Title: MOTORCYCLE ROCKER BOX ASSEMBLY

Abstract: A rocker box assembly including separable upper and lower portions is disclosed, along with a fastener for coupling the upper and lower portions. Preferably, only one fastener is used to couple the upper and lower portions, the fastener being positioned in an inner region of the rocker box assembly approximately through a center of the rocker box assembly so as to provide a substantially uniform coupling force across the rocker box assembly.
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,
FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL,
PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published: with international search report
BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] Embodiments of the present invention relate generally to rocker boxes for internal combustion engines, and more particularly to such rocker boxes as applied to twin cylinder motorcycle engines. Exemplary rocker boxes can be found, for example, in U.S. Published Patent Application No. 2005-0252471 and U.S. Patent No. 6,296,071, both of which are incorporated by reference herein in their entirety.

DESCRIPTION OF THE RELATED ART

[0002] Conventional rocker boxes typically involve a cast structure with parts (e.g., rocker arms, pushrods, etc) extending into and/or mounted within the cast structure. Due, in part, to the nature of cast rocker boxes, installing, removing, and adjusting the parts extending into and/or mounted within the cast rocker box is difficult.

[0003] Additionally, the cast structure of conventional rocker boxes tends to have a rough outer surface, which is difficult to finish into a smooth, more aesthetically pleasing surface. Further, this surface is particularly difficult to polish and/or chrome plate due to inconsistencies and defects inherent in parts produced by known casting processes. As such, it is difficult to manufacture a rocker box with an aesthetically pleasing outer surface.

[0004] Finally, conventional rocker boxes typically use multiple head cap screws and/or bolts along a periphery of an outer region of a rocker box to fasten an upper portion of the rocker box to a lower portion of the rocker box. Some configurations also use multiple screws and/or bolts to fasten the rocker box to a cylinder head or the like. These configurations can be
problematic, because they are cumbersome to assemble and disassemble due to the large number of screws and/or bolts. These configurations can also suffer from disproportionate coupling forces along the periphery of the rocker box, resulting in inadequate sealing and other related problems, given the screws/bolts must be individually torqued down to specified amounts so as to distribute a balanced coupling force across the rocker box. In addition, these configurations can have a reduced structural integrity due to the large number of holes drilled or cast into the rocker box to accommodate the screws/bolts. Other problems, such as degraded aesthetic properties, also exist.

[0005] Features of various embodiments disclosed in the present application may be used to overcome one or more of the problems discussed above and/or other problems in the art, as would be readily apparent to one of ordinary skill in the art after reading this disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Figure 1 is an exploded assembly view of a rocker box assembly according to an embodiment of the present invention.

[0007] Figure 2 is a top view of a lower portion of a rocker box assembly according to an embodiment of the present invention.

[0008] Figure 3 is a front view of the lower portion shown in Figure 2.

[0009] Figure 4 is a side view of the lower portion shown in Figure 2.

[0010] Figure 5 is a cross sectional view of the lower portion shown in Figure 2.

[0011] Figure 6 is another cross sectional view of the lower portion shown in Figure 2.
Figure 7 is another cross sectional view of the lower portion shown in Figure 2.

Figure 8 is a bottom view of an upper portion of a rocker box assembly according to an embodiment of the present invention.

Figure 9 is a side view of the upper portion shown in Figure 8.

Figure 10 is another side view of the upper portion shown in Figure 8.

Figure 11 is a cross sectional view of the upper portion shown in Figure 8.

Figure 12 is another cross sectional view of the upper portion shown in Figure 8.

Figure 13 is another cross sectional view of the upper portion shown in Figure 8.

Figure 14 is a top view of a fastener according to an embodiment of the present invention.

Figure 15 is a side view of the fastener of Figure 14.

Figure 16 is a cross sectional view of the fastener of Figure 14.

Figure 17 is a top view of a fastener according to another embodiment of the present invention.

Figure 18 is a side view of the fastener of Figure 17.

Figure 19 is a cross sectional view of the fastener of Figure 17.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Reference will now be made in detail to exemplary embodiments of the present invention. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.
For purposes of illustration only, a twin cylinder motorcycle engine will be used to describe various features and aspects of the present invention. It should be appreciated, however, that many embodiments of the present invention are applicable to non-motorcycle engines and components, to single cylinder motorcycle engines, and to motorcycle engines having more than two cylinders. As such, other uses for the disclosed embodiments are contemplated in addition to those described in detail below.

Motorcycles including twin cylinder motorcycle engines are generally known in the art. Such an engine may include a plurality of rocker box assemblies 100 (typically one per cylinder) as described in greater detail below with reference to Figures 1-13. It should be appreciated that certain components of the rocker box assemblies 100 have been omitted from the drawings for illustration purposes. Such components may include, for example, the rocker arms, rocker shafts, plugs and seals depicted in Figure 2 of U.S. Published Patent Application No. 2005/025247 1. Such components may also include the depicted breather assembly, which comprises a stop 301, flexible reed 302 and fastening device 303 positioned relative to breather openings 304, 305. Such a breather assembly may take advantage of features described in U.S. Published Patent Application No. 2006/01 021 13, which is incorporated by reference herein in its entirety. Other assemblies may also be provided, as would be readily apparent to one of ordinary skill in the art after reading this disclosure.

According to one embodiment of the present invention, each of the rocker box assemblies 100 comprise a separable upper portion 5 and a lower portion 8. One or both of separable upper portion 5 and lower portion 8 can be made of 6061 billet aluminum or like material, and may undergo a heat treatment process (e.g., a T6 heat treatment process). Preferably, the separable upper portion 5 and lower portion 8 can be coupled together so as to form an outer housing of rocker box assemblies 100, and are split
substantially parallel to the mounting surface of the cylinder head. Alignment and/or mounting of the lower portion 8 to the cylinder head may be facilitated by one or more bolts 222, screws, pins or the like, with or without a gasket 412. Alignment of the upper portion 5 to lower portion 8 may be facilitated by one or more dowel pins, or the like.

[0029] Additionally, the separable upper portion 5 and/or lower portion 8 may be finished, polished, painted, powder coated and/or chrome plated so as to include an aesthetically appealing outer surface (e.g., a highly reflective outer surface). Finishing/machining the upper portion 5 and/or lower portion 8 from billet aluminum also allows more precise control of dimensions, which better assures consistent internal clearances between the rocker arms and the upper portion 5, and between the valve springs and the upper portion 5. This can be an area of concern in applications using high lift cams and/or oversized aftermarket valve springs with stock cast evolution or twin cam style boxes, which tend to have considerable dimensional variation from part to part. Further, precise control of external dimensions assures consistent clearance between the upper portion 5 and the motorcycle frame (not shown).

[0030] In order to provide an oil tight seal between the separable upper portion 5 and lower portion 8 when coupled together, seals 101 (e.g., a gasket type/o-ring type seal) may be used as shown best in Figure 1. The seals 101 may be made of 70 Durometer Viton or like material, and installed in a groove formed within one or both of upper portion 5 and lower portion 8. Other configurations are also contemplated.

[0031] As previously noted, movable parts are positioned within the rocker box assemblies 100. Such movable parts may include, for example, rocker arm assemblies comprised of rocker arms, rocker shafts, and/or plugs. To facilitate positioning and housing of the rocker arm assemblies, one or both of the upper portion 5 and the lower portion 8 may include at least two cavities 410, 420 (Figure 7), which may be substantially opposite to each
other about a central axis 400. Preferably, each cavity 410, 420 has a
periphery adapted to receive a corresponding rocker arm, without a separate
to receive a corresponding rocker arm, without a separate
rocker arm supporting structure. More preferably, each cavity 410, 420 includes a substantially straight portion for receiving a rocker shaft, and side
portions for receiving pushrod assemblies (passing through pushrod holes
5 505) and for actuating valves. Additional cavities, holes, etc. may also be
provided.

[0032] According to one embodiment of the present invention, the rocker
box assembly includes upper and lower portions adapted to receive a
removable fastener 1000 that couples the two portions together. The
fastener 1000 is received by the rocker box assembly in a fastener receiving
orifice 1010, shown best in Figures 2 and 8. The fastener receiving orifice
1010 may be cast into the upper/lower portions, machined out of previously
cast upper/lower portions, or machined out along with the upper/lower
portions (e.g., machined out of an extruded aluminum shell), etc. Regardless
of the specific manufacturing process used, however, the fastener receiving
orifice 1010 preferably extends through both the upper portion 5 and the
lower portion 8. Alternatively, the fastener receiving orifice 1010 may
extend through the upper portion 5 and only partially into the lower portion
8. The upper portion 5, lower portion 8, or both the upper and lower
portions may include a threaded inner surface 1012 (Figure 5) adapted to
engage a corresponding threaded outer surface of the fastener 1000.
Alternatively, a nut may be provided (e.g., welded below a bottom surface of
the lower portion 8) for engaging a corresponding threaded outer surface of
the fastener 1000.

[0033] According to another embodiment of the present invention, a single
fastener 1000 is provided to couple the upper/lower portions in conjunction
with a single fastener receiving orifice 1010 provided in the upper/lower
portions. In such a configuration, the fastener receiving orifice 1010 is
preferably located within an inner region of the rocker box assembly 100, the inner region at least being inside of a seal positioned between the inner
region and an outer region of the rocker box assembly. See, for example, the outer seal of the two o-ring seals 101 in Figure 1. In this regard, the fastener receiving orifice 1010 will preferably be positioned between rocker arms supported within the rocker box assembly 100, thereby providing sufficient clearance for moving components contained within the rocker box assembly 100. Most preferably, a central axis 1022 of the fastener receiving orifice 1010 is substantially equidistant to each of two pairs of opposing edges of the upper portion of the rocker box assembly 100. As an example, the central axis 1022 of the fastener receiving orifice 1010 may be provided at or near the intersection of a first line extending from a first pair of diagonally opposite corners of a cylinder mounting surface and a second line extending from a second pair of diagonally opposite corners of the same cylinder mounting surface. In other words, the central axis 1022 of the fastener receiving orifice 1010 passes approximately through a center of the rocker box assembly 100.

[0034] By positioning the central axis 1022 of the fastener receiving orifice 100 in the manner described above, the present embodiment achieves as close to a substantially uniform coupling force across the rocker box assembly 100 as possible (i.e., when the fastener 1000 is received in the fastener receiving orifice 1010) without having to use a large number of screws/bolts. It should be appreciated that the substantially uniform coupling force referred to here corresponds to the force applied to the upper and lower portions at the same approximate distance away from the central axis 1022 of the fastener receiving orifice 1010. For some applications using a single fastener 1000 and fastener receiving orifice 1010, such as rectangular rocker box assemblies, there may be some variance between the coupling force along perpendicular edges of the rocker box assembly 100 due to a varying distance between adjacent edges and the center of the fastener receiving orifice 1010. However, it is desirable to reduce disproportionate coupling forces to the extent possible without having to
resort to a large number of screws/bolts as in conventional rocker box assemblies.

[0035] While the above referenced embodiment describes a configuration wherein only a single fastener/fastener receiving orifice is utilized, it should be appreciated that more than one fastener (with a corresponding number of fastener receiving orifices) may be used and still fall within the spirit and scope of embodiments disclosed herein. When multiple fasteners are used, however, the fastener receiving orifices should still be provided in an inner region of the rocker box assembly 100 in a pattern that minimizes the number of fasteners utilized and maximizes the uniformity of coupling forces across the rocker box assembly (to the extent possible). As an example, four fasteners/fastener receiving orifices may be utilized, wherein two fastener receiving orifices are provided along each of two perpendicular lines bisecting a cylinder mounting surface of the rocker box assembly 100. Other configurations are also contemplated.

[0036] For various embodiments of the present invention, as shown for example in Figures 1 and 11, the upper/lower portions of the rocker box assembly 100 may be fabricated in such a manner as to improve the alignability of the fastener 1000 with the fastener receiving orifice 1010 and/or to improve the aesthetic properties of visible areas of the rocker box assembly 100. As an example of improved aesthetic properties, at least one of the upper/lower portions may include a finished exterior surface, such as the finished surfaces previously described. Other aesthetic properties, such as providing stylish grooves, etched or cast logos, etc. may also be provided.

[0037] As an example of improved alignability, a top surface of the upper portion 5 may include a fastener receiving orifice 1010 with a beveled edge 1066 or other alignment features (e.g., tapered edges, etc.). The beveled edge 1066 acts as a guide to help facilitate proper alignment of the fastener 1000 with the fastener receiving orifice 1010. In conjunction with or in place of the beveled edge 1066, the fastener receiving orifice 1010 formed in the rocker box assembly 100 may include a head portion having a larger
diameter than that of a threaded portion. The head portion and threaded portion of the fastener receiving orifice 1010 preferably correspond in size and shape to head and threaded portions of the fastener 1000 itself, thereby more firmly retaining the fastener within the fastener receiving orifice 1010.

[0038] The fastener receiving orifice 1010 described above may be formed in the rocker box assembly 100 such that, when the fastener 1000 is received in the fastener receiving orifice 1010, no portion of the fastener 1000 extends significantly beyond a top surface of the upper portion 5. In this regard, a first end of the fastener 1000 may be substantially flush with an outer surface of the upper portion 5 of the rocker box assembly 100 when received in the fastener receiving orifice 1010. Similarly, a first end of the fastener 1000 may be recessed with respect to the outer surface of the upper portion 5 of the rocker box assembly 100 when received in the fastener receiving orifice 1010. Reducing (and preferably eliminating) the portion of the fastener 1000 extending beyond a top surface of the upper portion 5 provides additional clearance for maintenance and installation of the rocker box assembly 100, improves the aesthetic qualities of the rocker box assembly 100, and reduces the fastener 1000’s exposure to environmental conditions. Other advantages may also be realized from such a configuration.

[0039] As described above, several embodiments of the present invention are directed at rocker box assemblies 100 with one or more fastener receiving orifices 1010. Other embodiments of the present invention described below in reference to Figures 14-19 are directed particularly at fasteners usable with the above referenced rocker box assemblies 100 and/or with other applications as would be readily apparent to one of ordinary skill in the art after reading this disclosure.

[0040] The fastener 1000 previously described (and depicted in Figure 1) is one example of a fastener usable with embodiments of the present invention. Another fastener 3000 according to one embodiment of the
present invention is shown in Figures 14-16. The fastener 3000 preferably comprises a hollow tubular body, a head portion 3010 extending from a first end of the body toward a second end of a body, a threaded portion 3030 extending from the second end of the body toward the first end of the body, and a spacer portion 3020 extending between the head portion 3010 and the threaded portion 3030. The head portion 3010 may include one or more tool engaging surfaces 3010 for rotating the fastener 3000 relative to an object (e.g., a rocker box assembly 100) receiving the fastener 3000. By way of example, the head portion 3010 may include at least one hole having a central axis extending substantially parallel to a central axis of the hollow tubular body. Depending on the particular application at hand, the hole(s) may be slotted (see holes 3011), as shown with respect to the fastener 3000 of Figure 14 (see holes 4011), or substantially cylindrical, as shown with respect to the fastener 4000 of Figures 17-19. Other tool engaging surfaces are also contemplated, such as flats on internal or external surfaces of the head portion for engaging a wrench like device, as shown with respect to the fastener 1000 of Figure 1.

[0041] According to one embodiment of the present invention, the fastener 3000 has a body specifically adapted to allow access to components in or beneath the rocker box assembly 100 without having to disassemble the rocker box assembly 100 or remove the fastener 3000 from the rocker box assembly 100. In this regard, the fastener 3000's hollow tubular body may be provided with a substantially smooth inner surface extending from a first end of the body to a second end of the body and an inner diameter of sufficient size along the substantially smoother inner surface to permit access by a compression release tool or the like. Such a configuration is shown, for example, in the cross sectional views in Figures 16 and 19 of fasteners 3000, 4000 respectively. Similarly, the fastener receiving orifice 1010 may be oriented within the rocker box assembly 100 so as to provide desired access to specific areas within or beneath the rocker box assembly 100.
The foregoing description of various embodiments of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and modifications and variations are possible in light of the above teachings or may be acquired from practice of the invention. The embodiments were chosen and described in order to explain the principles of the invention and its practical application to enable one skilled in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated.
What is claimed is:

1. A rocker box fastener adapted to couple an upper portion of a rocker box to a lower portion of the rocker box, the fastener comprising:
   a hollow tubular body;
   a head portion extending from a first end of the body toward a second end of the body, the head portion including a tool engaging surface adapted to rotate the fastener relative to the rocker box; and
   a threaded portion extending from the second end of the body toward the first end of the body,
   wherein the fastener has an external periphery adapted to be received within the rocker box.

2. The fastener of claim 1, wherein the first end of the body is substantially flush with an outer surface of the upper portion of the rocker box when the fastener is received within the rocker box.

3. The fastener of claim 1, wherein the first end of the body is recessed with respect to an outer surface of the upper portion of the rocker box when the fastener is received within the rocker box.

4. The fastener of claim 1, further comprising a spacer portion extending between the threaded portion and the head portion.

5. The fastener of claim 1, wherein the threaded portion is provided on an outer surface of the hollow tubular body.

6. The fastener of claim 1, wherein the tool engaging surface comprises at least one hole having a central axis extending substantially parallel to a central axis of the hollow tubular body.
7. The fastener of claim 6, wherein the tool engaging surface comprises a plurality of holes.

8. The fastener of claim 6, wherein the at least one hole has a substantially cylindrical inner surface.

9. The fastener of claim 6, wherein the at least one hole comprises a slot.

10. The fastener of claim 1, wherein the tool engaging surface extends from the first end of the body toward the second end of the body along an interior of the hollow tubular body.

11. The fastener of claim 10, wherein the interior of the hollow tubular body has a substantially square cross section.

12. The fastener of claim 11, wherein the interior of the hollow tubular body has about a 3/4" square cross section.

13. The fastener of claim 1, wherein the first end of the body has a larger diameter than the second end of the body.

14. The fastener of claim 1, wherein the head portion includes a beveled inner edge.

15. The fastener of claim 1, wherein the hollow tubular body includes a substantially smooth inner surface extending from the first end of the body to the second end of the body.
16. The fastener of claim 1, wherein an interior of the hollow tubular body is of sufficient cross section to permit access to a compression release mechanism through the fastener.

17. The fastener of claim 1, wherein the fastener is a center locking screw.

18. A rocker box assembly, comprising:
   an upper portion;
   a lower portion;
   a fastener receiving orifice within an inner region of the rocker box assembly;
   a seal positioned between the inner region of the rocker box assembly and an outer region of the rocker box assembly, the seal being adapted to provide an oil tight seal between the upper portion and the lower portion when coupled together; and
   a fastener adapted to couple the upper portion with the lower portion when received in the fastener receiving orifice.

19. The rocker box assembly of claim 18, wherein the rocker box assembly includes only one fastener adapted to couple the upper portion with the lower portion.

20. The rocker box assembly of claim 18, wherein the fastener receiving orifice extends through both the upper portion of the rocker box assembly and the lower portion of the rocker box assembly.

21. The rocker box assembly of claim 18, wherein the fastener includes a threaded outer surface extending from a first end of the fastener toward a second end of the fastener, and
wherein the fastener receiving orifice includes a threaded inner surface within the lower portion of the rocker box assembly.

22. The rocker box assembly of claim 18, wherein the fastener applies a substantially uniform coupling force across the rocker box assembly when received in the fastener receiving orifice.

23. The rocker box assembly of claim 18, wherein a central axis of the fastener receiving orifice is substantially equidistant to at least two edges of the upper portion of the rocker box assembly.

24. The rocker box assembly of claim 23, wherein a central axis of the fastener receiving orifice passes through a center of the rocker box assembly.

25. The rocker box assembly of claim 18, wherein a top surface of the lower portion and a bottom surface of the upper portion are substantially planar to a mounting surface of a cylinder head.

26. The rocker box assembly of claim 18, wherein at least one of the upper portion and the lower portion includes a finished exterior surface.

27. The rocker box assembly of claim 26, wherein the finished exterior surface includes at least one of a painted surface, a powder coated surface, a chrome plated surface, a zinc plated surface, a black oxide surface, and a polished surface.

28. The rocker box assembly of claim 18, wherein at least one of the upper portion and the lower portion includes a plurality of grooves formed in an exterior surface.
29. The rocker box assembly of claim 18, wherein at least one of the upper portion and the lower portion comprises a billet aluminum material.

30. A motorcycle engine including the rocker box assembly of claim 18.

31. A motorcycle including the motorcycle engine of claim 30.

32. The rocker box assembly of claim 18, further comprising an open cell foam positioned within at least one of the upper and lower portions.

33. The rocker box assembly of claim 32, wherein the open cell foam is adapted to extract oil from air circulating within the rocker box assembly.

34. The rocker box assembly of claim 32, wherein the open cell foam is adapted to reduce noise emissions from the rocker box assembly.

35. The rocker box assembly of claim 32, wherein the open cell foam is adapted to reduce vibration emissions from the rocker box assembly.

36. The rocker box assembly of claim 32, wherein the open cell foam is adapted to extract pollutants from air circulating within the rocker box assembly.

37. A method of supporting a rocker arm in an internal combustion engine, comprising:

    positioning the rocker arm in a lower portion of a rocker box assembly;
    aligning a fastener with a fastener receiving orifice in an inner region of an upper portion of the rocker box assembly; and
    rotating the fastener relative to the fastener receiving orifice so as to achieve a substantially uniform coupling force along a mounting surface.
between the upper portion of the rocker box assembly and the lower portion of the rocker box assembly.

38. The method of claim 37, wherein the fastener receiving orifice is provided in substantially a center of the upper portion of the rocker box assembly.

39. The method of claim 37, wherein the fastener comprises a center locking screw.

40. The method of claim 37, wherein rotating the fastener comprises engaging a tool receiving surface on a head of the fastener.

41. The method of claim 37, wherein the tool receiving surface comprises at least one hole.

42. A method of fabricating a fastener for a rocker box assembly, comprising:
   - forming a tubular body;
   - forming a head portion extending from a first end of the body toward a second end of the body;
   - forming a pilot hole in the tubular body;
   - broaching a square in the pilot hole; and
   - cutting a thread in a threaded portion extending from the second end of the body toward the first end of the body.

43. The method of claim 42, wherein forming the pilot hole comprises drilling a 13/16" 0 pilot hole.

44. The method of claim 42, wherein broaching the square comprises broaching a %" square.
45. The method of claim 42, wherein forming the tubular body comprises machining the tubular body out of a stock material.

46. The method of claim 45, wherein the stock material comprises at least one of billet aluminum and 7000 series aluminum.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

F02F 7/00(2006.01)i, F02B 77/00(2006.01)i, F02B 61/02(2006.01)i, B62M 7/00(2006.01)i

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)

IPC 8 F02F 7/00, P16M 1/026

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

Korean patents and applications for inventions since 1975

Japanese utility models and applications for utility models since 1975

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

eKIPASS (K IPO internal) & key words motorcycle, rocker, cover

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
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<tr>
<td>A</td>
<td>US 2005/0252471 A1 (BRIAN HANOLD et al ) 17 November 2005 See abstract, claims 1-12, paragraphs 0021-0024, 0029, and figures 1-7</td>
<td>1-46</td>
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<td>A</td>
<td>JP 9-68101 A (NISSAN MOTOR CO., LTD) 11 March 1997 See abstract, claims 1-4, and figures 1, 2, 4, 5, 9, 10</td>
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<td>A</td>
<td>JP 2668666 B2 (KAWASAKI HEAVY IND LTD) 04 July 1997 See claim 1, and figures 1, 3, 4</td>
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<td>A</td>
<td>KR10-2007-0066017 A (HYUNDAI MOTOR COMPANY) 27 June 2007 See abstract, claim 1, and figures 1-6</td>
<td>1-46</td>
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* Special categories of cited documents

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

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Further documents are listed in the continuation of Box C

See patent family annex

Date of the actual completion of the international search

28 JULY 2008 (28 07 2008)

Date of mailing of the international search report

28 JULY 2008 (28.07.2008)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 139 Seonsa-ro, Seogu, Daejeon 302-701, Republic of Korea

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<td>JP 9-68101 A</td>
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