

**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).

**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)}
- 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 <a href="#">F02D 41/0235</a> )
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 <a href="#">F01N 3/0821</a> )}
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](#))
- 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} ( <a href="#">F01N 3/22</a> 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 <a href="#">F02D 41/0235</a> )}
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 ( <a href="#">F01N 3/2066</a> takes precedence)}
F01N 3/2066	.....	{Selective catalytic reduction [SCR]}
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 ( <a href="#">filtering in combination with catalytic reactors</a> <a href="#">F01N 3/035</a> )
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 ( <a href="#">F01N 3/2832</a> and <a href="#">F01N 3/2835</a> 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 ( <a href="#">F01N 3/2832</a> , <a href="#">F01N 3/2835</a> 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 ( <a href="#">F01N 3/2853</a> to <a href="#">F01N 3/2871</a> 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}
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}
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}
F01N 3/2875	.....	{by using elastic means, e.g. spring leaves, for retaining catalyst body in the housing ( <a href="#">F01N 3/2853</a> to <a href="#">F01N 3/2871</a> 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 <a href="#">F01N 3/0814</a> ; combined with particulate filters <a href="#">F01N 3/035</a> )}
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 <a href="#">F01N 3/22</a> )
F01N 3/303	.....	{Filtering additional air}
F01N 3/306	.....	{Preheating additional air}
F01N 3/32	.....	using air pump (using jet air pumps <a href="#">F01N 3/34</a> ; pumps in general <a href="#">F04</a> )
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
<b>F01N 5/00</b>	<b>Exhaust or silencing apparatus combined or associated with devices profiting by exhaust energy</b> (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 <a href="#">F02B</a> )
F01N 5/02	. the devices using heat
F01N 5/025	. . {the device being thermoelectric generators}
F01N 5/04	. the devices using kinetic energy
<b>F01N 9/00</b>	<b>Electrical control of exhaust gas treating apparatus</b> (monitoring or diagnostic devices for exhaust-gas treatment apparatus <a href="#">F01N 11/00</a> ; { electrical control of supply of combustible mixture or its constituents in relation with the state of the exhaust gas treating apparatus <a href="#">F02D 41/0235</a> } ; controlling combustion engines conjoint electrical control of two or more combustion engine functions <a href="#">F02D 43/00</a> )
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}
<b>F01N 11/00</b>	<b>Monitoring or diagnostic devices for exhaust-gas treatment apparatus, {e.g. for catalytic activity</b> (safety, indicating or supervising devices for internal combustion engines <a href="#">F02B 77/08</a> ; testing of machines <a href="#">G01M 13/00</a> )}
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}
<b>F01N 13/00</b>	<b>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 <a href="#">F01N 1/00</a> to <a href="#">F01N 5/00</a> , <a href="#">F01N 9/00</a> , <a href="#">F01N 11/00</a>}</b>
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 <a href="#">B60K 13/06</a> )}
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 <a href="#">F01N 13/12</a> ; treating exhaust by using liquids <a href="#">F01N 3/04</a> )}
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 <a href="#">F01N 1/00</a> ; intake silencers <a href="#">F02M 35/12</a> )}
F01N 13/008	. {Mounting or arrangement of exhaust sensors in or on exhaust apparatus (sensor arrangements for engine control <a href="#">F02D 41/1439</a> )}
F01N 13/009	. {having two or more separate purifying devices arranged in series}



- F01N 13/0093 . . {the purifying devices are of the same type}
- F01N 13/0097 . . {the purifying devices are arranged in a single housing}
- F01N 13/011 . {having two or more purifying devices arranged in parallel}
- F01N 13/017 . . {the purifying devices are arranged in a single housing}
- 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

#### **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

#### **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 (O<sub>3</sub>) 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
<b>F01N 2340/00</b>	<b>Dimensional characteristics of the exhaust system, e.g. length, diameter or volume of the apparatus; Spatial arrangements of exhaust apparatuses</b>
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
<b>F01N 2350/00</b>	<b>Arrangements for fitting catalyst support or particle filter element in the housing</b>
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
<b>F01N 2370/00</b>	<b>Selection of materials for exhaust purification</b>
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
<b>F01N 2390/00</b>	<b>Arrangements for controlling or regulating exhaust apparatus</b>
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
<b>F01N 2410/00</b>	<b>By-passing, at least partially, exhaust from inlet to outlet of apparatus, to atmosphere or to other device</b>
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 rechargeable 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  $\text{NH}_3$
- F01N 2560/022 . . for measuring or detecting CO or  $\text{CO}_2$
- F01N 2560/023 . . for measuring or detecting HC
- F01N 2560/024 . . for measuring or detecting hydrogen  $\text{H}_2$
- F01N 2560/025 . . for measuring or detecting  $\text{O}_2$ , 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 (H<sub>2</sub>S)

**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 clogging, e.g. purging
- 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	...	NH <sub>3</sub> -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