

FLEXIBLE TUBE CLEANING LANCE POSITIONER FRAME APPARATUS

BACKGROUND OF THE DISCLOSURE

[0001] The present disclosure is directed to high pressure fluid rotary nozzle systems. In particular, embodiments of the present disclosure are directed to an apparatus for positioning one or more flexible tube cleaning lances in registry with a heat exchanger tube sheet.

[0002] Conventional lance positioner frames are heavy rigid frame structures that can be assembled adjacent a heat exchanger once the tube sheet flange cover has been removed. Alternatively such frame assemblies can be bolted to the tube sheet directly. US Patent Nos. 4095305, 6626195, 6681839, and 7530363 disclose exemplary rectilinear frames adapted to be positioned adjacent or fastened to a heat exchanger tube sheet. Such assemblies are heavy, generally awkward to set up and utilize, and most require a substantial amount of space adjacent to or in line with the tube sheet which may limit the feasibility of using such assemblies. What is needed is an apparatus for precisely positioning one or more cleaning lances in registry with a heat exchanger tube sheet that is simple to erect, remains rigid, and takes up minimal space adjacent the tube sheet.

SUMMARY OF THE DISCLOSURE

[0003] The present disclosure directly addresses such needs. One embodiment of a frame apparatus for holding a flexible lance positioning mechanism adjacent to and spaced from a heat exchanger tube sheet in accordance with the present disclosure includes an upper guide rail, a lower guide rail, a positioner rail supported from one of the upper and lower guide rails and guided by the other of the upper and lower guide rails, and a rail clamp assembly fastened to a portion of a tube sheet. This rail clamp assembly operably holds one of the upper and lower guide rails in a fixed position with respect to the tube sheet. This rail clamp assembly has a flat plate or beam member adapted to be fastened to the tube sheet, a base plate spaced from the flat plate by one or more threaded shafts, and one or more clamp fingers rotatably fastened to the base plate. The one or more clamp fingers is operable to

rotate toward the base plate when the base plate is drawn against the flat plate or beam member by rotating the threaded shaft.

[0004] In one embodiment the member is an elongated beam having the rail clamp assembly at a distal end of the beam and a screw clamp assembly at a proximal end of the beam. In another embodiment the member is a generally trapezoidal shaped plate having a curved bottom edge and a plurality of apertures therethrough adjacent the bottom edge for receiving a plurality of bolts to fasten the member to the tube sheet. The base plate of the clamp assembly has a pair of spaced apart fingers rotatably supported therein and a pair of spaced apart threaded shafts beneath each of the fingers fastened to the base plate.

[0005] Each one of the fingers engages a ball nose spring plunger in a first position permitting a rail to be attached to the assembly and in a second position permitting the rail to be translated along the base plate or rotatably adjusted relative to the base plate. The threaded shaft is operated to draw the base plate to the beam to rotate the one or more fingers to a third position clamping the rail and preventing translation and rotation of the rail with respect to the base plate and tube sheet face.

[0006] Further features, advantages and characteristics of the embodiments of this disclosure will be apparent from reading the following detailed description when taken in conjunction with the drawing figures.

DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a perspective view of a first exemplary embodiment of a flexible lance positioner frame apparatus in accordance with the present disclosure oriented against and fastened to an exemplary heat exchanger tube sheet.

[0008] FIG. 2 is a perspective view of a second exemplary embodiment of a flexible lance positioner device in accordance with the present disclosure oriented against and fastened to a heat exchanger tube sheet.

[0009] FIG. 3 is a perspective view of a third exemplary embodiment of a flexible lance positioner device in accordance with the present disclosure fastened to a heat exchanger tube sheet shown in FIGS. 1 and 2.

[0010] FIG. 4 is a separate perspective view of one of the four clamp arm assemblies shown in FIG. 3.

[0011] FIG. 5 is an exploded view of the rail clamp assembly of the clamp arm assembly shown in FIG. 4

[0012] FIG. 6 is a side view of one of the rail clamp assemblies in accordance with the present disclosure with the rail clamp assembly in a first detent position and open to receive a frame rail therein.

[0013] FIG. 7 is a side view as in FIG. 6 with the rail clamp assembly in a second detent position such that the frame rail is retained but remains rotatably and axially adjustable relative to the base plate.

[0014] FIG. 8 is a side view as in FIG. 6 with the frame rail clamped in a final fixed position within the rail clamp assembly such that the frame rail is rotatably and axially fixed relative to the base plate.

[0015] FIG. 9 is a separate perspective view of a dual jaw clamp assembly utilized in the second exemplary embodiment of the positioner frame apparatus shown in FIG. 2.

[0016] FIG. 10 is a separate side view of a hook clamp finger utilized in the clamp assemblies shown in FIGS. 2 through 9.

DETAILED DESCRIPTION

[0017] A first exemplary frame apparatus **100** is shown in FIG. 1 bolted to a tube sheet **102**. The tube bundle is not shown in this figure for clarity, but it is understood that the tube sheet **102** essentially is the end face of a heat exchanger tube bundle, either removed from a heat exchanger or in place. The apparatus **100** has a top generally horizontal guide rail **104** that is fastened to a common leg of a rigid Y-shaped metal support member **106**. The other two legs of the support member **106** are bolted to the tube sheet flange that normally secures the heat exchanger tube side end cover (not shown). A bottom guide rail **108** is adjustably mounted and aligned parallel to the top guide rail **104** via a bolt **110** through an arcuate slot **112** in a flat bracket **114** that is fastened to the center of the Y-shaped support member **106** via another bolt **110**.

[0018] A positioner support rail **120** is oriented orthogonal to the lower guide rail **108**, i.e. substantially vertically as shown in FIG. **1**, and is driven by a remotely controlled air motor **122** horizontally along the lower guide rail **108**. A flexible lance positioner drive assembly **124** is mounted on the positioner support rail **120**. The position of the drive assembly **124** is changed along the support rail **120** via a remotely controlled air motor and gear assembly **126** in order to align the drive assembly **124** in registry with particular tubes in the tube bundle to be cleaned. The flexible lance drive **124** can then insert or withdraw one or more flexible lances (not shown) into and out of the tubes to which it is aligned.

[0019] A second exemplary frame apparatus **200** in accordance with the present disclosure is shown in FIG. **2**. The apparatus **200** has an upper generally horizontal guide rail **204**, a lower guide rail **206**, and a positioner support rail **208** that supports a flexible lance positioner drive assembly **124** as in the first embodiment shown in FIG. **1**. The upper guide rail **204** serves to provide mechanical alignment with rows of tubes present in the heat exchanger bundle. When so aligned, the drive assembly **124** can be moved up and down along the support rail **208** to precise positions in line adjacent with selected tubes within the tube sheet **202**. The lower guide rail **206** does not have to be installed parallel to the upper guide rail **204** as the lower guide rail follower carriage **209** can tolerate reasonable rotation within a plane roughly parallel to the face of the tube sheet **202**. The lower guide rail **206** and lower guide rail follower carriage **209** serve to mechanically support the drive assembly **124** in position and prevent deflection away from the tube sheet **202** generated by jet thrust, machine mass or force imparted to the system by the interaction between the drive assembly **124**, the flexible lance(s) and the heat exchanger tubes.

[0020] Each of the upper and lower guide rails **204** and **206** is fastened to the tube sheet **202** via a dual jaw clamp assembly **210** shown in more detail in FIG. **9**. Each clamp assembly **210** is designed to be fastened to the tube sheet **202** via a bolt through the center hole **212** or through one of the slots **214** and preferably another bolt through the other one of the slots **214**. The clamp assembly **210** has a generally trapezoidal flat mounting base plate **220** that has a curved base edge **222**. Parallel to the base edge **222** are the curved slots **214** which sandwich therebetween the center hole **212** above described. By mounting the base plate **220** to a tube sheet **202** via bolts, (not shown), with at least one bolt in one of the slots **214**, the

orientation of the base plate **220** may be tilted to facilitate alignment of the clamp assembly **210** with respect to a row of tubes penetrating the tube sheet **202**. Alternatively the base plate **220** may be fastened to the tube sheet **202** via a single bolt through the center hole **212**. In this latter case, the base plate cannot be slid along the slot, but can be rotated about the bolt axis to facilitate alignment. Preferably, however, at least one bolt in one of the slots **214** should be utilized along with another bolt in either the hole **212** or the other slot **214**.

[0021] The drive mechanism/air motor **122** is remotely operated to move the support rail **208** back and forth along the upper guide rail **204**. A follower roller assembly **209** fastens the lower end of the support rail **208** to the lower guide rail **206**. This follower roller assembly **209** restricts movement of the support rail **208** away from the tube sheet **202** while permitting free movement of the guide rail **208** back and forth along the lower guide rail **206**. In addition, this follower roller assembly **209** permits movement of the support rail **208** toward and away from the upper guide rail **204** while maintaining the support rail **208** in a plane parallel to the tube sheet **202**. It is to be understood that the above configuration may be reversed, with the drive mechanism **122** mounted on the lower guide rail **206** and the follower roller assembly **209** mounted on the upper guide rail **204**.

[0022] The dual clamp assembly **210** operation is included with the description of the following frame apparatus **300**. FIG. 3 is a perspective view of a third exemplary flexible lance positioner frame apparatus **300** in accordance with the present disclosure. This apparatus **300** is particularly designed to permit complete installation of the apparatus **300** on a tube sheet **302** of a heat exchanger without the need for any hand tools and also permits installation to a tube sheet that does not have bolt holes on its peripheral flange.

[0023] Apparatus **300** includes an upper guide rail **304**, a lower guide rail **306**, and a positioner support rail **308**. The positioner support rail **308** is moveably fastened to both the upper guide rail **304** and to the lower guide rail **306**. A drive mechanism **310** preferably including an air motor **122** is fastened to the upper end of the positioner support rail **308**. This drive mechanism **310** is remotely operated to move the support rail **308** back and forth along the upper guide rail **304**. A follower roller assembly **312** fastens the lower end of the support rail **308** to the lower guide rail

306. This follower roller assembly **312** restricts movement of the support rail **308** away from the tube sheet **302** while permitting free movement of the guide rail **308** back and forth along the lower guide rail **306**. In addition, this follower roller assembly **312** permits movement of the support rail **308** toward and away from the upper guide rail **304** while maintaining the support rail **308** in a plane parallel to the tube sheet **302**. It is to be understood that the above configuration may be reversed, with the drive mechanism **310** mounted on the lower guide rail **306** and the follower roller assembly **312** mounted on the upper guide rail **304**.

[0024] Each of the upper guide rails **104**, **108**, **204**, and **304**, the lower guide rails **206**, and **306**, and the positioner support rail **120**, **208** and **308** shown in FIGS. **1-3** is preferably an aluminum extrusion **316** having, in cross section, a generally rectangular tube shape having four side walls **318**. An end view or cross section of one embodiment of this extrusion **316** is visible in FIGS. **6** through **8**. Each of the four corners of the rail extrusion **316** extends outward to form an axially extending external rib **320**. Preferably at least one of the side walls **318** of each guide rail has a series of spaced closed slots **322** forming essentially a ladder surface that designed to operably engage with a drive sprocket (not shown) driven by one of the air motors **122** or **126** shown in FIGS. **1**, **2** and **3**.

[0025] The external ribs **320** on each of the rails **316** permit each rail **316** to be adjustably and securely held in a secure grip by the clamp mechanisms, either dual rail clamp assembly **210** or single rail clamp assembly **350**, the operation of which is shown in FIGS. **6**, **7** and **8**.

[0026] As is best shown in FIG. **3**, each of the rails **304** and **306** is fastened securely to the tube sheet **302** by a pair of rail clamp arm assemblies **325** in accordance with the present disclosure. One of the rail clamp arm assemblies **325** is separately shown in a perspective view in FIG. **4**. The rail clamp arm assembly **325** has a rail clamp **350** at a distal end of an elongated beam **326** and a screw clamp **328** at the proximal end of the beam **326**. The beam **326** is preferably an elongated rectangular metal plate, and may be made of steel or high strength aluminum.

[0027] The screw clamp **328** includes a pair of cross bolts **330** and **332** that pass through smooth axially spaced bores spaced from the proximal end of the beam **326**. The cross bolt **330** is fastened to the beam **326** via a nut **334** tightened against and

between the head of the bolt **330** and the beam **326**. Another nut **336** on the cross bolt **330** sets a minimum jaw width position on the cross bolt **330**.

[0028] The screw clamp **328** also includes a jaw member **338** that has two bores therethrough spaced to match the spacing between cross bolts **330** and **332** adjacent one end of the jaw member **338**. The jaw member **338** is also an elongated metal rectangular plate of steel or high strength aluminum. A caged nut **340** is fixed to an outer side of the jaw member **338** over one of the bores so that it is threaded onto and captures one end of the cross bolt **332**. The other end of the cross bolt **332** passing through the beam **326** is fixed to a cross bar handle **342**. The screw clamp **328** operates like a bench vice to capture and hold a portion of the heat exchanger flange **302** between the jaw member **338** and proximal end of the beam **326**.

[0029] The screw clamp **328** is positioned with the beam **326** and jaw member **338** over the edge or rim of the tube sheet flange and bar handle **342** is manually tightened to draw the beam **326** and jaw member **338** together against the tube sheet **302**. Different thicknesses of tube sheet **302** flanges may be accommodated by changing the position of nut **336** on the bolt **330** or for considerable increases in flange with, using a longer bolt **330** and cross bolt **332**. The rail clamp arm assembly **325** may be positioned anywhere on the rim/flange of the tube sheet **302** so long as the screw clamp **328** can gain a secure purchase on the tube sheet **302**. The jaw member **338** and/or the proximal end of the beam **326** may optionally be fit with locating pins (not shown) to fit within one of the bolt holes around the rim/flange of the tube sheet **302** if desired.

[0030] At the opposite end of the beam **326** in the rail clamp arm assembly **325** is a single rail clamp assembly **350**. This rail clamp assembly **350** is separately shown in an exploded perspective view in FIG. 5. The distal end **352** of the beam **326** has a threaded cross bore **354** therethrough. The distal end **352** also has a pair of arcuate slots **356** around and symmetrically spaced from the threaded cross bore **354** along the beam **326**.

[0031] The rail clamp assembly **350** essentially includes the distal end **352** of the beam **326**, a threaded handle shaft **358**, a base plate **360**, a hooked clamp finger **362** and a static clamp jaw **364** across a bottom end of the base plate **360**. The base plate **360** is a generally rectangular flat metal plate having a bottom end to

which is fastened the static clamp jaw **364**. Alternatively the static metal clamp jaw **364** may be integrally formed with the base plate **360**. A top end of the base plate **360** has a cutout recess or rectangular notch **366** sized to receive therein the hooked clamp finger **362**. This finger **362** is mounted to rotate about an axle screw **368** that extends across the recess **366** in the top end of the base plate **360**.

[0032] The threaded handle shaft **358** preferably has a cylindrical portion **370**, a threaded portion **372**, and a smaller diameter distal threaded end **374**. The cylindrical portion **370** has a cross bore **376** through which a handle bar **378** extends. The handle shaft **358** also preferably has a flat washer **380** around a shoulder of the threaded portion **372**. The threaded portion **372** engages the threaded bore **354**. The smaller diameter threaded distal end **374** passes through a bore **382** through the base plate **360** such that the base plate **360** is fastened securely to the distal end **374** of the handle shaft **358** when the shaft **358** is assembled through the threaded bore **354** through the beam **326**.

[0033] A guide pin or screw **361** is preferably fastened to and extends outward from a rear surface of the base plate **360** so as to ride within the slot **356** to permit the base plate **360** to be able to rotate through a limited arc about the bore **354** through the beam **326**. This guide pin **361** permits the rail clamp assembly **350** to have a limited range of adjustment about the distal end of the beam **326**.

[0034] A separate side view of the hook clamp finger **362** is shown in FIG. **10**. This finger **362** is metal plate that resembles a claw hammer with a parallel sided stem portion **386** that merges with an upper portion **388** close to a cross bore **390**. The finger **362** has opposite flat side surfaces **396** and a rear edge **398**. The upper portion **388** has a downwardly extending claw or hook portion **392** and an opposite hammerhead portion **394** that projects beyond the rear edge **398** of the parallel sided stem portion **386**.

[0035] Each side surface **396** has a depression **400** above and preferably slightly offset from vertical alignment with the cross bore **390**. Another depression **402** is spaced on an arc from depression **400** from the cross bore **390** and toward the hook portion **392**. Each of the depressions **400** and **402** is located so as to engage a ball nosed spring plunger **404** that projects from a bore through one or both sides of the base plate **360** into the recess **366**. When the finger **362** is rotated on the axle **368**

such that the plunger **404** engages the depression **402**, the hammerhead portion **394** extends further beyond the rear of the base plate **360** and the hook or claw **392** is raised to an install or release position as shown in FIG. **6** below. When the ball nosed spring plunger **404** engages the depression **400**, the finger **362** rotates on the axle **368** such that the hook or claw **392** moves forward with respect to base plate **360** and down with respect to the static metal clamp jaw **364**. This detent position permits loose retention of the extruded rail **316** in the assembly as shown in FIG. **7**.

[0036] FIGS. **6-8** illustrate the operation of each of the rail clamp assemblies **350** shown in FIG. **3** and incorporated into the dual rail clamp assemblies **210** shown in FIG. **2**. FIG. **6** is an end view of a single clamp assembly **350** or dual clamp assembly **210** shown in an open first position for receiving a rail **316** therein. It is to be understood that rail **316** may be any one of rails **104**, **108**, **204**, **206**, **304**, **306**, **208** and **308** described above.

[0037] In the open first position shown in FIG. **6**, the clamp assembly **350** is fully open. With the finger **362** in the position shown in FIG. **6**, the ball nose spring plunger **404** engages the depression **402** to hold the finger **362** in an open position. The handle **378** is fully threaded into the beam **326** such that washer **380** abuts against the beam **326**. This pushes the base plate **360** laterally away from the beam **326** to the position shown. In this FIG. **6**, a rail **316** is either being placed into the assembly **350** or removed therefrom. In the former case, the corner rib **320** is first placed into the lower jaw **364** and then the rail **316** is simply rotated counterclockwise to push the adjacent rib **320** of the rail **316** against the stem portion **386** of the finger **362**. This rotation causes the finger **362** to rotate clockwise from the first position until the stem portion **386** of the finger is almost flush with the surface of the base plate **360**. At the same time, the ball nose spring plunger **404** now engages the depression **400**. The user will feel a tactile snap as the plunger **404** engages the depression **400**. This corresponds to the finger **362** position shown in FIG. **7**. The handle **378** is then rotated counterclockwise to a position shown in FIG. **7** to prevent the finger **362** from being returned to the open position shown in FIG. **6**. With the finger **362** oriented as is shown in FIG. **7**, the rail **316** is securely retained, but the rail **316** may be axially or rotatably moved within the assemblies **350** to a desired position.

[0038] FIG. 8 shows the clamp assembly **350** in a rail locked position. The handle **378** is further turned counterclockwise to pull the base plate **360** fully against the beam **326**. This causes the hammerhead protrusion **394** on the upper portion **388** of the finger **362** to draw flush against the beam **326** so that the hook **392** of the finger **362** clamps the rail **316** against the base plate **360**. This rigidly locks the rail **316** between the jaw **364** and the hook **392** and against the base plate **360**.

[0039] The operation of the clamp assembly **210** shown in FIGS **2** and **9** is essentially the same as just described except that the base plate **224** has two recesses for two fingers **362**, the beam **326** is replaced by the base plate **220**, and there are two handle shafts **358** drawing the base plate **224** against the plate **220** to clamp the rail **316** in place. In the case of the clamp assembly **210**, two hook clamp fingers **362** and all associated parts are installed to a single base plate **222**. Because they are mechanically affixed to the same plate, there is no rotation permitted between the base plate **224** and the base **220**, and therefore only axial translation of the rail **316** is permitted when in the retention position shown in FIG. **7**.

[0040] Many changes may be made to the device, which will become apparent to a reader of this disclosure. For example, the fingers **362** may be shaped differently than above described. The rails **316** may not have four ribs **320** and could be configured with no ribs at all.

[0041] All such changes, alternatives and equivalents in accordance with the features and benefits described herein, are within the scope of the present disclosure. Such changes and alternatives may be introduced without departing from the spirit and broad scope of my invention as defined by the claims below and their equivalents.

CLAIMS

What is claimed is:

1. A frame apparatus for holding a flexible lance positioning mechanism adjacent to and spaced from a heat exchanger tube sheet, the apparatus comprising:

an upper guide rail;

a lower guide rail;

a positioner rail supported from one of the upper and lower guide rails and guided by the other of the upper and lower guide rails; and

a rail clamp assembly fastened to a portion of a tube sheet, the rail clamp assembly operably holding one of the upper and lower guide rails in a fixed position with respect to the tube sheet, the rail clamp assembly comprising:

a flat plate or beam member adapted to be fastened to the tube sheet;

a base plate spaced from the flat plate by one or more threaded shafts;

one or more clamp fingers rotatably fastened to the base plate, wherein the one or more clamp fingers is operable to rotate toward the base plate when the base plate is drawn against the flat plate or beam member.

2. The apparatus according to claim 1 wherein the flat plate or beam member is an elongated beam having the rail clamp assembly at a distal end of the beam and a screw clamp assembly at a proximal end of the beam.

3. The apparatus according to claim 1 wherein the flat plate or beam member is a generally trapezoidal shaped plate having a curved bottom edge and a plurality of apertures therethrough adjacent the bottom edge for receiving a plurality of bolts to fasten the member to the tube sheet.

4. The apparatus according to claim 3 wherein the base plate has a pair of spaced apart fingers rotatably supported therein and a pair of spaced apart threaded shafts beneath each of the fingers fastened to the base plate.

5. The apparatus according to claim 1 wherein each of the fingers engage a ball nose spring plunger in a first position permitting a rail to be attached to the

assembly and in a second position permitting the rail to be translated along the base plate.

6. The apparatus according to claim 5 wherein the threaded shaft draws the one or more fingers to a third position engaging the rail to hold rail within the rail clamp assembly.

7. A frame apparatus for holding a flexible lance positioning mechanism adjacent to and spaced from a heat exchanger tube sheet, the apparatus comprising:

an upper guide rail;

a lower guide rail;

a positioner support rail supported from the upper guide rail and restrained for lateral movement only along the lower guide rail; and

a plurality of rail clamp arm assemblies each configured to be fastened to a portion of a heat exchanger tube sheet so that each of the rail clamp arm assemblies operably holds one of the guide rails in a fixed position with respect to the tube sheet, each rail clamp arm assembly comprising:

an elongated beam having a screw clamp at a proximal end of the beam for fastening the elongated beam to the heat exchanger tube sheet; and

a rail clamp assembly at a distal end of the beam operable to releasably receive, hold and clamp a portion of one of the guide rails therein, wherein each rail clamp assembly includes a threaded hand screw threaded through the distal end of the beam into a base plate, a static clamp jaw fastened to the base plate, and a hooked clamp finger rotatably fastened to the base plate opposite the static clamp jaw.

8. The apparatus according to claim 7 wherein the clamp finger is rotatably fastened in a rectangular notch to the base plate via an axle screw.

9. The apparatus according to claim 8 wherein the hooked clamp finger has a parallel sided stem portion in the notch, a hook portion that extends toward the static clamp jaw and an opposite hammerhead portion that extends beyond a rear edge of the stem portion.

10. A frame apparatus for holding a flexible lance positioning mechanism adjacent to and spaced from a heat exchanger tube sheet, the apparatus comprising:

an upper guide rail;

a lower guide rail;

a positioner support rail supported from one of the upper and lower guide rails and restrained for lateral movement along the other of the guide rails; and

a plurality of rail clamp assemblies operable to releasably receive, hold and clamp a portion of one of the guide rails therein, each rail clamp assembly having a support plate adapted to be fastened to a peripheral portion of a heat exchanger tube sheet, a hand screw threaded through the support plate and rotatably fastened into a base plate, a static clamp jaw fastened to the base plate, and a hooked clamp finger rotatably fastened to the base plate opposite the static clamp jaw.

11. The apparatus according to claim 10 wherein the clamp finger is rotatably fastened in a rectangular notch to the base plate via an axle screw.

12. The apparatus according to claim 11 wherein the hooked clamp finger has a parallel sided stem portion in the notch, a hook portion that extends toward the static clamp jaw and an opposite hammerhead portion that extends beyond a rear edge of the stem portion.

13. The apparatus according to claim 12 wherein the hooked clamp finger is rotated toward the static clamp jaw when the hand screw tightens the base late against the support plate.

14. The apparatus according to claim 11 wherein each rail clamp assembly further comprises a ball nosed plunger extending from the base plate into the notch

so as to engage a depression in the hooked clamp finger to releasably hold the finger in an open position to receive a portion of a guide rail between the finger and the static clamp jaw.

15. The apparatus according to claim 12 wherein the hooked clamp finger is rotatably supported on an axle screw extending across the notch.

16. The apparatus according to claim 15 wherein the hammerhead portion extends toward the support plate from the base plate when the base plate is spaced from the support plate and causes the hook shaped finger to rotate toward the static clamp jaw when the base plate is fastened against the support plate.

17. The apparatus according to claim 15 further comprising a ball nosed plunger extending from the base plate into the notch above the axle screw.

18. The apparatus according to claim 17 wherein the plunger releasably engages a first detent in the hook shaped finger when the base plate is spaced from the support plate and the finger is rotated to a release position and engages a second detent in the hook shaped finger when the hook shaped finger is rotated to hold a rail between the hook shaped finger and the static clamp jaw.

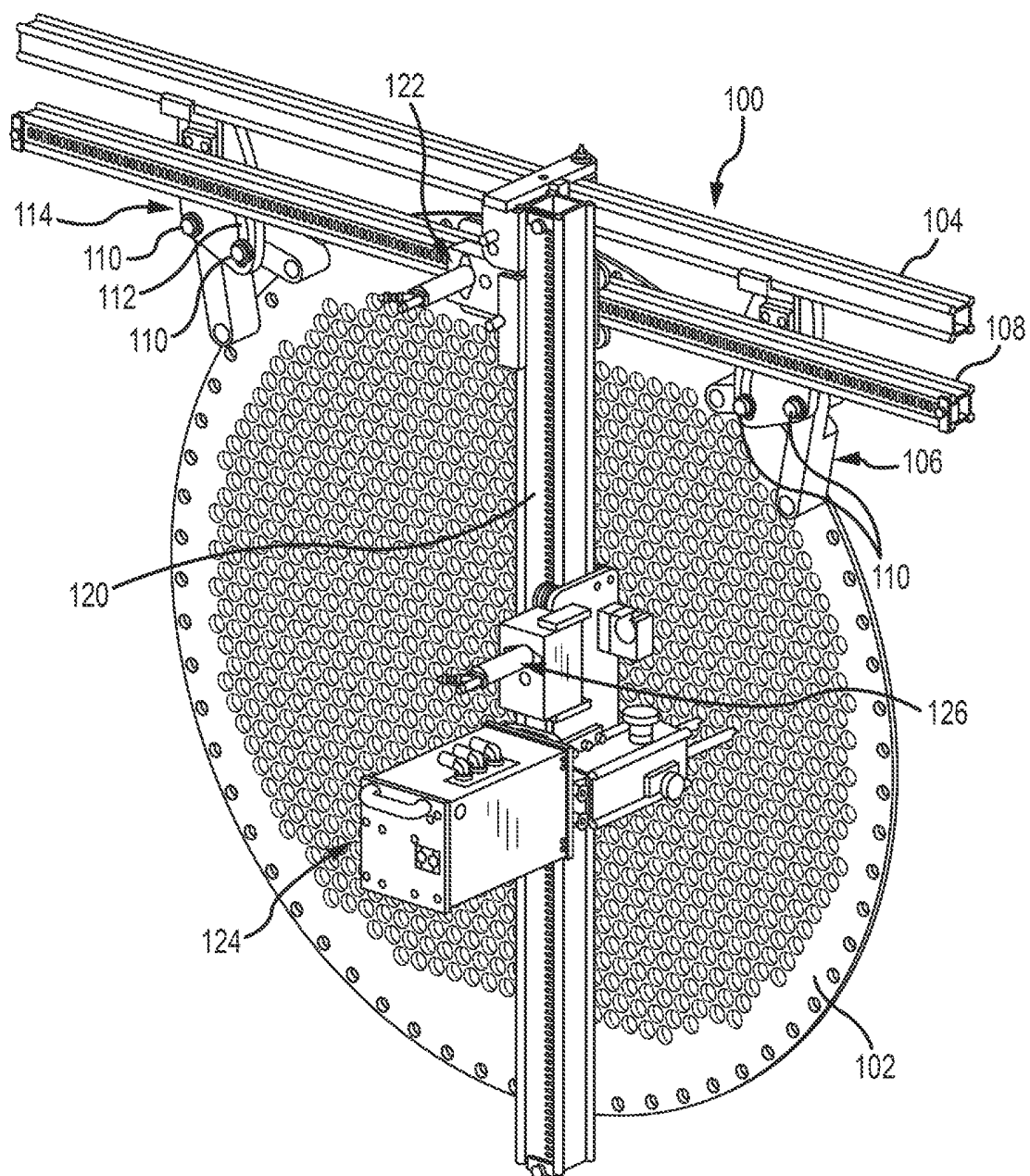


FIG.1

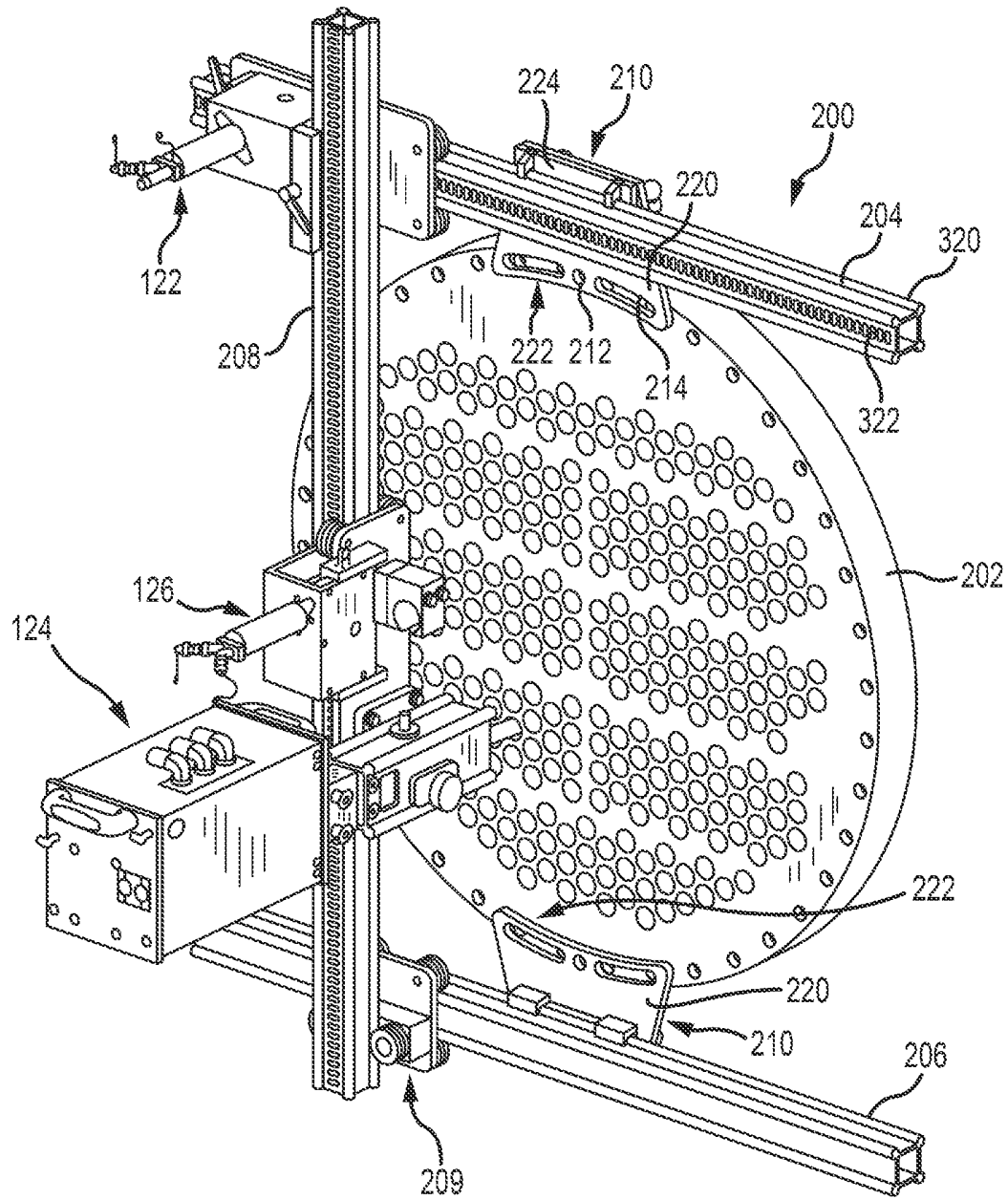


FIG.2

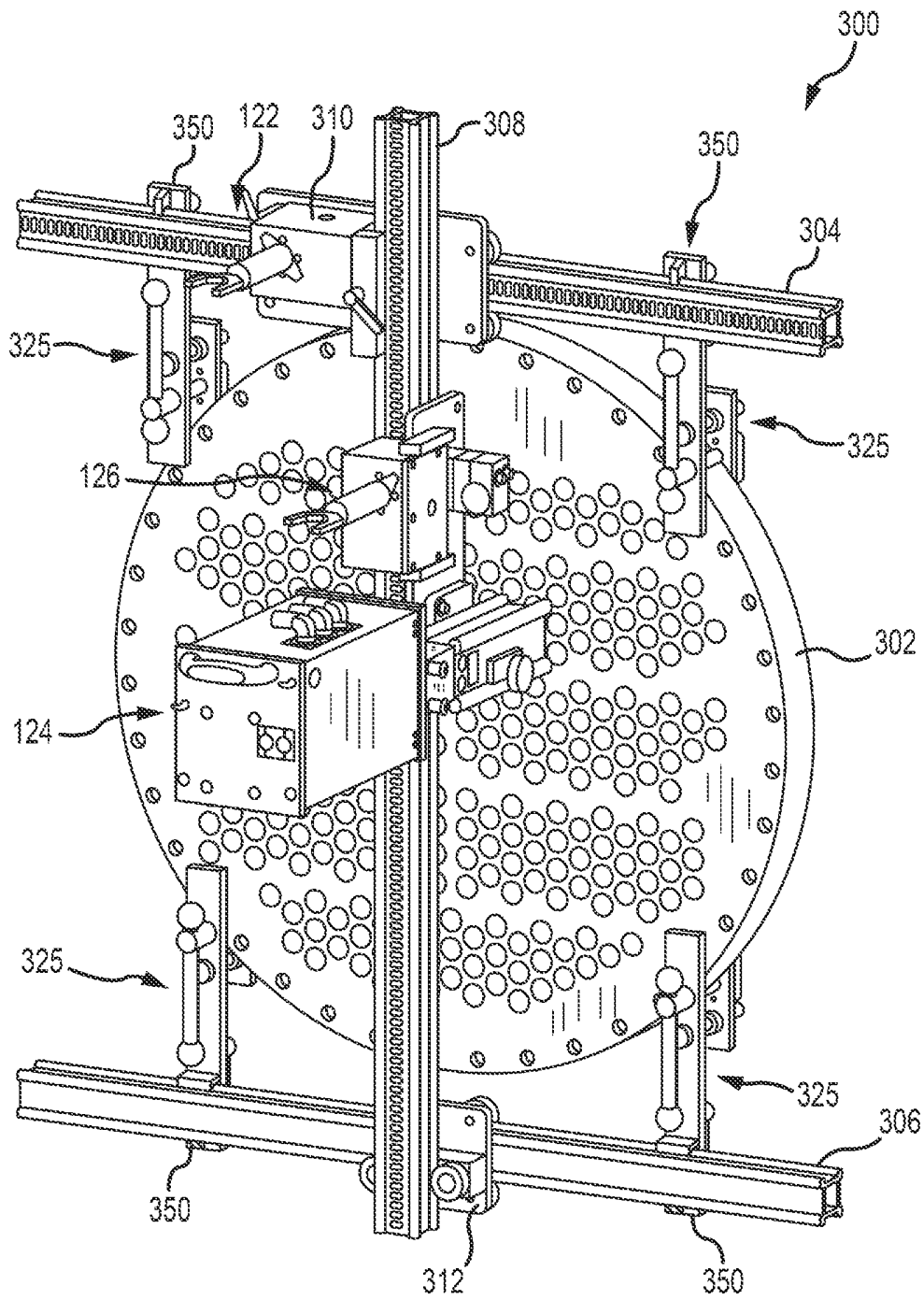


FIG. 3

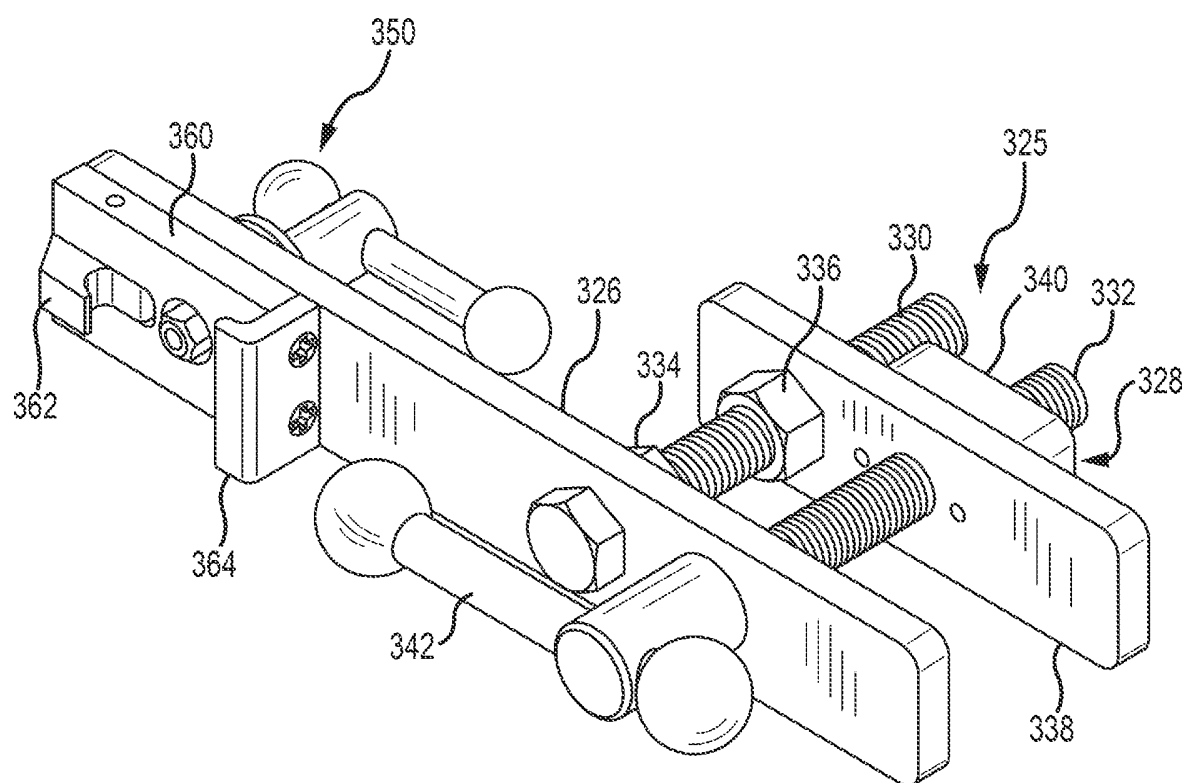


FIG.4

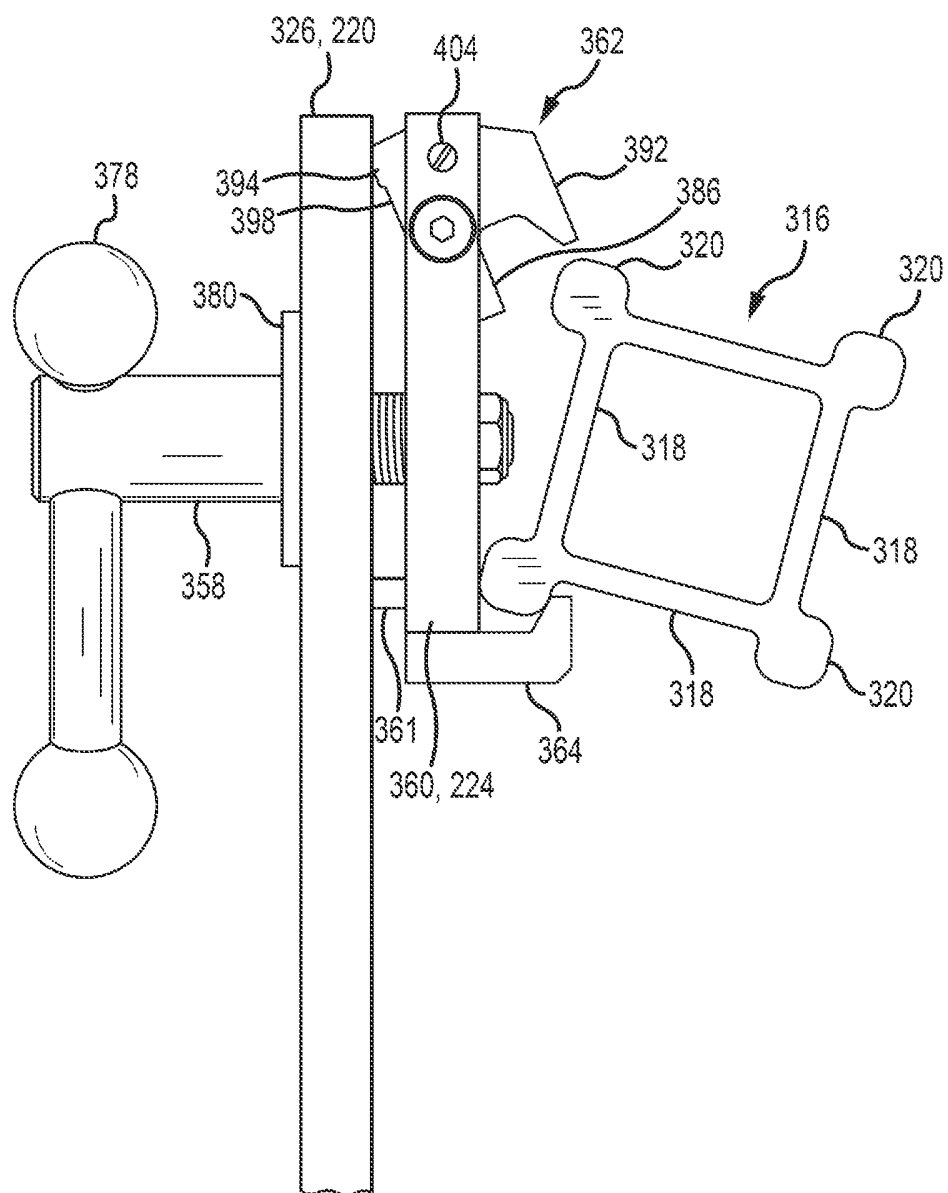


FIG. 6

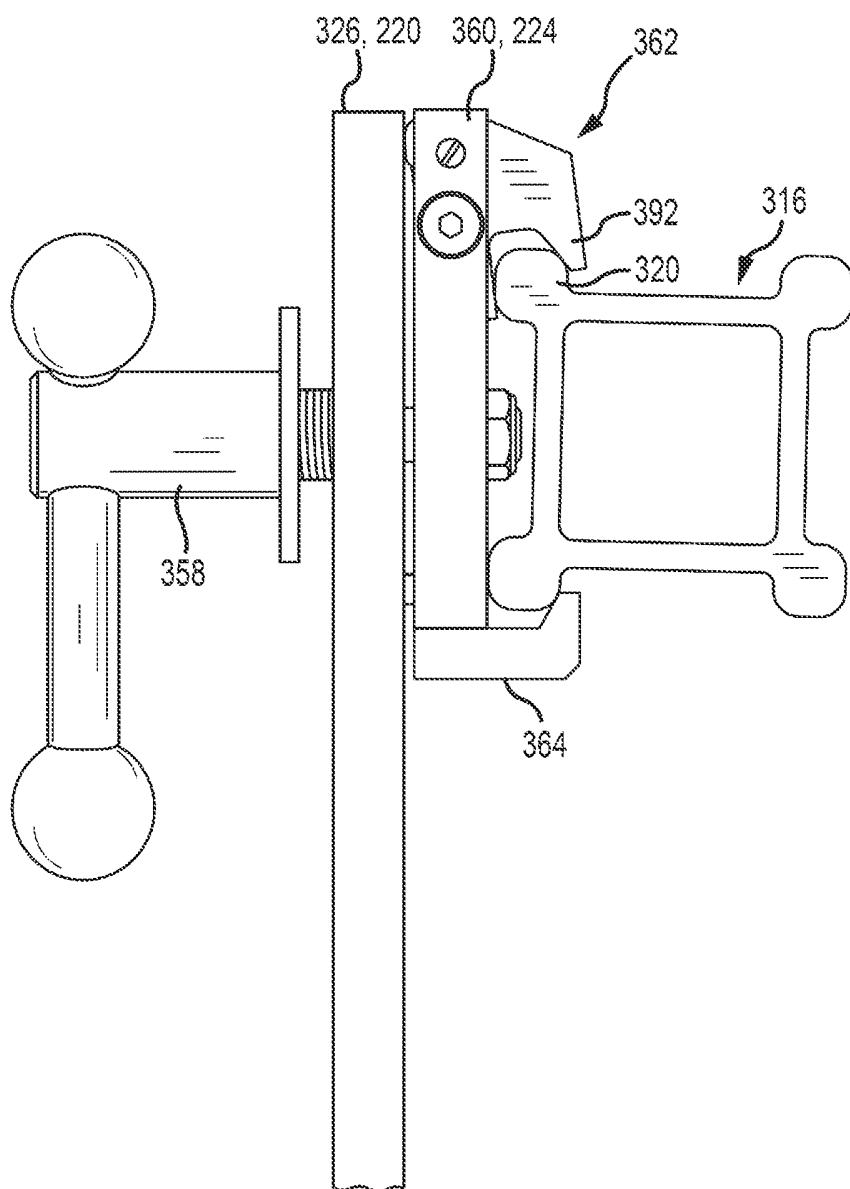


FIG. 7

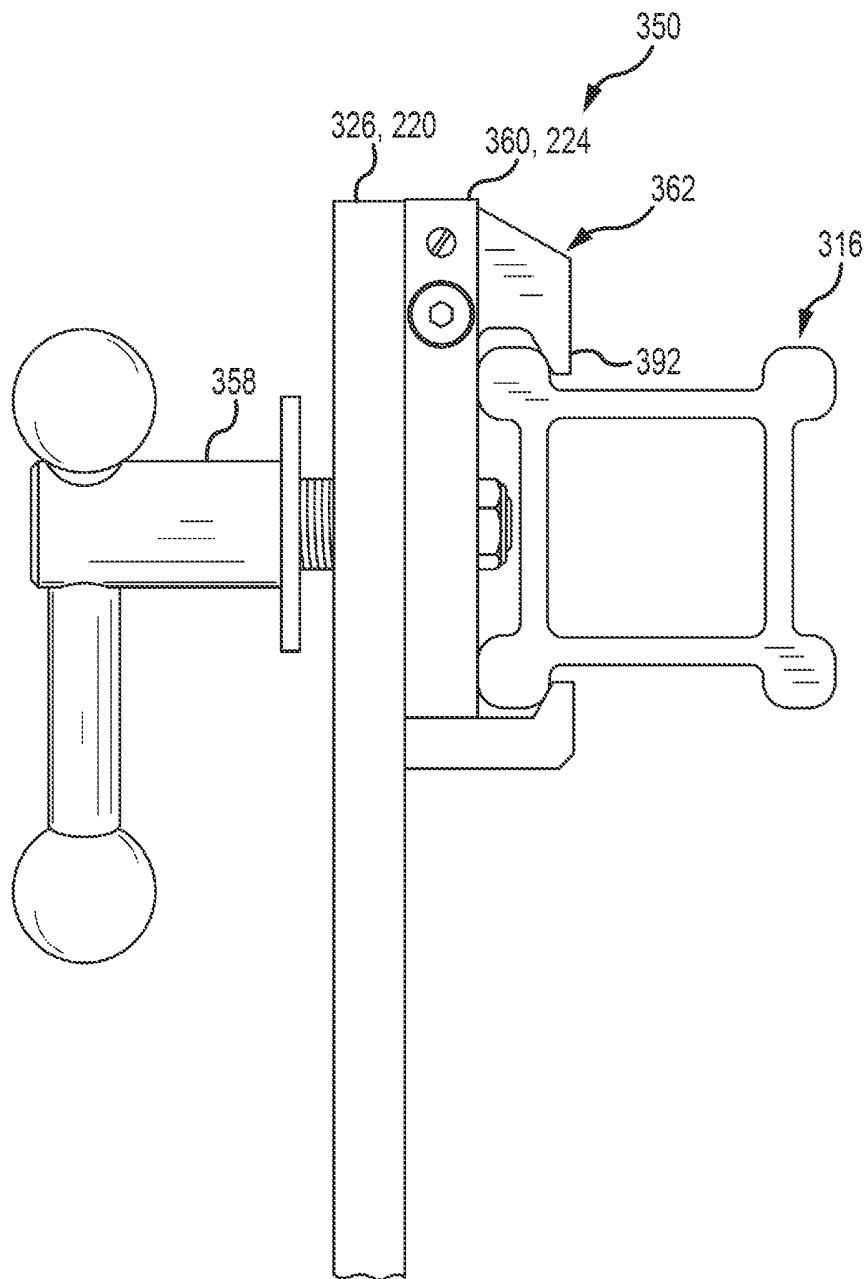


FIG. 8

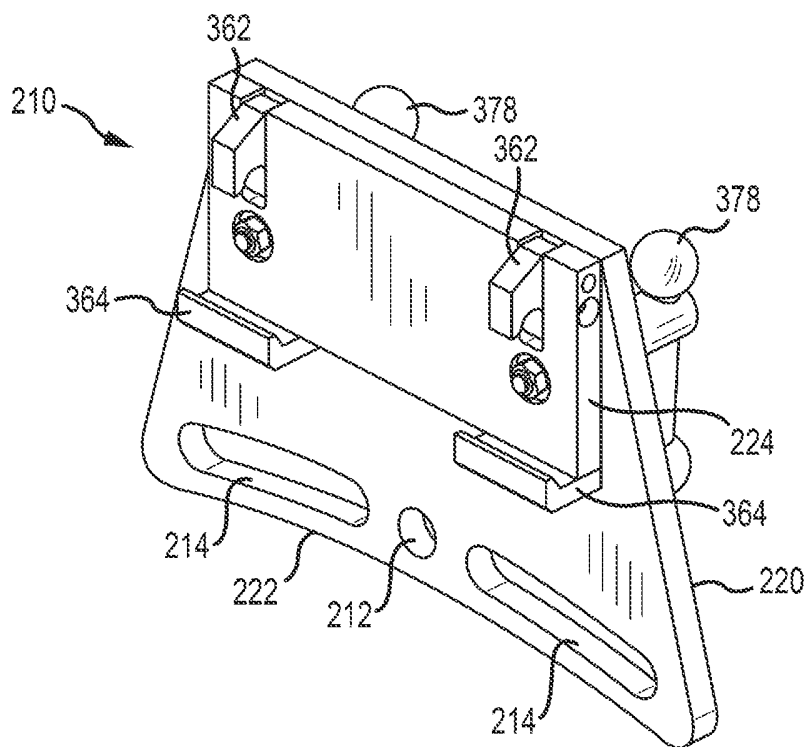


FIG. 9

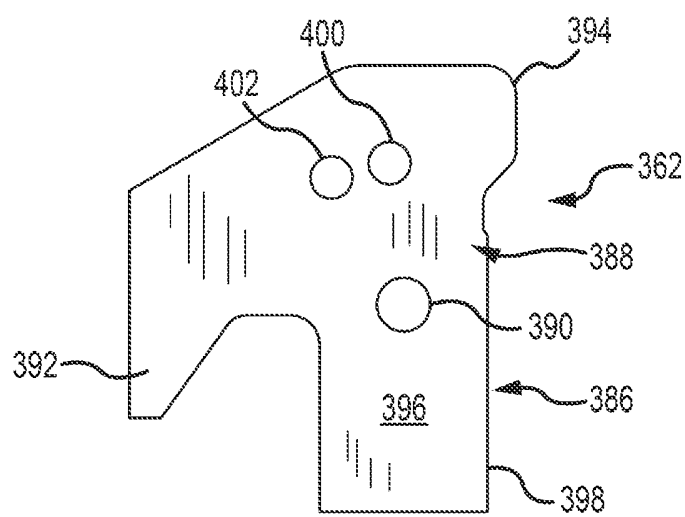


FIG. 10