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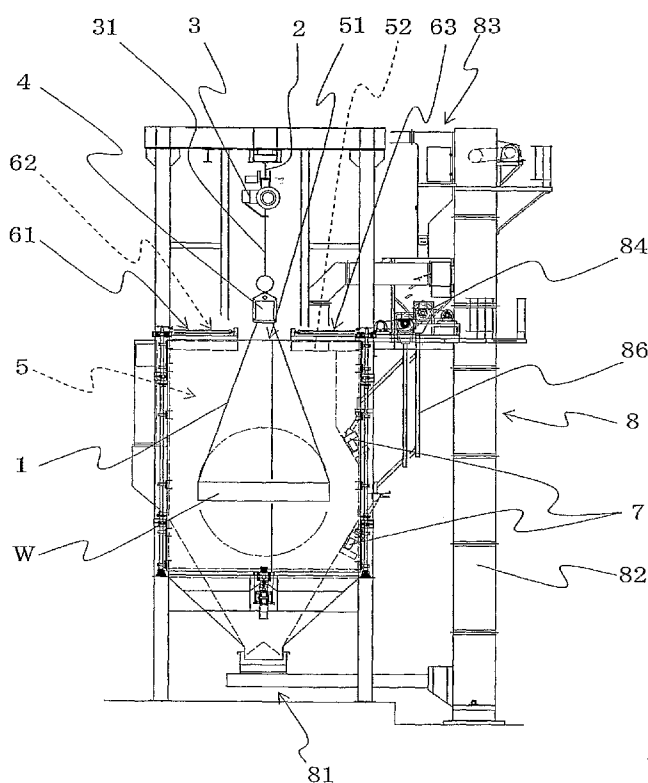
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(54) Title: SHOT-BLASTING MACHINE

Fig. 2



(57) Abstract: A shot-blasting machine for shot blasting a workpiece is disclosed. The shot-blasting machine comprises a rail 2 mounted on an upper part of the shot-blasting machine and extending in a horizontal direction, one or two hoists movable along the rail, and two inverting mechanisms 4. Each inverting mechanism 4 includes chain slings 1 for supporting one workpiece W at one end or the other end such that the workpiece W is suspended therefrom and includes a feeder for feeding the chain sling 1. An enclosure B in the shot-blasting machine has an entrance at one side and defines a projecting chamber 5 therein. The upper surface of the enclosure B is provided with an elongated opening 51. The volume of the projecting chamber 5 is to allow the workpiece W supported by the chain slings 1 to be moved along the direction that the rail 2 extends by running the hoist 3, while the workpiece W can be rotated about a rotating axis that is parallel to the direction that the rail 2 extends. The upper surface of the enclosure B is provided with a sealing mechanism 6 for preventing the shots from dispersing from the opening 51 by closing the opening 51 in which the chain slings 1 are inserted.



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Description

Shot-Blasting Machine

5 Field of the Invention

This invention relates to a shot-blasting machine, in particular, one suitable for shot blasting a large metal product.

10 Background of the Invention

As a conventional machine for shot blasting a large metal product as a workpiece, for instance, a shot-blasting machine with a rotary table is disclosed in Japanese Patent Early-Publication No. Hei 9-047966, assigned to the assignor of the present
15 application. In this machine, the workpiece is positioned on a rotary table such that it is to be processed by shot blasting while rotating it.

In this rotary table version of the shot-blasting machine, however, if a large metal product is processed by shot blasting, the rotary table causes blind spots in the
20 projection to the workpiece (for instance, the bottom surface of the workpiece, or a portion of the workpiece that falls within a shadow of the rotary table itself), since the workpiece is located on the rotary table. Therefore, it is impossible to thoroughly project shot to the surfaces to be processed of the workpiece. In particular, if the workpiece has a complex peripheral profile, or is a hollow-molded product using a core
25 mold, the blind spots of the workpiece are increased. Thus the areas where the projection is insufficient are also increased.

To overcome the disadvantage involving the rotary table version of the shot-blasting machine, a shot-blasting machine with a hoist is also known, as disclosed in Japanese
30 Patent Early-Publication No.Hei9-234671. In this hoist version of the shot-blasting

machine, the workpiece is suspended by a plurality of chains such that it can be tilted by adjusting the lengths of the chains while it is being processed by shot blasting. For instance, an elongated workpiece is suspended by a pair of chains at the opposed ends in its longitudinal axis such that the suspended workpiece can be tilted by
5 adjusting the length of each chain. Therefore, the hoist version is superior to the rotary table version in view of the shot-blasting quality of the former, since its blind spots are fewer than those of the latter.

In the hoist version in Hei 9-234671, however, the suspended workpiece cannot fully
10 rotate, e.g., around the longitudinal direction of it, although it can be tilted in its suspended position.

Therefore, if the surfaces to be processed of the workpiece are provided with pockets such as desired recesses or concave portions, projected shots accumulate therein, and
15 thus the shot-blasting process cannot be completely carried out on the surfaces to be processed. In addition, if the workpiece is an elongated one, it is necessary to lengthen the height, width, and the depth of a projecting chamber to more than the elongated length of the workpiece, to enhance the degree of freedom of tilting it. Further, if the workpiece is positioned in its vertical long position, it is a cause itself of
20 its instability. If the workpiece is positioned in its horizontal and long position, the distance between the paired chains that support the opposed ends of the workpiece is extended such that the angles of the inclinations of the paired chains are also increased. In such a situation, to smoothly guide the chains to their driving wheels, a sieve unit, which is provided on a ceiling of the projecting chamber, suffers from a
25 significant load. Because this causes the sieve unit to be worn out, and thus allows the shots to disperse from the projecting chamber, the working environment may be deteriorated, or each chain may break away due to its wear in the early stage. Further, in the prior art, the workpiece (if it is an elongated one) is suspended at the opposed ends in its longitudinal direction during the shot blasting in consideration of
30 its balance. In such a situation, in the prior art the opposed ends in the longitudinal

direction of the elongated workpiece are moved up and down to process the entire circumference of the workpiece. For instance, assuming the elongated workpiece is 5m long, and has a diameter of 0.2 m, the necessary measures of the projection chamber to move it up and down are 5 m in the vertical direction $\times$ 5 m in length $\times$ 0.2 m in width. Therefore, it is undesirable in the aspect of saving space, since the volume of the projection chamber increases relatively.

Summary of the Invention

Accordingly, one object of the present invention is to provide a shot-blasting machine that enables improvement of the abrasive quality, to decrease the volume of its projecting chamber, to prevent scattering of shots, and to provide suitable shot-blasting, especially for a large metal product.

The shot-blasting machine for shot blasting a workpiece of the present invention comprises a rail mounted on an upper part of the shot-blasting machine and extending in a horizontal direction; vertical moving means movable in a vertical direction and movable along the rail; two inverting mechanisms suspended from the vertical moving means, each including an endless member for supporting one workpiece at one end or the other end such that the workpiece is suspended therefrom and a feeder for feeding the endless member, wherein the inverting mechanisms cooperate with each other to reversibly rotate the workpiece in its suspended position by both its ends when supported by the endless members about an axis that is parallel to the direction of the extension of the rail; an enclosure having an entrance at one side and defining a projecting chamber therein, wherein the upper surface of the enclosure is provided with an elongated opening that extends from the entrance along the direction the rail extends such that it forms a passage for the endless members from which the workpiece is suspended, and wherein the volume of the projecting chamber is to allow the workpiece supported by the endless members to be moved along the direction of the extension of the rail by running the vertical moving means, while the workpiece

can be rotated about a rotating axis that is parallel to the direction of the extension of the rail; a projecting device mounted in the projecting chamber for projecting shots; a sealing mechanism mounted on the upper face of the enclosure for closing the opening in which the endless members are inserted to prevent the shots from scattering; and a
5 circulating means for collecting the projected shots and re-supplying them to the projecting device.

Preferably, the sealing mechanism includes a sealing member for closing the areas of the opening where the endless members are not located when in the state where the
10 vertical moving means is stopped while the workpiece is positioned at a predetermined position to be shot-blasted in the projecting chamber.

In one embodiment of the present invention, the sealing member includes a pair of the first, outer, seals that is located on the enclosure at positions that correspond to a
15 position in front of the preceding inverting mechanism of the two mechanisms, and a position in back of the following inverting mechanism when in the state where the vertical moving means are stopped while the workpiece is positioned at a predetermined position to be shot-blasted in the projecting chamber, each first, outer, seal is slidably arranged to slide in a direction that is orthogonal to the direction of
20 the extension, and a second, inner, seal located on the enclosure at a position that corresponds to a midpoint between the two inverting mechanisms when in the stopped state, wherein the second seal can be slid in a direction that is orthogonal to the direction of the extension. In this case, the sealing mechanism further preferably includes a pair of third seals located on the enclosure at positions that correspond to
25 the positions of the two inversion mechanisms that are stopped, when in the stopped state, wherein the third seals are slidably arranged along the direction that is orthogonal to the extending direction, wherein each third seal is provided with a plurality of gaps or cutouts in which the endless members are laterally interleaved. In one embodiment of the present invention, the third seal is also slidably arranged
30 along a direction that is the same as the direction of the extension.

In one embodiment of the present invention, the vertical moving means is one or two hoists that are adapted to vertically move the two inverting mechanisms.

5 Brief Description of the Drawings

The above and other objects and advantages of the present invention will become more apparent by reviewing the following detailed description with reference to the accompanying drawings.

10

Fig. 1 schematically illustrates a shot-blasting machine of one embodiment of the present invention.

Fig. 2 shows a front view of the machine of Fig. 1 in a view from its entrance.

15

Fig. 3 shows a plan view of the projecting chamber of the shot-blasting machine of Fig. 1, where a sealing mechanism is shown in its position when an opening is opened.

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Fig. 4 shows a plan view similar to that of Fig. 3, but an outer seal and an inner seal close the opening, while a seal for an endless member is shown in its position when it has not yet closed the opening.

25

Fig. 5 shows a plan view similar to that of Fig. 4, but the seal for the endless member is shown in its position when it also closes the opening.

Fig. 6 shows a plan view similar to that of Fig. 3, but the opened seal for the endless member is moved in the horizontal direction of travel of the endless member.

Detailed Description of the Preferred Embodiment

30

The upper portion of a shot-blasting machine of one embodiment shown in Figs. 1, 2, and 3 is provided with a horizontal rail 2, which can bear the load of a workpiece W to be suspended. The rail 2 is extended from above a working area S where a chain sling 1 is wound around and released from the workspace W to above an enclosure B
5 defining a projecting chamber 5 therein.

The rail 2 is provided with two hoists 3 (vertical moving means) that can move along the rail 2, and that can vertically move by means of, e.g., respective wires 31. Suspended from each wire 31 of each hoist 3 is an inverting mechanism 4. It includes
10 a chain sling 1 that forms an endless member by connecting both ends of a chain, and a feeding mechanism for feeding the chain sling 31. The chain sling 1 has a length that can wind around at least part of the circumference of the workpiece W. Two inverting mechanisms 4 cooperate with each other to reversibly rotate, to normally rotate, and to tilt one workpiece W in its suspended position while both its ends are
15 supported by the chain slings. One end of the enclosure B facing the working area S is provided with an entrance to access the projecting chamber 5 that is defined within the enclosure B. Further, a ceiling 52, which defines the upper surface of the projecting chamber 5, is provided with an elongated opening 51 (see Figs. 2 and 3). The elongated opening 51 extends from the entrance along the direction that the rail 2
20 extends such that it forms a passage for the chain slings 1 from which the workpiece W is suspended. The volume of the projecting chamber 5 is selected to allow the workpiece W that is supported by the chain slings 1 to be moved along the direction that the rail 2 extends by running the hoists 3, while the workpiece W can be rotated about a rotating axis that is substantially parallel to the direction that the rail 2
25 extends.

In the projecting chamber 5, a plurality of projecting devices 7 for accelerating and projecting shots are installed. Each projecting device may be a conventional and known device. In this embodiment, the projecting device is, but is not limited to, a
30 centrifugal projecting device. For instance, an air-projecting device that accelerates

and projects the shots by air may be used if just a limited portion of the entire circumference of a large workpiece is processed.

In the projecting chamber 5, a circulating means 8 that collects the projected shots and re-supplies them to the projection device is also installed. In Figs. 1 and 2, the circulating means 8 includes an oscillating conveyor 81 that is located at the bottom of the projecting chamber 5 for horizontally conveying the projected shots that fall under the projecting chamber 5, and a bucket elevator 82 that is located near the leading end of the conveyor 81 for upwardly conveying the shots that are conveyed by the conveyor 81. The upper end of the bucket elevator 82 is provided with a releasing outlet 83 for releasing the shots. Near the outlet 83, a horizontal screw conveyor 84 is arranged such that it receives the released shots therefrom. The horizontal screw conveyor 84 is provided with a plurality of exits 84a for the shots. Beneath the exits 84a of the horizontal screw conveyor 84, a hopper 85 for storing the shots is arranged such that the bottom of it communicates with a first pipe 86. The first pipe 86 is provided with a gate 87 to open and close the first pipe 86 to control the amount of the shots that flow through the pipe 86. In turn, the bottom of the gate 87 is connected to the second pipe 88, which communicates with the inlets of the respective projecting devices to supply the shots therein.

On the ceiling 52 of the projecting chamber 5, a sealing mechanism 6 is mounted such that it seals the projecting chamber 5 so as to prevent the projected shots from dispersing from the opening 51. The sealing mechanism 6 is configured such that it can prevent the shots from scattering, or dust from leaking, from the opening 51 of the projecting chamber 5 without interfering with the movement or the rotation of the chain slings 1 that are interleaved in the sealing mechanism by providing a plurality of cutouts or gaps in which the chain slings 1 can be laterally interleaved. For instance, the sealing mechanism 6 may be composed of, but it is not limited to, a pair of elastic bodies, such as a pair of single-layered rubbers or a pair of multiple-layered rubbers, each of which has a plurality of cut offs in which the chain slings 1 that are

located within the opening 51 can be laterally interleaved. These elastic bodies are intermated with each other in opposed sides of a moving path H (see Fig. 3) of the chain slings 1 in a horizontal direction along the direction that the rail 2 extends. The moving path H corresponds to a locus of movement of the hoists 3 (not shown in Fig. 3). Or, each elastic body may be a brush-shaped formed by, e.g., bundled wires made by a resin or a metal, a resin plate, a sponge, or a cloth brush. The intervals between the teeth of the brush receive laterally the chain slings 1 that are located within the opening 51.

However, part of the areas of the opening 51 where the chain slings 1 are not located during the shot-blasting process can be merely closed without considering the existence of each chain sling 1. Therefore, the portions of the sealing mechanism 6 for sealing those areas preferably consists of stiff materials, e.g., steel plates, to enhance abrasion resistance and to prevent leakage of the sealing mechanism 6. The areas of the opening 51 that can be merely closed without considering the existence of each chain sling 1 during the shot-blasting process include the front area of the preceding inverting mechanism of the two mechanisms 4, a rear area of the following inverting mechanism 4, and an area between the two mechanisms 4. Looking from the state when the hoists 3 are stopped with the workpiece W being positioned at a predetermined position to be shot-blasted in the projecting chamber 5. The sealing mechanism in the embodiment of Figs. 2 and 3 includes a pair of first, outer, seals 61, and a second, inner, seal 62, each of which is made of a steel plate.

The pair of the first, outer, seals 61 is located on the ceiling 52 at positions that correspond to a position in front of the preceding inverting mechanism of the two mechanisms 4, and a position in back of the following inverting mechanism 4, looking from the state when the hoists 3 are stopped with the workpiece W being positioned at a predetermined position to be shot-blasted in the projecting chamber 5. Each first, outer, seal 61 is drivingly coupled to a sliding mechanism, e.g., an air cylinder 61a such that the first seal 61 can be slid in a direction V that is orthogonal to the moving path

H by extending and contracting the air cylinder 61a. The second, inner, seal 62 is located on the ceiling 52 at a position that corresponds to a midpoint between the two inversion mechanisms 4, looking from the state when the hoists 3 are stopped with the workpiece W being positioned at a predetermined position to be shot-blasted in the projecting chamber 5. The second, inner, seal 62 is drivingly coupled to a sliding mechanism, e.g., an air cylinder 62a such that the second seal 62 can be slid in a direction V that is orthogonal to the moving path H by extending and contracting the air cylinder 62a. Marginal portions where the first seals 61 and the second seal 62 overlap are formed as hermetical sections (not shown) to prevent the leakage of the projected shots.

If the sealing mechanism 6 includes, as in this embodiment, a pair of first, outer, seals 61 and the second, inner, seal 62, the intersections therebetween in the opening 51 are configured such that the chain slings 1 can be interleaved in them, as discussed above.

Such a configuration is illustrated in the embodiment of Figs. 2 and 3 as a pair of third seals 63, in which the chain slings 1 can be interleaved. Although each third seal 63 is basically composed of a steel plate, it includes a hermetic section 6S. The hermetic section 6S includes elastic bodies such as single-layered or multiple layered rubber plates, each of which has a plurality of cut offs to prevent interfering with the movement and the rotation of the chain slings 1, as discussed above. In practice, because workpieces W of various sizes may be processed, the positions of the two inverting mechanisms 4 and thus of the chain slings 1 in the shot-blasting process, may be varied due to differences in the sizes of the workpieces W to be processed. It is thus preferable that the pair of the third seals 63 can slide also in a direction along the moving path H (the direction of the travel of the hoists 3) of the chain slings 1, not only in the direction V that is orthogonal to the moving path H. The pair of the third seals 63 is mounted on the ceiling 52 of the enclosure B of the projecting chamber 5 at positions corresponding to the two inverting mechanisms 4 when the hoists 3 are stopped to locate the workpiece W at the point where it is processed. The third seals 63 include respective sliding mechanisms, such as respective air cylinders 63b and a

common driving motor 63b, to adjust the distance between the third seals 63. Therefore, the third seals 63 can slide along the direction V that is orthogonal to the direction H by the extension and contraction of the air cylinders 63a, and can slide along the direction that is the same as the direction H by means of the driving motor 63b. Each third seal 63 is provided with U-shaped cutouts 63U in which the chain slings are laterally interleaved. Preferably, each hoist 3 includes a positioning sensor (not shown) to detect a position of the corresponding chain sling 1. By sliding the third seals 63 such that the portions of the chain slings 1 detected by the positioning sensors are aligned with the corresponding U-shaped cutouts 63U, the chain slings 1 may be laterally interleaved in the corresponding U-shaped cutouts 63U.

Regarding the steel plates of the first (outer) seals 61, the second (inner) seal 62, and the third seals 63 to receive the chain slings 1, their sides to be hit by the projected shots may be lined with liners that resists wear.

Although two of the hoists 3 are used in the illustrative embodiments, just one hoist may be used, if the interval between the two inverting mechanisms 4 can be fixed or varied. To vary the interval between the two inverting mechanisms 4 with just one hoist, an appropriate means to do so may be, for instance, a supporting frame having an air cylinder. In this case, the supporting frame is suspended from the hoist to support the two inverting mechanisms 4 such that the interval between the two inverting mechanisms 4 can be varied. Each hoist or one of two hoists may be, but is not limited to, an electrical wire hoist or an electrical chain-block-type hoist. As an alternative vertical moving means, a hydraulic cylinder or servo cylinder may be used to replace the hoist.

Each inverting mechanism 4 is not limited to the illustrative embodiment, but may be one that includes a circular endless member and a feeder for feeding the endless member. The endless member may be, to replace the chain sling 1, another configuration in which a circular endless member is formed by having its opposed ends

connected and can be at least partly wound around the circumference of the workpiece W. For instance, a sling belt or a circular wire may be used as the endless member.

Respective sliding mechanisms of the seals retract from the opening 51 while the workpiece W is traveling in the projecting chamber 5, and they are in close contact with the opening 51 while the workpiece W is shots-blasted. Each sliding mechanism may be replaced with a door with a pivotal linkage. A driving means for driving the sliding mechanism or the door may be replaced by the illustrated air cylinder, a hydraulic cylinder, a rotary cylinder, a servo cylinder, or a motor. For example, combining the motor with a rack-and-pinion device may replace the sliding mechanism.

Although the illustrated the circulating means 8 includes the oscillating conveyor 81, the bucket elevator 82, and the screw conveyor 84, it may be replaced with another configuration based on the internal volume of the projecting chamber 5 or a layout of a factory where it is installed, or both, such that it enables the shots to be conveyed and to separate them from molding sand, and to remove any dust.

Now an operation of the shot-blasting machine in the embodiment of the present invention will be explained by reference to an exemplary process to remove the molding sand from a cast product as the workpiece W. Because this exemplary process is intended to just be illustrative to explain the operation of the shot-blasting machine of the present invention, it is not intended to limit the present invention.

Conditions for Processing

The workpiece W that was used was a column of a machining center for a machine tool. It was made of cast iron, and was 4000 mm long, 2000 mm wide, and 450 mm thick. The projecting chamber 5 in the shot-blasting machine was 8000 mm long, 5000 mm wide, and 6500 mm high. Eight centrifugal projecting devices 7 were

mounted on the side in the projecting chamber 5. To carry out the shot-blasting, steel shots were used. Their particle size was 2.5 mm, the projection speed was 70 m/s, and the amount of the steel shots to be projected from each centrifugal projecting device 7 was 150 kg/min. To transport the workpiece W, two hoists 3 were used, each of which had the maximum hanging load of 12 tons, a maximum rolling-up speed of 8 m/min, and a maximum running speed of 10 m/min. Two inverting mechanisms 4 were used, each of which was a chain-sling-type inversion mechanism made by NIPPON HOIST CO., LTD., Hiroshima, Japan, with a maximum hanging load of 10 tons. In each inversion mechanism, the chain sling was 12 m long, and the maximum velocity for feeding it was 4 m/min.

Operation

The workpiece W is wound around the chain slings 1 such that it is suspended in the working area S. The hoists 3 are then moved along the rail 2 such that the suspended workpiece W is moved into the projecting chamber 5 through an entrance door, which is mounted on an end face of the projecting chamber 5. When the workpiece W reaches the predetermined position where it is to be shot blasted, the respective inverting mechanisms 4 feed the respective chain slings 1 to rotate the workpiece W at a constant rate. Simultaneously, the pair of the first (outer) seals 61 and the second (inner) seal 62 is slid to cover the opening 51. The third seals 63 for the endless members are then moved along in the direction of the traveling path of the chain slings 1 to align the third seals 63 with the positions of the chain slings 1. The third seals 63 are then slid to the opening 51 to receive the chain slings 1 in the corresponding U-shaped cutouts 63U in the third seals 63 to cause their interleaved relationship. The opening 51 is thus shielded entirely by the first, second, and the third seals. After the opening 51 is shielded, the centrifugal projecting devices 7 are activated to project the shots in the projecting chamber 5.

During the shot-blasting, the workpiece W is rotated in a given time, and then it is

stopped. In this stopped state, a desired portion, which has a complex shape and thus takes time to be processed, of the workpiece W, is located at a position where collisions by the shots may occur chiefly therein. After the workpiece W is stopped at a set time, it is then reversely rotated in the direction opposite to that of the preceding rotation. The workpiece W repeats the rotating step, the stopping step, and the reversely-rotating step in such a manner during the shot-blasting. If the workpiece W has a profile in which the shots may be accumulated in a pocket or pockets therein, the above stopping step may be replaced with a step of a normal or reversed rotation at a decelerating speed.

In this embodiment, the shots are projected over a total of 15 minutes. After the projection process is completed, the workpiece W is rotated in a given time to cause some shots that have remained and that have adhered to the workpiece W after the collisions to be dropped therefrom. Then the respective seals 61, 62, and 63 that have closed to shield the opening 51 are slid in directions to open the opening 51. The hoists 3 are then moved along the rail 2 to bring the workpiece W to the working area S. The workpiece W is then removed from the chain slings 1 and thus the operation is completed. By the resulting workpiece W having been shot blasted in the above manner, it was found that all its surfaces are evenly shot blasted with an excellent quality.

By the shot-blasting machine of the present invention, the chain slings 1 of the inverting mechanisms 4 are wound around the workpiece W such that it is rotated in the suspended position about its horizontal axis by driving the inverting mechanisms 4. In this manner, a pocket or pockets of the workpiece W can be oriented downwardly to drop some projected shots remaining therein such that the insides of the pockets to be processed can be exposed. Because the suspended workpiece W is rotated to enable its entire circumference to be processed, any remaining shots in the pocket or pockets can be adequately dropped therefrom. Any undesirable accumulation of the shots in the pocket or pockets in the workpiece can thus be

prevented from occurring, regardless of the circumferential position of such a pocket in the circumference of the workpiece W. Accordingly, the surfaces to be shot-blasted of the workpiece may be regularly exposed, to process them evenly with an enhanced quality in the process. Further, the sealing mechanism 6 can prevent the
5 undesirable scattering of the projected shots. In addition, because the workpiece W may be supported in its stable position by the chain slings 1, an accidental dropping of it may be prevented.

The movement of the workpiece W includes its moving along the direction of the
10 extension of the rail 2 and the rotation about its horizontal axis in the suspended and supported position by the endless members 1. Therefore, if the workpiece W is an elongated one, there is no necessity for a projecting chamber that has an excessive volume, since the shot-blasting machine of the present invention aligns the longitudinal axis of the workpiece W with the direction of the extension of the rail 2.
15 This enables the projecting chamber 5 to have a reduced volume in order to save space. For instance, if an elongated workpiece to be processed is 5 m long and has a diameter of 0.2 m, the conventional shot-blasting machine has been required to have a projecting chamber that has possible vertical distance of 5 m for such an elongated workpiece, 5 m long, 0.2 m wide. To process the same elongated workpiece by the
20 shot-blasting machine of the present invention, the volume of the projecting chamber 5 just requires a height of 0.2 m, a length of 5 m, and a width of 0.2 m, since the elongated workpiece is rotated about its longitudinal axis.

For instance, a suitable application for the shot-blasting machine of the present
25 invention may be, but is not limited to, shot-blasting to remove molding sand from a large cast product, e.g., its weight is over 1 ton, such as an upper die and a lower holder of press dies, a lathe-bed of a machine tool, a column of a machining center, a frame of a sheet-metal processing machine, a suction casing for an industrial machinery, a gear case for mechanical reduction gears, a cast-iron pipe whose nominal
30 diameter is 500 mm or more, a spiral casing for a compressor, and a discharge elbow

with an integral molded housing in which reduction gears are to be provided. The shot-blasting machine of the present invention may also be applicable to, but is not limited to, shot blasting to remove scales from, or to prepare surfaces before a coating process for, or to roughen surfaces to increase their frictional characteristics of, such
5 items as a frame-structured product in which components are welded in a desired configuration for use in a large welded structure, e.g., a bridge, a large ship, and an iron tower.

Although a specific embodiment and its alternative embodiments have been described
10 herein with certain dimensions, note that these embodiments and dimensions are merely examples and are not intended to limit the present invention. It should be appreciated that those skilled in the art might modify or change the above embodiments and their related dimensions without exceeding the spirit set forth in the appended claims.

Claims

1. A shot-blasting machine for shot blasting a workpiece, comprising:

a rail mounted on an upper part of said shot-blasting machine and extending in a
5 horizontal direction;

vertical moving means movable in a vertical direction and movable along said rail;

two inverting mechanisms suspended from the vertical moving means, each
including an endless member for supporting one workpiece at one end or the other end
such that the workpiece is suspended therefrom and a feeder for feeding said endless
10 member, wherein said inverting mechanisms cooperate with each other to reversibly
rotate the workpiece in its suspended position by both its ends is supported by said
endless members about an axis that is parallel to the direction that said rail extends;

an enclosure having an entrance at one side and defining a projecting chamber
therein, wherein the upper surface of said enclosure is provided with an elongated
15 opening that extends from said entrance along the direction that said rail extends
such that it forms a passage for said endless members from which the workpiece is
suspended, and wherein the volume of said projecting chamber is to allow the
workpiece supported by said endless members to be moved along the direction that
said rail extends by running said vertical moving means while the workpiece can be
20 rotated about a rotating axis that is parallel to the direction that said rail extends;

a projecting device mounted in said projecting chamber for projecting shots;

a sealing mechanism mounted on the upper face of said enclosure for closing said
opening in which said endless members are inserted to prevent the shots from
dispersing; and

25 circulating means for collecting the projected shots and re-supplying them to said
projecting device.

2. The shot-blasting machine of claim 1, wherein said sealing mechanism includes a
sealing member for closing the areas of said opening where said endless members are
30 not located in the state where said vertical moving means is stopped when the

workpiece is positioned at a predetermined position to be shot-blasted in the projecting chamber.

3. The shot-blasting machine of claim 2, wherein said sealing member includes a pair
5 of the first, outer, seals that is located on said enclosure at positions that correspond to a position in front of the preceding inverting mechanism of the two mechanisms, and a position in back of the following inverting mechanism, when in the state where said vertical moving means is stopped when the workpiece is positioned at a predetermined position to be shot-blasted in the projecting chamber, and wherein each
10 first, outer, seal is slidably arranged to slide in a direction that is orthogonal to said direction of extension; and

a second, inner, seal located on said enclosure at a position that corresponds to a midpoint between the two inverting mechanisms when in said stopped state, wherein said second seal can be slid in a direction that is orthogonal to said direction of the
15 extension.

4. The shot-blasting machine of claim 3, wherein said sealing mechanism further includes a pair of third seals located on said enclosure at positions that corresponds to the positions of the two inverting mechanisms that are stopped, when in said stopped
20 state, wherein said third seals are slidably arranged along the direction that is orthogonal to said direction of the extension, wherein each third seal is provided with a plurality of gaps or cutouts in which said endless members are laterally interleaved.

5. The shot-blasting machine of claim 3, wherein said third seal is also slidably
25 arranged along a direction that is the same as said direction of extension.

6. The shot-blasting machine of claim 1, wherein said vertical moving means is one or two hoists that are adapted to vertically move the two inverting mechanisms.

Fig. 1

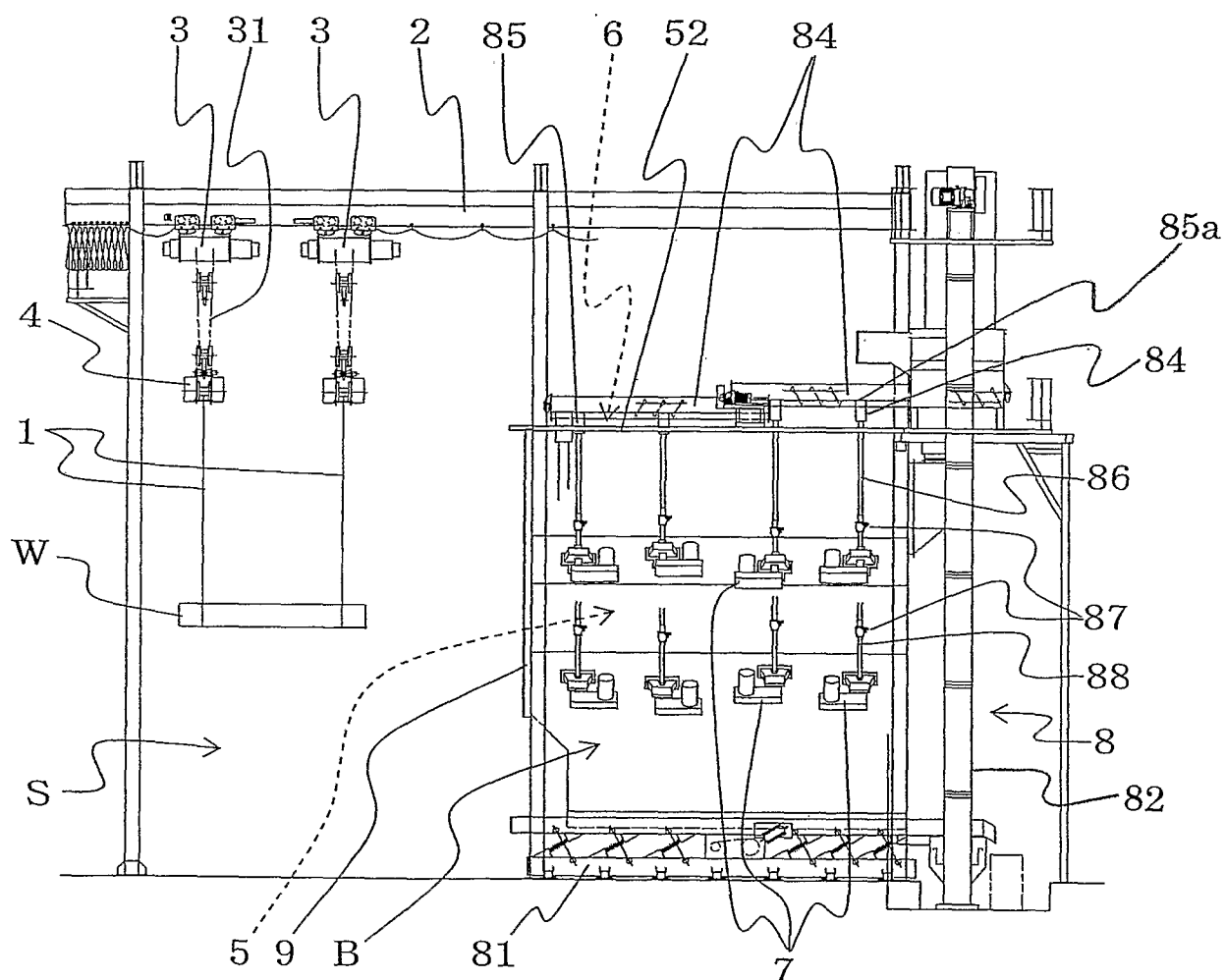


Fig. 2

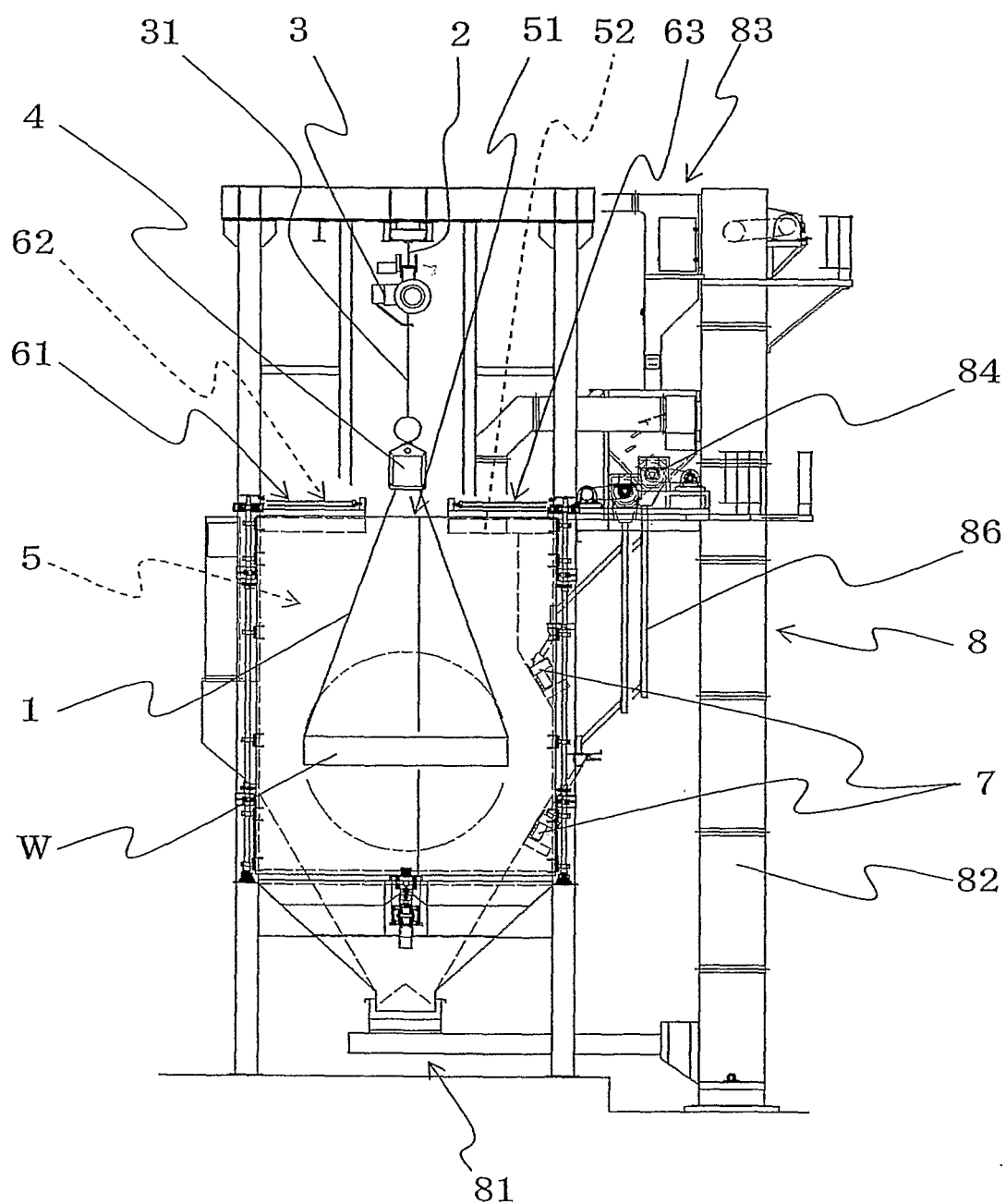


Fig. 3

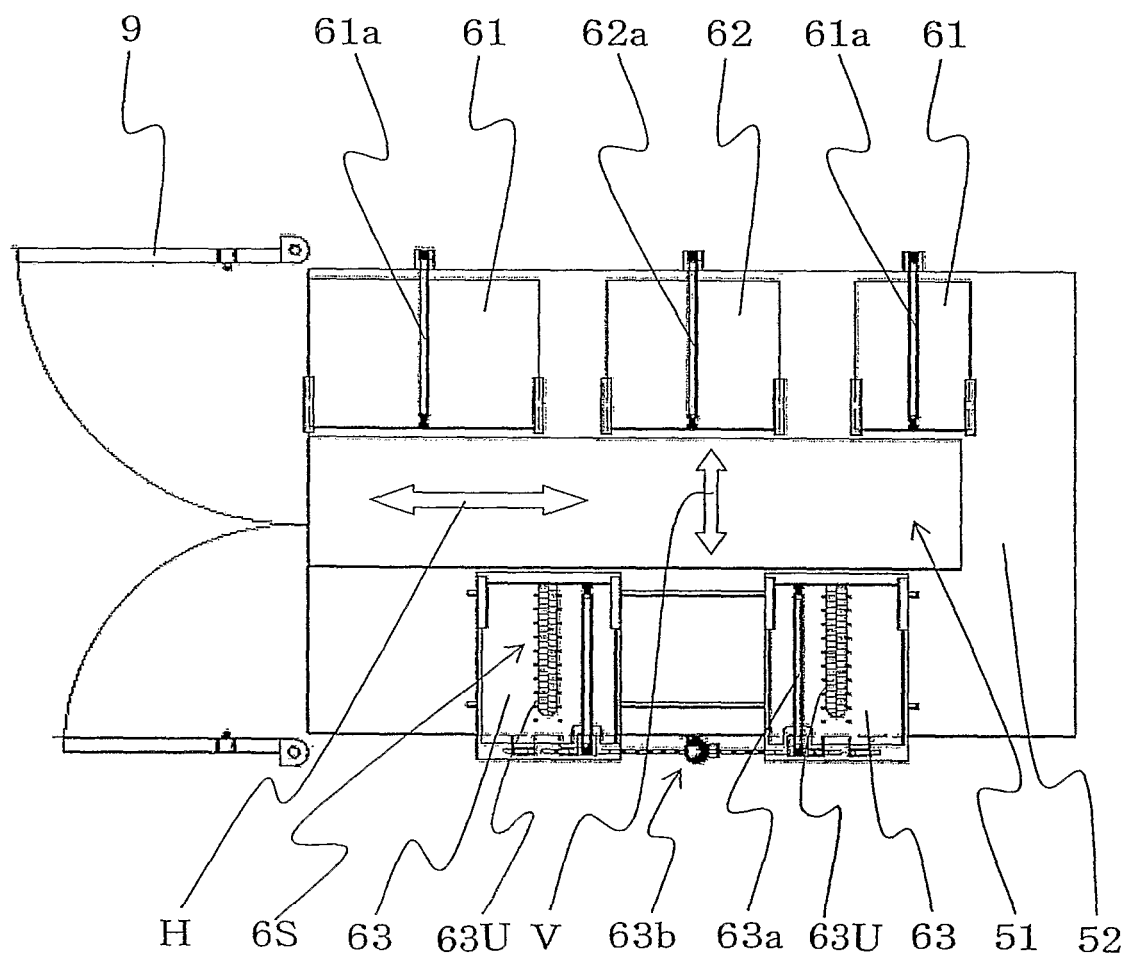


Fig. 4

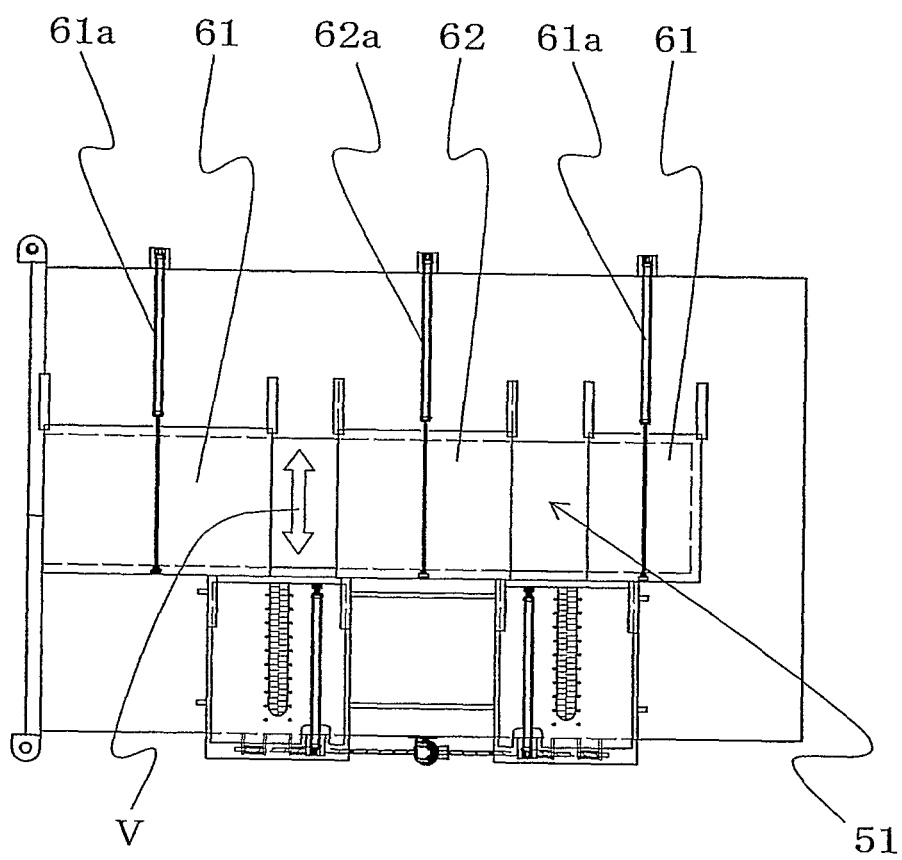


Fig. 5

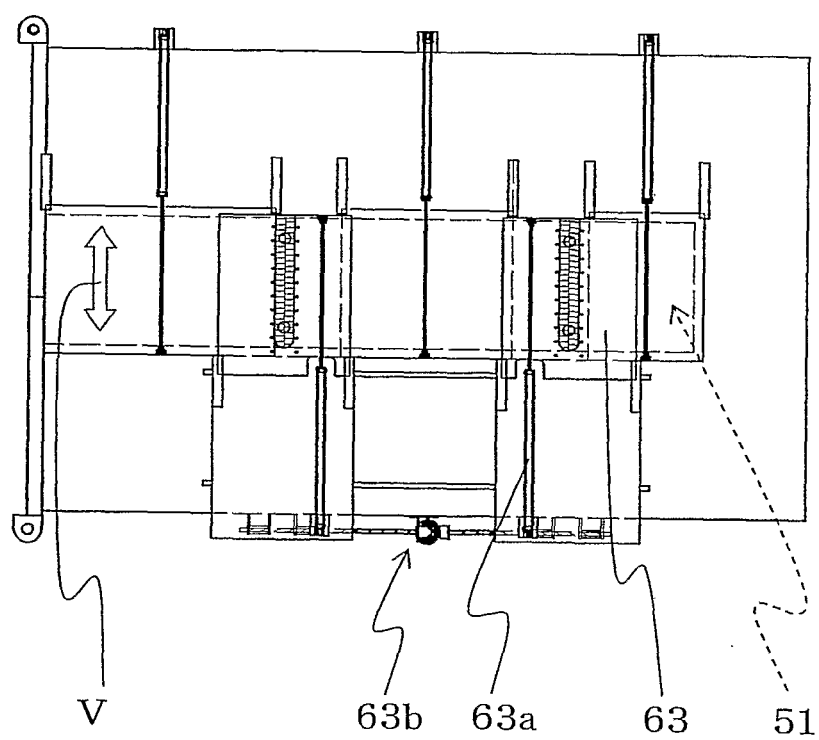
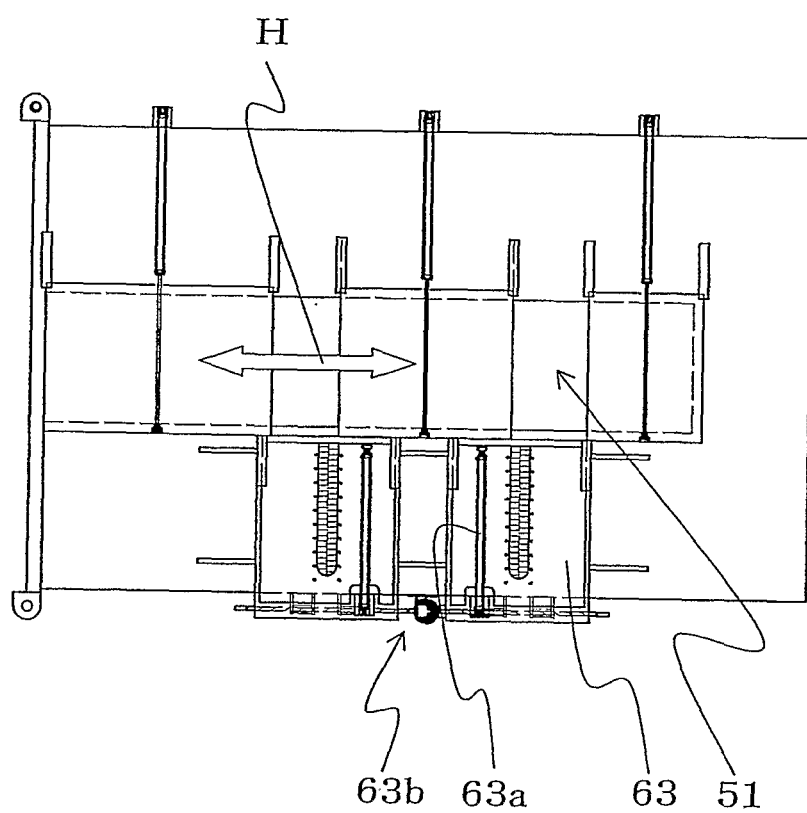


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No

PCT/JP2008/062966

A. CLASSIFICATION OF SUBJECT MATTER

INV. B24C3/08 B24C3/10 B24C3/18 B24C9/00

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)

B24C

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 26 13 669 A1 (BERGER MASCHF GMBH) 6 October 1977 (1977-10-06) pages 3-5 figures 1,2 claims 1,2,4	1,2,6
A	JP 51 143261 A (KOKUSAN KIKAI KK) 9 December 1976 (1976-12-09) figures 6,7 abstract	1,6
A	US 2 982 007 A (FUCHS HENRY O ET AL) 2 May 1961 (1961-05-02) column 2, lines 33-52 column 4, lines 38-53 figures 2,3,7,8	1
	-/--	



Further documents are listed in the continuation of Box C.



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Date of the actual completion of the international search

9 October 2008

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23/10/2008

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INTERNATIONAL SEARCH REPORT

International application No

PCT/JP2008/062966

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	JP 09 234671 A (TAIYO CHUKI KK; ARAI HIDEO) 9 September 1997 (1997-09-09) cited in the application the whole document	1-6

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/JP2008/062966

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