

APPARATUS FOR HANDLING BUILDING MATERIALS

The present invention relates to an apparatus for handling building materials, for example interior surfacing materials such as beam members, column members and like surfacing materials, and panel-like wall members
5 such as PC boards, ALC boards, glass plates, framed-glass plates, glass-plate sashes and the like.

On building sites it is frequently necessary to handle heavy building materials such as the above-mentioned interior surfacing materials and panel-like
10 wall members which are mounted either on exterior or interior surfaces of the building body to serve as exterior or interior walls. However, the weight and size of these building materials can make it very cumbersome for building workers to transport the
15 materials around the building site and to mount them in position.

For example, in the case of building materials which are to be mounted on the interior or exterior surfaces of the building body to serve as interior or exterior surfacing members of the building body, in
20 general, a great number of the building materials are piled up on the ground of the building site. Then, they are lifted up to their mounting areas of the building body by means of cranes and the like to be ready to be
25 mounted. In some cases, a great number of the building materials are lifted to a predetermined floor of the building body by means of cranes or working elevators, and temporarily piled up on the floor. After that, in
30 the case of exterior surfacing members, each of the building materials has to be moved out of the interior of the building body through an opening so as to be mounted on the exterior surface of the building body.

If the building materials are of large dimensions, only one item can be lifted up to the

predetermined floor each time the crane is operated. Consequently, if a great number of the building materials must be craned up to a high exterior surface of the building body and mounted on the exterior surface, it is
5 necessary to erect suitable scaffolding around the building body at no small cost of time and labor. Furthermore, the craning-up operation of the building materials takes too much time and thus considerably impairs working efficiency. In addition, in such
10 craning-up operations there is a risk that the building materials may become damaged by being knocked or may even fall to the ground by mistake.

Further, if the building materials are transported to a predetermined floor of the building body
15 for mounting at different predetermined mounting areas of the floor, the building workers have to transport them by hand to the predetermined mounting areas, and temporarily hold them at the predetermined areas during the mounting operation itself. However, such manual transporting and
20 manual mounting operation are troublesome and dangerous.

It is an object of the present invention to provide an apparatus suitable for transporting/mounting building materials which enables workers on a building site to more safely transport the building materials to a
25 predetermined mounting area of the building body so as to mount the building materials on the mounting area, the building materials being temporarily held by the apparatus at the mounting area until they are mounted.

The apparatus in accordance with the present
30 invention comprises:

a self-propelled vehicle body provided with a steering/driving means, said vehicle body having a substantially L-shaped form constructed of an upright main body and a pair of spaced apart, parallel lower
35 frames which extend horizontally forward from opposite sides of a lower portion of said upright main body of said vehicle body;

an elevator unit movably mounted on said upright main body of said vehicle body so as to be vertically movable along said upright main body;

5 a first frame means extending horizontally forward from said elevator unit, said first frame means having its rear end portion mounted on said elevator unit so as to be laterally movable in a horizontal plane relative to said lower frames;

10 a second frame means slidably mounted in said first frame means so as to be extended therefrom and retracted therein in the longitudinal direction of said first frame means; and

a supporting means for supporting building materials, said supporting means being so mounted on a forward-end portion of said second frame means as to be vertically swingable and also as to be rotatable on an axis perpendicular to the plane of said supporting means.

In a preferred embodiment of the present apparatus the supporting means comprises:

20 an adapter plate fixedly mounted on a front-end portion of a vertical mounting plate which in turn is mounted on a front-end portion of the second frame means through a pivot so as to be swingable in a vertical plane;

25 a guide ring fixedly mounted on an outer peripheral surface of a side portion of the adapter plate;

a swivel plate provided with a ring-like projection in its rear surface, the ring-like projection being rotatably mounted on an inner peripheral surface of the guide ring through a plurality of balls so as to be adjacent to a front surface of the adapter plate, the swivel plate being connected with a swivel motor fixedly mounted on the adapter plate;

35 a supporting plate mounted on the swivel plate through bracket means and a pivot so as to be swingable

in a horizontal plane relative to the swivel plate, the bracket means being fixed to a substantially central portion of a front surface of the swivel plate, the pivot being mounted on the bracket means, the supporting plate
5 being provided with a plurality of through-holes for supporting the building materials; and

a control means for swingably driving the supporting plate in a horizontal plane so as to position the supporting plate.

10 In this preferred embodiment of the apparatus of the present invention it is possible: to vertically move the supporting means by vertically moving the elevator unit, which is provided with the first frame means, along the upright main body of the vehicle body of
15 the apparatus; to laterally move the supporting means in a horizontal plane by laterally moving the first frame means with respect to the elevator unit; to move the supporting means back and forth by moving the second frame means back and forth in a horizontal plane in the
20 first frame means; to position the supporting means in both a horizontal and a vertical position thereof by swinging the adapter plate in a vertical plane relative to the second frame means; and to rotate the supporting means by rotating the swivel plate relative to the
25 adapter plate.

Consequently, in the apparatus of the present invention, it is possible for the supporting means or plate for supporting the building material to move vertically, to move horizontally, to move back and forth,
30 to swing in a vertical plane and to rotate. Therefore, the following handling operation is possible, by way of illustration. First of all, the supporting plate of the apparatus is positioned in an area immediately above at least one of the building materials piled up on the
35 ground or floor, so as to be oppositely disposed from the building material, and then the selected building

material is attached to the support plate, for example by means of bolts as will be hereinafter described. After that, the support plate is moved upward while rotated in a horizontal plane to rotate the building material by an angle of 90°, so that the building material is retracted into the vehicle body of the apparatus and held in a position on the lower frame of the vehicle body during its transportation by the apparatus. As described above, it is possible for the apparatus of the present invention to transport the building material to a predetermined mounting area for the building material safely and surely. In addition, during transportation of the building material, since the vehicle body of the apparatus has a substantially L-shaped form, the vehicle body of the apparatus is excellent in stability, and therefore there is no fear that the vehicle body of the apparatus will topple over even when the apparatus carries a heavy item.

After the apparatus reaches the predetermined mounting area for the building material, the supporting plate of the apparatus is moved upward and forward to take a vertical position so that the building material supported by the supporting plate is also moved upward and forward to take a vertical position, to enable the building material to extend forward from an opening portion of a building body. Under such circumstances, the supporting plate is moved rearward so that the building material is pressed against an exterior surface of the building body.

As described above, it is possible for the apparatus of the present invention to hold the building material in its mounting area until the building material is mounted on the exterior surface of the building body, which enables the operator to more easily mount an exterior surfacing member onto a building body.

Preferred embodiments of the present invention will now be described in detail with reference to the accompanying drawings, in which:

Figs. 1, 2 and 3 are a schematic front view, a
5 schematic plan view and a schematic side view,
respectively, of a preferred embodiment of the apparatus
of the present invention;

Fig. 4 is an enlarged perspective view of a
driving-wheel mounting portion of the apparatus;

10 Fig. 5 is a cross-sectional view of the
apparatus, illustrating a swivel portion and a supporting
portion of a front end of a second frame of the
apparatus;

Fig. 6 illustrates a hydraulic circuit for the
15 actuators employed in the apparatus;

Fig. 7 is a schematic perspective view of an
embodiment of a controller for controlling the actuators;

Figs. 8A to 8E are views illustrating operation
of the apparatus shown in Fig. 1; and

20 Fig. 9 is a view similar to Fig. 5,
illustrating another embodiment of the swivel portion and
the supporting portion of the front end of the second
frame of the apparatus of the present invention.

First of all, a first preferred embodiment of
25 the present invention will be described with reference to
Figs. 1 to 7.

As shown in Fig. 1, the apparatus comprises a
vehicle body 1 of a substantially L-shaped form and
constructed of an upright main body 2 and a pair of
30 spaced apart, parallel lower frame 3 which horizontally
extend forward from opposite sides of a lower portion of
the upright main body 2 of the vehicle body 1. In a
central portion of a lower part of the upright main body
2 of the vehicle body 1 is provided a steering/driving
35 wheel 4 serving as a steering/driving means of the
apparatus. The wheel 4 is rotatable on its vertical

axis. If necessary, a pair of auxiliary castors 5 are additionally provided in opposite sides of the lower part of the upright main body 2 of the vehicle body 1, as shown in Fig. 3, the castors being freely rotatable on their vertical axes. In addition, a front wheel 6 is rotatably mounted on a front-end portion of each of the lower frames 3 of the vehicle body 1. Incidentally, as shown in Figs. 2 and 3, an operator stand 80 may be provided in a right side or a left side of a lower portion of the main body 2 of the vehicle body 1 (indicated in phantom lines in Fig. 2).

For example, as shown in Fig. 4, the steering/driving wheel 4 is rotatably mounted in an inverted U-shaped bracket 7, while rotatably driven by a travelling motor 8 fixedly mounted in the bracket 7. A longitudinal shaft 9 is provided in a central portion of an upper end surface of the bracket 7 so as to extend upward from the central portion and is rotatably mounted in a pair of through-holes of a pair of vertically spaced apart supporting brackets 10 which are provided in the main body 2 of the vehicle body 1. For example, as shown in Fig. 4, a pinion 11 is fixedly mounted on the longitudinal shaft 9 while meshed with a rack 12 which is reciprocally driven in a horizontal plane by a steering cylinder 13 so that the vehicle body 2 is steered. Namely, in the steering operation, the longitudinal shaft 9 of the steering/driving wheel 4 is rotatably driven on its vertical axis together with the bracket 7 relative to the main body 2 of the vehicle body 1.

Incidentally, in the steering operation, it is also possible to rotatably drive the longitudinal shaft 9 of the steering/driving wheel 4 by a suitable torque actuator or hydraulic motor.

In plan view of the apparatus, as shown in Fig. 2, the main body 2 of the vehicle body 1 is provided with a concave portion 14 assuming a substantially C-shaped

form having its opening disposed in the front of the vehicle body 1. On opposite sides of the concave portion 14 of the main body 2 are provided a pair of vertical guide rails 15 which are oppositely disposed from each other as shown in Fig. 2. In the vertical guide rails 15 are slidably mounted a pair of rollers 17 which are rotatably mounted on, for example a pair of vertical plates 16a, 16b constituting an elevator element 16. As shown in Fig. 1, a vertical positioning cylinder 18 is provided with a piston rod 19, and is so mounted in the concave portion 14 of the main body 2 of the vehicle body 1 as to have its base-end portion connected to a lower portion of the main body 2 whilst a top-end portion of the piston rod thereof is disposed between the vertical plates 16a, 16b of the elevator element 16. On the top-end portion of the piston rod 19 of the positioning cylinder 18 is rotatably mounted a sprocket 20. A chain 21 runs round the sprocket 20 and has one end thereof fixed to a cylinder body 18a of the positioning cylinder 18, whilst the other end of the chain is fixed to the elevator element 16, whereby the elevator element 16 is moved up and down along the vertical guide rails 15 when the piston rod 19 of the positioning cylinder 18 is extended and retracted.

As shown in Fig. 1, the elevator element 16 is provided with a recessed portion 16c assuming a substantially C-shaped form which opens in the front of the vehicle body 1. A pair of horizontal guide rails 22 is fixedly mounted one on an upper and the other on a lower inner surface of the recessed portion 16c of the elevator element 16 so as to be oppositely disposed from each other, as shown in Fig. 1. A pair of rollers 24 is rotatably mounted one on an upper and the other on a lower surface of a mounting segment 23a of a sleeve-like first frame 23, which segment 23a is disposed between the horizontal guide rails 22 so that the rollers 24 are

rotatably received in the horizontal guide rails 22. As shown in Fig. 1, a base portion of the sleeve-like first frame 23 is disposed between the rollers 24 rotatably mounted on the mounting segment 23a. Consequently, the first frame 23 is laterally moved in a horizontal plane relative to the lower frames 3 of the main body 2 of the vehicle body 1 when the mounting segment 23a thereof is moved along the guide rails 22. As shown in Fig. 1, the first frame 23 extends forward from the main body 2 of the vehicle body 1. As shown in Fig. 2, a widthwise-positioning cylinder 50 is horizontally mounted between one of the horizontal guide rails 22 (i.e. an upper one 22 in the embodiment shown in Fig. 2) and the mounting segment 23a of the first frame 23.

In the first frame 23 is slidably mounted a sleeve-like second frame 25 which is extended from and retracted into the first frame 23 so as to be moved forward and rearward relative to the first frame 23. As shown in Fig. 1, a pair of elongated plates 26 are fixedly mounted on a front-end portion of the second frame 25. Opposite ends of a longitudinally-positioning cylinder 28 are rotatably mounted on a pair of pins 29, 30, the pin 29 being mounted on upper-end portions of the elongated plates 26, and the other pin 30 being mounted on upper-end portions of a pair of brackets 27 fixed to an upper surface of the base portion of the first frame 23. Consequently, when the longitudinally-positioning cylinder 28 is actuated, the second frame 25 is slidably extended and retracted along the first frame 23.

On the front-end portion of the second frame 26 is further mounted an adapter plate 31, to a back surface of which are fixed a pair of vertical mounting plates 32 which are rotatably mounted on lower portions of the elongated plates 26 through a horizontal pin 33. As shown in Fig. 1, each of a pair of angular-positioning cylinders 34 for angularly positioning each of the

vertical mounting plates 32 is rotatably mounted on a pair of pins 35, 36, the pin 35 being mounted on a rear-end portion of the vertical mounting plate 32, and the other pin 36 being mounted on a rear portion of the

5 second frame 25. On the adapter plate 31 is rotatably mounted a swivel plate 37 which is so driven by a swivel motor 38 as to rotate on an axis perpendicular to the adapter plate 31.

10 Namely, as shown in Fig. 5, a guide ring 39 is fixedly mounted on the adapter plate 31 through a plurality of bolts 40. A ring-like projection 41 is fixed to the swivel plate 37, while rotatably mounted in the guide ring 39 through a plurality of balls 42. A ring gear 43 is formed in an inner peripheral surface of the ring-like projection 41. To a power output shaft 15 38a of the swivel motor 38 is fixed a pinion 44 which meshes with the ring gear 43. Consequently, when the swivel motor 38 is actuated, the swivel plate 37 is rotatably driven by the motor 38. Incidentally, the 20 swivel motor 38 is housed in the second frame 25.

It is also possible to directly drive the swivel plate 37 by the swivel motor 38 without employing the ring gear 43, the motor 38 having its power output shaft 38a directly connected to a center of the swivel 25 plate 37.

On the swivel plate 37 is swingably mounted a supporting plate 45 through a pin 46 and a pair of brackets 46a, 46b. A pair of positioning bolts 47 whose length is adjustable is mounted on the swivel plate 37 so 30 as to extend forward in a plane perpendicular to the pin 46 and sandwich the pin 46 therebetween, as shown in Fig. 5. A front end of each of the positioning bolts 47 abuts on a rear surface of the supporting plate 45 to regulate a swinging angle of the supporting plate 45 35 relative to the swivel plate 37. The supporting plate 45 is provided with a plurality of through-holes 48.

In view of the above-described construction, it is possible for the supporting plate 45 to move up/down and back/forth relative to the vehicle body 1 of the apparatus. In addition, it is also possible for the supporting plate 45: to swing in a vertical plane to a vertical and a horizontal position thereof; to rotate; and to slightly swing in a horizontal plane.

As shown in Fig. 1, a contact sensor 49 is mounted on a front-end portion of each of the lower frames 3 of the vehicle body 1 so as to extend forward.

To each of actuators of the apparatus of the present invention such as the travelling motor 8, steering cylinder 13, vertical positioning cylinder 18, longitudinally-positioning cylinder 28, widthwise-positioning cylinder 50, swivel motor 38 and the angular-positioning cylinder 34 is supplied a pressure oil discharged from a hydraulic pump 52 through a first to a seventh control valves 51₁ to 51₇, as shown in Fig. 6. Each of the above control valves 51₁ to 51₇ is constructed of a solenoid operated four-way/three-position valve which is normally positioned in its N (neutral) position, and moved into a first pressure oil supplying position I or a second pressure oil supplying position II when a first solenoid 51₁ or a second solenoid 53₂ is energized. Each of the solenoids 53₁, 53₂ is controlled by a controller.

For example, as shown in Fig. 7, the above-mentioned controller comprises a box 60 on which a first lever 61 and a second lever 62 are pivotally mounted so as to be able to swing to and fro in a longitudinal and a width direction thereof. Further provided in controller are: a main switch 63; a pilot lamp 64; an emergency-stop button 65; and an operation button 66. In operation, when the first lever 61 is swung forward, the second solenoid 53₁ of the first control valve 51₁ is energized so that the travelling motor 8 rotates in a

normal direction thereof, whereby the vehicle body 1 of the apparatus of the present invention moves forward.

On the other hand, when the first lever 61 is swung rearward, the second solenoid 53₂ of the first control

5 valve 51₁ is energized so that the travelling motor 8 rotates in a direction counter to the above normal direction, whereby the vehicle body 1 moves rearward. When the first lever 61 is swung forward and leftward, the first solenoids 53₁ of the first 51₁ and the second
10 51₂ control valves are energized so that the travelling motor 8 rotates in the normal direction. At this time, the steering cylinder 13 is extended to steer the driving wheel 4 to the left so that the vehicle body 1 moves forward and leftward.

15 In a similar manner to the above, when the first lever 61 is swung rearward/leftward, forward/rightward and rearward/rightward, the vehicle body 1 moves rearward/leftward, forward/rightward and rearward/rightward, respectively.

20 On the other hand, when the first lever 61 is swung back and forth while its button 61a is depressed, the first solenoid 53₁ or the second solenoid 53₂ of the third control valve 51₃ is energized so that the vertical positioning cylinder 18 is extended and retracted to move
25 the supporting plate 45 up and down. When the second lever 62 is swung back and forth, the first 53₁ and the second 53₂ solenoids of the fourth control valve 51₄ are energized so that the longitudinally-positioning cylinder 28 is extended and retracted to move the supporting plate
30 45 back and forth relative to the vehicle body 1.

In addition, when the second lever 62 is swung in the width direction of the box 60, the first 53₁ and the second 53₂ solenoids of the fifth control valve 51₅ are energized so that the widthwise-positioning cylinder
35 50 is extended and retracted to move the supporting plate 45 widthwise relative to the vehicle body 1.

When the second lever 62 is swung back and forth while its button 62a is depressed, the first 53₁ and the second 53₂ solenoids of the seventh control valve 51₇ are energized so that the angularly-positioning
 5 cylinder 34 is extended and retracted to swing the supporting plate 45 in a vertical plane.

In a similar manner to the above, when the second lever 62 is swung widthwise, the first 53₁ and the second 53₂ solenoids of the sixth control valve 51₆ are
 10 energized so that the swivel motor 38 rotates in the normal direction and the direction counter to the normal direction to rotate the supporting plate 45 in its normal direction and a direction counter thereto through the swivel plate 37.

15 In addition to the two-lever type construction of the controller shown in Fig. 7, the controller may assume any other form, for example such as one provided with a number of levers for controlling a number of operations, or one which is electrically controlled by a
 20 remote control unit or a radio control unit.

Now, the handling of building materials utilizing the apparatus of Figs. 1-7 will be described in detail.

As shown in Fig. 8A, first of all, the
 25 supporting plate 45 is positioned at its horizontal position, while moved forward relative to the vehicle body 1. Then, the supporting plate 45 is lowered so as to be brought into contact with the top item "A" of a pile of building materials on the ground and which items
 30 are provided with a plurality of stud bolts, so that the stud bolts provided in the top item "A" area received in the through-holes 48 of the supporting plate 45 and then threadably engaged with nuts, whereby the building material "A" is fixed to the supporting plate 45.

35 In this case, since the building materials "A" are so piled up on the ground as to have their

longitudinal axes oriented toward a direction perpendicular to a travelling direction of the vehicle body 1, the building materials "A" extend widthwise beyond the vehicle body 1 on the ground.

5 As shown in Fig. 8B, in handling operation of the building material "A", the supporting plate 45 is slightly lifted while rotated together with the swivel plate 37 by an angle of 90° by means of the swivel motor 38, so that the building material "A" fixed to the
10 supporting plate 45 has its longitudinal axis aligned with the travelling direction of the vehicle body 1, whereby the building material "A" fixed to the supporting plate 45 is prevented from extending widthwise beyond the vehicle body 1. After that, the second frame 25 of the
15 vehicle body 1 is retracted to slightly move the supporting plate 45 rearward so that the building material "A" is held in a horizontal position in the vehicle body 1. Incidentally, in order to hold the building material "A" in a position indicated in phantom
20 lines in Fig. 8B, the first frame 23 of the vehicle body 1 is moved upward, and then the supporting plate 45 is swung upward to hold the building material "A" in a vertical position.

 Under such circumstances, as shown in Fig. 8C,
25 the vehicle body 1 travels forward so that the building material "A" fixed to the supporting plate 45 of the vehicle body 1 enters an opening portion "C" of a building body "B". At this time, when at least one of the contact sensors 49 of the vehicle body 1 touches a
30 lower part B₁ of the opening portion "C" of the building body "B", the vehicle body 1 automatically stops. Namely, the contact sensor 49 brought into contact with the lower part B₁ issues a signal to the first solenoid 53₁ of the first control valve 51₁ to de-energize the
35 same so that the first control valve 51₁ is held in its neutral position.

Since the vehicle body 1 of the illustrated apparatus has excellent stability, there is no fear that the vehicle body 1 carrying the building material "A" tilts forward in travelling under the influence of the weight of the building material "A". Namely, the vehicle body 1 is constructed of the main body 2 and the lower frames 3 so as to assume a substantially L-shaped form in its longitudinal section, while being supported by the steering/driving wheel 4 and the front wheels 6 with a long wheel base. In addition, the building material "A" retracts to a space above the lower frames 3 of the vehicle body 1 and is held in the space. Consequently, it is possible to support an overturning moment of the vehicle body 1 caused by the building material "A" fixed to the supporting plate 45 of the vehicle body 1, by means of the front wheels 6 and the weight of the main body 2 of the vehicle body 1.

In mounting operation of the building material "A", after the vehicle body 1 stops as described above, the first frame 23 of the vehicle body 1 is lifted, while the second frame 25 is extended forward, so that the supporting plate 45 is moved upward and forward. At this time, the adapter plate 31 is swung in a vertical plane to swing the supporting plate 45 upward in a vertical plane, so that the building material "A" is moved out of the building body "B" through the opening portion "C" of the building body "B", and held in a vertical position.

After that, the second frame 25 of the vehicle body 1 is retracted so that the supporting plate 45 is moved rearward relative to the vehicle body 1, whereby the building material "A" fixed to the supporting plate 45 abuts on an exterior surface B_2 of the building body "B". Then, the first frame 23 is moved vertically and widthwise to move the supporting plate 45 vertically and widthwise so that the building material "A" fixed to the

supporting plate 45 is positioned at a predetermined mounting area of the exterior surface B_2 of the building body "B".

As shown in Fig. 8D, in mounting operation of the building material "A" on the exterior surface B_2 of the building body "B", since it is not possible for the building material "A" to closely abut on the exterior surface B_2 of the building body "B" when a longitudinal center line of the vehicle body 1 is not perpendicular to the exterior surface B_2 of the building body "B", it is necessary to adjust the positioning bolts 47 so as to suitably tilt the supporting plate 45 in case that the longitudinal center line of the vehicle body 1 is not perpendicular to the exterior surface B_2 of the building body "B". Namely, in the case that the longitudinal center line of the vehicle body 1 is not perpendicular to the exterior surface B_2 of the building body "B", it is possible for the building material "A" to closely abut on the exterior surface B_2 of the building body "B" by suitably adjusting the positioning bolts 47 provided in the swivel plate 37 shown in Fig. 5.

Under such circumstances, the building material "A" is fixedly mounted on the exterior surface B_2 of the building body "B" by a suitable fastening means. After completion of mounting operation of the building material "A" on the exterior surface B_2 of the building body "B", the nuts which have been threadably engaged with the stud bolts of the building material "A" for fixing the building material "A" to the supporting plate 45 are loosened so that the building material "A" is separated from the supporting plate 45 of the vehicle body 1.

As shown in Fig. 8E, in the case that the building material "A" is mounted on a corner portion "D" of the building body "B", the first frame 23 of the vehicle body 1 is suitably moved widthwise by means of the widthwise-positioning cylinder 50 to move the

supporting plate 45 widthwise so that the building material "A" fixed to the supporting plate 45 is easily positioned at a predetermined mounting area of the building body "B".

5 In the above embodiment of the vehicle body 1 of the present invention, the building material "A" is fixed to the supporting plate 45 of the vehicle body 1 by means of the stud bolts provided in the building material "A" and the nuts threadably engaged with the stud bolts
10 through the supporting plate 45. In addition to the above construction, it is also possible for the vehicle body 1 to employ any other suitable mechanism for fixing the building material "A" to the supporting plate 45, such as a vacuum mechanism, a clamp mechanism and the
15 like. Furthermore, it is also possible for the supporting plate 45 to have various kinds of clamping attachments detachably mounted thereon so as to make it possible to transport and mount various kinds of building materials.

20 In addition, as shown in Fig. 9, it is possible for the vehicle body 1 to provide a mounting-plate member 70 in the swivel plate 37. In the mounting-plate member 70 is rotatably mounted a sleeve-like nut member 72 having a threaded hole 71, the nut member 72 being
25 prevented from moving in its longitudinal direction. A threaded rod 73 is threadably engaged with the threaded hole 71 of the sleeve-like nut member 72, while connected with the supporting plate 45 of the vehicle body 1. A rear-end portion of the nut member 72 is formed into a
30 square projection 72a assuming a square shape in cross section. The square projection 72a of the nut member 72 is rotatably driven by means of a ratchet wrench so that the supporting plate 45 is tilted, whereby the building material "A" fixed to the supporting plate 45 is brought
35 into a close contact with the exterior surface B₂ or an interior surface of the building body "B" in the case

that the longitudinal center line of the vehicle body 1 is not perpendicular to such surface of the building body "B".

5 In a similar manner to the above, it is possible for the vehicle body 1 of the apparatus of the present invention to mount the building material "A" on the interior surface of the building body "B".

CLAIMS:

1. An apparatus for handling building materials comprising:

a self-propelled vehicle body provided with a steering/driving means, said vehicle body having a substantially L-shaped form constructed of an upright main body and a pair of spaced apart, parallel lower frames which extend horizontally forward from opposite sides of a lower portion of said upright main body of said vehicle body;

an elevator unit movably mounted on said upright main body of said vehicle body so as to be vertically movable along said upright main body;

a first frame means extending horizontally forward from said elevator unit, said first frame means having its rear end portion mounted on said elevator unit so as to be laterally movable in a horizontal plane relative to said lower frames;

a second frame means slidably mounted in said first frame means so as to be extended therefrom and retracted therein in the longitudinal direction of said first frame means; and

a supporting means for supporting building materials, said supporting means being so mounted on a forward-end portion of said second frame means as to be vertically swingable and also as to be rotatable on an axis perpendicular to the plane of said supporting means.

2. The apparatus as set forth in Claim 1, wherein:

said steering/driving means of said self-propelled vehicle body is mounted substantially in the center of said lower portion of said main body of said vehicle body in the width direction thereof, and comprises:



a steering/driving wheel connected to a motor;
a front wheel rotatably mounted in a front-end portion of each of said lower frames of said vehicle body;

an inverted U-shaped bracket for supporting an axle of said steering/driving wheel and said motor connected with said axle;

a vertical shaft extending upward from an upper-end surface of said inverted U-shaped bracket;

a supporting bracket fixedly mounted on said main body of said vehicle body for rotatably supporting said vertical shaft;

a pinion concentrically fixed to said vertical shaft;

a rack meshing with said pinion, said rack being movably mounted on said main body of said vehicle body; and

a steering cylinder for driving said rack, the steering cylinder being fixedly mounted on said main body of said vehicle body.

3. The apparatus as set forth in Claim 1 or Claim 2, wherein:

said elevator unit comprises:

a pair of guide rails vertically provided in opposite sides of a vertically extending concave portion formed in the forward side of said main body of said vehicle body, said guide rails being oppositely disposed to each other in said concave portion of said main body;

a pair of vertical plates on each of which is rotatably mounted a roller which is slidably mounted in each of said guide rails, said vertical plates being spaced apart and parallel to each other;

an elevator element which supports a rear-end portion of said first frame means;



a vertical positioning cylinder having: its base-end portion connected with a lower portion of said concave portion of said main body of said vehicle body; and a front-end portion of its piston rod disposed between said vertical plates of said elevator unit in said concave portion of said main body, said vertical positioning cylinder being so mounted in said main body as to be vertical;

a sprocket rotatably mounted in said front-end portion of said piston rod of said vertical positioning cylinder; and

a chain running round said sprocket, said chain having opposite ends one of which is connected with a cylinder body of said vertical positioning cylinder, while the other end of said chain is connected with said elevator element.

4. The apparatus as set forth in any preceding claim, wherein:

said supporting means comprises:

an adapter plate fixedly mounted on a front-end portion of a vertical mounting plate which in turn is mounted on a front-end portion of said second frame means through a pivot so as to be swingable in a vertical plane;

a guide ring fixedly mounted on an outer peripheral surface of a side portion of said adapter plate;

a swivel plate provided with a ring-like projection in its rear surface, said ring-like projection being rotatably mounted on an inner peripheral surface of said guide ring through a plurality of balls so as to be adjacent to a front surface of said adapter plate, said swivel plate being connected with a swivel motor fixedly mounted on said adapter plate;



a supporting plate mounted on said swivel plate through bracket means and a pivot so as to be swingable in a horizontal plane relative to said swivel plate, said bracket means being fixed to a substantially central portion of a front surface of said swivel plate, said pivot being mounted on said bracket means, said supporting plate being provided with a plurality of through-holes for supporting said building materials; and

a control means for swingably driving said supporting plate in a plane perpendicular to said swivel plate so as to position said supporting plate relative to the surface of the building body.

5. The apparatus as set forth in Claim 4, wherein:

said control means for swingably driving said supporting plate is constructed of a pair of positioning bolts which are so fixed to said front surface of said swivel plate as to be oppositely disposed from each other across the diameter of said swivel plate so as to sandwich said bracket means therebetween, said positioning bolts having their longitudinal axes oriented toward said supporting plate.

6. The apparatus as set forth in Claim 4, wherein:

said control means for swingably driving said supporting plate comprises:

a mounting-plate member fixedly mounted on said swivel plate;

a nut member which is rotatably mounted in said mounting-plate member to penetrate the same, while prevented from moving in its longitudinal direction relative to said mounting-plate member, said nut member having its front portion formed into a threaded hole and



its rear portion formed into a square-shaped projection which assumes a square shape in its cross section to make it possible to rotatably drive said nut member by means of a ratchet wrench which engages with said square-shaped projection of said nut member in adjusting operation; and

a threaded rod having opposite ends, which threaded rod has an end thereof threadably engaged with said threaded hole of said nut member, and has the other end thereof connected with said supporting plate.

7. The apparatus as set forth in any preceding claim, wherein:

said supporting plate is adapted to detachably mount clamping attachments for clamping building materials of different kinds to said supporting plate.

8. Apparatus for handling building materials, substantially as hereinbefore described with reference to Figs. 1 to 8 or Figs. 1 to 8 as modified by Fig. 9 of the accompanying drawings.



* C L H S *