

# CPC COOPERATIVE PATENT CLASSIFICATION

**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.

**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](#)

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| <p><a href="#">2001/0005</a> . {Details, component parts or accessories of centrifugal governors}</p> <p><a href="#">2001/001</a> . . {Arrangement of centrifugal weights}</p> <p><a href="#">2001/0015</a> . . . {the weights being cup-shaped and carrying governor springs}</p> <p><a href="#">2001/002</a> . . {Arrangement of governor springs}</p> <p><a href="#">2001/0025</a> . . . {having at least two springs, one of them being idling spring}</p> <p><a href="#">2001/003</a> . . . {the main spring being active at maximum speed only}</p> <p><a href="#">2001/0035</a> . . . {the main spring being active at all speeds, e.g. its tension varying with the load, i.e. the position of pump control}</p> <p><a href="#">2001/004</a> . . {Arrangement of linkages between governor sleeve and pump control}</p> <p><a href="#">2001/0045</a> . . {Arrangement of means for influencing governor characteristics by operator}</p> <p><a href="#">2001/005</a> . . . {varying main spring tension}</p> <p><a href="#">2001/0055</a> . . . {varying pivotal point of linkages between governor sleeve and pump control}</p> <p><a href="#">2001/006</a> . . {Assembling; Disassembling; Replacing}</p> <p><a href="#">2001/0065</a> . . {Selection of particular materials}</p> <p><a href="#">2001/007</a> . {Means for adjusting stops for minimum and maximum fuel delivery}</p> <p><a href="#">2001/0075</a> . . {using engine temperature, e.g. to adjust the idling speed at cold start}</p> | <p><a href="#">2001/008</a> . . {using intake air pressure, e.g. adjusting full load stop at high supercharging pressures}</p> <p><a href="#">2001/0085</a> . {Arrangements using fuel pressure for controlling fuel delivery in quantity or timing}</p> <p><a href="#">2001/009</a> . . {Means for varying the pressure of fuel supply pump according to engine working parameters}</p> <p><a href="#">2001/0095</a> . {Mounting of control means with respect to injection apparatus or the engine}</p> <p><a href="#">1/02</a> . not restricted to adjustment of injection timing, e.g. varying amount of fuel delivered</p> <p><a href="#">1/025</a> . . {by means dependent on engine working temperature (<a href="#">F02D 1/08</a> takes precedence)}</p> <p><a href="#">1/04</a> . . by mechanical means dependent on engine speed, e.g. using centrifugal governors (<a href="#">F02D 1/08</a> takes precedence)</p> <p><a href="#">1/045</a> . . . {characterised by arrangement of springs or weights}</p> <p><a href="#">1/06</a> . . by means dependent on pressure of engine working fluid (<a href="#">F02D 1/08</a> takes precedence)</p> <p><a href="#">1/065</a> . . . {of intake of air}</p> <p><a href="#">1/08</a> . . Transmission of control impulse to pump control, e.g. with power drive or power assistance</p> <p><a href="#">2001/082</a> . . . {electric}</p> <p><a href="#">2001/085</a> . . . . {using solenoids}</p> <p><a href="#">2001/087</a> . . . . {using step motors}</p> <p><a href="#">1/10</a> . . . mechanical</p> <p><a href="#">1/12</a> . . . non-mechanical, e.g. hydraulic</p> <p><a href="#">1/122</a> . . . . {control impulse depending only on engine speed}</p> <p><a href="#">1/125</a> . . . . . {using a centrifugal governor}</p> <p><a href="#">1/127</a> . . . . . {using the pressure developed in a pump}</p> <p><a href="#">1/14</a> . . . . pneumatic</p> <p><a href="#">1/16</a> . Adjustment of injection timing (<a href="#">F02D 1/02</a> takes precedence {rotary distributor pumps <a href="#">F02M 41/00</a>; by adjustment of pumping elements <a href="#">F02M 59/20</a>})</p> <p><a href="#">1/162</a> . . {by mechanical means dependent on engine speed for angular adjustment of driving and driven shafts}</p> <p><a href="#">2001/165</a> . . {by means dependent on engine load}</p> <p><a href="#">2001/167</a> . . {by means dependent on engine working temperature, e.g. at cold start}</p> |
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1/18	. . with non-mechanical means for transmitting control impulse; with amplification of control impulse	2009/021	. . . {combined with an electromechanical governor, e.g. centrifuged governor and electric governor acting on the governor lever}
1/183	. . . {hydraulic}	2009/0211	. . . {combined with another mechanical or pneumatic governor}
2001/186	. . . . {using a pressure-actuated piston for adjustment of a stationary cam or roller support}	2009/0213	. . . {Electronic or electric governor}
<b>3/00</b>	<b>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)</b>	2009/0215	. . . {Pneumatic governor}
	<b>NOTE</b>	2009/0216	. . . {of the air-vane type}
	When the control apparatus or system forms part of the low-pressure fuel-injection apparatus it is classified in group F02M 69/00.	2009/0218	. . . {Details of governor springs}
3/02	. with continuous injection or continuous flow upstream of the injection nozzle	2009/022	. . . {Throttle control function parameters}
3/04	. Controlling fuel-injection and carburation, e.g. of alternative systems	2009/0222	. . . {Exhaust gas temperature}
<b>7/00</b>	<b>Other fuel-injection control</b>	2009/0223	. . . {Cooling water temperature}
7/002	. {Throttling of fuel passages between pumps and injectors or overflow passages (low-pressure fuel injection F02M 69/00)}	2009/0225	. . . {Intake air or mixture temperature}
7/005	. . {by mechanical means, e.g. using a centrifugal governor}	2009/0227	. . . {Atmospheric pressure}
7/007	. . {by fluid actuated means, e.g. slide valves}	2009/0228	. . . {Manifold pressure}
7/02	. Controlling fuel injection where fuel is injected by compressed air	2009/023	. . . {Engine speed}
2007/025	. . {Controlling compressed air quantity or pressure}	2009/0232	. . . {Fuel pump rack position}
	<b>NOTES</b>	2009/0233	. . . {Engine vibration}
	1. <u>accelerator lever</u> means a lever actuated by foot or hand (e.g. pedal).	2009/0235	. . . {Throttle control functions}
	2. <u>throttle lever</u> means a lever connected to the accelerator lever via a force transmitting element (e.g. cable, link) <u>and</u> mounted on the throttle axis.	2009/0237	. . . {Increasing combustion chamber gas temperature}
<b>9/00</b>	<b>Controlling engines by throttling air or fuel-and-air induction conduits or exhaust conduits</b>	2009/0238	. . . {Increasing ignition delay}
	<b>NOTE</b>	2009/024	. . . {Increasing intake vacuum}
	- in this group the following indexing codes are used: F02D 2700/00, F02D 2700/02, F02D 2700/04, F02D 2700/09	2009/0242	. . . {Increasing exhaust brake effect}
9/02	. concerning induction conduits (throttle valves, or arrangements thereof in conduits F02D 9/08)	2009/0244	. . . {Choking air flow at low speed and load}
2009/0201	. . {Arrangements; Control features; Details thereof}	2009/0245	. . . {Shutting down engine, e.g. working together with fuel cut-off}
2009/0203	. . . {Mechanical governor}	2009/0247	. . . {Opening the throttle a little on engine shutdown}
2009/0205	. . . {working on the throttle valve and another valve, e.g. choke}	2009/0249	. . . {Starting engine, e.g. closing throttle in Diesel engine to reduce starting torque}
2009/0206	. . . {specially positioned with relation to engine or engine housing}	2009/025	. . . {Opening the throttle a little during starting}
2009/0208	. . . {for small engines}	2009/0252	. . . {Opening a special valve-controlled intake passage (by-pass) during starting}
		2009/0254	. . . {Mechanical control linkage between accelerator lever and throttle valve}
		2009/0255	. . . {with means for correcting throttle position, e.g. throttle cable of variable length}
		2009/0257	. . . {having a pin and slob connection ("Leerweg")}
		2009/0259	. . . {having a dashpot, e.g. working in the throttle opening and closing directions}
		2009/0261	. . . {having a specially shaped transmission member, e.g. a cam, specially toothed gears, with a clutch}
		2009/0262	. . . {having two or more levers on the throttle shaft}
		2009/0264	. . . {in which movement is transmitted through a spring}
		2009/0266	. . . {in which movement is transmitted through a vacuum motor}
		2009/0267	. . . {for simultaneous action of a governor and an accelerator lever on the throttle}
		2009/0269	. . . {Throttle closing springs; Acting of throttle closing springs on the throttle shaft}
		2009/0271	. . . {with means for closing the throttle other than throttle closing springs}
		2009/0272	. . . {Two or more throttles disposed in series}
		2009/0274	. . . {one being controlled by pressure in intake conduit, e.g. for slowly opening the throttle as the other valve is suddenly opened}
		2009/0276	. . . {Throttle and EGR-valve operated together}

2009/0277	. . . {Fail-safe mechanisms, e.g. with limp-home feature, to close throttle if actuator fails, or if control cable sticks or breaks}	9/106	. . . . {Sealing of the valve shaft in the housing, e.g. details of the bearings}
2009/0279	. . . {Throttle valve control for intake system with two parallel air flow paths, each controlled by a throttle, e.g. a resilient flap disposed on a throttle}	9/1065	. . . {Mechanical control linkage between an actuator and the flap, e.g. including levers, gears, springs, clutches, limit stops of the like}
2009/0281	. . . {with means for detecting malfunction of one throttle and actuating only the correctly working throttle}	9/107	. . . {Manufacturing or mounting details}
2009/0283	. . . {Throttle in the form of an expander}	9/1075	. . . {Materials, e.g. composites}
2009/0284	. . . {Throttle control device with means for signalling a certain throttle opening, e.g. by a steplike increase of throttle closing spring force}	9/108	. . . . {Plastics}
2009/0286	. . . {Throttle control device with accelerator lever defining a stop for opening the throttle, e.g. the throttle itself being opened by air flow, a spring}	9/1085	. . . . {Non-organic materials, e.g. metals, alloys, ceramics}
2009/0288	. . . {Throttle control device specially adapted for spark-assisted compression-ignition engine (Diesel engine)}	9/109	. . . {having two or more flaps}
2009/0289	. . . {Throttle control device with means for establishing a variable resistance torque during throttle opening}	9/1095	. . . . {Rotating on a common axis, e.g. having a common shaft}
2009/0291	. . . {Throttle control device for throttle being disposed in a two-stroke engine transfer passage}	9/12	. . having slidably-mounted valve members; having valve members movable longitudinally of conduit
2009/0293	. . . {Throttle control device adapted to limit power development at low attitude}	9/14	. . . the members being slidable transversely of conduit
2009/0294	. . . {Throttle control device with provisions for actuating electric or electronic sensors}	9/16	. . . the members being rotatable
2009/0296	. . . {Throttle control device with stops for limiting throttle opening or closing beyond a certain position during certain periods of operation}	9/18	. . having elastic-wall valve members
2009/0298	. . . {Throttle control device with holding devices, i.e. to hold throttle in a predetermined position}	11/00	<b>Arrangements for, or adaptations to, non-automatic engine control initiation means, e.g. operator initiated (specially for reversing <a href="#">F02D 27/00</a>; arrangement or mounting of prime-mover control devices in vehicles <a href="#">B60K 26/00</a>)</b>
9/04	. concerning exhaust conduits ( <a href="#">throttle valves, or arrangements thereof in conduits F02D 9/08</a> )	11/02	. characterised by hand, foot, or like operator controlled initiation means
9/06	. . Exhaust brakes	11/04	. characterised by mechanical control linkages ( <a href="#">with power drive or assistance F02D 11/06</a> )
9/08	. Throttle valves specially adapted therefor; Arrangements of such valves in conduits ( <a href="#">throttle valves modified for use in or arranged in carburettors F02M</a> ; <a href="#">throttle valves in general F16K</a> )	11/06	. characterised by non-mechanical control linkages, e.g. fluid control linkages or by control linkages with power drive or assistance
9/10	. . having pivotally-mounted flaps	11/08	. . of the pneumatic type
9/1005	. . . {Details of the flap}	11/10	. . of the electric type
9/101	. . . . {Special flap shapes, ribs, bores or the like}	2011/101	. . . {characterised by the means for actuating the throttles}
9/1015	. . . . {Details of the edge of the flap, e.g. for lowering flow noise or improving flow sealing in closed flap position}	2011/102	. . . . {at least one throttle being moved only by an electric actuator}
9/102	. . . . {the flap having movable parts fixed onto it}	2011/103	. . . . {at least one throttle being alternatively mechanically linked to the pedal or moved by an electric actuator}
9/1025	. . . . {the rotation axis of the flap being off-set from the flap center axis}	2011/104	. . . . {using electric step motors}
9/103	. . . . . {the rotation axis being located at an edge}	11/105	. . . {characterised by the function converting demand to actuation, e.g. a map indicating relations between an accelerator pedal position and throttle valve opening or target engine torque}
9/1035	. . . {Details of the valve housing}	11/106	. . . {Detection of demand or actuation}
9/104	. . . . {Shaping of the flow path in the vicinity of the flap, e.g. having inserts in the housing}	11/107	. . . {Safety-related aspects}
9/1045	. . . . . {for sealing of the flow in closed flap position, e.g. the housing forming a valve seat}	2011/108	. . . {with means for detecting or resolving a stuck throttle, e.g. when being frozen in a position}
9/105	. . . . {having a throttle position sensor ( <a href="#">detection of actuation F02D 11/106</a> )}	13/00	<b>Controlling the engine output power by varying inlet or exhaust valve operating characteristics, e.g. timing (<a href="#">modifying valve gear F01L</a>)</b>
9/1055	. . . . {having a fluid by-pass}	2013/005	. {of throttleless spark ignited engines}
		13/02	. during engine operation
		13/0203	. . {Variable control of intake and exhaust valves}
		13/0207	. . . {changing valve lift or valve lift and timing}
		13/0211	. . . . {the change of valve timing is caused by the change in valve lift, i.e. both valve lift and timing are functionally related}
		13/0215	. . . {changing the valve timing only}
		13/0219	. . . . {by shifting the phase, i.e. the opening periods of the valves are constant}

13/0223	. . . {Variable control of the intake valves only}	17/026	. . . {delivering compressed fluid, e.g. air, reformed gas, to the active cylinders other than during starting}
13/0226	. . . {changing valve lift or valve lift and timing}	17/04	. rendering engines inoperative or idling, e.g. caused by abnormal conditions ( <a href="#">dependent on lubricating conditions F01M 1/22</a> ; <a href="#">dependent on cooling F01P 5/14</a> )
13/023	. . . . {the change of valve timing is caused by the change in valve lift, i.e. both valve lift and timing are functionally related}	<b>Controlling peculiar to specified types or adaptations of engines</b>	
13/0234	. . . {changing the valve timing only}	<b>19/00</b>	<b>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 <a href="#">F02D 21/00</a>)</b>
13/0238	. . . . {by shifting the phase, i.e. the opening periods of the valves are constant}	19/02	. peculiar to engines working with gaseous fuels ( <a href="#">apparatus, or control parts thereof, for mixing gas and air F02M</a> )
13/0242	. . {Variable control of the exhaust valves only}	19/021	. . {Control of components of the fuel supply system}
13/0246	. . . {changing valve lift or valve lift and timing}	19/022	. . . {to adjust the fuel pressure, temperature or composition}
13/0249	. . . {changing the valve timing only}	19/023	. . . {to adjust the fuel mass or volume flow}
13/0253	. . {Fully variable control of valve lift and timing using camless actuation systems such as hydraulic, pneumatic or electromagnetic actuators, e.g. solenoid valves}	19/024	. . . . {by controlling fuel injectors}
13/0257	. . {Independent control of two or more intake or exhaust valves respectively, i.e. one of two intake valves remains closed or is opened partially while the other is fully opened}	19/025	. . {Failure diagnosis or prevention; Safety measures; Testing}
13/0261	. . {Controlling the valve overlap}	19/026	. . {Measuring or estimating parameters related to the fuel supply system}
13/0265	. . . {Negative valve overlap for temporarily storing residual gas in the cylinder}	19/027	. . . {Determining the fuel pressure, temperature or volume flow, the fuel tank fill level or a valve position}
13/0269	. . {Controlling the valves to perform a Miller-Atkinson cycle}	19/028	. . . . {by estimation, i.e. without using direct measured parameter of a corresponding sensor}
13/0273	. . {Multiple actuations of a valve within an engine cycle}	19/029	. . . {Determining density, viscosity, concentration or composition}
13/0276	. . {Actuation of an additional valve for a special application, e.g. for decompression, exhaust gas recirculation or cylinder scavenging}	19/04	. peculiar to engines working with solid fuels, e.g. pulverised coal
13/028	. . {for two-stroke engines}	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
13/0284	. . . {Variable control of exhaust valves only}	19/0602	. . {Control of components of the fuel supply system}
2013/0288	. . . . {for cleaning the valves}	19/0605	. . . {to adjust the fuel pressure or temperature}
2013/0292	. . {in the start-up phase, e.g. for warming-up cold engine or catalyst}	19/0607	. . . {to adjust the fuel mass or volume flow}
2013/0296	. . {Changing the valve lift only}	19/061	. . . . {by controlling fuel injectors}
13/04	. . Using engine as brake	19/0613	. . . {Switch-over from one fuel to another ( <a href="#">F02D 19/081 takes precedence</a> )}
13/06	. . Cutting-out cylinders	19/0615	. . . . {being initiated by automatic means, e.g. based on engine or vehicle operating conditions}
13/08	. for rendering engine inoperative or idling	19/0618	. . . . {depending on the engine's or vehicle's position, e.g. on/off road or proximity to a harbor}
<b>15/00</b>	<b>Varying compression ratio (modifying valve gear <a href="#">F01L</a>)</b>	19/0621	. . . . {Purging of the fuel system}
	<b>NOTE</b>	19/0623	. . {Failure diagnosis or prevention; Safety measures; Testing}
	- in this group the following indexing codes are used:	19/0626	. . {Measuring or estimating parameters related to the fuel supply system}
	<a href="#">F02D 2700/03</a>	19/0628	. . . {Determining the fuel pressure, temperature or flow, the fuel tank fill level or a valve position}
15/02	. by alteration or displacement of piston stroke	19/0631	. . . . {by estimation, i.e. without using direct measurements of a corresponding sensor}
15/04	. by alteration of volume of compression space without changing piston stroke	19/0634	. . . {Determining a density, viscosity, composition or concentration ( <a href="#">F02D 19/087 takes precedence</a> )}
<b>17/00</b>	<b>Controlling engines by cutting out individual cylinders; Rendering engines inoperative or idling (controlling or rendering inoperative by varying inlet or exhaust valve operating characteristics <a href="#">F02D 13/00</a>)</b>		
	<b>NOTE</b>		
	- in this group the following indexing codes are used:		
	<a href="#">F02D 2700/05</a>		
17/02	. Cutting-out ( <a href="#">cutting-out engines in multiple engine arrangements F02D 25/04</a> )		
17/023	. . {the inactive cylinders acting as compressor other than for pumping air into the exhaust system}		



19/0636	. . . . {by estimation, i.e. without using direct measurements of a corresponding sensor}	19/105	. . . . {operating in a special mode, e.g. in a liquid fuel only mode for starting}
19/0639	. . {characterised by the type of fuels}	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 <a href="#">F02M</a> )
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}	<b>21/00</b>	<b>Controlling engines characterised by their being supplied with non-airborne oxygen or other non-fuel gas</b>
19/0647	. . . . {the gaseous fuel being liquefied petroleum gas [LPG], liquefied natural gas [LNG], compressed natural gas [CNG] or dimethyl ether [DME]}	21/02	. peculiar to oxygen-fed engines
19/0649	. . . {Liquid fuels having different boiling temperatures, volatilities, densities, viscosities, cetane or octane numbers}	21/04	. . with circulation of exhaust gases in closed or semi-closed circuits
19/0652	. . . . {Biofuels, e.g. plant oils}	21/06	. peculiar to engines having other non-fuel gas added to combustion air
19/0655	. . . . {at least one fuel being an alcohol, e.g. ethanol ( <a href="#">F02D 19/084</a> takes precedence)}	21/08	. . the other gas being the exhaust gas of engine (circulation of exhaust gas in oxygen-fed engines <a href="#">F02D 21/04</a> )
19/0657	. . . . {Heavy or light fuel oils; Fuels characterised by their impurities such as sulfur content or differences in grade, e.g. for ships}	2021/083	. . . {controlling exhaust gas recirculation electronically}
19/066	. . {Retrofit of secondary fuel supply systems; Conversion of engines to operate on multiple fuels}	2021/086	. . . {the exhaust gas recirculation valve being controlled by fuel pressure, e.g. indirectly}
19/0663	. . {Details on the fuel supply system, e.g. tanks, valves, pipes, pumps, rails, injectors or mixers}	21/10	. . having secondary air added to the fuel-air mixture (apparatus, or control parts thereof, for delivering secondary air <a href="#">F02M</a> )
19/0665	. . . {Tanks, e.g. multiple tanks}	<b>23/00</b>	<b>Controlling engines characterised by their being supercharged</b>
19/0668	. . . {Treating or cleaning means; Fuel filters}	23/005	. {with the supercharger being mechanically driven by the engine (supercharger drives <a href="#">F02B 39/00</a> )}
19/0671	. . . . {Means to generate or modify a fuel, e.g. reformers, electrolytic cells or membranes}	23/02	. the engine being of fuel-injection type
19/0673	. . . {Valves; Pressure or flow regulators; Mixers}	<b>25/00</b>	<b>Controlling two or more co-operating engines</b>
19/0676	. . . . {Multi-way valves; Switch-over valves}	25/02	. to synchronise speed
19/0678	. . . . {Pressure or flow regulators therefor; Fuel metering valves therefor}	25/04	. by cutting-out engines
19/0681	. . . . {Shut-off valves; Check valves; Safety valves; Pressure relief valves}	<b>27/00</b>	<b>Controlling engines characterised by their being reversible</b>
19/0684	. . . {High pressure fuel injection systems; Details on pumps, rails or the arrangement of valves in the fuel supply and return systems}	27/02	. by performing a programme
19/0686	. . . {Injectors}	<b>28/00</b>	<b>Programme-control of engines (programme-control specific to a type or purpose covered by one of the groups of this subclass except groups <a href="#">F02D 29/00</a>, <a href="#">F02D 39/00</a>, or by one group of another subclass, e.g. <a href="#">F01L</a>, see that group; programme-control in general <a href="#">G05B 19/00</a>)</b>
19/0689	. . . . {for in-cylinder direct injection}		
19/0692	. . . . {Arrangement of multiple injectors per combustion chamber}	<b>29/00</b>	<b>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</b>
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 ( <a href="#">F02D 19/12</a> 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}	29/02	. peculiar to engines driving vehicles; peculiar to engines driving variable pitch propellers
19/088	. . . . . {by estimation, i.e. without using direct measurements of a corresponding sensor}	29/04	. peculiar to engines driving pumps
19/10	. . . peculiar to compression-ignition engines in which the main fuel is gaseous	29/06	. peculiar to engines driving electric generators
		<b>Other controlling of engines</b>	
		<b>31/00</b>	<b>Use of speed-sensing governors to control combustion engines, not otherwise provided for</b>
		31/001	. {Electric control of rotation speed}
		31/002	. . {controlling air supply}

**NOTE**

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

- 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)**

- 41/0002 . {Controlling intake air}
- 41/0005 . . {during deceleration}
- 41/0007 . . {for control of turbo-charged or super-charged engines (control of the pumps [per se F02B 37/12](#))}
- 2041/001 . . {for engines with variable valve actuation}
- 2041/0012 . . . {with selective deactivation of cylinders}
- 2041/0015 . . {for engines with means for controlling swirl or tumble flow, e.g. by using swirl valves}
- 2041/0017 . . {by simultaneous control of throttle and exhaust gas recirculation}
- 2041/002 . . {by simultaneous control of throttle and variable valve actuation}
- 2041/0022 . . {for diesel engines by throttle control}
- 41/0025 . {Controlling engines characterised by use of non-liquid fuels, pluralities of fuels, or non-fuel substances added to the combustible mixtures}
- 41/0027 . . {the fuel being gaseous ([non-electrical control F02D 19/02](#))}
- 41/003 . . {Adding fuel vapours, e.g. drawn from engine fuel reservoir}
- 41/0032 . . . {Controlling the purging of the canister as a function of the engine operating conditions}
- 41/0035 . . . . {to achieve a special effect, e.g. to warm up the catalyst}
- 41/0037 . . . . {for diagnosing the engine ([diagnosis of purge control systems F02M 25/0809](#))}
- 41/004 . . . . {Control of the valve or purge actuator, e.g. duty cycle, closed loop control of position}
- 41/0042 . . . {Controlling the combustible mixture as a function of the canister purging, e.g. control of injected fuel to compensate for deviation of air fuel ratio when purging}

41/0045	. . . {Estimating, calculating or determining the purging rate, amount, flow or concentration}	41/0245	. . . . . {by increasing temperature of the exhaust gas leaving the engine}
41/0047	. . {Controlling exhaust gas recirculation [EGR] (temperature control with cooler in recirculation circuit <a href="#">F02M 26/33</a> )}	41/025	. . . . . {by changing the composition of the exhaust gas, e.g. for exothermic reaction on exhaust gas treating apparatus}
41/005	. . . {according to engine operating conditions}	41/0255	. . . . . {to accelerate the warming-up of the exhaust gas treating apparatus at engine start}
41/0052	. . . . {Feedback control of engine parameters, e.g. for control of air/fuel ratio or intake air amount}	2041/026	. . . . . {using an external load, e.g. by increasing generator load or by changing the gear ratio}
41/0055	. . . . {Special engine operating conditions, e.g. for regeneration of exhaust gas treatment apparatus}	2041/0265	. . . . . {to decrease temperature of the exhaust gas treating apparatus}
41/0057	. . . . {Specific combustion modes (combustion modes <a href="#">per se F02D 41/3017</a> )}	41/027	. . . . . {to purge or regenerate the exhaust gas treating apparatus}
41/006	. . . {using internal EGR (control of valve overlap for internal EGR <a href="#">F02D 13/0261</a> ; arrangements for internal EGR <a href="#">F02M 26/01</a> )}	41/0275	. . . . . {the exhaust gas treating apparatus being a NOx trap or adsorbent}
41/0062	. . . . {Estimating, calculating or determining the internal EGR rate, amount or flow}	41/028	. . . . . {Desulfurisation of NOx traps or adsorbent}
41/0065	. . . {Specific aspects of external EGR control (constructional details of EGR system <a href="#">F02M 26/00</a> )}	41/0285	. . . . . {the exhaust gas treating apparatus being a SOx trap or adsorbent}
2041/0067	. . . . {Determining the EGR temperature}	41/029	. . . . . {the exhaust gas treating apparatus being a particulate filter}
2041/007	. . . . . {by estimation}	41/0295	. . . . . {Control according to the amount of oxygen that is stored on the exhaust gas treating apparatus}
41/0072	. . . . {Estimating, calculating or determining the EGR rate, amount or flow (sensors in EGR systems <a href="#">F02M 26/45</a> )}	41/04	. . Introducing corrections for particular operating conditions ( <a href="#">F02D 41/14</a> takes precedence)
2041/0075	. . . . . {by using flow sensors}	41/042	. . . {for stopping the engine}
41/0077	. . . {Control of the EGR valve or actuator, e.g. duty cycle, closed loop control of position (EGR valve position sensor <a href="#">F02M 26/48</a> )}	41/045	. . . {Detection of accelerating or decelerating state (detection thereof in general <a href="#">G01P</a> )}
41/008	. {Controlling each cylinder individually}	41/047	. . . {Taking into account fuel evaporation or wall wetting; (special correction after fuel cut-off <a href="#">F02D 41/126</a> )}
41/0082	. . {per groups or banks ( <a href="#">F02D 41/0087</a> takes precedence)}	41/06	. . . for engine starting or warming up ( <a href="#">F02D 41/0255</a> takes precedence)
41/0085	. . {Balancing of cylinder outputs, e.g. speed, torque or air-fuel ratio}	41/061	. . . . {the corrections being time dependent}
41/0087	. . {Selective cylinder activation, i.e. partial cylinder operation (deceleration cut-off <a href="#">F02D 41/123</a> )}	41/062	. . . . {for starting ( <a href="#">F02D 41/061</a> takes precedence)}
41/009	. {using means for generating position or synchronisation signals}	41/064	. . . . . {at cold start ( <a href="#">F02D 41/067</a> takes precedence)}
2041/0092	. . {Synchronisation of the cylinders at engine start}	41/065	. . . . . {at hot start or restart ( <a href="#">F02D 41/067</a> takes precedence)}
2041/0095	. . {Synchronisation of the cylinders during engine shutdown}	41/067	. . . . . {with control of the choke (non electronic control of choke <a href="#">see F02M 1/10</a> )}
41/0097	. {using means for generating speed signals}	41/068	. . . . {for warming-up}
41/02	. Circuit arrangements for generating control signals	41/08	. . . for idling ( <a href="#">F02D 41/06</a> , <a href="#">F02D 41/16</a> take precedence)
41/0205	. . {using an auxiliary engine speed control (engine speed control <a href="#">per se F02D 31/00</a> )}	41/083	. . . . {taking into account engine load variation, e.g. air-conditioning}
41/021	. . {Introducing corrections for particular conditions exterior to the engine (conjoint control of vehicle sub-units for propelling the vehicle <a href="#">B60W 30/18</a> )}	41/086	. . . . {taking into account the temperature of the engine}
41/0215	. . . {in relation with elements of the transmission}	41/10	. . . for acceleration
41/022	. . . . {in relation with the clutch status}	41/102	. . . . {Switching from sequential injection to simultaneous injection}
41/0225	. . . . {in relation with the gear ratio or shift lever position}	41/105	. . . . {using asynchronous injection}
41/023	. . . . {in relation with the gear ratio shifting (conjoint control for improving gear change <a href="#">B60W 30/19</a> )}	41/107	. . . . {and deceleration}
41/0235	. . . {in relation with the state of the exhaust gas treating apparatus (control of exhaust gas treating apparatus <a href="#">per se F01N</a> )}	41/12	. . . for deceleration ( <a href="#">F02D 41/0005</a> , <a href="#">F02D 41/107</a> take precedence)
41/024	. . . . {to increase temperature of the exhaust gas treating apparatus}	41/123	. . . . {the fuel injection being cut-off}
		41/126	. . . . . {transitionnal corrections at the end of the cut-off period}
		41/14	. . Introducing closed-loop corrections

41/1401	. . . {characterised by the control or regulation method ( <a href="#">F02D 41/1473</a> , <a href="#">F02D 41/1477</a> take precedence)}	41/1446	. . . . . {the characteristics being exhaust temperatures}
41/1402	. . . . {Adaptive control}	41/1447	. . . . . {with determination means using an estimation}
41/1403	. . . . {Sliding mode control}	41/1448	. . . . . {the characteristics being an exhaust gas pressure}
41/1404	. . . . {Fuzzy logic control}	41/145	. . . . . {with determination means using an estimation}
41/1405	. . . . {Neural network control}	41/1451	. . . . . {the sensor being an optical sensor}
41/1406	. . . . {with use of a optimisation method, e.g. iteration}	41/1452	. . . . . {the characteristics being a COx content or concentration}
41/1408	. . . . {Dithering techniques}	41/1453	. . . . . {the characteristics being a CO content or concentration}
2041/1409	. . . . {using at least a proportional, integral or derivative controller}	41/1454	. . . . . {the characteristics being an oxygen content or concentration or the air-fuel ratio}
2041/141	. . . . {using a feed-forward control element}	41/1455	. . . . . {with sensor resistivity varying with oxygen concentration ( <a href="#">F02D 41/1456</a> takes precedence)}
2041/1411	. . . . {using a finite or infinite state machine, automaton or state graph for controlling or modelling}	41/1456	. . . . . {with sensor output signal being linear or quasi-linear with the concentration of oxygen}
2041/1412	. . . . {using a predictive controller}	41/1458	. . . . . {with determination means using an estimation}
2041/1413	. . . . {Controller structures or design}	41/1459	. . . . . {the characteristics being a hydrocarbon content or concentration}
2041/1415	. . . . . {using a state feedback or a state space representation}	41/146	. . . . . {the characteristics being an NOx content or concentration}
2041/1416	. . . . . {Observer}	41/1461	. . . . . {of the exhaust gases emitted by the engine}
2041/1417	. . . . . {Kalman filter}	41/1462	. . . . . {with determination means using an estimation}
2041/1418	. . . . . {Several control loops, either as alternatives or simultaneous}	41/1463	. . . . . {of the exhaust gases downstream of exhaust gas treatment apparatus}
2041/1419	. . . . . {the control loops being cascaded, i.e. being placed in series or nested}	41/1465	. . . . . {with determination means using an estimation}
2041/142	. . . . . {using different types of control law in combination, e.g. adaptive combined with PID and sliding mode}	41/1466	. . . . . {the characteristics being a soot concentration or content}
2041/1422	. . . . . {Variable gain or coefficients}	41/1467	. . . . . {with determination means using an estimation}
2041/1423	. . . . . {Identification of model or controller parameters}	2041/1468	. . . . . {the characteristics being an ammonia content or concentration of the exhaust gases}
2041/1424	. . . . . {Pole-zero cancellation}	2041/1469	. . . . . {with determination means using an estimation}
2041/1425	. . . . . {using a bond graph model or models with nodes}	2041/147	. . . . . {the characteristics being a hydrogen content or concentration of the exhaust gases}
2041/1426	. . . . . {taking into account control stability}	2041/1472	. . . . . {the characteristics being a humidity or water content of the exhaust gases}
2041/1427	. . . . . {Decoupling, i.e. using a feedback such that one output is controlled by only one input}	41/1473	. . . . {characterised by the regulation method}
2041/1429	. . . . . {Linearisation, i.e. using a feedback law such that the system evolves as a linear one}	41/1474	. . . . . {by detecting the commutation time of the sensor}
2041/143	. . . . . {the control loop including a non-linear model or compensator}	41/1475	. . . . . {Regulating the air fuel ratio at a value other than stoichiometry}
2041/1431	. . . . . {the system including an input-output delay}	41/1476	. . . . . {Biasing of the sensor}
2041/1432	. . . . . {the system including a filter, e.g. a low pass or high pass filter}	41/1477	. . . . {characterised by the regulation circuit or part of it, (e.g. comparator, PI regulator, output)}
2041/1433	. . . . {using a model or simulation of the system}	41/1479	. . . . . {Using a comparator with variable reference}
2041/1434	. . . . . {Inverse model}	41/148	. . . . . {Using a plurality of comparators}
2041/1436	. . . . . {Hybrid model}	41/1481	. . . . . {Using a delaying circuit}
2041/1437	. . . . . {Simulation}	41/1482	. . . . . {Integrator, i.e. variable slope}
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}		



41/1483	. . . . .	{Proportional component}	2041/2068	. . .	{characterised by the circuit design or special circuit elements}
41/1484	. . . . .	{Output circuit}	2041/2072	. . .	{Bridge circuits, i.e. the load being placed in the diagonal of a bridge to be controlled in both directions}
41/1486	. . . . .	{with correction for particular operating conditions}	2041/2075	. . .	{Type of transistors or particular use thereof}
41/1487	. . . . .	{Correcting the instantaneous control value}	2041/2079	. . .	{the circuit having several coils acting on the same anchor}
41/1488	. . . . .	{Inhibiting the regulation}	2041/2082	. . .	{the circuit being adapted to distribute current between different actuators or recuperate energy from actuators}
41/1489	. . . . .	{Replacing of the control value by a constant}	2041/2086	. . .	{with means for detecting circuit failures}
41/149	. . . . .	{Replacing of the control value by an other parameter}	2041/2089	. . .	{detecting open circuits}
41/1491	. . . . .	{Replacing of the control value by a mean value}	2041/2093	. . .	{detecting short circuits}
41/1493	. . . . .	{Details}	41/2096	. . .	{for controlling piezo-electric injectors (drive and control circuit for piezo-electric devices in general <a href="#">H01L 41/042</a> )}
41/1494	. . . . .	{Control of sensor heater}	41/22	. . .	Safety or indicating devices for abnormal conditions {(in air/fuel ratio feedback systems <a href="#">F02D 41/1495</a> , in electric control linkage <a href="#">F02D 11/107</a> , in purge control systems <a href="#">F02M 25/0809</a> )}
41/1495	. . . . .	{Detection of abnormalities in the air/fuel ratio feedback system}	41/221	. . .	{relating to the failure of actuators or electrically driven elements}
41/1496	. . . . .	{Measurement of the conductivity of a sensor ( <a href="#">F02D 41/1455</a> takes precedence)}	41/222	. . .	{relating to the failure of sensors or parameter detection devices}
41/1497	. . .	{With detection of the mechanical response of the engine}	2041/223	. . .	{Diagnosis of fuel pressure sensors}
41/1498	. . . . .	{measuring engine roughness}	2041/224	. . .	{Diagnosis of the fuel system}
41/16	. . .	for idling	2041/225	. . .	{Leakage detection}
41/18	. . .	by measuring intake air flow (measuring flow in general <a href="#">G01F</a> )	2041/226	. . .	{Fail safe control for fuel injection pump}
41/182	. . .	{for the control of a fuel injection device}	2041/227	. . .	{Limping Home, i.e. taking specific engine control measures at abnormal conditions}
41/185	. . .	{using a vortex flow sensor}	2041/228	. . .	{Warning displays}
41/187	. . .	{using a hot wire flow sensor}	41/24	. . .	characterised by the use of digital means
41/20	. . .	Output circuits, e.g. for controlling currents in command coils (current control in inductive loads in general <a href="#">H03K 17/64</a> )	41/2403	. . .	{using essentially up/down counters}
2041/2003	. . .	{using means for creating a boost voltage, i.e. generation or use of a voltage higher than the battery voltage, e.g. to speed up injector opening}	41/2406	. . .	{using essentially read only memories}
2041/2006	. . .	{by using a boost capacitor}	41/2409	. . .	{Addressing techniques specially adapted therefor}
2041/201	. . .	{by using a boost inductance}	41/2412	. . . . .	{One-parameter addressing technique}
2041/2013	. . .	{by using a boost voltage source}	41/2416	. . . . .	{Interpolation techniques}
2041/2017	. . .	{using means for creating a boost current or using reference switching}	41/2419	. . . . .	{Non-linear variation along at least one coordinate}
2041/202	. . .	{characterised by the control of the circuit}	41/2422	. . . . .	{Selective use of one or more tables}
2041/2024	. . .	{the control switching a load after time-on and time-off pulses}	41/2425	. . .	{Particular ways of programming the data}
2041/2027	. . . . .	{Control of the current by pulse width modulation or duty cycle control}	41/2429	. . . . .	{Methods of calibrating or learning}
2041/2031	. . .	{Control of the current by means of delays or monostable multivibrators}	41/2432	. . . . .	{Methods of calibration}
2041/2034	. . .	{Control of the current gradient}	41/2435	. . . . .	{characterised by the writing medium, e.g. bar code}
2041/2037	. . .	{for preventing bouncing of the valve needle}	41/2438	. . . . .	{Active learning methods}
2041/2041	. . .	{for controlling the current in the free-wheeling phase}	41/2441	. . . . .	{characterised by the learning conditions}
2041/2044	. . .	{using pre-magnetisation or post-magnetisation of the coils}	41/2445	. . . . .	{characterised by a plurality of learning conditions or ranges}
2041/2048	. . .	{said control involving a limitation, e.g. applying current or voltage limits}	41/2448	. . . . .	{Prohibition of learning}
2041/2051	. . .	{using voltage control}	41/2451	. . . . .	{characterised by what is learned or calibrated}
2041/2055	. . .	{with means for determining actual opening or closing time}	41/2454	. . . . .	{Learning of the air-fuel ratio control}
2041/2058	. . .	{using information of the actual current value}	41/2458	. . . . .	{with an additional dither signal}
2041/2062	. . . . .	{the current value is determined by simulation or estimation}	41/2461	. . . . .	{by learning a value and then controlling another value}
2041/2065	. . .	{the control being related to the coil temperature}	41/2464	. . . . .	{Characteristics of actuators}
			41/2467	. . . . .	{for injectors}
			41/247	. . . . .	{Behaviour for small quantities}
			41/2474	. . . . .	{Characteristics of sensors}

41/2477	. . . . . {characterised by the method used for learning}	41/365	. . . . . {with means for controlling timing and distribution}
41/248	. . . . . {using a plurality of learned values}	41/38	. . . of the high pressure type
41/2483	. . . . . {restricting learned values}	41/3809	. . . {Common rail control systems ( <a href="#">common rail apparatus F02M 55/025</a> , <a href="#">F02M 63/0225</a> )}
41/2487	. . . . . {Methods for rewriting}	41/3818	. . . . . {for petrol engines}
41/249	. . . . . {Methods for preventing the loss of data}	41/3827	. . . . . {for diesel engines}
41/2493	. . . . . {Resetting of data to a predefined set of values}	41/3836	. . . . . {Controlling the fuel pressure}
41/2496	. . . {the memory being part of a closed loop}	41/3845	. . . . . {by controlling the flow into the common rail, e.g. the amount of fuel pumped}
41/26	. . . using computer, e.g. microprocessor	41/3854	. . . . . {with elements in the low pressure part, e.g. low pressure pump}
41/263	. . . {the program execution being modifiable by physical parameters}	41/3863	. . . . . {by controlling the flow out of the common rail, e.g. using pressure relief valves}
41/266	. . . {the computer being backed-up or assisted by another circuit, e.g. analogue}	41/3872	. . . . . {characterised by leakage flow in injectors}
41/28	. . . Interface circuits	2041/3881	. . . . . {with multiple common rails, e.g. one rail per cylinder bank, or a high pressure rail and a low pressure rail}
2041/281	. . . . . {between sensors and control unit}	2041/389	. . . {for injecting directly into the cylinder}
2041/283	. . . . . {the sensor directly giving at least one digital reading}	41/40	. . . with means for controlling injection timing or duration
2041/285	. . . . . {the sensor having a signal processing unit external to the engine control unit}	41/401	. . . . . {Controlling injection timing ( <a href="#">F02D 41/402 takes precedence</a> )}
2041/286	. . . . . {comprising means for signal processing}	41/402	. . . . . {Multiple injections}
2041/288	. . . . . {for performing a transformation into the frequency domain, e.g. Fourier transformation}	41/403	. . . . . {with pilot injections}
41/30	. . . Controlling fuel injection ( <a href="#">F02D 41/182</a> , <a href="#">F02D 41/24 take precedence</a> )	41/405	. . . . . {with post injections}
41/3005	. . {Details not otherwise provided for}	41/406	. . . . . {Electrically controlling a diesel injection pump ( <a href="#">F02D 41/401 takes precedence</a> )}
41/3011	. . {according to or using specific or several modes of combustion}	41/407	. . . . . {of the in-line type}
41/3017	. . . {characterised by the mode(s) being used}	41/408	. . . . . {of the distributing type}
41/3023	. . . . . {a mode being the stratified charge spark-ignited mode}	<b>43/00</b>	<b>Conjoint electrical control of two or more functions, e.g. ignition, fuel-air mixture, recirculation, supercharging, exhaust-gas treatment (<a href="#">electrical control of exhaust gas treating apparatus per se F01N 9/00</a>)</b>
41/3029	. . . . . {further comprising a homogeneous charge spark-ignited mode}	43/02	. . . using only analogue means
41/3035	. . . . . {a mode being the premixed charge compression-ignition mode}	43/04	. . . using only digital means
41/3041	. . . . . {with means for triggering compression ignition, e.g. spark plug}	<b>45/00</b>	<b>Electrical control not provided for in groups <a href="#">F02D 41/00</a> - <a href="#">F02D 43/00</a> (<a href="#">electrical control of exhaust gas treating apparatus F01N 9/00</a>; <a href="#">electrical control of one of the functions</a>; ignition, lubricating, cooling, starting, intake-heating, see relevant subclasses for such functions)</b>
41/3047	. . . . . {said means being a secondary injection of fuel}		
2041/3052	. . . . . {the mode being the stratified charge compression-ignition mode}		
41/3058	. . . . . {the engine working with a variable number of cycles}		
41/3064	. . . {with special control during transition between modes}		
41/307	. . . . . {to avoid torque shocks}		
41/3076	. . . {with special conditions for selecting a mode of combustion, e.g. for starting, for diagnosing}		
41/3082	. . {Control of electrical fuel pumps}		
2041/3088	. . {for air assisted injectors}		
41/3094	. . {the fuel injection being effected by at least two different injectors, e.g. one in the intake manifold and one in the cylinder}		
41/32	. . . of the low pressure type ( <a href="#">F02D 41/3082 takes precedence</a> )		
41/34	. . . with means for controlling injection timing or duration ( <a href="#">ignition timing F02P 5/00</a> )		
41/345	. . . . . {Controlling injection timing ( <a href="#">F02D 41/365 takes precedence</a> )}		
41/36	. . . with means for controlling distribution ( <a href="#">arrangement of ignition distributors F02P 7/00</a> )		
		<b>2200/00</b>	<b>Input parameters for engine control</b>
		2200/02	. . the parameters being related to the engine
		2200/021	. . . Engine temperature
		2200/022	. . . . Estimation of engine temperature
		2200/023	. . . Temperature of lubricating oil or working fluid
		2200/024	. . . Fluid pressure of lubricating oil or working fluid
		2200/025	. . . Engine noise, e.g. determined by using an acoustic sensor
		2200/04	. . . Engine intake system parameters
		2200/0402	. . . the parameter being determined by using a model of the engine intake or its components
		2200/0404	. . . Throttle position
		2200/0406	. . . Intake manifold pressure
		2200/0408	. . . . Estimation of intake manifold pressure
		2200/0411	. . . Volumetric efficiency

2200/0414	. . .	Air temperature
2200/0416	. . . .	Estimation of air temperature
2200/0418	. . .	Air humidity
2200/06	. .	Fuel or fuel supply system parameters
2200/0602	. . .	Fuel pressure
2200/0604	. . . .	Estimation of fuel pressure
2200/0606	. . .	Fuel temperature
2200/0608	. . . .	Estimation of fuel temperature
2200/0611	. . .	Fuel type, fuel composition or fuel quality
2200/0612	. . . .	determined by estimation
2200/0614	. . .	Actual fuel mass or fuel injection amount
2200/0616	. . . .	determined by estimation
2200/0618	. . .	Actual fuel injection timing or delay, e.g. determined from fuel pressure drop
2200/0625	. . .	Fuel consumption, e.g. measured in fuel liters per 100 kms or miles per gallon
2200/063	. . .	Lift of the valve needle
2200/08	. .	Exhaust gas treatment apparatus parameters
2200/0802	. . .	Temperature of the exhaust gas treatment apparatus
2200/0804	. . . .	Estimation of the temperature of the exhaust gas treatment apparatus
2200/0806	. . .	NOx storage amount, i.e. amount of NOx stored on NOx trap
2200/0808	. . .	NOx storage capacity, i.e. maximum amount of NOx that can be stored on NOx trap
2200/0811	. . .	NOx storage efficiency
2200/0812	. . .	Particle filter loading
2200/0814	. . .	Oxygen storage amount
2200/0816	. . .	Oxygen storage capacity
2200/0818	. . .	SOx storage amount, e.g. for SOx trap or NOx trap
2200/10	. .	Parameters related to the engine output, e.g. engine torque or engine speed
2200/1002	. . .	Output torque
2200/1004	. . . .	Estimation of the output torque
2200/1006	. . .	Engine torque losses, e.g. friction or pumping losses or losses caused by external loads of accessories
2200/101	. . .	Engine speed
2200/1012	. . .	Engine speed gradient
2200/1015	. . .	Engines misfires
2200/50	. .	said parameters being related to the vehicle or its components
2200/501	. .	Vehicle speed
2200/502	. .	Neutral gear position
2200/503	. .	Battery correction, i.e. corrections as a function of the state of the battery, its output or its type
2200/60	. .	said parameters being related to the driver demands or status
2200/602	. .	Pedal position
2200/604	. .	Engine control mode selected by driver, e.g. to manually start particle filter regeneration or to select driving style
2200/606	. .	Driving style, e.g. sporty or economic driving
2200/70	. .	said parameters being related to the vehicle exterior
2200/701	. .	Information about vehicle position, e.g. from navigation system or GPS signal
2200/702	. .	Road conditions
2200/703	. .	Atmospheric pressure
2200/704	. . .	Estimation of atmospheric pressure

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

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

2250/02	. .	Fuel evaporation in fuel rails, e.g. in common rails
2250/04	. .	Fuel pressure pulsation in common rails
2250/06	. .	Reverse rotation of engine
2250/08	. .	Engine blow-by from crankcase chamber
2250/11	. .	Oil dilution, i.e. prevention thereof or special controls according thereto
2250/12	. .	Timing of calculation, i.e. specific timing aspects when calculation or updating of engine parameter is performed
2250/14	. .	Timing of measurement, e.g. synchronisation of measurements to the engine cycle
2250/16	. .	End position calibration, i.e. calculation or measurement of actuator end positions, e.g. for throttle or its driving actuator
2250/18	. .	Control of the engine output torque
2250/21	. .	during a transition between engine operation modes or states
2250/22	. .	by keeping a torque reserve, i.e. with temporarily reduced drive train or engine efficiency
2250/24	. .	by using an external load, e.g. a generator
2250/26	. .	by applying a torque limit
2250/28	. .	Control for reducing torsional vibrations, e.g. at acceleration
2250/31	. .	Control of the fuel pressure
2250/32	. .	Air-fuel ratio control in a diesel engine
2250/34	. .	Control of exhaust back pressure, e.g. for turbocharged engines
2250/36	. .	Control for minimising NOx emissions
2250/38	. .	Control for minimising smoke emissions, e.g. by applying smoke limitations on the fuel injection amount
2250/41	. .	Control to generate negative pressure in the intake manifold, e.g. for fuel vapor purging or brake booster

#### **2400/00 Control systems adapted for specific engine types; Special features of engine control systems not otherwise provided for; Power supply, connectors or cabling for engine control systems**

2400/02	. .	Four-stroke combustion engines with electronic control
2400/04	. .	Two-stroke combustion engines with electronic control
2400/06	. .	Small engines with electronic control, e.g. for hand held tools
2400/08	. .	Redundant elements, e.g. two sensors for measuring the same parameter
2400/11	. .	After-sales modification devices designed to be used to modify an engine afterwards
2400/12	. .	Engine control specially adapted for a transmission comprising a torque converter or for continuously variable transmissions
2400/14	. .	Power supply for engine control systems
2400/16	. .	Adaptation of engine control systems to a different battery voltages, e.g. for using high voltage batteries
2400/18	. .	Packaging of the electronic circuit in a casing
2400/21	. .	Engine cover with integrated cabling

- 2400/22 . Connectors or cables specially adapted for engine management applications
- 2700/00 Mechanical control of speed or power of a single cylinder piston engine**
  - 2700/02 . Controlling by changing the air or fuel supply
  - 2700/0202 . . for engines working with gaseous fuel, including those working with an ignition liquid
  - 2700/0205 . . . Controlling the air supply as well as the fuel supply
  - 2700/0207 . . . Controlling the air or mixture supply
  - 2700/021 . . . . Engines without compressor
  - 2700/0212 . . . . Engines with compressor
  - 2700/0215 . . . Controlling the fuel supply
  - 2700/0217 . . for mixture compressing engines using liquid fuel
  - 2700/022 . . . Controlling the air or the mixture supply as well as the fuel supply
    - 2700/0223 . . . . Engines with fuel injection
    - 2700/0225 . . . Control of air or mixture supply
    - 2700/0228 . . . . Engines without compressor
    - 2700/023 . . . . . by means of one throttle device
      - 2700/0233 . . . . . depending on several parameters
      - 2700/0235 . . . . . depending on the pressure of a gaseous or liquid medium
    - 2700/0238 . . . . . depending on the number of revolutions of a centrifugal governor
    - 2700/0241 . . . . . depending on another parameter
    - 2700/0243 . . . . . by means of a plurality of throttle devices
    - 2700/0246 . . . . for engines with compressor
    - 2700/0248 . . . . . by means of throttle devices
    - 2700/0251 . . . . . in the intake conduit
    - 2700/0253 . . . . . in the outlet conduit
    - 2700/0256 . . . . . by changing the speed of the compressor
    - 2700/0258 . . . . . by other means
  - 2700/0261 . . . Control of the fuel supply
  - 2700/0264 . . . . for engines with a fuel jet working with depression
    - 2700/0266 . . . . for engines with fuel injection
  - 2700/0269 . . for air compressing engines with compression ignition
    - 2700/0271 . . . Controlling the air supply as well as the fuel supply
    - 2700/0274 . . . Controlling the air supply
    - 2700/0276 . . . . Engines without compressor
    - 2700/0279 . . . . Engines with compressor
    - 2700/0282 . . . Control of fuel supply
    - 2700/0284 . . . . by acting on the fuel pump control element
    - 2700/0287 . . . . . depending on several parameters
    - 2700/0289 . . . . . depending on the pressure of a gaseous or liquid medium
    - 2700/0292 . . . . . depending on the speed of a centrifugal governor
    - 2700/0294 . . . . . depending on another parameter
    - 2700/0297 . . . . by control means in the fuel conduit between pump and injector
  - 2700/03 . Controlling by changing the compression ratio
  - 2700/035 . . without modifying the volume of the compression space, e.g. by changing the valve timing
  - 2700/04 . Controlling by throttling the exhaust conduit
  - 2700/05 . Controlling by preventing combustion in one or more cylinders
  - 2700/052 . . Methods therefor
  - 2700/054 . . . by keeping the exhaust valves open
- 2700/056 . . . by interrupting the medium supply
- 2700/058 . . . by another method
- 2700/07 . Automatic control systems according to one of the preceeding 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