



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.03.2014 Bulletin 2014/10

(51) Int Cl.:
F01N 13/18 (2010.01)

(21) Application number: **13181211.7**

(22) Date of filing: **21.08.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(30) Priority: **04.09.2012 JP 2012193795**

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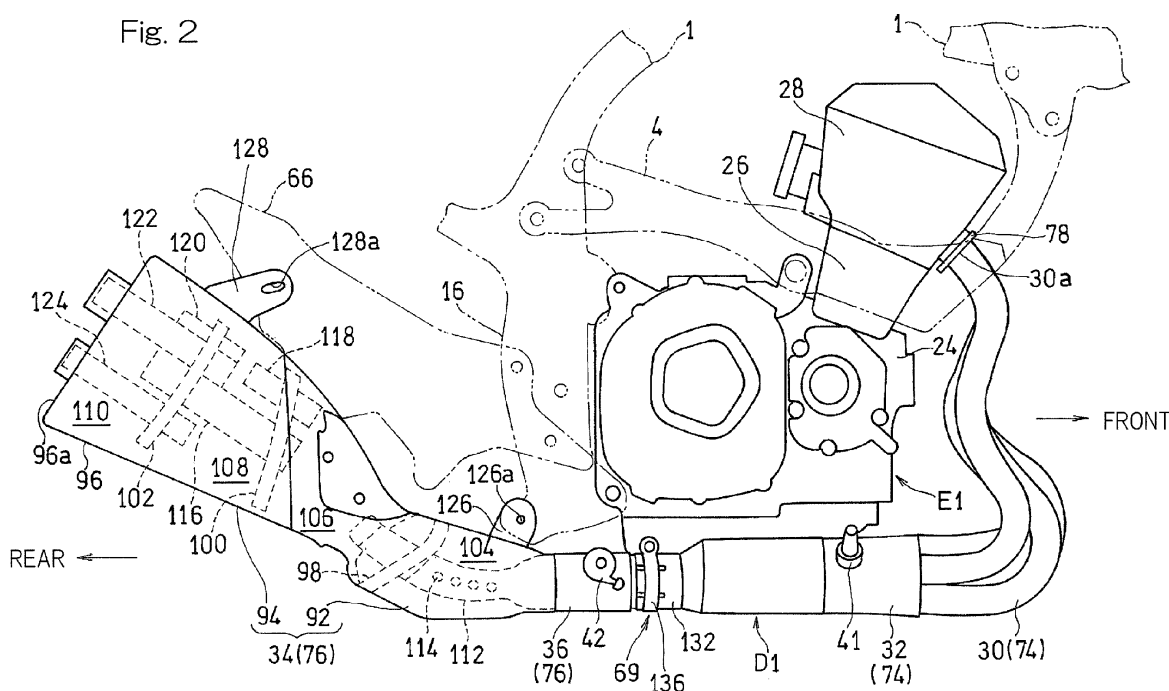
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(54) **Method of making a vehicle**

(57) A method of making first and second vehicles (M1, M2) of different output powers is such that a first exhaust device (D1) for a high output power is connectable with a connecting portion (88) of a first combustion engine (E1) in the first vehicle (M1) and a second exhaust device (D2) for a low output power is connectable with a connecting portion (88A) of the second combustion en-

gine (E2) in the second vehicle (M2), but the first exhaust device (D1) is non-connectable with the connecting portion (88A). The first vehicle (M1) of a high output power is assembled by connecting the first exhaust device (D1) with the first combustion engine (E1) and the second vehicle (M2) of a low output power is assembled by connecting the second exhaust device (D2) with the second combustion engine (E2).

Fig. 2



Description

BACKGROUND OF THE INVENTION

(Field of the Invention)

[0001] The present invention relates to a method of manufacturing a vehicle in a plurality of types having a common engine, to incorporate a different exhaust device, having a different exhaust characteristic.

(Description of Related Art)

[0002] In a vehicle such as, for example, a motorcycle, it is quite often that a plurality of similar types having different engine output powers even though the structure of an engine is common to all of them are made available. In order to change the output power, either modifying the air intake system or modifying the exhaust system (such as disclosed in, for example, the JP Laid-open Patent Publication No. 2002-364331) have been known in the art. By so constructing, without the arrangement of component parts being altered considerably, it is possible to provide a plurality of types of different engine output powers while having the substantially same appearance.

[0003] It has, however, been found that where the intake system is to be modified, the number of testing steps after the modification increases, and also it brings about a considerable impact on the rider's feeling. Where the exhaust system is to be modified, there is a risk that the output power may be modified against the intent of the manufacturer by fitting the exhaust system of a type having a high output power to a type having a low output power.

SUMMARY OF THE INVENTION

[0004] The present invention has been devised in view of the foregoing problems and inconveniences and is intended to provide a vehicle making method and a vehicle group, in which two vehicles having different output powers can be manufactured while the number of steps such as required in, for example, designing and/or testing is suppressed and also in which the modification of the output power against the intent of the manufacturer can be prevented.

[0005] In order to accomplish the foregoing object, the present invention in accordance with a first aspect thereof provides a vehicle making method which includes: a preparatory step of preparing first and second combustion engines having respective connecting portions with exhaust devices, which connecting portions are different from each other, but the remaining portions are formed to have common structures, and two, first and second exhaust devices having different characteristics and corresponding respectively to the first and second combustion engines; and an assembling step of connecting the combustion engines with the corresponding exhaust de-

vices to provide two types of first and second vehicles having different output powers. In such case, during the preparatory step, the first and second combustion engines and the first and second exhaust devices are prepared, in which the first exhaust device for a high output power is connectable with the connecting portion of the first combustion engine, and the second exhaust device for a low output power is connectable, but the first exhaust device is non-connectable, with the connecting portion of the second combustion engine. Also, during the assembling step, the first vehicle of a high output power is assembled by connecting the first exhaust device with the connecting portion of the first combustion engine and the second vehicle of a low output power is assembled by connecting the second exhaust device with the second combustion engine.

[0006] In this instance, the combustion engine referred to hereinbefore and hereinafter is to be understood as represented by an engine body portion including a crankcase, a cylinder block, a cylinder head, a head covering and others, except for an intake system, comprised of an air cleaner, a throttle body and others, and an exhaust system comprised of an exhaust pipe, a muffler and others. It is, however, to be noted that the combustion engine referred to hereinbefore and hereinafter may often include the engine body and an exhaust pipe, which is upstream side portions of the exhaust system.

[0007] According to the first aspect of the present invention, since the first and second combustion engines differ from each other in that they make use of different connecting portions with the exhaust devices, with no need to make the respective structures of the combustion engines markedly different from each other, two vehicles having different output powers can be manufactured and the number of steps required in, for example, designing and testing can be reduced. Also, influences which would be brought on output characteristics can be suppressed merely by differentiating the exhaust devices from each other and not the intake systems from each other. In addition, in the vehicle of a low output power, it is possible to avoid alternation to a high output power against the intent of the manufacturer by preventing the exhaust device for the low output power from being replaced with the exhaust device for the high output power.

[0008] In a preferred embodiment of the present invention, the first and second combustion engines and the first and second exhaust devices are preferably connected with each other by means of coupling or mating structures for connecting one of them with the other. In this case, due to the difference in coupling structure between the first and second combustion engines, the second exhaust device of the low output power is connectable with the connecting portion of the second combustion engine, but the first exhaust device of the high output power is non-connectable with the connecting portion of the second combustion engine.

[0009] According to the foregoing construction, with a simplified structure in which the coupling structures are

differentiated, the exhaust device for the high output power is non-connectable with the second combustion engine for the low output power and, therefore, it is possible to avoid the alteration of the exhaust device for the high output power against the intent of the manufacturer. For the different coupling structures, they include reversal of respective orientations of the male and the female and/or different shapes of a projected portion and a recessed portion. Also, where coupling is made with a flange after the connection, respective positions of bolt holes to be formed in the flange may be differentiated from each other.

[0010] Where the connecting portions are employed, the first and second combustion engine and the first and second exhaust devices are preferably connected with each other through coupling or mating members each having a tubular outer wall engaged in a tubular inner wall. In this case, because the coupling members of the first and second combustion engines are formed having been reversed in orientation relative to each other, the second exhaust device of the low output power is connectable with the connecting portion of the second combustion engine, but the first exhaust device of the high output power is non-connectable with the connecting portion of the second combustion engine. According to this feature, by reversing the respective orientations of the coupling members, not only can the non-interchangeable structure can be realized, but an undesirable increase of the number of component parts can also be suppressed.

[0011] In another preferred embodiment of the present invention, each of the first and second combustion engines preferably include a cylinder head and a first or second exhaust pipe separably connected with the first or second combustion engine and operable to guide exhaust gases, which have been exhausted from the cylinder head, towards the first or second exhaust device. In such case, during the preparatory step, the first and second exhaust pipes are prepared, in which the first exhaust pipe for a high output power is connectable with the cylinder head of the first combustion engine and the second exhaust pipe for a low output power is connectable with the cylinder head of the second combustion engine, but the first exhaust pipe is non-connectable with the cylinder head of the second combustion engine. Also, during the assembling step, the first exhaust pipe is connected with the cylinder head of the first combustion engine to thereby assemble the first vehicle and the second exhaust pipe is connected with the cylinder head of the second combustion engine to thereby assemble the second vehicle.

[0012] According to the above described embodiment, since in addition to the connecting portion between the exhaust device and the combustion engine, including the cylinder head and the exhaust pipe, the connecting portion between the cylinder head and the exhaust pipe are differentiated in structure from each other, the exhaust characteristic of the vehicle can be changed by the change of the exhaust pipe in addition to the change of

the exhaust device. As a result, the change in exhaust characteristic over a wide range can be accommodated.

[0013] Where the connecting portions between the cylinder heads and the exhaust pipes are differentiated in structure from each other, the cylinder heads of the first and second combustion engines are preferably connected with the first and second exhaust pipes, respectively, by means of connecting structures for connecting one of them with the other. In this case, due to the difference in coupling structure between the cylinder heads of the first and second combustion engines, the second exhaust pipe is to be connectable, but the first exhaust pipe is to be non-connectable, with the cylinder head of the second combustion engine. According to this structural feature, since the coupling structures between the cylinder head and the exhaust pipes are different from each other, a non-connectable structure, in which both of the cylinder heads and the exhaust pipes of different types are non-connectable, can be attained and, therefore, it is possible to avoid the alteration of the output power against the intent of the manufacturer.

[0014] A second aspect of the present invention also provides a vehicle group including first and second vehicles having different output power powers, respectively, in which the first vehicle includes a first combustion engine and a first exhaust device for a high output power and the second vehicle includes a second combustion engine and a second exhaust device for a low output power. In such case, the first and second combustion engines have different connecting portions for connection with the first and second exhaust devices, respectively, but have the remaining portions formed to represent a common structure. In this case, the first exhaust device is connectable with the first combustion engine, but non-connectable with the second combustion engine whereas the second exhaust device is formed to be connectable with the second combustion engine.

[0015] According to the second aspect of the present invention described above, since the first and second combustion engines differ from each other in that they make use of different connecting portions with the exhaust devices, with no need to make the respective structures of the combustion engines markedly different from each other, two vehicles having different output powers can be manufactured and the number of steps required in, for example, designing and testing can be reduced. Also, influences which would be brought on output characteristics can be suppressed merely by differentiating the exhaust devices from each other and not the intake systems from each other. In addition, in the vehicle of a low output power, it is possible to avoid alternation to a high output power against the intent of the manufacturer by preventing the exhaust device for the low output power from being replaced with the exhaust device for the high output power.

[0016] Any combination of at least two constructions, disclosed in the appended claims and/or the specification and/or the accompanying drawings should be construed

as included within the scope of the present invention. In particular, any combination of two or more of the appended claims should be equally construed as included within the scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] In any event, the present invention will become more clearly understood from the following description of preferred embodiments thereof, when taken in conjunction with the accompanying drawings. However, the embodiments and the drawings are given only for the purpose of illustration and explanation, and are not to be taken as limiting the scope of the present invention in any way whatsoever, which scope is to be determined by the appended claims. In the accompanying drawings, like reference numerals are used to denote like parts throughout the several views, and:

Fig. 1 is a side view showing a motorcycle which has been assembled according to a vehicle making method in one preferred embodiment of the present invention;

Fig. 2 is a fragmentary side view showing, on an enlarged scale, a combustion engine and an exhaust device both employed in the motorcycle shown in Fig. 1;

Fig. 3 is a fragmentary sectional view showing, on a further enlarged scale, a connection between the combustion engine and the exhaust device;

Fig. 4 is a fragmentary side view showing a coupling between exhaust upstream and downstream portions of the exhaust device;

Fig. 5 is a fragmentary side sectional view showing the coupling shown in Fig. 4;

Fig. 6 is a side view showing another motorcycle which has been assembled according to the vehicle making method in the preferred embodiment of the present invention;

Fig. 7 is a view similar to Fig. 3, but shows the connection between the combustion engine and the exhaust device both employed in the motorcycle shown fragmentarily in Fig. 6;

Fig. 8 is a fragmentary side view showing the coupling between the exhaust upstream and downstream portions of the exhaust device employed in the motorcycle shown in Fig. 6; and

Fig. 9 is a fragmentary side view showing the coupling between the exhaust upstream and downstream portions of the exhaust device shown in Fig. 8.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0018] Hereinafter, a preferred embodiment of the present invention will be described in detail with particular reference to the accompanying drawings. Before the description of the present invention proceeds, it is to be

noted that the terms "left" and "right" are used to denote opposite positions or directions, respectively, relative to a motorcycle rider or motorist then occupying a motorcycle rider's seat and looking forwards in a direction parallel to the longitudinal sense of the motorcycle.

[0019] Referring first to Fig. 1 showing a side view of a motorcycle M1, which is a first vehicle having been assembled according to a vehicle making method which pertains to the preferred embodiment of the present invention. A motorcycle frame structure FR of the first motorcycle M1 includes a main frame 1 which forms a part of a front frame assembly, a rear frame 2 which is rigidly connected with a rear portion of the main frame 1 and forms a part of a rear frame assembly, and a pair of left and right subframes 4 to extend from a front portion of the main frame 1 to a rear portion thereof. The subframes 4 referred to above are positioned laterally outwardly of a combustion engine E1.

[0020] The main frame 1 has a front end portion provided with a head tube 5, and an upper bracket 6 and a lower bracket 8 are supported by this main frame 1a through a steering shaft (not shown) which is rotatably inserted into the head tube 5. A front fork assembly 10 is supported by the upper and lower brackets 6 and 8 with a front wheel 12 rotatably supported at a lower end portion of the front fork assembly 10. A steering handlebar 14 is fitted to the upper bracket 6 at an upper end portion of the front fork assembly 10.

[0021] A rear end portion of the main frame 1 is inclined rearwardly slantwise, and a swingarm bracket 16 is formed at this rear end portion of the main frame 1. A swingarm 18 is pivotally supported by the swingarm bracket 16 through a pivot shaft 20, with a rear wheel 22 rotatably supported by a rear end portion of the swingarm 18. A first motorcycle combustion engine E1, which is a drive source for the motorcycle, is mounted on a substantially or generally intermediate portion of the main frame 1 with respect to the longitudinal sense of the motorcycle, in a fashion tilted forwardly. The rear wheel 22 referred to above is driven by the combustion engine E1 through a transmission member 21 such as, for example, a substantially endless chain.

[0022] The first motorcycle combustion engine E1 referred to above is an internal combustion engine and, in describing the preferred embodiment, is a parallel multi-cylinder, water cooled internal combustion engine such as, for example, a four-cylinder, four-stroke water-cooled internal combustion engine. The first combustion engine E1 includes a crankcase 24, a cylinder block 26 protruding upwardly from the crankcase 24, a cylinder head 28 mounted atop the cylinder block 26, and a head cover 29 positioned above the cylinder head 28 so as to enclose the cylinder head 28. The cylinder head 28 has a rear surface with which an air intake system, including a throttle body 23, having a throttle valve built therein, and an air cleaner (not shown), positioned upstream of the throttle body 23 with respect to the direction of flow of air towards the combustion engine, are fluid connected.

[0023] An exhaust system is fluid connected with a front surface of the cylinder head 28. In other words, four first exhaust pipes 30 are connected with the front surface of the cylinder head 28, and those first exhaust pipes 30 have their downstream ends merged together at a collecting pipe 32. A downstream end of this collecting pipe 32 with respect to the direction of flow of exhaust gases towards the atmosphere and an exhaust muffler 34, disposed on a right side of the rear wheel 22, are communicated with each other through a connecting tube 36. The first exhaust pipes 30, the collecting pipe 32, the exhaust muffler 34 and the connecting tube 36 altogether constitute a first exhaust device D1. A portion of the first exhaust device D1 downstream of the collecting pipe 32 is covered from lateral outer side by a covering 39. The details of the first exhaust device D1 referred to above will be described later.

[0024] An oxygen sensor 41 is mounted on an upstream portion of the collecting pipe 32 for detecting the concentration of oxygen contained in the exhaust gases, and a catalyst unit 40 for substantially removing obnoxious substances contained in the exhaust gases is accommodated within a portion of the collecting pipe 32 downstream of the oxygen sensor 41. The catalyst unit 40 is employed in two in number and those catalyst units 40 are positioned having been spaced a distance from each other in an anteroposterior direction, that is, in a direction parallel to the direction of flow of the exhaust gases. It will readily be seen that with the catalyst unit 40 positioned on the upstream side where the temperature of the exhaust gases is relatively high, the rate of reaction of the catalyst can be improved.

[0025] The connecting tube 36 referred to above has an exhaust valve 42 disposed therein for adjusting the cross sectional area of the exhaust passage, which is leading to the exhaust muffler 34. The provision of the exhaust valve 42 referred to above is effective to optimize the engine performance characteristic by driving the exhaust valve 42 in dependence on an engine operating condition.

[0026] A fuel tank 44 is mounted atop the main frame 1. A headlamp unit 46 is supported at a front surface portion of the front fork assembly 10, and a front cowl or fairing 48 made of a resinous material is supported by the headlamp unit 46 so as to enclose an area forwardly of and above the front fork assembly 10.

[0027] A radiator 50 for dissipating an engine coolant medium such as, for example, water is disposed forwardly above the combustion engine E in a fashion tilted forwards. A pair of left and right cowls 52 are arranged so as to extend from laterally upwardly of the radiator 50 to respective upper end portions of the left and right subframe 4 and laterally outwardly of the front portion of the main frame 1 and are supported by the main frame 1. A lower cowl 54 is supported beneath and on the first combustion engine E1 so as to enclose a lower portion of the first combustion engine E1 from laterally outside.

[0028] A seat assembly comprised of a rider's seat 56

and a fellow passenger's seat 58 is mounted on an upper portion of the rear frame 2. A first control unit CU1 is mounted below the rider's seat 56. Side coverings 60, one on each side of the motorcycle, extend from below the rider's seat 56 towards a rear portion of the cylinder block 26 of the first combustion engine E1 so as to cover rear half portions of the left and right subframes 4 and laterally outer sides of the first control unit CU1 from outside. Subframe covering 62, one on each side of the motorcycle, are supported by the subframe 4 so as to extend from respective front end portions of the associated side coverings 60 to corresponding lower portions of the side cowls 52 to thereby cover the front half portion of the subframe 4 from outside.

[0029] An upper frame covering 64 and a lower frame covering 66 are disposed at upper and lower locations, respectively, with each side covering 60 sandwiched therebetween. The upper frame covering 64 extends from the adjacent side cowl 52 to the associated side covering 60 along a lower edge of the fuel tank 44 to thereby cover the main frame 1 from outside. On the other hand, the lower frame covering 66 extends downwardly from the associated side covering 60 to cover the swingarm bracket 16 from outside.

[0030] A bracket 72 for supporting a brake pedal 68 and a fellow passenger's footrest 70 is fixed to a rear portion of the swingarm bracket 16, and this bracket 72 extends rearwardly and upwardly slantwise from the swingarm bracket 16 along the exhaust muffler 34.

[0031] Referring now to Fig. 2, the first exhaust device D1 has an exhaust upstream section 74, made up of the first exhaust pipes 30 and the collecting pipe 32, and an exhaust downstream section 76 made up of the connecting tube 36 and the exhaust muffler 34, and the exhaust upstream section 74 and the exhaust downstream section 76 are removably connected together by means of a coupling 69, the details of which coupling 69 will be described later.

[0032] The exhaust upstream section 74 is an assembly of the first exhaust pipes 30 and the collecting pipe 32 which are integrated together by means of welding, and is removably connected with the cylinder head 28 of the first combustion engine E1 through connections 78 at respective upstream end portions 30a of the first exhaust pipes 30.

[0033] As shown in Fig. 3, each of the upstream end portions 30a of the first exhaust pipes 30 is formed with an expanded diameter portion 80 formed by expanding a tube diametrically, and an exhaust pipe holder 82 of a substantially collared shape is fixed to an outer peripheral surface of the expanded diameter portion 80 by means of welding. A portion of the outer peripheral surface of the expanded diameter portion 80 upstream of the exhaust pipe holder 82 has a collar 84 fixed thereto by means of welding. The collar 84 has a constant inner diameter and has a sectional shape representing a substantially or generally L-shaped configuration defined by a tubular portion 84a, having a small diameter, and a

collar portion 84b extending from the tubular portion 84a in a radially outward direction and having a large diameter. This collar 84 is welded at an inner diametric surface of the tubular portion 84a to the outer peripheral surface of the expanded diameter portion 80 with a tip end of the tubular portion 84a protruding beyond a tip end of the expanded diameter portion 80. The connection 78 referred to above is constituted by the expanded diameter portion 80, the exhaust holder 82 and the collar 84.

[0034] On the other hand, the cylinder head 28 is formed integrally with a tubular exhaust pipe fitting member 86 having a fitting hole 88 defined therein for receiving the tubular portion 84a of the collar 84, which hole 88 has an inner diameter indicated by d1.

[0035] The exhaust downstream section 76 shown in Fig 2 is an assembly of the connecting tube 36 and the exhaust muffler 34, which are integrated together by means of welding. The exhaust muffler 34 is made up of a chamber portion 92 on an upstream side and a muffler portion 94 on a downstream side. More specifically, the interior of a muffler casing 96 forming the contour of the exhaust muffler 34 is divided by first to third partition wall 98, 100, 102 in the order from front into four interior spaces 104, 106, 108 and 110.

[0036] The interior space 104 positioned foremost is defined generally intermediate between the connecting tube 36 and the first partition wall 98 and forms a chamber compartment 104 in the chamber portion 92. A perforated tube 112 communicated with the connecting tube 36 is communicated with the interior space 106, which defines a first expansion chamber of the muffler portion 94 neighboring rearwardly, after having passed through the chamber compartment 104 and then extending across the first partition wall 98. The perforated pipe 112 has a plurality of communicating holes 114 so that a portion of the exhaust gases flowing through the perforated pipe 112 can flow into the chamber compartment 104 through the communicating holes 114 and can then be expanded and silenced.

[0037] The first expansion chamber 106 of the muffler portion 94 is defined generally intermediate between the first and second partition walls 98 and 100. In this first expansion chamber 106, the exhaust gases flowing therein through the perforated pipe 112 are expanded and silenced. The second partition wall 100 is provided with a first communicating tube 116 for communicating the first expansion chamber 106 with the rearmost interior space 110 and, also, with a second communicating tube 118 for communicating the first expansion chamber 106 with the interior space 108 positioned rearwardly thereof.

[0038] The rearmost interior space 110 is defined generally intermediate between the third partition wall 102 and a rear wall 96a of the muffler casing 96 and forms a second expansion chamber 110 of the muffler portion 94. In this second expansion chamber 110, the exhaust gases flowing from the first communicating tube 116 are expanded and silenced. The third partition wall 102 is provided with a third communicating tube 120 for com-

municating the second expansion chamber 110 with the interior space 108 forming the third expansion chamber of the muffler portion 94.

[0039] The third expansion chamber 108 of the muffler portion 94 is defined generally intermediate between the second and third partition walls 100 and 102. In this third expansion chamber 108, the exhaust gases flowing from the second communicating tube 118 and the third communicating tube 120 are expanded and silenced. The second and third communicating tubes 118 and 120 are disposed so as to face in a direction counter to the flow of the exhaust gases, and the exhaust gases flowing from the first expansion chamber 106 through the second communicating tube 118 and the exhaust gases flowing from the third expansion chamber 110 through the third communicating tube 120 collide against each other to thereby allow the exhaust gases to be further expanded and silenced. The third partition wall 102 is provided with two, fourth and fifth communicating tubes 122 and 124 for communicating the third expansion chamber 108 with the outside of the muffler casing 96 and, accordingly, the exhaust gases expanded and silenced within the third expansion chamber 108 are discharged to the outside after having flown through the fourth and fifth communicating tubes 122 and 124.

[0040] A first mounting piece 126 is fixed to a portion of the outer peripheral surface of the muffler casing 96 adjacent a front end portion thereof by means of welding. This first mounting piece 126 is provided with a bolt insertion hole 126a. Also, a second mounting piece 128 is fixed to a portion of the outer peripheral surface of the muffler casing 96 adjacent a rear end portion thereof by means of welding. The second mounting piece 128 is also provided with a bolt insertion hole 128a. The bolt insertion hole 128a is defined in the form of a slot.

[0041] Referring to Fig. 4, the coupling 69 referred to previously is made up of a male pipe 130, which is a sort of a coupling or mating member provided at an upstream end portion (a front end portion) of the exhaust downstream section 76, and a female pipe 132 which is a sort of a coupling or mating member provided at a downstream end portion (a rear end portion) of the exhaust upstream section 74.

[0042] As best shown in Fig. 5, the male pipe 130 is integrated with the exhaust downstream section 76 with at an outer peripheral surface of the rear end portion thereof fixed to an inner peripheral surface of the connecting tube 36 by means of welding. On the other hand, the female pipe 132 is integrated with the exhaust upstream section 74 with an outer peripheral surface of the front end portion thereof fixed to an inner peripheral surface of the collecting pipe 32 by means of welding. The female pipe 132 has a plurality of cutout grooves 133 defined therein and spaced equidistantly from each other in a peripheral direction thereof for the purpose of facilitating a diametric expansion and a diametric contraction.

[0043] In the description that follows, a method of assembling the first exhaust device D1 and a method of

fitting to the motorcycle body, that is, a vehicle making method will be described. At the outset, as a preparatory step, the exhaust upstream section 74, which is comprised of the first exhaust pipe 30, the collecting pipe 32 (both shown in Fig. 2) and the female pipe 132 (shown in Fig. 4), and the exhaust downstream section 76, which is comprised of the male pipe 130 (shown in Fig. 4), the connecting tube 36 and the exhaust muffler 34, are prepared.

[0044] During an assembling step, as shown in Fig. 5, the female pipe (coupling member) 132 is engaged in an outer periphery of the male pipe (coupling member) 130 through a gasket 134 and an outer periphery of the female pipe 132 is fastened with a clamping member 136 best shown in Fig. 2. By so doing, the exhaust upstream section 74 and the exhaust downstream section 76 are connected together to finish assemblage of the first exhaust device D1.

[0045] Subsequently, the collar 84 of each of the first exhaust pipes 30 is inserted into the corresponding fitting hole 88 in the cylinder head 28 best shown in Fig. 3. A packing 90 is interposed between a tip end face 86a of the exhaust pipe fitting member 86 and a collar portion 84b of the collar 84. By so doing, an upstream end portion (front portion) of the first exhaust device D1 best shown in Fig. 2 is supported by the first combustion engine E1.

[0046] Thereafter, a bolt (not shown) is inserted from the outside of the motorcycle body into the bolt insertion hole 126a in the first mounting piece 126 provided in the exhaust muffler 34 of the first exhaust device D1 and is then firmly threaded into a threaded hole (also not shown) defined in the swingarm bracket 16. By so doing, a substantially intermediate portion of the first exhaust device D1 in the anteroposterior direction comes to be supported by the swingarm bracket 16 of the main frame 1, that is, supported by the motorcycle body.

[0047] Also, the bolt 138 shown in Fig. 1 is inserted from the outside of the motorcycle body into the bolt insertion hole 128a in the second mounting piece 128 provided in the exhaust muffler 34 and is then firmly threaded into a threaded hole (not shown) in the bracket 72 fixed to the swingarm bracket 16. By so doing, the rear portion of the first exhaust device D1 is supported by the motorcycle body. Through those procedures described above, fitting of the first exhaust device D1 to the motorcycle body finishes.

[0048] In the description that follows, a motorcycle M2, which is a second vehicle assembled according to the vehicle making method of the present invention will be described with particular reference to Figs. 6 to 9. It is to be noted that the motorcycles M1 and M2, which are the first and second vehicles, respectively, are similar in type to each other in respect of the component structures and the appearance. Figs. 6 to 9 pertaining to the second motorcycle M2 correspond to Figs. 2 to 5 pertaining the first motorcycle M1 and, therefore, component parts shown in Figs. 6 to 9, which are alike those shown in Figs. 2 to 5 are designated by like reference numerals

and no description of the component parts common to those first and second motorcycles M1 and M2 will be reiterated for the sake of brevity.

[0049] A second combustion engine E2 mounted on the second motorcycle M2 best shown in Fig. 6 is identical with the first combustion engine E1 mounted on the first motorcycle M1 (best shown in Fig. 1), but has an output power set to a small value. In other words, the second combustion engine E2 has its output power suppressed by a second exhaust device D2 and the second motorcycle M2 is different from the first motorcycle M1 in respect of the provision of a second control unit CU2 that is tailored to suit to an output power characteristic of the second exhaust device D2, noting that structural features other than the use of this second control unit CU2 are similar to those employed in the first motorcycle M1.

[0050] With the second vehicle M2 for the low output power having been prepared in the manner described above, on the occasion that a rider such as, for example, a first-timer motorcyclist, who is green in driving with his or her motorcycle, attempts to drive the motorcycle, it is possible to prevent the output power of the vehicle from becoming excessive to thereby suppress a deviance of the vehicle performance against his or her driving skill and expertise. Also, with major components of the second combustion engine E2 of the second vehicle M2 for the low output power and major components of the first combustion engine E1 of the first vehicle M1 for the high output power are uniformized or communized, the respective costs of manufacture of the first and second vehicles M1 and M2 can be individually reduced.

[0051] The first and second combustion engines E1 and E2 differ from each other in connection with only a joint thereof with any one of the first and second exhaust devices D1 and D2, noting that remaining portions are formed to have common structures. More specifically, the inner diameter e2 of the fitting hole 88A in the exhaust pipe fitting member 86A, formed in the cylinder head 28 of the second combustion engine E2 as shown in Fig. 7 is formed to have a value smaller than the inner diameter e1 of the fitting hole 88 in the cylinder head 28 of the first combustion engine E1 as shown in Fig. 3, that is, $e2 < e1$. Other structural features than that described above are common to the first and second combustion engines E1 and E2.

[0052] Also, the inner diameter d2 of each of the second exhaust pipes 30A in the exhaust upstream section 74A of the second exhaust device D2 shown in Fig. 7 is also formed to have a value smaller than the inner diameter d1 of each of the first exhaust pipes 30 shown in Fig. 3, that is, $d2 < d1$, and, in correspondence therewith, the outer diameter f2 of the collar 84A of the second exhaust device D2 shown in Fig. 7, too, is formed to have a value smaller than the outer diameter f1 of the collar 84 shown in Fig. 3, that is, $f2 < f1$. With the inner diameter d1 of each of the first exhaust pipes 30 chosen to be greater than the inner diameter d2 of each of the second exhaust pipes 30A in this way, the exhaust passage is widened and,

despite of the common combustion engine, the output power of the first vehicle M1 increases.

[0053] Also, the outer diameter $f1$ of the tubular portion 84a of the collar 84 of each of the first exhaust pipes 30 is set to a value greater than the inner diameter $e2$ of the fitting hole 88A of the cylinder head 28 shown in Fig. 7 and cannot be inserted into the fitting hole 88A of the second combustion engine E2. In other words, each of the first exhaust pipes 30 shown in Fig. 3 cannot be fitted to the second combustion engine E2 shown in Fig. 7.

[0054] In addition, a second communicating tube 118A of the muffler 34A in the exhaust downstream section 76A of the second exhaust device D2 shown in Fig. 6 have its opposite ends closed so that a portion of the exhaust gases will not flow from the first expansion chamber 106 to the third expansion chamber 108. In other words, the muffler 34A of the second exhaust device D2 has a flow path narrower than that of the muffler 34 of the first exhaust device D1 shown in Fig. 2 and the output power is correspondingly reduced. With a minimum modification having been applied to the muffler 34 in the manner described above, the output power can be suppressed while the common combustion engine is equipped and, therefore, the number of designing steps and of testing steps can be reduced.

[0055] Yet, the connecting tube 36 of the second exhaust device D2 shown in Fig. 6 is not provided with any exhaust valve. The second exhaust device D2 has its output power lowered as compared with that of the first exhaust device D1 shown in Fig. 2 and, therefore, demands for optimization of characteristics with the use of the exhaust valve are not so strong and the cost can be reduced.

[0056] As shown in Figs. 8 and 9, a coupling 69A present at an intermediate portion of the second exhaust device D2 includes a male pipe 130A, which is a sort of a coupling member provided at a downstream end portion (rear end portion) of the exhaust upstream section 74A, and a female pipe 132A which is a sort of a coupling member provided at an upstream end portion (front end portion) of the exhaust downstream section 76A. In other words, against the coupling 69 of the first exhaust device D1 shown in Fig. 1, the male pipe 130 and the female pipe 132 are reversed relative to each other. Accordingly, the respective exhaust upstream sections 74 and 74A of the first and second exhaust devices D1 and D2 and the respective exhaust downstream sections 76 and 76A of the first and second exhaust devices D1 and D2 are non-interchangeable relative to each other.

[0057] It is to be noted that the first combustion engine E1 may include the exhaust upstream section 74, in which case each of the connections 78, which connects the cylinder head 28 with the corresponding first exhaust pipe 30 as shown in Fig. 3, may not be non-interchangeable with a connection 78A which connects the cylinder head 28 of the second combustion engine E2 with the corresponding exhaust pipe 30A as shown in Fig. 7. Coupling members 130 and 132 both shown in Fig. 4 connect

the exhaust downstream section 76 (first exhaust device) with the first combustion engine E1 and coupling members 130A and 132A both shown in Fig. 8 connect the exhaust downstream section 76A (second exhaust device) with the second combustion engine E2 and the both connections are hence non-interchangeable.

[0058] The control unit CU1, shown in Fig. 1, and the control unit CU2, shown in Fig. 6, execute different engine control methods (programs). Even the difference in control method makes the output power adjusted. The control unit CU1 shown in Fig. 1 and the control unit CU2 shown in Fig. 6 are so designed and so configured that they would not operate when interchanged with each other. More specifically, a program that will not be activated when they are interchanged is configured and/or the shape of a coupler connected with the control unit is altered.

[0059] The control unit issues a drive command to a controlled target machine or equipment such as, for example, an ignition device, a fuel injection device or an exhaust valve. The control unit makes use of a different program for commanding the controlled target machine or equipment so that the output power of the second vehicle M2, rather than the first vehicle M1, can be suppressed. It is to be noted that the target machine or equipment to be controlled by the control unit may include intake and exhaust valves.

[0060] In the embodiment now under discussion, arrangement has been employed that in addition to the suppression of the output power by means of the control unit with the use of the program, the output power is suppressed by altering exhaust characteristics physically such as, for example, by closing a portion of the communicating tube or changing the inner diameter of the exhaust pipe. By suppressing the output power with the use of both of the software and the hardware in this way, it is possible to more effectively avoid alteration of the output power against the intent of the designer as compared with the suppression of the output power with the use of only one of those software and the hardware. It is to be noted that the suppression of the output power may be such as to reduce the output power over the entire area or as to reduce the output power only in a high output power area including the maximum output power. Reduction of the output power by means of the exhaust device rather than the intake device is effective to minimize an adverse influence on the feeling during the travel. Also, alteration of the characteristic of the muffler is effective to alter the exhaust efficiency without changing the outer shape and also to reduce an adverse influence which would be brought on any other machines or equipments.

[0061] In the illustrated embodiment, the exhaust valve 42 is mounted on the exhaust downstream section 76 for the high output power and no exhaust valve is mounted on the exhaust downstream section 76A for the low output power. Accordingly, even if the exhaust downstream section 76 for the high output power is fitted to the second

vehicle M2 for the low output power, the control unit CU2 of the vehicle of the low output power is unable to drive the exhaust valve 42 and, hence, it is possible to avoid the alteration of the output power against the intent of the designer.

[0062] The method of assembling the second exhaust device D2 and the method of fitting to the motorcycle body, that is, the vehicle making method are similar to those described in connection with the first exhaust device D1, except for the differences found between the inner diameters e1 and e2 of the mounting holes 88 and 88A of the cylinder head 28, between the inner diameters d1 and d2 of the exhaust pipes 30 and 30A, orientation of the male and female coupling members of the couplings 69 and 69A and others.

[0063] As hereinabove described, since only the alteration of the inner diameter of the pipe and the orientation of the maleness and femaleness of the coupling members is sufficient, the positions and the structure of the first mounting piece 126 and the second mounting piece 128, which are mount portions relative to the motorcycle body, can be formed analogously. By way of example, where in altering to a similar type fitting is performed with a separate adaptor interposed between the first and second combustion engines E1 and E2, and the first and second exhaust devices D1 and D2, or between the exhaust upstream section 74 and 74A and the exhaust downstream sections 76 and 76A of the first and second exhaust devices D1 and D2, the exhaust device will be displaced rearwardly a distance corresponding to the size of the adaptor. As a result, a mounting portion of the exhaust device and a mounting position of the motorcycle body will be displaced with the consequence that the exhaust device can no longer be fixed to the motorcycle body, and therefore, it is necessary to alter the mounting portion for each of the types.

[0064] In the construction described above, as shown in Figs. 3 and 7 the first and second combustion engines E1 and E2 differ from each other only in that the respective mounting holes 88 and 88A of the cylinder heads 28, which are connecting portion with the first and second exhaust devices D1 and D2, have the inner diameters e1 and e2 that are different from each other. Accordingly, the two motorcycles M1 and M2 having the different output power can be manufactured with no need to alter the major structural features of the engines and, hence, the number of respective steps required in designing and testing can be reduced. Also, with the exhaust systems, not the intake systems, differentiated from each other, any influence which may be brought on the output characteristic can be suppressed. Also, in the motorcycle M2 having the low output power, it is possible to avoid the alteration to the combustion engine of the high output power against the intent of the manufacturer by preventing the first exhaust pipes 30 for the high output power from being fitted to the second combustion engine E2 of the low output power.

[0065] Yet, since between the first and second com-

bustion engines E1 and E2 coupling or mating structures of the cylinder head 28 relative to the exhaust upstream sections 74 and 74A are different, with a simplified structure it is possible to disable connection of the first exhaust device D1 for the high output power with the second combustion engine E2. Thereby, it is possible to avoid the alteration to the high output power of the exhaust device of the motorcycle M2 for the low output power against the intent of the manufacturer.

[0066] The first and second combustion engines E1 and E2 may include the exhaust upstream section 74 and 74A of the first and second exhaust devices D1 and D2, in which case the first and second combustion engines E1 and E2 and the exhaust downstream sections 76 and 76A are, as shown in Figs. 4 and 8, connected together by means of a coupling or mating structure in which one of them is connected with the other of them, and the couplings 69 and 69A are different in structure between the first and second combustion engines E1 and E2. By so doing, a non-interchangeable structure can be realized, in which the exhaust upstream sections 74 and 74A and the exhaust downstream sections 76 and 76A in the different types cannot be connectable with each other. As a result thereof, it is possible to avoid the alteration for the high output power against the intent of the manufacturer. Moreover, the non-interchangeable structure can be realized merely by reversing the orientation of the coupling members 130, 130A, 132 and 132A and, hence, an undesirable increase of the number of component parts can also be suppressed.

[0067] In addition to the structures of the couplings 69 and 69A, at which the exhaust upstream sections 74 and 74A and the exhaust downstream sections 76 and 76A are connected together as shown in Figs. 4 and 8, respectively, the connections between the first and second combustion engines E1 and E2 and the first and second exhaust devices D1 and D2 shown in Figs. 3 and 7, respectively, are differentiated from each other. Accordingly, it is possible to alter the engine displacement can be changed upon alteration of the inner diameters d1 and d2 of the first and second exhaust pipes 30 and 30A in addition to alteration of the muffler 34, 34A. As a result thereof, change in engine displacement over a further broad range can be accommodated.

[0068] Although in describing the foregoing preferred embodiment, the combustion engine and the exhaust upstream section, and the exhaust upstream section, and the exhaust downstream section have been shown and described as separable from each other so that among a plurality of types the combustion engine and the exhaust upstream section, and the exhaust upstream section and the exhaust downstream section may have a non-interchangeability, the non-interchangeability may be provided at only one location or three or more locations somewhere in the exhaust system of the combustion engine. For example, while the exhaust upstream sections are common to each other, only the exhaust downstream sections may be made non-interchangeable.

[0069] Although in describing the foregoing embodiment the first and second combustion engines E1 and E2 and the exhaust upstream sections 74, 74A, and the exhaust upstream sections 74 and 74A and the exhaust downstream sections 76 and 76A have been shown and described as non-interchangeable, it is sufficient that a device for the high output power is non-connectable at least in the vehicle for the low output power and a device for the low output power may be connectable in the vehicle for the high output power.

[0070] Although in describing the foregoing embodiment the males and the females have been shown and described as reversed in orientation for the different coupling structures employed between the exhaust upstream sections 74 and 74A and the exhaust downstream sections 76 and 76A of the first and second exhaust devices D1 and D2, other than that it is possible to differentiate the shape of a projection relative to a recess or to differentiate the position of a bolt hole to be defined in a flange where a flanged coupling is employed. Also, regarding a coupling or mating shape between the cylinder head and the exhaust upstream section, the coupling shape may be similarly differentiated or the position of the bolt hole may be similarly differentiated. Other than the male and the female, the inner diametric dimension, the hole shape and so on may be differentiated. For example, one may be round in shape, in which case the other is formed in a round shape having a key groove and, alternatively, one may be round in shape in which case the other is formed to an oval shape.

[0071] Furthermore, in the description of the foregoing embodiment, in the first exhaust device D1 on the side of the high output power, the exhaust upstream section 74 has been shown and described as having the female pipe 132 whereas the exhaust downstream section 76 has been shown and described as having the male pipe 130. However, the first exhaust device D1 on the side of the high output power may be so designed that the exhaust upstream section 74 has the male pipe 130 whereas the exhaust downstream section 76 has the female pipe 132. By so doing, in the first exhaust device D1 of the high output power, as a result that the exhaust gases may not collide against an upstream end face of the male pipe 130, the flow path resistance is lowered and, therefore, a further output increase can be expected.

[0072] Although the present invention has been fully described in connection with the preferred embodiments thereof with reference to the accompanying drawings which are used only for the purpose of illustration, those skilled in the art will readily conceive numerous changes and modifications within the framework of obviousness upon the reading of the specification herein presented of the present invention. By way of example, although in describing the preferred embodiment reference has been made to the motorcycle, the present invention is not necessarily limited to such motorcycle, but may be equally applied to any kind of vehicles having similar types that utilize a common engine.

[0073] Accordingly, such changes and modifications are, unless they depart from the scope of the present invention as delivered from the claims annexed hereto, to be construed as included therein.

[Reference Numerals]

[0074]

28	Cylinder head
30	First exhaust pipe
30A	Second exhaust pipe
88, 88A	Fitting hole (Connecting portion)
130, 130A	Male pipe (Coupling member)
132, 132A	Female pipe (Coupling member)
D1	First exhaust device
D2	Second exhaust device
E1	First combustion engine
E2	Second combustion engine
M1	First vehicle (Motorcycle)
M2	Second vehicle (Motorcycle)

Claims

1. A vehicle making method which comprises:

a preparatory step of preparing first and second combustion engines having respective connecting portions with exhaust devices, which connecting portions are different from each other, but the remaining portions are formed to have common structures, and two, first and second exhaust devices having different characteristics and corresponding respectively to the first and second combustion engines; and
an assembling step of connecting the combustion engines with the corresponding exhaust devices to provide two types of first and second vehicles having different output powers, wherein during the preparatory step, the first and second combustion engines and the first and second exhaust devices are prepared, in which the first exhaust device for a high output power is connectable with the connecting portion of the first combustion engine, and the second exhaust device for a low output power is connectable, but the first exhaust device is non-connectable, with the connecting portion of the second combustion engine; and
during the assembling step, the first vehicle of a high output power is assembled by connecting the first exhaust device with the connecting portion of the first combustion engine and the second vehicle of a low output power is assembled by connecting the second exhaust device with the second combustion engine.

2. The vehicle making method as claimed in claim 1, wherein
the first and second combustion engines and the first and second exhaust devices are connected with each other by means of coupling structures for connecting one of them with the other; and
due to the difference in coupling structure between the first and second combustion engines, the second exhaust device of the low output power is connectable with the connecting portion of the second combustion engine, but the first exhaust device of the high output power is non-connectable with the connecting portion of the second combustion engine. 5 10

3. The vehicle making method as claimed in claim 2, wherein
the first and second combustion engine and the first and second exhaust devices are connected with each other through coupling members each having a tubular outer wall engaged in a tubular inner wall; and
because the coupling members of the first and second combustion engines are formed having been reversed in orientation relative to each other, the second exhaust device of the low output power is connectable with the connecting portion of the second combustion engine, but the first exhaust device of the high output power is non-connectable with the connecting portion of the second combustion engine. 15 20 25 30

4. The vehicle making method as claimed in any one of claims 1 to 3, wherein
each of the first and second combustion engines comprises a cylinder head and a first or second exhaust pipe separably connected with the first or second combustion engine and operable to guide exhaust gases, which have been exhausted from the cylinder head, towards the first or second exhaust device; 35 40
during the preparatory step, the first and second exhaust pipes are prepared, in which the first exhaust pipe for a high output power is connectable with the cylinder head of the first combustion engine and the second exhaust pipe for a low output power is connectable with the cylinder head of the second combustion engine, but the first exhaust pipe is non-connectable with the cylinder head of the second combustion engine; and 45
during the assembling step, the first exhaust pipe is connected with the cylinder head of the first combustion engine to thereby assemble the first vehicle and the second exhaust pipe is connected with the cylinder head of the second combustion engine to thereby assemble the second vehicle. 50 55

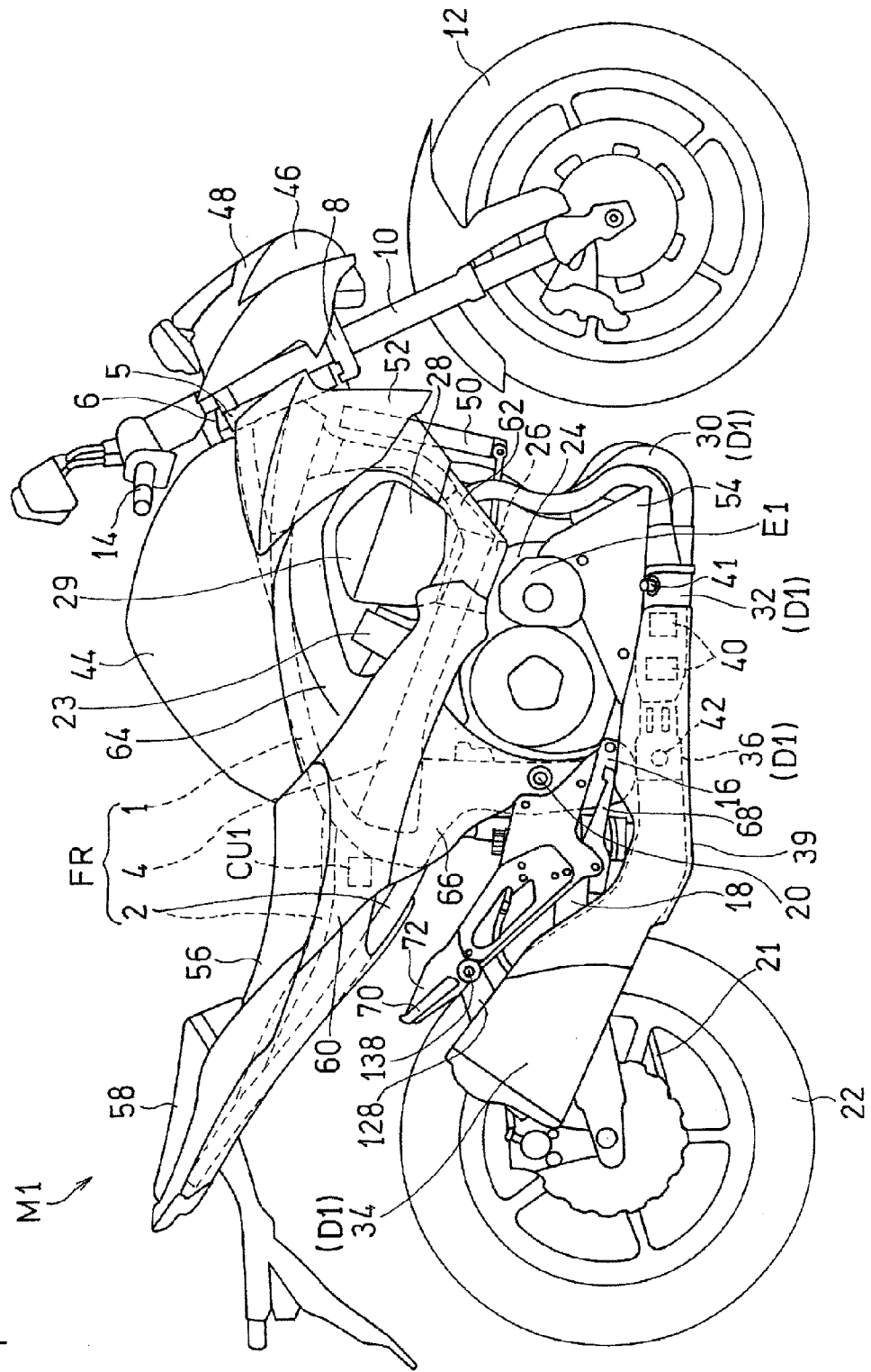
5. The vehicle making method as claimed in claim 4, wherein

the cylinder heads of the first and second combustion engines are connected with the first and second exhaust pipes, respectively, by means of connecting structures for connecting one of them with the other; and

due to the difference in coupling structure between the cylinder heads of the first and second combustion engines, the second exhaust pipe is connectable, but the first exhaust pipe is non-connectable, with the cylinder head of the second combustion engine.

6. A vehicle group comprising first and second vehicles having different output powers, the first vehicle including a first combustion engine and a first exhaust device for a high output power, the second vehicle including a second combustion engine and a second exhaust device for a low output power; wherein the first and second combustion engines have different connecting portions for connection with the first and second exhaust devices, respectively, but have the remaining portions formed to represent a common structure;
the first exhaust device is connectable with the first combustion engine, but non-connectable with the second combustion engine; and
the second exhaust device is formed to be connectable with the second combustion engine.

Fig. 1



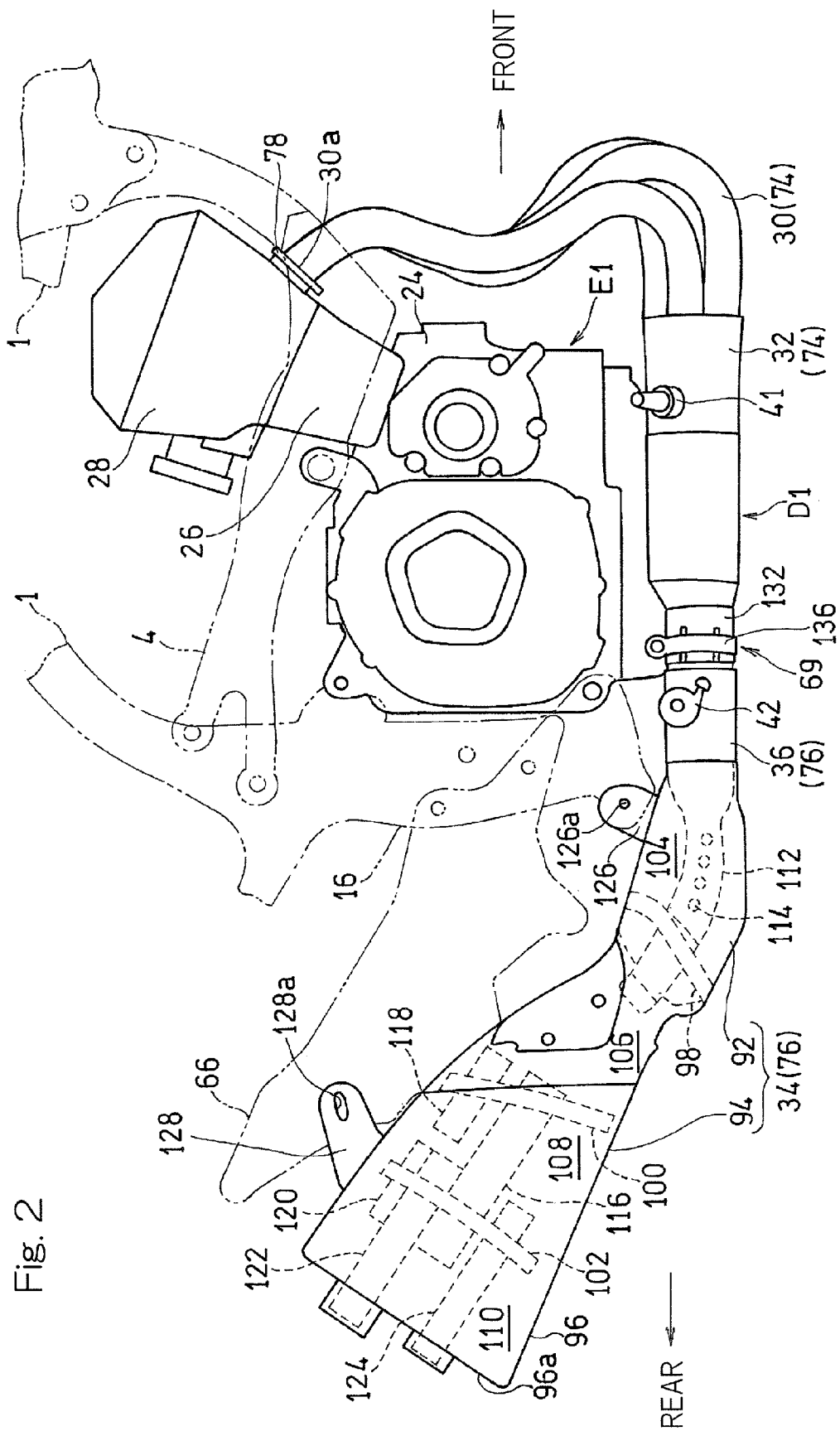


Fig. 2

Fig. 3

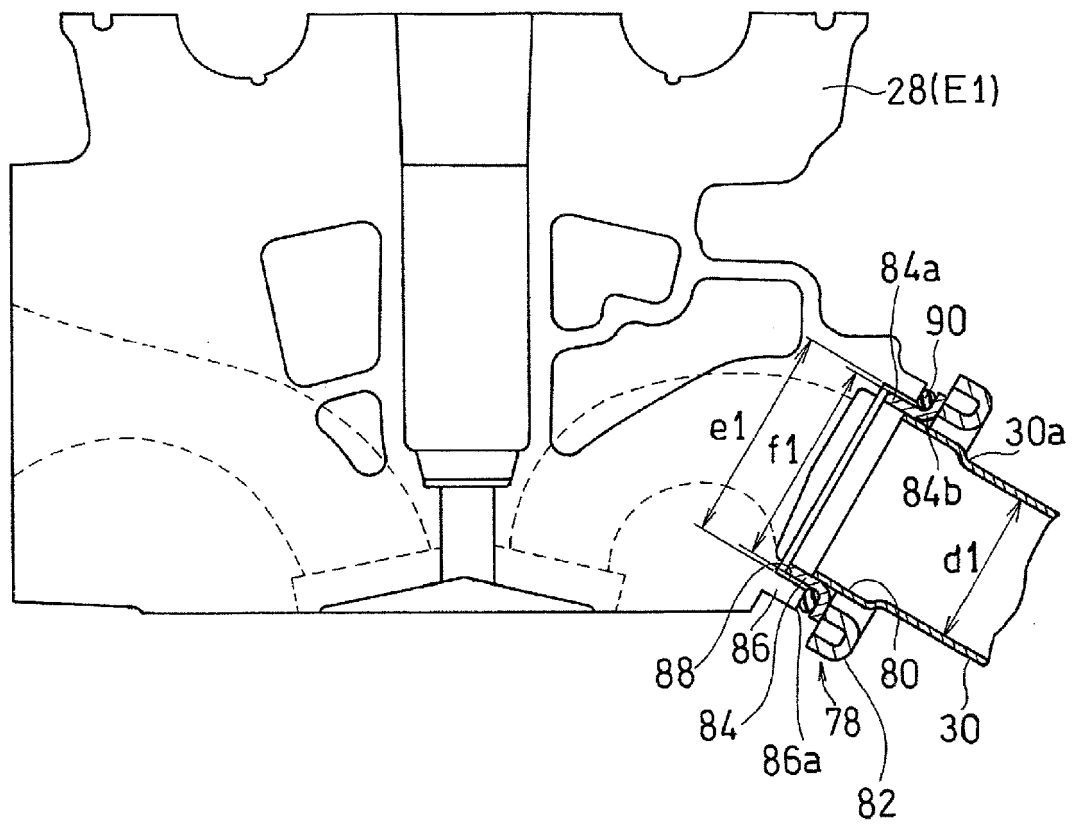


Fig. 4

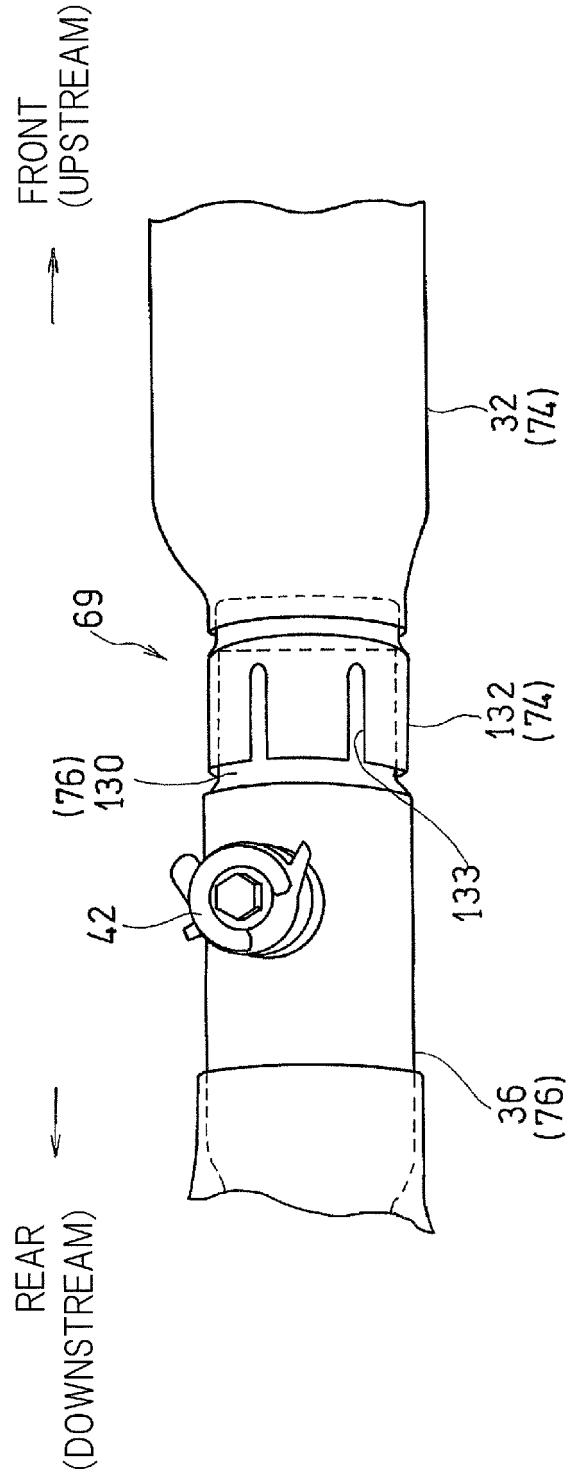
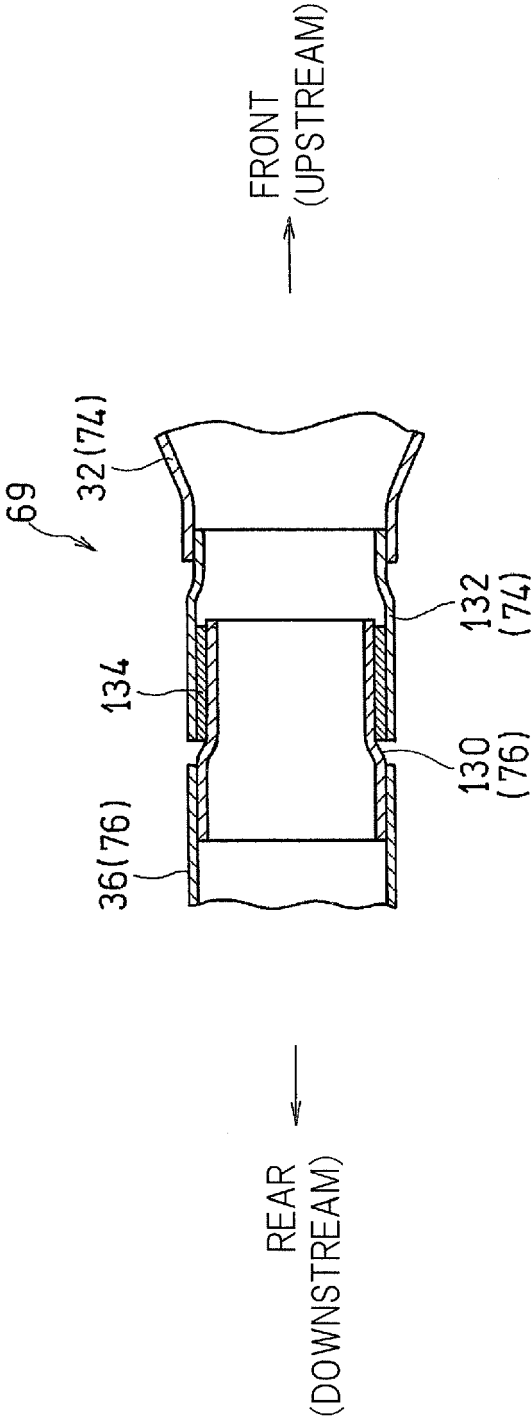


Fig. 5



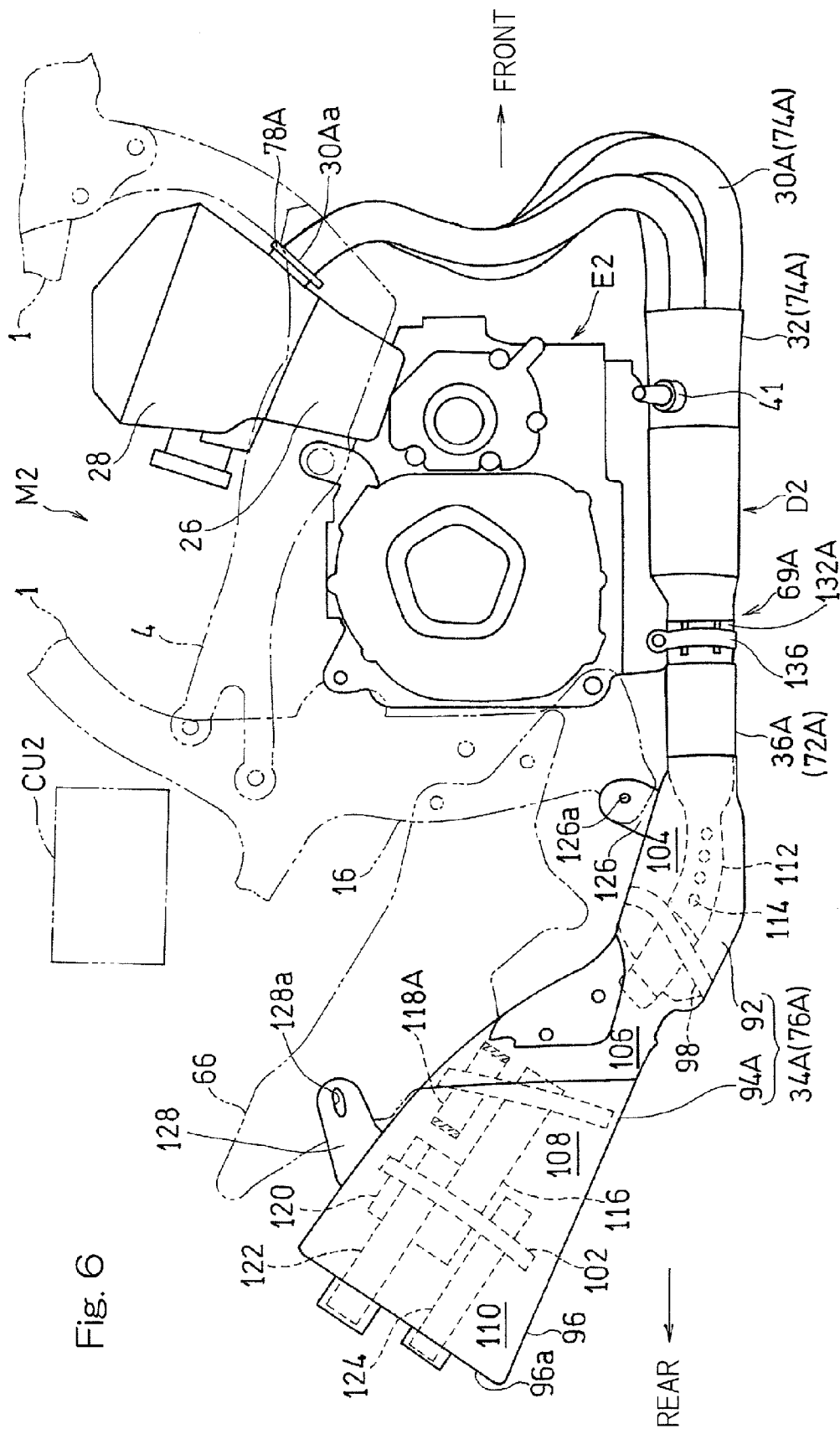


Fig. 6

Fig. 7

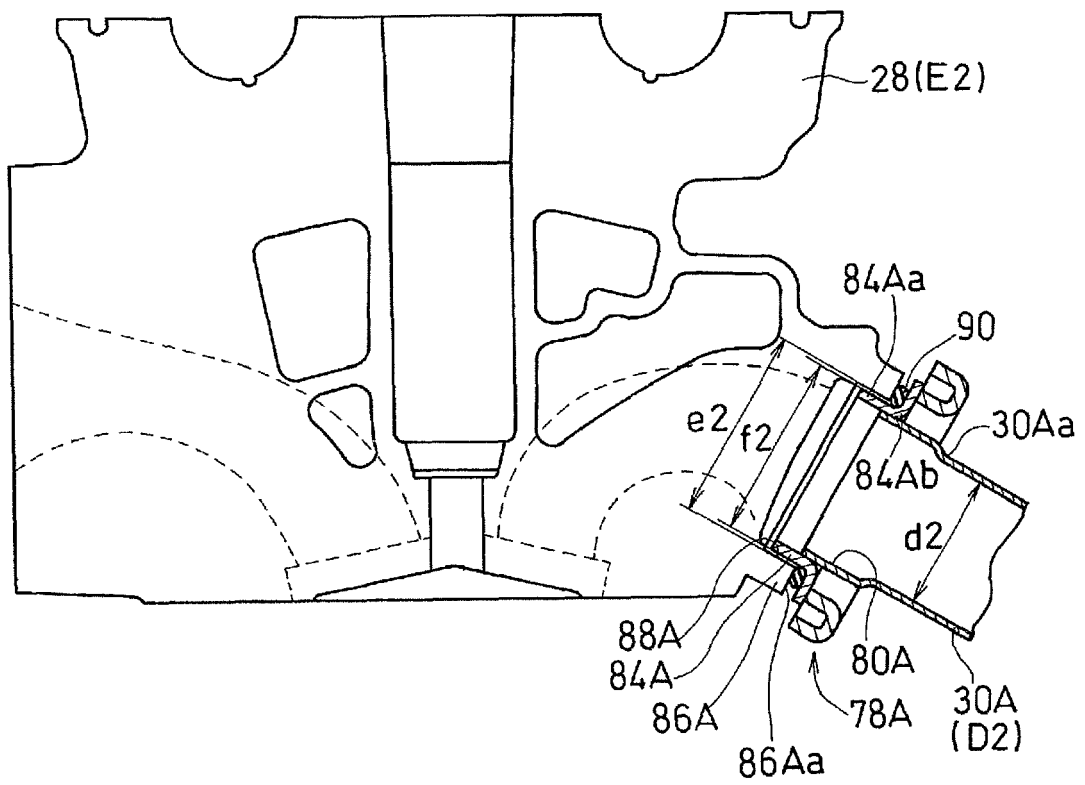


Fig. 8

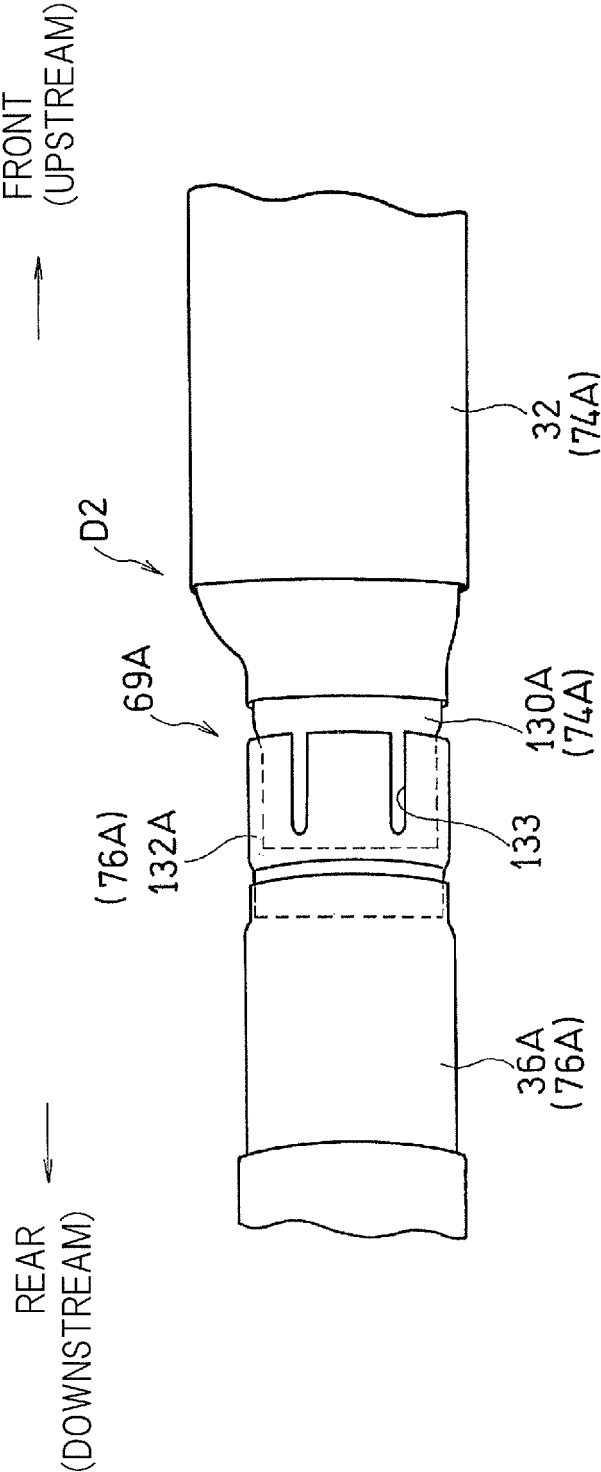
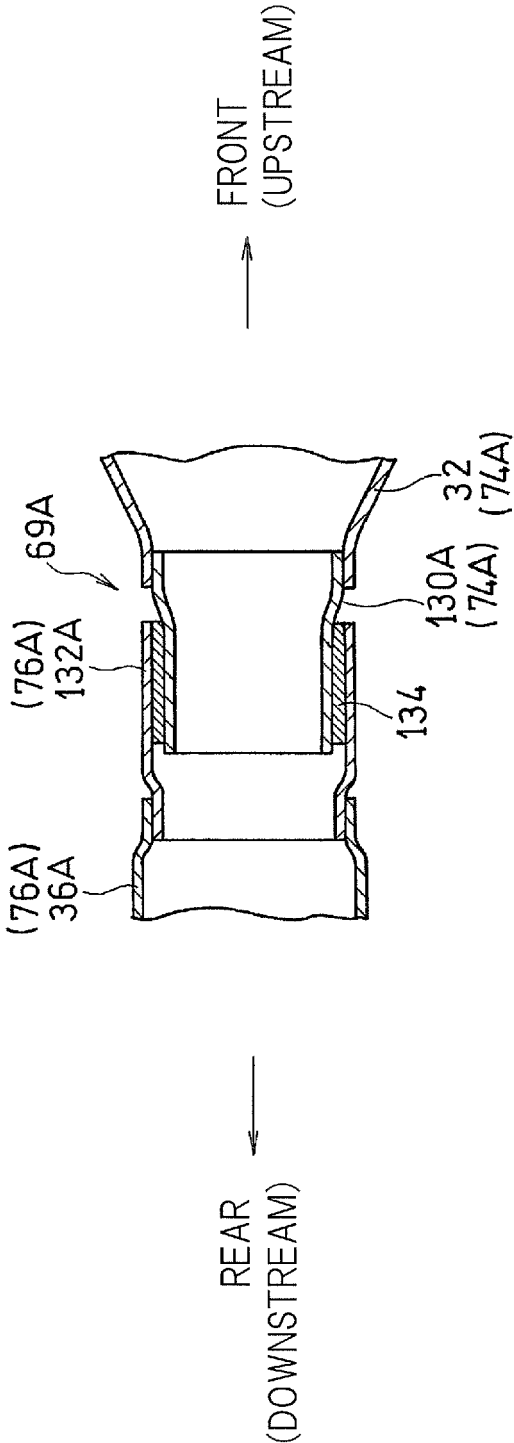


Fig. 9





EUROPEAN SEARCH REPORT

Application Number
EP 13 18 1211

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 December 2013	Examiner Blanc, Sébastien
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