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]
2001/0001 . . [Arrangement of centrifugal weights]
2001/0015 . . . [the weights being cup-shaped and carrying governor springs]
2001/0002 . . [Arrangement of governor springs]
2001/0025 . . . [having at least two springs, one of them being idling spring]
2001/0025 . . . [the main spring being active at maximum speed only]
2001/003 . . . [the main spring being active at all speeds, e.g. its tension varying with the load, i.e. the position of pump control]
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]

2001/0004 . . [Arrangement of linkages between governor sleeve and pump control]
2001/0005 . . [Arrangement of means for influencing governor characteristics by operator]
2001/0005 . . [varying main spring tension]
2001/0005 . . [varying pivotal point of linkages between governor sleeve and pump control]
2001/0006 . . [Assembling; Disassembling; Replacing]
2001/00065 . . [Selection of particular materials]
2001/0007 . . [Means for adjusting stops for minimum and maximum fuel delivery]
2001/00075 . . [using engine temperature, e.g. to adjust the idling speed at cold start]
2001/0008 . . [using intake air pressure, e.g. adjusting full load stop at high supercharging pressures]
2001/00085 . . [Arrangements using fuel pressure for controlling fuel delivery in quantity or timing]
2001/0009 . . [Means for varying the pressure of fuel supply pump according to engine working parameters]
2001/00095 . . [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 (F02D 1/08 takes precedence)]
1/04 . . . [by mechanical means dependent on engine speed, e.g. using centrifugal governors (F02D 1/08 takes precedence)]
1/045 . . . [characterised by arrangement of springs or weights]
Controlling, e.g. regulating, fuel injection

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") ]
Controlling, e.g. regulating, fuel injection

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)

9/10 . having pivotally-mounted flaps

9/1005 . [Details of the flap]

9/101 . [Special flap shapes, ribs, bores or the like]

9/1015 . [Details of the edge of the flap, e.g. for lowering flow noise or improving flow sealing in closed flap position]

9/102 . [the flap having movable parts fixed onto it]

9/1025 . [the rotation axis of the flap being off-set from the flap center axis]

9/103 . [the rotation axis being located at an edge]

9/1035 . [Details of the valve housing]

9/104 . [Shaping of the flow path in the vicinity of the flap, e.g. having inserts in the housing]

9/1045 . [for sealing of the flow in closed flap position, e.g. the housing forming a valve seat]

9/105 . [having a throttle position sensor (detection of actuation F02D 11/106)]

9/1055 . [having a fluid by-pass]

9/106 . [Sealing of the valve shaft in the housing, e.g. details of the bearings]

9/1065 . [Mechanical control linkage between an actuator and the flap, e.g. including levers, gears, springs, clutches, limit stops of the like]

9/107 . [Manufacturing or mounting details]

9/1075 . [Materials, e.g. composites]

9/108 . [Plastics]

9/1085 . [Non-organic materials, e.g. metals, alloys, ceramics]

9/109 . [having two or more flaps]

9/1095 . [Rotating on a common axis, e.g. having a common shaft]

9/11 . having slidably-mounted valve members; having valve members movable longitudinally of conduit

9/114 . the members being slidingly transversely of conduit

9/116 . the members being rotatable

9/118 . having elastic-wall valve members

11/00 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)

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]
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
Controlling peculiar to specified types or adaptations of engines

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 therefor of 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 therefor, 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
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)

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

- peculiar to engines driving vehicles; peculiar to engines driving variable pitch propellers

- peculiar to engines driving pumps

- peculiar to engines driving electric generators

Other controlling of engines

Use of speed-sensing governors to control combustion engines, not otherwise provided for

- (Electric control of rotation speed)

- [controlling air supply]

- {for idle speed control}

- {by controlling a throttle stop}

- {by controlling a throttle by-pass}

- {for maximum speed control}

- {controlling fuel supply}

- {for idle speed control}

- {for maximum speed control}

Controlling delivery of fuel or combustion-air, not otherwise provided for

- (using exhaust gas sensors F02D 35/0023, F02D 35/0046)

- {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]

- {depending on engine operating conditions, e.g. start, stop or ambient conditions}

- of combustion-air

Controlling engines, dependent on conditions exterior or interior to engines, not otherwise provided for

- (using electrical feedback (F02D 35/0015 takes precedence)]

NOTE
- Attention is drawn to the note preceding F02D 41/00.

- (using exhaust gas sensors (F02D 41/14 takes precedence)

- {Controlling air supply]

- {by means of by-pass passages}

- {by means of air pumps}

- {Controlling fuel supply]
Electrical control of combustion engines

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)
2041/0025 . . . (Controlling engines characterised by use of non-liquid fuels, pluralities of fuels, or non-fuel substances added to the combustible mixtures)
2041/0027 . . . (the fuel being gaseous (non-electrical control F02D 19/02))
2041/003 . . . (Adding fuel vapours, e.g. drawn from engine fuel reservoir)
2041/0032 . . . (Controlling the purging of the canister as a function of the engine operating conditions)
2041/0035 . . . (to achieve a special effect, e.g. to warm up the catalyst)
2041/0037 . . . (for diagnosing the engine (diagnosis of purge control systems F02M 25/0809))
2041/004 . . . (Control of the valve or purge actuator, e.g. duty cycle, closed loop control of position)
2041/0042 . . . (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)
2041/0045 . . . (Estimating, calculating or determining the purging rate, amount, flow or concentration)
2041/0047 . . . (Controlling exhaust gas recirculation [EGR] (temperature control with cooler in recirculation circuit F02M 26/33))
2041/005 . . . (according to engine operating conditions)
2041/0052 . . . (Feedback control of engine parameters, e.g. for control of air/fuel ratio or intake air amount)
2041/0055 . . . (Special engine operating conditions, e.g. for regeneration of exhaust gas treatment apparatus)
2041/0057 . . . (Specific combustion modes (combustion modes per se F02D 41/3017))
2041/006 . . . (using internal EGR (control of valve overlap for internal EGR F02D 13/026); arrangements for internal EGR F02M 26/001)
2041/0062 . . . (Estimating, calculating or determining the internal EGR rate, amount or flow)
2041/0065 . . . (Specific aspects of external EGR control (constructional details of EGR system F02M 26/00))
2041/0067 . . . (Determining the EGR temperature)
2041/007 . . . (by estimation)
2041/0072 . . . (Estimating, calculating or determining the EGR rate, amount or flow (sensors in EGR systems F02M 26/45))
2041/0075 . . . (by using flow sensors)
2041/0077 . . . (Control of the EGR valve or actuator, e.g. duty cycle, closed loop control of position (EGR valve position sensor F02M 26/48))
2041/008 . . . (Controlling each cylinder individually)
2041/0082 . . . (per groups or banks (F02D 41/0087 takes precedence))
2041/0085 . . . (Balancing of cylinder outputs, e.g. speed, torque or air-fuel ratio)
2041/0087 . . . (Selective cylinder activation, i.e. partial cylinder operation (deceleration cut-off F02D 41/123))
2041/009 . . . (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)
2041/0097 . . . (using means for generating speed signals)
2041/012 . . . (Circuit arrangements for generating control signals)
2041/0205 . . . (using an auxiliary engine speed control (engine speed control per se F02D 31/00))
2041/021 . . . (Introducing corrections for particular conditions exterior to the engine (conjoint control of vehicle sub-units for propelling the vehicle B60W 30/18))
2041/0215 . . . (in relation with elements of the transmission)
2041/022 . . . (in relation with the clutch status)
2041/0225 . . . (in relation with the gear ratio or shift lever position)
2041/023 . . . (in relation with the gear ratio shifting (conjoint control for improving gear change B60W 30/19))
2041/0235 . . . (in relation with the state of the exhaust gas treating apparatus (control of exhaust gas treating apparatus per se F01N))
2041/024 . . . (to increase temperature of the exhaust gas treating apparatus)
2041/0245 . . . (by increasing temperature of the exhaust gas leaving the engine)
2041/025 . . . (by changing the composition of the exhaust gas, e.g. for exothermic reaction on exhaust gas treating apparatus)
2041/0255 . . . (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)
2041/027 . . . (to purge or regenerate the exhaust gas treating apparatus)
2041/0275 . . . (the exhaust gas treating apparatus being a NOx trap or adsorbent)
2041/028 . . . (Desulphurisation of NOx traps or adsorbent)
2041/0285 . . . (the exhaust gas treating apparatus being a SOx trap or adsorbent)
2041/029 . . . (the exhaust gas treating apparatus being a particulate filter)
2041/0295 . . . (Control according to the amount of oxygen that is stored on the exhaust gas treating apparatus)
2041/04 . . . (Introducing corrections for particular operating conditions (F02D 41/14 takes precedence))
2041/042 . . . (for stopping the engine)
2041/045 . . . (Detection of accelerating or decelerating state (detection thereof in general G01P))
2041/047 . . . (Taking into account fuel evaporation or wall wetting (special correction after fuel cut-off F02D 41/126))
2041/06 . . . (for engine starting or warming up (F02D 41/0255 takes precedence))
2041/061 . . . (the corrections being time dependent)
2041/062 . . . (for starting (F02D 41/061 takes precedence))
Introducing closed-loop corrections for deceleration {F02D 41/0005, F02D 41/107 take precedence}

41/12

41/10 for deceleration

41/102 {Switching from sequential injection to simultaneous injection}

41/105 {using asynchronous injection}

41/107 {and deceleration {F02D 41/0005, F02D 41/107 take precedence}}

41/110 . . . . for changing cylinders

41/111 . . . . [is characterised by the control or regulation method (F02D 41/1473, F02D 41/1477 take precedence)]

41/112 . . . . {using asynchronous injection}

41/113 . . . . {and deceleration}

41/114 . . . . for changing cylinders

41/115 . . . . {identifying the number of cylinders}

41/116 . . . . [is characterised by the position of the sensor]

41/117 . . . . {Controller structures or design}

41/118 . . . . {with at least a feedback or state space representation}

41/119 . . . . [Observer]

41/120 . . . . {Kalman filter}

41/121 . . . . [Several control loops, either as alternatives or simultaneous]

41/122 . . . . [the control loops being cascaded, i.e. being placed in series or nested]

41/123 . . . . [using different types of control law in combination, e.g. adaptive combined with PID and sliding mode]

41/124 . . . . [variable gain or coefficients]

41/125 . . . . [identification of model or controller parameters]

41/126 . . . . [using a bond graph model or models with nodes]

41/127 . . . . [taking into account control stability]

41/128 . . . . [Decoupling, i.e. using a feedback such that one output is controlled by only one input]

2041/1429 . . . . [Linearisation, i.e. using a feedback law such that the system evolves as a linear one]

2041/143 . . . . [the control loop including a non-linear model or compensator]

2041/1431 . . . . [the system including an input-output delay]

2041/1432 . . . . [the system including a filter, e.g. a low pass or high pass filter]

2041/1433 . . . . [using a model or simulation of the system]

2041/1434 . . . . [Inverse model]

2041/1436 . . . . [Hybrid model]

2041/1437 . . . . [Simulation]

41/1438 . . . . [using means for determining characteristics of the combustion gases; Sensors therefor]

41/1439 . . . . [characterised by the position of the sensor]

41/144 . . . . [Sensor in intake manifold]

41/1441 . . . . [Plural sensors]

41/1443 . . . . [with one sensor per cylinder or group of cylinders]

41/1444 . . . . [characterised by the characteristics of the combustion gases]

41/1445 . . . . [the characteristics being related to the exhaust flow]

41/1446 . . . . [the characteristics being related to the exhaust flow]

41/1447 . . . . [with determination means using an estimation]

41/1448 . . . . [the characteristics being an exhaust gas pressure]

41/1449 . . . . [with determination means using an estimation]

41/1451 . . . . [the sensor being an optical sensor]

41/1452 . . . . [the characteristics being a COx content or concentration]

41/1453 . . . . [the characteristics being a CO content or concentration]

41/1454 . . . . [the characteristics being an oxygen content or concentration or the air-fuel ratio]

41/1455 . . . . [with sensor resistivity varying with oxygen concentration (F02D 41/1456 takes precedence)]

41/1456 . . . . [with sensor output signal being linear or quasi-linear with the concentration of oxygen]

41/1458 . . . . [with determination means using an estimation]

41/1459 . . . . [the characteristics being a hydrocarbon content or concentration]

41/146 . . . . [the characteristics being an NOx content or concentration]

41/1461 . . . . [of the exhaust gases emitted by the engine]

41/1462 . . . . [with determination means using an estimation]

41/1463 . . . . [of the exhaust gases downstream of exhaust gas treatment apparatus]

41/1465 . . . . [with determination means using an estimation]

41/1466 . . . . [the characteristics being a soot concentration or content]

41/1467 . . . . [with determination means using an estimation]
Electrical control of combustion engines

41/1487 . . . . (Correcting the instantaneous control value)
41/1488 . . . . (Inhibiting the regulation)
41/1489 . . . . [Replacing of the control value by a constant]
41/149 . . . . [Replacing of the control value by an other parameter]
41/1491 . . . . [Replacing of the control value by a mean value]
41/1493 . . . . [Details]
41/1494 . . . . [Control of sensor heater]
41/1495 . . . . [Detection of abnormalities in the air/fuel ratio feedback system]
41/1496 . . . . [Measurement of the conductivity of a sensor (F02D 41/1455 takes precedence)]
41/1497 . . . . [With detection of the mechanical response of the engine]
41/1498 . . . . [measuring engine roughness]
41/16 . . . . . for idling
41/18 . . by measuring intake air flow (measuring flow in general G01F)
41/182 . . . . [for the control of a fuel injection device]
41/185 . . . . [using a vortex flow sensor]
41/187 . . . . [using a hot wire flow sensor]
41/20 . . . . Output circuits, e.g. for controlling currents in command coils (current control in inductive loads in general H03K 17/64)
41/2003 . . . . [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]
41/2006 . . . . [by using a boost capacitor]
41/201 . . . . [by using a boost inductance]
41/2013 . . . . [by using a boost voltage source]
41/2017 . . . . [using means for creating a boost current or using reference switching]
2041/202 . . . . [characterised by the control of the circuit]
2041/2024 . . . . [the control switching a load after time-on and time-off pulses]
2041/2027 . . . . [Control of the current by pulse width modulation or duty cycle control]
2041/2031 . . . . [Control of the current by means of delays or monostable multivibrators]
2041/2034 . . . . [Control of the current gradient]
2041/2037 . . . . [for preventing bouncing of the valve needle]
2041/2041 . . . . [for controlling the current in the free-wheeling phase]
2041/2044 . . . . [using pre-magnetisation or post-magnetisation of the coils]
2041/2048 . . . . [said control involving a limitation, e.g. applying current or voltage limits]
2041/2051 . . . . [using voltage control]
2041/2055 . . . . [with means for determining actual opening or closing time]
2041/2058 . . . . [using information of the actual current value]
2041/2062 . . . . [the current value is determined by simulation or estimation]
2041/2065 . . . . [the control being related to the coil temperature]
2041/2068 . . . . [characterised by the circuit design or special circuit elements]
2041/2072 . . . . [Bridge circuits, i.e. the load being placed in the diagonal of a bridge to be controlled in both directions]
2041/2075 . . . . [Type of transistors or particular use thereof]
2041/2079 . . . . [the circuit having several coils acting on the same anchor]
2041/2082 . . . . [the circuit being adapted to distribute current between different actuators or recuperate energy from actuators]
2041/2086 . . . . [with means for detecting circuit failures]
2041/2089 . . . . [detecting open circuits]
2041/2093 . . . . [detecting short circuits]
Electrical control of combustion engines

Controlling fuel injection (F02D 41/182, F02D 41/24, take precedence)

[Non-linear variation along at least one coordinate]

Selective use of one or more tables

Particular ways of programming the data

Methods of calibrating or learning

Methods of calibration

characterised by the writing medium, e.g. bar code

Active learning methods

characterised by the learning conditions

characterised by a plurality of learning conditions or ranges

Prohibition of learning

characterised by what is learned or calibrated

Learning of the air-fuel ratio control

with an additional dither signal

by learning a value and then controlling another value

Characteristics of actuators

for injectors

Behaviour for small quantities

Characteristics of sensors

characterised by the method used for learning

using a plurality of learned values

restricting learned values

Methods for rewriting

Methods for preventing the loss of data

Resetting of data to a predefined set of values

the memory being part of a closed loop

using computer, e.g. microprocessor

the program execution being modifiable by physical parameters

the computer being backed-up or assisted by another circuit, e.g. analogue

Interface circuits

between sensors and control unit

the sensor directly giving at least one digital reading

the sensor having a signal processing unit external to the engine control unit

comprising means for signal processing

for performing a transformation into the frequency domain, e.g. Fourier transformation

Controlling fuel injection (F02D 41/182, F02D 41/24, take precedence)

Details not otherwise provided for

according to or using specific or several modes of combustion

characterised by the mode(s) being used

[a mode being the stratified charge spark-ignited mode]

[further comprising a homogeneous charge spark-ignited mode]

[a mode being the premixed charge compression-ignition mode]

[with means for triggering compression ignition, e.g. spark plug]

[said means being a secondary injection of fuel]

[the mode being the stratified charge compression-ignition mode]

[the engine working with a variable number of cycles]

[with special control during transition between modes]

[to avoid torque shocks]

[with special conditions for selecting a mode of combustion, e.g. for starting, for diagnosing]

[Control of electrical fuel pumps]

[for air assisted injectors]

[the fuel injection being effected by at least two different injectors, e.g. one in the intake manifold and one in the cylinder]

of the low pressure type (F02D 41/3082 takes precedence)

with means for controlling injection timing or duration (ignition timing F02P 5/00)

[Controlling injection timing (F02D 41/365 takes precedence)]

[Controlling the fuel pressure]

by controlling the flow into the common rail, e.g. the amount of fuel pumped

[with elements in the low pressure part, e.g. low pressure pump]

[by controlling the flow out of the common rail, e.g. using pressure relief valves]

[characterised by leakage flow in injectors]

[with multiple common rails, e.g. one rail per cylinder bank, or a high pressure rail and a low pressure rail]

[for injecting directly into the cylinder]

with means for controlling injection timing or duration

[Controlling injection timing (F02D 41/402 takes precedence)]

[Multiple injections]

[with pilot injections]

[with post injections]

Electrically controlling a diesel injection pump (F02D 41/401 takes precedence)

[of the in-line type]

[of the distributing type]

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 F01N 9/00)

using only analogue means

using only digital means
Electrical control of combustion engines

Input parameters for engine control

- The parameters being related to the engine
- Engine temperature
- Estimation of engine temperature
- Temperature of lubricating oil or working fluid
- Fluid pressure of lubricating oil or working fluid
- Engine noise, e.g. determined by using an acoustic sensor
- Engine intake system parameters
- Throttle position
- Intake manifold pressure
- Estimation of intake manifold pressure
- Volumetric efficiency
- Air temperature
- Estimation of air temperature
- Air humidity
- Fuel or fuel supply system parameters
- Fuel pressure
- Estimation of fuel pressure
- Fuel temperature
- Estimation of fuel temperature
- Fuel type, fuel composition or fuel quality
- Determined by estimation
- Actual fuel mass or fuel injection amount
- Determined by estimation
- Actual fuel injection timing or delay, e.g. determined from fuel pressure drop
- Fuel consumption, e.g. measured in fuel liters per 100 kms or miles per gallon
- Lift of the valve needle
- Exhaust gas treatment apparatus parameters
- Temperature of the exhaust gas treatment apparatus
- Estimation of the temperature of the exhaust gas treatment apparatus
- NOx storage amount, i.e. amount of NOx stored on NOx trap
- NOx storage capacity, i.e. maximum amount of NOx that can be stored on NOx trap
- NOx storage efficiency
- Particle filter loading
- Oxygen storage amount
- Oxygen storage capacity
- SOx storage amount, e.g. for SOx trap or NOx trap
- Parameters related to the engine output, e.g. engine torque or engine speed
- Output torque
- Estimation of the output torque
- Engine torque losses, e.g. friction or pumping losses or losses caused by external loads of accessories

Engine control related to specific problems or objectives

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

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