

WORKPIECE MANIPULATING APPARATUS

5 **Field of Invention**

This invention is related to an apparatus for manipulating workpieces. In particular, the invention relates to an apparatus for manipulating or turning workpieces having weights beyond the handling capacity of manual operation.

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Background of Invention

Vessel manufacturing often involves building of construction modules. Such construction modules are typically made of steel material and weight far beyond the handling capacity of manual operation, e.g. in at least several tons to over tens of tons. To manipulate such construction modules, e.g. changing the positions and orientation, moving from one location to the other at the production line or the ship-building yard, it is necessary to utilize heavy equipment such as gantry cranes and/or crawler cranes. Taking the operation of flipping a construction module as an example, a construction module of about 12.5 meters long, 2.5 meters wide and 1.25 meters thick at a weight of about 80 tons requires two cranes, one hangs the module stationary to serve as the fulcrum, and the other will move the module around the fulcrum to turn the module by stretching and releasing.

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As cranes are meant for performing load-lifting operations along vertical direction only, turning, flipping and rotation of such heavy construction module often requires two cranes and together with manual assistance to complete the task. Flipping of such a heavy construction module typically takes several hours. Such process raises safety concerns to operators and is labour-intensive. In addition, as crane availability constitutes a major role in the operational capacity of a shipyard, alleviating the demands for cranes is greatly desirable for yard operations.

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Summary of Invention

Embodiments of the present invention provide workpiece manipulating apparatuses which eases the operation procedure, increased the safety level and productivity.

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In accordance with an aspect of the present invention, there is provided a workpiece manipulating apparatus comprising: (a) a first support structure and a second support structure

disposed spaced apart from each other; (b) a frame adapted to receive the workpiece, the frame having a first end and a second end, the first end of the frame is coupled to the first support structure and the second end of the frame is coupled to the second support structure; and (c) a first fixture and a second fixture disposed on the frame, each fixture adapted to clamp a portion of the workpiece, wherein the frame is movably coupled to the first and second support structures and adapted to rotate about a horizontal axis to turn the workpiece.

In various embodiments, each of the first and second fixtures is adapted to clamp opposite end portions of the workpiece. Each of the first and second fixtures comprises an upper clamping plate and a lower clamping plate, clamping plates movably coupled to each other for clamping the workpiece. Each of the clamping plates further comprises at least one clamping attachment. In an embodiment, the clamping attachment is a screw clamp.

In various embodiment, the frame may comprise a plurality of clamping attachments distributed along the perimeter of the frame for clamping the workpiece.

In various embodiments, each of the upper clamping plate and lower clamping plate comprises two equally spaced apart screw clamps.

In various embodiments, the upper and lower clamping plates are removably attached to the frame.

In various embodiments, each of the first and second support structures further comprising a driving mechanism engaged to the frame to rotate the frame.

In various embodiments, a distance between the first support structure and the second support structure being variable.

In various embodiments, at least one of the support frames includes a platform to allow operator access.

Advantageously, the present invention allows a worker to easily manipulate movement of a workpiece (including carrying out welding or other works on the workpiece) in the “downhand” position (where a worker can look down on the workpiece while working on it) instead of the more difficult overhead position (where a worker has to look up at the workpiece over his head). This increases productivity, safety and quality.

Also, advantageously, the present device is easy to manufacture and fabricate since there are less individual parts to fabricate and assemble.

Other aspects and advantages of the present invention will become apparent from the following detailed description, illustrating by way of example the inventive concept of the present invention.

Brief Description of Figures

In order that the present invention may be fully understood and readily put into practical effect, there shall now be described by way of non-limitative examples only preferred embodiments of the present invention, the description being with reference to the accompanying illustrative figures.

In the Figures:

Figure 1 is a perspective view of the apparatus according to an embodiment of the present invention; and

Figure 2 is a perspective view of the operation of the apparatus according to an embodiment of the present invention.

Detailed Description of The Preferred Embodiments

With reference to Figure 1, there is provided a workpiece manipulating apparatus 5 comprising a first support structure 10 and a second support structure 15. Each of the first and second support structures may be disposed at a distance spaced apart from each other. Each support structure may provide a housing for containing any necessary mechanism or electrical components necessary to drive the apparatus 5. As such, each support structure may have the necessary controls on its surface to allow a user to operate the apparatus 5. Not shown in the Figures, a platform may be attached to any one of the first or second support structures 10, 15 allowing access by an operator for, e.g. assisting and monitoring the apparatus 5 process and/or for maintenance purpose. The distance between the first support structure 10 and the second support structure 15 may be varied to accommodate the frame 20.

The frame 20 is disposed intermediate the first support structure 10 and the second support structure 15. The frame 20 may be take the form of any angular structure, e.g. square,

rectangle or the like. In particular, the frame 20 may have a length on a side that would span the distance between the first support structure 10 and the second support structure 15. In an embodiment as can be seen in Figure 1, the frame 20 is substantially rectangle having a hollow centre adapted for receiving and accommodating the workpiece 8. The frame 20 comprises two transverse beams and two longitudinal beams. The longitudinal beams are the ones that span the distance between the first support structure 10 and the second support structure 15. While an embodiment of the present invention shows a frame 20 having a substantially rectangular shape, the frame 20 may take the form of other shapes, e.g. circular etc, so long as it is able to receive and accommodate the workpiece 8. In the case where the frame 20 is circular, its diameter would span the distance between first support structure 10 and the second support structure 15. In an embodiment, a length of the frame 20 (i.e. a longitudinal beam) may be varied to accommodate workpieces of varies sizes and lengths.

The frame 20 has a first end 20a and a second end 20b, the first end of the frame 20a is coupled to the first support structure 10 and the second end of the frame 20b is coupled to the second support structure 15. The coupling may introduce any suitable assembly that allows the frame 20 to move relative to the first and second support structures 15, 20. In particular, the assembly may be a driving mechanism that includes gears and sprockets which allow the frame 20 to rotate about a horizontal axis to turn the workpiece 8. This will be further described with reference to Figure 2 below. The attachment attaching the frame 20 to the first and second support structures 10, 15 – as shown at 20a and 20b – may include any suitable rotary mechanism for turning the frame 20 about a horizontal axis.

The frame 20 further comprises a first fixture 25 and a second fixture 30 that are disposed on the frame. Alternatively, there can be any number of fixtures disposed along a length of the frame 20 so long as these fixtures are adapted to clamp the workpiece 8 (or a portion of the workpiece 8) that is accommodated within the frame 20. Figure 1 shows that each of the first and second fixtures 25, 30 is adapted to clamp opposite portions of the workpiece 8.

In an embodiment, there are each of the first and second fixtures 25, 30 comprises an upper clamping plate 35 and a lower clamping plate 40. These clamping plates 35, 40 oppose each other across the hollow of the frame 20 and are movably coupled to each other for clamping the workpiece 8. The upper and lower clamping plates 35, 40 are attached to the frame 20 by any suitable means, e.g. screws and bolts etc. In an embodiment, the upper and lower clamping plates 35, 40 each comprises a foot that is attached to the frame 20 and a compaction beam that spans across the hollow of the frame 20. Opposite ends of the compaction beam are attached to its respective foot. The upper and lower clamping plates 35,

40 may be removably attached to the frame 20. The advantage of this feature will be evident when the operation of the apparatus 5 is described later below.

In order to improve grip on the workpiece 8, each of the clamping plates 25, 30 further comprises at least one clamping attachment 45. In an embodiment, the clamping attachment 45 is a screw clamp 45. Any suitable screw clamps 45 known to the skilled person may be used. Typical screw clamps 45 may include a threaded screw that is disposed in and through the clamping plate. Each threaded screw may have a pad at one end for contacting the workpiece 8, while having a bolt and turning device at the opposite end for tightening the screw clamp for gripping the workpiece 8. In an embodiment, each of the upper clamping plate 35 and lower clamping plate 40 comprises two equally spaced apart screw clamps 45. The positions of the screw clamps 45 on the upper clamping plate 35 correspond with those positions of the screw clamps 45 on the lower clamping plate 40 such that, with tighten, the gripping force provided by the screw clamps 45 are along the same axis or plane, thus providing the strongest gripping force. It is understood that the clamping attachment may be any suitable attachments, e.g. any device providing a set of jaws for gripping and clamping opposite sides or ends of the workpiece 8.

In addition to the above, the frame 20 may comprise a plurality of clamping attachments (screw clamps 45 in the present case) distributed along the perimeter of the frame 20 for clamping the workpiece 8, particular the sides of the workpiece 8.

Figure 2 shows the sequence of events (numbers 1 to 9) that will take place when the apparatus 5 is in operation, i.e. turning a workpiece 8.

At 1, the upper clamping plates 35 (compaction beams) are removed from the frame 20 – only the lower clamping plates 40 are attached to the frame 20. As such, the space bound by the frame 20 and the lower clamping plate 40 is adapted to receive and accommodate a workpiece 8 that requires manipulating or turning. This is shown at 2 where a workpiece 8 is hoisting into the space.

At 3, the upper clamping plate 35 (compaction beams) are then attached from the frame 20. The upper clamping plate 35 is then secured to the frame 20. At 4, the clamping screws 45 are then tightened to secure the workpiece 8 within the frame 20 of the apparatus 5.

At 5, the driving mechanism turns the frame about a horizontal axis. After a 180° turn, the driving mechanism is stopped. At this point, the workpiece 8 is overturned and the lower

clamping plate 40 faces upward as shown in 6. At 7, the screw clamps on the lower clamping plate 40 and the frame 20 are loosened. At 8, the lower clamping plate 40 is removed (compacted beam hoisted away). This frees up the workpiece 8 which can be removed from the frame 20 at 9.

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The invention includes any combinations or sub-combinations of any of the compounds disclosed in the application, such as it is intended that the appended claims be interpreted to include all modifications, permutations, additions and sub-combinations as are within the true spirit and scope of the embodiments discussed.

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Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the technology concerned that many variations or modifications in details of design or construction may be made without departing from the present invention.

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Claims

1. A workpiece manipulating apparatus comprising:
 - 5 (a) a first support structure and a second support structure disposed spaced apart from each other;
 - (b) a frame adapted to receive the workpiece, the frame having a first end and a second end, the first end of the frame is coupled to the first support structure and the second end of the frame is coupled to the second support structure;
 - 10 (c) a first fixture and a second fixture disposed on the frame, each fixture adapted to clamp a portion of the workpiece,wherein the frame is movably coupled to the first and second support structures and adapted to rotate about a horizontal axis to turn the workpiece.
- 15 2. The apparatus according to claim 1, wherein each of the first and second fixtures is adapted to clamp opposite end portions of the workpiece.
3. The apparatus according to any one of claims 1 or 2, wherein each of the first and second fixtures comprises an upper clamping plate and a lower clamping plate, clamping
20 plates movably coupled to each other for clamping the workpiece.
4. The apparatus according to claim 3, wherein each of the clamping plates further comprises at least one clamping attachment.
- 25 5. The apparatus according to any one of the preceding claims, wherein the frame further a plurality of clamping attachments distributed along the perimeter of the frame for clamping the workpiece.
- 30 6. The apparatus according to any one of claims 4 or 5, wherein the clamping attachment is a screw clamp.
7. The apparatus according to claim 6, wherein each of the upper clamping plate and lower clamping plate comprises two equally spaced apart screw clamps.
- 35 8. The apparatus according to any one of claims 3 to 7, wherein the upper and lower clamping plates are removably attached to the frame.

9. The apparatus according to any one of the preceding claims, wherein each of the first and second support structures further comprising a driving mechanism engaged to the frame to rotate the frame.

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10. The apparatus according to any one of the preceding claims, wherein a distance between the first support structure and the second support structure being variable.

10 11. The apparatus according to any one of the preceding claims, wherein at least one of the support frames includes a platform to allow operator access.

12. A workpiece manipulating apparatus substantially as hereinbefore described with reference to any one of the examples or to any one of the accompanying drawings.