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(54) **WOK-PIECE POSITIONER**

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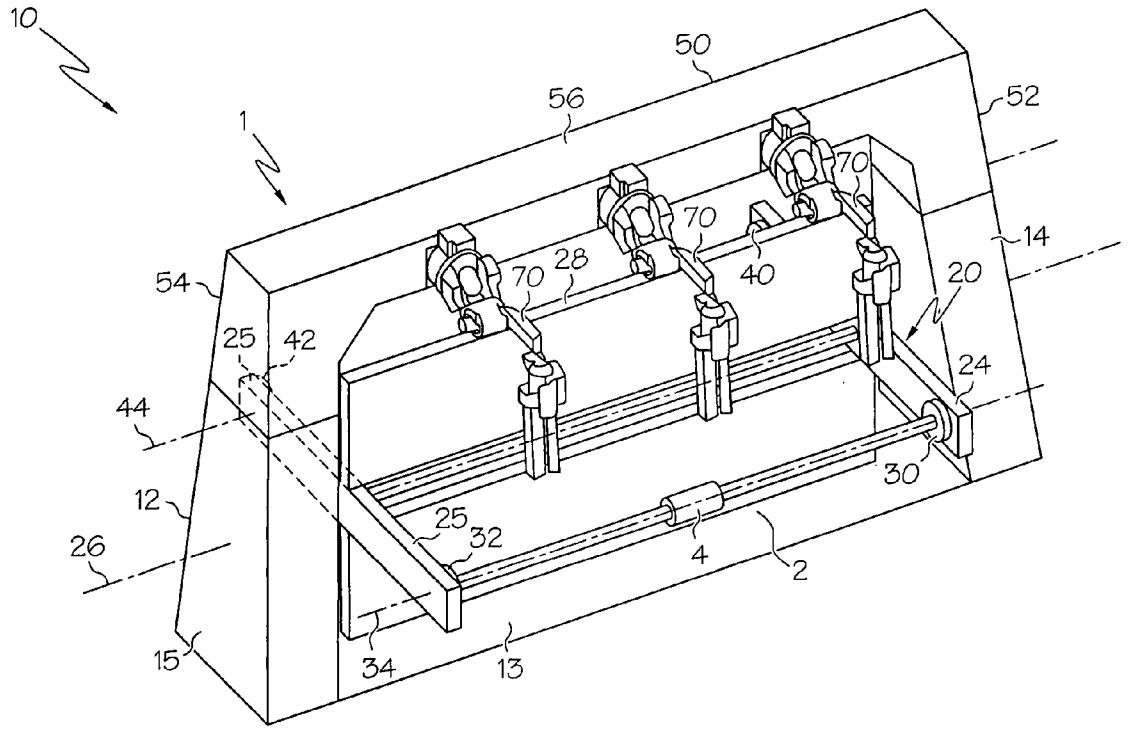
(57) **ABSTRACT**

Work-piece positioners include a positioner chassis, a rotary framework coupled to the chassis, and a mezzanine disposed above the chassis, wherein the mezzanine is configured to mount one or more robots above the positioner. The rotary framework may be configured such that it may rotate a work-piece between a work-piece load/unload zone and a work zone about a framework axis. More particularly, the mezzanine may be secured to the chassis such that when one or more robots are mounted to the mezzanine, the one or more robots may be positioned above the work zone of the positioner.



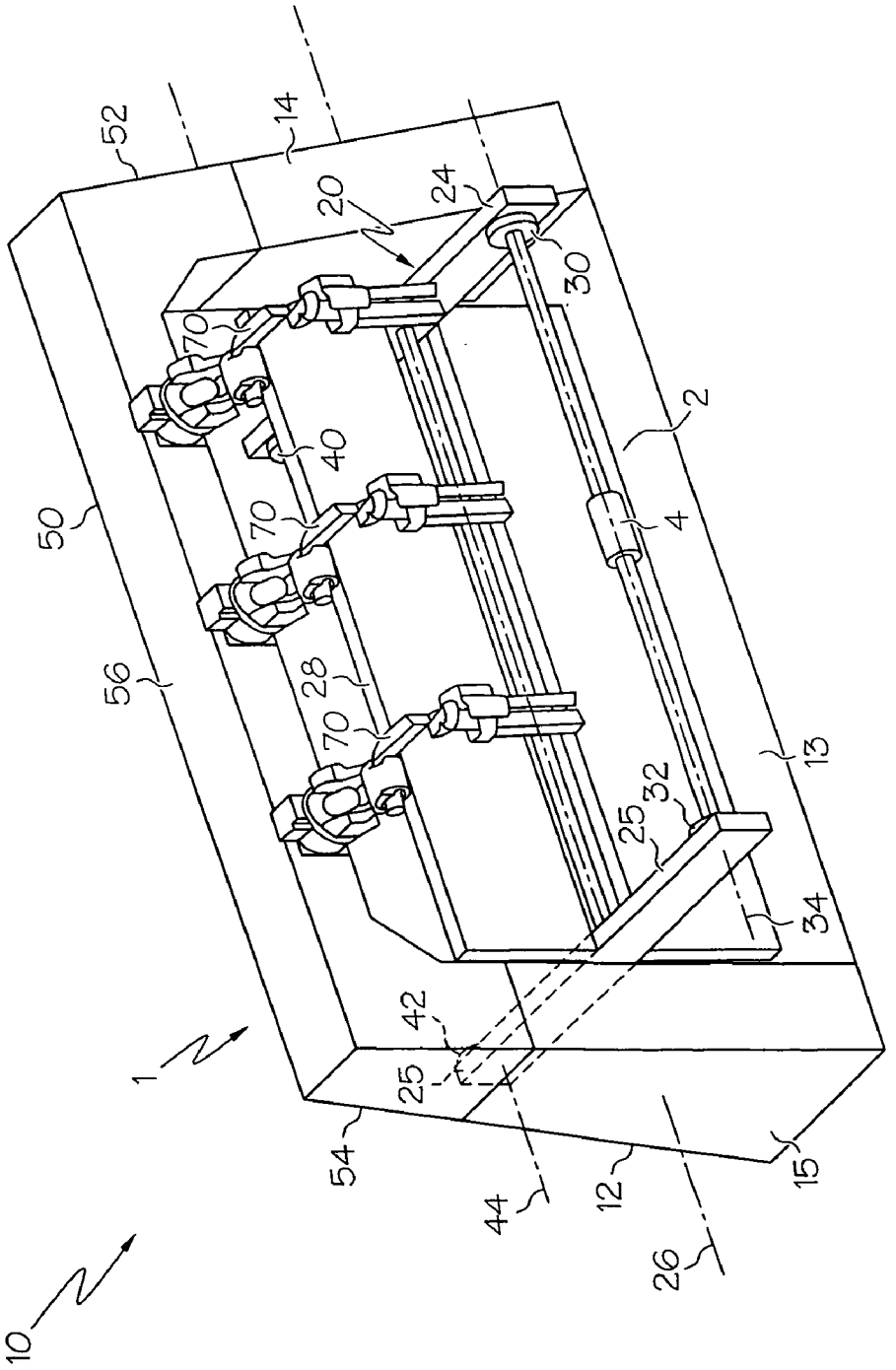

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FIG. 1

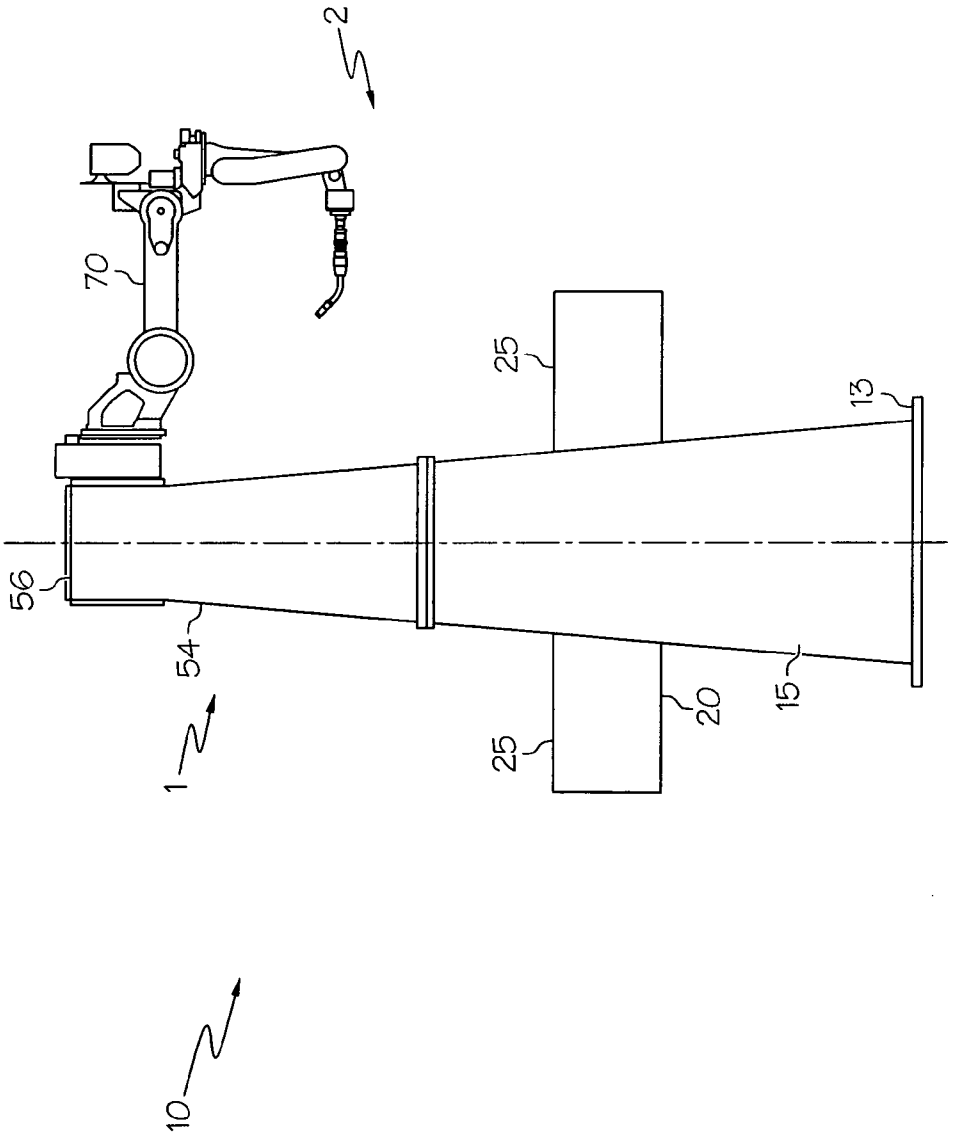

FIG. 2

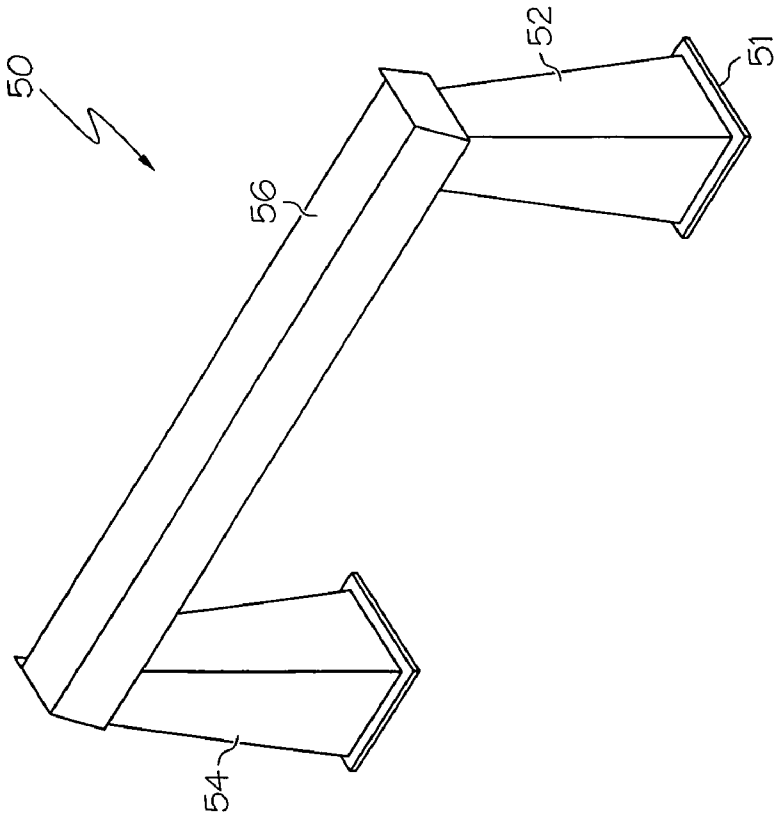

FIG. 3

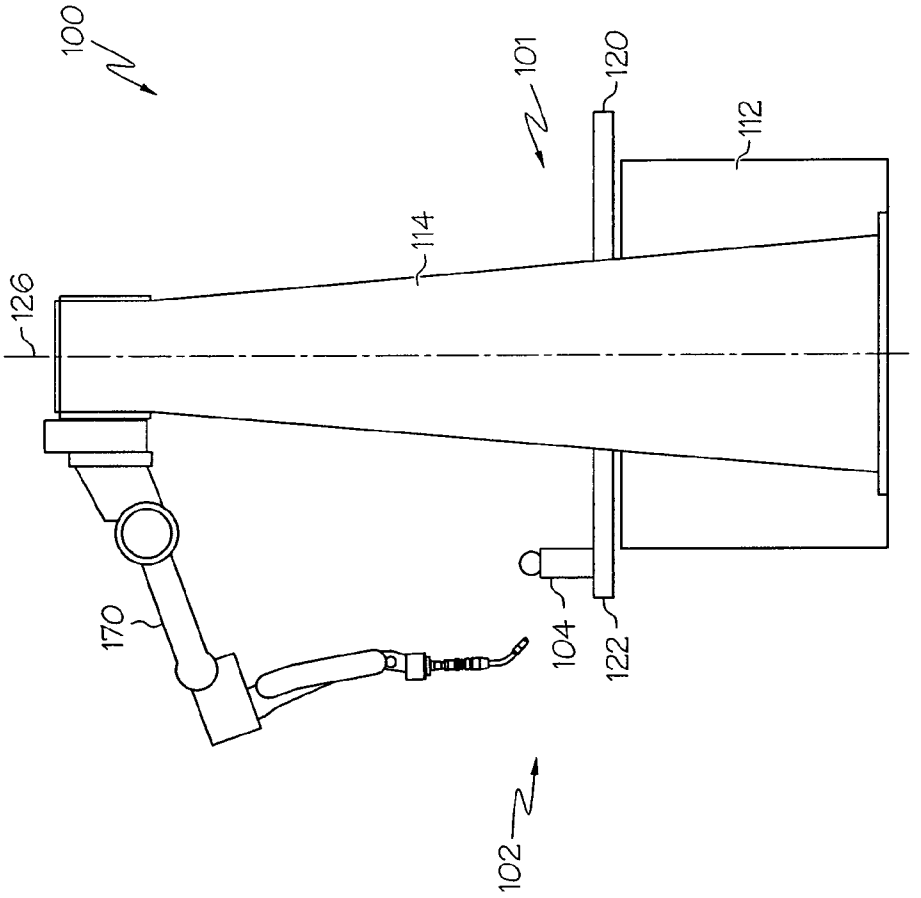

FIG. 4

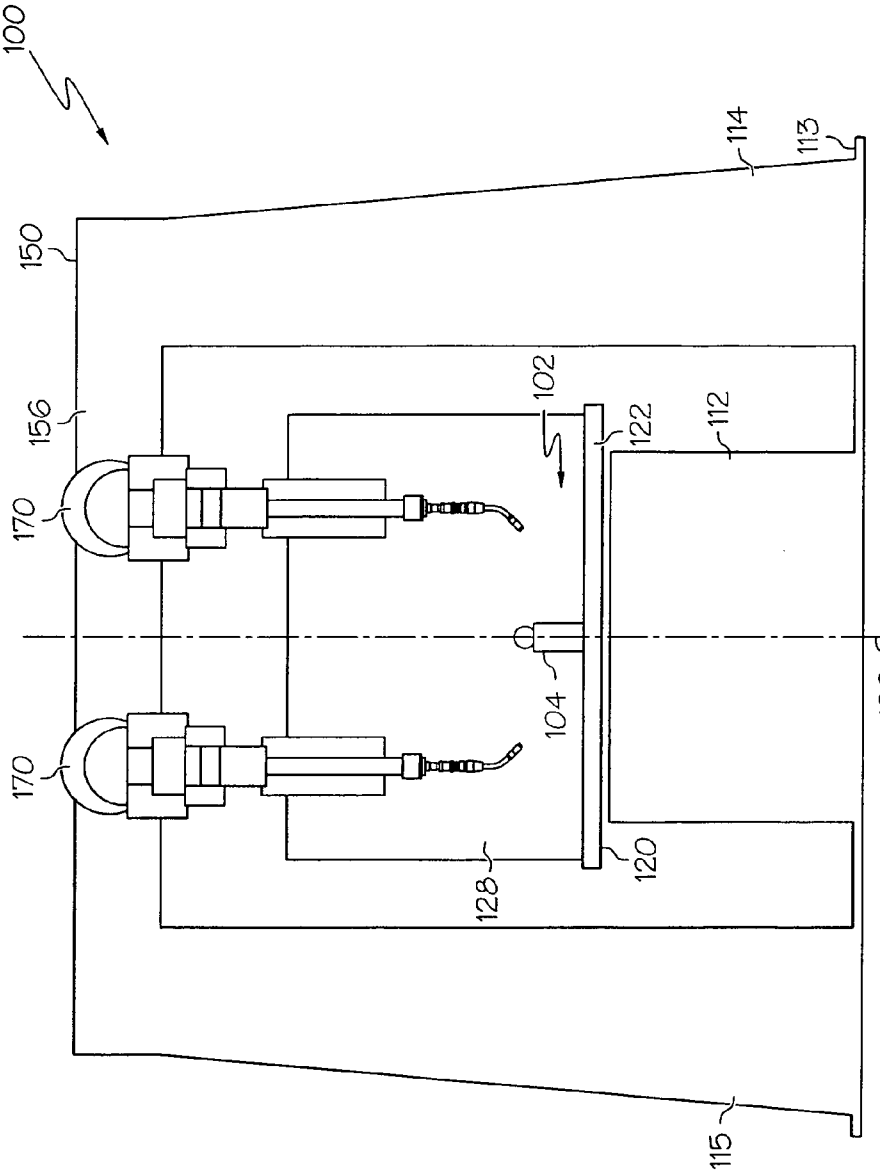

FIG. 5

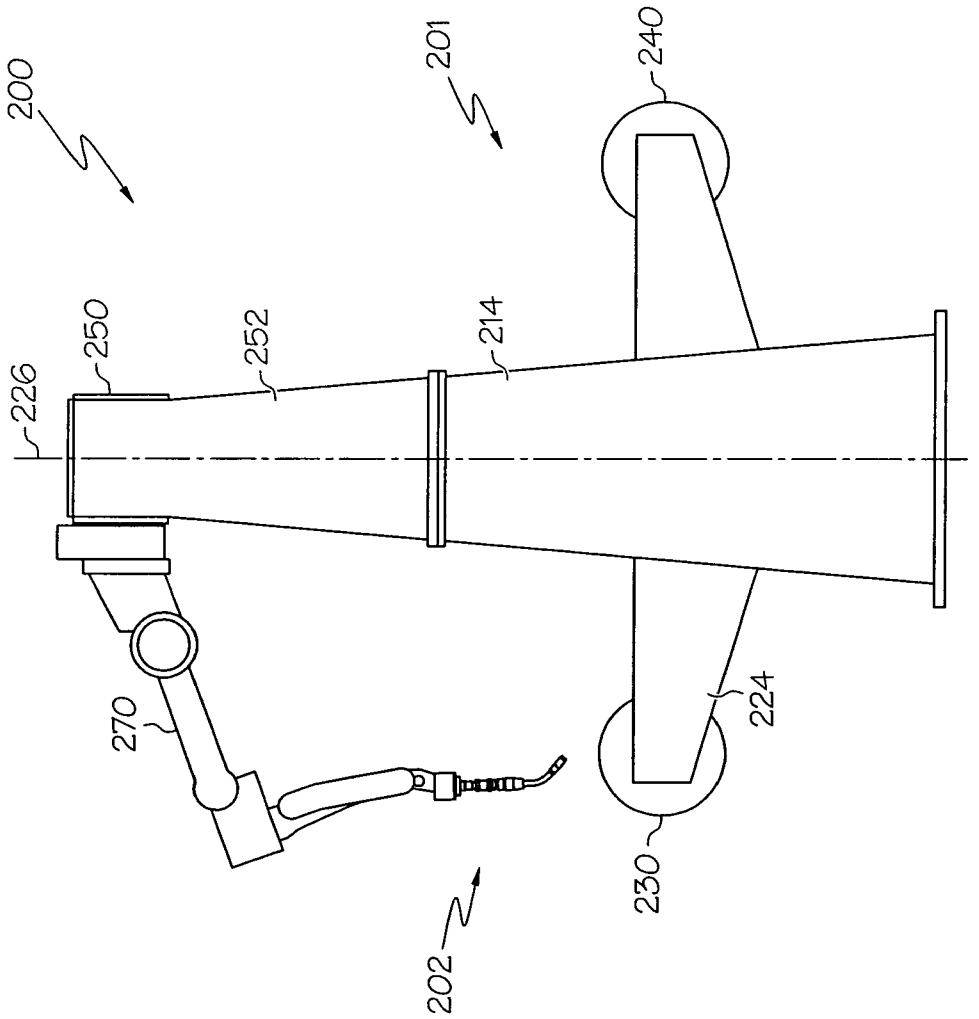

FIG. 6

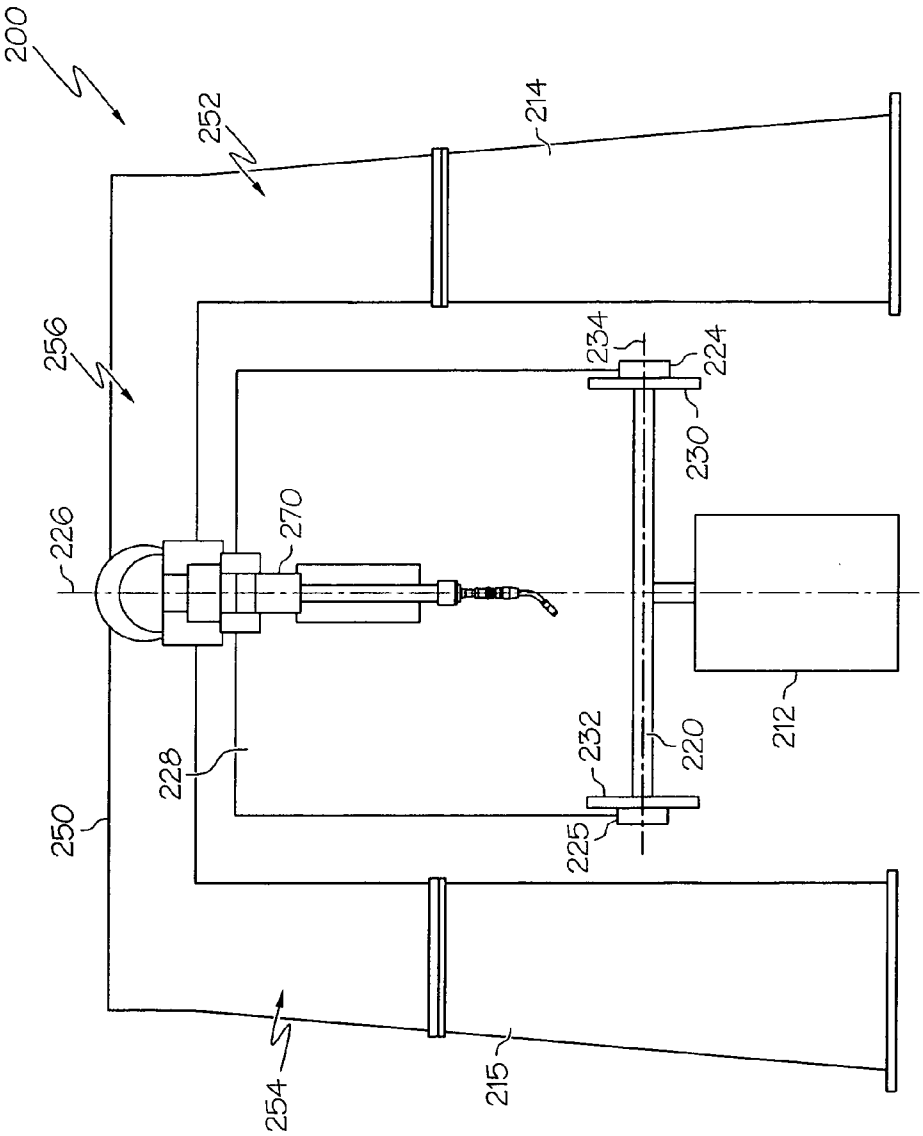
200
252
214
256
234
224
230
226
270
212
228
232
220
250
225
254
215

FIG. 7

WOK-PIECE POSITIONER

BACKGROUND OF THE INVENTION

[0001] The present invention relates to work-piece positioners. More particularly, the present invention relates to a work-piece positioner that comprises a positioner chassis and an overhead mezzanine configured such that a robot or multiple robots may be mounted to it above the positioner and/or a work zone.

[0002] Industries often employ work-piece positioners to hold, manipulate, move, or orient a work-piece while one or more robots perform a variety of applications on the work-piece. Some of the positioners may include an unload/load zone and a work zone, wherein the positioner moves work-pieces back and forth between the unload/load zone and the work zone. Generally, the robot has been placed on the floor adjacent to these types of work-piece positioners such that the robot may work on the work-piece held by the positioner. This configuration consumes a significant amount of valuable floor space because both the positioner and the robot are consuming the floor space. This issue is magnified if the application requires multiple robots to perform tasks on the work-piece because each robot will consume additional floor space, adding to the overall footprint of the robot work cell (e.g., work-piece positioner and robot(s)).

SUMMARY OF THE INVENTION

[0003] Accordingly, the present invention is intended to address and obviate problems and shortcomings and otherwise improve previous work-piece positioners.

[0004] An exemplary embodiment of the work-piece positioner of the present invention includes a positioner chassis, a rotary framework coupled to the chassis, and a mezzanine disposed above the chassis, wherein the mezzanine includes a substantially horizontal member and is configured to mount at least one robot above the positioner. The rotary framework may be configured such that it may rotate a work-piece between a work-piece load/unload zone and a work zone about a framework axis.

[0005] In another exemplary embodiment of the work-piece positioner of the present invention, the positioner comprises a positioner chassis, a framework rotatably coupled to the chassis, and a mezzanine disposed above the chassis and configured to mount at least one robot above the positioner. The rotary framework of this embodiment is configured to move a work-piece from a work-piece load/unload zone to a work zone and is rotable about a substantially horizontal axis.

[0006] In still a further exemplary embodiment of the present invention, a work-piece positioner comprises a work-piece chassis, a movable framework movably coupled to the chassis, a mezzanine disposed above the chassis and configured to mount at least one robot above the positioner, and at least one robot mounted to the mezzanine. In addition, the rotary framework is configured to move a work-piece from a work-piece load/unload zone to the work zone. Such a positioner defines a footprint having an area of less than 30 m^2 and the at least one robot is within this footprint.

[0007] A further understanding of the nature and advantages of the present invention may be realized by reference to the remaining portions of the specification and the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] While the specification concludes with claims particularly pointing out and distinctly claiming the invention, embodiments of the invention will be better understood from the following description taken in conjunction with the accompanying drawings in which:

[0009] **FIG. 1** is an isometric view of an exemplary embodiment of a work-piece positioner according to the present invention;

[0010] **FIG. 2** is a side elevational view of the work-piece positioner illustrated in **FIG. 1**;

[0011] **FIG. 3** is an isometric view of the mezzanine of the work-piece positioner illustrated in **FIG. 1**;

[0012] **FIG. 4** is a side elevational view of another exemplary embodiment of a work-piece positioner according to the present invention;

[0013] **FIG. 5** is a front elevational view of the work-piece positioner illustrated in **FIG. 4**;

[0014] **FIG. 6** is a side elevational view of another exemplary embodiment of a work-piece positioner according to the present invention; and

[0015] **FIG. 7** is a front elevational view of the work-piece positioner illustrated in **FIG. 6**.

[0016] The embodiments set forth in the drawings are illustrative in nature and not intended to be limiting of the invention which is defined by the claims. Moreover, individual features illustrated in the drawings will be more fully apparent and understood with reference to the following detailed description.

DETAILED DESCRIPTION OF THE INVENTION

[0017] Referring to **FIGS. 1-3**, an exemplary embodiment of a work-piece positioner **10** of the present invention is shown as including a positioner chassis **12**, a rotary framework **20**, a first set of work-piece supports **30** and **32**, a second set of work-piece supports **40** and **42**, and a mezzanine **50**. Positioner **10** may also include a load/unload zone **1** and a work zone **2** disposed on an opposite side of positioner **10** from load/unload zone **1**, wherein rotary framework **20** may move a work-piece **4** (e.g., automotive components) back and forth between load/unload zone **1** and work zone **2**.

[0018] As shown in **FIG. 3**, mezzanine **50** includes a first mezzanine support **52** and a second mezzanine support **54**, each of which are substantially vertical in orientation and a substantially horizontal member **56**. First and second supports **52** and **54** may optionally include a flange end **51** to connect to positioner chassis **12**. First and second supports **52** and **54** may be secured or affixed to opposite ends of substantially horizontal member **56** using a variety of conventional or yet-to-be discovered methods without departing from the scope of the present invention. For example, first and second mezzanine supports **52** and **54** and horizontal member **56** may be welded together, bolt connected, or formed as an integral unit to form mezzanine **50**. As shown in **FIGS. 1-2**, mezzanine **50** may be secured to positioner chassis **12** (described later herein) by welding the flange ends **51** to flanges on the chassis. However, it is understood

that the positioner chassis and mezzanine may be connected together using a variety of known or yet-to-be discovered securing devices or methods (e.g., weld or bolt connections) without departing from the scope of the present invention. Alternatively, rather than securing mezzanine **50** to positioner chassis **12**, first and second mezzanine supports **52** and **54** may be disposed along the floor adjacent positioner chassis (as shown in **FIG. 7** and described later herein).

[**0019**] Mezzanine **50** of the present invention may be configured to support one robot or multiple robots above positioner chassis **12**, rotary framework **20**, work-piece supports **30**, **32**, **40**, and **42**, load/unload zone **1**, and/or work zone **2**. For example, as shown in **FIGS. 1-2**, three robots **70** may be mounted to mezzanine **50** above work zone **2**, which enables robots **70** to perform a variety of applications on work-piece **4** while being held by either first set of work-piece supports **30** and **32** (as shown) or second set of work-piece supports **40** and **42** within work zone **2**. Such applications that may be performed by robots **70** on work-piece **4** may include, but are not limited to, welding, cutting, assembly, etc. The mounting of robots **70** to mezzanine **50** above positioner **10** allows the positioner **10** and robots **70** to encompass a single footprint that is smaller than the combined footprint of a conventional positioner and robot work cell (i.e., wherein both the positioner and the robots are mounted on the floor). In one exemplary embodiment, positioner **10** and one or more robots **70** mounted to positioner **10** may define a footprint of less than 30 m^2. In another exemplary embodiment, positioner **10** and one or more robots mounted to positioner **10** may define a footprint of less than or equal to 25 m^2. In yet another exemplary embodiment, positioner **10** and two robots mounted to positioner **10** may define a footprint of less than or equal to 10 m^2. The footprint of the present invention (i.e., work-piece positioner and mounted robot) represents a reduction in required floor space from about 20% to about 45% compared to a conventional work-piece positioner and robot work cell. Such a positioner and robot configuration is particularly advantageous because it frees up industrial floor space to be used for additional applications, which is valuable.

[**0020**] Since mezzanine **50** is configured to mount robots thereon, the particular materials and dimensions of mezzanine **50** are chosen to provide the necessary rigidity and strength to support the desired number of robots to be mounted above positioner **10**, including but not limited to formed sheet metal, plate steel, or any other conventional or yet-to-be developed materials. It is understood that mezzanine **50** may also take on other shapes and configurations such as having only a substantially vertical mezzanine support configured for robot mounting (not shown) or a cantilevered, substantially horizontal member (not shown) secured to a single mezzanine support (not shown), wherein a robot may be mounted to the horizontal member such that the robot may rotate between multiple work zones.

[**0021**] Still referring to **FIGS. 1-3**, positioner chassis **12** may include a base **13** connected to a first column **14** and to a second column **15** positioned opposite first column **14**, wherein first and second columns have a substantially vertical orientation. In this embodiment, first and second columns **14** and **15** are welded to first and second supports **52** and **54**, respectively. Positioner chassis **12** is configured to support both the mezzanine **50** and at least one robot (e.g., **70**). In this exemplary embodiment, positioner chassis **12** may be fabricated from steel such as formed sheet metal or plate steel. Such positioner chassis **12** may comprise a variety of different shapes, sizes, materials, and components without departing from the scope of the present invention. For example, positioner chassis **12** may be fabricated such that first column **14** and first support **52** are not two separate components welded together but a single component forming a vertical support (e.g., a single piece of plate steel). Similarly, second column **15** and second support **54** may be a single component forming a vertical support (e.g., a single piece of sheet steel) rather than two separate components welded together. Horizontal member **56** may be welded between both of these columns.

[**0022**] With regard to rotary framework **20** of the exemplary embodiment in **FIGS. 1-2**, it includes opposite rotary framework arms **24** and **25** and may be coupled to first and second vertical columns **14** and **15** so as to be rotatable about a framework axis **26**. Framework axis **26** is in a substantially horizontal orientation. Rotary framework **20** may rotate 180 degrees around framework axis **26** between load/unload zone **1** and work zone **2**. However, it is understood that rotary framework **20** may rotate any number of degrees about framework axis **26**.

[**0023**] In this exemplary embodiment, rotary framework arms **24** and **25** may include a first set of work-piece supports **30** and **32** located at one end of framework arms **24** and **25**, respectively, so as to define a first work-piece axis **34** extending between first set of work-piece supports **30** and **32**. Rotary framework **20** may also include a second set of work-piece supports **40** and **42** that are located at an opposite end of framework arms **24** and **25**, respectively, from first set of work-piece supports **30** and **32**. Second set of work-piece supports **40** and **42** define a second work-piece axis **44** extending between the second set of work-piece supports **40** and **42**. First work-piece axis **34** and second work-piece axis **44** may lie in a common work-piece plane. Such rotary framework may hold one or more work-pieces (e.g., work-piece **4**) with first and second sets of work-piece supports to rotate and/or move the work-pieces between load/unload zone **1** and work zone **2**. **FIGS. 1-2** also show that rotary framework **20** may include a divider **28** to separate load/unload zone **1** from work zone **2** in order to provide protection to an operator positioned near load/unload zone **2** from the work being performed in work zone **1**. Divider **28** may be oriented substantially perpendicular to rotary framework arms **24** and **25**.

[**0024**] As discussed herein, positioner chassis **12** and rotary framework **20** may be made of any known or yet to be discovered material having sufficient strength and rigidity to withstand the stresses and forces of the moving rotary framework **20** and the load associated with one or more work-pieces held by rotary framework **20**. And, as described above, the material for and the size and dimensions of positioner chassis **12** are configured such that chassis **12** may support the weight of the mezzanine **50** and one or more robots mounted to mezzanine **50**. Such a positioner is commercially available from Motoman, Inc., West Carrollton, Ohio, within the 6000 Series of positioners.

[**0025**] In addition, positioner **10** may include a drive motor assembly, and any associated gears, clutches, etc., which are all beyond the scope of the present invention and

may be gleaned from conventional teachings, e.g., U.S. Pat. Nos. 4,666,363, 5,074,741, and 5,873,569, the disclosures of which are incorporated herein by reference. For example, work-piece positioner **10** may comprise a single drive motor (not shown) and a clutch assembly (not shown) arranged to impart selectively rotary motion to the rotary framework **20** about the framework axis **26** and rotary motion to work-piece **4** supported by first set of work-piece supports **30** and **32**.

[**0026**] Positioner **10** may also include one or more robots mounted to mezzanine **50** above positioner **10** and/or work zone **2**. Such robots **70** may include any variety of conventional or yet-to-be developed robots, lasers, or other robotic equipment necessary to perform the desired applications to work-piece **4** within work zone **2** without departing from the scope of the present invention. In one exemplary embodiment, industrial robots commercially available from Motoman, Inc. of West Carrollton, Ohio may be mounted to positioner **10**.

[**0027**] In operation, an operator may load work-piece **4** between first set of work-piece supports **30** and **32** while first set of work-piece supports are positioned in the load/unload zone **1**. Drive motor and clutch assembly may rotate framework arms **24** and **25** such that first set of work-piece supports **30** and **32** and work-piece **4** may be rotated 180 degrees from load/unload zone **1** to work zone **1**. All the axes of rotation of the positioner may rotate simultaneously during the sweep from zone **1** to zone **2**, resulting in the work-piece being in the desired position at the end of the sweep motion. Once in work zone **2**, robots **70** mounted upon mezzanine **50** may perform applications on work-piece **4** from above this work zone as shown in **FIG. 1**. While robots **70** perform this work, the operator may unload and/or load a second work-piece (not shown) between second set of work-piece supports **40** and **42**. As described above, divider **28** may provide protection to load/unload zone **1** (i.e., operator) from potential hazards of the work being performed within work zone **2**. Once robots **70** have completed work on work-piece **4**, rotary framework arms **24** and **25** may be rotated 180 degrees back to load/unload **1** such that work-piece **4** may be unloaded and a new work-piece loaded onto positioner **10** between first set of work-piece supports **30** and **32**.

[**0028**] The work-piece positioner of the present invention may combine the mezzanine with a variety of different types of positioner chasses, rotary frameworks, and work-piece supports without departing from the scope of the invention. For example, **FIGS. 4-5** show positioner **100** as including a mezzanine **150**, a positioner chassis **112**, and a rotary framework **120** rotatably coupled to chassis **112**, wherein rotary framework **120** includes a table **122** that rotates about a vertical axis **126**. In this exemplary embodiment, rotary framework **120** rotates a work-piece **104** that has been positioned on rotary framework **120** from a load/unload zone **101** to a work zone **102**. Such a rotary framework **120** may rotate work-piece **104** (e.g., 180 degrees) between load/unload zone **101** and work zone **102**. As described above with reference to the first exemplary embodiment, positioner **100** may be capable of simultaneous, multiple axis movement such that the work-piece may be in the desired position at the end of the sweep motion from zone **101** to zone **102**. As shown, rotary framework **120** may also include a divider **128** separating rotary framework **120** into two areas to provide protection to an operator and to separate work-pieces held by rotary framework **120**. In the exemplary embodiment shown in **FIGS. 4-5**, rotary framework **120** is a turntable-style positioner, wherein a substantially circular table rotates about a substantially vertical axis **126** between two positions (i.e., load/unload zone **101** and work zone **102**). Although, as described above, mezzanine may be configured to support any number of robots, this particular exemplary embodiment shows two robots **170** mounted to mezzanine **150**, specifically to a horizontal member **156** of mezzanine **150**, above work zone **102**. In this exemplary embodiment, positioner chassis **112** includes a first vertical support **114** and a second vertical support **115** that are then welded to horizontal member **156** of mezzanine **150** and is configured to support both the mezzanine and one or more robots (e.g., **170**). This exemplary embodiment of the positioner **10** and robots **170** of the present invention may also comprise the same footprint as described above herein. The positioner of this exemplary embodiment is commercially available from Motoman, Inc., West Carrollton, Ohio, within the 1200 Series of positioners.

[**0029**] In still another exemplary embodiment of the present invention shown in **FIGS. 6-7**, positioner **200** includes mezzanine **250**, positioner chassis **212**, a rotary framework **220**, a first set of work-pieces supports **230** and **232**, and a second set of work-piece supports **240** and **242**, wherein rotary framework **220** rotates about a vertical rotary framework axis **226**. Such rotary framework **220** may also include opposite rotary framework arms **224** and **225**, wherein first set of work-piece supports **230** and **232** are located at one end of opposite framework arms **224** and **225**, respectively, so as to define a first work-piece axis **234** extending between first set of work-piece supports. Rotary framework **220** may also include a second set of work-piece supports **240** and **242** that are located at an opposite end of opposite framework arms **224** and **225**, respectively, from first set of work-piece supports **230** and **232**. Second set of work-piece supports **240** and **242** may also define a second work-piece axis (not shown) extending between the second set of work-piece supports. The first and second work-piece axes may lie in a common work-piece plane. Such rotary framework may hold one or more work-pieces with first and second sets of work-piece supports to rotate and/or move work-pieces between load/unload zone **201** and work zone **202**.

[**0030**] Still referring to **FIGS. 6-7**, mezzanine **250** may include first and second mezzanine supports **252** and **254** that are secured to a substantially horizontal member **256** and is configured to hold one or more robots **270** (e.g., one in this exemplary embodiment). First and second mezzanine supports **252** and **254** may be attached (e.g., welded) to a base **213** of positioner **200** and positioned along the floor adjacent positioner chassis **212**. Such a positioner may rotate a work-piece (not shown) held in first set of work-piece supports **230** and **232** about framework axis **226** (e.g., 180 degrees) from a load/unload zone **201** to a work zone **202**, and then allow a second work-piece (not shown) to be loaded onto second set of work-piece supports **240** an **242** in load/unload zone **201**. Additionally, this configuration of positioner **200** and robot **270** may define a combined footprint as detailed above herein.

[**0031**] As will be understood by those familiar with the art, the present invention may be embodied in other specific

forms without departing from the spirit or essential characteristics thereof. For example, the invention is not limited to the type and dimensions of the transport vehicle specifically disclosed. Accordingly, the disclosures and descriptions herein are intended to be illustrative, but not limiting.

What is claimed is:

1. A work-piece positioner comprising:

a positioner chassis;

a rotary framework coupled to said chassis, said rotary framework configured to rotate a work-piece between a work-piece load/unload zone and a work zone about a framework axis; and

a mezzanine disposed above said chassis, said mezzanine including a substantially horizontal member and configured to mount at least one robot above said positioner.

2. The work-piece positioner of claim 1, wherein said mezzanine is affixed to said positioner chassis, and wherein said positioner chassis is configured to support both said mezzanine and said at least one robot above said positioner.

3. The work-piece positioner of claim 1, wherein said mezzanine is comprised of a first mezzanine support and a second mezzanine support secured to opposite ends of said horizontal member.

4. The work-piece positioner of claim 4, wherein said work-piece support is comprised of:

opposite rotary framework arms rotatable about said framework axis;

a first set of work-piece supports positioned on one end of said framework arms so as to define a first work-piece axis extending between said first set of work-piece supports; and

a second set of work-piece supports positioned on an end of said framework arms opposite said first set of work-piece supports so as to define a second work-piece axis extending between said second set of work-piece supports.

5. The work-piece positioner of claim 4, wherein said rotary framework is comprised of a work-piece support rotatable about said framework axis and said framework axis is substantially vertical.

6. The work-piece positioner of claim 4, wherein framework axis is substantially horizontal.

7. The work-piece positioner of claim 1, wherein a divider is disposed along said rotary framework so as to separate it into two areas.

8. The work-piece positioner of claim 1, further comprising one or more robots mounted to said mezzanine such that said one or more robots are disposed above said work zone of said positioner.

9. An work-piece positioner comprising:

a positioner chassis;

a framework rotatably coupled to said chassis and configured to rotate a work-piece between a work-piece load/unload zone and a work zone about a substantially horizontal axis; and

a mezzanine disposed above said chassis, wherein said mezzanine is configured to mount at least one robot above said positioner.

10. The work-piece positioner of claim 9, wherein said mezzanine is affixed to said positioner chassis, and wherein said positioner chassis is configured to support both said mezzanine and said at least one robot above said positioner.

11. The work-piece positioner of claim 10, wherein said mezzanine is comprised of a first mezzanine support and a second mezzanine support secured to opposite ends of a substantially horizontal member.

12. The work-piece positioner of claim 19, wherein said rotary framework is comprised of:

opposite rotary framework arms;

a first set of work-piece supports positioned on one end of said framework arms so as to define a first work-piece axis extending between said first set of work-piece supports; and

a second set of work-piece supports positioned on an end of said framework arms opposite said first set of work-piece supports so as to define a second work-piece axis extending between said second set of work-piece supports.

13. The work-piece positioner of claim 9, wherein a divider is disposed along said rotary framework so as to separate it into two areas.

14. The work-piece positioner of claim 9, further comprising one or more robots mounted to said mezzanine such that said one or more robots are disposed above said work zone of said positioner.

15. A work-piece positioner comprising:

a positioner chassis;

a movable framework movably coupled to said chassis, said framework configured to move a work-piece from a work-piece load/unload zone to a robot work zone;

a mezzanine disposed above said chassis, said mezzanine configured for mounting at least one robot above said positioner;

at least one robot mounted to said mezzanine; and

wherein said positioner defines a footprint having an area of less than about 30 m^2 and said at least one robot is within said footprint.

16. The work-piece of claim 15, wherein said framework is rotatably coupled to said chassis such that said framework rotates a work-piece from said load/unload zone to said work zone about a framework axis.

17. The work-piece positioner of claim 15, wherein said mezzanine is comprised of a substantially horizontal member.

18. The work-piece of claim 17, wherein said mezzanine is comprised of a first mezzanine support and a second mezzanine support secured to opposite ends of said horizontal member.

19. The work-piece positioner of claim 15, wherein said footprint is less than or equal to about 10 m^2, and wherein said at least one robot comprises two robots.

20. The work-piece positioner of claim 15, wherein said mezzanine is affixed to said positioner chassis, and wherein said positioner chassis is configured to support both said mezzanine and said at least one robot above said positioner.

* * * * *