

Declarations under Rule 4.17:

- *as to the identity of the inventor (Rule 4.17(i))*
- *of inventorship (Rule 4.17(iv))*

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

A POWER UNIT FOR A MOTOR VEHICLE

TECHNICAL FIELD

[0001] The present subject matter, in general, relates to a power unit for a motor vehicle and, in particular relates to a discharge system for the power unit.

5

BACKGROUND

[0002] Generally, motor vehicles like saddle-ride type vehicles which are compact are provided with an internal combustion (IC) engine unit. These saddle-ride type vehicles have gained popularity due to their compact layout and their ability to carry an additional passenger and/or to carry loads on them. These vehicles may constitute two-wheels or three-wheels depending on application, engine layout etc. Some of these vehicles are provided with a swinging-type engine, and a connecting link like a toggle link is provided to swingably support the IC engine unit. Some other type of saddle-ride type vehicle have the IC engine fixedly mounted to the frame. In these vehicles the IC engine may be forwardly inclined.

15 Thus, these vehicles have a discharge system that is extending at a lower portion of the vehicle and extending towards a muffler body positioned on one of the sides of the vehicle or may be at a center. Thus, the vehicle is to be provided with sufficient ground clearance to securely accommodate the discharge system, which is one of many packaging & layout challenges in such vehicles.

20 [0003] Additionally, these saddle ride-type motor vehicles are operated in different terrains and with different driving patterns as those are dependent on the location of operation or user, which are beyond control of the manufacturer. These vehicles when operated in such different terrains and with different driving patterns may affect the discharge system which is one of lower disposed systems of the vehicle.

25 [0004] Moreover, when the swinging-type IC engine is provided, it further undergoes upward and downward motion due to swinging mounting. The discharge system directly connected to the IC engine directly receives such impacts from the IC engine. Thus, the discharge system requires a rigid and secure mounting.

30 [0005] Moreover, the discharge system has to perform optimally in order to treat exhaust gases without any failure of the system even under severe usage conditions.

For example, a poor ground clearance may damage the discharge system, which is substantially at a lower portion on the vehicle affecting the performance of the discharge system. So, in addition to treatment of burnt gases effectively, there is need for accommodating the discharge system securely.

5

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The detailed description is described with reference to the accompanying figures. The same numbers are used throughout the drawings to reference like features and components.

10

[0007] Fig. 1 depicts a left side view of an exemplary motor vehicle, in accordance with an embodiment of the present subject matter.

[0008] Fig. 2 illustrates a right side view of a frame member with power unit, in accordance with an embodiment of the present subject matter.

[0009] Fig. 3 depicts a portion of the power unit, in accordance with an embodiment of the present subject matter.

15

[00010] Fig. 4 depicts a sectional view of a portion of the power unit taken along axis X-X' of Fig. 3, in accordance with an embodiment of the present subject matter.

[00011] Fig. 5 depicts an exploded view of a portion of the discharge system, in accordance with an embodiment of the present subject matter.

20

[00012] Fig. 6 (a) depicts a front perspective view of the discharge system and a sectional view taken along axis P-P', in accordance with an embodiment of the present subject matter.

[00013] Fig. 6 (b) depicts a detailed sectional view of a portion of the discharge system of Fig. 6 (a), in accordance with an embodiment of the present subject matter.

25

[00014] Fig. 7 depicts a front view of a portion of a motor vehicle mounted with the power unit, in accordance with another embodiment of the present subject matter.

30

[00015] Fig. 8 depicts a graphical representation of conversions efficiency of treatment device plotted against time.

DETAILED DESCRIPTION

[00016] Conventionally, motor vehicles are provided with a treatment device for treating the exhaust gases before they leave the discharge system. This treatment device requires certain light-off temperature for it to be functional. However, vehicles with a power unit that generates less heat or in case of conventional engines during start, especially during cold start, the power unit would not be able to produce sufficient heat for a treatment device to reach the activation temperature. This would result in the burnt gases leaving the power unit without treatment or conversion whereby harmful gases might get released into the atmosphere. Generally, the harmful gases that are produced may include various harmful components including total hydrocarbons (THC), carbon monoxide (CO), and nitrogen oxides (NO_x). Thus, there is a need for attaining early activation of the treatment device to reduce emission of harmful gases.

[00017] For example, considering a low exhaust flow type power unit, say vehicles that operate at relatively low engine rotations per minute (RPM) with single speed, which is used in high torque applications - with a low capacity power unit, the temperature at the exhaust is low. So, the treatment device would take time to attain the light-off temperatures. This would result in poor performance of the treatment device with poor conversion efficiency thereby resulting in emission of untreated gases. Fig. 8 depicts a graphical representation of the conversion efficiency of a treatment device plotted against time. Curve A depicts the conversion efficiency of the treatment in the discharge system as per the design(s) known in art and as explained above. As can be seen, referring to Curve A, for the treatment device to reach the saturation, which is the stabilized conversion point, it takes more time. Especially, during initial operating condition of the power unit, the conversion is poor resulting in harmful gasses reaching the atmosphere.

[00018] Moreover, in general, the treatment device is disposed either in in discharge pipe or in muffler body. If the treatment device is disposed in the muffler body, the muffler body being away from the combustion chamber & its exhaust port / pipe, there would be drastic drop in temperature which would delay the activation

of the treatment device. Whereas, a treatment device mounted in the discharge pipe would either take large volume in discharge pipe or would require widening of the discharge pipe, which adversely effects the vehicle layout as well as performance of the powertrain as a whole. Additionally, in vehicles having a power unit disposed at a lower portion, like the forward inclined engine vehicles, the ground clearance would be affected. Also, widening of the discharge pipe would further reduce the ground clearance due to widening of the discharge pipe in up-down direction, which is not desirable, especially in a vehicle with the engine disposed at substantially lower portion. Moreover, such a problem would be applicable to vehicles having a vertical or slightly forward inclined engine as the front wheel, front fender, frame member-portion that supports the power unit in front portion (which extend downward from head tube) are in the vicinity of the discharge pipe leading to clearance issue. Such vehicles have a very stiff challenge of achieving compact vehicle width, compact vehicle length as well as adequate ground clearance along with reasonable utility saddle space. One side the wheel well forms the constraint in terms of the wheel size & the freedom available in the layout space confounded by the saddle utility floor board space maximization with operating ground clearance on the bottom side & comfortable seating height on the top side. Typically, a backbone type frame structure with a substantially forwardly inclined or horizontal powertrain layout disposed below the backbone is attempted to overcome such challenges with the vehicle length / wheel base being an additional challenge in the rear side.

[00019] In some designs known in the art, the treatment device will be welded to the discharge pipe either on both ends or on one end. This, would require careful welding on the discharge pipe without causing deviation of the pipe. Also, this would require replacement of entire discharge pipe, along with the muffler body as the muffler body is also welded to the discharge system, in case of failure of the treatment device. This is not cost effective as the entire discharge system requires replacement making it expensive. In another design known in the art, a treatment device casing is welded to the pipe and the treatment device is disposed within the casing, which would also require replacement of the entire discharge system in case

of failure of the any components like the treatment device. Thus, in either of aforementioned designs, clearance would be affected.

[00020] Further, to maintain ground clearance and for manufacturing feasibility of the discharge pipe, due to the presence of a bend in the discharge pipe very close to the connection of cylinder-head side of the discharge pipe, the treatment device is disposed subsequent to the bend. Due to disposition of the treatment device away from the discharge port, the time taken for treatment device to reach its activation temperature will get delayed adversely affecting efficiency of the treatment device. Further, such designs would require heating of the treatment device using heating systems like coils or through known process. Such heating systems require additional accommodation space near the treatment device, which would affect the ground clearance or part clearance with other components, which is not desirable.

[00021] Moreover, some vehicles have a discharge pipe with smaller diameter and accommodation of treatment device in such discharge pipes would require using of longer treatment device that has to be disposed after the bend (the bend here is on the discharge pipe near to the cylinder connection portion) and the treatment device would have to be accommodated along a substantial length, which may result in non-uniform heating again leading to poor efficiency of the treatment device. Moreover, a treatment device with a larger volume, having bigger diameter, would have inadequate operating layout clearance related short comings as discussed above. In such systems, to improve efficiency of the treatment device, a higher coating volume may be used, which would increase the cost of the treatment device. However, during failure of the treatment device, the entire discharge system has to be replaced, making a cost ineffective system.

[00022] Hence, there is a need for addressing the aforementioned and other shorts comings in the prior art. Thus, there is a need for treating the exhaust gases effectively before emitting into the atmosphere. The treatment device is to be securely accommodated in the discharge pipe with early light-off of the treatment device and at the same time, the discharge system is to be optimally disposed without affecting ground clearance and/or interference with other ancillary systems.

[00023] The present subject matter provides a discharge system of a power unit for a motor vehicle. The motor vehicle comprises a power unit including an internal combustion (IC) engine. A cylinder-head of the IC engine includes a discharge port provided towards at least one side thereof. The discharge system includes a
5 discharge pipe having one end connected to the discharge port and other end connected to a muffler.

[00024] In one embodiment, the power unit is a forwardly inclined type, having a cylinder axis/ piston axis being forwardly inclined, that is fixedly mounted to a frame member of the motor vehicle. Accordingly, the power unit is mounted to a
10 lower portion of the frame member.

[00025] The present subject matter having a power unit including an air intake system and a discharge system. The intake system includes an air control apparatus, which is capable of providing regulated air and fuel into the combustion chamber, through an intake port. Similarly, the discharge system is connected to discharge
15 port for scavenging of the burnt gases from the combustion chamber.

[00026] The power unit includes a cylinder portion defined by a cylinder block mounted to a crankcase of the power unit. One end of the cylinder portion is defined by the cylinder-head and the cylinder-head supports a valve assembly. The valve assembly includes at least one intake valve and at least one exhaust valve. An intake
20 passage defines a path between an intake connecting portion and the at least one intake valve. A discharge port defines a path connecting a discharge-connecting portion to the at least one exhaust valve. The discharge system is connected to be in fluid communication to the discharge port through the discharge-connecting portion.

[00027] The discharge system includes a muffler body disposed at the downstream end portion thereof. An upstream end portion of the discharge system is in fluid communication with the at least one discharge port of the cylinder-head. The discharge system includes a discharge pipe and a sleeve member, wherein the discharge pipe is disposed downstream of the sleeve member.
25

[00028] The discharge system includes a discharge passage, disposed in fluid communication with the discharge port, is connecting the cylinder-head to at least
30

one muffler body. The discharge passage includes a discharge pipe forming at least a portion thereof.

[00029] At least one treatment device forming at least a portion of the discharge passage is disposed at an upstream end of the discharge pipe and at a downstream end portion of the discharge port. At least a portion of the treatment device is annularly enclosed by at least a portion of the cylinder-head forming the discharge port. It is a feature of the present subject matter that the treatment device can be compactly and securely accommodated even before a first bend of the discharge pipe. Further, the treatment device is disposed close to the discharge port thereby resulting in early light-off.

[00030] The discharge system includes a first treatment device that is capable of treating burnt gases that are leaving the cylinder-head and the first treatment device is mouth mounted to the cylinder-head. The cylinder-head is adapted to support the treatment device with a cross-sectional area of the discharge passage increasing/flaring in the downstream direction with at least a portion matching an outer diameter/ diameter of the treatment device. Thus, it is an aspect of the present subject matter that the treatment device is disposed in proximity to the exhaust valves thereby enabling early activation of the treatment device.

[00031] It is a feature of the present subject matter that the cross-sectional area of the discharge passage that is adapted to at least partially support the treatment device enables complete utilization of the area of the treatment device as the area of the exhaust gases leaving the discharge passage and the area of the exhaust gases entering the treatment device is substantially same.

[00032] The treatment device is disposed at the mouth of the discharge passage is having at least a portion mounted to the discharge passage and the remaining portion of the treatment device is configured to be within the discharge system. It is a feature of the present subject matter that the treatment device is optimally configured within the discharge system.

[00033] In one embodiment, the sleeve member annularly encloses the treatment device, wherein an upstream end of the sleeve member abuts at least a portion of the cylinder-head forming a tight seal therebetween. Thus, the present subject

matter causes the burnt gases or the exhaust gases leaving the cylinder-head to enter the treatment device even before completely leaving the discharge passage. It is an aspect that even during starting of the power unit, the exhaust gases passing through the discharge pipe itself cause heating of the treatment device leading to early light-off.

[00034] It is a feature of the present subject matter that according to one embodiment, the flaring of the discharge passage in downstream portion improve the time the exhaust gasses spend while passing through the treatment device. Thus, the treatment device is effectively used for treatment of the gasses. In one implementation, the flaring of the discharge passage is made to be gradual thereby the exhaust gases flowing therethrough follow the change in cross-section and thereby entering the treatment device having similar cross section resulting in improved treatment device utilization or uniformity.

[00035] The flaring of the discharge passage can be adapted to suit the power unit design irrespective of the capacity of the power unit without affecting the performance thereof.

[00036] In one embodiment, at least one sealing member is disposed between contact surfaces of the sleeve member and the cylinder-head, wherein the sealing member can have one or more contact surfaces. For example, the sealing member can be a disc, a cylinder, or a combination of disc and cylinder.

[00037] In one embodiment, a downstream end portion of the sleeve member includes a first flange portion extending in radial direction thereof. Similarly, an upstream end portion of the discharge pipe is provided with a second flange portion, wherein the second flange portion is secured to the first flange portion. Further, an interfacing member is disposed between the first flange portion and the second flange portion enabling leak-proof flow of exhaust gases therebetween.

[00038] It is a feature that the sleeve member acts as a protective casing for the treatment device for protecting the treatment device from physical damages or from external factors that would affect the functionality.

[00039] The sleeve member can be a casted part, a molded part, a welded sheet metal part, a cured part made of rigid material including any known metal or a fiber reinforced plastic.

5 [00040] It is a feature that the sleeve member at least partially surrounds the treatment device annularly with a clearance provided therebetween that acts as a thermal seal thereby retaining the temperature of the treatment device. Also, the treatment device is protected from any direct contact.

[00041] In one embodiment, the treatment device has a downstream end supported by the sleeve member and the upstream end supported by the cylinder-head. However, in another embodiment, the treatment device has a downstream end
10 supported by the interfacing member and the upstream end supported by the cylinder-head. Thus, the treatment device is having at least a portion sandwiched between the cylinder-head and the discharge system thereby securely and compactly mounting thereat.

15 [00042] It is a feature of the present subject matter that the treatment device can be before a first bend of the discharge pipe without compromising on ground clearance or interference with other components.

[00043] The present subject matter enables accommodation of the treatment device closer to the cylinder portion, at least partially being accommodated within
20 the discharge passage, thereby suppressing extension of the discharge pipe.

[00044] For example, in a forwardly inclined type power unit, the treatment device accommodated at least partially in the discharge passage as per the present subject matter suppresses swelling of the discharge pipe downward direction. Further, in a power unit having the discharge-connecting portion disposed slightly towards the
25 vehicle lateral side, the present subject matter suppresses the swelling of the discharge pipe in vehicle lateral direction.

[00045] It is an aspect of the present subject matter that the treatment device is disposed before a first bend in the discharge pipe. This can be a first treatment device, which can be a preliminary treatment device or a primary treatment device.
30 For example, if a preliminary treatment device is disposed as per the present subject matter, the primary treatment device may be disposed subsequent to the first bend

or at any point on the rest of the discharge pipe offering as ample length of the discharge pipe is available due to the compact design of the discharge system of the present subject matter.

[00046] It is an aspect that, even in vehicles having the power unit disposed at a lower portion of the body frame, the ground clearance would not be affected as at least a portion of the treatment device is accommodated in the discharge port and is disposed before the first bend, wherein the first bend would be one of the lower points of the vehicle. Thus, clearance of the vehicle is not affected and at the same time the treatment device is securely disposed away from any impacts due to bumps or uneven terrains.

[00047] It is another aspect that the need for welding using an adapter or otherwise for accommodating the treatment device, whereby weak points due to welding or the need for welding itself is eliminated. Thus, the present subject matter is cost effective as it eliminates need for additional adapter and the need for welding or the like thereby saving time and cost.

[00048] It is a feature of the present subject matter that the treatment device is disposed upstream of the discharge pipe, the discharge pipe can have a smaller diameter, especially for vehicles having low floor board, whereby desired ground clearance is also achieved due to smaller diameter discharge pipes. Also, use of smaller diameter discharge pipes saves material cost.

[00049] Furthermore, the scope of the present subject matter is not limited to a discharge system having a preliminary treatment device disposed in the discharge pipe and the primary treatment device disposed in the muffler. As it is applicable to a discharge system having one of the primary treatment device or the preliminary treatment device being disposed in the discharge pipe and the other of the primary treatment device or the preliminary treatment device being disposed in the first portion, as the first portion is capable of accommodating any of the treatment device.

[00050] These and other advantages of the present subject matter would be described in greater detail in conjunction with an embodiment of a two wheeled saddle type vehicle with the figures in the following description.

[00051] Arrows wherever provided in the top right corner in the drawings depicts direction with respect to the vehicle, wherein an arrow F denotes front direction, an arrow R indicates rear direction, an arrow UP denotes upward direction, an arrow DW denotes downward direction, an arrow RH denotes right side, and an arrow LH denotes left side.

[00052] Fig. 1 illustrates a left side view of an exemplary two-wheeled vehicle, in accordance with an embodiment of present subject matter. The vehicle 100 has a frame member 105, which acts as a structural member of the vehicle 100. The frame member 105 includes a head tube 106 through which a steering assembly is rotatably journaled. The steering assembly includes a handle bar assembly 110 connected to a front wheel 115 through one or more front suspension(s) 120. A front fender 125 covers at least a portion of the front wheel 115. Further, the frame member 105 includes a main frame 107 extending rearwardly downward from the head tube 106. A fuel tank 130 is mounted to the main frame 107 (also referred as backbone frame) at a downward extending portion thereof. Furthermore, the main frame 107 extends substantially horizontally rearward from a rear portion of the downward extending portion of the main frame 107, which is referred to as a down frame 108. In addition, the frame member 105 includes one or more rear frame(s) 109 that extends inclinedly rearward from a rear portion of the down frame 108. In a preferred embodiment, the frame member 105 is a mono-tube type or single tube back-bone type, which extends from a front portion F to a rear portion R of the vehicle 100. In a preferred embodiment, the frame member 105 is having a single tubular frame structure with a back-bone type structure.

[00053] The power unit 200 is mounted to the down frame 108. In an embodiment, the power unit 200 includes an IC engine with at least one cylinder & operating with lower top engine RPM, with higher low end torque configuration with a single speed transmission. In another embodiment, the power unit 200 also includes an electric motor operated in conjunction with the IC engine. The fuel tank 130 is functionally connected to the power unit 200. In a preferred embodiment, power unit is forwardly inclined type i.e. a piston axis of the engine is forwardly inclined. The power unit 200 is functionally coupled to a rear wheel 140 through a

transmission system. A swing arm 145 is swingably connected to the frame member 105 and the rear wheel 140 is rotatably supported by the swing arm 145. One or more rear suspension(s) 150, which are connecting the swing arm 145 at an angle, to sustain both the radial and axial forces occurring due to wheel reaction, are secured to the frame member 105. A rear fender 155 is disposed above the rear wheel 140 is capable of covering at least a portion of the rear wheel 140. A seat assembly 160 is disposed rearward of a step-through portion 170 of the vehicle. A floorboard 165 is mounted to the down frame 108, which is a lower portion of the frame member 105, and is disposed at the step-through portion 170. However, the step-through portion 170 is optional and the space may be filled by a storage member to store luggage or energy storage elements. In an embodiment, the seat assembly 160 includes a rider seat 161, and a pillion seat 162 and is positioned substantially above the rear wheel 140. The floorboard 165 covers at least a portion of the power unit 200. Further, the vehicle 100 is provided with at least one set of foot-rest(s) 180 for the rider/pillion to rest their feet.

[00054] The power unit 200 includes an air intake system (not shown), a discharge system 205 (shown in Fig. 2). The intake system includes an air fuel control device that is capable of providing regulated air flow and fuel into the combustion chamber through an intake port. Similarly, the discharge system 205 is connected to the discharge port 261 (shown in Fig. 4) for scavenging of the burnt gases from the combustion chamber.

[00055] Fig. 2 illustrates a right side view of the frame member 105 having the power unit 200 suspended thereto, in accordance with an embodiment of the present subject matter. The power unit 200 includes a cylinder portion (not shown) defined by a cylinder block 220 and the cylinder block 220 is mounted to a crankcase 221 of the power unit. The cylinder block 220 supports a cylinder-head 222 that includes a valve assembly. In the present embodiment, a single cylinder type power unit is depicted. However, the present subject matter is applicable to multi-cylinder type power units. The valve assembly includes at least one intake valve 236 (shown in Fig. 4) and at least one exhaust valve 260 (shown in Fig. 4), which enable entry of air-fuel mixture into the cylinder portion through an intake port and scavenging of

burnt gases from the cylinder portion through a discharge port. In the present embodiment, the power unit 200 is suspended from the frame member 105 at a lower portion 108 of the frame member 105, which is the down frame 108 in the present embodiment. The discharge system 205 is connected to the discharge port at a discharge-connecting portion 226 (shown in Fig. 5) and the discharge system 205 extends sideward and rearward towards a rear portion of the vehicle 100. The discharge system 205 includes a muffler body 270 disposed at the downstream end portion of the discharge system 205, wherein the muffler body 270 is capable of attenuating noise generated during combustion process and also the muffler body 270 is capable of accommodating at least one another exhaust treatment device therein. Further, in the power unit 200, as shown in Fig. 2, an air control apparatus including a throttle body or a carburettor 195 is disposed at an upward portion thereof.

[00056] In the depicted embodiment, the discharge system 205 extends from the cylinder-head 222 downward of the foot-rest 180 and downward of cooling cowl 224 of the power unit 200. The cooling cowl 224 covers at least a portion of the power unit 200 for providing forced air cooling through a cooling fan. (not shown).

[00057] In the depicted embodiment, the power unit 200 is secured to the frame member 105 through a mounting bracket 190, which is secured to the down frame 108 (as shown in Fig. 1). The mounting bracket 190, is also capable of supporting a large capacitive discharge ignition (CDI) coil. The CDI coil Mounting scheme is configured without affecting the interfacing parts. An additional CDI-bracket may be used to mount the CDI coil without interfering with the packaging of other components. This provides ease of accessibility, assembly & service. Also, the CDI coil can separately be accessed.

[00058] In another embodiment, the power unit 200 may be swingably connected to the frame member 105, and the connection is made at a substantially lower portion of the frame member 105.

[00059] The discharge system 205 includes a discharge passage 204, which functionally connects the muffler body 270 to the cylinder-head 222. The discharge passage 204 includes a discharge pipe 210 having a downstream end portion

connected to the muffler body 270. An upstream end portion 211 of the discharge system 200 is in fluid communication with the discharge port 261 (shown in Fig. 4) through a sleeve member 215 (shown in Fig. 3). In one embodiment, the discharge pipe 210 along with the sleeve member 215 are secured to the cylinder-head 222 at the connecting portion of the cylinder-head 222.

[00060] Fig. 3 shows a detailed view of the cylinder-head and a portion of the discharge system in accordance with an embodiment of the present subject matter. Fig. 4 shows a sectional view of the discharge system with the section taken along axis X-X', in accordance with the embodiment of Fig. 3. The discharge system 205 includes a first treatment device 250 that is capable of treating burnt gases that are leaving the cylinder-head 222. The first treatment device 250 is disposed in proximity to the discharge port 261 so that the treatment device 250 can attain early light-off even in cold start conditions.

[00061] Further, the treatment device 250 is capable of treating the burnt gasses, conventionally referred to as exhaust gasses, that pass therethrough. The treatment device 250 constitutes a mantle 251 and a substrate 252 (shown in Fig. 6 (b)). The mantle 251 acts as a casing and a structural member that holds the substrate 252. The substrate 252 of the treatment device 250, typically, supports catalytic material like platinum or any other alternate material(s) and the substrate is also referred to as 'treatment device support'. The substrate is capable of offering large surface area. For example, the substrate may have a honeycomb structure. However, depending on the application, the substrate 252 may have any other known structures including at least a first pattern covering certain portion thereof and a second pattern covering the rest of the substrate portion.

[00062] The cylinder-head 222 includes at least one exhaust valve 260 that is timed to open and close according to engine performance requirements using a cam shaft assembly (not shown), which would be mounted on a top-portion 225 of the cylinder-head 222. The cylinder-head 222 includes a spark plug-mounting 235 for securing a spark plug thereat. The discharge port 261 is a portion defined in the cylinder-head 222 that enables passing of the burnt gasses from the cylinder portion to the discharge system 205. In other words, the discharge port 261 is capable of

leading exhaust from a combustion chamber towards an outer side of the cylinder-head 222. The discharge port 261 is having a cross-sectional area 262 increasing in the downstream direction. The cross-sectional area 262 is expanding to match substantially a cross-sectional area/ diameter D1 of the treatment device 250. In other words, the discharge port 261 of the cylinder-head 222 is adapted to flare in downstream direction to match profile/ diameter D1 (shown in Fig. 6 (b)) of the treatment device 250. Thus, the increasing cross-sectional area 262 of the discharge port 261 enables the gases leaving the discharge passage to be completely utilize the area of the treatment device 250 thereby offering improved area utilization or uniformity index.

[00063] As depicted in Fig. 4, the treatment device 250, in accordance with one embodiment, is disposed at discharge port 261. In other words, the treatment device 250 is disposed at the mouth of the discharge port 261 whereby by at least a portion 213 of the cylinder-head 222 annularly surrounds at least a portion 214 of the treatment device 250.

[00064] Further, the sleeve member 215 annularly encloses the treatment device 250, wherein an upstream end 217 of the sleeve member 215 abuts at least a portion of the cylinder-head 222 forming a tight seal therebetween. In one embodiment, a disc type or a pipe type sealing member 218 (shown in Fig. 5) is disposed between contact surfaces of the sleeve member 215 and the cylinder-head 222. Further, the sleeve member 215 includes a cylindrical profile. However, the sleeve member 215 may be adapted to accommodate the treatment device 250, wherein the profile of the sleeve member 215 is having a profile complementing the profile of the treatment device 250. Further, a downstream end portion of the sleeve member 215 includes a first flange portion 216 extending in radial direction thereof. Further, an upstream end portion 211 of the discharge pipe 210 is provided with a second flange portion 212, wherein the second flange portion 212, in an assembled condition, is disposed adjacent to the first flange portion 216. A downstream end portion of the discharge pipe 210 extends rearward of the motor vehicle 100 after taking a first bend 206. Further, an interfacing member 230 is disposed between the first flange portion 216 and the second flange portion 212, enabling leak-proof flow of exhaust

gases therebetween. The interfacing member 230 is sandwiched between the first flange portion 216 and the second flange portion 212. The discharge passage 204 includes the interfacing member 230 to form a fluid connection between a downstream end portion 254 (shown in Fig. 6 (b)) of the treatment device 250.

5 [00065] Fig. 5 depicts an exploded view of a portion of the discharge system, in accordance with an embodiment of the present subject matter. The cylinder-head 222 includes a discharge-connecting portion 226 at which the discharge system 205 gets connected. The discharge-connecting portion 226 includes two or more connecting apertures 227 provided radially outward of the discharge-connecting
10 portion 226. In one embodiment, the connecting apertures 227 are disposed in line and substantially orthogonal to axis of the discharge port 261. In another embodiment, one of the connecting apertures 227 may be disposed outward/inward with reference to another connecting aperture 227.

[00066] The discharge passage 204 has a discharge axis D-D' taken at the
15 treatment device 250, wherein a downstream end portion of the discharge port 261 aligns with the discharge axis D-D' and an upstream portion 211 of the discharge pipe 210 also aligns with the D-D'. Thus, the alignment along the discharge axis D-D' enables streamlined flow of exhaust gases. Also, uniformity of the exhaust gas flow is created from the discharge port 261 to the discharge pipe 210 by offering
20 optimum utilization of the surface of the treatment device 250 due to uniform flow.

[00067] The treatment device 250 is mounted such that the discharge port 261 at least partially covers the treatment device 250. In other words, the treatment device 250 will be mouth mounted to the discharge port 261 (as shown in Fig. 4) whereby it is at least partially located in the discharge port 261. In one embodiment, a
25 substantial portion of the treatment device 250 would be disposed within the discharge port 261 depending on the length and the cross-sectional area of the discharge port 261. Thus, even in vehicle starting condition the temperature around the discharge port would reach higher temperatures quickly which would enable the treatment device to heat up quickly .

30 [00068] Further, the sleeve member 215 is disposed to abut the cylinder-head 222 at the discharge-connecting portion 226, wherein the sealing member 218 is

disposed therebetween. In another embodiment, to improve sealing, the sealing member 218 may be adapted to provide facial/axial abutting and also radial abutting to further improve sealing.

[00069] Further, the discharge pipe 210 is functionally connected to the sleeve member 215 so as to be in fluid communication. In one embodiment, the interfacing member 230 is integrally formed with the discharge pipe 210. Also, the interfacing member 230 includes an extended portion 231 that passes through the flange portion 212 and extending towards other side of the flange portion 212 thereby offering a leak proof structure. Also, a common mounting means e.g. bolts 265 are used to secured the discharge system 205 to the cylinder-head 222. In one embodiment, the common mounting bolts 265 run through the second flange portion 212, and the first flange portion 216, to be secured to the connecting apertures 227. Thus, the common mounting bolts 265 enable in retaining a desired alignment between all the elements forming the discharge pipe 210. As per another embodiment, the mounting means can be studs integrated with cylinder 220.

[00070] Thus, the burnt gases or the exhaust gases leaving the cylinder-head would be entering the treatment device 250 even before completely leaving the discharge port 261 region whereby the exhaust gas before being subjected to temperature reduction due to convection. Further, the widening portion of the discharge port 261 provides increasing cross-sectional area (also referred to as flaring) whereby the amount of the time the exhaust gasses spent while passing through the treatment device 250 is improved. Further, the flaring of the discharge passage can be adapted to suit the power unit design irrespective of the capacity of the power unit without affecting the performance thereof.

[00071] Fig. 6 (a) depicts a perspective view of the discharge system and a sectional view taken along axis P-P', in accordance with an embodiment of the present subject matter. Fig. 6 (b) depicts a detailed view of a portion of the sectional view of the discharge system, in accordance with the embodiment of Fig. 6 (a). In case of a power unit having a forwardly inclined cylinder portion, the discharge port 261 extends either downward or downwardly sideward to which the discharge system 205 is connected. The present subject matter, enables configuration of the

treatment device 250 closer to the cylinder portion. Moreover, even in such forwardly inclined type cylinder portion, the ground clearance is not affected as the treatment device 250 is at least partially disposed within the discharge port 261, whereby the distance between the cylinder portion is reduced and also efficiency of the treatment device is improved.

[00072] Further, considering Fig. 6 (b) in conjunction with Fig. 5, the present subject matter enables replacement of only the treatment device 250 during failure of the treatment device 250. As the treatment device 250 is supported by the sleeve member 215 between the cylinder-head 222 and the discharge pipe 210, the present matter offers enables accessing the treatment for servicing or replacement. Thus, the present subject matter is cost effective as does not require replacement of the entire discharge system when the treatment device fails.

[00073] In one embodiment, the cylinder-head 222 is provided with at least one secondary port 267 at the discharge port 261. The secondary port 267 may be used for mounting an oxygen sensor, a secondary air injector outlet pipe, an exhaust gas recirculation inlet pipe or the like.

[00074] Further, the treatment device 250 is having a first length L1 and the sleeve member is having second length L2, both being axial lengths. In one implementation, the first length L1 and the second length L2 are substantially equal. In the depicted embodiment, the treatment device 250 is disposed outward from the sleeve member 215 with an (axial) offset L3, wherein this enables the treatment device 250 to be mount mounted or disposed in to the discharge port 261. Further, the offset L3 also enables the discharge pipe 210 to be optimally disposed from the ground as it is moved upward. The offset L3 is due to a protruded portion 219 of the treatment device 250.

[00075] The sleeve member 215 substantially annularly encloses the treatment device 250 whereby the treatment device 250 is protected from foreign objects like stones, dirt, or water splash with affecting the physical properties or performance properties of these foreign objects. Consequently, the treatment device 250 is protected from undesirable quenching or cooling. Thus, in spite of the power unit 200 being disposed at a substantially lower portion of the vehicle, and the discharge

system 205 being disposed substantially at a lower portion, the treatment device 250 performance is only improved.

[00076] Moreover, in a naked type vehicle applications having a power unit 200 substantially exposed to atmosphere and the discharge system 205, the treatment device 250 is protected from sudden temperature drop as the sleeve member 215 acts as a thermal seal that retains the temperature around the treatment device 250. Accordingly, the sleeve member 215 acts as a casing and also a protective member. In one embodiment, a gap is maintained in radial direction between the treatment device 250 and the sleeve member 215 thereby offering a thermal seal therebetween & thus any welding is eliminated.

[00077] Furthermore, as shown in Fig. 6 (a), the discharge pipe 210 is having a first bend 206 immediately after the second flange portion, as the present subject matter enables such bend in spite of accommodation of the treatment device 250. Further, the according to the present subject matter, the discharge pipe 210 may have one or more bends 207 depending on the routing thereof and the one or more bends 207 are either in lateral direction or in upward direction. Thus, the present subject matter enables accommodation of the discharge system 205 compactly in the vehicle 100 without affecting the ground clearance and position other ancillary components of the vehicle 100 while achieving good wheel well layout space, compact vertical packaging with low floor board utility space & adequate ground clearance with compact vehicle length / wheel base.

[00078] Fig. 7 depicts a front view of a portion of the vehicle with the power unit, in accordance with an embodiment of the present subject matter. As can be seen, the power unit 200 is forward inclined type. As per an embodiment, the discharge-connecting portion 226 of the discharge port 261 (as shown in Fig. 4) is substantially downward and slightly inclined towards a lateral side. The discharge system 205 is connected to the discharge-connecting portion 226 and is extending downward from the discharge-connecting portion 226 and subsequently extending rearward towards the muffler body 270 of the vehicle 100. Further, the discharge system 205 includes a discharge pipe 210, which is substantially having a uniform diameter. Further, the treatment device 250 mouth mounted or at least partially

mounted to the discharge port 261. The sleeve member 215 and the discharge pipe 210 support the discharge pipe 210 about the discharge port 261. The muffler body 270 is secured to the frame member 105 through the muffler bracket 271.

[00079] As shown in Fig. 7, in a front view of the vehicle, the discharge passage is accommodated substantially inward with reference to an imaginary line 280 passing through an outer lateral periphery of the power unit 200. Thus, growth of the power unit 200 in width direction RH-LH of the vehicle 100 is limited whereby the discharge system 205 is protected from coming contact with any external objects, which may damage the system 204. Also, the treatment device 250, which is an exothermic device is disposed securely away from the foot-rest 180 of rider, thereby improving driving comfort.

[00080] Fig. 8 shows the conversion efficiency of the treatment device plotted against time. The Curve B shows the conversion efficiency of the treatment device in accordance with an embodiment of the present subject matter. As can be seen, the treatment device 250 offers improved conversion efficiency at the time start of the power unit 200. As the treatment device 250 is disposed in proximity to the discharge port 261 (as shown in Fig. 4), the treatment device 250 offers improved conversion efficiency. Further, even in power units having low flow and that operate at lower speeds (RPM), the disposition of the treatment device 250 in proximity to the discharge port 261, offers improved conversion efficiency. Further, the Area C, which is additional area under the Curve B depicts the improved conversions offered by the discharge system 205 of the present subject matter.

[00081] It is to be understood that the aspects of the embodiments are not necessarily limited to the features described herein. Many modifications and variations of the present subject matter are possible in the light of above disclosure. Therefore, within the scope of claims of the present subject matter, the present disclosure may be practiced other than as specifically described.

List of reference signs:

100	vehicle	216	first flange portion
105	frame member	218	sealing member
5 106	head tube	219	protruded portion
107	main frame	35 220	cylinder block
108	down frame/ lower portion	221	crankcase
109	rear frame	222	cylinder-head
110	handlebar assembly	224	cooling cowl
10 130	fuel tank	225	top-portion
140	rear wheel	40 226	connecting portion
145	swingarm	227	connecting aperture
155	rear fender	230	interfacing member
160	seat assembly	235	spark plug-mounting
15 161	rider seat	236	intake valve
162	pillion seat	45 250	first treatment device/ treatment device
165	floorboard	254	downstream end portion
170	step-through portion	260	exhaust valve
180	foot-rest	261	discharge port
20 190	mounting bracket	50 262	cross-sectional area
195	air control apparatus	265	common mounting bolts
200	power unit	270	muffler body
204	discharge passage	280	imaginary line
205	discharge system	L1	first length
25 206	first bend	55 L2	second length
207	bend	L3	offset
210	discharge pipe	D1	diameter
212	second flange portion	D-D'	discharge axis
213	portion (of cylinder head)		
30 214	portion (of treatment device)		

We claim:

1. A power unit (200) for a motor vehicle (100), said power unit (200) comprising:

a cylinder-head (222) including at least one intake port and at least one discharge port (261), said at least one discharge port (261) capable of leading exhaust from a combustion chamber towards an outer side of said cylinder-head (222);

a discharge system (205) connected to said at least one discharge port (261) of said cylinder-head (222) at a discharge-connecting portion (226), said discharge system (205) comprising:

a discharge passage (204), disposed in fluid communication with said discharge port (261), is functionally connecting said cylinder-head (222) to at least one muffler body (270), and said discharge passage (204) includes a discharge pipe (210) forming at least a portion of said discharge passage (204); and

at least one treatment device (250) forming at least a portion of said discharge passage (204) is disposed at an upstream end of said discharge pipe (210) and at a downstream end portion of said discharge port (261), and at least a portion of said treatment device (250) is configured to be mount mounted & annularly enclosed by at least a portion of said cylinder-head (222).

2. The power unit (200) as claimed in claim 1, wherein said discharge system (205) includes a sleeve member (215), said sleeve member (215) capable of at least partially enclosing said treatment device (250), and said sleeve member (215) is secured to said discharge-connecting portion (226) of said cylinder-head (222).

3. The power unit (200) as claimed in claim 2, wherein said treatment device (250) is disposed at an axial offset (L3) with respect to said sleeve member (215), wherein said treatment device (250) at least partially protrudes outward from said sleeve member (215), and a protruded portion (219) of said treatment device (250) is accommodated at said discharge port (216).

4. The power unit (200) as claimed in claim 1, wherein said discharge port (216) of said cylinder-head (222) is adapted to flare in downstream direction to match a diameter (D1) of said treatment device (250).
5. The power unit (200) as claimed in claim 1, wherein said discharge passage (204) includes an interfacing member (230) to form a fluid connection between a downstream end portion (254) of said treatment device (250) with said discharge pipe (210), and wherein a sleeve member (230) of said discharge system (205) at least partially annularly overlaps with said interfacing member (230).
6. The power unit (200) as claimed in claim 5, wherein said interfacing member (230) is sandwiched between said sleeve member (215) and a second flange portion (212) of said discharge pipe (210).
7. The power unit (200) as claimed in claim 5, wherein said discharge passage (204) includes a discharge axis (D-D') taken at the treatment device (250), wherein a downstream end portion of the discharge port (261) aligns with the discharge axis (D-D') and an upstream portion (211) of the discharge pipe (210) aligns with the discharge axis (D-D').
8. The power unit (200) as claimed in claim 1, wherein said discharge system (205) is secured to said cylinder-head (222) secured through one or more common mounting means (265) running through a second flange portion (212), and a first flange portion (216).
9. The power unit (200) as claimed in claim 1, wherein said discharge passage (204) includes a first bend (206) formed on said discharge pipe (210), said treatment device (250) is disposed upstream of said first bend (206), and said first bend (206) formed to change a direction of the discharge passage (204) in at least one of a sideward and a downward direction with respect to said motor vehicle (100).
10. The power unit (200) as claimed in claim 2, wherein said discharge system (205) includes a sealing member (218) disposed between a discharge-connecting portion (226) and said sleeve member (215), and said sealing member (218) provides at least one of an axial abutting and a radial abutting.

11. The power unit (200) as claimed in claim 1, wherein said discharge passage (204) is accommodated substantially inward with reference to an imaginary line (280) passing through an outer lateral periphery of said power unit (200).

12. The power unit (200) as claimed in claim 1, wherein said power unit (200) is forwardly inclined type, said power unit (200) is secured to a lower portion (108) of said frame member (105) by at least one of a fixed mounting and a swingable mounting, said frame member (105) being a single tubular frame, and said power unit (200) is having a high-low end torque at a lower RPM.

13. A motor vehicle (100) comprising:

10 a frame member (105); and

at least one power unit (200), said power unit (200) secured to a lower portion (108) of said frame member (105) by at least one of a fixed mounting and a swingable mounting, said power unit (200) comprising:

15 a cylinder-head (222) including at least one intake port and at least one discharge port (261), said discharge port (261) capable of leading exhaust gas from a combustion chamber towards an outer side of said cylinder-head (222);

a discharge system (205) connected to said at least one discharge port (261) of said cylinder-head (222) at a discharge-connecting portion (226), said discharge system (205) comprising:

20 a discharge passage (204) disposed in fluid communication with said discharge port (261) is connecting said cylinder-head (222) to at least one muffler body (270), and said discharge passage (204) includes a discharge pipe (210) forming at least a portion of said discharge passage (204); and

25 at least one treatment device (250) forming at least a portion of said discharge passage (204) is disposed at an upstream end of said discharge pipe (210) and at a downstream end portion (263) of said discharge port (261), and at least a portion of said treatment device (250) is

configured to be mount mounted & annularly enclosed by at least a portion of said cylinder-head (222).

14. A cylinder-head (222) for a power unit (200), said cylinder-head (222) comprising:

5 at least one discharge port (261) capable of leading exhaust from a combustion chamber of said power unit (200) towards an outer side of said cylinder-head (222); and

a discharge-connecting portion (226) for connecting a discharge system (205) thereat, said discharge system (205) includes
10 a discharge passage (204), at least one treatment device (250) forming at least a portion of said discharge passage (204), and said treatment device (250) is disposed at a downstream end portion (263) of said discharge port (261), and at least a portion of said treatment device (250) is annularly enclosed by at least a portion of
15 said cylinder-head (222), and

said discharge port (261) is adapted to flare in downstream direction to match a diameter (D1) of said treatment device (250).

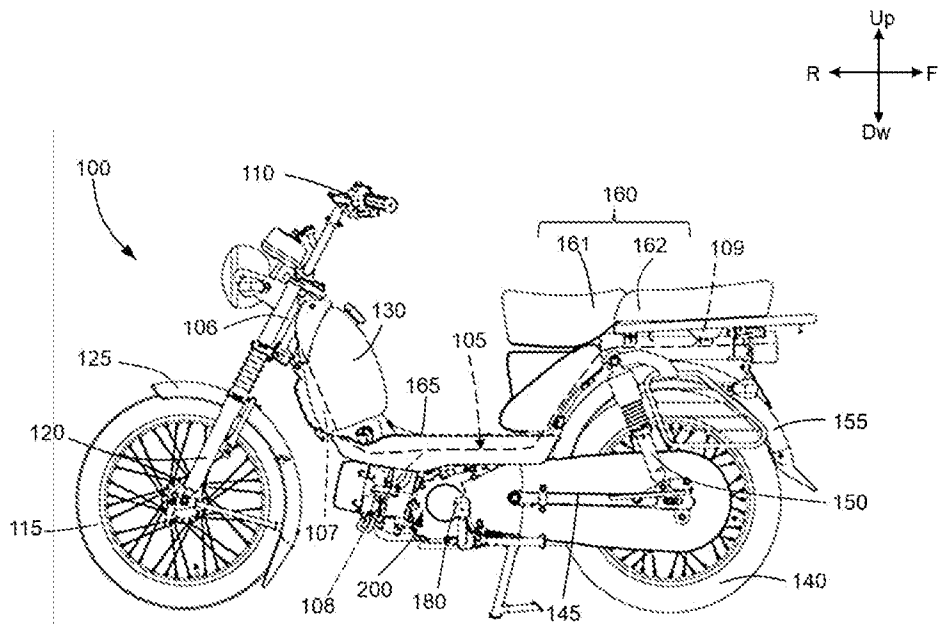


Fig. 1

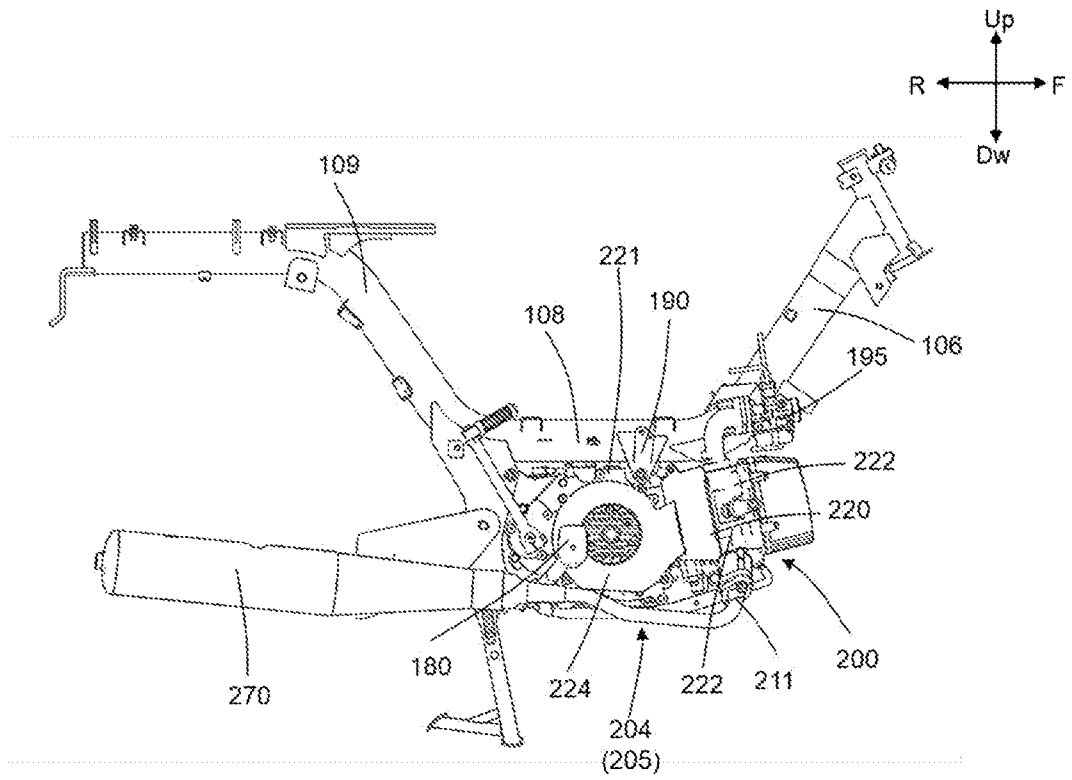


Fig. 2

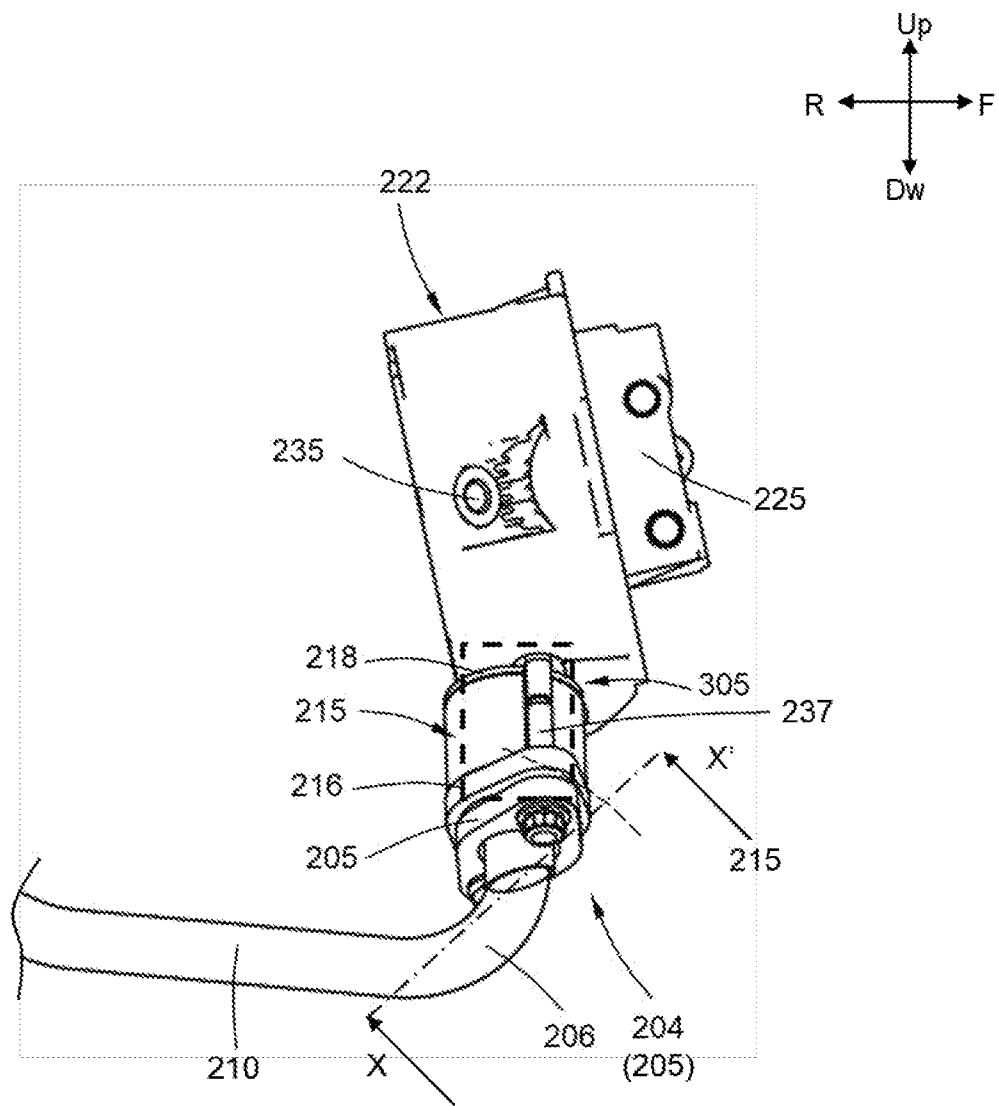


Fig. 3

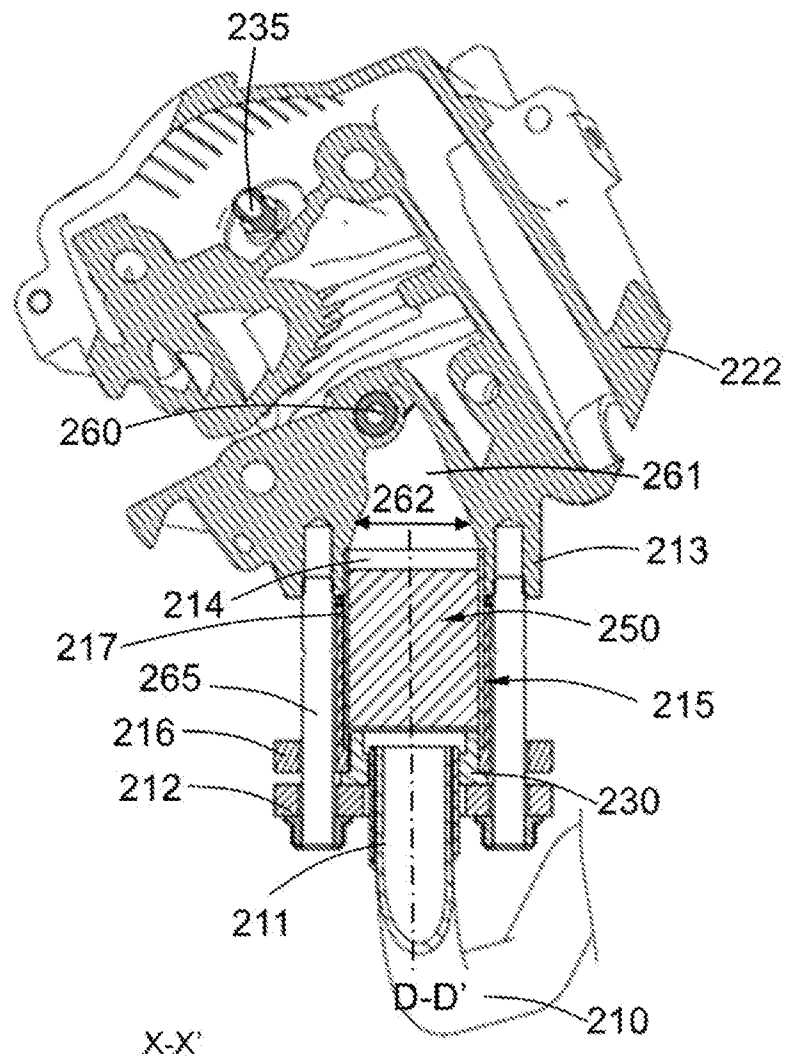
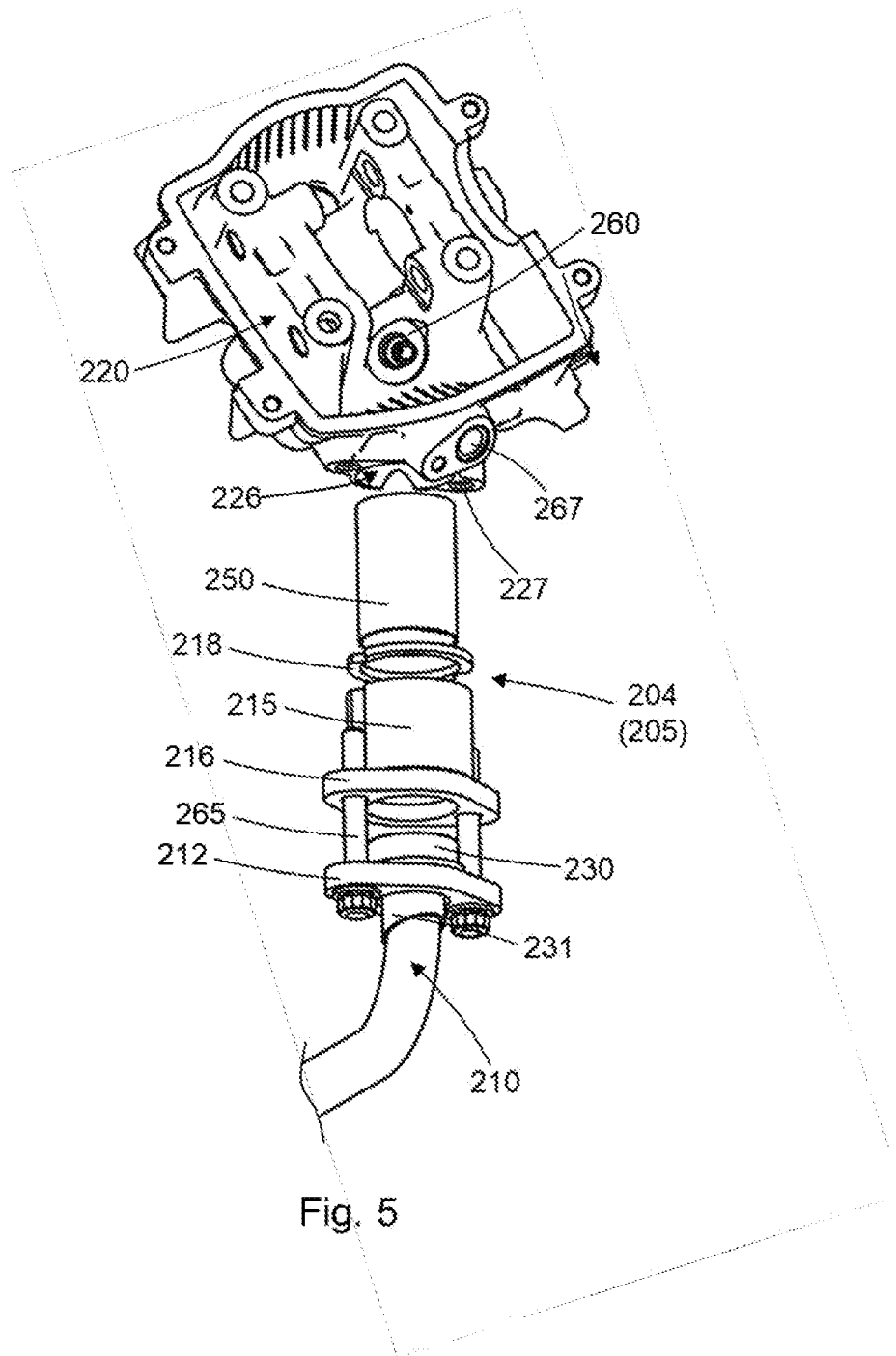
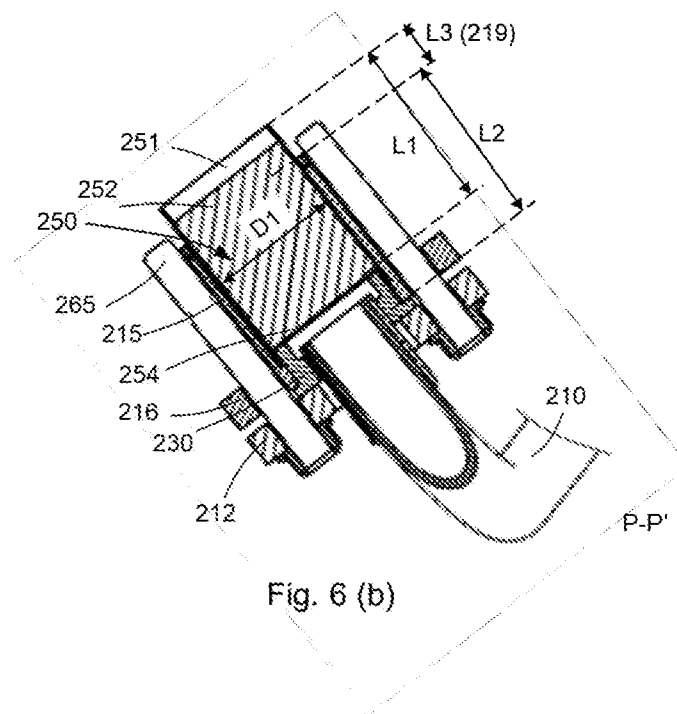
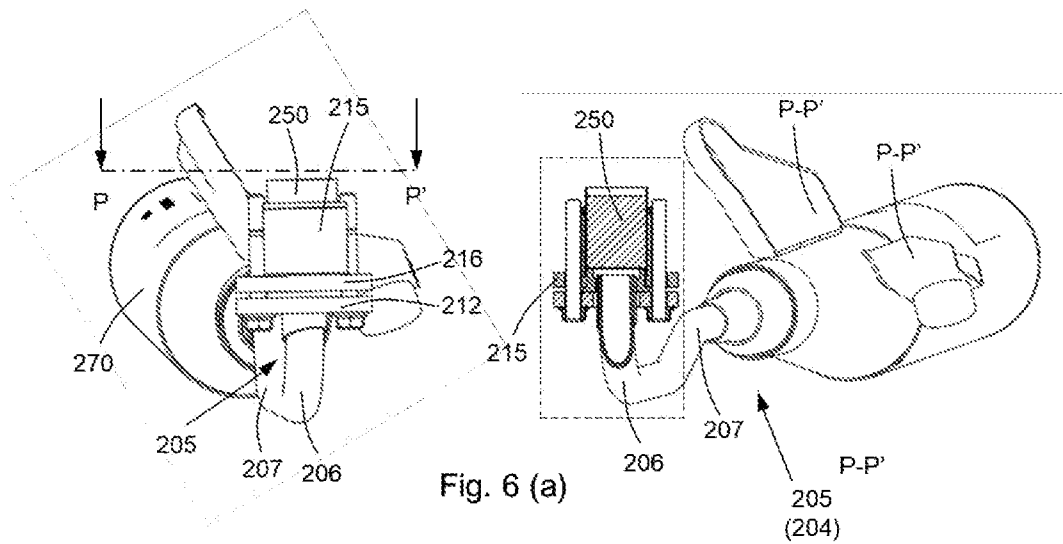


Fig. 4





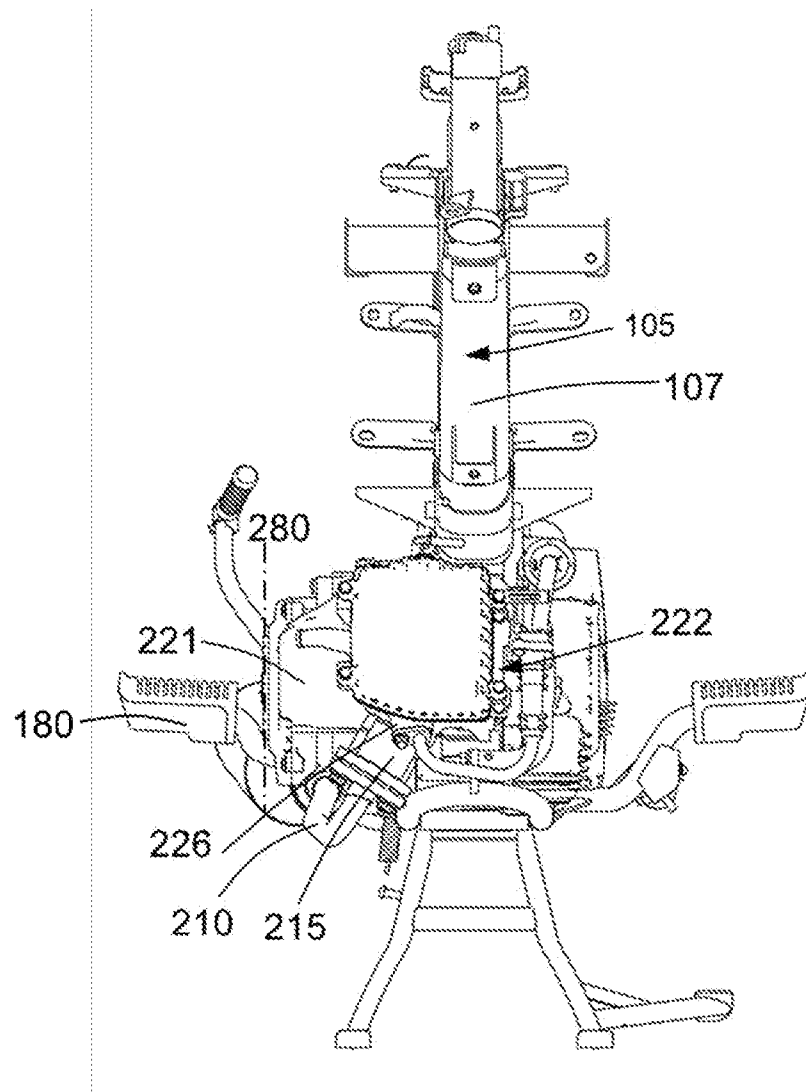


Fig. 7

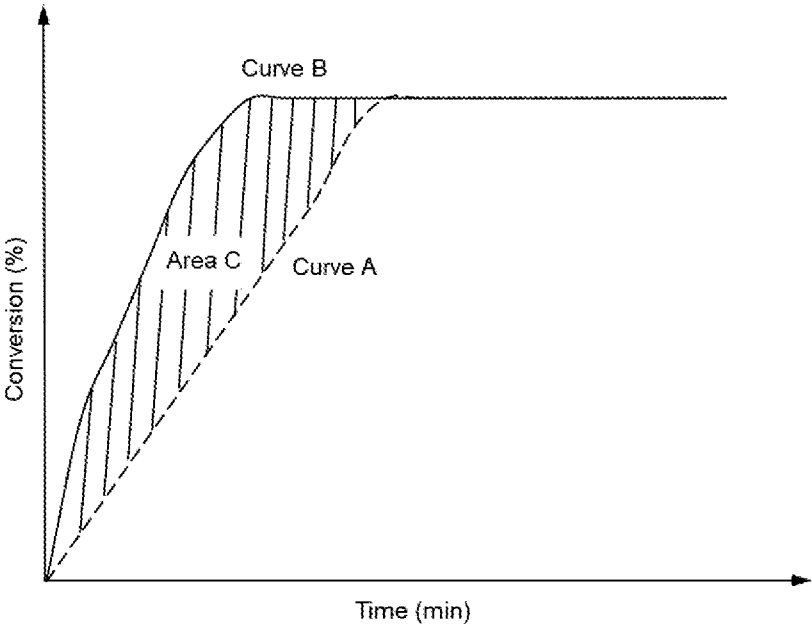


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/IN2020/050254

A. CLASSIFICATION OF SUBJECT MATTER

INV. F01N3/10 F01N3/34 F01N13/00 F01N13/18
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 35 09 969 A1 (ELLES FRIEDRICH) 21 November 1985 (1985-11-21) abstract page 3 claims 1-5 figures 1,2	1,2
X	FR 2 321 591 A1 (HONDA MOTOR CO LTD [JP]) 18 March 1977 (1977-03-18) page 3, line 24 - page 5, line 27 page 7, line 35 - page 8, line 11 figures 1-3 ----- -/-	1,2,4,5, 7,9-14



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 June 2020

Date of mailing of the international search report

11/08/2020

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Ikas, Gerhard

INTERNATIONAL SEARCH REPORT

International application No
PCT/IN2020/050254

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	WO 2020/016829 A1 (PIAGGIO & C SPA [IT]) 23 January 2020 (2020-01-23) paragraphs [0016] - [0020], [0023] - [0026] claims 1-14 figures 1-5 -----	1,2, 7-10,13
A	DE 41 09 847 A1 (DAIMLER BENZ AG [DE]) 1 October 1992 (1992-10-01) column 2, line 18 - line 42 claims 1,2 figures 1,2 -----	1-14
A	US 5 212 949 A (SHIOZAWA SHIGEKI [JP]) 25 May 1993 (1993-05-25) column 4, line 11 - line 49 figures 2,3 -----	1-14
A	JP S52 63509 A (HONDA MOTOR CO LTD) 26 May 1977 (1977-05-26) figures 4,5 -----	1-14
A	JP 2011 174473 A (NGK SPARK PLUG CO) 8 September 2011 (2011-09-08) figures 1-9 -----	1-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IN2020/050254

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 3509969	A1	21-11-1985	NONE
FR 2321591	A1	18-03-1977	DE 2635725 A1 03-03-1977 FR 2321591 A1 18-03-1977 GB 1563338 A 26-03-1980 JP S561452 B2 13-01-1981 JP S5224616 A 24-02-1977 JP S5337227 A 06-04-1978 JP S5650092 B2 26-11-1981 JP S5913292 Y2 20-04-1984 JP S58108224 U 23-07-1983
WO 2020016829	A1	23-01-2020	NONE
DE 4109847	A1	01-10-1992	NONE
US 5212949	A	25-05-1993	JP 2984027 B2 29-11-1999 JP H0427707 A 30-01-1992 US 5212949 A 25-05-1993
JP S5263509	A	26-05-1977	NONE
JP 2011174473	A	08-09-2011	JP 5118231 B2 16-01-2013 JP 2011174473 A 08-09-2011