed up injector opening}	41/2403	. .	{using essentially up/down counters}
2041/2006	. . .	{by using a boost capacitor}	41/2406	. .	{using essentially read only memories}
2041/201	. . .	{by using a boost inductance}	41/2409	. . .	{Addressing techniques specially adapted therefor}
2041/2013	. . .	{by using a boost voltage source}	41/2412	. . . .	{One-parameter addressing technique}
2041/2017	. .	{using means for creating a boost current or using reference switching}	41/2416	. . . .	{Interpolation techniques}

41/2419	. . . . {Non-linear variation along at least one coordinate}	2041/3052	. . . . {the mode being the stratified charge compression-ignition mode}
41/2422	. . . . {Selective use of one or more tables}	41/3058	. . . . {the engine working with a variable number of cycles}
41/2425	. . . {Particular ways of programming the data}	41/3064	. . . {with special control during transition between modes}
41/2429	. . . . {Methods of calibrating or learning}	41/307	. . . . {to avoid torque shocks}
41/2432	. . . . . {Methods of calibration}	41/3076	. . . {with special conditions for selecting a mode of combustion, e.g. for starting, for diagnosing}
41/2435	. . . . . {characterised by the writing medium, e.g. bar code}	41/3082	. . {Control of electrical fuel pumps}
41/2438	. . . . . {Active learning methods}	2041/3088	. . {for air assisted injectors}
41/2441	. . . . . {characterised by the learning conditions}	41/3094	. . {the fuel injection being effected by at least two different injectors, e.g. one in the intake manifold and one in the cylinder}
41/2445	. . . . . {characterised by a plurality of learning conditions or ranges}	41/32	. . of the low pressure type { <a href="#">F02D 41/3082 takes precedence</a> }
41/2448	. . . . . {Prohibition of learning}	41/34	. . . with means for controlling injection timing or duration ( <a href="#">ignition timing F02P 5/00</a> )
41/2451	. . . . . {characterised by what is learned or calibrated}	41/345	. . . . {Controlling injection timing ( <a href="#">F02D 41/365 takes precedence</a> )}
41/2454	. . . . . {Learning of the air-fuel ratio control}	41/36	. . . with means for controlling distribution (arrangement of ignition distributors <a href="#">F02P 7/00</a> )
41/2458	. . . . . {with an additional dither signal}	41/365	. . . . {with means for controlling timing and distribution}
41/2461	. . . . . {by learning a value and then controlling another value}	41/38	. . of the high pressure type
41/2464	. . . . . {Characteristics of actuators}	41/3809	. . . {Common rail control systems ( <a href="#">common rail apparatus F02M 55/025, F02M 63/0225</a> )}
41/2467	. . . . . {for injectors}	41/3818	. . . . {for petrol engines}
41/247	. . . . . {Behaviour for small quantities}	41/3827	. . . . {for diesel engines}
41/2474	. . . . . {Characteristics of sensors}	41/3836	. . . . {Controlling the fuel pressure}
41/2477	. . . . . {characterised by the method used for learning}	41/3845	. . . . . {by controlling the flow into the common rail, e.g. the amount of fuel pumped}
41/248	. . . . . {using a plurality of learned values}	41/3854	. . . . . {with elements in the low pressure part, e.g. low pressure pump}
41/2483	. . . . . {restricting learned values}	41/3863	. . . . . {by controlling the flow out of the common rail, e.g. using pressure relief valves}
41/2487	. . . . {Methods for rewriting}	41/3872	. . . . . {characterised by leakage flow in injectors}
41/249	. . . . . {Methods for preventing the loss of data}	2041/3881	. . . . {with multiple common rails, e.g. one rail per cylinder bank, or a high pressure rail and a low pressure rail}
41/2493	. . . . . {Resetting of data to a predefined set of values}	2041/389	. . . {for injecting directly into the cylinder}
41/2496	. . . {the memory being part of a closed loop}	41/40	. . . with means for controlling injection timing or duration
41/26	. . using computer, e.g. microprocessor	41/401	. . . . {Controlling injection timing ( <a href="#">F02D 41/402 takes precedence</a> )}
41/263	. . . {the program execution being modifiable by physical parameters}	41/402	. . . . {Multiple injections}
41/266	. . . {the computer being backed-up or assisted by another circuit, e.g. analogue}	41/403	. . . . . {with pilot injections}
41/28	. . . Interface circuits	41/405	. . . . . {with post injections}
2041/281	. . . . {between sensors and control unit}	41/406	. . . . {Electrically controlling a diesel injection pump ( <a href="#">F02D 41/401 takes precedence</a> )}
2041/283	. . . . . {the sensor directly giving at least one digital reading}	41/407	. . . . . {of the in-line type}
2041/285	. . . . . {the sensor having a signal processing unit external to the engine control unit}	41/408	. . . . . {of the distributing type}
2041/286	. . . . {comprising means for signal processing}	43/00	<b>Conjoint electrical control of two or more functions, e.g. ignition, fuel-air mixture, recirculation, supercharging, exhaust-gas treatment (electrical control of exhaust gas treating apparatus per se <a href="#">F01N 9/00</a>)</b>
2041/288	. . . . . {for performing a transformation into the frequency domain, e.g. Fourier transformation}	43/02	. . using only analogue means
41/30	. Controlling fuel injection {( <a href="#">F02D 41/182, F02D 41/24 take precedence</a> )}	43/04	. . using only digital means
41/3005	. . {Details not otherwise provided for}		
41/3011	. . {according to or using specific or several modes of combustion}		
41/3017	. . . {characterised by the mode(s) being used}		
41/3023	. . . . {a mode being the stratified charge spark-ignited mode}		
41/3029	. . . . . {further comprising a homogeneous charge spark-ignited mode}		
41/3035	. . . . {a mode being the premixed charge compression-ignition mode}		
41/3041	. . . . . {with means for triggering compression ignition, e.g. spark plug}		
41/3047	. . . . . {said means being a secondary injection of fuel}		

**45/00** **Electrical control not provided for in groups F02D 41/00 - F02D 43/00** (electrical control of exhaust gas treating apparatus F01N 9/00; electrical control of one of the functions; ignition, lubricating, cooling, starting, intake-heating, see relevant subclasses for such functions)

#### **2200/00** **Input parameters for engine control**

- 2200/02 . the parameters being related to the engine
- 2200/021 . . Engine temperature
- 2200/022 . . . Estimation of engine temperature
- 2200/023 . . Temperature of lubricating oil or working fluid
- 2200/024 . . Fluid pressure of lubricating oil or working fluid
- 2200/025 . . Engine noise, e.g. determined by using an acoustic sensor
- 2200/04 . . Engine intake system parameters
- 2200/0402 . . . the parameter being determined by using a model of the engine intake or its components
- 2200/0404 . . . Throttle position
- 2200/0406 . . . Intake manifold pressure
- 2200/0408 . . . . Estimation of intake manifold pressure
- 2200/0411 . . . Volumetric efficiency
- 2200/0414 . . . Air temperature
- 2200/0416 . . . . Estimation of air temperature
- 2200/0418 . . . Air humidity
- 2200/06 . . Fuel or fuel supply system parameters
- 2200/0602 . . . Fuel pressure
- 2200/0604 . . . . Estimation of fuel pressure
- 2200/0606 . . . Fuel temperature
- 2200/0608 . . . . Estimation of fuel temperature
- 2200/0611 . . . Fuel type, fuel composition or fuel quality
- 2200/0612 . . . . determined by estimation
- 2200/0614 . . . Actual fuel mass or fuel injection amount
- 2200/0616 . . . . determined by estimation
- 2200/0618 . . . Actual fuel injection timing or delay, e.g. determined from fuel pressure drop
- 2200/0625 . . . Fuel consumption, e.g. measured in fuel liters per 100 kms or miles per gallon
- 2200/063 . . . Lift of the valve needle
- 2200/08 . . Exhaust gas treatment apparatus parameters
- 2200/0802 . . . Temperature of the exhaust gas treatment apparatus
- 2200/0804 . . . . Estimation of the temperature of the exhaust gas treatment apparatus
- 2200/0806 . . . NOx storage amount, i.e. amount of NOx stored on NOx trap
- 2200/0808 . . . NOx storage capacity, i.e. maximum amount of NOx that can be stored on NOx trap
- 2200/0811 . . . NOx storage efficiency
- 2200/0812 . . . Particle filter loading
- 2200/0814 . . . Oxygen storage amount
- 2200/0816 . . . Oxygen storage capacity
- 2200/0818 . . . SOx storage amount, e.g. for SOx trap or NOx trap
- 2200/10 . . Parameters related to the engine output, e.g. engine torque or engine speed
- 2200/1002 . . . Output torque
- 2200/1004 . . . . Estimation of the output torque
- 2200/1006 . . . Engine torque losses, e.g. friction or pumping losses or losses caused by external loads of accessories

- 2200/101 . . . Engine speed
- 2200/1012 . . . Engine speed gradient
- 2200/1015 . . . Engines misfires
- 2200/50 . said parameters being related to the vehicle or its components
- 2200/501 . . Vehicle speed
- 2200/502 . . Neutral gear position
- 2200/503 . . Battery correction, i.e. corrections as a function of the state of the battery, its output or its type
- 2200/60 . said parameters being related to the driver demands or status
- 2200/602 . . Pedal position
- 2200/604 . . Engine control mode selected by driver, e.g. to manually start particle filter regeneration or to select driving style
- 2200/606 . . Driving style, e.g. sporty or economic driving
- 2200/70 . said parameters being related to the vehicle exterior
- 2200/701 . . Information about vehicle position, e.g. from navigation system or GPS signal
- 2200/702 . . Road conditions
- 2200/703 . . Atmospheric pressure
- 2200/704 . . . Estimation of atmospheric pressure

**Controlling, e.g. regulating, fuel injection** (peculiar to engines characterised by their use of non-liquid fuels, pluralities of fuels, or non-fuel substances added to the combustible mixtures F02D 19/00; peculiar to supercharged engines F02D 23/00; automatic controllers for prime movers, in general G05D)

#### **2250/00** **Engine control related to specific problems or objectives**

- 2250/02 . Fuel evaporation in fuel rails, e.g. in common rails
- 2250/04 . Fuel pressure pulsation in common rails
- 2250/06 . Reverse rotation of engine
- 2250/08 . Engine blow-by from crankcase chamber
- 2250/11 . Oil dilution, i.e. prevention thereof or special controls according thereto
- 2250/12 . Timing of calculation, i.e. specific timing aspects when calculation or updating of engine parameter is performed
- 2250/14 . Timing of measurement, e.g. synchronisation of measurements to the engine cycle
- 2250/16 . End position calibration, i.e. calculation or measurement of actuator end positions, e.g. for throttle or its driving actuator
- 2250/18 . Control of the engine output torque
- 2250/21 . . during a transition between engine operation modes or states
- 2250/22 . . by keeping a torque reserve, i.e. with temporarily reduced drive train or engine efficiency
- 2250/24 . . by using an external load, e.g. a generator
- 2250/26 . . by applying a torque limit
- 2250/28 . Control for reducing torsional vibrations, e.g. at acceleration
- 2250/31 . Control of the fuel pressure
- 2250/32 . Air-fuel ratio control in a diesel engine
- 2250/34 . Control of exhaust back pressure, e.g. for turbocharged engines
- 2250/36 . Control for minimising NOx emissions
- 2250/38 . Control for minimising smoke emissions, e.g. by applying smoke limitations on the fuel injection amount

- 2250/41 . Control to generate negative pressure in the intake manifold, e.g. for fuel vapor purging or brake booster
- 2400/00 Control systems adapted for specific engine types; Special features of engine control systems not otherwise provided for; Power supply, connectors or cabling for engine control systems**
- 2400/02 . Four-stroke combustion engines with electronic control
- 2400/04 . Two-stroke combustion engines with electronic control
- 2400/06 . Small engines with electronic control, e.g. for hand held tools
- 2400/08 . Redundant elements, e.g. two sensors for measuring the same parameter
- 2400/11 . After-sales modification devices designed to be used to modify an engine afterwards
- 2400/12 . Engine control specially adapted for a transmission comprising a torque converter or for continuously variable transmissions
- 2400/14 . Power supply for engine control systems
- 2400/16 . Adaptation of engine control systems to a different battery voltages, e.g. for using high voltage batteries
- 2400/18 . Packaging of the electronic circuit in a casing
- 2400/21 . Engine cover with integrated cabling
- 2400/22 . Connectors or cables specially adapted for engine management applications
- 2700/00 Mechanical control of speed or power of a single cylinder piston engine**
- 2700/02 . Controlling by changing the air or fuel supply
- 2700/0202 . . for engines working with gaseous fuel, including those working with an ignition liquid
- 2700/0205 . . . Controlling the air supply as well as the fuel supply
- 2700/0207 . . . Controlling the air or mixture supply
- 2700/021 . . . . Engines without compressor
- 2700/0212 . . . . Engines with compressor
- 2700/0215 . . . Controlling the fuel supply
- 2700/0217 . . for mixture compressing engines using liquid fuel
- 2700/022 . . . Controlling the air or the mixture supply as well as the fuel supply
- 2700/0223 . . . . Engines with fuel injection
- 2700/0225 . . . Control of air or mixture supply
- 2700/0228 . . . . Engines without compressor
- 2700/023 . . . . . by means of one throttle device
- 2700/0233 . . . . . depending on several parameters
- 2700/0235 . . . . . depending on the pressure of a gaseous or liquid medium
- 2700/0238 . . . . . depending on the number of revolutions of a centrifugal governor
- 2700/0241 . . . . . depending on another parameter
- 2700/0243 . . . . . by means of a plurality of throttle devices
- 2700/0246 . . . . for engines with compressor
- 2700/0248 . . . . . by means of throttle devices
- 2700/0251 . . . . . in the intake conduit
- 2700/0253 . . . . . in the outlet conduit
- 2700/0256 . . . . . by changing the speed of the compressor
- 2700/0258 . . . . . by other means
- 2700/0261 . . . Control of the fuel supply
- 2700/0264 . . . . for engines with a fuel jet working with depression
- 2700/0266 . . . . for engines with fuel injection
- 2700/0269 . . . for air compressing engines with compression ignition
- 2700/0271 . . . Controlling the air supply as well as the fuel supply
- 2700/0274 . . . Controlling the air supply
- 2700/0276 . . . . Engines without compressor
- 2700/0279 . . . . Engines with compressor
- 2700/0282 . . . Control of fuel supply
- 2700/0284 . . . . by acting on the fuel pump control element
- 2700/0287 . . . . . depending on several parameters
- 2700/0289 . . . . . depending on the pressure of a gaseous or liquid medium
- 2700/0292 . . . . . depending on the speed of a centrifugal governor
- 2700/0294 . . . . . depending on another parameter
- 2700/0297 . . . . by control means in the fuel conduit between pump and injector
- 2700/03 . Controlling by changing the compression ratio
- 2700/035 . . without modifying the volume of the compression space, e.g. by changing the valve timing
- 2700/04 . Controlling by throttling the exhaust conduit
- 2700/05 . Controlling by preventing combustion in one or more cylinders
- 2700/052 . . Methods therefor
- 2700/054 . . . by keeping the exhaust valves open
- 2700/056 . . . by interrupting the medium supply
- 2700/058 . . . by another method
- 2700/07 . Automatic control systems according to one of the preceding groups in combination with control of the mechanism receiving the engine power
- 2700/09 . Other ways of controlling
- 2700/10 . Control of the timing of the fuel supply period with relation to the piston movement