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(71) Applicant (for all designated States except US):
HYUNDAI HEAVY INDUSTRIES CO., LTD.
[KR/KR]; 1, Jeonha-dong, Dong-gu, Ulsan 682-792 (KR).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **KIM, Jong-Jun**
[KR/KR]; Daesong Hyundai APT.203-905, Daesong-dong,

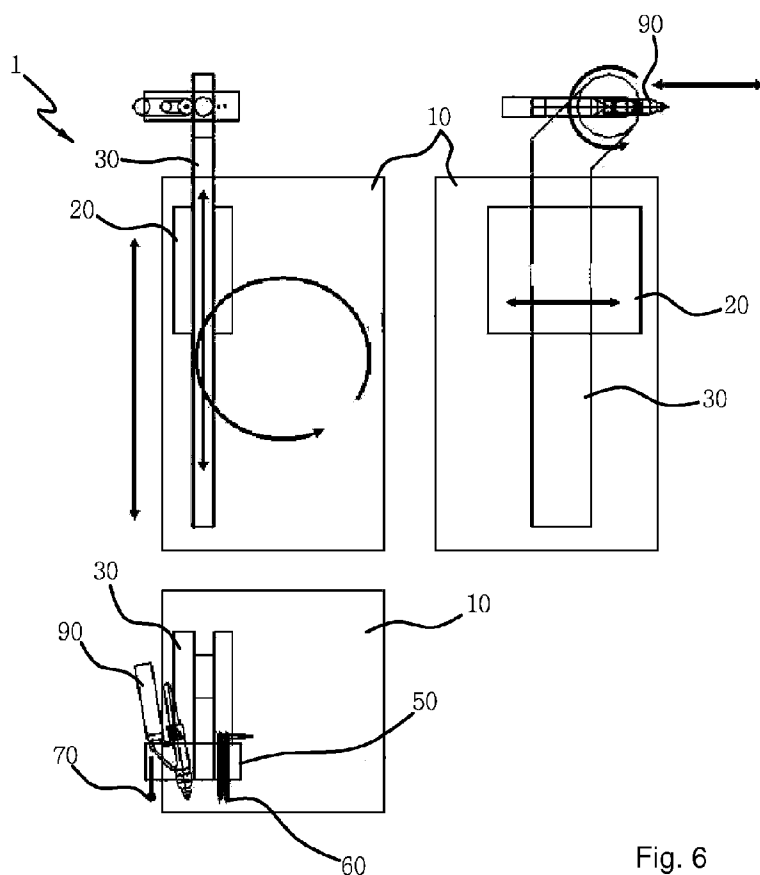
Dong-gu, Ulsan 682-754 (KR). **PARK, In-Wan** [KR/KR]; Samsung APT.202-2203, Dal-dong, Nam-gu, Ulsan 680-751 (KR). **SHIN, Sang-Ryong** [KR/KR]; Sam-jeungwan 615, 279-15, Seobu-dong Dong-gu, Ulsan 682-808 (KR). **LEE, Ji-Hyoung** [KR/KR]; Hyundai Myeong-duk APT.109-703, Seobu-dong, Dong-gu, Ulsan 682-753 (KR). **KIM, Jeom-Goo** [KR/KR]; Seongwon Santevill APT.104-505, Seobu-dong, Dong-gu, Ulsan 682-762 (KR). **KIM, Kyeong-Ju** [KR/KR]; Seongwon Santevill APT.112-1204, Seobu-dong, Dong-gu, Ulsan 682-762 (KR). **BAEK, Ho-Seong** [KR/KR]; 656-70, Hwajong-dong, Dong-gu, Ulsan 682-820 (KR). **KANG, Seong-Hwi** [KR/KR]; Seobu Family Hyundai APT.102-1206, Seobu-dong, Dong-gu, Ulsan 682-752 (KR).

(74) Agents: **CHANG, Soon-Boo** et al.; B-812 Woolim Lion's Valley, 371-28, Gasan-dong, Geumcheon-gu, Seoul 153-803 (KR).

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(54) Title: AUTOMATIC WELDING DEVICE FOR ANGLE PIECES MOUNTED TO CORNERS IN CARGO TANKS OF MEMBRANE-TYPE LNG TANKER



(57) Abstract: Disclosed herein is an automatic welding device for angle pieces mounted to corners in the cargo tanks of a membrane-type LNG tanker. The automatic welding device includes a carriage main body, a welding head rotating means, a welding head vertical movement means, a welding head lateral movement means, a welding head unit, and a welding torch. The carriage main body is mounted on a rail so as to be moved horizontally along the rail. The welding head rotating means is mounted to the upper surface of the carriage main body so as to be rotated. The welding head vertical movement means is mounted at a predetermined position on the upper surface of the welding head rotating means so as to be vertically and laterally moved. The welding head lateral movement means is connected with the welding head vertical movement means.

Fig. 6



AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, 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, 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, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Description

AUTOMATIC WELDING DEVICE FOR ANGLE PIECES MOUNTED TO CORNERS IN CARGO TANKS OF MEMBRANE-TYPE LNG TANKER

Technical Field

- [1] The present invention relates, in general, to an automatic welding device for angle pieces mounted to corners in the cargo tanks of a membrane-type liquefied Natural Gas (LNG) tanker and, more particularly, to an automatic welding device for angle pieces mounted to corners in the cargo tanks of a membrane-type LNG tanker, which enables automatic welding of angle pieces, which are mounted to corners in the cargo tanks of a membrane-type LNG tanker, which has chiefly depended on manual welding work because working positions are greatly restricted due to very small working spaces and because working members having various dimensions are also used, thus greatly improving productivity by greatly decreasing the incidence of welding defects, as well as by greatly increasing welding speed and maintaining uniform welding quality.

Background Art

- [2] FIG. 1 is a conceptual view showing the structure of the cargo tanks of a membrane-type LNG tanker. As shown in FIG. 1, the cargo tanks 1 of the typical membrane-type LNG tanker include a plurality of corners 10 and 10a. Angle pieces (not shown) are mounted to the corners 10 and 10a by welding. That is, as shown in FIG. 1, angle pieces, each of which is formed to have an angle of 90 degrees, are mounted to respective corners A 10 by welding, and angle pieces, each of which is formed to have an angle of 135 degrees, are mounted to respective corners B 10a.
- [3] FIG. 2 is a view showing an angle piece mounted to corner A, and FIG. 3 is a view showing an angle piece mounted to corner B. As shown in FIG. 2, the angle piece 11 mounted to the corner A 10 is bent to have an angle of 90 degrees, linear welding portions 110 and 111 are formed in two side portions of the angle piece 11, and respective curved welding portions 112 and 113 are formed in the upper and lower ends of the angle piece 11. Furthermore, as shown in FIG. 3, the angle piece 11a, which is mounted to the corners B 10a, is bent to have an angle of 135 degrees, linear welding portions 110a and 111a are formed in two side portions of the angle piece 11a, and respective curved welding portions 112a and 113a are formed in the upper and lower ends of the angle piece 11a. The angle pieces 11 and 11a, which are formed as described above, are respectively mounted to the corner 10 and the corners 10a of corrugated boards 20 and 20a by welding, as shown in FIGS. 2 and 3.
- [4] FIG. 4 is a schematic view showing the welding positions of a worker, who welds

angle pieces in the cargo tanks, and FIG. 5 is a schematic view showing the welding position of a worker when welding is conducted using a conventional automatic welding device, which is used to weld a corrugated board. As shown in FIG. 4, angle pieces (not shown) are generally mounted to the corners 10 in the very narrow cargo tanks 1, so that a worker must generally perform welding work in front of the angle pieces, and welding positions are restricted. Furthermore, the welding work is chiefly manually performed because angle pieces having various dimensions are used. Furthermore, as shown in FIG. 5, when welding is performed using a conventional automatic welding device 40, which is used to weld a corrugated board 20, it is difficult for the worker to observe a welding portion 30, so that difficulties arise when the work of welding angle pieces (not shown) is performed using the conventional automatic welding device 40, and thus, in reality, angle pieces are manually welded. As a result, problems occur in that productivity is greatly lowered because the welding work takes a very long time to perform, and in that reliability of welding is greatly lowered because the rate of welding defects is increased due to inconsistent welding quality.

Disclosure of Invention

Technical Problem

- [5] Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide an automatic welding device for angle pieces mounted to corners in the cargo tanks of a membrane-type LNG tanker, which enables both linear and curved portions of angle pieces, which are mounted to corners in the cargo tanks of a membrane-type LNG tanker, to be automatically welded using a single piece of equipment, thus greatly improving productivity by greatly decreasing the incidence of welding defects, as well as by greatly increasing welding speed and maintaining constant welding quality.

Technical Solution

- [6] In order to accomplish the above object, the present invention provides an automatic welding device for angle pieces mounted to corners in the cargo tanks of a membrane-type LNG tanker, including: a carriage main body mounted on a rail so as to be moved horizontally along the rail, the rail being mounted adjacent to corners of the cargo tanks of a membrane-type LNG tanker, to which angle pieces are mounted; a welding head rotating means mounted to the upper surface of the carriage main body so as to be rotated; a welding head vertical movement means mounted at a predetermined position on the upper surface of the welding head rotating means; a welding head lateral movement means connected with the welding head vertical movement means so as to be moved vertically along with the welding head vertical movement means and to be

moved laterally in the traveling direction of the carriage main body; and a welding head unit, including: a welding torch rotating means, which is mounted at the leading end of the welding head lateral movement means; a welding torch vertical movement means, which is mounted on one side of the welding torch rotating means; and a welding torch, which is mounted on one side of the welding torch vertical movement means.

Advantageous Effects

- [7] According to the present invention, the automatic welding device for angle pieces mounted to corners in the cargo tanks of a membrane-type LNG tanker enables automatic welding of the facing joint portions of angle pieces, which have been manually welded, thus greatly improving productivity by greatly decreasing the incidence of welding defects, as well as by greatly increasing welding speed and maintaining uniform welding quality.

Brief Description of the Drawings

- [8] The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:
- [9] FIG. 1 is a conceptual view showing the structure of the cargo tanks of a membrane-type LNG tanker;
- [10] FIG. 2 is a view showing an angle piece mounted to corner A;
- [11] FIG. 3 is a view showing an angle piece mounted to corner B;
- [12] FIG. 4 is a schematic view showing the welding positions of a worker, who welds angle pieces in the cargo tanks;
- [13] FIG. 5 is a schematic view showing the welding position of a worker when welding is conducted using a conventional automatic welding device, which is used to weld a corrugated board;
- [14] FIG. 6 is a schematic view of an automatic welding device for angle pieces according to an embodiment of the present invention;
- [15] FIG. 7 is a view showing an example of the installation of the automatic welding device for angle pieces according to the embodiment of the present invention;
- [16] FIG. 8 is a view showing the installation of a carriage main body according to an embodiment of the present invention;
- [17] FIG. 9 is a view showing, in detail, a welding head rotating means according to an embodiment of the present invention;
- [18] FIG. 10 is a view showing, in detail, a welding head unit according to an embodiment of the present invention;
- [19] FIG. 11 is a view illustrating a process of the automatic welding device for angle

pieces according to the embodiment of the present invention welding the curved welding portion of an angle piece;

[20] FIG. 12 is a view showing the automatic welding device for angle pieces according to the embodiment of the present invention, which moves to weld the linear welding portions of angle pieces; and

[21] FIG. 13 is a view illustrating a process of the automatic welding device for angle pieces according to the embodiment of the present invention welding the linear welding portions of angle pieces.

Best Mode for Carrying Out the Invention

[22] In order to accomplish the above object, the present invention provides an automatic welding device for angle pieces mounted to corners in the cargo tanks of a membrane-type LNG tanker, including: a carriage main body mounted on a rail so as to be moved horizontally along the rail, the rail being mounted adjacent to corners of the cargo tanks of a membrane-type LNG tanker, to which angle pieces are mounted; a welding head rotating means mounted to the upper surface of the carriage main body so as to be rotated; a welding head vertical movement means mounted at a predetermined position on the upper surface of the welding head rotating means; a welding head lateral movement means connected with the welding head vertical movement means so as to be moved vertically along with the welding head vertical movement means and to be moved laterally in the traveling direction of the carriage main body; and a welding head unit, including: a welding torch rotating means, which is mounted at the leading end of the welding head lateral movement means; a welding torch vertical movement means, which is mounted on one side of the welding torch rotating means; and a welding torch, which is mounted on one side of the welding torch vertical movement means.

[23] The present invention is described in detail with reference to the accompanying drawings below.

[24] FIG. 6 is a schematic view of an automatic welding device for angle pieces according to an embodiment of the present invention, FIG. 7 is a view showing an example of the installation of the automatic welding device for angle pieces according to the embodiment of the present invention, FIG. 8 is a view showing the installation of a carriage main body according to an embodiment of the present invention, FIG. 9 is a view showing, in detail, a welding head rotating means according to an embodiment of the present invention, and FIG. 10 is a view showing, in detail, a welding head unit according to an embodiment of the present invention. As shown in FIGS. 6 to 10, the automatic welding device 1 for angle pieces according to an embodiment of the present invention includes a carriage main body 10, a welding head rotating means 40, a

welding head vertical movement means 20, a welding head lateral movement means 30, and a welding head unit 50.

[25] The carriage main body 10 of the automatic welding device for angle pieces, which is constructed as described above, is mounted on a rail 5 so as to be moved horizontally along the rail 5, which is mounted adjacent to corners 4 in the cargo tanks 3 of a membrane-type LNG tanker, in which angle pieces 2 are mounted.

[26] That is, the carriage main body 10, as shown in FIG. 8, includes a fastening bracket 101, which is configured such that a plurality of rollers 102 attached to two side surfaces of the rail 5 is mounted to two sides of the lower portion of the fastening bracket 101, a clamping device 103, which is mounted on one side of the fastening bracket 101 so as to be connected to rollers 102, which are attached to a side portion of the fastening bracket 101, a pinion gear 104, which is mounted in the central portion of the fastening bracket 101 and is connected to a rack gear 5a, which is mounted in the upper central portion of the rail 5, and a traveling motor 105, which is connected to the upper end of the pinion gear 104.

[27] The welding head rotating means 40 is mounted to the carriage main body 10 so as to be rotated.

[28] That is, the welding head rotating means 40, as shown in FIG. 9, includes a rotary shaft 400, which is mounted in the upper portion of the carriage main body 10 and is configured such that a driven pulley 401 is mounted to the lower end of the rotary shaft 400, a rotary plate 402, which is configured such that one end thereof is connected to the upper end of the rotary shaft 400, a drive motor 404, which is located on one side of the rotary shaft 400 and is configured such that a driving pulley 403 is mounted to the rotary shaft 400, mounted in the upper portion of the carriage main body 10, and a timing belt 405, which is responsible for connecting the driven pulley 401 and the driving pulley 403 to each other and transmitting the rotational force of the driving pulley 403 to the driven pulley 401.

[29] Furthermore, it is preferred that a laser line generation device 80 be further mounted on one side of the rotary plate 402 so that a welding torch 90 coincides with a welding line by forming a laser line 80a, which is located on a line identical to that of the welding torch.

[30] The welding head vertical movement means 20 is mounted at a predetermined position on the upper surface of the welding head rotating means 40. The welding head lateral movement means 30 is connected with the welding head vertical movement means 20 so as to be moved vertically along with the welding head vertical movement means 20 and to be moved laterally in the traveling direction of the carriage main body 10.

[31] Each of the welding head vertical movement means 20 and the welding head lateral

movement means 30, described above, is constructed using an electric slider, two parallel Linear Motion (LM) guides, and a ball screw, which are applied to typical automatic welding devices. Thus, in the present invention, a detailed description of the construction of these parts is omitted.

[32] The welding head unit 50, as shown in FIG. 10, includes a welding torch rotating means 500, which is mounted at the leading end of the welding head lateral movement means 30, a welding torch vertical movement means 510, which is mounted on one side of the welding torch rotating means 500, and a welding torch (not shown), which is mounted on one side of the welding torch vertical movement means 510.

[33] The welding torch rotating means 500 of the welding head unit 50, which is constructed as described above, includes a worm gear 501, which is mounted at the leading end of the welding head lateral movement means 30 so as to be rotated, a guide fastening bracket 502, which is mounted to one end of the rotary shaft 504 of the worm wheel 501a of the worm gear 501, and a pair of curved-surface tracking displacement sensors 60, which are mounted in the central portion of a sensor fastening bracket 503, which is mounted to the other end of the rotary shaft 504 of the worm wheel 501a of the worm gear 501.

[34] Furthermore, the welding torch vertical movement means 510 includes a pair of LM guides 511, which are mounted on one side surface of the welding torch rotating means 500, a vertical movement block 512, which is mounted to the first surfaces of the LM guides 511 and is configured such that a ball screw 514 is disposed in the central portion of the vertical movement block 512, so that the vertical movement block 512 moves vertically along the LM guides 511 in response to rotation of the ball screw 514, a torch fastening bracket 513, which is configured such that one end thereof is mounted on one side surface of the vertical movement block 512 and the welding torch is mounted to the other end thereof, and a vertical displacement sensor 70, which is mounted to one side of the torch fastening bracket 513 so as to be located at the front of the welding torch.

[35] A welding process, which is performed by the automatic welding device for angle pieces according to the embodiment of the present invention, is described with reference to FIGS. 7 to 13 below.

[36] FIG. 11 is a view illustrating a process of the automatic welding device for angle pieces according to the embodiment of the present invention welding the curved welding portion of an angle piece. First, the process of the automatic welding device 1 for angle pieces according to the embodiment of the present invention welding the curved welding portion 2a of an angle piece 2 is described with reference to FIGS. 7 to 11.

[37] As shown in FIG. 7, the rail 5 is mounted adjacent to the corners 4 in the cargo tanks

3 of a membrane-type LNG tanker, to which the angle pieces 2 are mounted. The automatic welding device 1 for angle pieces according to the embodiment of the present invention is mounted at an arbitrary location on the rail 5, and then the location of the automatic welding device 1 is fixed. In this case, the automatic welding device 1 for angle pieces is mounted on the rail such that the welding torch 90 coincides with the welding line of the curved welding portion 2a of each angle piece 2.

[38] That is, as shown in FIG. 8, the rollers 102, which are mounted to the two sides of the lower portion of the fastening bracket 101 of the carriage main body 10, are attached to the two side surfaces of the rail 5 and, subsequently, the clamping device 103 is operated such that the carriage main body 10 is located on the rail 5. Here, the carriage main body 10 is mounted on the rail 5 such that the rack gear 5a, which is mounted in the upper portion of the rail 5, and the pinion gear 104, which is mounted in the carriage main body 10, are engaged with each other.

[39] After the automatic welding device 1 for angle pieces according to the present invention has been mounted on the rail 5 as described above, welding work for the curved welding portion 2a of each angle piece 2 is performed while operating the automatic welding device 1 at a welding starting point in the curved welding portion 2a of each angle piece 2.

[40] When the welding work for the curved welding portion 2a is started as described above, as shown in FIG. 11, the welding for the curved welding portion 2a of each angle piece 2 is performed while the welding head lateral movement means 30 moves horizontally in one direction along the welding line of the curved welding portion 2a of each angle piece 2. At the same time, the shape and height of the curved welding portion 2a are detected by the vertical displacement sensor 70 and the curved-surface tracking displacement sensors 60, which are located on respective sides of the welding torch 90.

[41] As shown in (a) and (b) of FIG. 11, shape and height values for the curved welding portion 2a, which are detected by the vertical displacement sensor (not shown) and the curved-surface tracking displacement sensors (not shown), are not changed in a linear portion S of the curved welding portion 2a of each angle piece, and thus welding work for the linear portion S of the curved welding portion 2a of each angle piece is performed while moving only the welding head lateral movement means 30 horizontally in one direction.

[42] Subsequently, when the welding head unit 50 reaches the protruding portion C of the curved welding portion 2a of each angle piece and, thus, the values detected by the curved-surface tracking displacement sensors 60 are changed, the welding head unit 50 rotates a predetermined angle in the counterclockwise direction so that the welding torch 90 is perpendicular to the protruding portion C according to the changed values

detected by the curved-surface tracking displacement sensors 60, as shown in (c) of FIG. 11. That is, when the welding head unit 50 reaches the protruding portion C of the curved welding portion 2a of each angle piece and, thus, the values detected by the curved-surface tracking displacement sensors 60 are changed, the worm 501b of the worm gear 501, shown in FIG. 10, is rotated according to the changed value detected by the curved-surface tracking displacement sensors 60, and thus the worm wheel 501a is rotated. Accordingly, the sensor fastening bracket 503 and the welding torch vertical movement means 510, which are connected to the respective ends of the rotary shaft 504 of the worm wheel 501, are rotated, and thus the welding head unit 50 rotates the predetermined angle in the counterclockwise direction, as shown in (c) of FIG. 11.

[43] After the welding head unit 50 is rotated in the counterclockwise direction, so that the welding torch 90 is perpendicular to the protruding portion C, as described above, the welding head vertical movement means 20 and the welding torch vertical movement means 510 operate according to variation in height of the protruding portion C of the curved welding portion 2a of each angle piece, which is detected by the vertical displacement sensor 70, and thus the welding head unit 50 and the welding torch 90 are raised.

[44] That is, after the welding head unit 50 is rotated in the counterclockwise direction, so that the welding torch 90 is perpendicular to the protruding portion C, as described above, the welding head vertical movement means 20 operates according to variation in the height of the protruding portion C of the curved welding portion 2a of each angle piece, which is detected by the vertical displacement sensor 70, and thus the ball screw 514 of the welding torch vertical movement means 510, shown in FIG. 10, operates while the welding head lateral movement means 30 is raised. Accordingly, the vertical movement block 512 is raised along the LM guides 511, and thus the welding torch 90, which is mounted to the torch fastening bracket 513, is raised when the torch fastening bracket 513 is raised.

[45] The shape and height of the protruding portion C of the curved welding portion 2a of each angle piece are tracked using the values that are detected by the curved-surface tracking displacement sensors 60 and the vertical displacement sensor 70, as described above. Accordingly, the welding head lateral movement means 30 moves horizontally in one direction and, thus, the welding head vertical movement means 20 operates while the welding head unit 50, which has rotated a predetermined angle in the counterclockwise direction, rotates in the clockwise direction in response to the operation of the welding torch rotating means 500, so that the welding torch vertical movement means 510 operates while the welding head unit 50 is raised when the welding head lateral movement means 30 is raised, and thus welding work is performed while the welding torch 90 is also raised. In this case, the welding head 50 reaches the vertex of

the protruding portion C, which is shown in (d) of FIG. 11.

[46] After the welding torch 90 reaches the vertex of the protruding portion C as shown in (d) of FIG. 11, the welding torch rotating means 500, shown in FIG. 10, operates while the welding head lateral movement means 30 moves horizontally in one direction according to the shape and height of the protruding portion C of the curved welding portion 2a of each angle piece C, which are detected by the curved-surface tracking displacement sensors 60 and the vertical displacement sensor 70, so that the welding head vertical movement means 20 and the welding torch vertical movement means 510 operate while the welding head 50 rotates in the clockwise direction so as to be perpendicular to the protruding portion C as shown in (e) of FIG. 11, and thus the welding head unit 50 and the welding torch 90 are lowered. Accordingly, welding work for the protruding portion C of the curved welding portion 2a of each angle piece is performed while the welding torch 90 moves along the protruding portion C. After the above-described welding work for the protruding portion C has been finished, the welding head 50, which has rotated in the clockwise direction, is rotated in the counter-clockwise direction by the welding torch rotating means 500 so that another linear portion S of the curved welding portion 2a of each angle piece and the welding torch 90 are perpendicular to each other according to the values detected by the curved-surface tracking displacement sensors 60, and, subsequently, the welding head lateral movement means 30 moves horizontally in one direction along the linear portion S of the curved welding portion 2a of each angle piece, so that welding work for the second linear portion S of the curved welding portion 2a of each angle piece is performed. In this manner, the welding work for the curved welding portion 2a of each angle piece is achieved.

[47] FIG. 12 is a view showing the automatic welding device for angle pieces according to the embodiment of the present invention, which moves to weld the linear welding portions of angle pieces, and FIG. 13 is a view illustrating a process of the automatic welding device for angle pieces according to the embodiment of the present invention welding the linear welding portions of angle pieces. After the automatic welding device 1 for angle pieces according to the present invention finishes the welding work for the curved welding portion 2a of each angle piece 2, as described above, the carriage main body 10 moves a predetermined distance horizontally in one direction along the rail (not shown), as shown in FIG. 12.

[48] That is, after the automatic welding device 1 for angle pieces finishes the welding work for the curved welding portion 2a of each angle piece 2, the traveling motor 105 causes the pinion gear 104, which is engaged with the rack gear 5a mounted on the rail 5, to be rotated while operating as shown in FIG. 8, and thus the carriage main body 10 moves the predetermined distance horizontally in one direction along the rail 5, as

shown in FIG. 12.

- [49] When the welding head rotating means 40, mounted to the carriage main body 10, operates after the carriage main body 10 has moved the predetermined distance horizontally in one direction along the rail, the rotary plate 402 of the welding head rotating means 40 is rotated in the counterclockwise direction, and thus the welding head vertical movement means 20, the welding head lateral movement means 30 and the welding head unit 50, which are mounted on the upper surface of the rotary plate 402, are rotated in the counterclockwise direction.
- [50] In this case, the laser generation device 80 for generating the laser line 80a is mounted on one side of the rotary plate 402, so that the operation of the rotary plate 402, which rotates in the counterclockwise direction, is stopped when the laser line 80a generated by the laser generation device 80 coincides with the welding line of the linear welding portion 2b for each angle piece 2, and thus the welding torch 90 coincides with the welding line of the linear welding portion 2b for each angle piece 2.
- [51] When the welding torch 90 coincides with the welding line of the linear welding portion 2b for each angle piece 2, as described above, welding work for the linear welding portion 2b for each angle piece 2 is performed while the welding head lateral movement means 30 moves horizontally in one direction along the welding line of the linear welding portion 2b for each angle piece 2.
- [52] Subsequently, when the welding torch 90 reaches the corner 2c of each angle piece while the work of welding the linear welding portion 2b for each angle piece 2 is performed, as shown in (b) of FIG. 13, the welding head unit 50 is rotated in the clockwise direction so as to be perpendicular to the corner 2c of each angle piece according to the values detected by the curved-surface tracking displacement sensors (not shown), as shown in (c) of FIG. 13.
- [53] That is, as shown in FIG. 10, the worm wheel 501a rotates when the worm 501b of the welding torch rotating means 500 rotates according to the values detected by the curved-surface tracking displacement sensors (not shown), so that the rotary shaft 504 is rotated such that the welding torch vertical movement means 510 is rotated in the clockwise direction, and thus the welding head unit 50 is rotated in the clockwise direction so as to be perpendicular to the corner 2c of each angle piece, as shown in (c) of FIG. 13.
- [54] When the welding head lateral movement means 30 continues to be moved horizontally in one direction after the welding head unit 50 is rotated in the clockwise direction, as described above, the height and shape of the linear welding portion 2b of each angle piece are changed, so that the welding head vertical movement means 20 operates according to the values detected by the vertical displacement sensor (not shown) while the welding head unit 50 is further rotated in the clockwise direction so

as to be perpendicular to the linear welding portion 2b of each angle piece according to the value detected by the curved-surface tracking displacement sensors, as shown in (d) of FIG. 13, therefore the welding work is completed after welding work is performed to the end point of the linear welding portion 2b of each angle piece while raising the welding head lateral movement means 30 along with the welding head vertical movement means 20, as shown in (e) of FIG. 13.

- [55] In the automatic welding device for angle pieces mounted to corners in the cargo tanks of a membrane-type LNG taker according to the embodiment of the present invention, a pair of curved-surface tracking displacement sensors 60 and a vertical displacement sensor 70 are arranged at the left and right sides of the welding torch 90, so that minute variation in the shape of the curved welding portion 2a and the inclined linear welding portion 2b of each angle piece 2 can be detected, therefore there are no non-detectable regions, which are very short welding sections. Furthermore, the welding head unit 50 is spaced apart from the carriage main body 10 by a predetermined distance, and the automatic welding device 1 for angle pieces is configured to approach the welding line from the side thereof, so that interference between a worker's eyes and working members is minimized, and thus the arc can be easily observed when the worker performs welding work, with the result that the facing joint portions of angle pieces, which have been manually welded, can be automatically welded, so that productivity can be greatly improved by greatly decreasing the incidence of welding defects, as well as by greatly increasing welding speed and maintaining uniform welding quality.

Industrial Applicability

- [56] According to the present invention, the automatic welding device for angle pieces mounted to corners in the cargo tanks of a membrane-type LNG tanker enables automatic welding of the facing joint portions of angle pieces, which have been manually welded, thus improving productivity by greatly decreasing the incidence of welding defects, as well as by greatly increasing welding speed and maintaining uniform welding quality.
- [57] Although the preferred embodiment of the present invention has been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Claims

- [1] An automatic welding device for angle pieces mounted to corners in cargo tanks of a membrane-type LNG tanker, comprising:
a carriage main body mounted on a rail so as to be moved horizontally along the rail, the rail being mounted adjacent to corners in cargo tanks of a membrane-type LNG tanker, to which angle pieces are mounted;
welding head rotating means mounted to an upper surface of the carriage main body so as to be rotated;
welding head vertical movement means mounted on a portion of an upper surface of the welding head rotating means;
welding head lateral movement means connected with the welding head vertical movement means so as to be moved vertically along with the welding head vertical movement means and to be moved laterally in a traveling direction of the carriage main body; and
a welding head unit, comprising: welding torch rotating means, which is mounted at a leading end of the welding head lateral movement means; welding torch vertical movement means, which is mounted on one side of the welding torch rotating means; and a welding torch, which is mounted on one side of the welding torch vertical movement means.
- [2] The automatic welding device according to claim 1, wherein the carriage main body comprises:
a fastening bracket, which is configured such that a plurality of rollers attached to two side surfaces of the rail is mounted to two sides of a lower portion of the fastening bracket;
a clamping device, which is mounted on one side of the fastening bracket so as to be connected to rollers, which are attached to a side portion of the fastening bracket;
a pinion gear, which is mounted in a central portion of the fastening bracket and is connected to a rack gear, which is mounted in an upper central portion of the rail; and
a traveling motor, which is connected to an upper end of the pinion gear.
- [3] The automatic welding device according to claim 1, wherein the welding head rotating means comprises:
a rotary shaft, which is mounted in an upper portion of the carriage main body and is configured such that a driven pulley is mounted to a lower end of the rotary shaft;
a rotary plate, which is configured such that one end thereof is connected to an

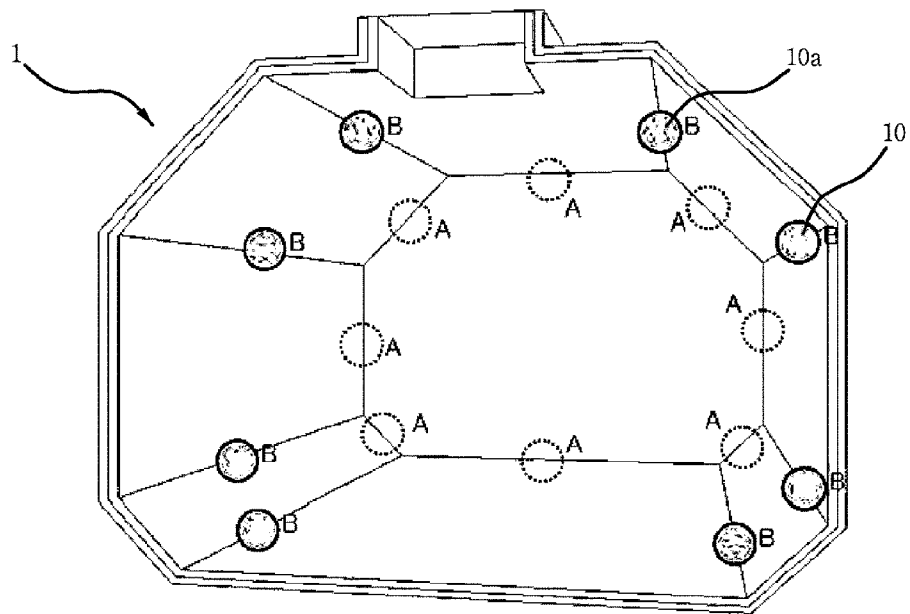
upper end of the rotary shaft;

a drive motor, which is located on a side of the rotary shaft and is configured such that a driving pulley is mounted to the rotary shaft, mounted in the upper portion of the carriage main body; and

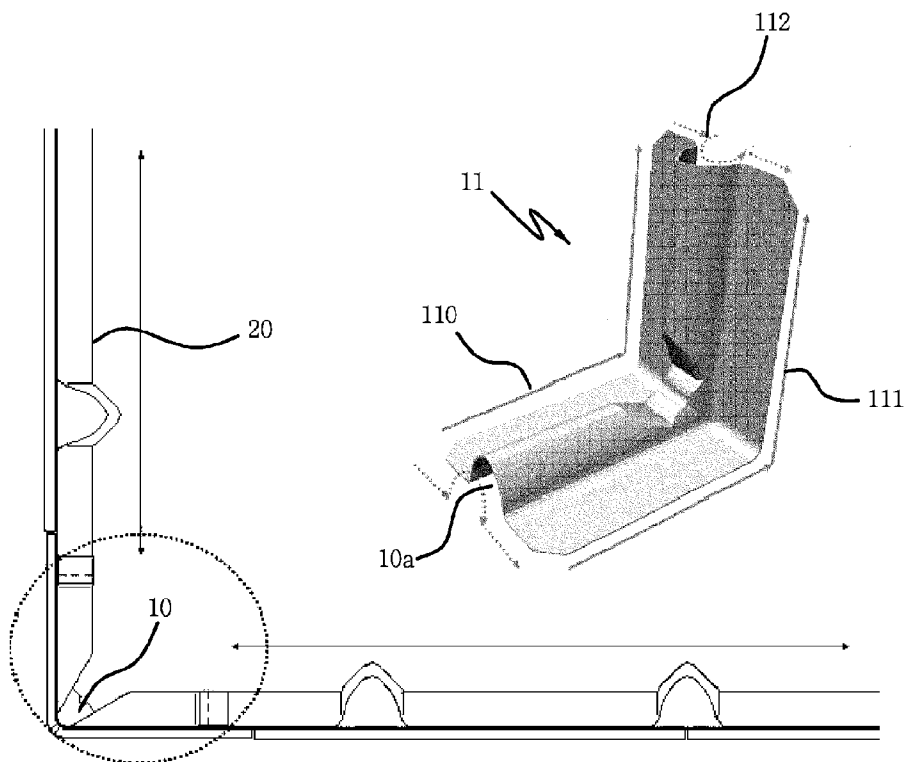
a timing belt, which is responsible for connecting the driven pulley and the driving pulley to each other and transmitting a rotational force of the driving pulley to the driven pulley.

- [4] The automatic welding device according to claim 3, wherein a laser line generation device is further mounted on one side of the rotary plate so that a welding torch coincides with a welding line by forming a laser line, which is located on a line identical to that of the welding torch.
- [5] The automatic welding device according to claim 1, wherein the welding torch rotating means comprises:
- a worm gear, which is mounted at a leading end of the welding head lateral movement means so as to be rotated;
 - a guide fastening bracket, which is mounted to one end of a rotary shaft of a worm wheel of the worm gear; and
 - a pair of curved-surface tracking displacement sensors, which are mounted in a central portion of a sensor fastening bracket, which is mounted to a remaining end of the rotary shaft of the worm wheel of the worm gear.
- [6] The automatic welding device according to claim 1, wherein the welding torch vertical movement means comprises:
- a pair of Linear Motion (LM) guides, which are mounted on one side surface of the welding torch rotating means;
 - a vertical movement block, which is mounted to first surfaces of the LM guides and is configured such that a ball screw is disposed in a central portion of the vertical movement block, so that the vertical movement block moves vertically along the LM guides in response to rotation of the ball screw;
 - a torch fastening bracket, which is configured such that one end thereof is mounted on one side surface of the vertical movement block, and the welding torch is mounted to a remaining end thereof; and
 - a vertical displacement sensor, which is mounted to a side of the torch fastening bracket so as to be located at a front of the welding torch.

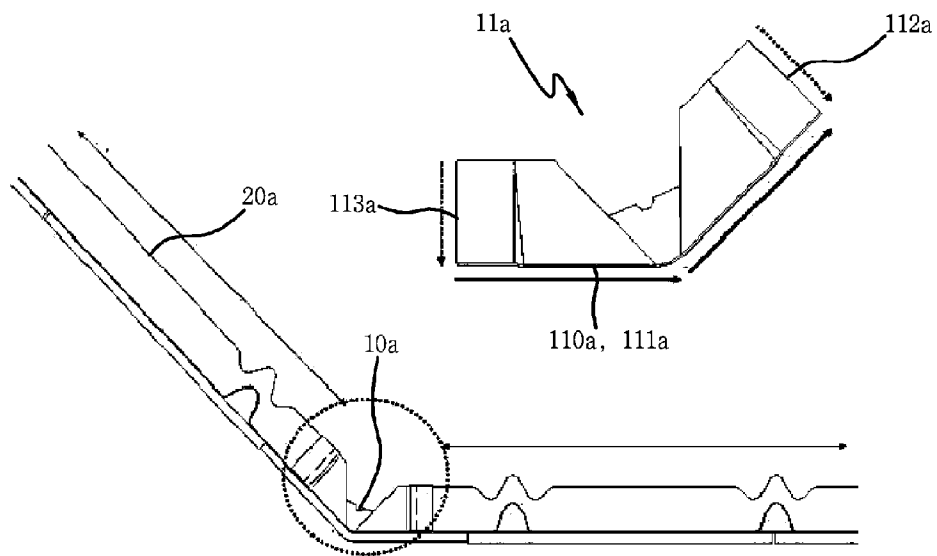
[Fig. 1]



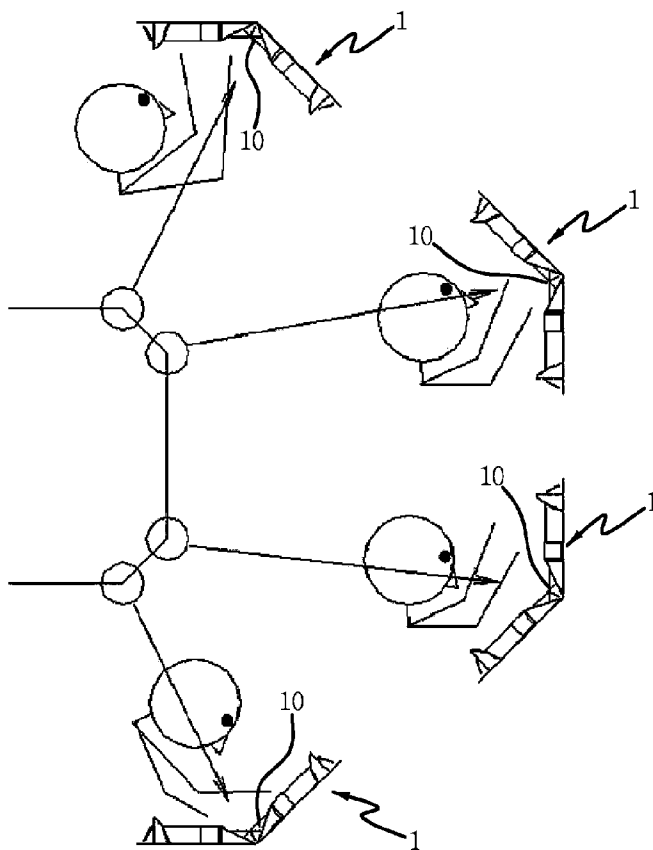
[Fig. 2]



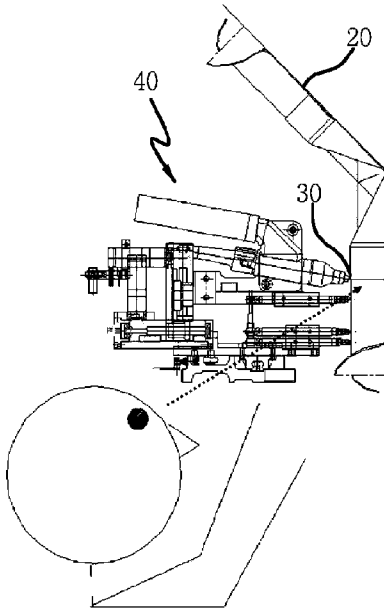
[Fig. 3]



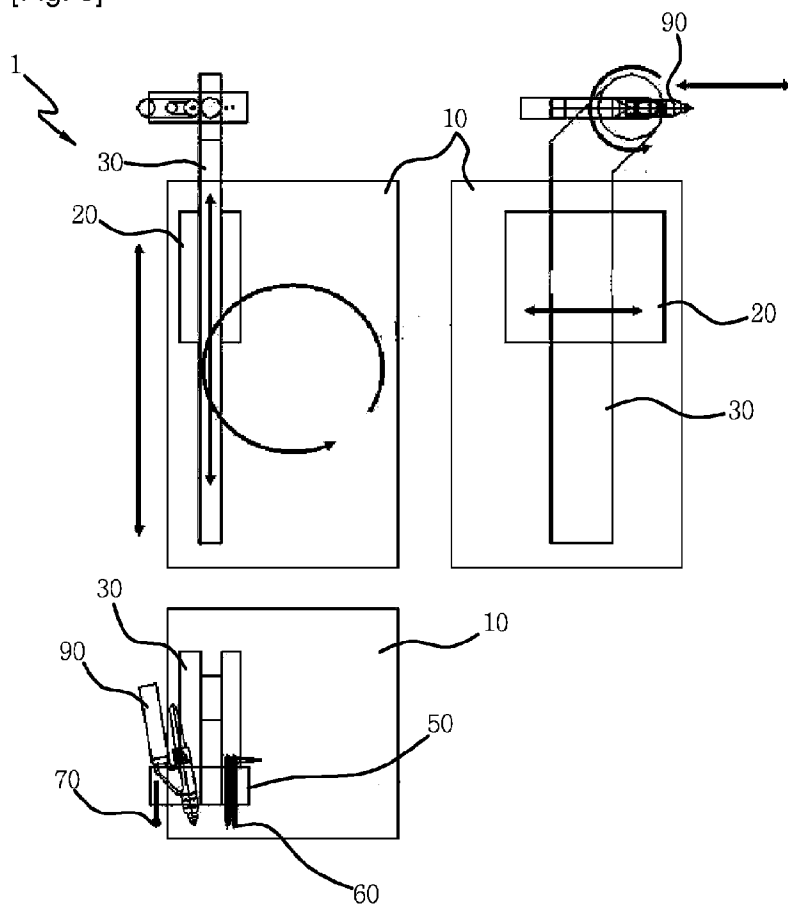
[Fig. 4]



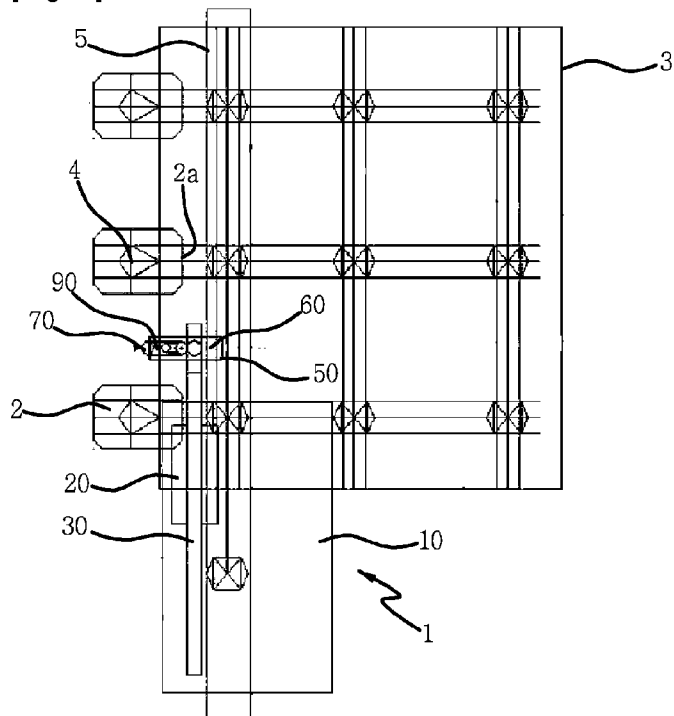
[Fig. 5]



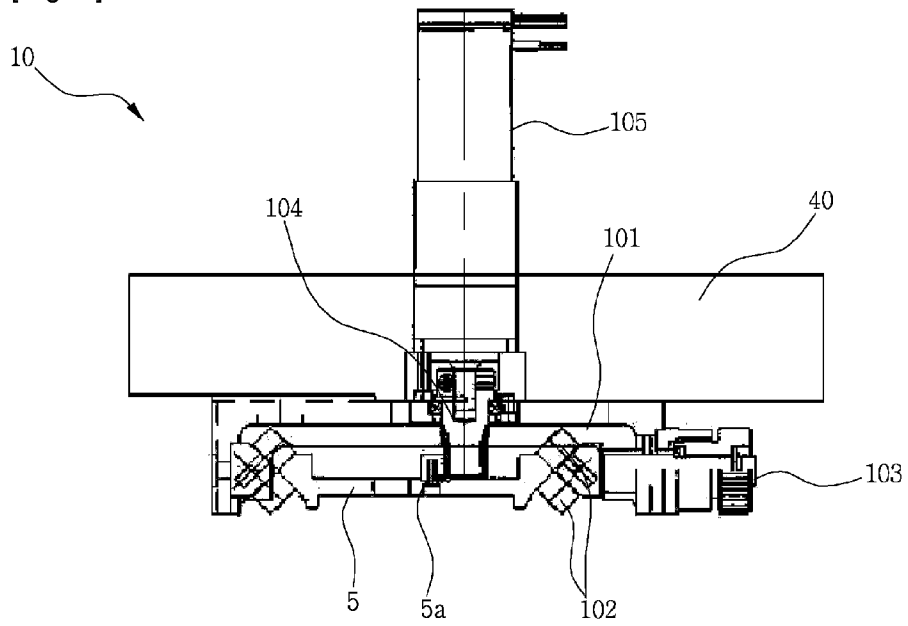
[Fig. 6]



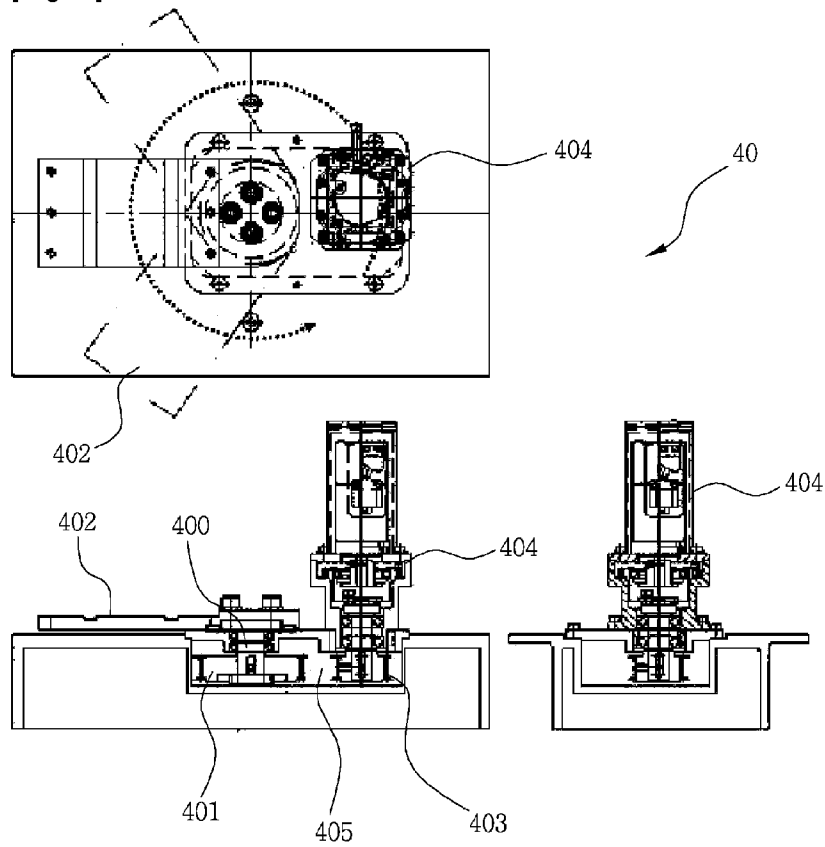
[Fig. 7]



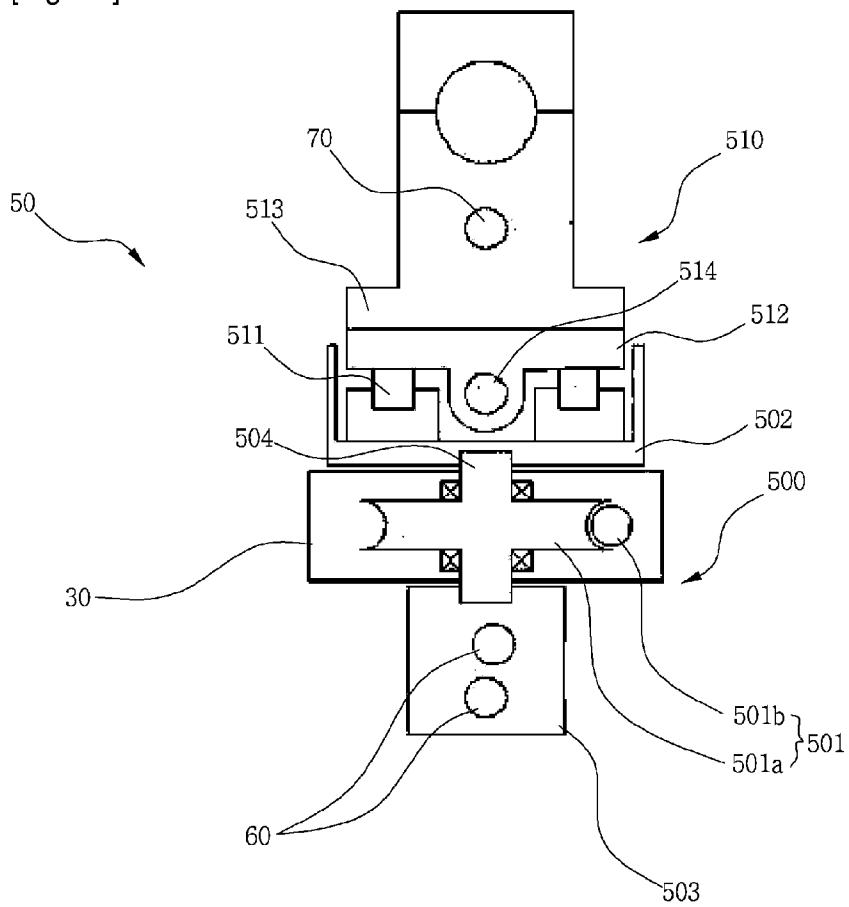
[Fig. 8]



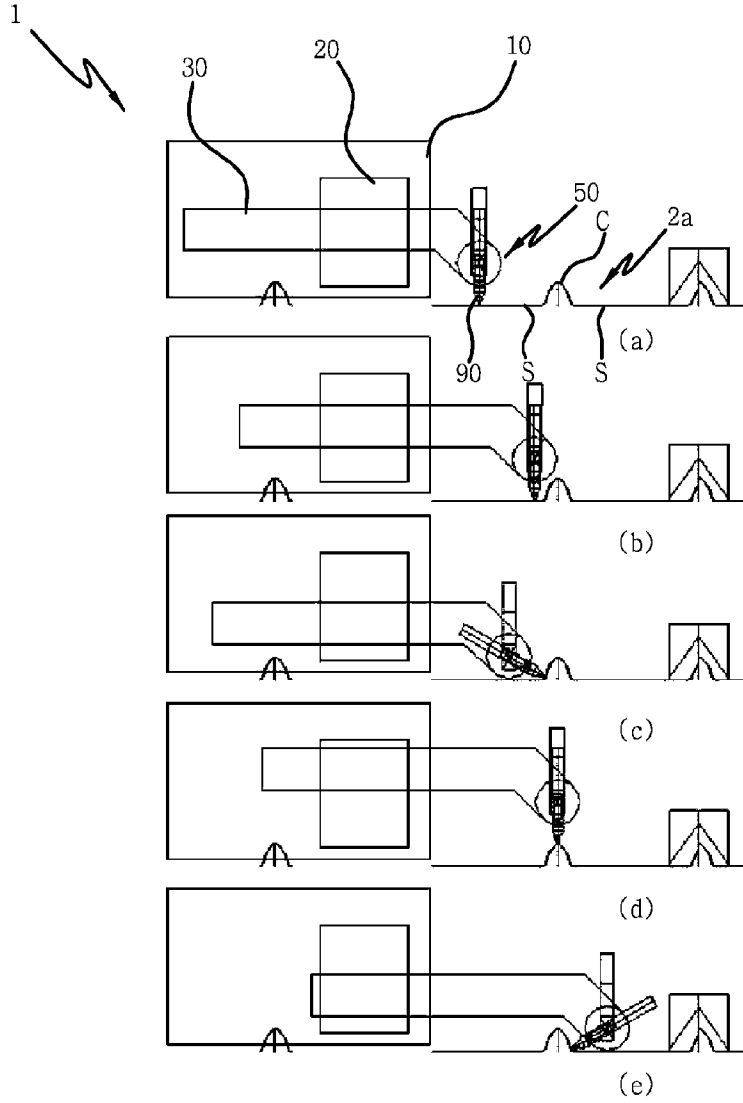
[Fig. 9]



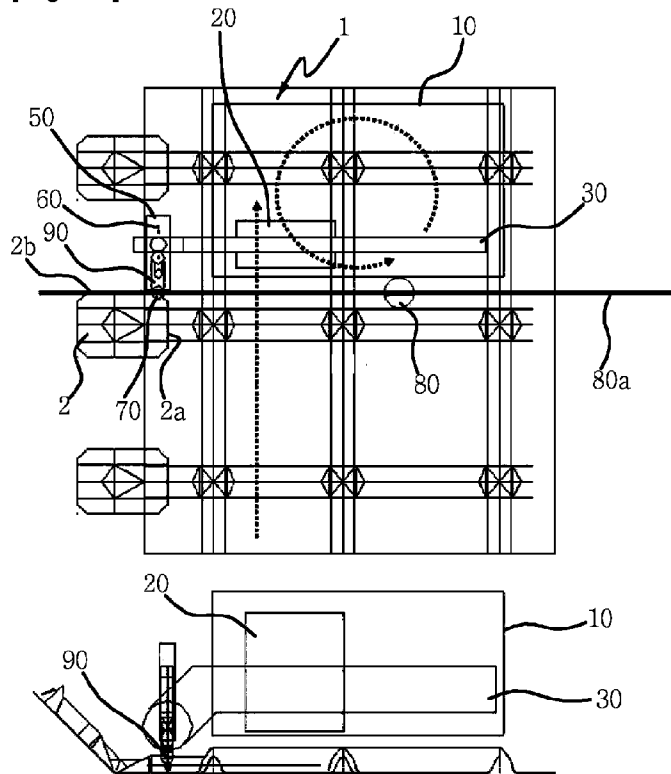
[Fig. 10]



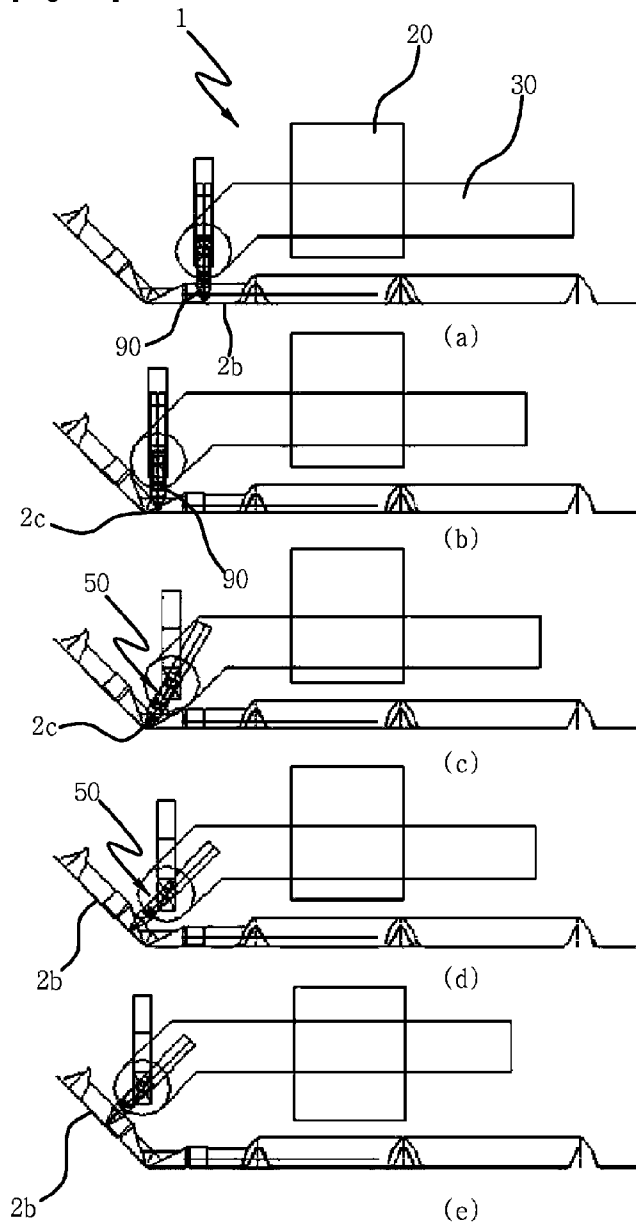
[Fig. 11]



[Fig. 12]



[Fig. 13]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/000626**A. CLASSIFICATION OF SUBJECT MATTER*****B23K 37/02(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 B23K 9/127, B23K 37/02, B23K 9/12, B23K 7/10

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 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 (KIPO INTERNAL) "welding" , "cart"**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR100732311B1 (HANJIN HEAVY INDUSTRIES & CONSTRUCTION CO., LTD.) 19 June 2007 See page 2, line 10 to page 3, line 50; claims 1-4	1-6
A	KR1020000045564A (SAMSUNG HEAVY IND. CO., LTD.) 25 July 2000 See page 3, line 20 to page 3, line 56; claims 1-7	1-6
A	JP2005-334965A (KOYO DOCKYARD CO., LTD. , KIRONII SANGYO KK) 08 December 2005 See paragraph 26 to paragraph 55; claim 1-5	1-6
A	US5693286A (ISAMU HATANAKA et al.) 02 December 1997 See column 3, line 31 to column 6, line 54; claims 1-8	1-6

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

14 MAY 2008 (14.05.2008)

Date of mailing of the international search report

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Government Complex-Daejeon, 139 Seonsa-ro, Seo-
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2008/000626

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