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}
2001/0007  .  . {Arrangement of linkages between governor sleeve and pump control}
2001/0008  .  . {Arrangement of means for influencing governor characteristics by operator}
2001/0009  .  . {Varying main spring tension}
2001/0010  .  . {Varying pivotal point of linkages between governor sleeve and pump control}
2001/0011  .  . {Assembly; Disassembly; Replacing}
2001/0012  .  . {Means for adjusting stops for minimum and maximum fuel delivery}
2001/0013  .  . {Using engine temperature, e.g. to adjust the idling speed at cold start}
2001/0014  .  . {Using intake air pressure, e.g. adjusting full load stop at high supercharging pressures}
2001/0015  .  . {Arrangements using fuel pressure for controlling fuel delivery in quantity or timing}
2001/0016  .  . {Means for varying the pressure of fuel supply pump according to engine working parameters}
2001/0017  .  . {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}
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

2009/021 . . . . . concern induction conduits (throttle valves, or arrangements thereof in conduits F02D 9/00)

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]

2009/0201 . . . . . {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")]

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Controlling, e.g. regulating, fuel injection

9/04 . . . (having a dashpot, e.g. working in the throttle opening and closing directions)
9/06 . . . (having a specially shaped transmission member, e.g. a cam, specially toothed gears, with a clutch)
9/04 . . . (having two or more levers on the throttle shaft)
9/04 . . . [in which movement is transmitted through a spring]
9/04 . . . [in which movement is transmitted through a vacuum motor]
9/04 . . . [for simultaneous action of a governor and an accelerator lever on the throttle]
9/04 . . . [Throttle closing springs; Acting of throttle closing springs on the throttle shaft]
9/04 . . . [with means for closing the throttle other than throttle closing springs]
9/04 . . . [Two or more throttles disposed in series]
9/04 . . . [one being controlled by pressure in intake conduit, e.g. for slowly opening the throttle as the other valve is suddenly opened]
9/04 . . . [Throttle and EGR-valve operated together]
9/04 . . . [Fail-safe mechanisms, e.g. with limp-home feature, to close throttle if actuator fails, or if control cable sticks or breaks]
9/04 . . . [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]
9/04 . . . [with means for detecting malfunction of one throttle and actuating only the correctly working throttle]
9/04 . . . [Throttle in the form of an expander]
9/04 . . . [Throttle control device with means for signalling a certain throttle opening, e.g. by a steplike increase of throttle closing spring force]
9/04 . . . [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]
9/04 . . . [Throttle control device specially adapted for spark-assisted compression-ignition engine (Diesel engine)]
9/04 . . . [Throttle control device with means for establishing a variable resistance torque during throttle opening]
9/04 . . . [Throttle control device for throttle being disposed in a two-stroke engine transfer passage]
9/04 . . . [Throttle control device adapted to limit power development at low attitude]
9/04 . . . [Throttle control device with provisions for actuating electric or electronic sensors]
9/04 . . . [Throttle control device with stops for limiting throttle opening or closing beyond a certain position during certain periods of operation]
9/04 . . . [Throttle control device with holding devices, i.e. to hold throttle in a predetermined position]

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]
9/12 . . . . . . [having slidably-mounted valve members; having valve members movable longitudinally of conduit]
9/14 . . . . . . . the members being slideable transversely of conduit
9/16 . . . . . . . the members being rotatable
9/18 . . . . . . . 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]
Controlling, e.g. regulating, fuel injection

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

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 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
Controlling peculiar to specified types or adaptations of engines

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}
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)
- 2041/0018 . . . (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))
- 41/0049 . . . . . . (for starting (F02D 41/061))
- 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 13/026), arrangements for internal EGR F02M 26/010)
- 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)
- 41/012 . . . . . . (Circuit arrangements for generating control signals)
- 41/0205 . . . . . . (using an auxiliary engine speed control (engine speed control per se F02D 31/080))
- 41/021 . . . . . . (Introducing corrections for particular conditions exterior to the engine (joint 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 (joint 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 . . . . . . (Desulphurisation 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 F01P))
- 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))
Introducing closed-loop corrections

41/10       for idling (F02D 41/06, F02D 41/16 take precedence)
41/102      [Switching from sequential injection to simultaneous injection]
41/105      [using asynchronous injection]
41/107      [and deceleration]
41/12       for deceleration (F02D 41/0005, F02D 41/107 take precedence)
41/123      [the fuel injection being cut-off]
41/126      [transitional corrections at the end of the cut-off period]

2041/1401   [characterised by the control or regulation method (F02D 41/473, F02D 41/477 take precedence)]
2041/1402   [Adaptive control]
2041/1403   [Sliding mode control]
2041/1404   [Fuzzy logic control]
2041/1405   [Neural network control]
2041/1406   [with use of a optimisation method, e.g. iteration]
2041/1408   [Dithering techniques]
2041/1411   [using a finite or infinite state machine, automaton or state graph for controlling or modelling]
2041/1412   [using a predictive controller]
2041/1413   [Controller structures or design]
2041/1415   [using a state feedback or a state space representation]
2041/1416   [Observer]
2041/1417   [Kalman filter]
2041/1418   [Several control loops, either as alternatives or simultaneous]
2041/1419   [the control loops being cascaded, i.e. being placed in series or nested]
2041/142   [using different types of control law in combination, e.g. adaptive combined with PID and sliding mode]
2041/1422   [Variable gain or coefficients]
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]

Electrical control of combustion engines
Electrical control of combustion engines

- 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]
- 41/2096 . . . [for controlling piezo-electric injectors (drive and control circuit for piezo-electric devices in general H01L 41/042)]
- 41/22 . . . Safety or indicating devices for abnormal conditions (in air/fuel ratio feedback systems F02D 41/1495, in electric control linkage F02D 11/107, in purge control systems F02M 25/0809)
- 41/221 . . . [relating to the failure of actuators or electrically driven elements]
- 41/222 . . . [relating to the failure of sensors or parameter detection devices]
- 2041/223 . . . [Diagnosis of fuel pressure sensors]
- 2041/224 . . . [Diagnosis of the fuel system]
- 2041/225 . . . [Leakage detection]
- 2041/226 . . . [Fail safe control for fuel injection pump]
- 2041/227 . . . [Limping Home, i.e. taking specific engine control measures at abnormal conditions]
- 2041/228 . . . [Warning displays]
- 41/24 . . . [characterised by the use of digital means]
- 41/2403 . . . [using essentially up/down counters]
- 41/2406 . . . [using essentially read only memories]
- 41/2409 . . . [Addressing techniques specially adapted therefor]
- 41/2412 . . . [One-parameter addressing technique]
- 41/2416 . . . [Interpolation techniques]
Electrical control of combustion engines

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

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

- 2200/02 The parameters being related to the engine
- 2200/03 Engine temperature
- 2200/04 Estimation of engine temperature
- 2200/05 Temperature of lubricating oil or working fluid
- 2200/06 Fluid pressure of lubricating oil or working fluid
- 2200/07 Engine noise, e.g. determined by using an acoustic sensor
- 2200/08 Engine intake system parameters
- 2200/09 Throttle position
- 2200/10 Intake manifold pressure
- 2200/11 Estimation of intake manifold pressure
- 2200/12 Volumetric efficiency
- 2200/13 Air temperature
- 2200/14 Estimation of air temperature
- 2200/15 Air humidity
- 2200/16 Fuel or fuel supply system parameters
  - 2200/17 Fuel pressure
  - 2200/18 Estimation of fuel pressure
  - 2200/19 Fuel temperature
  - 2200/20 Estimation of fuel temperature
  - 2200/21 Fuel type, fuel composition or fuel quality
  - 2200/22 Determined by estimation
  - 2200/23 Actual fuel mass or fuel injection amount
  - 2200/24 Determined by estimation
  - 2200/25 Actual fuel injection timing or delay, e.g. determined from fuel pressure drop
  - 2200/26 Fuel consumption, e.g. measured in fuel liters per 100 kms or miles per gallon
  - 2200/27 Lift of the valve needle
  - 2200/28 Exhaust gas treatment apparatus parameters
  - 2200/29 Temperature of the exhaust gas treatment apparatus
  - 2200/30 Estimation of the temperature of the exhaust gas treatment apparatus
  - 2200/31 NOx storage amount, i.e. amount of NOx stored on NOx trap
  - 2200/32 NOx storage capacity, i.e. maximum amount of NOx that can be stored on NOx trap
  - 2200/33 NOx storage efficiency
  - 2200/34 Particle filter loading
  - 2200/35 Oxygen storage amount
  - 2200/36 Oxygen storage capacity
  - 2200/37 SOx storage amount, e.g. for SOx trap or NOx trap
  - 2200/38 Parameters related to the engine output, e.g. engine torque or engine speed
  - 2200/39 Output torque
  - 2200/40 Estimation of the output torque
  - 2200/41 Engine torque losses, e.g. friction or pumping losses or losses caused by external loads of accessories

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**Controling, 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 peculiar to supercharged engines; automatic controllers for prime movers, in general)

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

- 2250/01 Fuel evaporation in fuel rails, e.g. in common rails
- 2250/02 Fuel pressure pulsation in common rails
- 2250/03 Reverse rotation of engine
- 2250/04 Engine blow-by from crankcase chamber
- 2250/05 Oil dilution, i.e. prevention thereof or special controls according thereto
- 2250/06 Timing of calculation, i.e. specific timing aspects when calculation or updating of engine parameter is performed
- 2250/07 Timing of measurement, e.g. synchronisation of measurements to the engine cycle
- 2250/08 End position calibration, i.e. calculation or measurement of actuator end positions, e.g. for throttle or its driving actuator
- 2250/09 Control of the engine output torque
- 2250/10 During a transition between engine operation modes or states
- 2250/11 By keeping a torque reserve, i.e. with temporarily reduced drive train or engine efficiency
- 2250/12 By using an external load, e.g. a generator
- 2250/13 By applying a torque limit
- 2250/14 Control for reducing torsional vibrations, e.g. at acceleration
- 2250/15 Control of the fuel pressure
- 2250/16 Air-fuel ratio control in a diesel engine
- 2250/17 Control of exhaust back pressure, e.g. for turbocharged engines
- 2250/18 Control for minimising NOx emissions
- 2250/19 Control for minimising smoke emissions, e.g. by applying smoke limitations on the fuel injection amount

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**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)
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