CPC COOPERATIVE PATENT CLASSIFICATION

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).

Guidance heading:

F01N 1/00 **Silencing apparatus characterised by method of silencing** { by cooling F01N 3/02 ; using liquids F01N 3/04 }

F01N 1/003 . { by using dead chambers communicating with gas flow passages (resonance chambers F01N 1/02 ; chambers containing sound-absorbing materials F01N 1/24) }

F01N 1/006 . . { comprising at least one perforated tube extending from inlet to outlet of the silencer }

F01N 1/02 . by using resonance

F01N 1/023 . . { Helmholtz resonators }

F01N 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 }

F01N 1/04 . . having sound-absorbing materials in resonance chambers

F01N 1/06 . by using interference effect

F01N 1/065 . . { by using an active noise source, e.g. speakers }

F01N 1/08 . by reducing exhaust energy by throttling or whirling

F01N 1/081 . . { by passing the gases through a mass of particles }

F01N 1/082 . . { the gases passing through porous members (F01N 1/081 takes precedence) }

F01N 1/083 . . { using transversal baffles defining a tortuous path for the gases or successively throttling gas flow }

F01N 1/084 . . { the gases flowing through the silencer two or more times longitudinally in opposite directions, e.g. using parallel or concentric tubes }

F01N 1/085 . . { using a central core throttling gas passage }

F01N 1/086 . . { having means to impart whirling motion to the gases (with helically or spirally shaped channels F01N 1/12) }

F01N 1/087 . . . { using tangential inlets into a circular chamber }

F01N 1/088 . . . { using vanes arranged on gas flow path or gas flow tubes with tangentially directed apertures }

F01N 1/089 . . { using two or more expansion chambers in series (F01N 1/083 , F01N 1/084 , F01N 1/086 take precedence) }

F01N 1/10 . . in combination with sound-absorbing materials (F01N 1/125 takes precedence)

F01N 1/12 . . using spirally or helically shaped channels (cyclones B04C)

F01N 1/125 . . . { in combination with sound-absorbing materials }

F01N 1/14 . by adding air to exhaust gases { (in tailpipes F01N 13/082 , F01N 13/20) }

F01N 1/16 . by using movable parts

F01N 1/161 . . { for adjusting resonance or dead chambers or passages to resonance or dead chambers }

F01N 1/163 . . . { by means of valves }

F01N 1/165 . . { for adjusting flow area }

F01N 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) }

F01N 1/168 . . { for controlling or modifying silencing characteristics only }

F01N 1/18 . . having rotary movement

F01N 1/20 . . having oscillating or vibrating movement { the parts being resilient walls F01N 1/22 }

F01N 1/22 . . the parts being resilient walls

F01N 1/24 . by using sound-absorbing materials (F01N 1/04 , F01N 1/06 , F01N 1/10 , F01N 1/14 , F01N 1/16 take precedence)

F01N 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 })

F01N 3/005 . { for draining or otherwise eliminating condensates or moisture accumulating in the apparatus (F01N 3/02 takes precedence) } [c0809]

F01N 3/01 . by means of electric or electrostatic separators

F01N 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 })

F01N 3/0205 .. { using heat exchangers }
F01N 3/021 .. by means of filters
F01N 3/0211 ... { Arrangements for mounting filtering elements in housing, e.g. with means for compensating thermal expansion or vibration }
F01N 3/0212 ... { with one or more perforated tubes surrounded by filtering material, e.g. filter candles }
F01N 3/0214 ... { with filters comprising movable parts, e.g. rotating filters }
F01N 3/0215 ... { the filtering elements having the form of disks or plates }
F01N 3/0217 ... { the filtering elements having the form of hollow cylindrical bodies }
F01N 3/0218 ... { the filtering elements being made from spirally-wound filtering material }
F01N 3/022 ... characterised by specially adapted filtering structure, e.g. honeycomb, mesh or fibrous
F01N 3/0222 .... { the structure being monolithic, e.g. honeycombs }
F01N 3/0224 .... { the structure being granular }
F01N 3/0226 .... { the structure being fibrous }
F01N 3/0228 .... { the structure being made of foamed rubber or plastics }
F01N 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)
F01N 3/0231 .... { using special exhaust apparatus upstream of the filter for producing nitrogen dioxide, e.g. for continuous filter regeneration systems (CRT) }
F01N 3/0232 .... { removing incombustible material from a particle filter, e.g. ash }
F01N 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 }
F01N 3/0234 .... { using heat exchange means in the exhaust line }
F01N 3/0235 .... { using exhaust gas throttling means }
F01N 3/0236 .... { using turbine waste gate valve }
F01N 3/0237 .... { for regenerating ex situ }
F01N 3/0238 .... { for regenerating during engine standstill }
F01N 3/025 .... using fuel burner or by adding fuel to exhaust
F01N 3/0253 ..... { adding fuel to exhaust gases }
F01N 3/0256 ..... { the fuel being ignited by electrical means }
F01N 3/027 .... using electric or magnetic heating means
F01N 3/0275 ..... { using electric discharge means }
F01N 3/028 ..... using microwaves
F01N 3/029 .... by adding non-fuel substances to exhaust
F01N 3/0293 ..... { injecting substances in exhaust stream }
F01N 3/0296 ..... { having means for preheating additional substances }
F01N 3/031 ... having means for by-passing filters, e.g. when clogged or during cold engine start
F01N 3/032 .... during filter regeneration only
F01N 3/033 ... in combination with other devices { with adsorbents or absorbents F01N 3/0821 }
F01N 3/0335 .... { with exhaust silencers in a single housing }
F01N 3/035 .... with catalytic reactors, { e.g. catalysed diesel particulate filters }

F01N 3/037 .. by means of inertial or centrifugal separators, e.g. of cyclone type, optionally combined or associated with agglomerators

F01N 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

F01N 3/04 .. using liquids

F01N 3/043 ... { without contact between liquid and exhaust gases }

F01N 3/046 .... { Exhaust manifolds with cooling jacket }

F01N 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 })

F01N 3/055 ... { without contact between air and exhaust gases }

F01N 3/06 . for extinguishing sparks

F01N 3/08 . for rendering innocuous (using electric or electrostatic separators F01N 3/01 ; chemical aspects B01D 53/92)

F01N 3/0807 .. { by using absorbents or adsorbents }

F01N 3/0814 ... { combined with catalytic converters, e.g. NOx absorption/storage reduction catalysts }

F01N 3/0821 ... { combined with particulate filters (catalysed diesel particulate filters F01N 3/035) }

F01N 3/0828 ... { characterised by the absorbed or adsorbed substances }

F01N 3/0835 .... { Hydrocarbons }

F01N 3/0842 .... { Nitrogen oxides }

F01N 3/085 .... { Sulfur or sulfur oxides }

F01N 3/0857 .... { Carbon oxides }

F01N 3/0864 .... { Oxygen }

F01N 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) }

F01N 3/0878 .... { Bypassing absorbents or adsorbents }

F01N 3/0885 .... { Regeneration of deteriorated absorbents or adsorbents, e.g. desulfurization of NOx traps }

F01N 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) }

F01N 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)

WARNING

New subgroups of F01N 3/10 are not complete pending a reorganisation

F01N 3/101 ... { Three-way catalysts }

F01N 3/103 ... { Oxidation catalysts for HC and CO only }

F01N 3/105 ... { General auxiliary catalysts, e.g. upstream or downstream of the main catalyst }

F01N 3/106 .... { Auxiliary oxidation catalysts }

F01N 3/108 .... { Auxiliary reduction catalysts }

F01N 3/18 ... characterised by methods of operation ; Regulation

F01N 3/20 .... specially adapted for catalytic conversion; { Methods of operation or regulation of catalytic converters } (F01N 3/22 takes precedence)

F01N 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) }

F01N 3/2013 ..... { using electric or magnetic heating means }

F01N 3/202 ..... { using microwaves }

F01N 3/2026 ..... { directly electrifying the catalyst substrate, i.e. heating the electrically conductive catalyst substrate by joule effect }

F01N 3/2033 ..... { using a fuel burner or introducing fuel into exhaust duct }

F01N 3/204 ..... { using an exhaust gas igniter, e.g. a spark or glow plug, without introducing fuel into exhaust duct }

F01N 3/2046 ..... { Periodically cooling catalytic reactors }

F01N 3/2053 ..... { By-passing catalytic reactors, e.g. to prevent overheating }

F01N 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) }

F01N 3/2066 ..... { Selective catalytic reduction (SCR) }

WARNING

This subgroup is not complete pending a reorganisation. See also group F01N 3/206 for documents published before March 2004.

F01N 3/2073 ..... { with means for generating a reducing substance from the exhaust gases }

F01N 3/208 ..... { Control of selective catalytic reduction (SCR), e.g. dosing of reducing agent }

F01N 3/2086 ..... { Activating the catalyst by light, photo-catalysts }

F01N 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 }

F01N 3/22 .... Regulation of additional air supply only, e.g. using by-passes or variable air pump drives

F01N 3/222 ..... { using electric valves only }

F01N 3/225 ..... { Electric control of additional air supply }

F01N 3/227 ..... { using pneumatically operated valves, e.g. membrane valves }

F01N 3/24 ... characterised by constructional aspects of converting apparatus (filtering in combination with catalytic reactors F01N 3/035)

F01N 3/26 .... Construction of thermal reactors

F01N 3/28 .... Construction of catalytic reactors

F01N 3/2803 ..... { characterised by structure, by material or by manufacturing of catalyst support }

F01N 3/2807 ..... { Metal other than sintered metal (F01N 3/2832 and F01N 3/2835 take precedence) }

F01N 3/281 ..... { Metallic honeycomb monoliths made of stacked or rolled sheets,

foils or plates }

F01N 3/2814 . . . . . { all sheets, plates or foils being corrugated }

F01N 3/2817 . . . . . { only with non-corrugated sheets, plates or foils }

F01N 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 }

F01N 3/2825 . . . . . { Ceramics (F01N 3/2832 , F01N 3/2835 take precedence) }

F01N 3/2828 . . . . . { Ceramic multi-channel monoliths, e.g. honeycombs }

F01N 3/2832 . . . . . { granular, e.g. pellets }

F01N 3/2835 . . . . . { fibrous }

F01N 3/2839 . . . . . { Arrangements for mounting catalyst support in housing, e.g. with means for compensating thermal expansion or vibration }

F01N 3/2842 . . . . . { specially adapted for monolithic supports, e.g. of honeycomb type (F01N 3/2853 to F01N 3/2871 take precedence) }

F01N 3/2846 . . . . . { specially adapted for granular supports, e.g. pellets }

F01N 3/285 . . . . . { specially adapted for fibrous supports, e.g. held in place by screens }

F01N 3/2853 . . . . . { using mats or gaskets between catalyst body or housing }

F01N 3/2857 . . . . . { the mats or gaskets being at least partially made of intumescent material, e.g. unexpanded vermiculite }

F01N 3/286 . . . . . { the mats or gaskets having corrugations or cavities }

WARNING

This group is not complete pending a reorganisation. See also F01N 3/2853 and F01N 3/2857

F01N 3/2864 . . . . . { the mats or gaskets comprising two or more insulation layers }

F01N 3/2867 . . . . . { the mats or gaskets being placed at the front or end face of catalyst body }

WARNING

This group is not complete pending a reorganisation. See also F01N 3/2853 and F01N 3/2857

F01N 3/2871 . . . . . { the mats or gaskets having an additional, e.g. non-insulating or non-cushioning layer, a metal foil or an adhesive layer }

WARNING

This group is not complete pending a reorganisation. See also F01N 3/2853 and F01N 3/2857

F01N 3/2875 . . . . . { by using elastic means, e.g. spring leaves, for retaining catalyst body in the housing (F01N 3/2853 to F01N 3/2871 take precedence) }

F01N 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 }

F01N 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) }

F01N 3/2885 . . . . . { with exhaust silencers in a single housing }

F01N 3/2889 . . . . . { with heat exchangers in a single housing }

F01N 3/2892 . . . . . { Exhaust flow directors or the like, e.g. upstream of catalytic device }

F01N 3/2896 . . . . . { Liquid catalyst carrier }

F01N 3/30 . . . . Arrangements for supply of additional air (regulation, e.g. using air by-passes or variable air pump drives F01N 3/22)

F01N 3/303 . . . . . { Filtering additional air }

F01N 3/306 . . . . . { Preheating additional air }

F01N 3/32 . . . . . using air pump (using jet air pumps F01N 3/34 ; pumps in general F04)

F01N 3/323 . . . . . { Electrically driven air pumps }

F01N 3/326 . . . . . { Engine-driven air pumps }

F01N 3/34 . . . . . using air conduits or jet air pumps, e.g. near the engine exhaust port

F01N 3/36 . . . . Arrangements for supply of additional fuel

F01N 3/38 . . . . Arrangements for igniting

F01N 5/00 **Exhaust or silencing apparatus combined or associated with devices profiting by exhaust energy** (predominant aspects of such devices, see the relevant classes for the devices; using kinetic or wave energy of exhaust gases in exhaust systems for charging F02B)

NOTE

- in this group the following indexing code is used: F02M 2700/31

F01N 5/02 . the devices using heat

F01N 5/025 . . { the device being thermoelectric generators }

WARNING

This group is not complete pending a reorganisation. See also F01N 5/02

F01N 5/04 . the devices using kinetic energy

F01N 9/00 **Electrical control of exhaust gas treating apparatus** (monitoring or diagnostic devices for exhaust-gas treatment apparatus F01N 11/00 ; { electrical control of supply of combustible mixture or its constituents in relation with the state of the exhaust gas treating apparatus F02D 41/0235 } ; controlling combustion engines conjoint electrical control of two or more combustion engine functions F02D 43/00)

F01N 9/002 . { of filter regeneration, e.g. detection of clogging }

F01N 9/005 . { using models instead of sensors to determine operating characteristics of exhaust systems, e.g. calculating catalyst temperature instead of measuring it directly }

F01N 9/007 . { Storing data relevant to operation of exhaust systems for later retrieval and analysis, e.g. to research exhaust system malfunctions }

F01N 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) }

F01N 11/002 . { the diagnostic devices measuring or estimating temperature or pressure in, or downstream of the exhaust apparatus }

F01N 11/005 . . { the temperature or pressure being estimated, e.g. by means of a theoretical model }

F01N 11/007 . { the diagnostic devices measuring oxygen or air concentration downstream of the exhaust apparatus }

Guidance heading:

F01N 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 to F01N 5/00 , F01N 9/00 , F01N 11/00 }

F01N 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) }

F01N 13/002 . { Apparatus adapted for particular uses, e.g. for portable devices driven by machines or engines }

F01N 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) }

F01N 13/005 . . { with parts constructed of non-metallic material, e.g. of rubber }

F01N 13/007 . { Apparatus used as intake or exhaust silencer (silencing methods F01N 1/00 ; intake silencers F02M 35/12) }

F01N 13/008 . { Mounting or arrangement of exhaust sensors in or on exhaust apparatus (sensor arrangements for engine control F02D 41/1439) }

F01N 13/02 . having two or more separate silencers in series

F01N 13/04 . having two or more silencers in parallel e.g. having interconnections for multi-cylinder engines

F01N 13/06 . specially adapted for star-arrangement of cylinders, e.g. exhaust manifolds

F01N 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 })

F01N 13/082 . . { of tailpipe, e.g. with means for mixing air with exhaust for exhaust cooling, dilution or evacuation (F01N 13/20 takes precedence) }

F01N 13/085 . . { having means preventing foreign matter from entering exhaust conduit }

F01N 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) }

F01N 13/10 . . of exhaust manifolds { (with cooling jacket F01N 3/046) }

F01N 13/102 . . . { having thermal insulation }

F01N 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 }

F01N 13/107 . . . { More than one exhaust manifold or exhaust collector }

F01N 13/12 . specially adapted for submerged exhausting

F01N 13/14 . having thermal insulation { (exhaust manifolds F01N 13/102) }

F01N 13/141 . . { Double-walled exhaust pipes or housings }

F01N 13/143 . . . { with air filling the space between both walls }

F01N 13/145 . . . { with gas other than air filling the space between both walls }

F01N 13/146 . . . { with vacuum in the space between both walls }

F01N 13/148 . . { Multiple layers of insulating material }

F01N 13/16 . Selection of particular materials

F01N 13/18 . Construction facilitating manufacture, assembly, or disassembly

F01N 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) }

F01N 13/1811 . . . { with means permitting relative movement, e.g. compensation of thermal expansion or vibration }

F01N 13/1816 . . . . { the pipe sections being joined together by flexible tubular elements only, e.g. using bellows or strip-wound pipes }

F01N 13/1822 . . . . { for fixing exhaust pipes or devices to vehicle body }

F01N 13/1827 . . . { Sealings specially adapted for exhaust systems (sealings in general F16J 15/00) }

F01N 13/1833 . . { specially adapted for small internal combustion engines, e.g. used in model applications }

F01N 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 }

F01N 13/1844 . . . { Mechanical joints }

F01N 13/185 . . . . { the connection being realised by deforming housing, tube, baffle, plate, or parts thereof }

F01N 13/1855 . . . . { the connection being realised by using bolts, screws, rivets or the like }

F01N 13/1861 . . { the assembly using parts formed by casting or moulding }

F01N 13/1866 . . . { the channels or tubes thereof being made integrally with the housing }

F01N 13/1872 . . { the assembly using stamp-formed parts or otherwise deformed sheet-metal }

F01N 13/1877 . . . { the channels or tubes thereof being made integrally with the housing }

F01N 13/1883 . . { manufactured by hydroforming }

F01N 13/1888 . . { the housing of the assembly consisting of two or more parts, e.g. two half-shells }

F01N 13/1894 . . . { the parts being assembled in longitudinal direction }

F01N 13/20 . having flared outlets, e.g. of fish-tail shape

Guidance heading:

F01N 2013/00 **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 to F01N 5/00 , F01N 9/00 , F01N 11/00 }

F01N 2013/02 . having two or more separate silencers in series

F01N 2013/023 . . with two or more of the same type of purifying devices in series

F01N 2013/026 . . in a single housing

F01N 2013/04 . having two or more silencers in parallel e.g. having interconnections for multi-cylinder engines

F01N 2013/045 . . in a single housing

Guidance heading:

F01N 2210/00 **Combination of methods of silencing**

F01N 2210/02 . Resonance and interference

F01N 2210/04 . Throttling-expansion and resonance

F01N 2210/06 . Throttling-expansion and interference

Guidance heading:

F01N 2230/00 **Combination of silencers and other devices**

F01N 2230/02 . Exhaust filters

F01N 2230/04 . Catalytic converters

F01N 2230/06 . Spark arresters

F01N 2230/08 . Thermal reactors

F01N 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**

F01N 2240/02 . a heat exchanger

F01N 2240/04 . an electric, e.g. electrostatic, device other than a heater

F01N 2240/05 . a magnetic, e.g. electromagnetic, device other than a valve

F01N 2240/06 . an inertial, e.g. centrifugal, device

F01N 2240/10 . a heat accumulator

F01N 2240/12 . a thermal reactor

F01N 2240/14 . a fuel burner

F01N 2240/16 . an electric heater, i.e. a resistance heater

F01N 2240/18 . an adsorber or absorber

F01N 2240/20 . a flow director or deflector

F01N 2240/22 . a condensation chamber

F01N 2240/25 . an ammonia generator

F01N 2240/26 . an exhaust gas reservoir, e.g. emission buffer

F01N 2240/28 . a plasma reactor

F01N 2240/30 . a fuel reformer

F01N 2240/32 . a fuel cell

F01N 2240/34 . an electrolyser

F01N 2240/36 . an exhaust flap

F01N 2240/38 . an ozone (O3) generator, e.g. for adding ozone after generation of ozone from air

F01N 2240/40 . a hydrolysis catalyst

F01N 2250/00 Combinations of different methods of purification

F01N 2250/02 . filtering and catalytic conversion

F01N 2250/04 . afterburning and catalytic conversion

F01N 2250/06 . afterburning and filtering

F01N 2250/08 . filtering and inertial particulate separation

F01N 2250/10 . cooling and filtering

F01N 2250/12 . absorption or adsorption, and catalytic conversion

F01N 2250/14 . absorption or adsorption, and filtering

F01N 2260/00 Exhaust treating devices having provisions not otherwise provided for

F01N 2260/02 . for cooling the device

F01N 2260/022 . . using air
F01N 2260/024 . . using a liquid

F01N 2260/04 . for regeneration or reactivation, e.g. of catalyst

F01N 2260/06 . for improving exhaust evacuation or circulation, or reducing back-pressure

F01N 2260/08 . for preventing heat loss or temperature drop, using other means than layers of heat-insulating material

F01N 2260/10 . for avoiding stress caused by expansions or contractions due to temperature variations

F01N 2260/12 . for resisting high pressure

F01N 2260/14 . for modifying or adapting flow area or back-pressure

F01N 2260/16 . for reducing exhaust flow pulsations

F01N 2260/18 . for improving rigidity, e.g. by wings, ribs

F01N 2260/20 . for heat or sound protection, e.g. using a shield or specially shaped outer surface of exhaust device

F01N 2260/22 . for preventing theft of exhaust parts or devices, e.g. anti-theft arrangements

F01N 2260/24 . for identifying exhaust parts or devices, e.g. by labels, stickers or directly printing

F01N 2260/26 . for preventing enter of dirt into the device

F01N 2270/00 Mixing air with exhaust gases

F01N 2270/02 . for cooling exhaust gases or the apparatus

F01N 2270/04 . for afterburning

F01N 2270/06 . for silencing

F01N 2270/08 . for evacuation of exhaust gases, e.g. in tail-pipes

F01N 2270/10 . for rendering exhaust innocuous, e.g. by dilution

F01N 2290/00 Movable parts or members in exhaust systems for other than for control purposes

F01N 2290/02 . with continuous rotary movement
F01N 2290/04 . . driven by exhaust gases
F01N 2290/06 . . driven by auxiliary drive

F01N 2290/08 . with oscillating or vibrating movement
F01N 2290/10 . . actuated by pressure of exhaust gases, e.g. exhaust pulses

F01N 2310/00 **Selection of sound absorbing or insulating material**

F01N 2310/02 . Mineral wool, e.g. glass wool, rock wool, asbestos or the like

F01N 2310/04 . Metallic wool, e.g. steel wool, copper wool or the like

F01N 2310/06 . Porous ceramics

F01N 2310/08 . Exfoliated vermiculite, e.g. zonolite, coke, pumice

F01N 2310/10 . Plastic foam

F01N 2310/12 . Granular material

F01N 2310/14 . Wire mesh fabric, woven glass cloth or the like

F01N 2330/00 **Structure of catalyst support or particle filter**

F01N 2330/02 . Metallic plates or honeycombs, e.g. superposed or rolled-up corrugated or otherwise deformed sheet metal

F01N 2330/04 . . Methods of manufacturing

F01N 2330/06 . Ceramic, e.g. monoliths

F01N 2330/08 . Granular material

F01N 2330/10 . Fibrous material, e.g. mineral or metallic wool

F01N 2330/101 . . using binders, e.g. to form a permeable mat, paper or the like

F01N 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

F01N 2330/12 . Metallic wire mesh fabric or knitting

F01N 2330/14 . Sintered material

F01N 2330/18 . Composite material

F01N 2330/20 . Plastics, e.g. polymers, polyester, polyurethane

F01N 2330/22 . Metal foam

F01N 2330/30 . Honeycomb supports characterised by their structural details

F01N 2330/32 . . characterised by the shape, form or number of corrugations of plates, sheets or foils

F01N 2330/321 . . . with two or more different kinds of corrugations in the same substrate

F01N 2330/322 . . . Corrugations of trapezoidal form

F01N 2330/323 . . . Corrugations of saw-tooth or triangular form

F01N 2330/324 . . . Corrugations of rectangular form

F01N 2330/325 . . . Corrugations of omega form
F01N 2330/34 . . with flow channels of polygonal cross section
F01N 2330/36 . . with flow channels formed by tubes
F01N 2330/38 . . flow channels with means to enhance flow mixing, (e.g. protrusions or projections)
F01N 2330/40 . . made of a single sheet, foil or plate
F01N 2330/42 . . made of three or more different sheets, foils or plates stacked one on the other
F01N 2330/44 . . made of stacks of sheets, plates or foils that are folded in S-form
F01N 2330/48 . . characterised by the number of flow passages, e.g. cell density

F01N 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

F01N 2340/00 Dimensional characteristics of the exhaust system, e.g. length, diameter or volume of the apparatus ; Spatial arrangements of exhaust apparatuses

F01N 2340/02 . characterised by the distance of the apparatus to the engine, or the distance between two exhaust treating apparatuses

F01N 2340/04 . characterised by the arrangement of an exhaust pipe, manifold or apparatus in relation to vehicle frame or particular vehicle parts

F01N 2340/06 . characterised by the arrangement of the exhaust apparatus relative to the turbine of a turbocharger

F01N 2350/00 Arrangements for fitting catalyst support or particle filter element in the housing

F01N 2350/02 . Fitting ceramic monoliths in a metallic housing
F01N 2350/04 . . with means compensating thermal expansion
F01N 2350/06 . . with means preventing gas flow by-pass or leakage

F01N 2350/08 . with means for compressing granular material

F01N 2370/00 Selection of materials for exhaust purification

F01N 2370/02 . used in catalytic reactors
F01N 2370/04 . . Zeolitic material

F01N 2370/22 . used in non-catalytic purification apparatus
F01N 2370/24 . . Zeolitic material
F01N 2370/30 . . Materials having magnetic properties

F01N 2370/40 . Activated carbon or charcoal

F01N 2390/00 Arrangements for controlling or regulating exhaust apparatus

F01N 2390/02 . using electric components only

F01N 2390/04 . using electropneumatic components

F01N 2390/06 . using pneumatic components only

F01N 2390/08 . using mechanical components only, e.g. actuated manually

F01N 2410/00 By-passing, at least partially, exhaust from inlet to outlet of apparatus, to atmosphere or to other device

F01N 2410/02 . in case of high temperature, e.g. overheating of catalytic reactor

F01N 2410/03 . in case of low temperature

F01N 2410/04 . during regeneration period, e.g. of particle filter

F01N 2410/06 . at cold starting

F01N 2410/08 . in case of clogging, e.g. of particle filter

F01N 2410/10 . for reducing flow resistance, e.g. to obtain more engine power

F01N 2410/12 . in case of absorption, adsorption or desorption of exhaust gas constituents

F01N 2410/14 . in case of excessive pressure, e.g. using a safety valve

F01N 2430/00 Influencing exhaust purification, e.g. starting of catalytic reaction, filter regeneration, or the like, by controlling engine operating characteristics

F01N 2430/02 . by cutting out a part of engine cylinders

F01N 2430/04 . by adding non-fuel substances to combustion air or fuel, e.g. additives

F01N 2430/06 . by varying fuel-air ratio, e.g. by enriching fuel-air mixture

F01N 2430/08 . by modifying ignition or injection timing

F01N 2430/085 . . at least a part of the injection taking place during expansion or exhaust stroke

F01N 2430/10 . by modifying inlet or exhaust valve timing

F01N 2450/00 Methods or apparatus for fitting, inserting or repairing different elements

F01N 2450/02 . Fitting monolithic blocks into the housing

F01N 2450/04 . Filling or emptying a chamber with granular material

F01N 2450/06 . Inserting sound absorbing material into a chamber

F01N 2450/08 . Repairing the housing or pipe-joints

F01N 2450/10 . Fitting temporarily exhaust apparatus on exhaust conduit, e.g. in confined

environment, garage or the like

F01N 2450/16 . by using threaded joints

F01N 2450/18 . by using quick-active type locking mechanisms, e.g. clips

F01N 2450/20 . by mechanical joints, e.g. by deforming housing, tube, baffle plate or parts thereof

F01N 2450/22 . by welding or brazing

F01N 2450/24 . by bolts, screws, rivets or the like

F01N 2450/26 . by bayonet fittings

F01N 2450/28 . by using adhesive material, e.g. cement

F01N 2450/30 . Removable or rechangeable blocks or cartridges, e.g. for filters

F01N 2450/40 . Retrofitting exhaust apparatus

F01N 2470/00 Structure or shape of gas passages, pipes or tubes

F01N 2470/02 . Tubes being perforated

F01N 2470/04 . . characterised by shape, disposition or dimensions of apertures

F01N 2470/06 . Tubes being formed by assembly of stamped or otherwise deformed sheet-metal

F01N 2470/08 . Gas passages being formed between the walls of an outer shell and an inner chamber

F01N 2470/10 . Tubes having non-circular cross section

F01N 2470/12 . Tubes being corrugated

F01N 2470/14 . Plurality of outlet tubes, e.g. in parallel or with different length

F01N 2470/16 . Plurality of inlet tubes, e.g. discharging into different chambers

F01N 2470/18 . the axis of inlet or outlet tubes being other than the longitudinal axis of apparatus

F01N 2470/20 . Dimensional characteristics of tubes, e.g. length, diameter

F01N 2470/22 . Inlet and outlet tubes being positioned on the same side of the apparatus

F01N 2470/24 . Concentric tubes or tubes being concentric to housing, e.g. telescopically assembled

F01N 2470/26 . Tubes being formed by extrusion, drawing or rolling

F01N 2470/28 . Tubes being formed by moulding or casting x

F01N 2470/30 . Tubes with restrictions, i.e. venturi or the like, e.g. for sucking air or measuring mass flow

F01N 2490/00 **Structure, disposition or shape of gas-chambers**

F01N 2490/02 . Two or more expansion chambers in series connected by means of tubes
F01N 2490/04 . . the gases flowing longitudinally from inlet to outlet only in one direction
F01N 2490/06 . . the gases flowing longitudinally from inlet to outlet in opposite directions

F01N 2490/08 . Two or more expansion chambers in series separated by apertured walls only

F01N 2490/10 . Two or more expansion chambers in parallel

F01N 2490/12 . Chambers having variable volumes

F01N 2490/14 . Dead or resonance chambers connected to gas flow tube by relatively short side-tubes

F01N 2490/15 . Plurality of resonance or dead chambers
F01N 2490/155 . . being disposed one after the other in flow direction

F01N 2490/16 . Chambers with particular shapes, e.g. spherical

F01N 2490/18 . Dimensional characteristics of gas chambers

F01N 2490/20 . Chambers being formed inside the exhaust pipe without enlargement of the cross section of the pipe, e.g. resonance chambers

F01N 2510/00 **Surface coverings**

F01N 2510/02 . for thermal insulation

F01N 2510/04 . for sound absorption

F01N 2510/06 . for exhaust purification, e.g. catalytic reaction
F01N 2510/061 . . usable with leaded fuels
F01N 2510/063 . . zeolites
F01N 2510/065 . . for reducing soot ignition temperature
F01N 2510/067 . . usable with sulfurised fuels
F01N 2510/068 . . characterised by the distribution of the catalytic coatings
F01N 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
F01N 2510/0684 . . . having more than one coating layer, e.g. multi-layered coatings

F01N 2510/08 . for corrosion prevention

F01N 2510/10 . for preventing carbon deposits, e.g. chromium

F01N 2510/12 . for smell removal

F01N 2510/14 . for dehydrating

F01N 2530/00 **Selection of materials for tubes, chambers or housings**

F01N 2530/02 . Corrosion resistive metals
F01N 2530/04 . . Steel alloys, e.g. stainless steel

F01N 2530/06 . Aluminium or alloys thereof

F01N 2530/18 . Plastics material, e.g. polyester resin
F01N 2530/20 . . reinforced with mineral or metallic fibres

F01N 2530/22 . Flexible elastomeric material

F01N 2530/24 . Sintered porous material, e.g. bronze, aluminium or the like

F01N 2530/26 . Multi-layered walls

F01N 2550/00 **Monitoring or diagnosing the deterioration of exhaust systems**

F01N 2550/02 . Catalytic activity of catalytic converters

F01N 2550/03 . of sorbing activity of adsorbents or absorbents

F01N 2550/04 . Filtering activity of particulate filters

F01N 2550/05 . Systems for adding substances into exhaust

F01N 2550/06 . By-pass systems
F01N 2550/10 . . of catalytic converters
F01N 2550/12 . . of particulate filters

F01N 2550/14 . Systems for adding secondary air into exhaust

F01N 2550/20 . Monitoring artificially aged exhaust systems

F01N 2550/22 . of electric heaters for exhaust systems or their power supply

F01N 2550/24 . Determining the presence or absence of an exhaust treating device

F01N 2560/00 **Exhaust systems with means for detecting or measuring exhaust gas components or characteristics**

F01N 2560/02 . the means being an exhaust gas sensor
F01N 2560/021 . . for measuring or detecting ammonia NH3
F01N 2560/022 . . for measuring or detecting CO or CO2
F01N 2560/023 . . for measuring or detecting HC
F01N 2560/024 . . for measuring or detecting hydrogen H2
F01N 2560/025 . . for measuring or detecting O2, e.g. lambda sensors

F01N 2560/026 . . for measuring or detecting NOx
F01N 2560/027 . . for measuring or detecting SOx
F01N 2560/028 . . for measuring or detecting humidity or water

F01N 2560/05 . the means being a particulate sensor

F01N 2560/06 . the means being a temperature sensor

F01N 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

F01N 2560/08 . the means being a pressure sensor

F01N 2560/12 . Other sensor principles, e.g. using electro conductivity of substrate or radio frequency

F01N 2560/14 . having more than one sensor of one kind

F01N 2560/20 . Sensor having heating means

F01N 2570/00 Exhaust treating apparatus eliminating, absorbing or adsorbing specific elements or compounds

F01N 2570/02 . Lead

F01N 2570/04 . Sulfur or sulfur oxides

F01N 2570/06 . Zinc

F01N 2570/08 . Phosphorus

F01N 2570/10 . Carbon or carbon oxides

F01N 2570/12 . Hydrocarbons

F01N 2570/14 . Nitrogen oxides
F01N 2570/145 . . Dinitrogen oxide

F01N 2570/16 . Oxygen

F01N 2570/18 . Ammonia

F01N 2570/20 . Formaldehyde

F01N 2570/22 . Water or humidity

F01N 2570/24 . Hydrogen sulfide (H2S)

F01N 2590/00 Exhaust or silencing apparatus adapted to particular use, e.g. for military applications, airplanes, submarines

F01N 2590/02 . for marine vessels or naval applications

F01N 2590/021 . . for outboard engines
F01N 2590/022 . . for jetskis

F01N 2590/04 . for motorcycles

F01N 2590/06 . for hand-held tools or portables devices

F01N 2590/08 . for heavy duty applications, e.g. trucks, buses, tractors, locomotives

F01N 2590/10 . for stationary applications

F01N 2590/11 . for hybrid vehicles

F01N 2610/00 Adding substances to exhaust gases

F01N 2610/01 . the substance being catalytic material in liquid form

F01N 2610/02 . the substance being ammonia or urea

F01N 2610/03 . the substance being hydrocarbons, e.g. engine fuel

F01N 2610/04 . the substance being hydrogen

F01N 2610/05 . the substance being carbon monoxide

F01N 2610/06 . the substance being in the gaseous form

F01N 2610/08 . with prior mixing of the substances with a gas, e.g. air
F01N 2610/085 . . Controlling the air supply

F01N 2610/10 . the substance being heated, e.g. by heating tank or supply line of the added substance
F01N 2610/102 . . after addition to exhaust gases, e.g. by a passively or actively heated surface in the exhaust conduit
F01N 2610/105 . . Control thereof
F01N 2610/107 . . using glow plug heating elements

F01N 2610/11 . the substance or part of the dosing system being cooled

F01N 2610/12 . the substance being in solid form, e.g. pellets or powder

F01N 2610/14 . Arrangements for the supply of substances, e.g. conduits
F01N 2610/1406 . . Storage means for substances, e.g. tanks or reservoirs
F01N 2610/1413 . . . Inlet and filling arrangements therefore
F01N 2610/142 . . . Controlling the filling of the tank
F01N 2610/1426 . . Filtration means
F01N 2610/1433 . . Pumps
F01N 2610/144 . . . Control thereof
F01N 2610/1446 . . Means for damping of pressure fluctuations in the delivery system, e.g. by puffer

volumes or throttling

F01N 2610/1453 . . Sprayers or atomisers ; Arrangement thereof in the exhaust apparatus

F01N 2610/146 . . . Control thereof, e.g. control of injectors or injection valves

F01N 2610/1466 . . Means for venting air out of conduits or tanks

F01N 2610/1473 . . Overflow or return means for the substances, e.g. conduits or valves for the return path

F01N 2610/148 . . Arrangement of sensors

F01N 2610/1486 . . Means to prevent the substance from freezing

F01N 2610/1493 . . Means for prevention of purging or clogging

Guidance heading:

F01N 2900/00 Details of electrical control or of the monitoring of the exhaust gas treating apparatus

F01N 2900/04 . Methods of control or diagnosing

F01N 2900/0402 . . using adaptive learning

F01N 2900/0404 . . using a data filter

F01N 2900/0406 . . using a model with a division of the catalyst or filter in several cells

F01N 2900/0408 . . using a feed-back loop

F01N 2900/0411 . . using a feed-forward control

F01N 2900/0412 . . using pre-calibrated maps, tables or charts

F01N 2900/0414 . . using a state observer

F01N 2900/0416 . . using the state of a sensor, e.g. of an exhaust gas sensor

F01N 2900/0418 . . using integration or an accumulated value within an elapsed period

F01N 2900/0421 . . using an increment counter when a predetermined event occurs

F01N 2900/0422 . . measuring the elapsed time

F01N 2900/06 . Parameters used for exhaust control or diagnosing

F01N 2900/0601 . . being estimated

F01N 2900/0602 . . Electrical exhaust heater signals

F01N 2900/08 . . said parameters being related to the engine

F01N 2900/10 . . said parameters being related to the vehicle or its components

F01N 2900/102 . . . Travelling distance

F01N 2900/104 . . . Battery status

F01N 2900/12 . . said parameters being related to the vehicle exterior

F01N 2900/14 . . said parameters being related to the exhaust gas

F01N 2900/1402 . . . Exhaust gas composition

F01N 2900/1404 . . . Exhaust gas temperature

F01N 2900/1406 . . . Exhaust gas pressure

F01N 2900/1411 . . . Exhaust gas velocity

F01N 2900/16 . . said parameters being related to the exhaust apparatus, e.g. particulate filter or catalyst

F01N 2900/1602 . . . Temperature of exhaust gas apparatus
F01N 2900/1606 . . . Particle filter loading or soot amount
F01N 2900/1611 . . . Particle filter ash amount
F01N 2900/1612 . . . SOx amount trapped in catalyst
F01N 2900/1614 . . . NOx amount trapped in catalyst
F01N 2900/1616 . . . NH3-slip from catalyst
F01N 2900/1618 . . . HC-slip from catalyst
F01N 2900/1621 . . . Catalyst conversion efficiency
F01N 2900/1622 . . . Catalyst reducing agent absorption capacity or consumption amount
F01N 2900/1624 . . . Catalyst oxygen storage capacity
F01N 2900/1626 . . . Catalyst activation temperature
F01N 2900/1628 . . . Moisture amount in exhaust apparatus
F01N 2900/1631 . . . Heat amount provided to exhaust apparatus
F01N 2900/18 . . said parameters being related to the system for adding a substance into the exhaust
F01N 2900/1804 . . . Properties of secondary air added directly to the exhaust
F01N 2900/1806 . . . Properties of reducing agent or dosing system
F01N 2900/1808 . . . . Pressure
F01N 2900/1811 . . . . Temperature
F01N 2900/1812 . . . . Flow rate
F01N 2900/1814 . . . . Tank level
F01N 2900/1818 . . . . Concentration of the reducing agent
F01N 2900/1821 . . . . Injector parameters
F01N 2900/1822 . . . . Pump parameters
F01N 2900/1824 . . . . Properties of the air to be mixed with added substances, e.g. air pressure or air temperature