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- (81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
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[Continued on next page]

- (54) **Title:** FLOOR MOUNT ETC PEDAL WITH INTEGRATED KICKDOWN AND TACTILE ALERT MECHANISMS

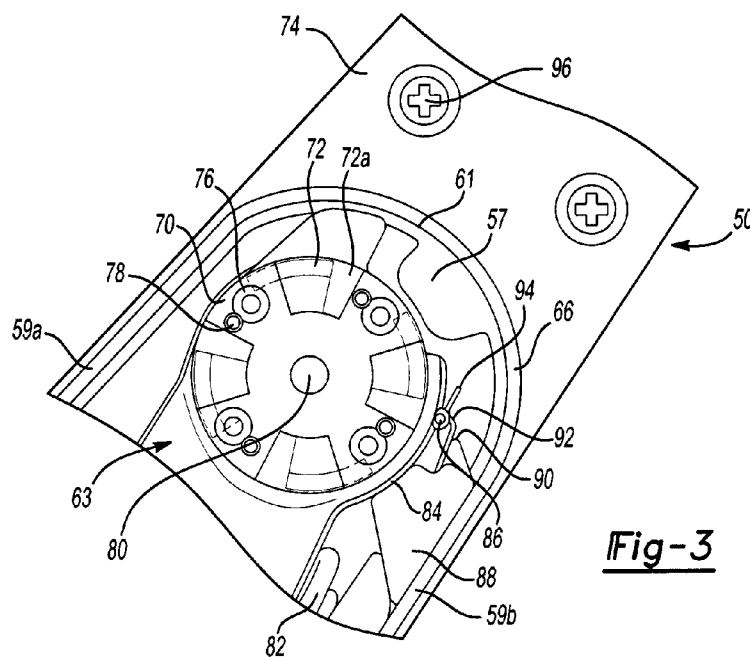


Fig-3

(57) **Abstract:** A pedal assembly for simulating the feel of a standard pedal assembly in a vehicle. The pedal assembly includes a pedal pivotally mounted to a housing. A lever arm is further provided connecting the pedal to the housing. A kickdown sub-assembly is mounted within the housing. The kickdown sub-assembly includes a bead and an abutment portion. Depression of the pedal assembly results in movement of the bead towards the abutment portion and provides for kickdown when the bead contacts the abutment portion and then subsequently moves past the abutment portion.

**Declarations under Rule 4.17:**

— *of inventorship (Rule 4.17(iv))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Published:

— *with international search report (Art. 21(3))*

FLOOR MOUNT ETC PEDAL WITH INTEGRATED KICKDOWN AND TACTILE ALERT MECHANISMS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority of U.S. Provisional Application 61/529,621 filed August 31, 2011, and U.S. Provisional Application 61/535,670 filed September 16, 2011, the contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

[0002] This invention relates generally to pedal assemblies. More particularly, this invention relates to an ETC pedal assembly replicating the feel of a standard pedal.

BACKGROUND OF THE INVENTION

[0003] It is known to use pedal assemblies having position sensors to produce a “fly-by-wire type” pedal assembly for vehicle control such as brake and throttle operation. A significant drawback of these pedal assemblies is the removal of the physical connection of the pedal to the vehicle control. This removes the resistance or pedal feel that the driver typically is accustomed to during vehicle operation. As such, it is desirable to simulate the feel of mechanical pedal assemblies. Additionally, it is advantageous to provide a kickdown feature to provide clearly perceptible increase in the reaction force prior to the point when a downshifting signal is sent during a forceful depression of the accelerator pedal.

SUMMARY OF THE INVENTION

[0004] The present invention relates to a pedal assembly for simulating the feel of a standard pedal assembly in a vehicle. The pedal assembly includes a pedal pivotally mounted to a housing. A lever arm or connecting rod is further provided connecting the pedal to the housing. A kickdown subassembly is mounted within the housing. The kickdown subassembly includes a bead and an abutment portion. Depression of the pedal results in movement of the bead towards the abutment portion and provides for kickdown when the bead contacts the abutment portion and then subsequently moves over and past the abutment portion.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0005] Figure 1 illustrates a perspective view of the pedal assembly of the present invention;
- [0006] Figure 2 illustrates a side view of the kickdown subassembly in a rest position;
- [0007] Figure 3 illustrates the kickdown subassembly in a working position;
- [0008] Figure 4 illustrates an exploded perspective view of the connection of the pedal to the housing;
- [0009] Figure 5 illustrates a perspective view of the pedal assembly including the sensor;
- [0010] Figure 6 illustrates a side view of the pedal assembly;
- [0011] Figure 7 illustrates a perspective side-rear view of the pedal assembly; and
- [0012] Figure 8 illustrates a side view of the pedal assembly having sensors and various vibration-creating motors.

DETAILED DESCRIPTION OF THE INVENTION

[0013] The present invention is a floor mount ETC pedal assembly with a kickdown feature. The assembly includes a housing member and a pedal. The pedal is mounted to the housing member. The pedal is also connected by a connecting rod to the housing. The lever arm has a hub which is pivotally mounted within the housing. The housing also contains a hysteresis generating device and a kickdown feature.

[0014] Figure 1 illustrates the pedal assembly of the present invention. The pedal assembly 10 is provided having a pedal 16 having an upper portion 12 and a lower portion 14. The pedal assembly 10 and pedal 16 further include traction portions 18 to aid in gripping the user foot to the pedal.

[0015] The pedal assembly 10 further includes a housing 50 containing a generally rectangular boxlike structure 51 angled from a lower end 20. The housing 50 is operable to hold various components of the pedal assembly. The housing 50 includes structural elements 53 and a cover 52.

[0016] The pedal 16 connects to a lower portion or base 20. The base 20 includes a lower surface 22 operable to be flush with a floor of a vehicle. The lower surface 22 includes a plurality of connection members 24. The connection members 24 may be snap fit bosses or other clip means. The base 20 further includes an upper surface 30. The upper surface 30 is

operable to connect to the pedal 16. The base 20 includes a structural indentation 32 corresponding to structure at the lower portion 14 of the pedal 16. In the present embodiment the structure is generally I or T shaped. The base 20 includes an aperture or structure identical to that of the lower portion 14 of the pedal 16.

[0017] The connection portions 34, 36 connecting the pedal 16 to the base 20 are a living hinge. The living hinge 34, 36 allows the pedal 16 to flex and pivot at the base 20 and the living hinge 34, 36.

[0018] The living hinge 34, 36 extends between the end portion of the base 20 and the pad portion or pedal 16. A pair of wings extend from the pad portion towards the housing to cover a connecting arm.

[0019] As shown in Figures 2 and 3, the housing 50 has an inner cavity 57 extending between a pair of side walls 59a, 59b. The housing 50 further includes an upper radiused wall 61. A support boss with an angled surface extends on the front side wall.

[0020] A hub portion 63 or kickdown feature is illustrated in Figures 2 and 3. The hub portion is mounted to a pin 80. A partially tubular cavity is formed to receive a ball of a connecting rod at the other end (to be discussed below). The hub 63 further includes at least one planar disk surface 70, 72. The disks or disk surfaces 70, 72 have a plurality of apertures 72, 76, 78 which are aligned with various planar disk surfaces 70 when the disks are at rest as shown in Figure 2. When the disks 70, 72 rotate about one another, as shown in Figure 3, the various apertures 72a, 74, 76, 78 become misaligned.

[0021] The hub 63 further includes a circumferential friction surface portion 70, 72. The hub 63 further includes a blocking plate. The blocking plate function is part of a noncontacting position sensor. A ridge or bead 86 extends in an axial direction along the friction surfaces. The bead 86 is biased against a slide 88 when the pedal is at rest, as shown in Figure 2. Rotation of the hub 63 moves the bead away from the slide 88 to an abutment portion 92. The abutment portion 92 includes a lower portion 90 and an upper portion 94. An abutment surface and abutment portion 92 is operable to hinder movement of the bead 86 to prevent, or delay, the hub from further rotation. This friction surface provides for hysteresis. As the bead 86 slides along the abutment portion 92, friction is created and/or a signal is sent to provide the hysteresis. A

signal may be sent to a control system to activate the hysteresis. Further, a signal may be sent to the various motors to provide vibratory responses.

[0022] A finger extends outwardly from the hub and is positioned to engage the abutment portion of the housing. The abutment portion 92, also known as a spring steel element, extends outwardly from a slide 88 along the friction surface. Depression of the pedal 16 results in rotation of the rotor or hub 63 to move the bead 86 towards the abutment portion 92 or the spring steel element. When the pedal 16 is depressed sufficiently, the bead 86 contacts the spring steel element or abutment portion 92 and moves the abutment portion 92 out of the way to provide a kickdown. The kickdown feature allows the user to quickly accelerate as the pedal movement is then not stifled.

[0023] As shown in Figure 4, a cup 106 is formed between the lower hub and the tubular cavity 102 to receive a coil spring 82. The coil spring 82 extends between the cup 106 and a trapezoidal shaped end cap. The end cap has two angled side surfaces. The spring 82 biases the lever away from the end cap so that the finger engages the stop and bead 86 engages the slide 88. The connecting rod 110 includes a ball portion 108. The cup 106 is operable to receive the ball 108. Various connection members 110 secure the apparatus together. A cap 112 is used to cover the ball joint created by the ball 108 and the cup 106.

[0024] Further, a cavity 114 is provided within the housing. The connection portion 104 connects the ball 108 and connecting rod 110 to the spring 82. The connecting rod 110 provides further support and connects the pedal 16 to the housing 50. The connecting rod 110 may pivot and rotate within the cavity 106. The connecting rod 110 puts less stress on the pedal functionality should the pedal experience a side load condition.

[0025] As shown in Figure 5, a cover piece 56 is snapped into position to cover the cavity in the housing 50. The cover 56 has a circular opening to expose the blocking plate. An encapsulated electronic unit 62 is attached using a heat stake rollover operation 122. Various structural elements 58, 64 are also used to connect the cover piece 56 to the housing 50. The heat stake rollover application is shown at the connection portion as shown in reference numeral 54. A connector portion 60 of the cover 56 connects to a wiring harness to deliver the signal produced by the position sensor to the throttle. Any type of noncontacting position sensor may be used; however, a suitable sensor is maintained by the assignee of the present invention. The

sensor may be connected to a control unit operable to send signals to the appropriate area. The sensor may send a signal to a control unit, and the control unit will send a signal to a vibratory motor to notify the driver of a particular vehicle condition.

[0026] Figures 6-8 illustrate a second embodiment of the pedal assembly including the tactile feedback mechanisms. These tactile feedback mechanisms are generally discussed above and may also include the use of a control unit operable to receive signals from sensors and operable to instruct motors or other units to perform. The tactile feedback mechanisms may include both a vibratory mechanism and a haptic mechanism. The pedal assembly 200 includes a pedal 202 having an upper portion and a lower portion 206. The same structural elements and living hinge 238 are applied to the secondary embodiment as were structurally applied in the previous embodiment discussed above. The pedal 202 connects to the base 220 of the assembly. A housing 252 includes an electronic unit 260. The housing 252 includes various vibratory and haptic mechanisms 250. When a sensor is triggered, the vibratory and haptic mechanisms 250 create sensory alerts to the user. When the sensor is triggered, a control unit also located within the sensor may send a signal to the vibratory and haptic mechanisms 250 to activate the mechanisms and provide a warning or other alert to the drive by vibrating the pedal.

[0027] A control unit 251 receives signals from the appropriate external sensors and sends a signal to activate either the vibratory motor or the haptic motor or both. Different tactile feedbacks may be provided for different tactile alerts for different conditions. Thus, the vibratory mechanisms 250 can be activated by the control unit 251 when it is determined by a driver alertness system that the driver is drowsy and a separate signal can be generated to activate the haptic mechanisms indicating, for instance, a potential collision threat.

[0028] A vibrating motor 250 is mounted to extend transversely along the housing 252. The motor 250 moves a weight to cause vibration. The vibration is carried through the housing and connecting rod to the pedal 202 thus providing a vibratory sensation which is tactilely sensed by the driver's foot.

[0029] The feedback mechanisms provide tactile feedback to the driver's foot through the pedal to alert the driver to desired conditions. These conditions may be, for example, excessive speed, driver alertness, and collision avoidance. The system includes a control unit mounted to the housing 252 which receives signals from external sources such as radar sensors, a driver

awareness system, or a speedometer and determines by reference to predetermined rules when to provide signals to the feedback mechanisms.

[0030] These Figures 6-8 illustrate the housing of the first embodiment described in Figures 1-5 and have been altered to accommodate a vibratory mechanism, a haptic mechanism, and a control unit. As shown in Figure 7, the control unit 251 includes a cover 253 which extends over the sensor and over the motor 250.

[0031] The haptic motor 250 is mounted to the forward side of the housing 252 opposite the pedal 202. The haptic motor 250 is a DC motor and is operable to axially move a rod supporting a boss member on the free end of the rod. The boss member has an angled surface and replaces the support boss in the first embodiment. Activation of the haptic motor 250 results in movement of the rod in an axial direction towards the motor which draws the angled surface of the support boss member against the correspondingly angled surface of the end cap holding the spring to compress the spring. Compression of the spring results in a greater return force delivered by the arm and connecting rod to the pedal. The increased return force is thus sensed tactilely by the driver's foot.

[0032] The ball joint 108, 208 is inserted from one end of the cylindrical opening and a cap is snapped in place over the opening. The ball joint 108, 208 connection puts less stress on the pedal functionality should the pedal experience a side load condition.

[0033] The noncontacting position sensor frequently used involves rotation of the hub as shown in Figures 2 and 3 creating eddy currents in the coils which are measured to determine rotation of the hub.

[0034] Thus is disclosed a compact pedal assembly having hysteresis and a kickdown feature as well as tactile alert mechanisms.

[0035] The invention is not restricted to the illustrative examples and embodiments described above. The embodiments are not intended as limitations on the scope of the invention. Methods, apparatus, compositions, and the like described herein are exemplary and not intended as limitations on the scope of the invention. Changes therein and other uses will occur to those skilled in the art. The scope of the invention is defined by the scope of the appended claims.

CLAIMS

1. A pedal assembly for simulating the feel of a standard pedal assembly in a vehicle, the pedal assembly for use in a vehicle, the pedal assembly comprising:
 - a pedal pivotally mounted to a housing;
 - a kickdown subassembly mounted in the housing, the kickdown subassembly having a bead and an abutment portion;
 - wherein depression of the pedal results in movement of the bead towards the abutment portion and providing for kickdown when the bead contacts the abutment portion and subsequently moves past and over the abutment portion.
2. The pedal assembly of claim 1 wherein the pedal further connects to the housing by means of a rod.
3. The pedal assembly of claim 1 wherein the pedal is connected to the housing with a living hinge.
4. The pedal assembly of claim 3 wherein the pedal connects to the housing with a living hinge having a connector with at least one flange.
5. The pedal assembly of claim 4 wherein the housing includes corresponding structure to accept the connector of the living hinge.
6. The pedal assembly of claim 1 wherein the pedal assembly further includes a hysteresis generating device.
7. The pedal assembly of claim 1 wherein the housing includes at least one snap fit boss operable to engage and connect to the vehicle floor.

8. A pedal assembly for simulating the feel of a standard pedal assembly in a vehicle and providing notification to a vehicle user, the pedal assembly for use in a vehicle, the pedal assembly comprising:

a pedal pivotally mounted to a housing;

a vibratory motor connected to the pedal, the vibratory motor mounted to the housing;

and

a control unit connected to the vibratory motor operable to activate the vibratory motor when providing a notification to the drive.

9. The pedal assembly of claim 8 further including a kickdown subassembly.

10. The pedal assembly of claim 9 wherein the kickdown subassembly mounted in the housing wherein depression of the pedal assembly results in movement of the bead towards an abutment portion and providing for kickdown when the bead contacts the abutment portion and subsequently moves past the abutment portion.

11. The pedal assembly of claim 8 wherein a haptic mechanism is connected to the assembly.

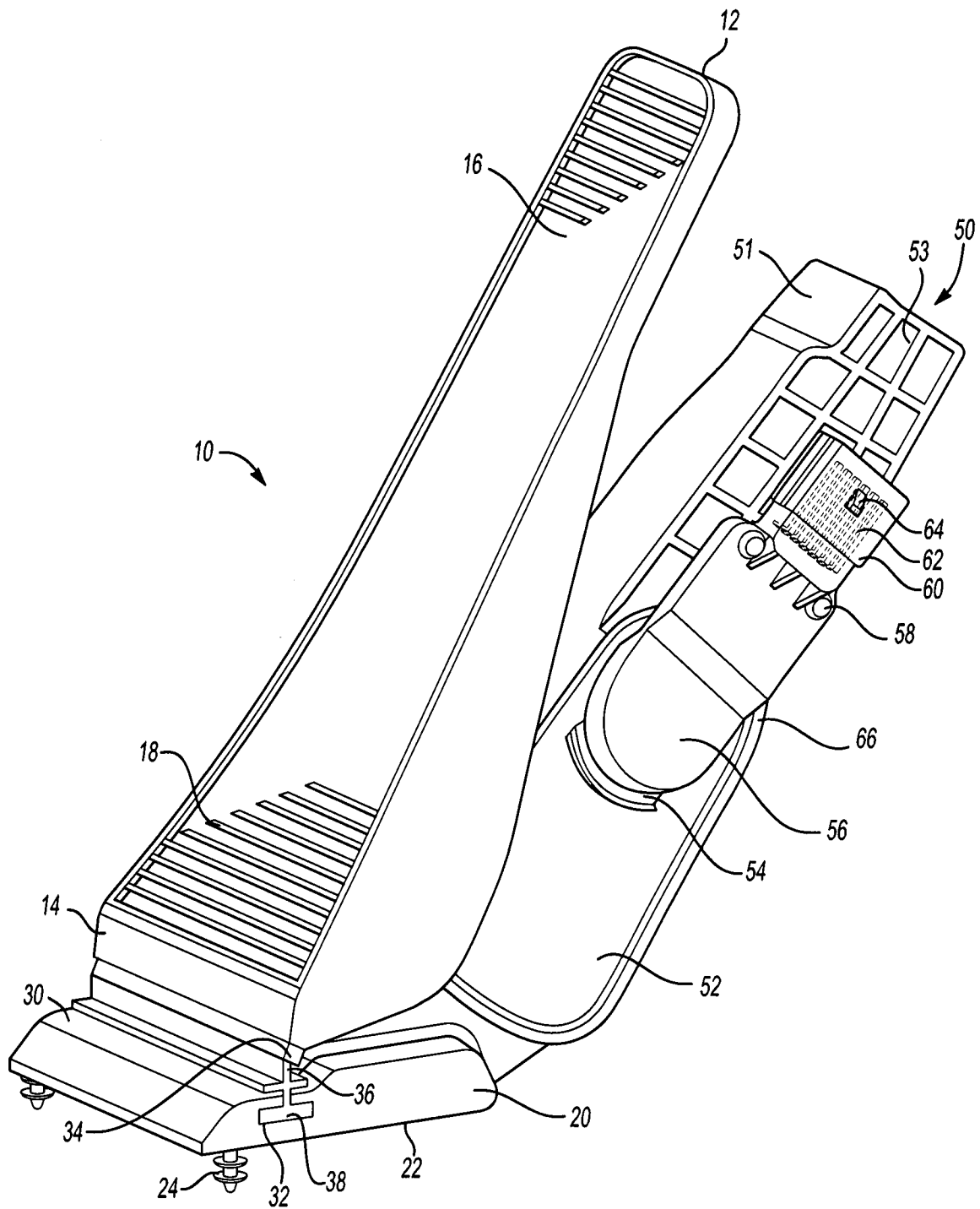
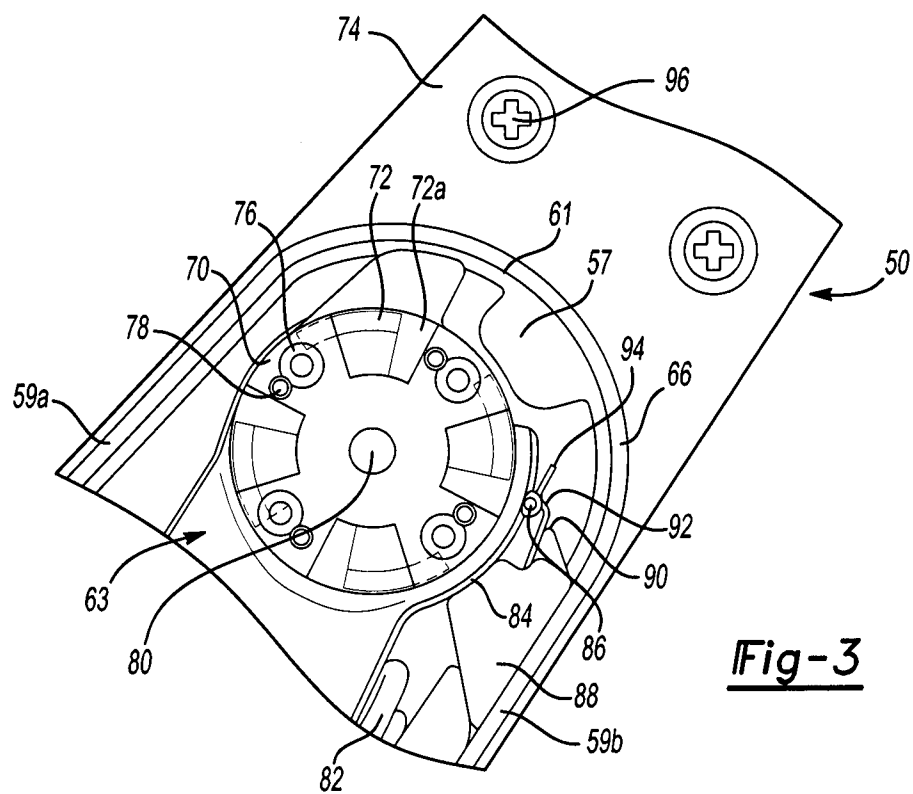
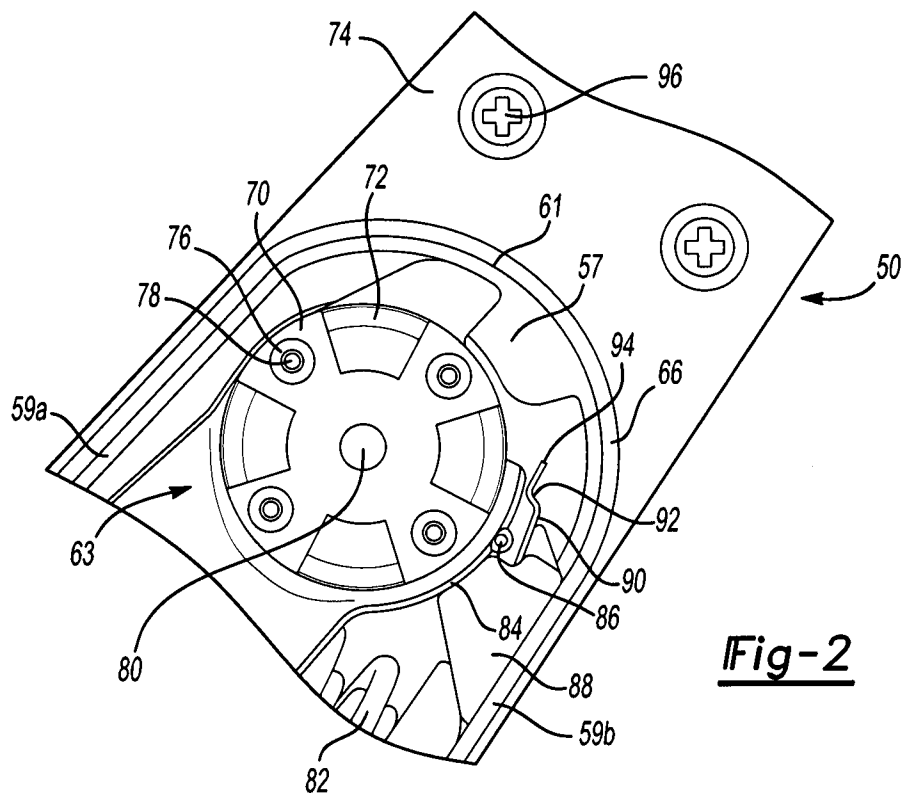


Fig-1



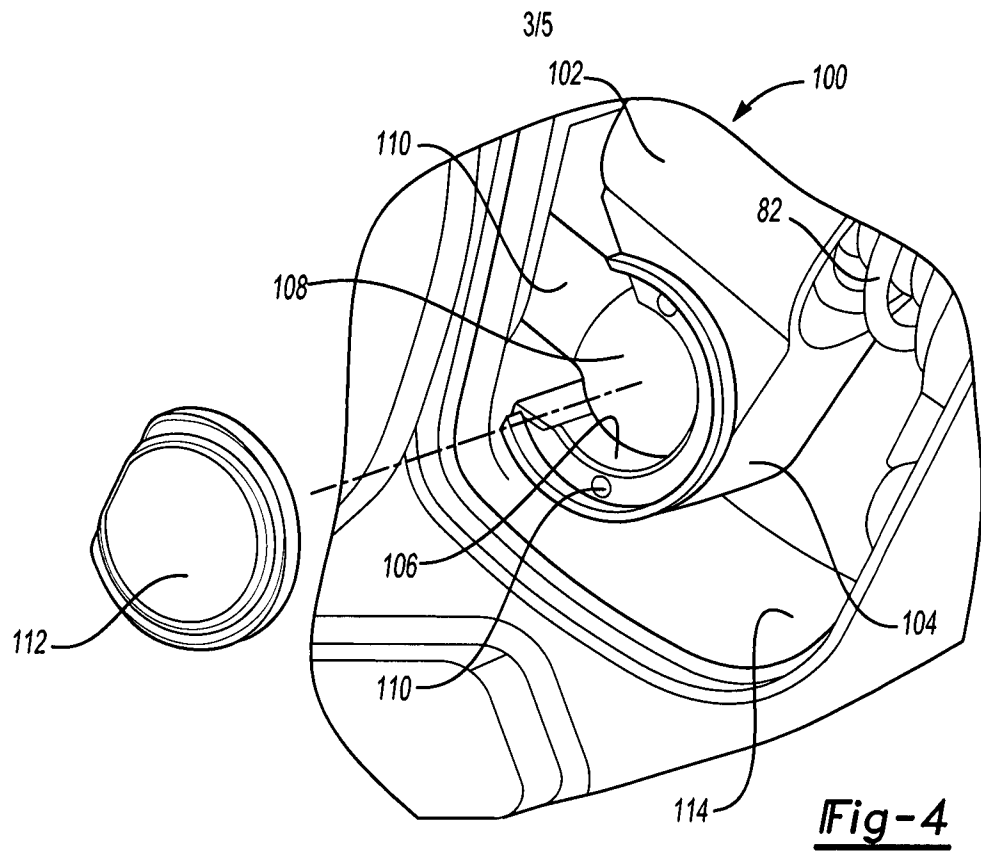


Fig-4

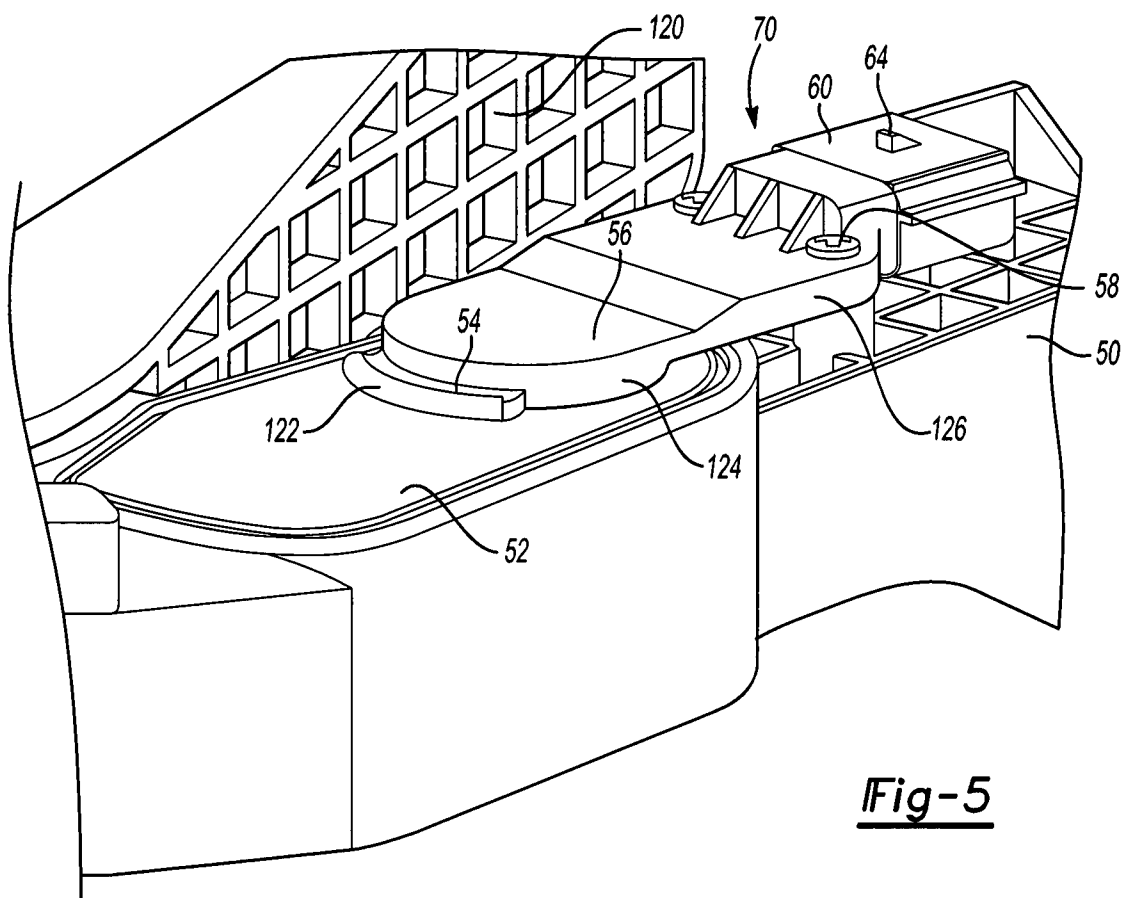


Fig-5

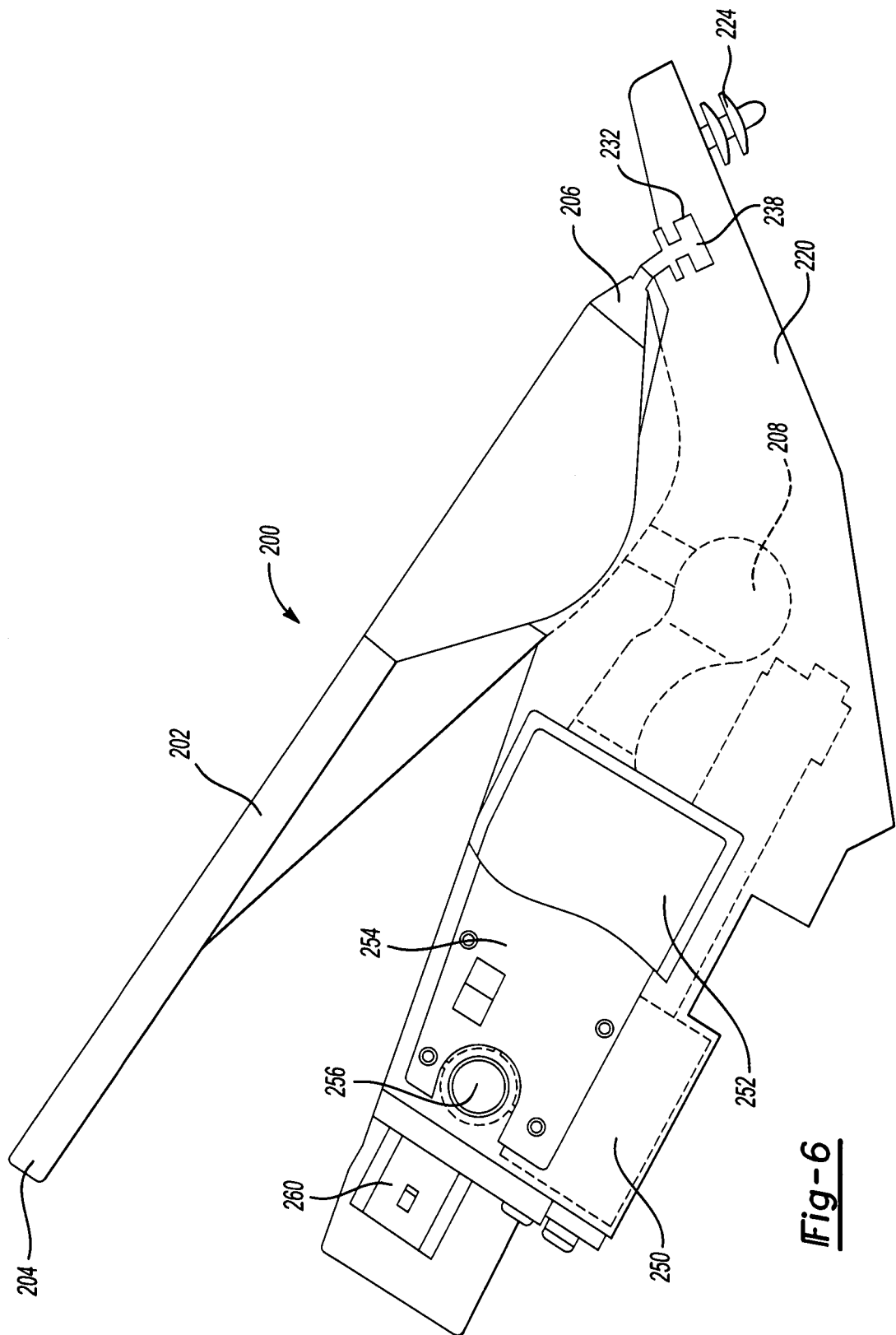
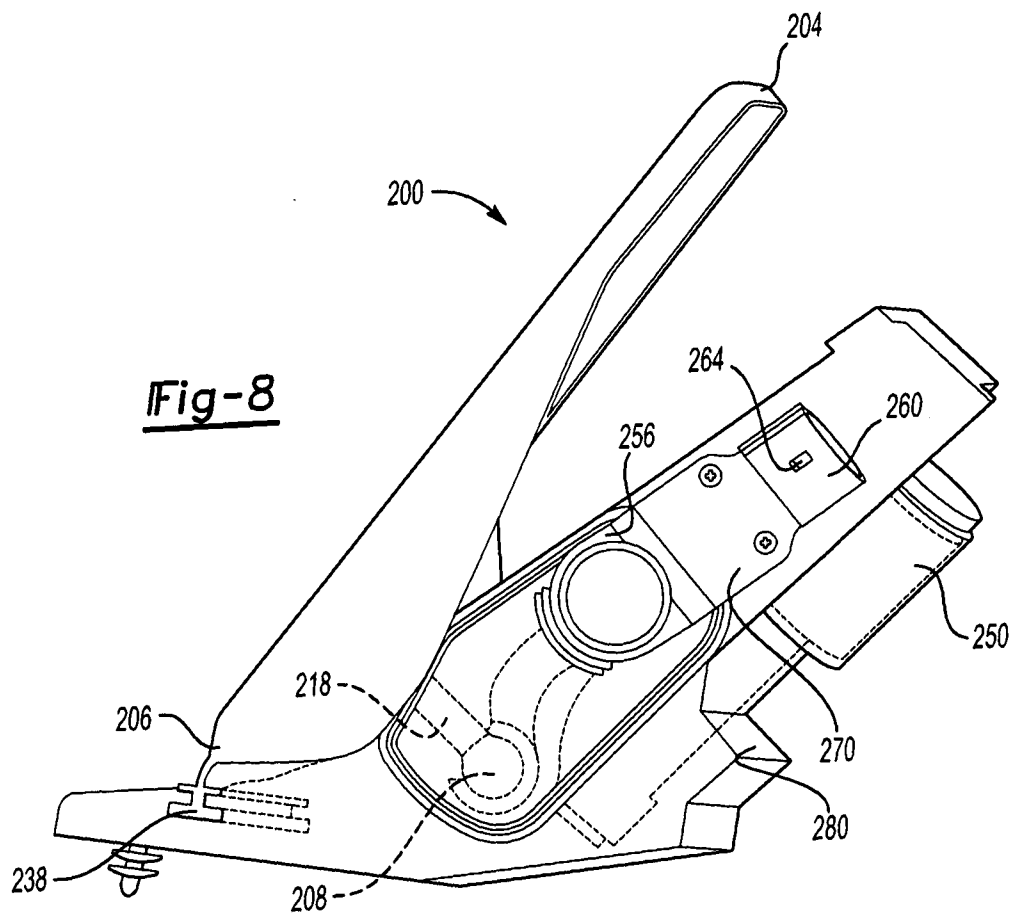
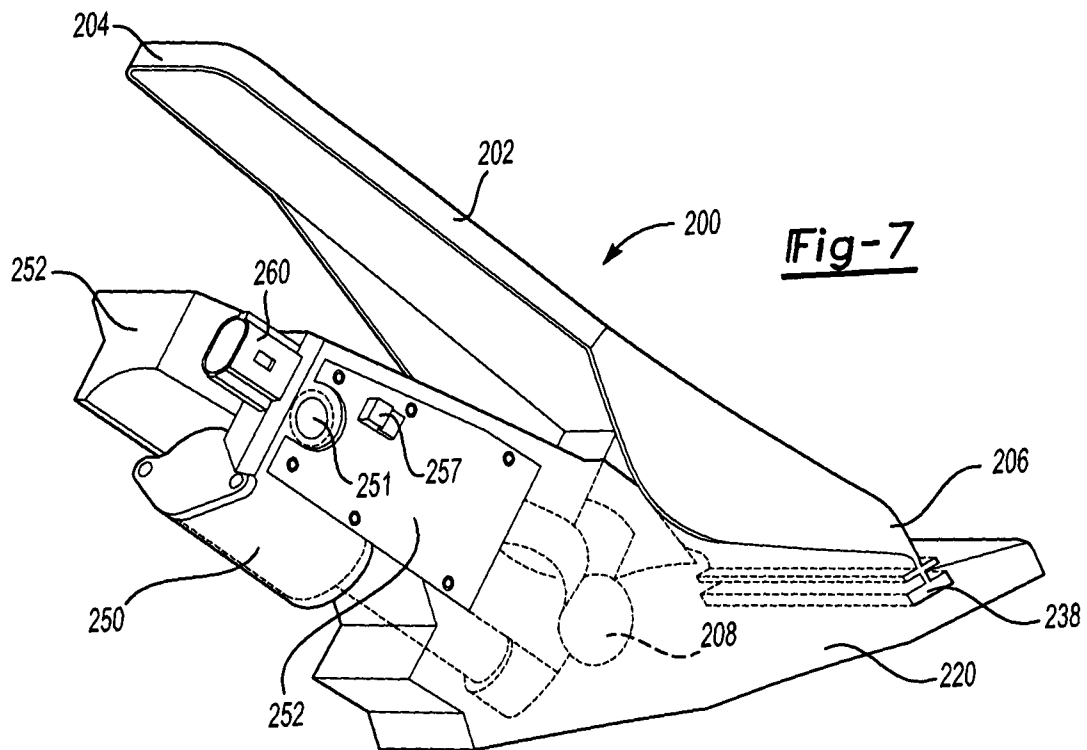


Fig-6

5/5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2012/001691

A. CLASSIFICATION OF SUBJECT MATTER

IPC: **G05G 1/30** (2009.01) , **B60K 26/02** (2006.01) , **B60T 7/04** (2006.01)

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: **G05G 1/30** (2009.01) , **B60K 26/02** (2006.01) , **B60T 7/04** (2006.01)

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

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

DB : TOTALPATENT

KW : SNAP FIT, VIBRAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO2007116293A1 (ELLIOT) 18 October 2007 (18-10-2007)	1, 6 2-5, 7, 9-10
X Y	KR100724700B1 (KIM et al.) 28 May 2007 (28-05-2007)	1, 6 2-5, 7, 9-10
Y	US7717012B2 (KIM et al.) 18 May 2010 (18-05-2010)	2-5
Y	US7946192B2 (KIM et al.) 24 May 2011 (24-05-2011)	7
A	US6289762B1 (SILVA) 18 September 2001 (18-09-2001)	1-7
A	US6318208B1 (THONGS, Jr. et al.) 20 November 2001 (20-11-2001)	1-7

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

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Date of mailing of the international search report

31 December 2012 (31-12-2012)

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Authorized officer

Alan Jones (819) 934-8531

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2012/001691

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US2007193401A1 (CAMPBELL) 23 August 2007 (23-08-2007)	1-7
A	WO2009001188A2 (WILLEMSSEN et al.) 31 December 2008 (31-12-2008)	1-7
X Y	US2011132134A1 (KIM et al.) 09 June 2011 (09-06-2011)	8, 11 9-10
X Y	WO2011072943A1 (SCHMITT et al.) 23 June 2011 (23-06-2011)	8, 11 9-10
X Y	US7331256B2 (ALLARD et al.) 19 February 2008 (19-02-2008)	8, 11 9-10

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons :

1. ☐ Claim Nos. :
because they relate to subject matter not required to be searched by this Authority, namely :

2. ☐ Claim Nos. :
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically :

3. ☐ Claim Nos. :
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows :

Group A - Claims 1-7 feature a kickdown subassembly having a bead and an abutment portion; wherein depression of a pedal results in movement of the bead towards the abutment portion, providing for kickdown when the bead contacts the abutment portion and subsequently moves past and over the abutment portion;

Group B - Claims 8-11 feature a vibratory motor connected to a pedal, the vibratory motor mounted to a housing; and a control unit connected to the vibratory motor operable to activate the vibratory motor when providing a notification to the drive.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos. :
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos. :

- Remark on Protest** ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2012/001691

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
WO2007116293A1	18 October 2007 (18-10-2007)	AU2007235644A1 BRPI0709482A2 CN101427193A CN101427193B EP2010986A1 EP2010986A4 JP2009532272A KR20090005156A US2007234842A1	18 October 2007 (18-10-2007) 19 July 2011 (19-07-2011) 06 May 2009 (06-05-2009) 18 July 2012 (18-07-2012) 07 January 2009 (07-01-2009) 02 February 2011 (02-02-2011) 10 September 2009 (10-09-2009) 12 January 2009 (12-01-2009) 11 October 2007 (11-10-2007)
KR100724700B1	28 May 2007 (28-05-2007)	None	
US7717012B2	18 May 2010 (18-05-2010)	KR100644796B1 US2007157755A1	03 November 2006 (03-11-2006) 12 July 2007 (12-07-2007)
US7946192B2	24 May 2011 (24-05-2011)	CN101596861A DE102008061160A1 JP2009292458A KR100911560B1 US2009293666A1	09 December 2009 (09-12-2009) 03 December 2009 (03-12-2009) 17 December 2009 (17-12-2009) 10 August 2009 (10-08-2009) 03 December 2009 (03-12-2009)
US6289762B1	18 September 2001 (18-09-2001)	DE69920115D1 DE69920115T2 EP0974886A2 EP0974886A3 EP0974886B1 GB9815705D0 GB2339887A GB2339887B	21 October 2004 (21-10-2004) 13 October 2005 (13-10-2005) 26 January 2000 (26-01-2000) 17 April 2002 (17-04-2002) 15 September 2004 (15-09-2004) 16 September 1998 (16-09-1998) 09 February 2000 (09-02-2000) 11 December 2002 (11-12-2002)
US6318208B1	20 November 2001 (20-11-2001)	None	
US2007193401A1	23 August 2007 (23-08-2007)	CN201302680Y WO2007089537A1	02 September 2009 (02-09-2009) 09 August 2007 (09-08-2007)
WO2009001188A2	31 December 2008 (31-12-2008)	US2008314192A1 WO2009001188A3	25 December 2008 (25-12-2008) 12 February 2009 (12-02-2009)