



- (51) International Patent Classification:
E02F 3/76 (2006.01)
- (21) International Application Number:
PCT/US2014/045060
- (22) International Filing Date:
1 July 2014 (01.07.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (71) Applicant: VOLVO CONSTRUCTION EQUIPMENT
AB [SE/SE]; SE-631 85 Eskilstuna (SE).
- (72) Inventor; and
- (71) Applicant (for US only): VOGEL, Lynn [US/US]; 573
East King St., Chambersburg, Pennsylvania 17201 (US).
- (74) Agents: SCHIVLEY, G. Gregory et al.; Harness, Dickey
& Pierce, P.L.C., P.O. Box 828, Bloomfield Hills,
Michigan 48303 (US).
- (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, IR, IS, JP, KE, KG, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
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.

- (84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

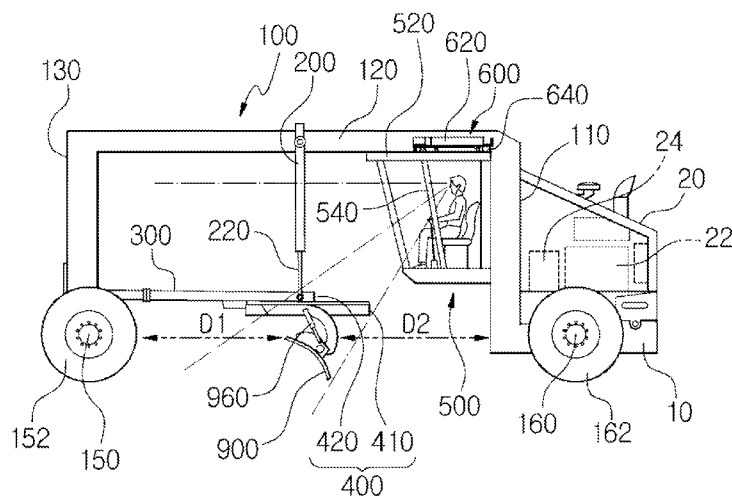
— of inventorship (Rule 4.17(iv))

Published:

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

(54) Title: MOTOR GRADER

FIG. 2



(57) Abstract: A motor grader is disclosed. In order to increase the operator's visibility, a main frame is located at a higher position than the operator's view. As the distance between the main frame and the ground increases, the space for lifting operation and rotation operation of the lift arm, including the blade, can be expanded, and thus, operability can be enhanced.

MOTOR GRADER

TECHNICAL FIELD

The present invention relates to a motor grader, more particularly, a
5 motor grader, wherein an angle of a blade of the grader is adjusted upwardly or
downwardly using a lifting cylinder to grade the surface of the ground to become
flat regardless of geographical features or soil conditions.

BACKGROUND OF THE INVENTION

10 Generally, a motor grader is a construction machine used in grading the
surface of the ground to be flat. Most motor graders have a blade carried
between the front and rear wheels of a long vehicle body and a power unit
containing an engine in the rear portion to , grade and smooth out the surface of
the ground using the blade while moving itself. Such a motor grader is used in
15 the grading work for wide areas, such as an airfield, a playing field, a road, etc.,
and the finishing work for paving, excavating and slope surface.

As an example, US PAT 4,807,461 discloses a motor grader. This
patent is characterized by a main frame comprising a rear unit and a center unit,
a cross section of which has a box-like structure. With such feature, locally high
20 stresses can be relieved.

Meanwhile, as illustrated in FIG. 1, a motor grader comprises: a tractor
(1000), wherein tandem rear wheels (1200) are formed in the bottom, and a
power unit is formed in the top; an operator's cab (1100) mounted on one upper
side of the tractor (1000); a main frame (2000) connected to a chassis of the
25 tractor (1000) using an articulated hinge and formed longitudinally forward; a
front axle (2300) formed in the front end of the main frame (2000); a lift arm
(3000) mounted on one side of the main frame (2000) in a horizontal direction; a
rotation unit (5000) connected to the lift arm (3000) to be lifted to a drawbar
(4000), which is hinge-connected to the front wheels; and a blade (6000)
30 mounted in the rotation unit (5000) such that the angle rotates and is in contact
with the surface of the ground.

Meanwhile, the intermediate portion of the main frame is bent upwardly
and is spaced apart from the surface of the ground to be located in the upper

portion. A lift arm is mounted in the bent intermediate portion, and thus, ascending or descending of a rotation plate is possible within a specific distance from the surface of the ground although the height is limited.

However, the intermediate portion of the main frame in the conventional
5 technology was located lower than the operator's cab, specifically, the operator's seat. Further, the work equipment, including a drawbar, a rotation plate and a blade as well as a lift arm, is arranged in a structurally complicated manner in the intermediate portion. Accordingly, there was a problem of blocking the operator's view to check the ground and the vehicle's front wheels. That is, since
10 the intermediate portion of the main frame blocks the operator's view, it is obstructed to constantly check the state of work between the ground and the blade. Thus, the operator cannot correctly check, with his/her eyes, the blade and the site where the grading work is performed. Additionally, it is difficult to anticipate the situation of the ground ahead of the front wheels, which results in
15 an exposure to its unsafe state, such as a rollover accident, due to the appearance of a sudden obstacle. Further, due to the long length of the main frame, the front wheel axle becomes lighter than the tractor equipped with various weighty units, and the front wheel wobbles significantly when driving on rough road, which results in unstable driving. In order to solve the problem, it
20 was required that a counter weight be mounted on the front of the main frame. In such a case, the vehicle became heavier and moved slowly, and fuel consumption was increased and work efficiency was lowered.

Accordingly, many manufacturers have attempted to change of the disposition of the operator's cab or improve the structure of the operator's cab.
25 However, there has still been a problem the operator's view being blocked.

SUMMARY OF THE INVENTION

It is an objective of the present invention to provide a motor grader, wherein in order to increase the operator's visibility, the main frame is disposed
30 higher than at least the operator's view to secure a clear view; and the distance between the main frame and the ground is increased, so that the space for lifting operation and rotation operation of a lift arm, including a blade, can be widened to enhance operability.

It is another objective of the present invention to provide a motor grader, wherein by may reduce the length of the main frame, the wheel base between the front wheel and the rear wheel is more symmetric about the blade position, so that the front wheel axle and the rear wheel axle can be arranged at equal
5 distances to stably secure balance.

It is still another objective of the present invention to provide a motor grader, wherein in order to protect the operator, a roll-over protective structure (ROPS) is mounted on the top of the operator's cab to the overhead frame for secure stability.

10

The above objectives of the present invention can be achieved by a motor grader comprised of:

a chassis provided with a rear wheel axle and mounted with a power unit;
a main frame connected to the chassis and extends longitudinally toward the
15 front, the main frame comprising a rear vertical part connected to the chassis and extending upwardly, a central horizontal part connected to the rear vertical part and extending horizontally and a front vertical part connected to the central horizontal part and extending downwardly;
a front wheel axle mounted in the front vertical part;
20 a lift arm mounted longitudinally to the central horizontal part of the main frame and performing lifting and falling movement , the lift arm being mounted perpendicularly to the central horizontal part;
a rotation part connected to the lift arm performing lifting and falling movement and connected to the drawbar hinge-connected to the front wheel axle, the
25 rotation part having a circle provided with a gear formed in the circumferential direction on the bottom, and a universal connector engaged with the gear;
a blade mounted on the circle to grade the ground, the blade having a cylinder unit connected to the outer circumference of the circle such that its length is controlled; and
30 an operator's cab mounting a roof connected to the rearmost bottom surface of the central horizontal part of the main frame. According to an aspect of the present invention, the main frame is formed integrally with a chassis by the bottom portion of the rear vertical unit extending horizontally.

According to an example of the present invention, the main frame is formed in a rectangular shape by perpendicularly forming the front vertical unit and the rear vertical unit and horizontally forming the central horizontal unit.

5 According to another example of the present invention, it is possible that the main frame is formed in a trapezoidal shape by obliquely forming the front vertical unit and the rear vertical unit and horizontally forming the central horizontal unit.

It is preferable that the blade is disposed in the center of the wheel base between the front wheel axle and the rear wheel axle, and thus, is located at equal distance from the front wheel axle and the rear wheel axle, respectively.

It is preferable that the operator's cab includes a ROPS.

It is preferable that the rear wheel axle is formed unitarily.

15 According to the present invention, the intermediate portion of the main frame is located higher than the operator's view to secure a clear line of sight. Accordingly, such disposition enables the operator to more correctly check the situation of the work between the ground and the blade and can easily check the state of the blade. Additionally, with expanded visibility, the operator can anticipate the situation of the ground ahead of the front wheel, and thus, avoid obstacles and prevent accidents, such as rollovers, before they occur.

Further, as the central site of the main frame becomes higher, the entire length is reduced, and the length of the wheel base is shortened to complement the unstable front wheels. Accordingly, without equipping a counter weight or with a counter weight in a more compact shape than the conventional one, an effect of load balancing maintenance can be sufficiently obtained. Accordingly, the manufacturing costs can be reduced. Additionally, the fuel efficiency and operability can be enhanced by load reduction. With these improved effects, the operator's fatigue can be relieved and the work efficiency can be further increased.

30

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a conventional motor grader.

FIG. 2 is a lateral view of a motor grader according to an example of the present invention.

5 FIG. 3 is a front view of a motor grader according to an example of the present invention.

FIG. 4 to FIG. 6 show variously modified examples of the main frame in the motor grader according to of the present invention.

10 FIG. 7 is a perspective view of the operator's cab in the motor grader according to an example of the present invention.

FIG. 8 is a lateral view of the operator's cab in the motor grader according to an example of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

15 A detailed description of a preferred example of the present invention is provided below by referring to the attached drawings.

The examples to be explained below are provided only to describe the invention in a manner sufficiently clear and complete to enable a person having ordinary skill in the art to readily carry it out, and do not limit the technical features or the subject matter of the present invention. Further, the size or shape of the components shown in the drawings may be exaggerated for purposes of clarification or for convenience sake. The terms specifically defined by considering the constitution and operation of the present invention may vary depending on the operator's intention or practice. The definitions of such terms are based on the descriptions throughout the specification of the subject application.

25 Among the attached drawings, FIG. 2 is a lateral view of a motor grader according to an example of the present invention. FIG. 3 is a front view of a motor grader according to an example of the present invention. FIG. 4 to FIG. 6 shows examples of variously modified versions of the main frame in the motor grader according to of the present invention. FIG. 7 is a perspective view of the operator's cab in the motor grader according to an example of the present

30

invention. FIG. 8 is a lateral view of the operator's cab in the motor grader according to an example of the present invention.

As shown in FIG. 2 to FIG. 8, the motor grader according to the present invention comprises a chassis (10), a main frame (100), a lift arm (200), a drawbar (300) and an operator's cab (500). The chassis (10) has a rear wheel axle (160) formed in the bottom and loads a power unit (20) in the top. The power unit (20) comprises an engine (22), which exhibits advance and reverse driving power, and hydraulics (24), which provides hydraulic pressure to control the motion of various units. The main frame (100) is connected to the chassis (10) and extends longitudinally forward.

As an example, the main frame (100) comprises: a rear vertical part (110), one end of which is connected to the chassis (10) and which is formed upwardly; a central horizontal part (120), which is connected to the rear vertical part (110) and is formed horizontally; and a front vertical part (130), which is connected to the central horizontal part (120) and is formed downwardly. The lower portion of the rear vertical part (110) extends horizontally to be integrally formed with the chassis (10), or a portion which extends from the rear vertical part (110) of the main frame (100) functions as a chassis without separately distinguishing a chassis. By such an integral formation, the rigidity of the main frame (100) can be further enhanced. Of course, the rear vertical part (110) of the main frame (100) may be connected to the chassis by a separate connection means. Additionally, an articulated hinge (not shown) may be employed as a connection means. As the refraction angle between the left and right directions of the main frame (100) becomes larger by employing an articulated hinge, the turning radius of the vehicle may be reduced, and thus, work efficiency can be enhanced. A front wheel axle (150) is formed in the front vertical part (130) of the main frame (100), and a front wheel (152) is mounted in the front wheel axle (150). The front wheel (152) is supported on the ground to be driven in a non-powered idling form.

Meanwhile, the lift arm (200) is mounted in the central horizontal part of the main frame (100). The lift arm (200) is longitudinally mounted and, and the lifting operation of a rod (220) is performed by hydraulic pressure. The lift arm (200) is perpendicularly mounted, so that the lifting operation of the blade (900) connected to the rod (220) can be performed in the perpendicular direction.

Accordingly, the blade (900) can adjust the space in contact with the ground. A rotation part (400) is connected to the rod of the lift arm (200) to be lifted and is horizontally connected to one side of the drawbar (300) hinge-connected to the front wheel axle (150). The rotation part (400) comprises a circle (410), in which
5 a gear is formed in the bottom in the circumferential direction, and a universal connector (420) engaged with the gear. The blade (900) is mounted in the circle (410) to grade the ground. The rotation angle of the blade (900) can be adjusted by the rotation of the circle (410). The blade (900) is connected to a plurality of cylinder unit (960) and is installed to both sides of the outer circumference of the
10 circle (410) symmetrically. Accordingly, the lifting operation of the blade (900) can be more exquisitely adjusted since the rod of the plurality of cylinder unit (960) is controlled.

An operator's cab (500) is disposed in the bottom of the central vertical part (120) of the main frame (100) and is coupled to the rearmost portion of the
15 central vertical part (120) across the roof (520) of the operator's cab (500). Since the operator's cab (500) is disposed rearward, a wider view angle for the front can be secured, and thus, visibility can be enhanced.

The main frame (100) is typically configured such that the central vertical part (120) is disposed higher than the front vertical part (130) and the rear
20 vertical part (110). However, the main frame (100) may be carried out by slightly modifying the basic shape thereof. As shown in FIG. 2, the main frame (100) is formed in a rectangular shape by perpendicularly forming the front vertical part (130) and the rear vertical part (110) and horizontally forming the central horizontal part (120). This is the most basic shape and provides the shortest
25 distance of the wheel base between the front wheel axle (150) and the rear wheel axle (160).

Referring the other modified examples of the main frame (100), as shown in Fig. 4, the main frame (100) is formed in a trapezoidal shape by obliquely forming the front vertical part (130) and the rear vertical part (110) and
30 horizontally forming the central horizontal part (120). The front vertical part (130) is obliquely connected upwardly, and the rear vertical part (110) is obliquely connected downwardly.

The wheel base in this example is longer than that in the example as shown in FIG. 2. However, since the central vertical part (120) is located in the top of the operator's cab, visibility can be enhanced.

As shown in FIG. 3, a plurality of openings(135) may be formed in front
5 vertical part (130) for forward visibility in such a manner that they are not to interfere with frame stability.

In the other modified examples, as shown in FIG. 5, the main frame (100) is configured such that the front vertical part (130) is perpendicularly connected, and the rear vertical part (110) is obliquely connected downwardly. Further, as
10 shown in FIG. 6, the main frame (100) is configured such that the front vertical part (130) is obliquely connected upwardly, and the rear vertical parts (110) are connected. In the examples of the present invention, the shapes of the main frame (100) are classified largely in rectangle and trapezoid. It is advisable that the blade (900) be disposed in the center of the wheel base between the front
15 wheel axle (150) and the rear wheel axle (160) regardless of the shape. Accordingly, the blade (900) should be located at equal distance (equidistance; $D1=D2$) from the front wheel axle (150) and the rear wheel axle (160), respectively.

In such shape of the main frame (100), since the blade (900) is located at
20 equal distance from the front wheel axle (150) and the rear wheel axle (160), respectively, balance can be stably maintained, and more stable driving performance can be provided due to the weight of the front wheel (152). The central vertical part (120) of the main frame (100) moves upwardly, and thus, the center of gravity is higher and an unstable state may occur. However, the
25 reduction of the wheel base and the disposition of the blade (900) in the center can counter-balance such an unstable state. Additionally, it is possible to expand the width of the vehicle body to compensate for the higher center of gravity.

Meanwhile, the operator's cab (500) includes an ROPS (540). The ROPS (540) is configured to have a box shape by vertically or horizontally connecting
30 the rigid frame along the edge of the operator's cab (500). Accordingly, in the event of a rollover accident, the collapse of the operator's cab (500) is prevented to protect the operator.

Meanwhile, the conventional motor grader mainly takes a tandem type by comprising at least two rear wheel axles (160). However, the rear wheel axle (160) of the present invention is formed unitarily.

Meanwhile, a fixing means (600) is included to connect the main frame (100) and the roof (520) of the operator's cab (500). As shown in FIG. 6 to FIG. 8, the fixing means (600) includes a subframe (620), which is formed in both sides of the central horizontal part (120) of the main frame (100) and is disposed on the top surface of the roof (520) of the operator's cab (500), and a buffer means (640), which connects the subframe (620) and the top surface of the roof (520) and cushions the impact and maintains balance.

As shown in FIG. 7 and FIG. 8, the subframe (620) comprises a plurality of first bars (621), one end of which is connected to the lateral side of the main frame (100) perpendicularly, and a second bar (622), which is connected to the other end of the plurality of first bars (621) and is formed to be parallel to the lateral side of the main frame (100), and thus, is formed in a lattice shape. The subframe (620) is disposed to almost cover the top surface of the roof (520) of the operator's cab.

The buffer means (640) is provided to absorb rolling impact of the operator's cab (500) and comprises a spring, both ends of which are supported on the subframe (620) and the top surface of the roof (520) to be compressed and extended. An elastic tube wrapping the outside of the spring is combined so that foreign substances, such as soil and dirt, may not enter and pollute the area. Further, an oil shock absorber or a gas shock absorber may be employed as the buffer means (640). The buffer means (640) is operated to maintain stability and absorb wheel wobbles while driving, specifically, rolling, which may occur because only the top roof of the operator's cab is combined with the bottom of the main frame.

Drawings' Reference Numerals

10: chassis

20: power unit

100: main frame

110: rear vertical part

120: central horizontal part

130: front vertical part

5 200: lift arm

300: drawbar

400: rotation part

500: operator's cab

540: roll-over protective structure

600: fixing means

620: subframe

640: buffer means

900: blade

960: cylinder unit

10

CLAIMS

1. A motor grader, comprising:
a chassis provided with a rear wheel axle and mounted with a power unit;
5 a main frame connected to the chassis and extends longitudinally toward the front, the main frame comprising a rear vertical part connected to the chassis and extending upwardly, a central horizontal part connected to the rear vertical part and extending horizontally and a front vertical part connected to the central horizontal part and extending downwardly;
10 a front wheel axle mounted in the front vertical part;
a lift arm mounted longitudinally to the central horizontal part of the main frame and performing lifting and falling operation, the lift arm being mounted perpendicularly to the central horizontal part;
a rotation part connected to the lift arm performing lifting and falling
15 operation and connected to the drawbar hinge-connected to the front wheel axle, the rotation part having a circle provided with a gear formed in the circumferential direction on the bottom, and a universal connector engaged with the gear;
a blade mounted on the circle to grade the ground, the blade having a
20 cylinder unit connected to the outer circumference of the circle such that its length is controlled; and
an operator's cab mounting a roof connected to the rearmost bottom surface of the central horizontal part of the main frame.
- 25 2. The motor grader according to Claim 1, wherein the main frame is formed integrally the chassis by the bottom of the rear vertical part extending horizontally.
- 30 3. The motor grader according to Claim 1, wherein the main frame is formed in a rectangular shape by perpendicularly forming the front vertical part and the rear vertical part are and horizontally forming the central horizontal part.

4. The motor grader according to Claim 1, wherein the main frame is formed in a trapezoidal shape such by obliquely forming the front vertical part and horizontally forming the central horizontal part.

5 5. The motor grader according to Claim 1, wherein the blade is disposed in the center of the wheel base between the front wheel axle and the rear wheel axle, and is located at an equal distance from the front wheel axle and the rear wheel axle, respectively.

10 6. The motor grader according to Claim 1, wherein the operator's cab includes a roll-over protective structure (ROPS).

15 7. The motor grader according to Claim 6, wherein the ROPS comprises a rigid frame formed vertically or horizontally in the edge of the operator's cab.

8. The motor grader according to Claim 1, wherein the rear wheel axle is formed unitarily.

20 9. The motor grader according to Claim 1, further comprising a fixing means to connect the main frame and the roof of the operator's cab.

10. The motor grader according to Claim 9, wherein the fixing means comprises:
25 a subframe formed in both sides of the main frame and disposed on the top of the roof of the operator's cab; and
a buffer means connects the sub frame to the top of the roof, and buffers the impact and maintains balance.

11. The motor grader according to Claim 10, wherein the subframe comprises:

a plurality of first bars, one end of which is connected to the lateral surface of the main frame at a right angle; and

5 a second bar connected to the other end of the plurality of first bars, and formed to be parallel to the lateral surface of the main frame.

FIG. 1

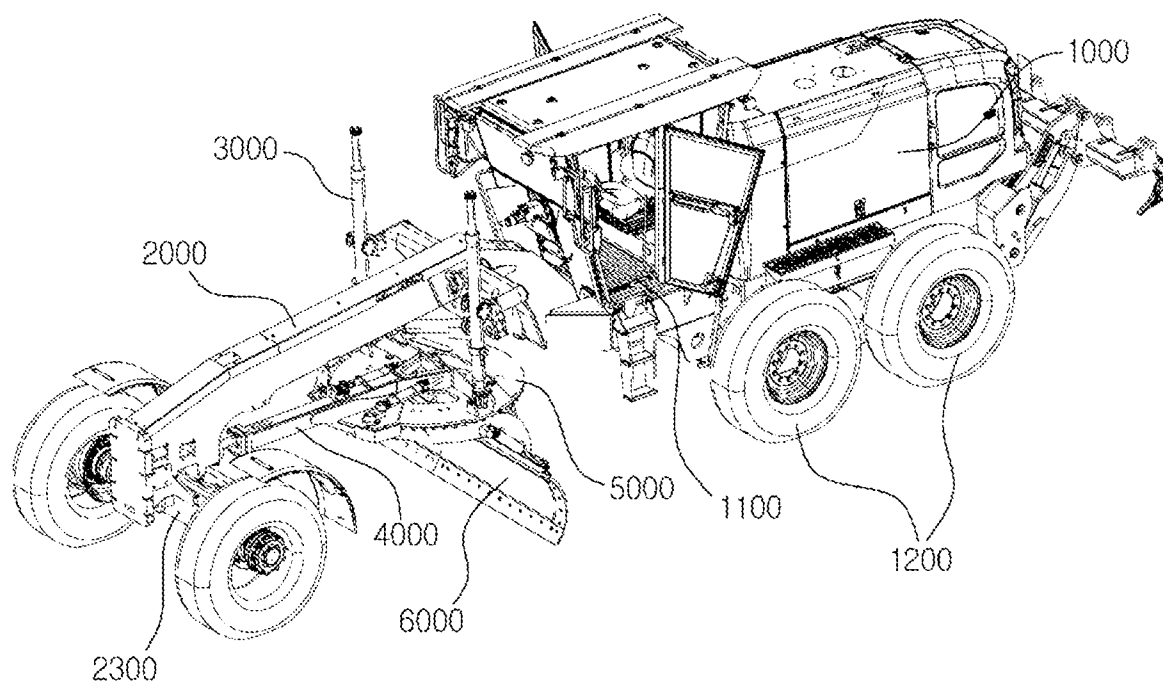


FIG. 2

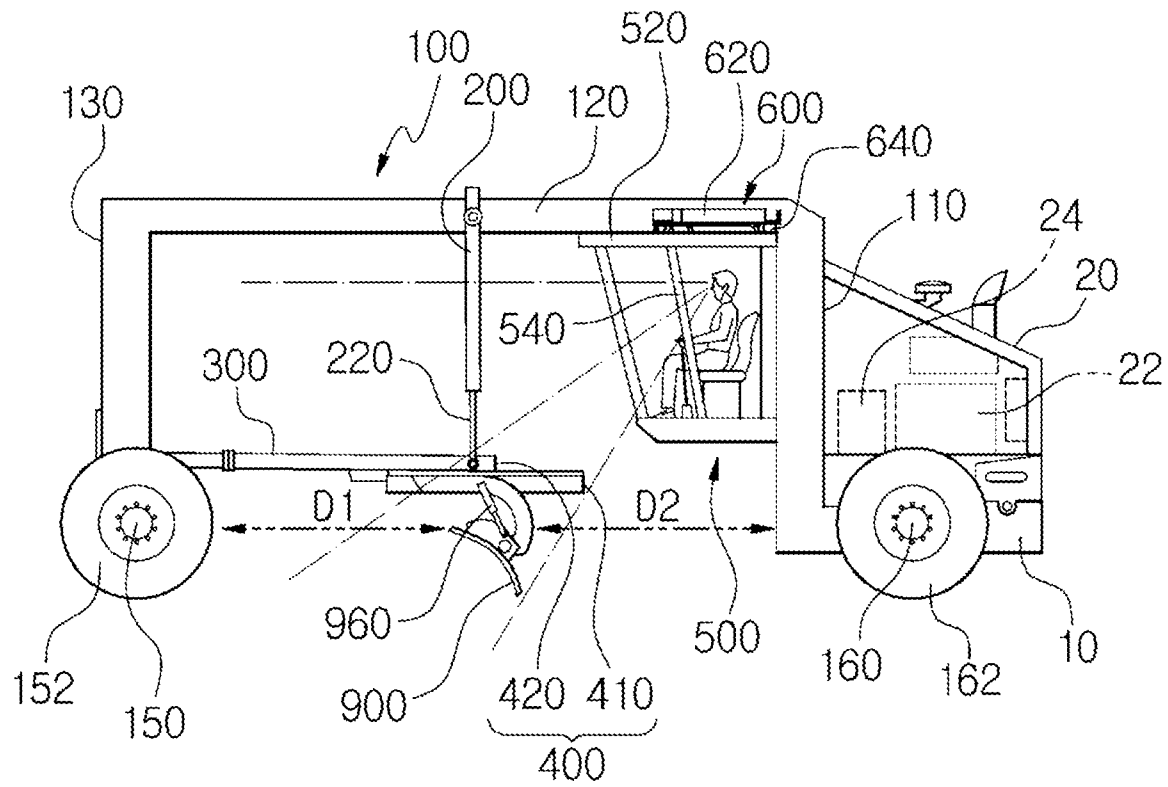


FIG. 3

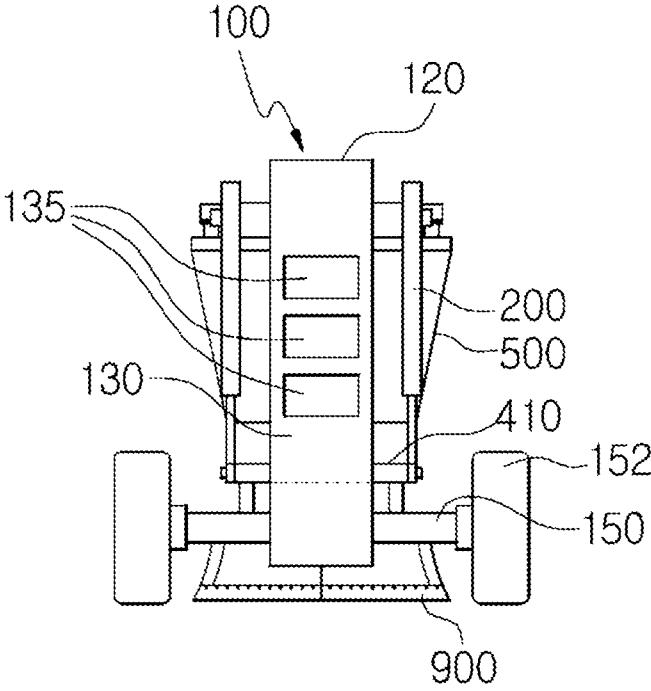


FIG. 4

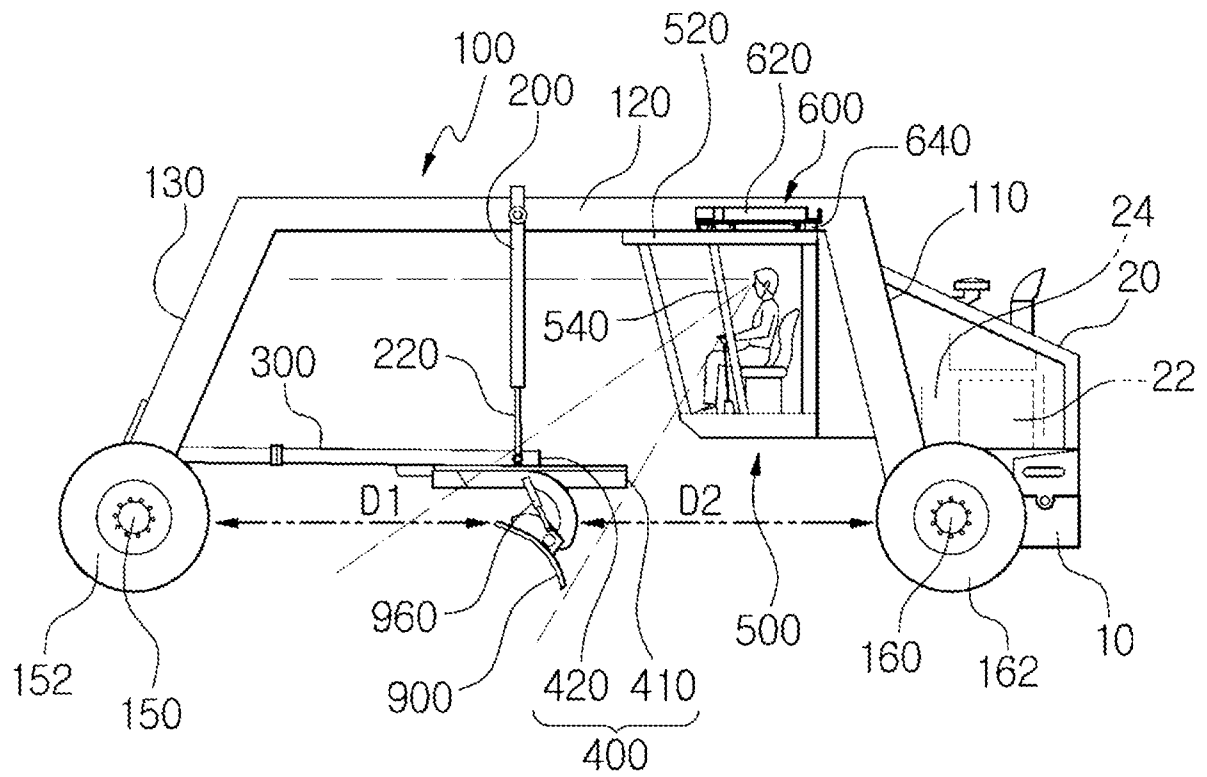


FIG. 5

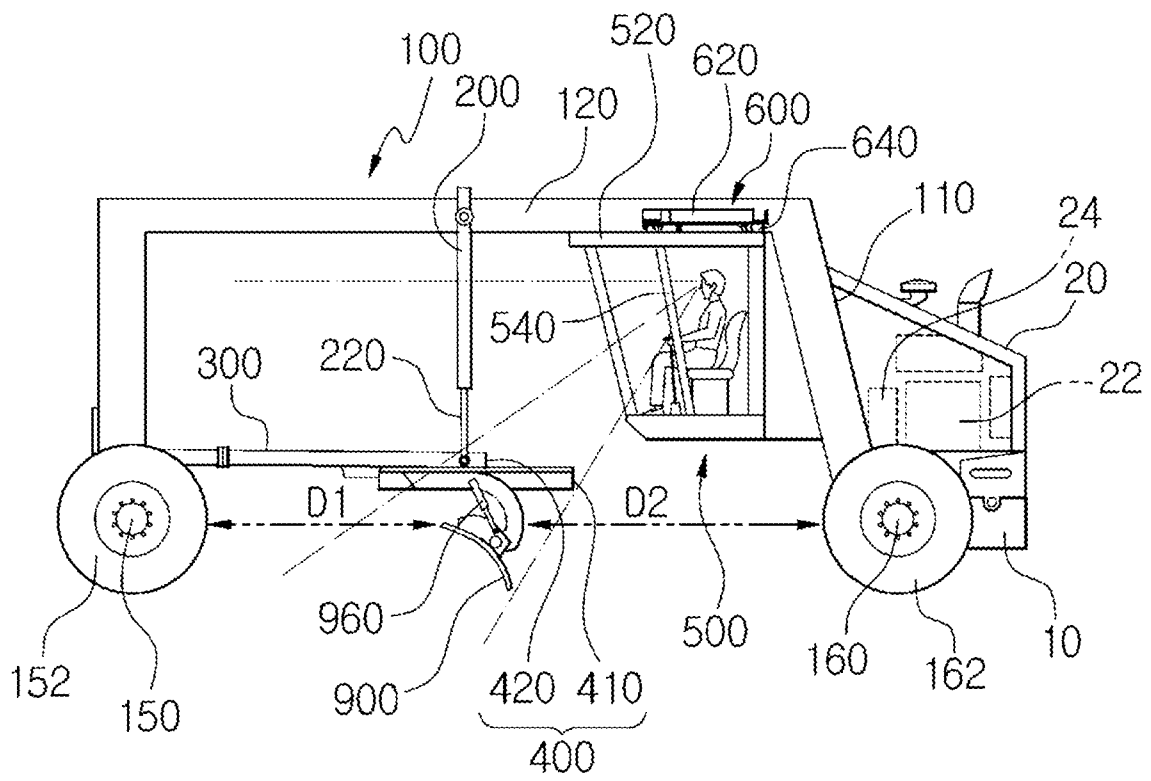


FIG. 6

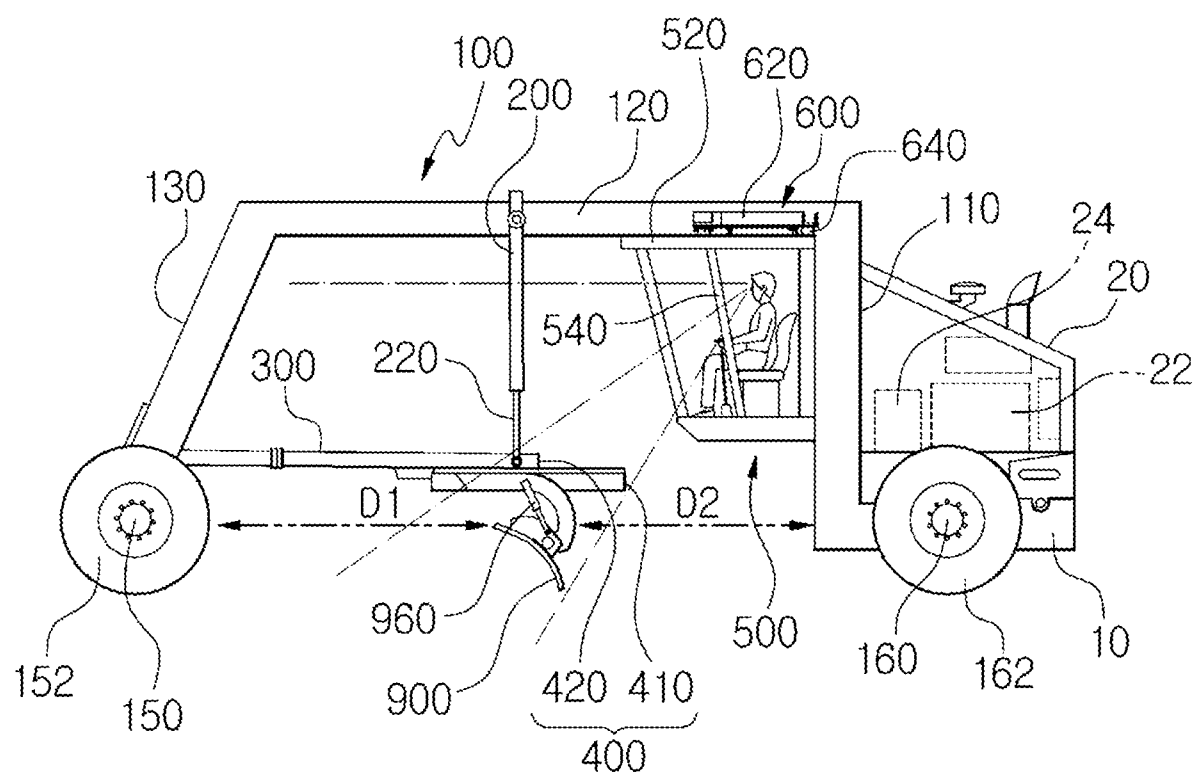


FIG. 7

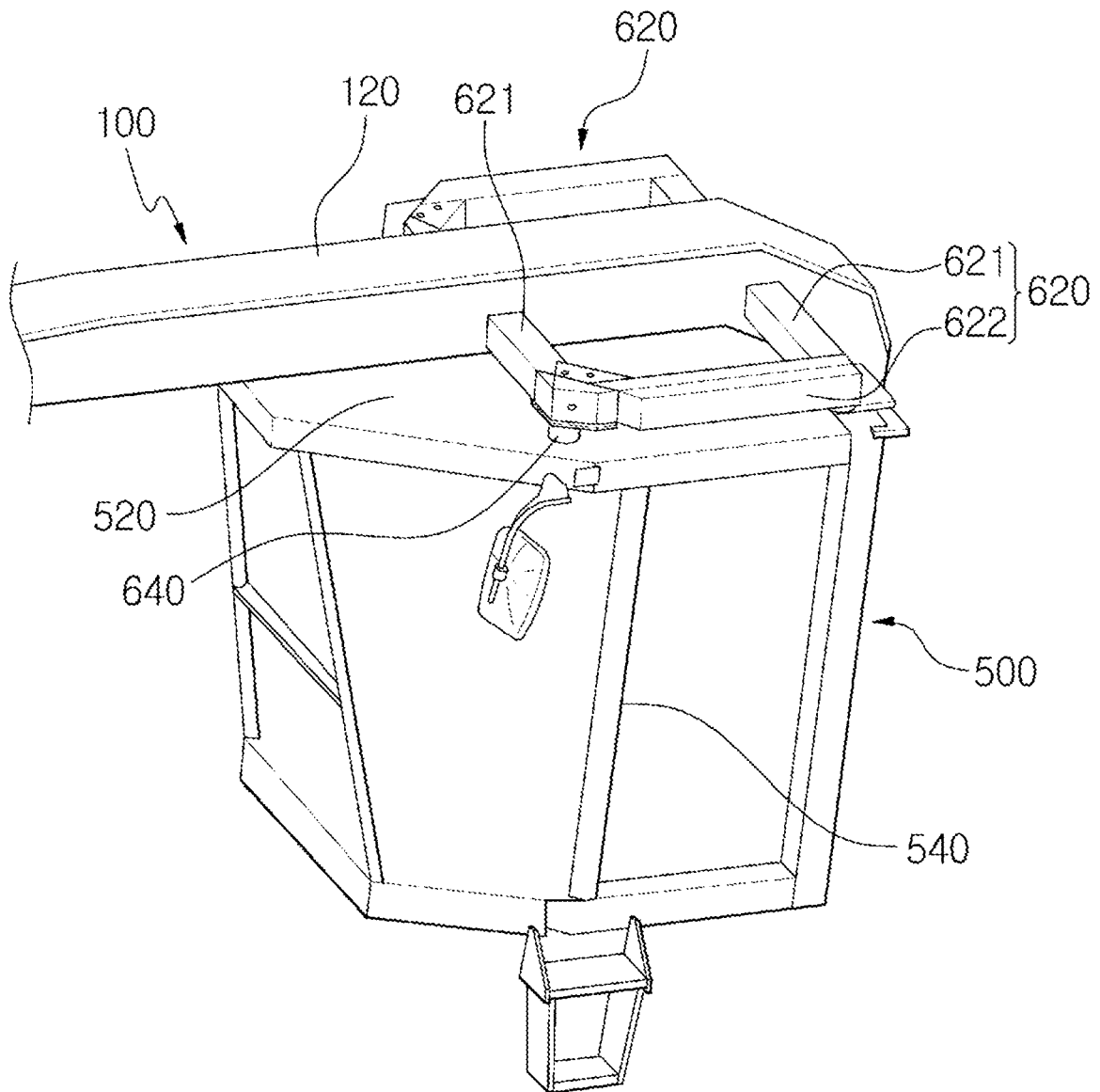
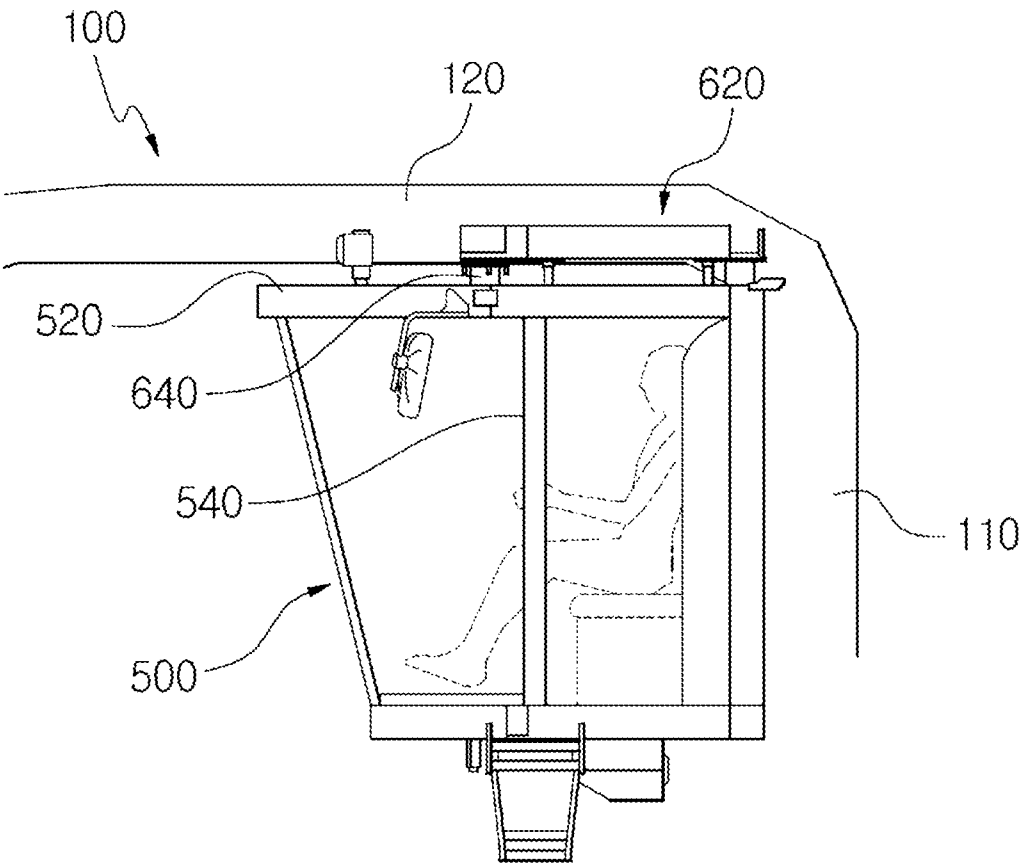


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/045060**A. CLASSIFICATION OF SUBJECT MATTER****E02F 3/76(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)

E02F 3/76; E02F 9/16; E02F 3/80; E02F 3/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: motor grader, chassis, wheel axle, lift, rotation, circle, universal connector, blade, cylinder, cab, ROPS**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3976146 A (DESOURDY, BERNARD) 24 August 1976 See abstract, column 1, line 55 - column 2, line 63, claims 1,5, and figures 1,2.	1-9
A		10, 11
Y	US 6851485 B2 (MAEDA et al.) 08 February 2005 See abstract, column 3, lines 31-54, column 4, lines 22-29, claim 1, and figures 1,2,5.	1-9
Y	US 2013-0221703 A1 (KIM, KANG-TAE) 29 August 2013 See abstract, paragraph [0029], claim 1, and figure 1.	6,7
A	US 2008-0110651 A1 (STUBBEN, DAVID WILLIAM) 15 May 2008 See abstract, paragraphs [0016],[0017], and figure 1.	1-11
A	US 7735574 B2 (SMART et al.) 15 June 2010 See abstract, column 11, lines 1-22, and figures 5a,5b.	1-11



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

16 March 2015 (16.03.2015)

Date of mailing of the international search report

16 March 2015 (16.03.2015)

Name and mailing address of the ISA/KR

International Application Division
Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan City, 302-701,
Republic of Korea

Facsimile No. ++82 42 472 7140

Authorized officer

KIM, Jin Ho

Telephone No. +82-42-481-8699



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2014/045060

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 03976146 A	24/08/1976	None	
US 6851485 B2	08/02/2005	CN 1506535 A JP 04029973 B2 JP 2004-190232 A US 2004-0149463 A1	23/06/2004 09/01/2008 08/07/2004 05/08/2004
US 2013-0221703 A1	29/08/2013	CN 103180518 A EP 2631372 A1 EP 2631372 A4 JP 2013-541653 A KR 10-2013-0135246 A WO 2012-053671 A1	26/06/2013 28/08/2013 10/09/2014 14/11/2013 10/12/2013 26/04/2012
US 2008-0110651 A1	15/05/2008	CA 2607535 A1 CA 2607535 C US 7575068 B2	30/04/2008 23/12/2014 18/08/2009
US 7735574 B2	15/06/2010	CA 2558134 A1 CA 2558134 C US 2007-0068691 A1	23/03/2007 19/07/2011 29/03/2007