

**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](#))

**F02D 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](#)

- |                                |                                                                                                                               |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <a href="#">F02D 2001/0005</a> | . {Details, component parts or accessories of centrifugal governors}                                                          |
| <a href="#">F02D 2001/001</a>  | . . {Arrangement of centrifugal weights}                                                                                      |
| <a href="#">F02D 2001/0015</a> | . . . {the weights being cup-shaped and carrying governor springs}                                                            |
| <a href="#">F02D 2001/002</a>  | . . {Arrangement of governor springs}                                                                                         |
| <a href="#">F02D 2001/0025</a> | . . . {having at least two springs, one of them being idling spring}                                                          |
| <a href="#">F02D 2001/003</a>  | . . . {the main spring being active at maximum speed only}                                                                    |
| <a href="#">F02D 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} |
| <a href="#">F02D 2001/004</a>  | . . {Arrangement of linkages between governor sleeve and pump control}                                                        |
| <a href="#">F02D 2001/0045</a> | . . {Arrangement of means for influencing governor characteristics by operator}                                               |
| <a href="#">F02D 2001/005</a>  | . . . {varying main spring tension}                                                                                           |

- F02D 2001/0055 . . . {varying pivotal point of linkages between governor sleeve and pump control}
- F02D 2001/006 . . {Assembling; Disassembling; Replacing}
- F02D 2001/0065 . . {Selection of particular materials}
- F02D 2001/007 . {Means for adjusting stops for minimum and maximum fuel delivery}
- F02D 2001/0075 . . {using engine temperature, e.g. to adjust the idling speed at cold start}
- F02D 2001/008 . . {using intake air pressure, e.g. adjusting full load stop at high supercharging pressures}
- F02D 2001/0085 . {Arrangements using fuel pressure for controlling fuel delivery in quantity or timing}
- F02D 2001/009 . . {Means for varying the pressure of fuel supply pump according to engine working parameters}
- F02D 2001/0095 . {Mounting of control means with respect to injection apparatus or the engine}
- F02D 1/02 . not restricted to adjustment of injection timing, e.g. varying amount of fuel delivered
- F02D 1/025 . . {by means dependent on engine working temperature ([F02D 1/08](#) takes precedence)}
- F02D 1/04 . . {by mechanical means dependent on engine speed, e.g. using centrifugal governors ([F02D 1/08](#) takes precedence)}
- F02D 1/045 . . . {characterised by arrangement of springs or weights}
- F02D 1/06 . . by means dependent on pressure of engine working fluid ([F02D 1/08](#) takes precedence)
- F02D 1/065 . . . {of intake of air}
- F02D 1/08 . . Transmission of control impulse to pump control, e.g. with power drive or power assistance
- F02D 2001/082 . . . {electric}
- F02D 2001/085 . . . . {using solenoids}
- F02D 2001/087 . . . . {using step motors}
- F02D 1/10 . . . mechanical
- F02D 1/12 . . . non-mechanical, e.g. hydraulic
- F02D 1/122 . . . . {control impulse depending only on engine speed}
- F02D 1/125 . . . . . {using a centrifugal governor}
- F02D 1/127 . . . . . {using the pressure developed in a pump}
- F02D 1/14 . . . . pneumatic
- F02D 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](#)})
- F02D 1/162 . . {by mechanical means dependent on engine speed for angular adjustment of driving and driven shafts}
- F02D 2001/165 . . {by means dependent on engine load}
- F02D 2001/167 . . {by means dependent on engine working temperature, e.g. at cold start}
- F02D 1/18 . . {with non-mechanical means for transmitting control impulse; with amplification of control impulse}
- F02D 1/183 . . . {hydraulic}
- F02D 2001/186 . . . . {using a pressure-actuated piston for adjustment of a stationary cam or roller support}

**F02D 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](#).

- [F02D 3/02](#) . with continuous injection or continuous flow upstream of the injection nozzle
- [F02D 3/04](#) . Controlling fuel-injection and carburation, e.g. of alternative systems

**F02D 7/00** Other fuel-injection control

- [F02D 7/002](#) . {Throttling of fuel passages between pumps and injectors or overflow passages (low-pressure fuel injection [F02M 69/00](#))}
- [F02D 7/005](#) . . {by mechanical means, e.g. using a centrifugal governor}
- [F02D 7/007](#) . . {by fluid actuated means, e.g. slide valves}
- [F02D 7/02](#) . Controlling fuel injection where fuel is injected by compressed air
- [F02D 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.

**F02D 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](#)

- [F02D 9/02](#) . concerning induction conduits (throttle valves, or arrangements thereof in conduits [F02D 9/08](#))
- [F02D 2009/0201](#) . . {Arrangements; Control features; Details thereof}
- [F02D 2009/0203](#) . . . {Mechanical governor}
- [F02D 2009/0205](#) . . . {working on the throttle valve and another valve, e.g. choke}
- [F02D 2009/0206](#) . . . {specially positioned with relation to engine or engine housing}
- [F02D 2009/0208](#) . . . {for small engines}
- [F02D 2009/021](#) . . . {combined with an electromechanical governor, e.g. centrifuged governor and electric governor acting on the governor lever}

F02D 2009/0211	. . .	{combined with another mechanical or pneumatic governor}
F02D 2009/0213	. . .	{Electronic or electric governor}
F02D 2009/0215	. . .	{Pneumatic governor}
F02D 2009/0216	. . .	{of the air-vane type}
F02D 2009/0218	. . .	{Details of governor springs}
F02D 2009/022	. . .	{Throttle control function parameters}
F02D 2009/0222	. . .	{Exhaust gas temperature}
F02D 2009/0223	. . .	{Cooling water temperature}
F02D 2009/0225	. . .	{Intake air or mixture temperature}
F02D 2009/0227	. . .	{Atmospheric pressure}
F02D 2009/0228	. . .	{Manifold pressure}
F02D 2009/023	. . .	{Engine speed}
F02D 2009/0232	. . .	{Fuel pump rack position}
F02D 2009/0233	. . .	{Engine vibration}
F02D 2009/0235	. . .	{Throttle control functions}
F02D 2009/0237	. . .	{Increasing combustion chamber gas temperature}
F02D 2009/0238	. . .	{Increasing ignition delay}
F02D 2009/024	. . .	{Increasing intake vacuum}
F02D 2009/0242	. . .	{Increasing exhaust brake effect}
F02D 2009/0244	. . .	{Choking air flow at low speed and load}
F02D 2009/0245	. . .	{Shutting down engine, e.g. working together with fuel cut-off}
F02D 2009/0247	. . .	{Opening the throttle a little on engine shutdown}
F02D 2009/0249	. . .	{Starting engine, e.g. closing throttle in Diesel engine to reduce starting torque}
F02D 2009/025	. . .	{Opening the throttle a little during starting}
F02D 2009/0252	. . .	{Opening a special valve-controlled intake passage (by-pass) during starting}
F02D 2009/0254	. . .	{Mechanical control linkage between accelerator lever and throttle valve}
F02D 2009/0255	. . .	{with means for correcting throttle position, e.g. throttle cable of variable length}
F02D 2009/0257	. . .	{having a pin and slob connection ("Leerweg")}
F02D 2009/0259	. . .	{having a dashpot, e.g. working in the throttle opening and closing directions}
F02D 2009/0261	. . .	{having a specially shaped transmission member, e.g. a cam, specially toothed gears, with a clutch}
F02D 2009/0262	. . .	{having two or more levers on the throttle shaft}
F02D 2009/0264	. . .	{in which movement is transmitted through a spring}
F02D 2009/0266	. . .	{in which movement is transmitted through a vacuum motor}
F02D 2009/0267	. . .	{for simultaneous action of a governor and an accelerator lever on the throttle}
F02D 2009/0269	. . .	{Throttle closing springs; Acting of throttle closing springs on the throttle shaft}
F02D 2009/0271	. . .	{with means for closing the throttle other than throttle closing springs}
F02D 2009/0272	. . .	{Two or more throttles disposed in series}
F02D 2009/0274	. . .	{one being controlled by pressure in intake conduit, e.g. for slowly opening the throttle as the other valve is suddenly opened}

- F02D 2009/0276 . . . {Throttle and EGR-valve operated together}
- F02D 2009/0277 . . . {Fail-safe mechanisms, e.g. with limp-home feature, to close throttle if actuator fails, or if control cable sticks or breaks}
- F02D 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}
- F02D 2009/0281 . . . {with means for detecting malfunction of one throttle and actuating only the correctly working throttle}
- F02D 2009/0283 . . . {Throttle in the form of an expander}
- F02D 2009/0284 . . . {Throttle control device with means for signalling a certain throttle opening, e.g. by a steplike increase of throttle closing spring force}
- F02D 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}
- F02D 2009/0288 . . . {Throttle control device specially adapted for spark-assisted compression-ignition engine (Diesel engine)}
- F02D 2009/0289 . . . {Throttle control device with means for establishing a variable resistance torque during throttle opening}
- F02D 2009/0291 . . . {Throttle control device for throttle being disposed in a two-stroke engine transfer passage}
- F02D 2009/0293 . . . {Throttle control device adapted to limit power development at low attitude}
- F02D 2009/0294 . . . {Throttle control device with provisions for actuating electric or electronic sensors}
- F02D 2009/0296 . . . {Throttle control device with stops for limiting throttle opening or closing beyond a certain position during certain periods of operation}
- F02D 2009/0298 . . . {Throttle control device with holding devices, i.e. to hold throttle in a predetermined position}
- F02D 9/04 . concerning exhaust conduits (throttle valves, or arrangements thereof in conduits [F02D 9/08](#))
- F02D 9/06 . . Exhaust brakes
- F02D 9/08 . Throttle valves specially adapted therefor; Arrangements of such valves in conduits (throttle valves modified for use in or arranged in carburetors [F02M](#); throttle valves in general [F16K](#))
- F02D 9/10 . . having pivotally-mounted flaps
- F02D 9/1005 . . . {Details of the flap}
- F02D 9/101 . . . . {Special flap shapes, ribs, bores or the like}
- F02D 9/1015 . . . . . {Details of the edge of the flap, e.g. for lowering flow noise or improving flow sealing in closed flap position}
- F02D 9/102 . . . . {the flap having movable parts fixed onto it}
- F02D 9/1025 . . . . {the rotation axis of the flap being off-set from the flap center axis}
- F02D 9/103 . . . . . {the rotation axis being located at an edge}
- F02D 9/1035 . . . {Details of the valve housing}
- F02D 9/104 . . . . {Shaping of the flow path in the vicinity of the flap, e.g. having inserts in the housing}
- F02D 9/1045 . . . . . {for sealing of the flow in closed flap position, e.g. the housing forming a valve seat}
- F02D 9/105 . . . . {having a throttle position sensor (detection of actuation [F02D 11/106](#))}

F02D 9/1055	. . . . {having a fluid by-pass}
F02D 9/106	. . . . {Sealing of the valve shaft in the housing, e.g. details of the bearings}
F02D 9/1065	. . . {Mechanical control linkage between an actuator and the flap, e.g. including levers, gears, springs, clutches, limit stops of the like}
F02D 9/107	. . . {Manufacturing or mounting details}
F02D 9/1075	. . . {Materials, e.g. composites}
F02D 9/108	. . . . {Plastics}
F02D 9/1085	. . . . {Non-organic materials, e.g. metals, alloys, ceramics}
F02D 9/109	. . . {having two or more flaps}
F02D 9/1095	. . . . {Rotating on a common axis, e.g. having a common shaft}
F02D 9/12	. . having slidably-mounted valve members; having valve members movable longitudinally of conduit
F02D 9/14	. . . the members being slidable transversely of conduit
F02D 9/16	. . . the members being rotatable
F02D 9/18	. . having elastic-wall valve members
<b>F02D 11/00</b>	<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>
F02D 11/02	. characterised by hand, foot, or like operator controlled initiation means
F02D 11/04	. characterised by mechanical control linkages ( <a href="#">with power drive or assistance F02D 11/06</a> )
F02D 11/06	. characterised by non-mechanical control linkages, e.g. fluid control linkages or by control linkages with power drive or assistance
F02D 11/08	. . of the pneumatic type
F02D 11/10	. . of the electric type
F02D 2011/101	. . . {characterised by the means for actuating the throttles}
F02D 2011/102	. . . . {at least one throttle being moved only by an electric actuator}
F02D 2011/103	. . . . {at least one throttle being alternatively mechanically linked to the pedal or moved by an electric actuator}
F02D 2011/104	. . . . {using electric step motors}
F02D 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}
F02D 11/106	. . . {Detection of demand or actuation}
F02D 11/107	. . . {Safety-related aspects}
F02D 2011/108	. . . {with means for detecting or resolving a stuck throttle, e.g. when being frozen in a position}
<b>F02D 13/00</b>	<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>
F02D 2013/005	. {of throttleless spark ignited engines}
F02D 13/02	. during engine operation
F02D 13/0203	. . {Variable control of intake and exhaust valves}

F02D 13/0207	. . . {changing valve lift or valve lift and timing}
F02D 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}
F02D 13/0215	. . . {changing the valve timing only}
F02D 13/0219	. . . . {by shifting the phase, i.e. the opening periods of the valves are constant}
F02D 13/0223	. . {Variable control of the intake valves only}
F02D 13/0226	. . . {changing valve lift or valve lift and timing}
F02D 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}
F02D 13/0234	. . . {changing the valve timing only}
F02D 13/0238	. . . . {by shifting the phase, i.e. the opening periods of the valves are constant}
F02D 13/0242	. . {Variable control of the exhaust valves only}
F02D 13/0246	. . . {changing valve lift or valve lift and timing}
F02D 13/0249	. . . {changing the valve timing only}
F02D 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}
F02D 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}
F02D 13/0261	. . {Controlling the valve overlap}
F02D 13/0265	. . . {Negative valve overlap for temporarily storing residual gas in the cylinder}
F02D 13/0269	. . {Controlling the valves to perform a Miller-Atkinson cycle}
F02D 13/0273	. . {Multiple actuations of a valve within an engine cycle}
F02D 13/0276	. . {Actuation of an additional valve for a special application, e.g. for decompression, exhaust gas recirculation or cylinder scavenging}
F02D 13/028	. . {for two-stroke engines}
F02D 13/0284	. . . {Variable control of exhaust valves only}
F02D 2013/0288	. . . . {for cleaning the valves}
F02D 2013/0292	. . {in the start-up phase, e.g. for warming-up cold engine or catalyst}
F02D 2013/0296	. . {Changing the valve lift only}
F02D 13/04	. . Using engine as brake
F02D 13/06	. . Cutting-out cylinders
F02D 13/08	. for rendering engine inoperative or idling

## **F02D 15/00** **Varying compression ratio** (modifying valve gear [F01L](#))

### **NOTE**

- in this group the following indexing codes are used:

[F02D 2700/03](#)

F02D 15/02	. by alteration or displacement of piston stroke
F02D 15/04	. by alteration of volume of compression space without changing piston stroke



**F02D 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](#)

- [F02D 17/02](#)      . Cutting-out (cutting-out engines in multiple engine arrangements [F02D 25/04](#))
- [F02D 17/023](#)      . . {the inactive cylinders acting as compressor other than for pumping air into the exhaust system}
- [F02D 17/026](#)      . . . {delivering compressed fluid, e.g. air, reformed gas, to the active cylinders other than during starting}
- [F02D 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**

**F02D 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](#))

- [F02D 19/02](#)      . peculiar to engines working with gaseous fuels (apparatus, or control parts thereof, for mixing gas and air [F02M](#))
- [F02D 19/021](#)      . . {Control of components of the fuel supply system}
- [F02D 19/022](#)      . . . {to adjust the fuel pressure, temperature or composition}
- [F02D 19/023](#)      . . . {to adjust the fuel mass or volume flow}
- [F02D 19/024](#)      . . . . {by controlling fuel injectors}
- [F02D 19/025](#)      . . {Failure diagnosis or prevention; Safety measures; Testing}
- [F02D 19/026](#)      . . {Measuring or estimating parameters related to the fuel supply system}
- [F02D 19/027](#)      . . . {Determining the fuel pressure, temperature or volume flow, the fuel tank fill level or a valve position}
- [F02D 19/028](#)      . . . . {by estimation, i.e. without using direct measured parameter of a corresponding sensor}
- [F02D 19/029](#)      . . . {Determining density, viscosity, concentration or composition}
- [F02D 19/04](#)      . peculiar to engines working with solid fuels, e.g. pulverised coal
- [F02D 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
- [F02D 19/0602](#)      . . {Control of components of the fuel supply system}
- [F02D 19/0605](#)      . . . {to adjust the fuel pressure or temperature}
- [F02D 19/0607](#)      . . . {to adjust the fuel mass or volume flow}
- [F02D 19/061](#)      . . . . {by controlling fuel injectors}
- [F02D 19/0613](#)      . . . {Switch-over from one fuel to another ([F02D 19/081](#) takes precedence)}
- [F02D 19/0615](#)      . . . . {being initiated by automatic means, e.g. based on engine or vehicle operating conditions}



F02D 19/0618	. . . . {depending on the engine's or vehicle's position, e.g. on/off road or proximity to a harbor}
F02D 19/0621	. . . . {Purging of the fuel system}
F02D 19/0623	. . {Failure diagnosis or prevention; Safety measures; Testing}
F02D 19/0626	. . {Measuring or estimating parameters related to the fuel supply system}
F02D 19/0628	. . . {Determining the fuel pressure, temperature or flow, the fuel tank fill level or a valve position}
F02D 19/0631	. . . . {by estimation, i.e. without using direct measurements of a corresponding sensor}
F02D 19/0634	. . . {Determining a density, viscosity, composition or concentration ( <a href="#">F02D 19/087</a> takes precedence)}
F02D 19/0636	. . . . {by estimation, i.e. without using direct measurements of a corresponding sensor}
F02D 19/0639	. . {characterised by the type of fuels}
F02D 19/0642	. . . {at least one fuel being gaseous, the other fuels being gaseous or liquid at standard conditions}
F02D 19/0644	. . . . {the gaseous fuel being hydrogen, ammonia or carbon monoxide}
F02D 19/0647	. . . . {the gaseous fuel being liquefied petroleum gas [LPG], liquefied natural gas [LNG], compressed natural gas [CNG] or dimethyl ether [DME]}
F02D 19/0649	. . . {Liquid fuels having different boiling temperatures, volatilities, densities, viscosities, cetane or octane numbers}
F02D 19/0652	. . . . {Biofuels, e.g. plant oils}
F02D 19/0655	. . . . . {at least one fuel being an alcohol, e.g. ethanol ( <a href="#">F02D 19/084</a> takes precedence)}
F02D 19/0657	. . . . {Heavy or light fuel oils; Fuels characterised by their impurities such as sulfur content or differences in grade, e.g. for ships}
F02D 19/066	. . {Retrofit of secondary fuel supply systems; Conversion of engines to operate on multiple fuels}
F02D 19/0663	. . {Details on the fuel supply system, e.g. tanks, valves, pipes, pumps, rails, injectors or mixers}
F02D 19/0665	. . . {Tanks, e.g. multiple tanks}
F02D 19/0668	. . . {Treating or cleaning means; Fuel filters}
F02D 19/0671	. . . . {Means to generate or modify a fuel, e.g. reformers, electrolytic cells or membranes}
F02D 19/0673	. . . {Valves; Pressure or flow regulators; Mixers}
F02D 19/0676	. . . . {Multi-way valves; Switch-over valves}
F02D 19/0678	. . . . {Pressure or flow regulators therefor; Fuel metering valves therefor}
F02D 19/0681	. . . . {Shut-off valves; Check valves; Safety valves; Pressure relief valves}
F02D 19/0684	. . . {High pressure fuel injection systems; Details on pumps, rails or the arrangement of valves in the fuel supply and return systems}
F02D 19/0686	. . . {Injectors}
F02D 19/0689	. . . . {for in-cylinder direct injection}
F02D 19/0692	. . . . {Arrangement of multiple injectors per combustion chamber}
F02D 19/0694	. . . . {operating with a plurality of fuels}

- F02D 19/0697 . . . {Arrangement of fuel supply systems on engines or vehicle bodies; Components of the fuel supply system being combined with another device}
- F02D 19/08 . . simultaneously using pluralities of fuels ([F02D 19/12](#) takes precedence)
- F02D 19/081 . . . {Adjusting the fuel composition or mixing ratio; Transitioning from one fuel to the other}
- F02D 19/082 . . . {Premixed fuels, i.e. emulsions or blends}
- F02D 19/084 . . . . {Blends of gasoline and alcohols, e.g. E85}
- F02D 19/085 . . . . {Control based on the fuel type or composition}
- F02D 19/087 . . . . . {with determination of densities, viscosities, composition, concentration or mixture ratios of fuels}
- F02D 19/088 . . . . . {by estimation, i.e. without using direct measurements of a corresponding sensor}
- F02D 19/10 . . . peculiar to compression-ignition engines in which the main fuel is gaseous
- F02D 19/105 . . . . {operating in a special mode, e. g. in a liquid fuel only mode for starting}
- F02D 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](#))
  
- F02D 21/00** **Controlling engines characterised by their being supplied with non-airborne oxygen or other non-fuel gas**
- F02D 21/02 . . peculiar to oxygen-fed engines
- F02D 21/04 . . with circulation of exhaust gases in closed or semi-closed circuits
- F02D 21/06 . . peculiar to engines having other non-fuel gas added to combustion air
- F02D 21/08 . . the other gas being the exhaust gas of engine ([circulation of exhaust gas in oxygen-fed engines F02D 21/04](#))
- F02D 2021/083 . . . {controlling exhaust gas recirculation electronically}
- F02D 2021/086 . . . {the exhaust gas recirculation valve being controlled by fuel pressure, e.g. indirectly}
- F02D 21/10 . . having secondary air added to the fuel-air mixture ([apparatus, or control parts thereof, for delivering secondary air F02M](#))
  
- F02D 23/00** **Controlling engines characterised by their being supercharged**
- F02D 23/005 . . {with the supercharger being mechanically driven by the engine ([supercharger drives F02B 39/00](#))}
- F02D 23/02 . . the engine being of fuel-injection type
  
- F02D 25/00** **Controlling two or more co-operating engines**
- F02D 25/02 . . to synchronise speed
- F02D 25/04 . . by cutting-out engines
  
- F02D 27/00** **Controlling engines characterised by their being reversible**
- F02D 27/02 . . by performing a programme

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

**F02D 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](#)

- [F02D 29/02](#) . peculiar to engines driving vehicles; peculiar to engines driving variable pitch propellers
- [F02D 29/04](#) . peculiar to engines driving pumps
- [F02D 29/06](#) . peculiar to engines driving electric generators

**Other controlling of engines**

**F02D 31/00** **Use of speed-sensing governors to control combustion engines, not otherwise provided for**

- [F02D 31/001](#) . {Electric control of rotation speed}
- [F02D 31/002](#) . . {controlling air supply}
- [F02D 31/003](#) . . . {for idle speed control}
- [F02D 31/004](#) . . . . {by controlling a throttle stop}
- [F02D 31/005](#) . . . . {by controlling a throttle by-pass}
- [F02D 31/006](#) . . . {for maximum speed control}
- [F02D 31/007](#) . . {controlling fuel supply}
- [F02D 31/008](#) . . . {for idle speed control}
- [F02D 31/009](#) . . . {for maximum speed control}

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

- [F02D 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}
- [F02D 33/006](#) . . {depending on engine operating conditions, e.g. start, stop or ambient conditions}
- [F02D 33/02](#) . of combustion-air

**F02D 35/00** **Controlling engines, dependent on conditions exterior or interior to engines, not otherwise provided for**

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

### **NOTE**

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

- F02D 35/0015 . {using exhaust gas sensors ([F02D 41/14](#) takes precedence)}
- F02D 35/0023 . . {Controlling air supply}
- F02D 35/003 . . . {by means of by-pass passages}
- F02D 35/0038 . . . {by means of air pumps}
- F02D 35/0046 . . {Controlling fuel supply}
- F02D 35/0053 . . . {by means of a carburettor}
- F02D 35/0061 . . . . {Controlling the emulsifying air only ([F02D 35/0076](#), [F02D 35/0084](#) take precedence)}
- F02D 35/0069 . . . . {Controlling the fuel flow only ([F02D 35/0076](#), [F02D 35/0084](#) take precedence)}
- F02D 35/0076 . . . . {using variable venturi carburettors}
- F02D 35/0084 . . . . {using two barrel carburettors}
- F02D 35/0092 . . . {by means of fuel injection}
- F02D 35/02 . on interior conditions
- F02D 35/021 . . {using an ionic current sensor}
- F02D 35/022 . . {using an optical sensor, e.g. in-cylinder light probe}
- F02D 35/023 . . {by determining the cylinder pressure}
- F02D 35/024 . . . {using an estimation}
- F02D 35/025 . . {by determining temperatures inside the cylinder, e.g. combustion temperatures}
- F02D 35/026 . . . {using an estimation}
- F02D 35/027 . . {using knock sensors}
- F02D 35/028 . . {by determining the combustion timing or phasing}

### **F02D 37/00 Controlling conjointly two or more functions of engines, not otherwise provided for**

- F02D 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](#)})

### **F02D 39/00 Other non-electrical control**

- F02D 39/02 . for four-stroke engines
- F02D 39/04 . for engines with other cycles than four-stroke, e.g. two-stroke
- F02D 39/06 . for engines adding the fuel substantially at the end of compression stroke
- F02D 39/08 . for engines adding the fuel substantially before compression stroke
- F02D 39/10 . for free-piston engines; for engines without rotary main shaft

**Electrical control of combustion engines****NOTES**

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

**F02D 41/00****Electrical control of supply of combustible mixture or its constituents***(F02D 43/00 takes precedence)*

- |                |                                                                                                                                                                             |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| F02D 41/0002   | . {Controlling intake air}                                                                                                                                                  |
| F02D 41/0005   | . . {during deceleration}                                                                                                                                                   |
| F02D 41/0007   | . . {for control of turbo-charged or super-charged engines (control of the pumps per se <a href="#">F02B 37/12</a> )}                                                       |
| F02D 2041/001  | . . {for engines with variable valve actuation}                                                                                                                             |
| F02D 2041/0012 | . . . {with selective deactivation of cylinders}                                                                                                                            |
| F02D 2041/0015 | . . {for engines with means for controlling swirl or tumble flow, e.g. by using swirl valves}                                                                               |
| F02D 2041/0017 | . . {by simultaneous control of throttle and exhaust gas recirculation}                                                                                                     |
| F02D 2041/002  | . . {by simultaneous control of throttle and variable valve actuation}                                                                                                      |
| F02D 2041/0022 | . . {for diesel engines by throttle control}                                                                                                                                |
| F02D 41/0025   | . {Controlling engines characterised by use of non-liquid fuels, pluralities of fuels, or non-fuel substances added to the combustible mixtures}                            |
| F02D 41/0027   | . . {the fuel being gaseous (non-electrical control <a href="#">F02D 19/02</a> )}                                                                                           |
| F02D 41/003    | . . {Adding fuel vapours, e.g. drawn from engine fuel reservoir}                                                                                                            |
| F02D 41/0032   | . . . {Controlling the purging of the canister as a function of the engine operating conditions}                                                                            |
| F02D 41/0035   | . . . . {to achieve a special effect, e.g. to warm up the catalyst}                                                                                                         |
| F02D 41/0037   | . . . . {for diagnosing the engine (diagnosis of purge control systems <a href="#">F02M 25/0809</a> )}                                                                      |
| F02D 41/004    | . . . . {Control of the valve or purge actuator, e.g. duty cycle, closed loop control of position}                                                                          |
| F02D 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} |
| F02D 41/0045   | . . . {Estimating, calculating or determining the purging rate, amount, flow or concentration}                                                                              |
| F02D 41/0047   | . . {Controlling exhaust gas recirculation [EGR] (temperature control with cooler in recirculation circuit <a href="#">F02M 25/0738</a> )}                                  |
| F02D 41/005    | . . . {according to engine operating conditions}                                                                                                                            |

F02D 41/0052	. . . .	{Feedback control of engine parameters, e.g. for control of air/fuel ratio or intake air amount}
F02D 41/0055	. . . .	{Special engine operating conditions, e.g. for regeneration of exhaust gas treatment apparatus}
F02D 41/0057	. . . .	{Specific combustion modes (combustion modes per se <a href="#">F02D 41/3017</a> )}
F02D 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 25/0752</a> )}
F02D 41/0062	. . . .	{Estimating, calculating or determining the internal EGR rate, amount or flow}
F02D 41/0065	. . . .	{Specific aspects of external EGR control (constructional details of EGR system <a href="#">F02M 25/07</a> )}
F02D 2041/0067	. . . .	{Determining the EGR temperature}
F02D 2041/007	. . . . .	{by estimation}
F02D 41/0072	. . . .	{Estimating, calculating or determining the EGR rate, amount or flow (sensors in EGR systems <a href="#">F02M 25/0753</a> )}
F02D 2041/0075	. . . . .	{by using flow sensors}
F02D 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 25/0756</a> )}
F02D 41/008	. .	{Controlling each cylinder individually}
F02D 41/0082	. .	{per groups or banks ( <a href="#">F02D 41/0087</a> takes precedence)}
F02D 41/0085	. .	{Balancing of cylinder outputs, e.g. speed, torque or air-fuel ratio}
F02D 41/0087	. .	{Selective cylinder activation, i.e. partial cylinder operation (deceleration cut-off <a href="#">F02D 41/123</a> )}
F02D 41/009	. .	{using means for generating position or synchronisation signals}
F02D 2041/0092	. .	{Synchronisation of the cylinders at engine start}
F02D 2041/0095	. .	{Synchronisation of the cylinders during engine shutdown}
F02D 41/0097	. .	{using means for generating speed signals}
F02D 41/02	. .	Circuit arrangements for generating control signals
F02D 41/0205	. .	{using an auxiliary engine speed control (engine speed control per se <a href="#">F02D 31/00</a> )}
F02D 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> )}
F02D 41/0215	. . . .	{in relation with elements of the transmission}
F02D 41/022	. . . .	{in relation with the clutch status}
F02D 41/0225	. . . .	{in relation with the gear ratio or shift lever position}
F02D 41/023	. . . .	{in relation with the gear ratio shifting (conjoint control for improving gear change <a href="#">B60W 30/19</a> )}
F02D 41/0235	. . . .	{in relation with the state of the exhaust gas treating apparatus (control of exhaust gas treating apparatus per se <a href="#">F01N</a> )}
F02D 41/024	. . . .	{to increase temperature of the exhaust gas treating apparatus}
F02D 41/0245	. . . . .	{by increasing temperature of the exhaust gas leaving the engine}
F02D 41/025	. . . . .	{by changing the composition of the exhaust gas, e.g. for exothermic reaction on exhaust gas treating apparatus}
F02D 41/0255	. . . . .	{to accelerate the warming-up of the exhaust gas treating apparatus at engine start}

F02D 2041/026	. . . . .	{using an external load, e.g. by increasing generator load or by changing the gear ratio}
F02D 2041/0265	. . . . .	{to decrease temperature of the exhaust gas treating apparatus}
F02D 41/027	. . . . .	{to purge or regenerate the exhaust gas treating apparatus}
F02D 41/0275	. . . . .	{the exhaust gas treating apparatus being a NOx trap or adsorbent}
F02D 41/028	. . . . .	{Desulfurisation of NOx traps or adsorbent}
F02D 41/0285	. . . . .	{the exhaust gas treating apparatus being a SOx trap or adsorbent}
F02D 41/029	. . . . .	{the exhaust gas treating apparatus being a particulate filter}
F02D 41/0295	. . . . .	{Control according to the amount of oxygen that is stored on the exhaust gas treating apparatus}
F02D 41/04	. .	Introducing corrections for particular operating conditions ( <a href="#">F02D 41/14</a> takes precedence)
F02D 41/042	. . .	{for stopping the engine}
F02D 41/045	. . .	{Detection of accelerating or decelerating state (detection thereof in general <a href="#">G01P</a> )}
F02D 41/047	. . .	{Taking into account fuel evaporation or wall wetting; (special correction after fuel cut-off <a href="#">F02D 41/126</a> )}
F02D 41/06	. . .	for engine starting or warming up {( <a href="#">F02D 41/0255</a> takes precedence)}
F02D 41/061	. . . .	{the corrections being time dependent}
F02D 41/062	. . . .	{for starting ( <a href="#">F02D 41/061</a> takes precedence)}
F02D 41/064	. . . . .	{at cold start ( <a href="#">F02D 41/067</a> takes precedence)}
F02D 41/065	. . . . .	{at hot start or restart ( <a href="#">F02D 41/067</a> takes precedence)}
F02D 41/067	. . . . .	{with control of the choke (non electronic control of choke see <a href="#">F02M 1/10</a> )}
F02D 41/068	. . . . .	{for warming-up}
F02D 41/08	. . .	for idling ( <a href="#">F02D 41/06</a> , <a href="#">F02D 41/16</a> take precedence)
F02D 41/083	. . . .	{taking into account engine load variation, e.g air-conditionning}
F02D 41/086	. . . .	{taking into account the temperature of the engine}
F02D 41/10	. . .	for acceleration
F02D 41/102	. . . .	{Switching from sequential injection to simultaneous injection}
F02D 41/105	. . . .	{using asynchronous injection}
F02D 41/107	. . . .	{and deceleration}
F02D 41/12	. . .	for deceleration {( <a href="#">F02D 41/0005</a> , <a href="#">F02D 41/107</a> take precedence)}
F02D 41/123	. . . .	{the fuel injection being cut-off}
F02D 41/126	. . . . .	{transitionnal corrections at the end of the cut-off period}
F02D 41/14	. .	Introducing closed-loop corrections
F02D 41/1401	. . .	{characterised by the control or regulation method ( <a href="#">F02D 41/1473</a> , <a href="#">F02D 41/1477</a> take precedence)}
F02D 41/1402	. . . .	{Adaptive control}
F02D 41/1403	. . . .	{Sliding mode control}
F02D 41/1404	. . . .	{Fuzzy logic control}
F02D 41/1405	. . . .	{Neural network control}



F02D 41/1406	. . . .	{with use of a optimisation method, e.g. iteration}
F02D 41/1408	. . . .	{Dithering techniques}
F02D 2041/1409	. . . .	{using at least a proportional, integral or derivative controller}
F02D 2041/141	. . . .	{using a feed-forward control element}
F02D 2041/1411	. . . .	{using a finite or infinite state machine, automaton or state graph for controlling or modelling}
F02D 2041/1412	. . . .	{using a predictive controller}
F02D 2041/1413	. . . .	{Controller structures or design}
F02D 2041/1415	. . . . .	{using a state feedback or a state space representation}
F02D 2041/1416	. . . . .	{Observer}
F02D 2041/1417	. . . . .	{Kalman filter}
F02D 2041/1418	. . . . .	{Several control loops, either as alternatives or simultaneous}
F02D 2041/1419	. . . . .	{the control loops being cascaded, i.e. being placed in series or nested}
F02D 2041/142	. . . . .	{using different types of control law in combination, e.g. adaptive combined with PID and sliding mode}
F02D 2041/1422	. . . . .	{Variable gain or coefficients}
F02D 2041/1423	. . . . .	{Identification of model or controller parameters}
F02D 2041/1424	. . . . .	{Pole-zero cancellation}
F02D 2041/1425	. . . . .	{using a bond graph model or models with nodes}
F02D 2041/1426	. . . . .	{taking into account control stability}
F02D 2041/1427	. . . . .	{Decoupling, i.e. using a feedback such that one output is controlled by only one input}
F02D 2041/1429	. . . . .	{Linearisation, i.e. using a feedback law such that the system evolves as a linear one}
F02D 2041/143	. . . . .	{the control loop including a non-linear model or compensator}
F02D 2041/1431	. . . . .	{the system including an input-output delay}
F02D 2041/1432	. . . . .	{the system including a filter, e.g. a low pass or high pass filter}
F02D 2041/1433	. . . . .	{using a model or simulation of the system}
F02D 2041/1434	. . . . .	{Inverse model}
F02D 2041/1436	. . . . .	{Hybrid model}
F02D 2041/1437	. . . . .	{Simulation}
F02D 41/1438	. . .	{using means for determining characteristics of the combustion gases; Sensors therefor}
F02D 41/1439	. . . .	{characterised by the position of the sensor}
F02D 41/144	. . . . .	{Sensor in intake manifold}
F02D 41/1441	. . . . .	{Plural sensors}
F02D 41/1443	. . . . .	{with one sensor per cylinder or group of cylinders}
F02D 41/1444	. . . . .	{characterised by the characteristics of the combustion gases}
F02D 41/1445	. . . . .	{the characteristics being related to the exhaust flow}
F02D 41/1446	. . . . .	{the characteristics being exhaust temperatures}
F02D 41/1447	. . . . .	{with determination means using an estimation}

F02D 41/1448	. . . . .	{the characteristics being an exhaust gas pressure}
F02D 41/145	. . . . .	{with determination means using an estimation}
F02D 41/1451	. . . . .	{the sensor being an optical sensor}
F02D 41/1452	. . . . .	{the characteristics being a COx content or concentration}
F02D 41/1453	. . . . .	{the characteristics being a CO content or concentration}
F02D 41/1454	. . . . .	{the characteristics being an oxygen content or concentration or the air-fuel ratio}
F02D 41/1455	. . . . .	{with sensor resistivity varying with oxygen concentration (F02D 41/1456 takes precedence)}
F02D 41/1456	. . . . .	{with sensor output signal being linear or quasi-linear with the concentration of oxygen}
F02D 41/1458	. . . . .	{with determination means using an estimation}
F02D 41/1459	. . . . .	{the characteristics being a hydrocarbon content or concentration}
F02D 41/146	. . . . .	{the characteristics being an NOx content or concentration}
F02D 41/1461	. . . . .	{of the exhaust gases emitted by the engine}
F02D 41/1462	. . . . .	{with determination means using an estimation}
F02D 41/1463	. . . . .	{of the exhaust gases downstream of exhaust gas treatment apparatus}
F02D 41/1465	. . . . .	{with determination means using an estimation}
F02D 41/1466	. . . . .	{the characteristics being a soot concentration or content}
F02D 41/1467	. . . . .	{with determination means using an estimation}
F02D 2041/1468	. . . . .	{the characteristics being an ammonia content or concentration of the exhaust gases}
F02D 2041/1469	. . . . .	{with determination means using an estimation}
F02D 2041/147	. . . . .	{the characteristics being a hydrogen content or concentration of the exhaust gases}
F02D 2041/1472	. . . . .	{the characteristics being a humidity or water content of the exhaust gases}
F02D 41/1473	. . . . .	{characterised by the regulation method}
F02D 41/1474	. . . . .	{by detecting the commutation time of the sensor}
F02D 41/1475	. . . . .	{Regulating the air fuel ratio at a value other than stoichiometry}
F02D 41/1476	. . . . .	{Biasing of the sensor}
F02D 41/1477	. . . . .	{characterised by the regulation circuit or part of it,(e.g. comparator, PI regulator, output)}
F02D 41/1479	. . . . .	{Using a comparator with variable reference}
F02D 41/148	. . . . .	{Using a plurality of comparators}
F02D 41/1481	. . . . .	{Using a delaying circuit}
F02D 41/1482	. . . . .	{Integrator, i.e. variable slope}
F02D 41/1483	. . . . .	{Proportional component}
F02D 41/1484	. . . . .	{Output circuit}
F02D 41/1486	. . . . .	{with correction for particular operating conditions}
F02D 41/1487	. . . . .	{Correcting the instantaneous control value}

F02D 41/1488	. . . . . {Inhibiting the regulation}
F02D 41/1489	. . . . . {Replacing of the control value by a constant}
F02D 41/149	. . . . . {Replacing of the control value by an other parameter}
F02D 41/1491	. . . . . {Replacing of the control value by a mean value}
F02D 41/1493	. . . . . {Details}
F02D 41/1494	. . . . . {Control of sensor heater}
F02D 41/1495	. . . . . {Detection of abnormalities in the air/fuel ratio feedback system}
F02D 41/1496	. . . . . {Measurement of the conductivity of a sensor ( <a href="#">F02D 41/1455</a> takes precedence)}
F02D 41/1497	. . . {With detection of the mechanical response of the engine}
F02D 41/1498	. . . . {measuring engine roughness}
F02D 41/16	. . . for idling
F02D 41/18	. . by measuring intake air flow ( <a href="#">measuring flow in general G01F</a> )
F02D 41/182	. . . {for the control of a fuel injection device}
F02D 41/185	. . . {using a vortex flow sensor}
F02D 41/187	. . . {using a hot wire flow sensor}
F02D 41/20	. Output circuits, e.g. for controlling currents in command coils ( <a href="#">current control in inductive loads in general H03K 17/64</a> )
F02D 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}
F02D 2041/2006	. . . {by using a boost capacitor}
F02D 2041/201	. . . {by using a boost inductance}
F02D 2041/2013	. . . {by using a boost voltage source}
F02D 2041/2017	. . {using means for creating a boost current or using reference switching}
F02D 2041/202	. . {characterised by the control of the circuit}
F02D 2041/2024	. . . {the control switching a load after time-on and time-off pulses}
F02D 2041/2027	. . . . {Control of the current by pulse width modulation or duty cycle control}
F02D 2041/2031	. . . {Control of the current by means of delays or monostable multivibrators}
F02D 2041/2034	. . . {Control of the current gradient}
F02D 2041/2037	. . . {for preventing bouncing of the valve needle}
F02D 2041/2041	. . . {for controlling the current in the free-wheeling phase}
F02D 2041/2044	. . . {using pre-magnetisation or post-magnetisation of the coils}
F02D 2041/2048	. . . {said control involving a limitation, e.g. applying current or voltage limits}
F02D 2041/2051	. . . {using voltage control}
F02D 2041/2055	. . . {with means for determining actual opening or closing time}
F02D 2041/2058	. . . {using information of the actual current value}
F02D 2041/2062	. . . . {the current value is determined by simulation or estimation}
F02D 2041/2065	. . . {the control being related to the coil temperature}
F02D 2041/2068	. . {characterised by the circuit design or special circuit elements}
F02D 2041/2072	. . . {Bridge circuits, i.e. the load being placed in the diagonal of a bridge to be controlled in both directions}

F02D 2041/2075	. . . {Type of transistors or particular use thereof}
F02D 2041/2079	. . . {the circuit having several coils acting on the same anchor}
F02D 2041/2082	. . . {the circuit being adapted to distribute current between different actuators or recuperate energy from actuators}
F02D 2041/2086	. . {with means for detecting circuit failures}
F02D 2041/2089	. . . {detecting open circuits}
F02D 2041/2093	. . . {detecting short circuits}
F02D 41/2096	. . {for controlling piezo-electric injectors (drive and control circuit for piezo-electric devices in general <a href="#">H01L 41/042</a> )}
F02D 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> )}
F02D 41/221	. . {relating to the failure of actuators or electrically driven elements}
F02D 41/222	. . {relating to the failure of sensors or parameter detection devices}
F02D 2041/223	. . . {Diagnosis of fuel pressure sensors}
F02D 2041/224	. . {Diagnosis of the fuel system}
F02D 2041/225	. . . {Leakage detection}
F02D 2041/226	. . . {Fail safe control for fuel injection pump}
F02D 2041/227	. . {Limping Home, i.e. taking specific engine control measures at abnormal conditions}
F02D 2041/228	. . {Warning displays}
F02D 41/24	. characterised by the use of digital means
F02D 41/2403	. . {using essentially up/down counters}
F02D 41/2406	. . {using essentially read only memories}
F02D 41/2409	. . . {Addressing techniques specially adapted therefor}
F02D 41/2412	. . . . {One-parameter addressing technique}
F02D 41/2416	. . . . {Interpolation techniques}
F02D 41/2419	. . . . {Non-linear variation along at least one coordinate}
F02D 41/2422	. . . . {Selective use of one or more tables}
F02D 41/2425	. . . {Particular ways of programming the data}
F02D 41/2429	. . . . {Methods of calibrating or learning}
F02D 41/2432	. . . . . {Methods of calibration}
F02D 41/2435	. . . . . {characterised by the writing medium, e.g. bar code}
F02D 41/2438	. . . . . {Active learning methods}
F02D 41/2441	. . . . . {characterised by the learning conditions}
F02D 41/2445	. . . . . {characterised by a plurality of learning conditions or ranges}
F02D 41/2448	. . . . . {Prohibition of learning}
F02D 41/2451	. . . . . {characterised by what is learned or calibrated}
F02D 41/2454	. . . . . {Learning of the air-fuel ratio control}
F02D 41/2458	. . . . . {with an additional dither signal}
F02D 41/2461	. . . . . {by learning a value and then controlling another value}

F02D 41/2464	. . . . . {Characteristics of actuators}
F02D 41/2467	. . . . . {for injectors}
F02D 41/247	. . . . . {Behaviour for small quantities}
F02D 41/2474	. . . . . {Characteristics of sensors}
F02D 41/2477	. . . . . {characterised by the method used for learning}
F02D 41/248	. . . . . {using a plurality of learned values}
F02D 41/2483	. . . . . {restricting learned values}
F02D 41/2487	. . . . . {Methods for rewriting}
F02D 41/249	. . . . . {Methods for preventing the loss of data}
F02D 41/2493	. . . . . {Resetting of data to a predefined set of values}
F02D 41/2496	. . . {the memory being part of a closed loop}
F02D 41/26	. . using computer, e.g. microprocessor
F02D 41/263	. . . {the program execution being modifiable by physical parameters}
F02D 41/266	. . . {the computer being backed-up or assisted by another circuit, e.g. analogue}
F02D 41/28	. . . Interface circuits
F02D 2041/281	. . . . {between sensors and control unit}
F02D 2041/283	. . . . {the sensor directly giving at least one digital reading}
F02D 2041/285	. . . . {the sensor having a signal processing unit external to the engine control unit.}
F02D 2041/286	. . . . {comprising means for signal processing}
F02D 2041/288	. . . . {for performing a transformation into the frequency domain, e.g. Fourier transformation}
F02D 41/30	. Controlling fuel injection {(F02D 41/182, F02D 41/24 take precedence)}
F02D 41/3005	. . {Details not otherwise provided for}
F02D 41/3011	. . {according to or using specific or several modes of combustion}
F02D 41/3017	. . . {characterised by the mode(s) being used}
F02D 41/3023	. . . . {a mode being the stratified charge spark-ignited mode}
F02D 41/3029	. . . . {further comprising a homogeneous charge spark-ignited mode}
F02D 41/3035	. . . . {a mode being the premixed charge compression-ignition mode}
F02D 41/3041	. . . . {with means for triggering compression ignition, e.g. spark plug}
F02D 41/3047	. . . . . {said means being a secondary injection of fuel}
F02D 2041/3052	. . . . {the mode being the stratified charge compression-ignition mode}
F02D 41/3058	. . . . {the engine working with a variable number of cycles}
F02D 41/3064	. . . {with special control during transition between modes}
F02D 41/307	. . . . {to avoid torque shocks}
F02D 41/3076	. . . {with special conditions for selecting a mode of combustion, e.g. for starting, for diagnosing}
F02D 41/3082	. . {Control of electrical fuel pumps}
F02D 2041/3088	. . {for air assisted injectors}
F02D 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}

F02D 41/32	. . . of the low pressure type {(F02D 41/3082 takes precedence)}
F02D 41/34	. . . with means for controlling injection timing or duration (ignition timing F02P 5/00)
F02D 41/345	. . . . {Controlling injection timing (F02D 41/365 takes precedence)}
F02D 41/36	. . . with means for controlling distribution (arrangement of ignition distributors F02P 7/00)
F02D 41/365	. . . . {with means for controlling timing and distribution}
F02D 41/38	. . . of the high pressure type
F02D 41/3809	. . . . {Common rail control systems (common rail apparatus F02M 55/025, F02M 63/0225)}
F02D 41/3818	. . . . {for petrol engines}
F02D 41/3827	. . . . {for diesel engines}
F02D 41/3836	. . . . {Controlling the fuel pressure}
F02D 41/3845	. . . . . {by controlling the flow into the common rail, e.g. the amount of fuel pumped}
F02D 41/3854	. . . . . {with elements in the low pressure part, e.g. low pressure pump}
F02D 41/3863	. . . . . {by controlling the flow out of the common rail, e.g. using pressure relief valves}
F02D 41/3872	. . . . . {characterised by leakage flow in injectors}
F02D 2041/3881	. . . . {with multiple common rails, e.g. one rail per cylinder bank, or a high pressure rail and a low pressure rail}
F02D 2041/389	. . . . {for injecting directly into the cylinder}
F02D 41/40	. . . with means for controlling injection timing or duration
F02D 41/401	. . . . {Controlling injection timing (F02D 41/402 takes precedence)}
F02D 41/402	. . . . {Multiple injections}
F02D 41/403	. . . . . {with pilot injections}
F02D 41/405	. . . . . {with post injections}
F02D 41/406	. . . . {Electrically controlling a diesel injection pump (F02D 41/401 takes precedence)}
F02D 41/407	. . . . . {of the in-line type}
F02D 41/408	. . . . . {of the distributing type}
<b>F02D 43/00</b>	<b>Conjoint electrical control of two or more functions, e.g. ignition, fuel-air mixture, recirculation, supercharging, exhaust-gas treatment (electrical control of exhaust gas treating apparatus per se F01N 9/00)</b>
F02D 43/02	. using only analogue means
F02D 43/04	. using only digital means
<b>F02D 45/00</b>	<b>Electrical control not provided for in groups F02D 41/00 to 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)</b>
<b>F02D 2200/00</b>	<b>Input parameters for engine control</b>
F02D 2200/02	. the parameters being related to the engine

F02D 2200/021	. . .	Engine temperature
F02D 2200/022	. . .	Estimation of engine temperature
F02D 2200/023	. . .	Temperature of lubricating oil or working fluid
F02D 2200/024	. . .	Fluid pressure of lubricating oil or working fluid
F02D 2200/025	. . .	Engine noise, e.g. determined by using an acoustic sensor
F02D 2200/04	. . .	Engine intake system parameters
F02D 2200/0402	. . .	the parameter being determined by using a model of the engine intake or its components
F02D 2200/0404	. . .	Throttle position
F02D 2200/0406	. . .	Intake manifold pressure
F02D 2200/0408	. . . .	Estimation of intake manifold pressure
F02D 2200/0411	. . .	Volumetric efficiency
F02D 2200/0414	. . .	Air temperature
F02D 2200/0416	. . . .	Estimation of air temperature
F02D 2200/0418	. . .	Air humidity
F02D 2200/06	. . .	Fuel or fuel supply system parameters
F02D 2200/0602	. . .	Fuel pressure
F02D 2200/0604	. . . .	Estimation of fuel pressure
F02D 2200/0606	. . .	Fuel temperature
F02D 2200/0608	. . . .	Estimation of fuel temperature
F02D 2200/0611	. . .	Fuel type, fuel composition or fuel quality
F02D 2200/0612	. . . .	determined by estimation
F02D 2200/0614	. . .	Actual fuel mass or fuel injection amount
F02D 2200/0616	. . . .	determined by estimation
F02D 2200/0618	. . .	Actual fuel injection timing or delay, e.g. determined from fuel pressure drop
F02D 2200/0625	. . .	Fuel consumption, e.g. measured in fuel liters per 100 kms or miles per gallon
F02D 2200/063	. . .	Lift of the valve needle
F02D 2200/08	. . .	Exhaust gas treatment apparatus parameters
F02D 2200/0802	. . .	Temperature of the exhaust gas treatment apparatus
F02D 2200/0804	. . . .	Estimation of the temperature of the exhaust gas treatment apparatus
F02D 2200/0806	. . .	NOx storage amount, i.e. amount of NOx stored on NOx trap
F02D 2200/0808	. . .	NOx storage capacity, i.e. maximum amount of NOx that can be stored on NOx trap
F02D 2200/0811	. . .	NOx storage efficiency
F02D 2200/0812	. . .	Particle filter loading
F02D 2200/0814	. . .	Oxygen storage amount
F02D 2200/0816	. . .	Oxygen storage capacity
F02D 2200/0818	. . .	SOx storage amount, e.g. for SOx trap or NOx trap
F02D 2200/10	. . .	Parameters related to the engine output, e.g. engine torque or engine speed
F02D 2200/1002	. . .	Output torque



F02D 2200/1004	. . . . Estimation of the output torque
F02D 2200/1006	. . . Engine torque losses, e.g. friction or pumping losses or losses caused by external loads of accessories
F02D 2200/101	. . . Engine speed
F02D 2200/1012	. . . Engine speed gradient
F02D 2200/1015	. . . Engines misfires
F02D 2200/50	. said parameters being related to the vehicle or its components
F02D 2200/501	. . Vehicle speed
F02D 2200/502	. . Neutral gear position
F02D 2200/503	. . Battery correction, i.e. corrections as a function of the state of the battery, its output or its type
F02D 2200/60	. said parameters being related to the driver demands or status
F02D 2200/602	. . Pedal position
F02D 2200/604	. . Engine control mode selected by driver, e.g. to manually start particle filter regeneration or to select driving style
F02D 2200/606	. . Driving style, e.g. sporty or economic driving
F02D 2200/70	. said parameters being related to the vehicle exterior
F02D 2200/701	. . Information about vehicle position, e.g. from navigation system or GPS signal
F02D 2200/702	. . Road conditions
F02D 2200/703	. . Atmospheric pressure
F02D 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)

<b>F02D 2250/00</b>	<b>Engine control related to specific problems or objectives</b>
F02D 2250/02	. Fuel evaporation in fuel rails, e.g. in common rails
F02D 2250/04	. Fuel pressure pulsation in common rails
F02D 2250/06	. Reverse rotation of engine
F02D 2250/08	. Engine blow-by from crankcase chamber
F02D 2250/11	. Oil dilution, i.e. prevention thereof or special controls according thereto
F02D 2250/12	. Timing of calculation, i.e. specific timing aspects when calculation or updating of engine parameter is performed
F02D 2250/14	. Timing of measurement, e.g. synchronisation of measurements to the engine cycle
F02D 2250/16	. End position calibration, i.e. calculation or measurement of actuator end positions, e.g. for throttle or its driving actuator
F02D 2250/18	. Control of the engine output torque
F02D 2250/21	. . during a transition between engine operation modes or states
F02D 2250/22	. . by keeping a torque reserve, i.e. with temporarily reduced drive train or engine efficiency
F02D 2250/24	. . by using an external load, e.g. a generator

F02D 2250/26	. . . by applying a torque limit
F02D 2250/28	. Control for reducing torsional vibrations, e.g. at acceleration
F02D 2250/31	. Control of the fuel pressure
F02D 2250/32	. Air-fuel ratio control in a diesel engine
F02D 2250/34	. Control of exhaust back pressure, e.g. for turbocharged engines
F02D 2250/36	. Control for minimising NOx emissions
F02D 2250/38	. Control for minimising smoke emissions, e.g. by applying smoke limitations on the fuel injection amount
F02D 2250/41	. Control to generate negative pressure in the intake manifold, e.g. for fuel vapor purging or brake booster
<b>F02D 2400/00</b>	<b>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</b>
F02D 2400/02	. Four-stroke combustion engines with electronic control
F02D 2400/04	. Two-stroke combustion engines with electronic control
F02D 2400/06	. Small engines with electronic control, e.g. for hand held tools
F02D 2400/08	. Redundant elements, e.g. two sensors for measuring the same parameter
F02D 2400/11	. After-sales modification devices designed to be used to modify an engine afterwards
F02D 2400/12	. Engine control specially adapted for a transmission comprising a torque converter or for continuously variable transmissions
F02D 2400/14	. Power supply for engine control systems
F02D 2400/16	. Adaptation of engine control systems to a different battery voltages, e.g. for using high voltage batteries
F02D 2400/18	. Packaging of the electronic circuit in a casing
F02D 2400/21	. Engine cover with integrated cabling
F02D 2400/22	. Connectors or cables specially adapted for engine management applications
<b>F02D 2700/00</b>	<b>Mechanical control of speed or power of a single cylinder piston engine</b>
F02D 2700/02	. Controlling by changing the air or fuel supply
F02D 2700/0202	. . . for engines working with gaseous fuel, including those working with an ignition liquid
F02D 2700/0205	. . . . Controlling the air supply as well as the fuel supply
F02D 2700/0207	. . . . Controlling the air or mixture supply
F02D 2700/021	. . . . Engines without compressor
F02D 2700/0212	. . . . Engines with compressor
F02D 2700/0215	. . . . Controlling the fuel supply
F02D 2700/0217	. . . for mixture compressing engines using liquid fuel
F02D 2700/022	. . . . Controlling the air or the mixture supply as well as the fuel supply
F02D 2700/0223	. . . . Engines with fuel injection
F02D 2700/0225	. . . . Control of air or mixture supply
F02D 2700/0228	. . . . Engines without compressor
F02D 2700/023	. . . . . by means of one throttle device

F02D 2700/0233	. . . . . depending on several parameters
F02D 2700/0235	. . . . . depending on the pressure of a gaseous or liquid medium
F02D 2700/0238	. . . . . depending on the number of revolutions of a centrifugal governor
F02D 2700/0241	. . . . . depending on another parameter
F02D 2700/0243	. . . . . by means of a plurality of throttle devices
F02D 2700/0246	. . . . . for engines with compressor
F02D 2700/0248	. . . . . by means of throttle devices
F02D 2700/0251	. . . . . in the intake conduit
F02D 2700/0253	. . . . . in the outlet conduit
F02D 2700/0256	. . . . . by changing the speed of the compressor
F02D 2700/0258	. . . . . by other means
F02D 2700/0261	. . . Control of the fuel supply
F02D 2700/0264	. . . . for engines with a fuel jet working with depression
F02D 2700/0266	. . . . for engines with fuel injection
F02D 2700/0269	. . for air compressing engines with compression ignition
F02D 2700/0271	. . . Controlling the air supply as well as the fuel supply
F02D 2700/0274	. . . Controlling the air supply
F02D 2700/0276	. . . . Engines without compressor
F02D 2700/0279	. . . . Engines with compressor
F02D 2700/0282	. . . Control of fuel supply
F02D 2700/0284	. . . . by acting on the fuel pump control element
F02D 2700/0287	. . . . . depending on several parameters
F02D 2700/0289	. . . . . depending on the pressure of a gaseous or liquid medium
F02D 2700/0292	. . . . . depending on the speed of a centrifugal governor
F02D 2700/0294	. . . . . depending on another parameter
F02D 2700/0297	. . . . by control means in the fuel conduit between pump and injector
F02D 2700/03	. Controlling by changing the compression ratio
F02D 2700/035	. . without modifying the volume of the compression space, e.g. by changing the valve timing
F02D 2700/04	. Controlling by throttling the exhaust conduit
F02D 2700/05	. Controlling by preventing combustion in one or more cylinders
F02D 2700/052	. . Methods therefor
F02D 2700/054	. . . by keeping the exhaust valves open
F02D 2700/056	. . . by interrupting the medium supply
F02D 2700/058	. . . by another method
F02D 2700/07	. Automatic control systems according to one of the preceeding groups in combination with control of the mechanism receiving the engine power
F02D 2700/09	. Other ways of controlling
F02D 2700/10	. Control of the timing of the fuel supply period with relation to the piston movement