

CPC COOPERATIVE PATENT CLASSIFICATION

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

ENGINES OR PUMPS

F01 MACHINES OR ENGINES IN GENERAL (combustion engines [F02](#); machines for liquids [F03](#), [F04](#)); ENGINE PLANTS IN GENERAL; STEAM ENGINES

F01N GAS-FLOW SILENCERS OR EXHAUST APPARATUS FOR MACHINES OR ENGINES IN GENERAL; GAS-FLOW SILENCERS OR EXHAUST APPARATUS FOR INTERNAL COMBUSTION ENGINES ({[evacuation of fumes from the area where they are produced B08B 15/00](#); [arrangement of exhaust or silencing apparatus on percussive tools B25D 17/12](#)} ; [arrangements in connection with gas exhaust of propulsion units in vehicles B60K 13/00](#), {[on ships or other waterborne vessels B63H 21/32](#), [on aircraft B64D 33/04](#); [arrangement of exhaust or silencing apparatus on firearms F41A 21/30](#); [ground installations for reducing aircraft engine or jet noise B64F 1/26](#); [silencers specially adapted for steam engines F01B 31/16](#); [air-intake silencers for gas turbine or jet propulsion plants F02C 7/045](#); [jet pipe or nozzles for jet propulsion plants F02K](#)} ; [combustion-air intake silencers specially adapted for, or arranged on, internal-combustion engines F02M 35/00](#); {[combating noise or silencing in positive displacement machines or pumps F04B 39/0027](#), [in rotary-piston machines or pumps F04C 29/06](#), [in non-positive displacement pumps F04D 29/66](#); [means in valves for absorbing noise F16K 47/02](#); [noise absorbers in pipe system F16L 55/02](#); [conducting smoke or fumes from various locations to the outside F23J 11/00](#); [means for preventing or suppressing noise in air-conditioning or ventilation systems F24F 13/24](#)} ; [protecting against, or damping, noise in general G10K 11/16](#))

NOTE

Attention is drawn to the notes preceding Class [F01](#), especially as regards Note 2(b).

WARNING

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

1/00	Silencing apparatus characterised by method of silencing { by cooling F01N 3/02 ; using liquids F01N 3/04 }	1/081	. . { by passing the gases through a mass of particles }
		1/082	. . { the gases passing through porous members (F01N 1/081 takes precedence) }
1/003	. { by using dead chambers communicating with gas flow passages (resonance chambers F01N 1/02; chambers containing sound-absorbing materials F01N 1/24) }	1/083	. . { using transversal baffles defining a tortuous path for the gases or successively throttling gas flow }
1/006	. . { comprising at least one perforated tube extending from inlet to outlet of the silencer }	1/084	. . { the gases flowing through the silencer two or more times longitudinally in opposite directions, e.g. using parallel or concentric tubes }
1/02	. by using resonance	1/085	. . { using a central core throttling gas passage }
1/023	. . { Helmholtz resonators }	1/086	. . { having means to impart whirling motion to the gases (with helically or spirally shaped channels F01N 1/12) }
1/026	. . { Annular resonance chambers arranged concentrically to an exhaust passage and communicating with it, e.g. via at least one opening in the exhaust passage }	1/087	. . . { using tangential inlets into a circular chamber }
1/04	. . having sound-absorbing materials in resonance chambers	1/088	. . . { using vanes arranged on gas flow path or gas flow tubes with tangentially directed apertures }
1/06	. by using interference effect	1/089	. . { using two or more expansion chambers in series (F01N 1/083, F01N 1/084, F01N 1/086 take precedence) }
1/065	. . { by using an active noise source, e.g. speakers }		
1/08	. by reducing exhaust energy by throttling or whirling		

- 1/10 . . in combination with sound-absorbing materials
([F01N 1/125](#) takes precedence)
- 1/12 . . using spirally or helically shaped channels
(cyclones [B04C](#))
- 1/125 . . . {in combination with sound-absorbing materials}
- 1/14 . by adding air to exhaust gases {(in tailpipes [F01N 13/082](#), [F01N 13/20](#))}
- 1/16 . by using movable parts
- 1/161 . . {for adjusting resonance or dead chambers or passages to resonance or dead chambers}
- 1/163 . . . {by means of valves}
- 1/165 . . {for adjusting flow area}
- 1/166 . . {for changing gas flow path through the silencer or for adjusting the dimensions of a chamber or a pipe ([F01N 1/165](#) takes precedence)}
- 1/168 . . {for controlling or modifying silencing characteristics only}
- 1/18 . . having rotary movement
- 1/20 . . having oscillating or vibrating movement {(the parts being resilient walls [F01N 1/22](#))}
- 1/22 . . the parts being resilient walls
- 1/24 . by using sound-absorbing materials ([F01N 1/04](#), [F01N 1/06](#), [F01N 1/10](#), [F01N 1/14](#), [F01N 1/16](#) take precedence)
- 3/00 Exhaust or silencing apparatus having means for purifying, rendering innocuous, or otherwise treating exhaust** (electric control [F01N 9/00](#); monitoring or diagnostic devices for exhaust-gas treatment apparatus [F01N 11/00](#) ; collecting or removing exhaust gases of vehicle engines in workshops [B08B 15/00](#), on highways [E01C 1/005](#))
- 3/005 . {for draining or otherwise eliminating condensates or moisture accumulating in the apparatus ([F01N 3/02](#) takes precedence)}
- 3/01 . by means of electric or electrostatic separators
- 3/02 . for cooling, or for removing solid constituents of, exhaust (by means of electric or electrostatic separators [F01N 3/01](#) ; mixing air with exhaust in tailpipes [F01N 13/082](#), [F01N 13/20](#))
- 3/0205 . . {using heat exchangers}
- 3/021 . . by means of filters
- 3/0211 . . . {Arrangements for mounting filtering elements in housing, e.g. with means for compensating thermal expansion or vibration}
- 3/0212 . . . {with one or more perforated tubes surrounded by filtering material, e.g. filter candles}
- 3/0214 . . . {with filters comprising movable parts, e.g. rotating filters}
- 3/0215 . . . {the filtering elements having the form of disks or plates}
- 3/0217 . . . {the filtering elements having the form of hollow cylindrical bodies}
- 3/0218 . . . {the filtering elements being made from spirally-wound filtering material}
- 3/022 . . . characterised by specially adapted filtering structure, e.g. honeycomb, mesh or fibrous
- 3/0222 {the structure being monolithic, e.g. honeycombs}
- 3/0224 {the structure being granular}
- 3/0226 {the structure being fibrous}
- 3/0228 {the structure being made of foamed rubber or plastics}
- 3/023 . . . using means for regenerating the filters, e.g. by burning trapped particles (by electrically controlling the supply of combustible mixture or its constituents only [F02D 41/0235](#))
- 3/0231 {using special exhaust apparatus upstream of the filter for producing nitrogen dioxide, e.g. for continuous filter regeneration systems [CRT]}
- 3/0232 {removing incombustible material from a particle filter, e.g. ash}
- 3/0233 {periodically cleaning filter by blowing a gas through the filter in a direction opposite to exhaust flow, e.g. exposing filter to engine air intake}
- 3/0234 {using heat exchange means in the exhaust line}
- 3/0235 {using exhaust gas throttling means}
- 3/0236 {using turbine waste gate valve}
- 3/0237 {for regenerating ex situ}
- 3/0238 {for regenerating during engine standstill}
- 3/025 using fuel burner or by adding fuel to exhaust
- 3/0253 {adding fuel to exhaust gases}
- 3/0256 {the fuel being ignited by electrical means}
- 3/027 using electric or magnetic heating means
- 3/0275 {using electric discharge means}
- 3/028 using microwaves
- 3/029 by adding non-fuel substances to exhaust
- 3/0293 {injecting substances in exhaust stream}
- 3/0296 {having means for preheating additional substances}
- 3/031 . . . having means for by-passing filters, e.g. when clogged or during cold engine start
- 3/032 during filter regeneration only
- 3/033 . . . in combination with other devices {(with adsorbents or absorbents [F01N 3/0821](#))}
- 3/0335 {with exhaust silencers in a single housing}
- 3/035 with catalytic reactors {, e.g. catalysed diesel particulate filters}
- 3/037 . . by means of inertial or centrifugal separators, e.g. of cyclone type, optionally combined or associated with agglomerators
- 3/038 . . by means of perforated plates defining expansion chambers associated with condensation and collection chambers, e.g. for adiabatic expansion of gases and subsequent collection of condensed liquids
- 3/04 . . using liquids
- 3/043 . . . {without contact between liquid and exhaust gases}
- 3/046 {Exhaust manifolds with cooling jacket}
- 3/05 . . by means of air, e.g. by mixing exhaust with air (silencers working by addition of air to exhaust [F01N 1/14](#); arrangements for the supply of additional air for the thermal or catalytic conversion of noxious components of exhaust [F01N 3/30](#) ; in tailpipes [F01N 13/082](#))
- 3/055 . . . {without contact between air and exhaust gases}
- 3/06 . for extinguishing sparks
- 3/08 . for rendering innocuous (using electric or electrostatic separators [F01N 3/01](#); chemical aspects [B01D 53/92](#))

- 3/0807 . . {by using absorbents or adsorbents}
- 3/0814 . . . {combined with catalytic converters, e.g. NOx absorption/storage reduction catalysts}
- 3/0821 . . . {combined with particulate filters (catalysed diesel particulate filters [F01N 3/035](#))}
- 3/0828 . . . {characterised by the absorbed or adsorbed substances}
- 3/0835 {Hydrocarbons}
- 3/0842 {Nitrogen oxides}
- 3/085 {Sulfur or sulfur oxides}
- 3/0857 {Carbon oxides}
- 3/0864 {Oxygen}
- 3/0871 . . . {Regulation of absorbents or adsorbents, e.g. purging (by electrically controlling the supply of combustible mixture or its constituents only [F02D 41/0235](#))}
- 3/0878 {Bypassing absorbents or adsorbents}
- 3/0885 {Regeneration of deteriorated absorbents or adsorbents, e.g. desulfurization of NOx traps}
- 3/0892 . . {Electric or magnetic treatment, e.g. dissociation of noxious components (electric filters [F01N 3/01](#); regeneration of exhaust filters [F01N 3/023](#); heating catalytic converters [F01N 3/2006](#))}
- 3/10 . . by thermal or catalytic conversion of noxious components of exhaust (by using other chemical processes, chemical aspects of catalytic conversion, e.g. using specified catalysts, [B01D 53/34](#))
- 3/101 . . . {Three-way catalysts}
- 3/103 . . . {Oxidation catalysts for HC and CO only}
- 3/105 . . . {General auxiliary catalysts, e.g. upstream or downstream of the main catalyst}
- 3/106 {Auxiliary oxidation catalysts}
- 3/108 {Auxiliary reduction catalysts}
- 3/18 . . . characterised by methods of operation; Control
- 3/20 specially adapted for catalytic conversion ([F01N 3/22](#) takes precedence) ; Methods of operation or control of catalytic converters}
- 3/2006 {Periodically heating or cooling catalytic reactors, e.g. at cold starting or overheating (by electrically controlling the supply of combustible mixture or its constituents only [F02D 41/0235](#))}
- 3/2013 {using electric or magnetic heating means}
- 3/202 {using microwaves}
- 3/2026 {directly electrifying the catalyst substrate, i.e. heating the electrically conductive catalyst substrate by joule effect}
- 3/2033 {using a fuel burner or introducing fuel into exhaust duct}
- 3/204 {using an exhaust gas igniter, e.g. a spark or glow plug, without introducing fuel into exhaust duct}
- 3/2046 {Periodically cooling catalytic reactors}
- 3/2053 {By-passing catalytic reactors, e.g. to prevent overheating}
- 3/206 {Adding periodically or continuously substances to exhaust gases for promoting purification, e.g. catalytic material in liquid form, NOx reducing agents ([F01N 3/2066](#) takes precedence)}
- 3/2066 {Selective catalytic reduction [SCR]}
- 3/2073 {with means for generating a reducing substance from the exhaust gases}
- 3/208 {Control of selective catalytic reduction [SCR], e.g. dosing of reducing agent}
- 3/2086 {Activating the catalyst by light, photo-catalysts}
- 3/2093 {Periodically blowing a gas through the converter, e.g. in a direction opposite to exhaust gas flow or by reversing exhaust gas flow direction}
- 3/22 Control of additional air supply only, e.g. using by-passes or variable air pump drives
- 3/222 {using electric valves only}
- 3/225 {Electric control of additional air supply}
- 3/227 {using pneumatically operated valves, e.g. membrane valves}
- 3/24 characterised by constructional aspects of converting apparatus (filtering in combination with catalytic reactors [F01N 3/035](#))
- 3/26 Construction of thermal reactors
- 3/28 Construction of catalytic reactors
- 3/2803 {characterised by structure, by material or by manufacturing of catalyst support}
- 3/2807 {Metal other than sintered metal ([F01N 3/2832](#) and [F01N 3/2835](#) take precedence)}
- 3/281 {Metallic honeycomb monoliths made of stacked or rolled sheets, foils or plates}
- 3/2814 {all sheets, plates or foils being corrugated}
- 3/2817 {only with non-corrugated sheets, plates or foils}
- 3/2821 {the support being provided with means to enhance the mixing process inside the converter, e.g. sheets, plates or foils with protrusions or projections to create turbulence}
- 3/2825 {Ceramics ([F01N 3/2832](#), [F01N 3/2835](#) take precedence)}
- 3/2828 {Ceramic multi-channel monoliths, e.g. honeycombs}
- 3/2832 {granular, e.g. pellets}
- 3/2835 {fibrous}
- 3/2839 {Arrangements for mounting catalyst support in housing, e.g. with means for compensating thermal expansion or vibration}
- 3/2842 {specially adapted for monolithic supports, e.g. of honeycomb type ([F01N 3/2853](#) - [F01N 3/2871](#) take precedence)}
- 3/2846 {specially adapted for granular supports, e.g. pellets}
- 3/285 {specially adapted for fibrous supports, e.g. held in place by screens}

- 3/2853 {using mats or gaskets between catalyst body and housing}
- 3/2857 {the mats or gaskets being at least partially made of intumescent material, e.g. unexpanded vermiculite}
- 3/286 {the mats or gaskets having corrugations or cavities}
- 3/2864 {the mats or gaskets comprising two or more insulation layers}
- 3/2867 {the mats or gaskets being placed at the front or end face of catalyst body}
- 3/2871 {the mats or gaskets having an additional, e.g. non-insulating or non-cushioning layer, a metal foil or an adhesive layer}
- 3/2875 {by using elastic means, e.g. spring leaves, for retaining catalyst body in the housing ([F01N 3/2853](#) - [F01N 3/2871](#) take precedence)}
- 3/2878 {by using non-elastic means for retaining catalyst body in the housing, e.g. a metal chamfer, or by corrugation or deformation of the metal housing}
- 3/2882 {Catalytic reactors combined or associated with other devices, e.g. exhaust silencers or other exhaust purification devices ([combined with absorbents or adsorbents only F01N 3/0814](#); [combined with particulate filters F01N 3/035](#))}
- 3/2885 {with exhaust silencers in a single housing}
- 3/2889 {with heat exchangers in a single housing}
- 3/2892 {Exhaust flow directors or the like, e.g. upstream of catalytic device}
- 3/2896 {Liquid catalyst carrier}
- 3/30 Arrangements for supply of additional air ([control, e.g. using by-passes or variable air pump drives, F01N 3/22](#))
- 3/303 {Filtering additional air}
- 3/306 {Preheating additional air}
- 3/32 using air pump ([using jet air pumps F01N 3/34](#); [pumps in general F04](#))
- 3/323 {Electrically driven air pumps}
- 3/326 {Engine-driven air pumps}
- 3/34 using air conduits or jet air pumps, e.g. near the engine exhaust port
- 3/36 Arrangements for supply of additional fuel
- 3/38 Arrangements for igniting

5/00 Exhaust or silencing apparatus combined or associated with devices profiting from exhaust energy ([using kinetic or wave energy of exhaust gases in exhaust systems for charging F02B](#); [predominant aspects of such devices, see the relevant classes for the devices](#))

- 5/02 . the devices using heat
- 5/025 . . {the device being thermoelectric generators}
- 5/04 . the devices using kinetic energy

9/00 Electrical control of exhaust gas treating apparatus ([monitoring or diagnostic devices for exhaust-gas treatment apparatus F01N 11/00](#); [conjoint electrical control of two or more combustion engine functions F02D 43/00](#))

- 9/002 . {of filter regeneration, e.g. detection of clogging}
- 9/005 . {using models instead of sensors to determine operating characteristics of exhaust systems, e.g. calculating catalyst temperature instead of measuring it directly}
- 9/007 . {Storing data relevant to operation of exhaust systems for later retrieval and analysis, e.g. to research exhaust system malfunctions}

11/00 Monitoring or diagnostic devices for exhaust-gas treatment apparatus {, e.g. for catalytic activity ([safety, indicating or supervising devices for internal combustion engines F02B 77/08](#); [testing of machines G01M 13/00](#))

- 11/002 . {the diagnostic devices measuring or estimating temperature or pressure in, or downstream of the exhaust apparatus}
- 11/005 . . {the temperature or pressure being estimated, e.g. by means of a theoretical model}
- 11/007 . {the diagnostic devices measuring oxygen or air concentration downstream of the exhaust apparatus}

13/00 Exhaust or silencing apparatus characterised by constructional features {; Exhaust or silencing apparatus, or parts thereof, having pertinent characteristics not provided for in, or of interest apart from, groups [F01N 1/00](#) - [F01N 5/00](#), [F01N 9/00](#), [F01N 11/00](#)}

- 13/001 . {Gas flow channels or gas chambers being at least partly formed in the structural parts of the engine or machine ([using structural parts of the vehicle B60K 13/06](#))}
- 13/002 . {Apparatus adapted for particular uses, e.g. for portable devices driven by machines or engines}
- 13/004 . {specially adapted for marine propulsion, i.e. for receiving simultaneously engine exhaust gases and engine cooling water ([for submerged exhausting F01N 13/12](#); [treating exhaust by using liquids F01N 3/04](#))}
- 13/005 . . {with parts constructed of non-metallic material, e.g. of rubber}
- 13/007 . {Apparatus used as intake or exhaust silencer ([silencing methods F01N 1/00](#); [intake silencers F02M 35/12](#))}
- 13/008 . {Mounting or arrangement of exhaust sensors in or on exhaust apparatus ([sensor arrangements for engine control F02D 41/1439](#))}
- 13/009 . {having two or more separate purifying devices arranged in series}
- 13/0093 . . {the purifying devices are of the same type}
- 13/0097 . . {the purifying devices are arranged in a single housing}
- 13/011 . {having two or more purifying devices arranged in parallel}
- 13/017 . . {the purifying devices are arranged in a single housing}
- 13/02 . having two or more separate silencers in series
- 13/04 . having two or more silencers in parallel, e.g. having interconnections for multi-cylinder engines
- 13/06 . specially adapted for star-arrangement of cylinders, e.g. exhaust manifolds

- 13/08 . Other arrangements or adaptations of exhaust conduits {(pipes, joints or supports therefor in general [F16L](#); collecting or removing exhaust gases of vehicle engines in workshops [B08B 15/00](#), on highways [E01C 1/005](#))}
- 13/082 . . {of tailpipe, e.g. with means for mixing air with exhaust for exhaust cooling, dilution or evacuation ([F01N 13/20](#) takes precedence)}
- 13/085 . . {having means preventing foreign matter from entering exhaust conduit}
- 13/087 . . {having valves upstream of silencing apparatus for by-passing at least part of exhaust directly to atmosphere (valves for changing gas flow path through the silencer [F01N 1/166](#))}
- 13/10 . . of exhaust manifolds {(with cooling jacket [F01N 3/046](#))}
- 13/102 . . . {having thermal insulation}
- 13/105 . . . {having the form of a chamber directly connected to the cylinder head, e.g. without having tubes connected between cylinder head and chamber}
- 13/107 . . . {More than one exhaust manifold or exhaust collector}
- 13/12 . specially adapted for submerged exhausting
- 13/14 . having thermal insulation {(exhaust manifolds [F01N 13/102](#))}
- 13/141 . . {Double-walled exhaust pipes or housings}
- 13/143 . . . {with air filling the space between both walls}
- 13/145 . . . {with gas other than air filling the space between both walls}
- 13/146 . . . {with vacuum in the space between both walls}
- 13/148 . . {Multiple layers of insulating material}
- 13/16 . Selection of particular materials
- 13/18 . Construction facilitating manufacture, assembly, or disassembly
- 13/1805 . . {Fixing exhaust manifolds, exhaust pipes or pipe sections to each other, to engine or to vehicle body (pipe joints in general [F16L](#); fixing auxiliaries in motor vehicles in general [B60K](#))}
- 13/1811 . . . {with means permitting relative movement, e.g. compensation of thermal expansion or vibration}
- 13/1816 {the pipe sections being joined together by flexible tubular elements only, e.g. using bellows or strip-wound pipes}
- 13/1822 {for fixing exhaust pipes or devices to vehicle body}
- 13/1827 . . . {Sealings specially adapted for exhaust systems (sealings in general [F16J 15/00](#))}
- 13/1833 . . {specially adapted for small internal combustion engines, e.g. used in model applications}
- 13/1838 . . {characterised by the type of connection between parts of exhaust or silencing apparatus, e.g. between housing and tubes, between tubes and baffles}
- 13/1844 . . . {Mechanical joints}
- 13/185 {the connection being realised by deforming housing, tube, baffle, plate, or parts thereof}
- 13/1855 {the connection being realised by using bolts, screws, rivets or the like}
- 13/1861 . . {the assembly using parts formed by casting or moulding}
- 13/1866 . . . {the channels or tubes thereof being made integrally with the housing}
- 13/1872 . . {the assembly using stamp-formed parts or otherwise deformed sheet-metal}
- 13/1877 . . . {the channels or tubes thereof being made integrally with the housing}
- 13/1883 . . {manufactured by hydroforming}
- 13/1888 . . {the housing of the assembly consisting of two or more parts, e.g. two half-shells}
- 13/1894 . . . {the parts being assembled in longitudinal direction}
- 13/20 . having flared outlets, e.g. of fish-tail shape
- 2210/00** **Combination of methods of silencing**
- 2210/02 . Resonance and interference
- 2210/04 . Throttling-expansion and resonance
- 2210/06 . Throttling-expansion and interference
- 2230/00** **Combination of silencers and other devices**
- 2230/02 . Exhaust filters
- 2230/04 . Catalytic converters
- 2230/06 . Spark arresters
- 2230/08 . Thermal reactors
- 2240/00** **Combination or association of two or more different exhaust treating devices, or of at least one such device with an auxiliary device, not covered by indexing codes [F01N 2230/00](#) or [F01N 2250/00](#), one of the devices being**
- 2240/02 . a heat exchanger
- 2240/04 . an electric, e.g. electrostatic, device other than a heater
- 2240/05 . a magnetic, e.g. electromagnetic, device other than a valve
- 2240/06 . an inertial, e.g. centrifugal, device
- 2240/10 . a heat accumulator
- 2240/12 . a thermal reactor
- 2240/14 . a fuel burner
- 2240/16 . an electric heater, i.e. a resistance heater
- 2240/18 . an adsorber or absorber
- 2240/20 . a flow director or deflector
- 2240/22 . a condensation chamber
- 2240/25 . an ammonia generator
- 2240/26 . an exhaust gas reservoir, e.g. emission buffer
- 2240/28 . a plasma reactor
- 2240/30 . a fuel reformer
- 2240/32 . a fuel cell
- 2240/34 . an electrolyser
- 2240/36 . an exhaust flap
- 2240/38 . an ozone (O₃) generator, e.g. for adding ozone after generation of ozone from air
- 2240/40 . a hydrolysis catalyst
- 2250/00** **Combinations of different methods of purification**
- 2250/02 . filtering and catalytic conversion
- 2250/04 . afterburning and catalytic conversion
- 2250/06 . afterburning and filtering
- 2250/08 . filtering and inertial particulate separation
- 2250/10 . cooling and filtering
- 2250/12 . absorption or adsorption, and catalytic conversion
- 2250/14 . absorption or adsorption, and filtering
- 2260/00** **Exhaust treating devices having provisions not otherwise provided for**
- 2260/02 . for cooling the device
- 2260/022 . . using air
- 2260/024 . . using a liquid

- 2260/04 . for regeneration or reactivation, e.g. of catalyst
- 2260/06 . for improving exhaust evacuation or circulation, or reducing back-pressure
- 2260/08 . for preventing heat loss or temperature drop, using other means than layers of heat-insulating material
- 2260/10 . for avoiding stress caused by expansions or contractions due to temperature variations
- 2260/12 . for resisting high pressure
- 2260/14 . for modifying or adapting flow area or back-pressure
- 2260/16 . for reducing exhaust flow pulsations
- 2260/18 . for improving rigidity, e.g. by wings, ribs
- 2260/20 . for heat or sound protection, e.g. using a shield or specially shaped outer surface of exhaust device
- 2260/22 . for preventing theft of exhaust parts or devices, e.g. anti-theft arrangements
- 2260/24 . for identifying exhaust parts or devices, e.g. by labels, stickers or directly printing
- 2260/26 . for preventing enter of dirt into the device
- 2270/00 Mixing air with exhaust gases**
- 2270/02 . for cooling exhaust gases or the apparatus
- 2270/04 . for afterburning
- 2270/06 . for silencing
- 2270/08 . for evacuation of exhaust gases, e.g. in tail-pipes
- 2270/10 . for rendering exhaust innocuous, e.g. by dilution
- 2290/00 Movable parts or members in exhaust systems for other than for control purposes**
- 2290/02 . with continuous rotary movement
- 2290/04 . . driven by exhaust gases
- 2290/06 . . driven by auxiliary drive
- 2290/08 . with oscillating or vibrating movement
- 2290/10 . . actuated by pressure of exhaust gases, e.g. exhaust pulses
- 2310/00 Selection of sound absorbing or insulating material**
- 2310/02 . Mineral wool, e.g. glass wool, rock wool, asbestos or the like
- 2310/04 . Metallic wool, e.g. steel wool, copper wool or the like
- 2310/06 . Porous ceramics
- 2310/08 . Exfoliated vermiculite, e.g. zonolite, coke, pumice
- 2310/10 . Plastic foam
- 2310/12 . Granular material
- 2310/14 . Wire mesh fabric, woven glass cloth or the like
- 2330/00 Structure of catalyst support or particle filter**
- 2330/02 . Metallic plates or honeycombs, e.g. superposed or rolled-up corrugated or otherwise deformed sheet metal
- 2330/04 . . Methods of manufacturing
- 2330/06 . Ceramic, e.g. monoliths
- 2330/08 . Granular material
- 2330/10 . Fibrous material, e.g. mineral or metallic wool
- 2330/101 . . using binders, e.g. to form a permeable mat, paper or the like
- 2330/102 . . . fibrous material being fiber reinforced polymer made of plastic matrix reinforced by fine glass or in the form of a loose mass of filaments or fibers
- 2330/12 . Metallic wire mesh fabric or knitting
- 2330/14 . Sintered material
- 2330/18 . Composite material
- 2330/20 . Plastics, e.g. polymers, polyester, polyurethane
- 2330/22 . Metal foam
- 2330/30 . Honeycomb supports characterised by their structural details
- 2330/32 . . characterised by the shape, form or number of corrugations of plates, sheets or foils
- 2330/321 . . . with two or more different kinds of corrugations in the same substrate
- 2330/322 . . . Corrugations of trapezoidal form
- 2330/323 . . . Corrugations of saw-tooth or triangular form
- 2330/324 . . . Corrugations of rectangular form
- 2330/325 . . . Corrugations of omega form
- 2330/34 . . with flow channels of polygonal cross section
- 2330/36 . . with flow channels formed by tubes
- 2330/38 . . flow channels with means to enhance flow mixing, (e.g. protrusions or projections)
- 2330/40 . . made of a single sheet, foil or plate
- 2330/42 . . made of three or more different sheets, foils or plates stacked one on the other
- 2330/44 . . made of stacks of sheets, plates or foils that are folded in S-form
- 2330/48 . . characterised by the number of flow passages, e.g. cell density
- 2330/60 . Discontinuous, uneven properties of filter material, e.g. different material thickness along the longitudinal direction; Higher filter capacity upstream than downstream in same housing
- 2340/00 Dimensional characteristics of the exhaust system, e.g. length, diameter or volume of the apparatus; Spatial arrangements of exhaust apparatuses**
- 2340/02 . characterised by the distance of the apparatus to the engine, or the distance between two exhaust treating apparatuses
- 2340/04 . characterised by the arrangement of an exhaust pipe, manifold or apparatus in relation to vehicle frame or particular vehicle parts
- 2340/06 . characterised by the arrangement of the exhaust apparatus relative to the turbine of a turbocharger
- 2350/00 Arrangements for fitting catalyst support or particle filter element in the housing**
- 2350/02 . Fitting ceramic monoliths in a metallic housing
- 2350/04 . . with means compensating thermal expansion
- 2350/06 . . with means preventing gas flow by-pass or leakage
- 2350/08 . with means for compressing granular material
- 2370/00 Selection of materials for exhaust purification**
- 2370/02 . used in catalytic reactors
- 2370/04 . . Zeolitic material
- 2370/22 . used in non-catalytic purification apparatus
- 2370/24 . . Zeolitic material
- 2370/30 . . Materials having magnetic properties
- 2370/40 . Activated carbon or charcoal
- 2390/00 Arrangements for controlling or regulating exhaust apparatus**
- 2390/02 . using electric components only
- 2390/04 . using electropneumatic components
- 2390/06 . using pneumatic components only
- 2390/08 . using mechanical components only, e.g. actuated manually
- 2410/00 By-passing, at least partially, exhaust from inlet to outlet of apparatus, to atmosphere or to other device**

- 2410/02 . in case of high temperature, e.g. overheating of catalytic reactor
- 2410/03 . in case of low temperature
- 2410/04 . during regeneration period, e.g. of particle filter
- 2410/06 . at cold starting
- 2410/08 . in case of clogging, e.g. of particle filter
- 2410/10 . for reducing flow resistance, e.g. to obtain more engine power
- 2410/12 . in case of absorption, adsorption or desorption of exhaust gas constituents
- 2410/14 . in case of excessive pressure, e.g. using a safety valve
- 2430/00 Influencing exhaust purification, e.g. starting of catalytic reaction, filter regeneration, or the like, by controlling engine operating characteristics**
- 2430/02 . by cutting out a part of engine cylinders
- 2430/04 . by adding non-fuel substances to combustion air or fuel, e.g. additives
- 2430/06 . by varying fuel-air ratio, e.g. by enriching fuel-air mixture
- 2430/08 . by modifying ignition or injection timing
- 2430/085 . . at least a part of the injection taking place during expansion or exhaust stroke
- 2430/10 . by modifying inlet or exhaust valve timing
- 2450/00 Methods or apparatus for fitting, inserting or repairing different elements**
- 2450/02 . Fitting monolithic blocks into the housing
- 2450/04 . Filling or emptying a chamber with granular material
- 2450/06 . Inserting sound absorbing material into a chamber
- 2450/08 . Repairing the housing or pipe-joints
- 2450/10 . Fitting temporarily exhaust apparatus on exhaust conduit, e.g. in confined environment, garage or the like
- 2450/16 . by using threaded joints
- 2450/18 . by using quick-active type locking mechanisms, e.g. clips
- 2450/20 . by mechanical joints, e.g. by deforming housing, tube, baffle plate or parts thereof
- 2450/22 . by welding or brazing
- 2450/24 . by bolts, screws, rivets or the like
- 2450/26 . by bayonet fittings
- 2450/28 . by using adhesive material, e.g. cement
- 2450/30 . Removable or rechargeable blocks or cartridges, e.g. for filters
- 2450/40 . Retrofitting exhaust apparatus
- 2470/00 Structure or shape of gas passages, pipes or tubes**
- 2470/02 . Tubes being perforated
- 2470/04 . . characterised by shape, disposition or dimensions of apertures
- 2470/06 . Tubes being formed by assembly of stamped or otherwise deformed sheet-metal
- 2470/08 . Gas passages being formed between the walls of an outer shell and an inner chamber
- 2470/10 . Tubes having non-circular cross section
- 2470/12 . Tubes being corrugated
- 2470/14 . Plurality of outlet tubes, e.g. in parallel or with different length
- 2470/16 . Plurality of inlet tubes, e.g. discharging into different chambers
- 2470/18 . the axis of inlet or outlet tubes being other than the longitudinal axis of apparatus
- 2470/20 . Dimensional characteristics of tubes, e.g. length, diameter
- 2470/22 . Inlet and outlet tubes being positioned on the same side of the apparatus
- 2470/24 . Concentric tubes or tubes being concentric to housing, e.g. telescopically assembled
- 2470/26 . Tubes being formed by extrusion, drawing or rolling
- 2470/28 . Tubes being formed by moulding or casting x
- 2470/30 . Tubes with restrictions, i.e. venturi or the like, e.g. for sucking air or measuring mass flow
- 2490/00 Structure, disposition or shape of gas-chambers**
- 2490/02 . Two or more expansion chambers in series connected by means of tubes
- 2490/04 . . the gases flowing longitudinally from inlet to outlet only in one direction
- 2490/06 . . the gases flowing longitudinally from inlet to outlet in opposite directions
- 2490/08 . Two or more expansion chambers in series separated by apertured walls only
- 2490/10 . Two or more expansion chambers in parallel
- 2490/12 . Chambers having variable volumes
- 2490/14 . Dead or resonance chambers connected to gas flow tube by relatively short side-tubes
- 2490/15 . Plurality of resonance or dead chambers
- 2490/155 . . being disposed one after the other in flow direction
- 2490/16 . Chambers with particular shapes, e.g. spherical
- 2490/18 . Dimensional characteristics of gas chambers
- 2490/20 . Chambers being formed inside the exhaust pipe without enlargement of the cross section of the pipe, e.g. resonance chambers
- 2510/00 Surface coverings**
- 2510/02 . for thermal insulation
- 2510/04 . for sound absorption
- 2510/06 . for exhaust purification, e.g. catalytic reaction
- 2510/061 . . usable with leaded fuels
- 2510/063 . . zeolites
- 2510/065 . . for reducing soot ignition temperature
- 2510/067 . . usable with sulfurised fuels
- 2510/068 . . characterised by the distribution of the catalytic coatings
- 2510/0682 . . . having a discontinuous, uneven or partially overlapping coating of catalytic material, e.g. higher amount of material upstream than downstream or vice versa
- 2510/0684 . . . having more than one coating layer, e.g. multi-layered coatings
- 2510/08 . for corrosion prevention
- 2510/10 . for preventing carbon deposits, e.g. chromium
- 2510/12 . for smell removal
- 2510/14 . for dehydrating
- 2530/00 Selection of materials for tubes, chambers or housings**
- 2530/02 . Corrosion resistive metals
- 2530/04 . . Steel alloys, e.g. stainless steel
- 2530/06 . Aluminium or alloys thereof
- 2530/18 . Plastics material, e.g. polyester resin
- 2530/20 . . reinforced with mineral or metallic fibres
- 2530/22 . Flexible elastomeric material
- 2530/24 . Sintered porous material, e.g. bronze, aluminium or the like

2530/26	. Multi-layered walls	2590/022	. . for jetskis
2550/00	Monitoring or diagnosing the deterioration of exhaust systems	2590/04	. for motorcycles
2550/02	. Catalytic activity of catalytic converters	2590/06	. for hand-held tools or portables devices
2550/03	. of sorbing activity of adsorbents or absorbents	2590/08	. for heavy duty applications, e.g. trucks, buses, tractors, locomotives
2550/04	. Filtering activity of particulate filters	2590/10	. for stationary applications
2550/05	. Systems for adding substances into exhaust	2590/11	. for hybrid vehicles
2550/06	. By-pass systems	2610/00	Adding substances to exhaust gases
2550/10	. . of catalytic converters	2610/01	. the substance being catalytic material in liquid form
2550/12	. . of particulate filters	2610/02	. the substance being ammonia or urea
2550/14	. Systems for adding secondary air into exhaust	2610/03	. the substance being hydrocarbons, e.g. engine fuel
2550/20	. Monitoring artificially aged exhaust systems	2610/04	. the substance being hydrogen
2550/22	. of electric heaters for exhaust systems or their power supply	2610/05	. the substance being carbon monoxide
2550/24	. Determining the presence or absence of an exhaust treating device	2610/06	. the substance being in the gaseous form
2560/00	Exhaust systems with means for detecting or measuring exhaust gas components or characteristics	2610/08	. with prior mixing of the substances with a gas, e.g. air
2560/02	. the means being an exhaust gas sensor	2610/085	. . Controlling the air supply
2560/021	. . for measuring or detecting ammonia NH ₃	2610/10	. the substance being heated, e.g. by heating tank or supply line of the added substance
2560/022	. . for measuring or detecting CO or CO ₂	2610/102	. . after addition to exhaust gases, e.g. by a passively or actively heated surface in the exhaust conduit
2560/023	. . for measuring or detecting HC	2610/105	. . Control thereof
2560/024	. . for measuring or detecting hydrogen H ₂	2610/107	. . using glow plug heating elements
2560/025	. . for measuring or detecting O ₂ , e.g. lambda sensors	2610/11	. the substance or part of the dosing system being cooled
2560/026	. . for measuring or detecting NOx	2610/12	. the substance being in solid form, e.g. pellets or powder
2560/027	. . for measuring or detecting SOx	2610/14	. Arrangements for the supply of substances, e.g. conduits
2560/028	. . for measuring or detecting humidity or water	2610/1406	. . Storage means for substances, e.g. tanks or reservoirs
2560/05	. the means being a particulate sensor	2610/1413	. . . Inlet and filling arrangements therefore
2560/06	. the means being a temperature sensor	2610/142	. . . Controlling the filling of the tank
2560/07	. the means being an exhaust gas flow rate or velocity meter or sensor, intake flow meters only when exclusively used to determine exhaust gas parameters	2610/1426	. . Filtration means
2560/08	. the means being a pressure sensor	2610/1433	. . Pumps
2560/12	. Other sensor principles, e.g. using electro conductivity of substrate or radio frequency	2610/144	. . . Control thereof
2560/14	. having more than one sensor of one kind	2610/1446	. . Means for damping of pressure fluctuations in the delivery system, e.g. by puffer volumes or throttling
2560/20	. Sensor having heating means	2610/1453	. . Sprayers or atomisers; Arrangement thereof in the exhaust apparatus
2570/00	Exhaust treating apparatus eliminating, absorbing or adsorbing specific elements or compounds	2610/146	. . . Control thereof, e.g. control of injectors or injection valves
2570/02	. Lead	2610/1466	. . Means for venting air out of conduits or tanks
2570/04	. Sulfur or sulfur oxides	2610/1473	. . Overflow or return means for the substances, e.g. conduits or valves for the return path
2570/06	. Zinc	2610/148	. . Arrangement of sensors
2570/08	. Phosphorus	2610/1486	. . Means to prevent the substance from freezing
2570/10	. Carbon or carbon oxides	2610/1493	. . Purging the reducing agent out of the conduits or nozzle
2570/12	. Hydrocarbons	2900/00	Details of electrical control or of the monitoring of the exhaust gas treating apparatus
2570/14	. Nitrogen oxides	2900/04	. Methods of control or diagnosing
2570/145	. . Dinitrogen oxide	2900/0402	. . using adaptive learning
2570/16	. Oxygen	2900/0404	. . using a data filter
2570/18	. Ammonia	2900/0406	. . using a model with a division of the catalyst or filter in several cells
2570/20	. Formaldehyde	2900/0408	. . using a feed-back loop
2570/22	. Water or humidity	2900/0411	. . using a feed-forward control
2570/24	. Hydrogen sulfide (H ₂ S)	2900/0412	. . using pre-calibrated maps, tables or charts
2590/00	Exhaust or silencing apparatus adapted to particular use, e.g. for military applications, airplanes, submarines	2900/0414	. . using a state observer
2590/02	. for marine vessels or naval applications		
2590/021	. . for outboard engines		

2900/0416	. .	using the state of a sensor, e.g. of an exhaust gas sensor
2900/0418	. .	using integration or an accumulated value within an elapsed period
2900/0421	. .	using an increment counter when a predetermined event occurs
2900/0422	. .	measuring the elapsed time
2900/06	.	Parameters used for exhaust control or diagnosing
2900/0601	. .	being estimated
2900/0602	. .	Electrical exhaust heater signals
2900/08	. .	said parameters being related to the engine
2900/10	. .	said parameters being related to the vehicle or its components
2900/102	. . .	Travelling distance
2900/104	. . .	Battery status
2900/12	. .	said parameters being related to the vehicle exterior
2900/14	. .	said parameters being related to the exhaust gas
2900/1402	. . .	Exhaust gas composition
2900/1404	. . .	Exhaust gas temperature
2900/1406	. . .	Exhaust gas pressure
2900/1411	. . .	Exhaust gas flow rate, e.g. mass flow rate or volumetric flow rate
2900/16	. .	said parameters being related to the exhaust apparatus, e.g. particulate filter or catalyst
2900/1602	. . .	Temperature of exhaust gas apparatus
2900/1606	. . .	Particle filter loading or soot amount
2900/1611	. . .	Particle filter ash amount
2900/1612	. . .	SOx amount trapped in catalyst
2900/1614	. . .	NOx amount trapped in catalyst
2900/1616	. . .	NH ₃ -slip from catalyst
2900/1618	. . .	HC-slip from catalyst
2900/1621	. . .	Catalyst conversion efficiency
2900/1622	. . .	Catalyst reducing agent absorption capacity or consumption amount
2900/1624	. . .	Catalyst oxygen storage capacity
2900/1626	. . .	Catalyst activation temperature
2900/1628	. . .	Moisture amount in exhaust apparatus
2900/1631	. . .	Heat amount provided to exhaust apparatus
2900/18	. .	said parameters being related to the system for adding a substance into the exhaust
2900/1804	. . .	Properties of secondary air added directly to the exhaust
2900/1806	. . .	Properties of reducing agent or dosing system
2900/1808	. . . .	Pressure
2900/1811	. . . .	Temperature
2900/1812	. . . .	Flow rate
2900/1814	. . . .	Tank level
2900/1818	. . . .	Concentration of the reducing agent
2900/1821	. . . .	Injector parameters
2900/1822	. . . .	Pump parameters
2900/1824	. . . .	Properties of the air to be mixed with added substances, e.g. air pressure or air temperature