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(54) AFTERTREATMENT SYSTEM

(57) An aftertreatment system (202) for treating a high-volume exhaust flow is provided. The aftertreatment system (202) includes a first module (224) and a second module (240). The aftertreatment system (202) also includes a main inlet conduit (204), a first inlet conduit (208), a second inlet conduit (210), a first outlet conduit (256), and a second outlet conduit (258). Each of the first inlet conduit (208) and the second inlet conduit (210) is adapted to split the exhaust flow downstream of the main inlet conduit (204) into a first stream (220) and a second stream (222) flowing therethrough respectively. The splitting of the exhaust flow is adapted to limit a backpressure within the aftertreatment system (202).

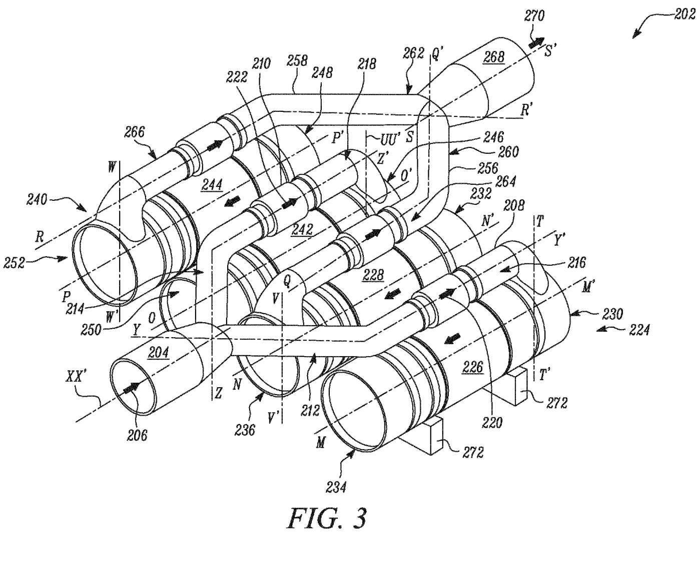

FIG. 3

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Description

Technical Field

[0001] The present disclosure relates to an aftertreatment system. More particularly, the present disclosure relates to an aftertreatment system for treating a high-volume exhaust flow.

Background

[0002] Large internal combustion engines, such as used for marine applications, power generation, and other applications, may generate a high-volume exhaust flow during an operation. Such high-volume exhaust flow may be treated within an aftertreatment system to comply with emissions control standards. However, the high volume of exhaust gases flowing through various components of an aftertreatment system can result in excessive backpressure within the aftertreatment system due to a limited flow capacity of the exhaust flow through the aftertreatment system.

[0003] In some situations, the flow capacity of the aftertreatment system may be increased by increasing the diameter or length (or other dimensions) of pipes and other components of the aftertreatment systems, including, but not limited to, a catalyst, a mixing element, a filter, and a housing. This may lead to an increase in the overall size of the aftertreatment system. The increase in size of the aftertreatment system and the components thereof may, in turn, result in increased costs such as research and development cost, manufacturing cost, new tooling, among other costs. Hence, there is a need for an improved aftertreatment system for treating high-volume exhaust flow while mitigating such cost increases.

[0004] German Patent Number 4,114,745 describes an exhaust system for a four-stroke combustion engine. The engine operates at a pulsating working frequency driven by a number of cylinders each of which has an outlet to a manifold for the pulsating emission of exhaust gases. Two pulsating exhaust gas flows are passed through a catalyst matrix phase shifted against each other from one third to two thirds of the period of the working frequency. Each pulsating exhaust flow is supplied via a manifold merged from groups of two cylinders. The resulting common exhaust manifolds conjoin the catalytic converter matrix from opposite ends. The treated exhaust gases leave the catalytic matrix by a common exhaust pipe.

Summary of the Disclosure

[0005] In an aspect of the present disclosure, an aftertreatment system for treating a high-volume exhaust flow is provided. The aftertreatment system includes a first module having a first mixing element. The aftertreatment system includes a second module having a second mixing element. The second module has a configuration similar to a configuration of the first module. The aftertreatment system includes a main inlet conduit adapted to receive the exhaust flow. The aftertreatment system includes a first inlet conduit fluidly coupled to the main inlet conduit and the first module. The aftertreatment system includes a second inlet conduit fluidly coupled to the main inlet conduit and the second module. The aftertreatment system also includes a first outlet conduit fluidly coupled to the first module. The aftertreatment system further includes a second outlet conduit fluidly coupled to the second module. Each of the first inlet conduit and the second inlet conduit is adapted to split the exhaust flow downstream of the main inlet conduit into a first stream and a second stream flowing therethrough respectively. The splitting of the exhaust flow is adapted to limit a backpressure within the aftertreatment system. Each of the first mixing element and the second mixing element is adapted to improve a mixing of the first stream and the second stream within the first module and the second module, respectively.

[0006] In another aspect of the present disclosure, an engine is provided. The engine includes an engine block and a plurality of cylinders provided in the engine block. The engine includes a cylinder head provided on the engine block. The engine also includes an exhaust manifold fluidly coupled to the plurality of cylinders. The exhaust manifold is adapted to receive a high-volume exhaust flow from the plurality of cylinders. The engine further includes an aftertreatment system fluidly coupled to the exhaust manifold. The aftertreatment system is adapted to receive and treat the high-volume exhaust flow from the exhaust manifold. The aftertreatment system includes a first module having a first mixing element. The aftertreatment system includes a second module having a second mixing element. The second module has a configuration similar to a configuration of the first module. The aftertreatment system includes a main inlet conduit fluidly coupled to the exhaust manifold. The main inlet conduit is adapted to receive the exhaust flow from the exhaust manifold. The aftertreatment system includes a first inlet conduit fluidly coupled to the main inlet conduit and the first module. The aftertreatment system includes a second inlet conduit fluidly coupled to the main inlet conduit and the second module. The aftertreatment system also includes a first outlet conduit fluidly coupled to the first module. The aftertreatment system further includes a second outlet conduit fluidly coupled to the second module. Each of the first inlet conduit and the second inlet conduit is adapted to split the exhaust flow downstream of the main inlet conduit into a first stream and a second stream flowing therethrough respectively. The splitting of the exhaust flow is adapted to limit a backpressure within the aftertreatment system. Each of the first mixing element and the second mixing element is adapted to improve a mixing of the first stream and the second stream within the first module and the second module, respectively.

[0007] In yet another aspect of the present disclosure, a method for limiting a backpressure within an aftertreatment system having a high-volume exhaust flow therethrough is provided. The method includes receiving the exhaust flow through a main inlet conduit. The method includes splitting the exhaust flow downstream of the main inlet conduit in a first stream using a first inlet conduit, and a second stream using a second inlet conduit. The method includes receiving the first stream through a first module. The method includes receiving the second stream through a second module. The method also includes flowing the first stream from the first module through a first outlet conduit. The method further includes flowing the second stream from the second module through a second outlet conduit.

[0008] Other features and aspects of this disclosure will be apparent from the following description and the accompanying drawings.

Brief Description of the Drawings

[0009]

FIG. 1 is a perspective view of an exemplary engine, according to one embodiment of the present disclosure;

FIG. 2 is a top view of an aftertreatment system for the engine of FIG. 1, according to one embodiment of the present disclosure;

FIG. 3 is a perspective view of the aftertreatment system of FIG. 2, according to one embodiment of the present disclosure;

FIG. 4 is a perspective view of an aftertreatment system for the engine of FIG. 1, according to another embodiment of the present disclosure;

FIG. 5 is a perspective view of an aftertreatment system for the engine of FIG. 1, according to another embodiment of the present disclosure;

FIG. 6 is a front view of the aftertreatment system of FIG. 5, according to one embodiment of the present disclosure; and

FIG. 7 is a flowchart illustrating a method of working of the aftertreatment system of FIGS. 2, 4, and 5, according to an embodiment of the present disclosure.

Detailed Description

[0010] Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or the like parts. Referring to FIG. 1, an exemplary engine 102 is illustrated. The engine 102 is an internal combustion engine powered by any fuel known in the art, such as natural gas, diesel, gasoline, and/or a combination thereof. In some embodiments, the engine 102 may be associated with a machine (not shown) including but not limited to, a locomotive, a marine vessel, a land vehicle, and a power generator, among others. The engine 102 and/or the machine may be employed in any industry including, but not limited to, construction, agriculture, forestry, mining, transportation, waste management, aviation, marine, material handling, and power generation.

[0011] The engine 102 includes an engine block 104. The engine block 104 includes one or more cylinders 105 provided therein. The cylinders 105 may be arranged in any configuration including but not limited to, an inline, radial, and "V", among others. Each of the cylinders 105 is adapted to receive a piston (not shown) therein. The cylinders 105 are adapted to generate a high-volume exhaust flow therefrom. The engine 102 also includes a cylinder head 106 mounted on the engine block 104. The cylinder head 106 houses one or more components and/or systems of the engine 102 including but not limited to, an intake manifold 107, a valve train (not shown), and sensors (not shown), among others.

[0012] The engine 102 also includes an exhaust manifold 108 provided on the cylinder head 106. In one embodiment, the exhaust manifold 108 may be coupled to the cylinder head 106. In another embodiment, the exhaust manifold 108 may be integral with respect to the cylinder head 106, based on application requirements. The exhaust manifold 108 is fluidly coupled to the cylinders 105. Accordingly, the exhaust manifold 108 is adapted to receive the high-volume exhaust flow from the cylinders 105. Additionally, the engine 102 may include various other components and/or systems (not shown) including but not limited to, a crankcase, a fuel system, an air system, a cooling system, a lubrication system, a turbocharger, an exhaust gas recirculation system, and other peripheries, among others.

[0013] Referring to FIGS. 2, 3, 4, 5, and 6, an aftertreatment system 202 is illustrated. In certain aspects of the present disclosure, the aftertreatment system 202 may be associated with the engine 102. The aftertreatment system 202 will be hereinafter interchangeably referred to as "the system 202". The system 202 is fluidly coupled to the exhaust manifold 108. Accordingly, the system 202 is adapted to receive and treat the high-volume exhaust flow from the exhaust manifold 108. The system 202 is adapted to treat exhaust gases present in the exhaust flow using various methods known in the art including but not limited to, filtration, oxidation, and reduction, among others.

[0014] The system 202 includes a main inlet conduit 204. The main inlet conduit 204 is fluidly coupled to the exhaust manifold 108. Accordingly, the main inlet conduit 204 is adapted to receive the exhaust flow therein, as shown by an arrow 206, from the exhaust manifold 108. In the illustrated embodiment, the main inlet conduit 204 includes a hollow, elongated, and cylindrical configuration defining a longitudinal axis X-X' thereof. In other embodiments, the main inlet conduit 204 may include any other configuration including but not limited to, triangular, elliptical, and rectangular, among others, based on application requirements.

[0015] The system 202 includes a first inlet conduit 208 and a second inlet conduit 210. In the illustrated embodiment, each of the first inlet conduit 208 and the second inlet conduit 210 includes a hollow, elongated, and cylindrical configuration defining a longitudinal axis Y-Y', Z-Z' thereof respectively. In other embodiments, each of the first inlet conduit 208 and the second inlet conduit 210 may include any other configuration including but not limited to, triangular, elliptical, and rectangular, among others, based on application requirements.

[0016] Also, each of the first inlet conduit 208 and the second inlet conduit 210 includes a first portion 212, 214 and a second portion 216, 218 thereof respectively. The first portion 212 of the first inlet conduit 208 is inclined with respect to the second portion 216 thereof defining an angle "P1" therebetween. The first portion 214 of the second inlet conduit 210 is inclined with respect to the second portion 218 thereof defining an angle "P2" therebetween. In the illustrated embodiment, the angle "P1" is equal to the angle "P2". In other embodiments, the angle "P1" may vary with respect to the angle "P2", based on application requirements.

[0017] Each of the first inlet conduit 208 and the second inlet conduit 210 is fluidly coupled to the main inlet conduit 204. More specifically, the first portion 212 of the first inlet conduit 208 is coupled to the main inlet conduit 204 defining an angle "A1" with respect to the longitudinal axis X-X' of the main inlet conduit 204. Also, the first portion 214 of the second inlet conduit 210 is coupled to the main inlet conduit 204 defining an angle "A2" with respect to the longitudinal axis X-X' of the main inlet conduit 204. In the illustrated embodiment, the angle "A1" is equal to the angle "A2". In other embodiments, the angle "A1" may vary with respect to the angle "A2", based on application requirements.

[0018] Each of the first inlet conduit 208 and the second inlet conduit 210 is adapted to split the exhaust flow downstream of the main inlet conduit 204 into a first stream 220 and a second stream 222 flowing therethrough respectively. In the illustrated embodiment, a cross-sectional area of the first inlet conduit 208 is equal to a cross-sectional area of the second inlet conduit 210. Accordingly, a volume of the first stream 220 is equal to a volume of the second stream 222. As such, the exhaust flow is split downstream of the main inlet conduit 204 in a ratio of 50:50 in the first stream 220 and the second stream 222 respectively.

[0019] In other embodiments, the cross-sectional area of the first inlet conduit 208 may be different with respect to the cross-sectional area of the second inlet conduit 210. Accordingly, the volume of the first stream 220 may vary with respect to the volume of the second stream 222. As such, the exhaust flow may be split downstream of the main inlet conduit 204 in any ratio including but not limited to, 40:60, 60:40, 30:70, and 70:30, among others, in the first stream 220 and the second stream 222 respectively, based on application requirements. The splitting of the exhaust flow downstream of the main inlet conduit 204 into the first stream 220 and the second stream 222 is adapted to limit a backpressure within the system 202 and/or on the engine 102.

[0020] The system 202 includes a first module 224 fluidly coupled to the first inlet conduit 208. More specifically, the first module 224 includes a first sub-module 226 and a second sub-module 228. The first sub-module 226 is fluidly coupled to the second portion 216 of the first inlet conduit 208. Accordingly, the first sub-module 226 is adapted to receive the first stream 220 therein from the first inlet conduit 208.

[0021] Each of the first sub-module 226 and the second sub-module 228 includes a hollow, elongated, and cylindrical configuration defining a longitudinal axis M-M', N-N' thereof respectively. In other embodiments, each of the first sub-module 226 and the second sub-module 228 may include any other configuration including but not limited to, rectangular, and triangular, among others, based on application requirements. Accordingly, each of the first sub-module 226 and the second sub-module 228 includes a first end 230, 232 and a second end 234, 236 respectively. The first end 230, 232 is distal with respect to the second end 234, 236 respectively.

[0022] Each of the first sub-module 226 and the second sub-module 228 is adapted to house one or more components of the system 202. For example, in the illustrated embodiment, the first sub-module 226 includes a first filter element (not shown). The first filter element is adapted to filter particulate matter from the first stream 220. The first filter element may be any filter element known in the art including but not limited to, a Diesel Particulate Filter (DPF), and a partial flow filter, among others. Additionally, or optionally, the first sub-module 226 may also include other components not shown herein, based on application requirements.

[0023] Also, the second sub-module 228 includes a first catalytic reduction unit (not shown). The first catalytic reduction unit is adapted to reduce Nitrogen Oxides (NOx) present in the first stream 220. The first catalytic reduction unit may be any catalytic converter known in the art, such as a Selective Catalytic Reduction (SCR) unit. Additionally, or optionally, the second sub-module 228 may also include other components, such as an Ammonia Oxidation Catalyst (AOC) unit (not shown), based on application requirements.

[0024] The first module 224 further includes a first auxiliary conduit 238. The first auxiliary conduit 238 is fluidly coupled to the first sub-module 226 and the second sub-module 228. More specifically, the first auxiliary conduit 238 is fluidly coupled to the second end 234 of the first sub-module 226 and the first end 232 of the second sub-module 228. Accordingly, the first auxiliary conduit 238 is adapted to receive the first stream 220 therein from the first sub-module 226, and further allow flow of the first stream 220 into the second sub-module 228.

[0025] The first auxiliary conduit 238 includes a first dosing unit (not shown) and a first mixing element (not shown) therein. The first dosing unit is adapted to inject a reductant fluid in the first stream 220. The first dosing unit may be any dosing unit known in the art, such as a Diesel Exhaust Fluid (DEF) dosing unit. The first mixing element may be any mixing unit known in the art including but not limited to, a perforated type mixing unit, a flap type mixing unit, a turbulence flow type mixing unit, a spiral flow type mixing unit, and/or a combination thereof, among others. The first mixing element is adapted to improve a mixing of the reductant fluid and the first stream 220 within the first module 224. In other embodiments, the first auxiliary conduit 238 may include any other component/s of the system 202, based on application requirements.

[0026] It should be noted that the first sub-module 226, the second sub-module 228, and the first auxiliary conduit 238 described herein is merely exemplary. In another embodiment, the first module 224 may include a single sub-module without the first auxiliary conduit 238. In yet another embodiment, the first module 224 may include multiple sub-modules, of which each sub-module may or may not have a first auxiliary conduit 238, based on application requirements. Also, location, sequence, configuration, and inclusion of the first filter element, the DEF dosing unit, the first mixing element, the first catalytic reduction unit, and/or the AOC unit within the first sub-module 226, the second sub-module 228, and/or the first auxiliary conduit 238 may vary based on application requirements.

[0027] The system 202 also includes a second module 240 fluidly coupled to the second inlet conduit 210. The second module 240 includes a configuration similar to a configuration of the first module 224. Accordingly, the second module 240 includes a third sub-module 242 and a fourth sub-module 244. The third sub-module 242 is fluidly coupled to the second portion 218 of the second inlet conduit 210. Accordingly, the third sub-module 242 is adapted to receive the second stream 222 therein from the second inlet conduit 210.

[0028] Each of the third sub-module 242 and the fourth sub-module 244 includes a hollow, elongated, and cylindrical configuration defining a longitudinal axis O-O', P-P' thereof respectively. In other embodiments, each of the third sub-module 242 and the fourth sub-module 244 may include any other configuration including but not limited to, rectangular, and triangular, among others, based on application requirements. Accordingly, each of the third sub-module 242 and the fourth sub-module 244 includes a first end 246, 248 and a second end 250, 252 respectively. The first end 246, 248 is distal with respect to the second end 250, 252 respectively.

[0029] Each of the third sub-module 242 and the fourth sub-module 244 is adapted to house one or more components of the system 202. For example, in the illustrated embodiment, the third sub-module 242 includes a second filter element (not shown). The second filter element is adapted to filter particulate matter from the second stream 222. The second filter element may be any filter element known in the art including but not limited to, the Diesel Particulate Filter (DPF), and the partial flow filter, among others. Additionally, or optionally, the third sub-module 242 may also include other components not shown herein, based on application requirements.

[0030] Also, the fourth sub-module 244 includes a second catalytic reduction unit (not shown). The second catalytic reduction unit is adapted to reduce Nitrogen Oxides (NOx) present in the second stream 222. The second catalytic reduction unit may be any catalytic converter known in the art, such as the Selective Catalytic Reduction (SCR) unit. Additionally, or optionally, the fourth sub-module 244 may also include other components, such as the Ammonia Oxidation Catalyst (AOC) unit, based on application requirements.

[0031] The second module 240 further includes a second auxiliary conduit 254. The second auxiliary conduit 254 is fluidly coupled to the third sub-module 242 and the fourth sub-module 244. More specifically, the second auxiliary conduit 254 is fluidly coupled to the second end 250 of the third sub-module 242 and the first end 248 of the fourth sub-module 244. Accordingly, the second auxiliary conduit 254 is adapted to receive the second stream 222 therein from the third sub-module 242, and further allow flow of the second stream 222 into the fourth sub-module 244.

[0032] The second auxiliary conduit 254 includes a second dosing unit (not shown) and a second mixing element (not shown) therein. The second dosing unit is adapted to inject the reductant fluid in the second stream 222. The second dosing unit may be any dosing unit known in the art, such as the Diesel Exhaust Fluid (DEF) dosing unit. The second mixing element may be any mixing unit known in the art including but not limited to, the perforated type mixing unit, the flap type mixing unit, the turbulence flow type mixing unit, the spiral flow type mixing unit, and/or a combination thereof, among others. The second mixing element is adapted to improve a mixing of the reductant fluid and the second stream 222 within the second module 240. In other embodiments, the second auxiliary conduit 254 may include any other component/s of the system 202, based on application requirements.

[0033] It should be noted that the third sub-module 242, the fourth sub-module 244, and the second auxiliary conduit 254 described herein is merely exemplary. In another embodiment, the second module 240 may include a single sub-module without the second auxiliary conduit 254. In yet another embodiment, the second module 240 may include multiple sub-modules, of which each sub-module may or may not have a second auxiliary conduit 254, based on application requirements. Also, location, sequence, configuration, and inclusion of the second filter element, the DEF dosing unit, the second mixing element, the second catalytic reduction unit, and/or the AOC unit within the third sub-module 242, the fourth sub-module 244, and/or the second auxiliary conduit 254 may vary based on application requirements.

[0034] The system 202 includes a first outlet conduit 256 and a second outlet conduit 258. In the illustrated embodiment, each of the first outlet conduit 256 and the second outlet conduit 258 includes a hollow, elongated, and cylindrical configuration defining a longitudinal axis Q-Q', R-R' thereof respectively. In other embodiments, each of the first outlet conduit 256 and the second outlet conduit 258 may include any other configuration including but not limited to, triangular, elliptical, and rectangular, among others, based on application requirements.

[0035] Also, each of the first outlet conduit 256 and the second outlet conduit 258 includes a first portion 260, 262 and a second portion 264, 266 thereof respectively. The first portion 260 of the first outlet conduit 256 is inclined with respect to the second portion 264 thereof defining an angle "P3" therebetween. The first portion 262 of the second outlet conduit 258 is inclined with respect to the second portion 266 thereof defining an angle "P4" therebetween. In the illustrated embodiment, the angle "P3" is equal to the angle "P4". In other embodiments, the angle "P3" may vary with respect to the angle "P4", based on application requirements.

[0036] The first outlet conduit 256 is fluidly coupled to the first module 224. More specifically, in the illustrated embodiment, the second portion 264 of the first outlet conduit 256 is fluidly coupled to the second sub-module 228 of the first module 224. Accordingly, the first outlet conduit 256 is adapted to receive the first stream 220 therein from the second sub-module 228. Also, the second outlet conduit 258 is fluidly coupled to the second module 240. More specifically, in the illustrated embodiment, the second portion 266 of the second outlet conduit 258 is fluidly coupled to the fourth sub-module 244 of the second module 240. Accordingly, the second outlet conduit 258 is adapted to receive the second stream 222 therein from the fourth sub-module 244.

[0037] The system 202 also includes a main outlet conduit 268. In the illustrated embodiment, the main outlet conduit 268 includes a hollow, elongated, and cylindrical configuration defining a longitudinal axis S-S' thereof. In other embodiments, the main outlet conduit 268 may include any other configuration including but not limited to, triangular, elliptical, and rectangular, among others, based on application requirements. The main outlet conduit 268 is fluidly coupled to each of the first outlet conduit 256 and the second outlet conduit 258.

[0038] Accordingly, the main outlet conduit 268 is adapted to receive the first stream 220 and the second stream 222 therein from the first outlet conduit 256 and the second outlet conduit 258 respectively. Also, the main outlet conduit 268 is adapted to merge the first stream 220 and the second stream 222 therein, as shown by an arrow 270. The main outlet conduit 268 may be further fluidly coupled to a downstream component (not shown) including but not limited to, a muffler, a silencer, a funnel, and a flare, among others, based on application requirements.

[0039] In the illustrated embodiment, each of the first outlet conduit 256 and the second outlet conduit 258 is inclined with respect to the main outlet conduit 268. More specifically, the first portion 260 of the first outlet conduit 256 is coupled to the main outlet conduit 268 defining an angle "A3" with respect to the longitudinal axis S-S' of the main outlet conduit 268. Also, the first portion 262 of the second outlet conduit 258 is coupled to the main outlet conduit 268 defining an angle "A4" with respect to the longitudinal axis S-S' of the main outlet conduit 268. In the illustrated embodiment, the angle "A3" is equal to the angle "A4". In other embodiments, the angle "A3" may vary with respect to the angle "A4", based on application requirements.

[0040] In the illustrated embodiment, a cross-sectional area of the first outlet conduit 256 is equal to a cross-sectional area of the second outlet conduit 258. Accordingly, the volume of the first stream 220 flowing through the first outlet conduit 256 is equal to the volume of the second stream 222 flowing through the second outlet conduit 258. In other embodiments, the cross-sectional area of the first outlet conduit 256 may be different with respect to the cross-sectional area of the second outlet conduit 258. Accordingly, the volume of the first stream 220 may vary with respect to the volume of the second stream 222 including but not limited to, 40:60, 60:40, 30:70, and 70:30, among others, in the first outlet conduit 256 and the second outlet conduit 258 respectively, based on application requirements.

[0041] The first module 224 including the first sub-module 226 and the second sub-module 228, and the second module 240 including the third sub-module 242, and the fourth sub-module 244 may be oriented in any configuration with respect to one another, based on application requirements. For example, referring to FIGS. 2, 3, and 4, each of the first sub-module 226, the second sub-module 228, the third sub-module 242, and the fourth sub-module 244 is disposed parallel to and spaced apart with respect to one another in a single horizontal plane.

[0042] In another embodiment, referring to FIGS. 5 and 6, the first module 224 is disposed parallel to and spaced apart with respect to the second module 240 in separate vertical planes respectively. Also, each of the first sub-module 226 and the second sub-module 228 is disposed parallel to and spaced apart with respect to one another in a single vertical plane in a stacked configuration. Similarly, each of the third sub-module 242 and the fourth sub-module 244 is disposed parallel to and spaced apart with respect to one another in a single vertical plane in the stacked configuration.

[0043] The first inlet conduit 208, the second inlet conduit 210, the first outlet conduit 256, and the second outlet conduit 258 may be coupled to the first module 224 and the second module 240 respectively in any orientation, based on application requirements. For example, referring to FIGS. 2 and 3, the second portion 216 of the first inlet conduit 208 is oriented parallel to the longitudinal axis M-M' of the first sub-module 226. Also, the second portion 216 of the first inlet conduit 208 is coupled to the first end 230 of the first sub-module 226 along a lateral axis T-T' of the first sub-module 226. The second portion

218 of the second inlet conduit 210 is oriented parallel to the longitudinal axis O-O' of the third sub-module 242. Also, the second portion 218 of the second inlet conduit 210 is coupled to the first end 246 of the third sub-module 242 along a lateral axis U-U' of the third sub-module 242.

[0044] Further, the second portion 264 of the first outlet conduit 256 is oriented parallel to the longitudinal axis N-N' of the second sub-module 228. Also, the second portion 264 of the first outlet conduit 256 is coupled to the second end 236 of the second sub-module 228 along a lateral axis V-V' of the second sub-module 228. The second portion 266 of the second outlet conduit 258 is oriented parallel to the longitudinal axis P-P' of the fourth sub-module 244. Also, the second portion 266 of second outlet conduit 258 is coupled to the second end 252 of the fourth sub-module 244 along a lateral axis W-W' of the fourth sub-module 244.

[0045] In other embodiments, referring to FIGS. 4, 5 and 6, the second portion 216 of the first inlet conduit 208 is coupled to the first end 230 of the first sub-module 226 at an angle "B1" with respect to the lateral axis T-T' of the first sub-module 226. Also, the second portion 218 of the second inlet conduit 210 is coupled to the first end 246 of the third sub-module 242 inclined at an angle "B2" with respect to the lateral axis U-U' of the third sub-module 242.

[0046] Further, the second portion 264 of first outlet conduit 256 is coupled to the second end 236 of the second sub-module 228 inclined at an angle "B3" with respect to the lateral axis V-V' of the second sub-module 228. The second portion 266 of second outlet conduit 258 is coupled to the second end 252 of the fourth sub-module 244 inclined at an angle "B4" with respect to the lateral axis W-W' of the fourth sub-module 244. In the illustrated embodiment, each of the angles "B1", "B2", "B3", and "B4" is equal to one another. In other embodiments, one or more of the angles "B1", "B2", "B3", and "B4" may vary with respect to one another, based on application requirements.

[0047] It should be noted that the orientation, arrangement, location, configuration of the first module 224, the first sub-module 226, the second sub-module 228, the second module 240, the third sub-module 242, the fourth sub-module 244, the first inlet conduit 208, the second inlet conduit 210, the first outlet conduit 256, and/or the second outlet conduit 258 described herein is merely exemplary and may vary based on application requirements. For example, one or more sub-modules of the system 202 may be arranged in a single horizontal or vertical plane, and a remaining of the sub-modules may be arranged in a separate horizontal or vertical plane, based on application requirements. Also, one or more conduits of the system 202 may be oriented along any axis of the respective sub-module, and a remaining of the conduits may be oriented at any other angle with respect to any axis of the respective sub-module, based on application requirements

[0048] Further, referring to FIGS. 3, 4, 5, and 6, the system 202 may include one or more mounting elements 272 including but not limited to, one or more mounting brackets, and fasteners, among others. The mounting elements 272 are adapted to mount the system 202 on ground or with respect to one another. For example, as shown in FIGS. 3 and 4, the mounting elements 272 are arranged horizontally to receive the first module 224 and the second module 240 thereon in order to mount the system 202 on the ground. Also, as shown in FIGS. 5 and 6, the mounting elements 272 are arranged vertically to receive the first module 224 and the second module 240 thereon in order to mount the system 202 in the stacked configuration.

Industrial Applicability

[0049] The present disclosure relates to a method 700 of working of the aftertreatment system 202. Referring to FIG. 7, a flowchart of the method 700 is illustrated. At step 702, the main inlet conduit 204 receives the high-volume exhaust flow therein, as shown by the arrow 206. The exhaust flow is received through the main inlet conduit 204 from the exhaust manifold 108 of the engine 102. At step 704, the exhaust flow is split downstream of the main inlet conduit 204. More specifically, the exhaust flow is split in the first stream 220 using the first inlet conduit 208. Also, the exhaust flow is split in the second stream 222 using the second inlet conduit 210. In other embodiments, the exhaust flow may be split in multiple streams, based on application requirements. The splitting of the high-volume exhaust flow provides to limit the backpressure within the system 202 and/or the engine 102.

[0050] At step 706, the first stream 220 is received through the first module 224 from the first inlet conduit 208. More specifically, the first stream 220 is received through the first sub-module 226, the first auxiliary conduit 238, and the second sub-module 228. As such, the first stream 220 may be received through the first filter element, the DEF dosing unit, the first mixing element, the first catalytic reduction unit, and/or the AOC unit. The first mixing element provides to improve the mixing of the first stream 220 within the first module 224.

[0051] At step 708, the second stream 222 is received through the second module 240 from the second inlet conduit 210. More specifically, the second stream 222 is received through the third sub-module 242, the second auxiliary conduit 254, and the fourth sub-module 244. As such, the second stream 222 may be received through the second filter element, the DEF dosing unit, the second mixing element, the second catalytic reduction unit, and/or the AOC unit. The second mixing element provides to improve the mixing of the second stream 222 within the second module 240. It should be noted that the step 706 and the step 708 are performed simultaneously.

[0052] At step 710, the first stream 220 is flown out from the first module 224 through the first outlet conduit

256. At step 712, the second stream 222 is flown from the second module 240 through the second outlet conduit 258. Additionally, or optionally, the first stream 220 and the second stream 222 is merged downstream of the first module 224 and the second module 240 respectively. In such a situation, the first stream 220 and the second stream 222 is merged in the main outlet conduit 268 downstream of the first module 224 and the second module 240 respectively, as shown by the arrow 270. It should be noted that the step 710 and the step 712 are performed simultaneously.

[0053] The system 202 provides a simple, effective, and cost-efficient method for limiting the backpressure and for improving the mixing of the exhaust flow within the system 202 during the high-volume exhaust flow. As such, the system 202 employs a relatively small size of the first module 224 and the second module 240 with respect to a single, large aftertreatment module. Accordingly, development and manufacturing cost for the system 202 may be substantially lower compared to development and manufacturing cost for the single, large aftertreatment module.

[0054] The system 202 also provides a modular design based on application or user requirements. More specifically, multiple modules/sub-modules similar to the first module 224 and the second module 240 may be added to the system 202 in order to increase a capacity thereof, and/or to limiting the backpressure within the system 202 and/or on the engine 102. Also, the first module 224 and the second module 240 may have a configuration similar to an existing aftertreatment module, in turn, reducing an overall cost of the system 202. The system 202 may be retrofitted in any high-volume exhaust flow system with little or no modification to the existing system.

[0055] While aspects of the present disclosure have been particularly shown and described with reference to the embodiments above, it will be understood by those skilled in the art that various additional embodiments may be contemplated by the modification of the disclosed machines, systems and methods without departing from the spirit and scope of the disclosure. Such embodiments should be understood to fall within the scope of the present disclosure as determined based upon the claims and any equivalents thereof.

Claims

1. An aftertreatment system (202) for treating a high-volume exhaust flow, the aftertreatment system (202) comprising:

   a first module (224);
   a second module (240) having a configuration similar to a configuration of the first module (224);
   a main inlet conduit (204) adapted to receive the exhaust flow;
   a first inlet conduit (208) fluidly coupled to the main inlet conduit (204) and the first module (224);
   a second inlet conduit (210) fluidly coupled to the main inlet conduit (204) and the second module (240);
   a first outlet conduit (256) fluidly coupled to the first module (224); and
   a second outlet conduit (258) fluidly coupled to the second module (240);
   wherein each of the first inlet conduit (208) and the second inlet conduit (210) is adapted to split the exhaust flow downstream of the main inlet conduit (204) into a first stream (220) and a second stream (222) flowing therethrough respectively, and wherein splitting of the exhaust flow is adapted to limit a backpressure within the aftertreatment system (202).

2. The aftertreatment system (202) of claim 1, wherein a cross sectional area of the first inlet conduit (208) is equal in size to a cross sectional area of the second inlet conduit (210).

3. The aftertreatment system (202) of claim 1, wherein a cross sectional area of the first inlet conduit (208) is different in size than a cross sectional area of the second inlet conduit (210).

4. The aftertreatment system (202) of claim 1, wherein each of the first module (224) and the second module (240) includes at least one of a diesel particulate filter (226), a diesel exhaust fluid dosing unit (238), and a selective catalytic reduction unit (228).

5. The aftertreatment system (202) of claim 1 further includes a main outlet conduit (268) fluidly coupled to each of the first outlet conduit (256) and the second outlet conduit (258).

6. The aftertreatment system (202) of claim 1, wherein at least one the first inlet conduit (208), the first outlet conduit (256), the second inlet conduit (210), and the second outlet conduit (258) is disposed along a lateral axis of the first module (224) and the second module (240) respectively.

7. The aftertreatment system (202) of claim 1, wherein at least one the first inlet conduit (208), the first outlet conduit (256), the second inlet conduit (210), and the second outlet conduit (258) is disposed at an angle with respect to a lateral axis of the first module (224) and the second module (240) respectively.

8. The aftertreatment system (202) of claim 1, wherein the first module (224) includes:

   a first sub-module (226) fluidly coupled to the

first inlet conduit (208);
a second sub-module (228) fluidly coupled to the first outlet conduit (208); and
a first auxiliary conduit (238) fluidly coupled between the first sub-module (226) and the second sub-module (228).

9. The aftertreatment system (202) of claim 8, wherein the second module (240) includes:

a third sub-module (242) fluidly coupled to the second inlet conduit (210);
a fourth sub-module (244) fluidly coupled to the second outlet conduit (258); and
a second auxiliary conduit (254) fluidly coupled between the third sub-module (242) and the fourth sub-module (244).

10. The aftertreatment system (202) of claim 9, wherein at least one of the first sub-module (226) and the second sub-module (228), and the third sub-module (242) and the fourth sub-module (244) is disposed in a stacked configuration.

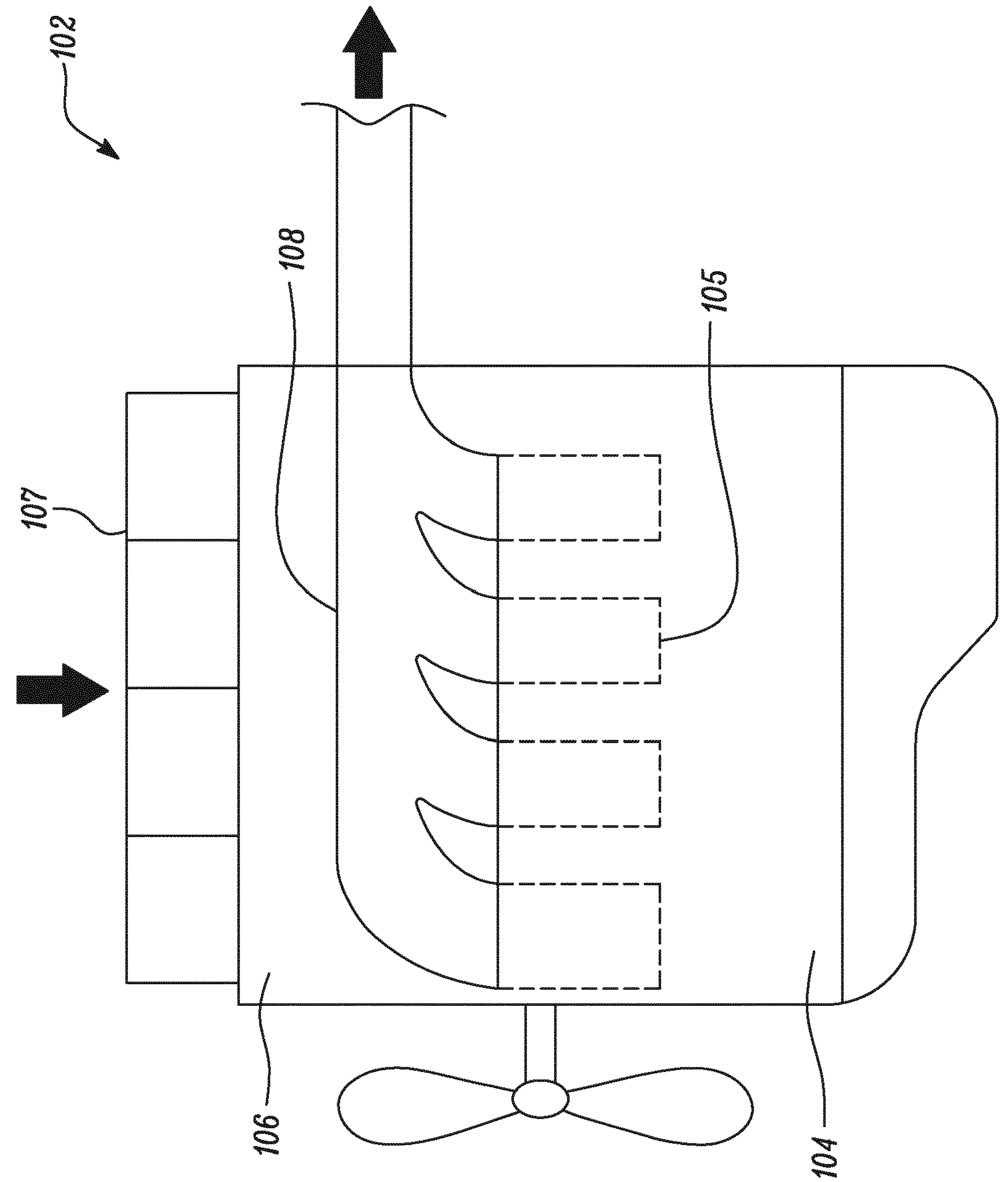
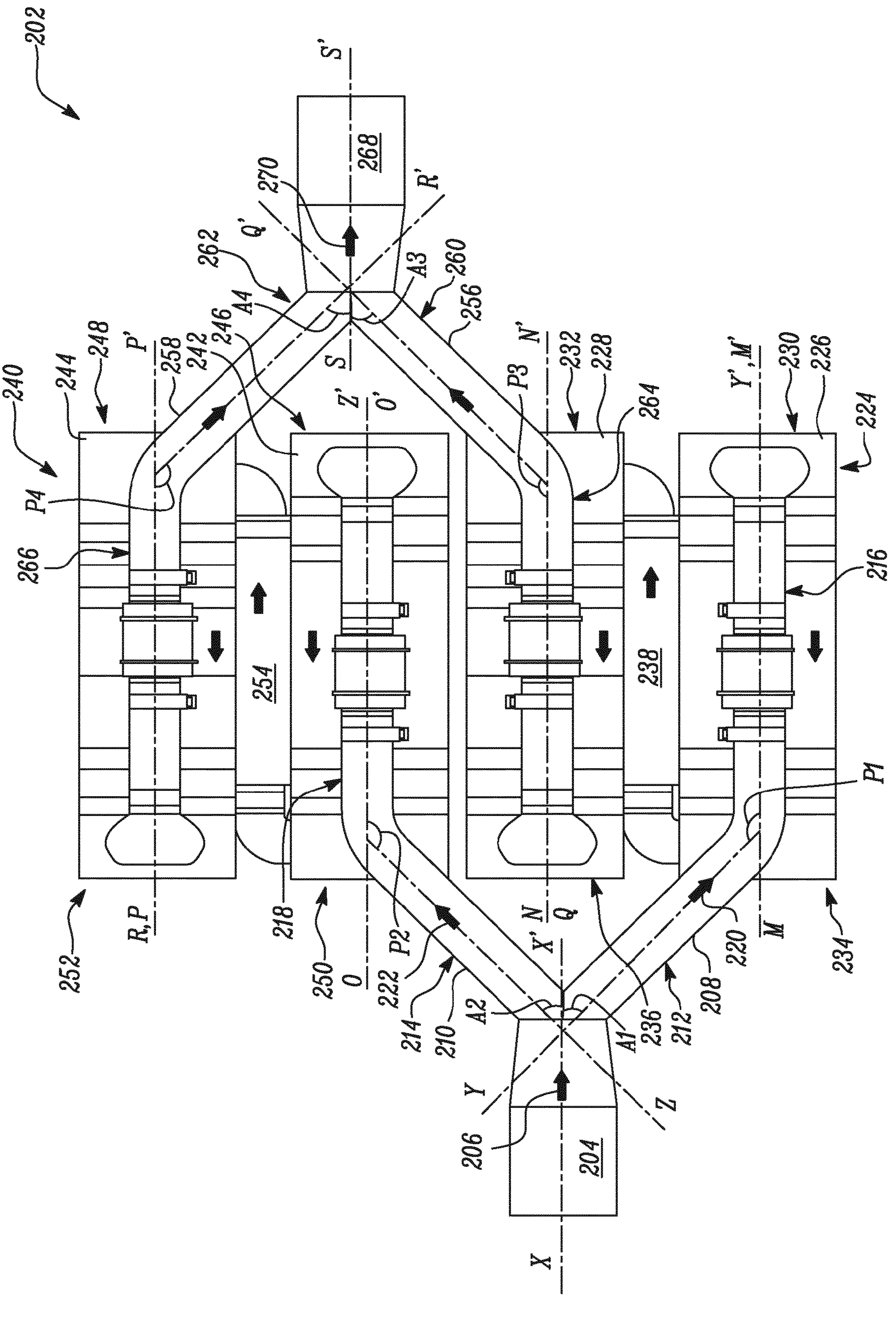


FIG. 1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270
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Q'
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A4
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242
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P'
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N'
232
228
P3
264
Y', M'
230
226
224
Z'
O'
P4
266
216
254
238
P1
218
R, P
252
250
O
P2
222
214
210
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X'
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Q
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A1
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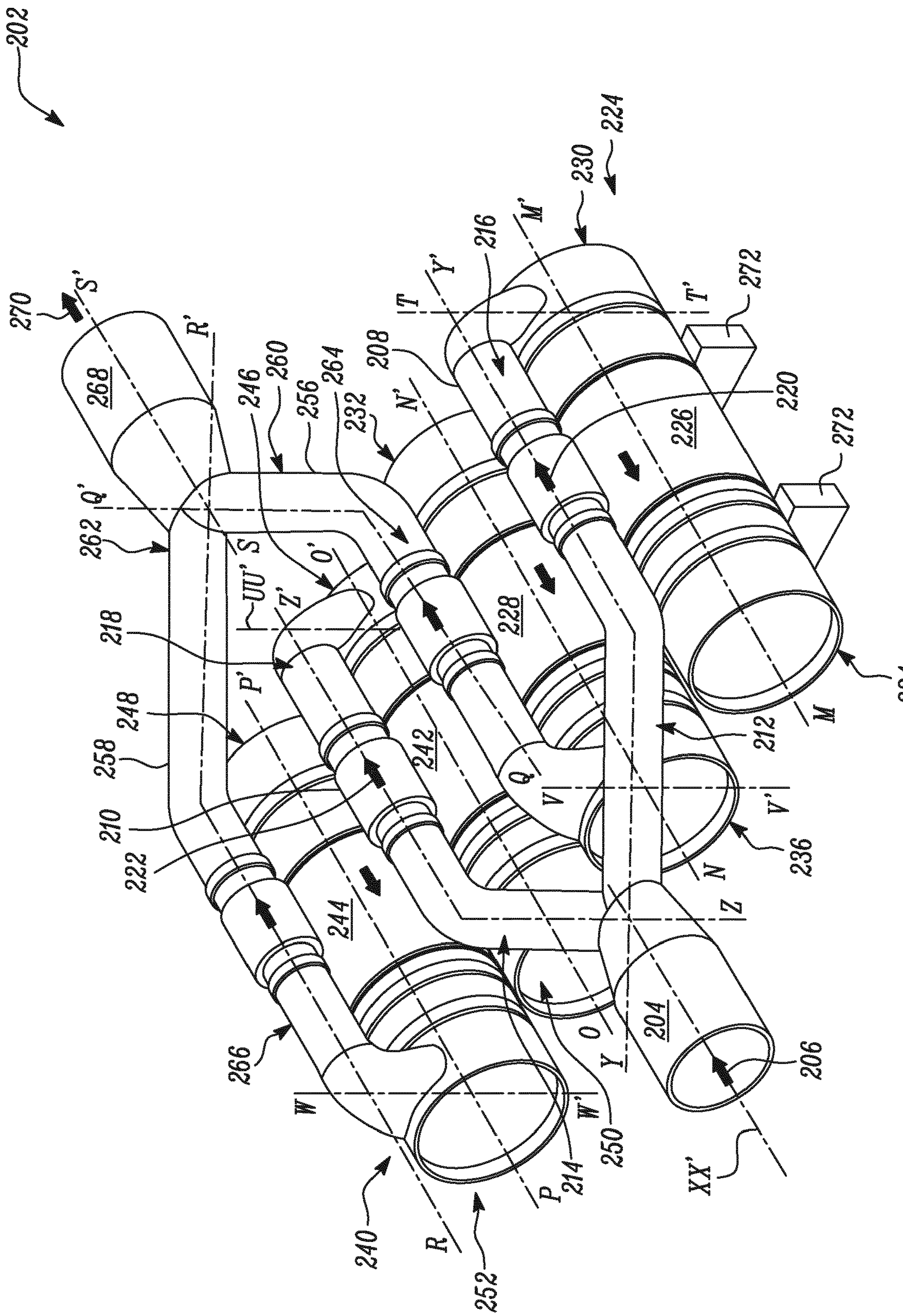
208
220
M
234
Y
Z
206
204
X

FIG. 2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UU'
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228
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P'
248
258
210
222
242
Q
V
V'
212
234
M
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R
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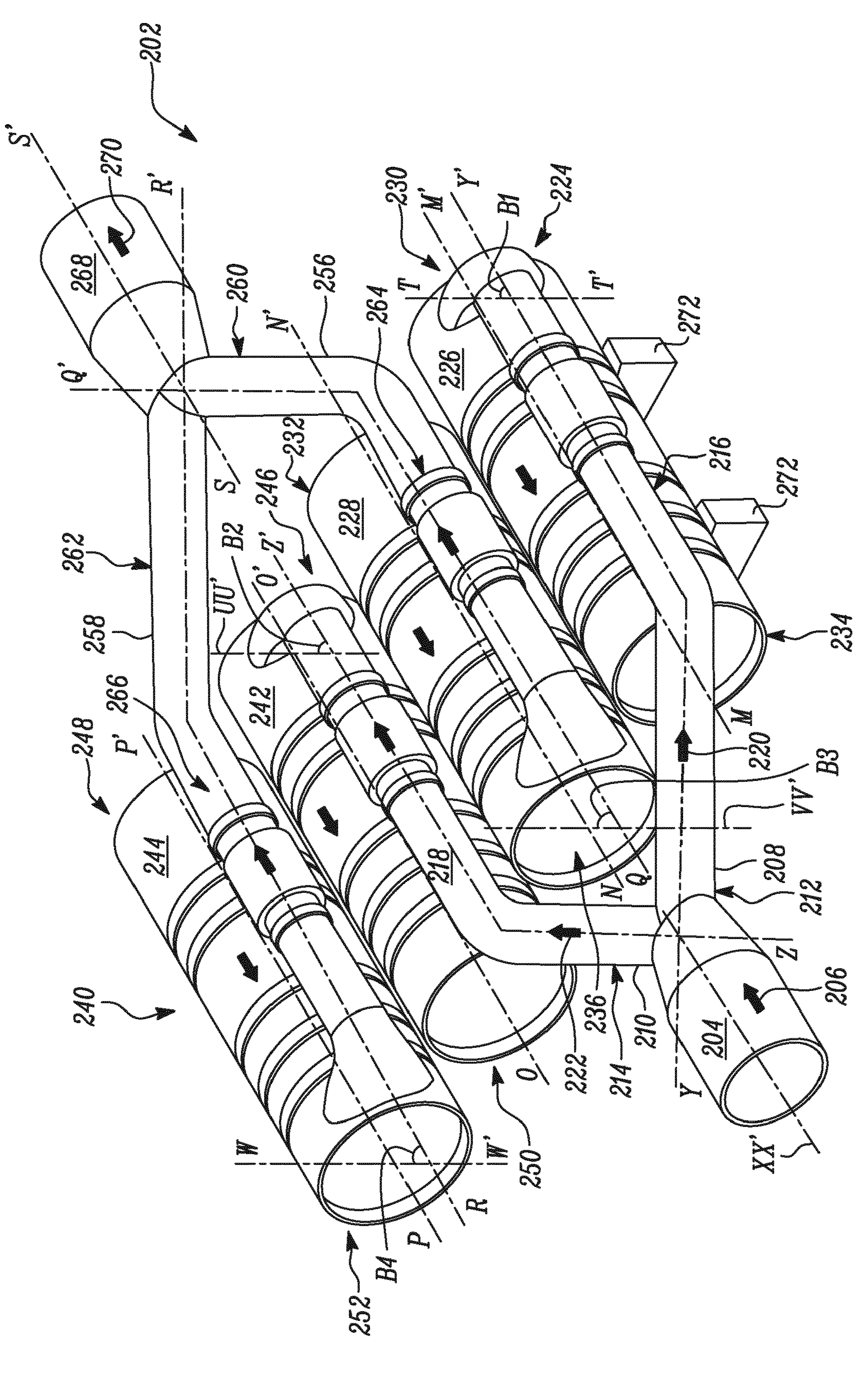
P
214
250
XX'

FIG. 3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232
228
246
Z'
B2
O'
UU'
262
258
242
266
P'
248
244
218
234
220
M
B3
VV'
208
212
N
Q
222
236
214
210
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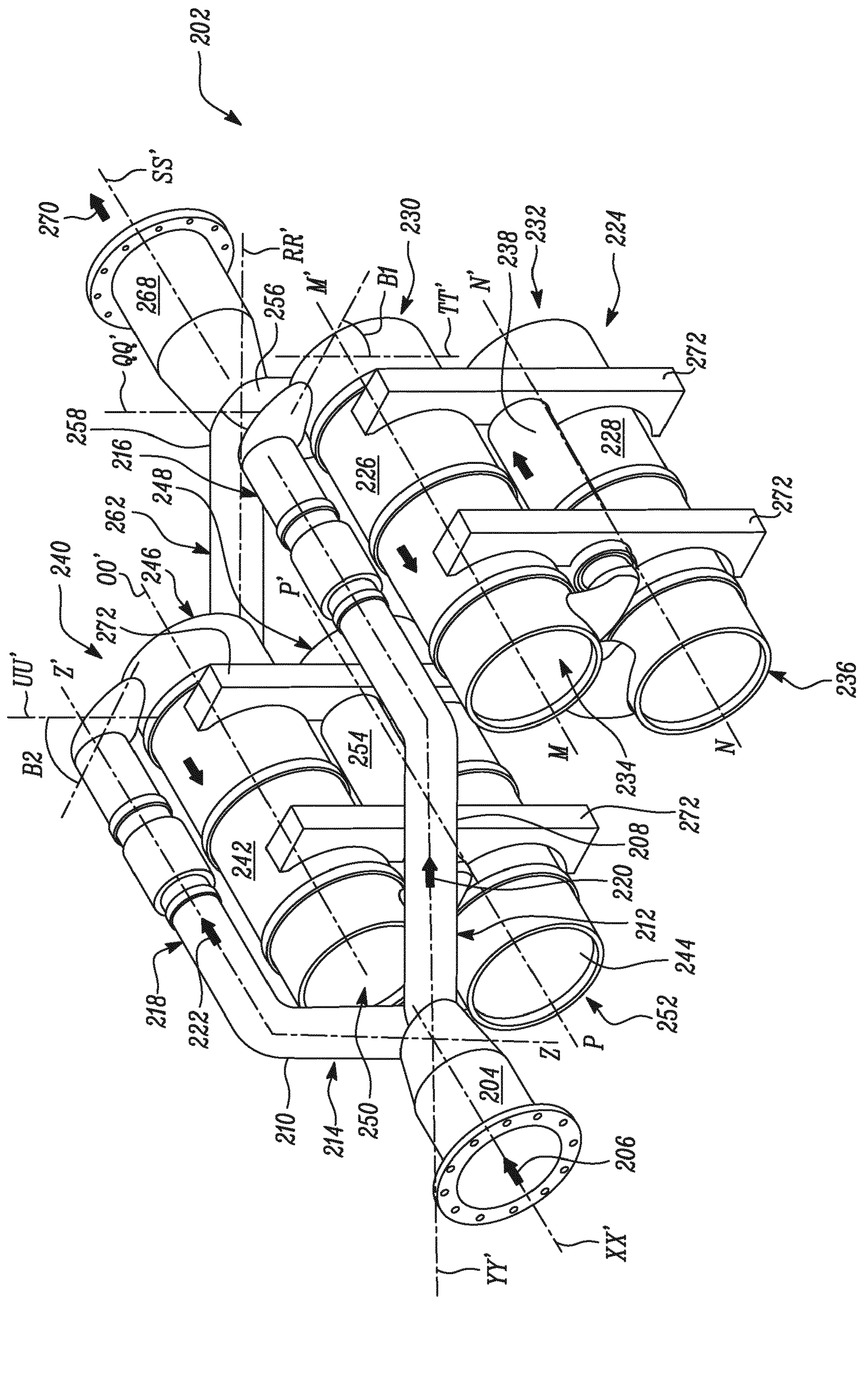
W'
R
P
B4
252

FIG. 4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230
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238
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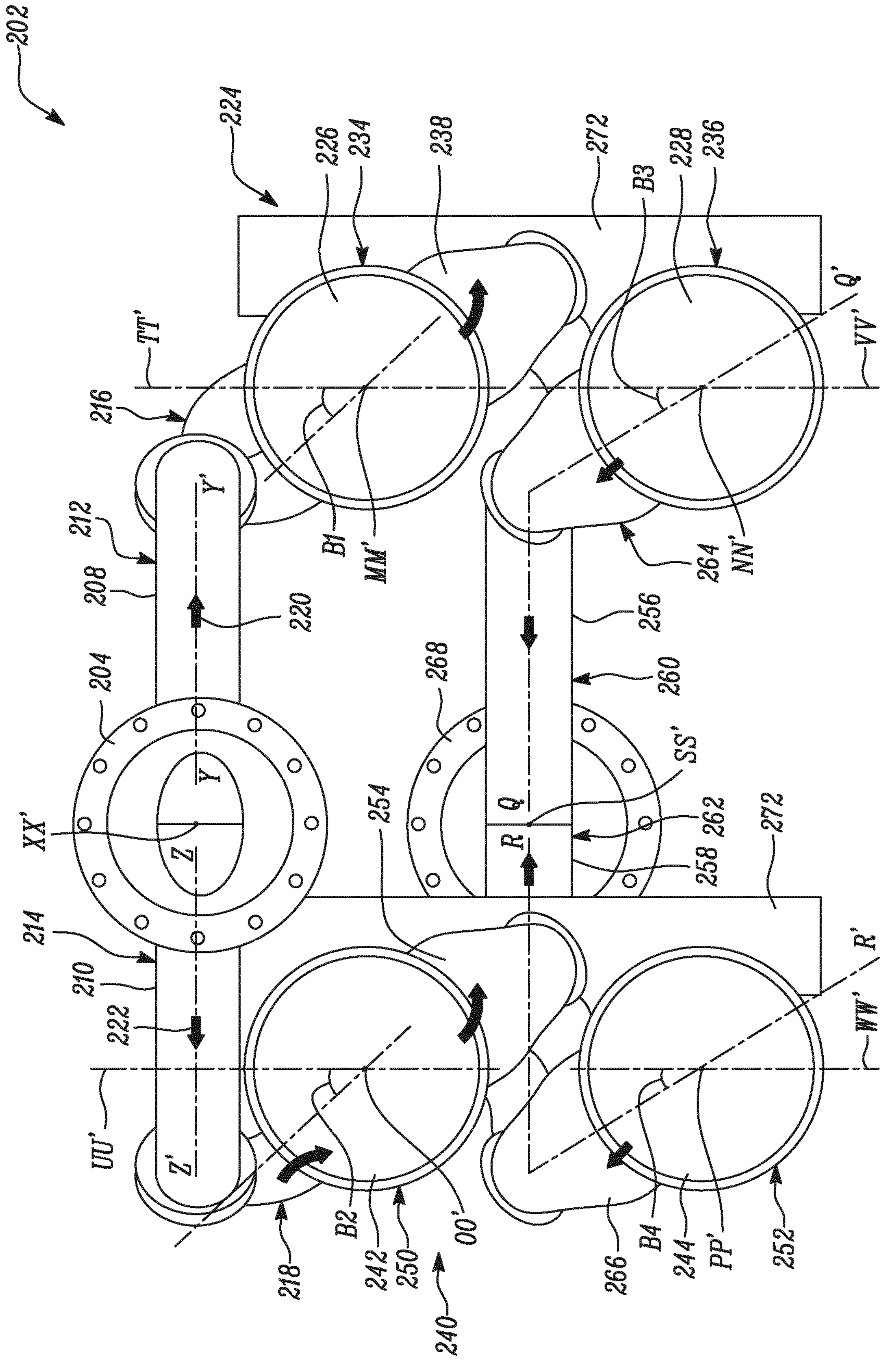
216
248
262
226
228
240
OO'
246
P'
272
UU'
Z'
B2
254
234
M
N
236
242
208
272
220
212
244
218
222
250
252
P
Z
210
214
204
206
YY'
XX'

FIG. 5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226
234
238
272
B3
228
236
TT'
Q'
VV'
216
212
208
Y'
B1
MM'
264
NN'
220
256
204
268
260
XX'
Y
Z
SS'
Q
R
262
254
258
272
214
210
R'
222
WW'
UU'
Z'
B2
242
250
OO'
218
240
266
B4
244
PP'
252

FIG. 6

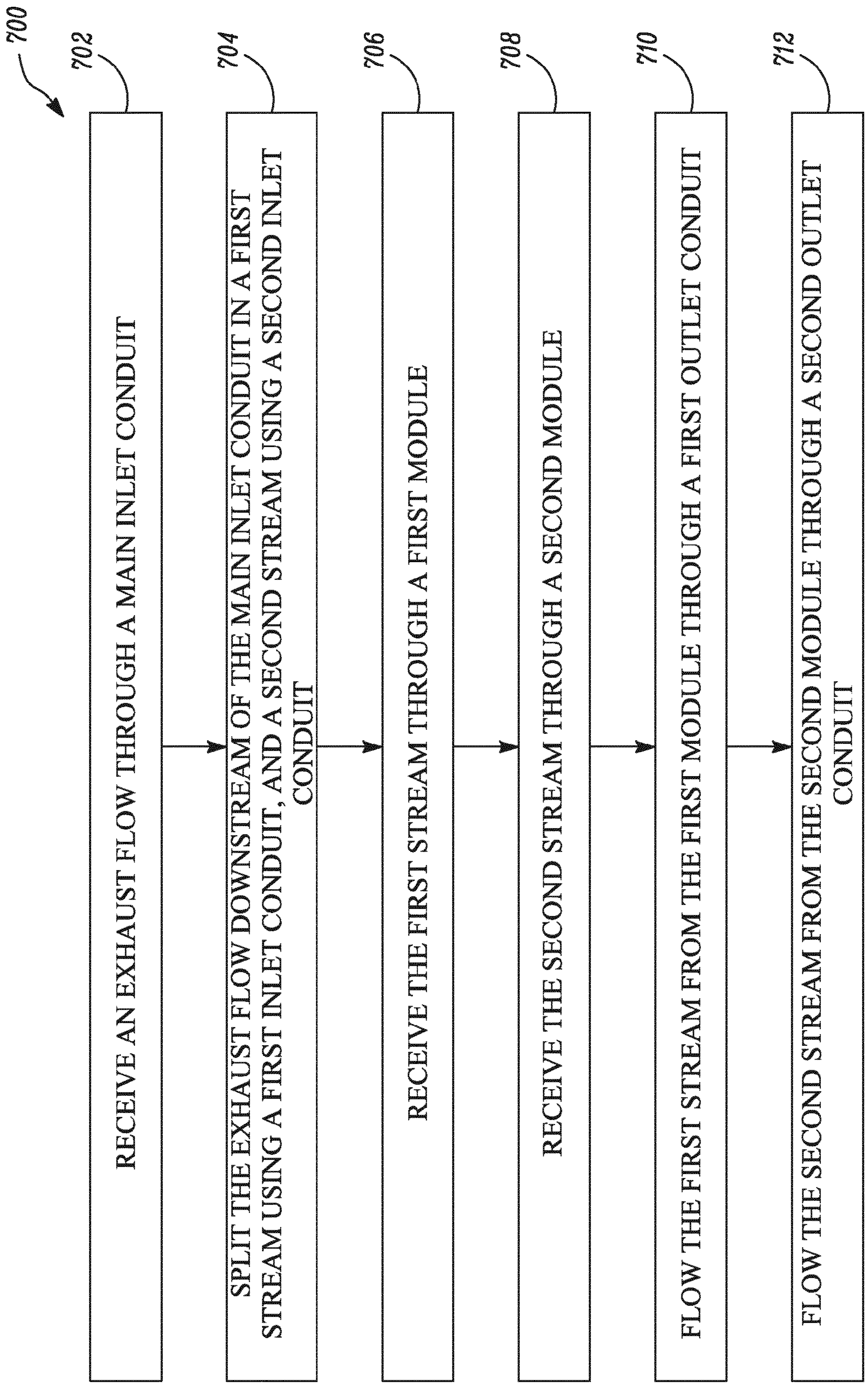
700
702
RECEIVE AN EXHAUST FLOW THROUGH A MAIN INLET CONDUIT
704
SPLIT THE EXHAUST FLOW DOWNSTREAM OF THE MAIN INLET CONDUIT IN A FIRST STREAM USING A FIRST INLET CONDUIT, AND A SECOND STREAM USING A SECOND INLET CONDUIT
706
RECEIVE THE FIRST STREAM THROUGH A FIRST MODULE
708
RECEIVE THE SECOND STREAM THROUGH A SECOND MODULE
710
FLOW THE FIRST STREAM FROM THE FIRST MODULE THROUGH A FIRST OUTLET CONDUIT
712
FLOW THE SECOND STREAM FROM THE SECOND MODULE THROUGH A SECOND OUTLET CONDUIT

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 18 18 8116

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