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Linden et al.

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(54) **PROPELLER REPAIR APPARATUS**

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B21D 5/01 (2006.01)

(52) **U.S. Cl.** **72/31.02**; 72/293; 72/383; 72/453.02; 72/455

(58) **Field of Classification Search** 72/31.02, 72/293, 381, 383, 386, 453.02, 455
See application file for complete search history.

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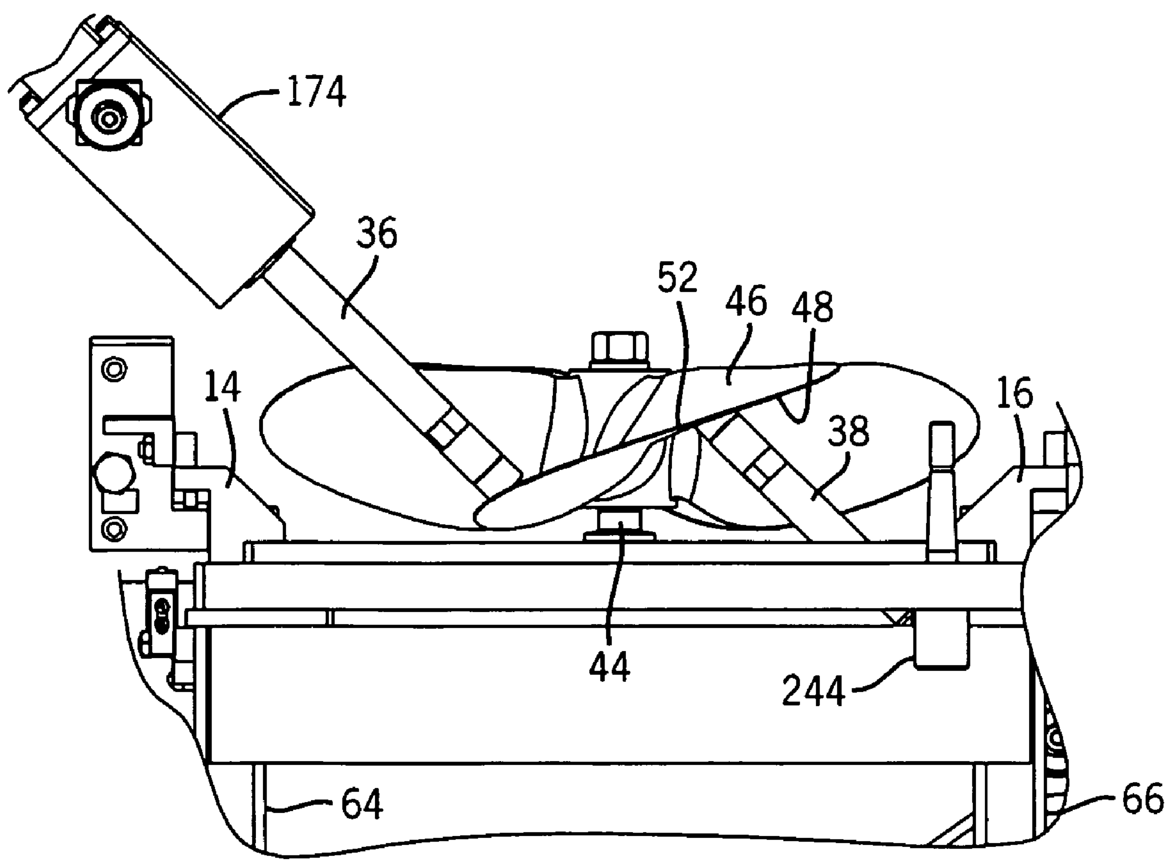
(57) **ABSTRACT**

A propeller repair apparatus suitable for repairing and changing the pitch of a propeller includes a first rail parallel to and spaced from a second rail. A tapered shaft extends upwardly between the first and second rails for mounting a propeller thereon. A first frame extending between the first and second rails is movably mounted on the first and second rails for movement along the first and second rails. In one embodiment, a first actuator is pivotally mounted to the first frame and includes an extendible ram engagable with a propeller mounted on the tapered shaft.

18 Claims, 11 Drawing Sheets



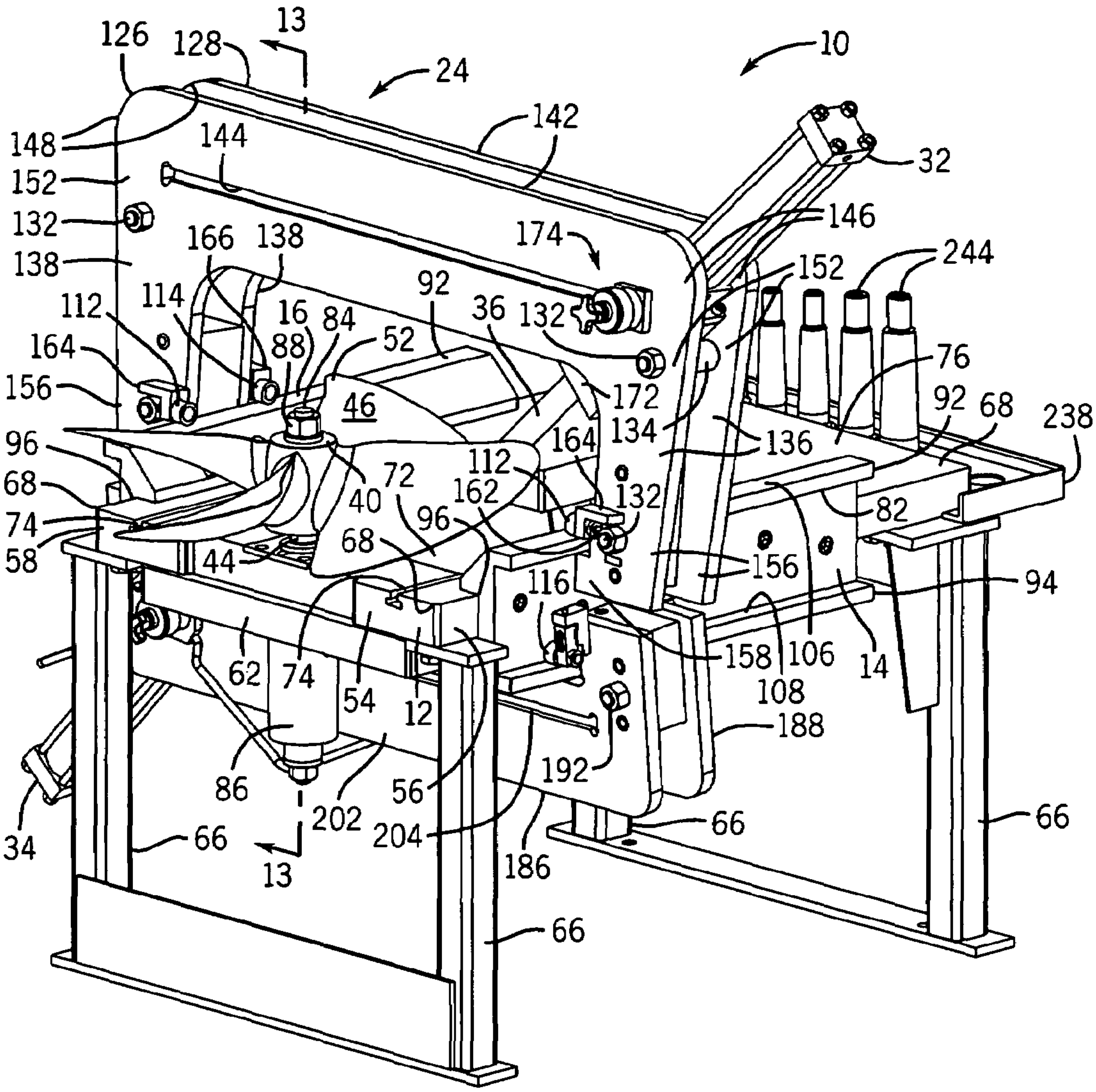


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FIG. 1

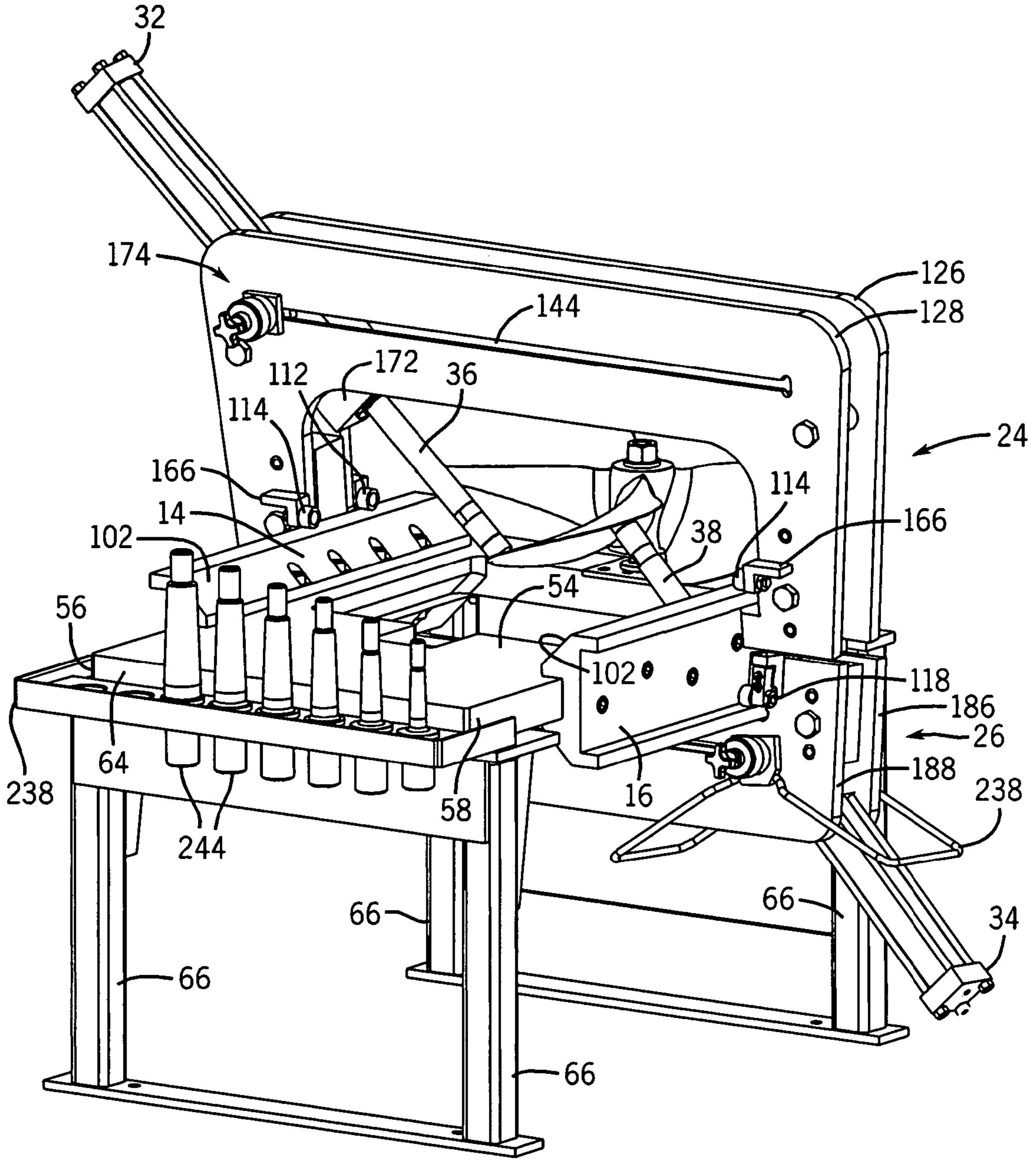

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FIG. 2

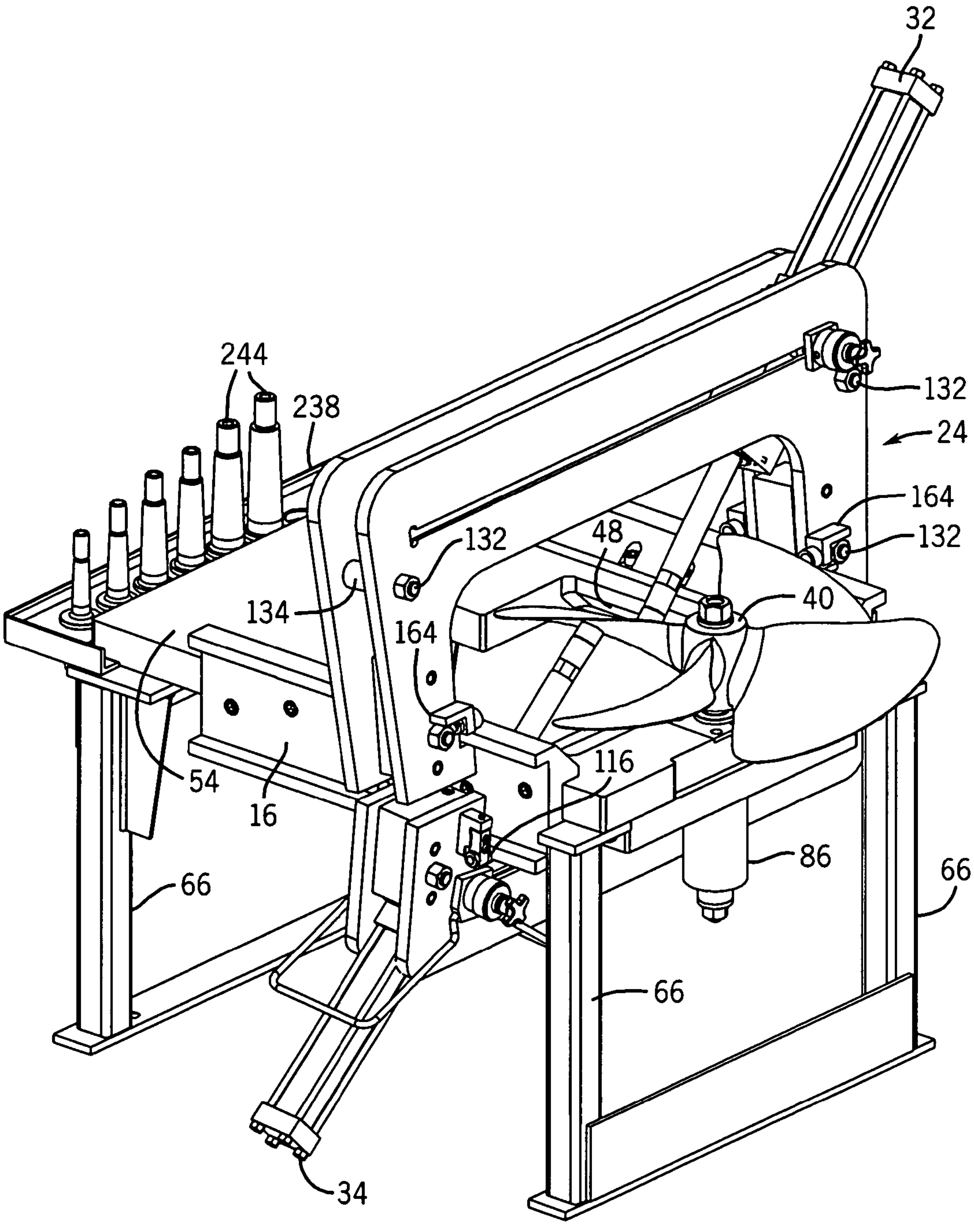

FIG. 3

FIG. 4

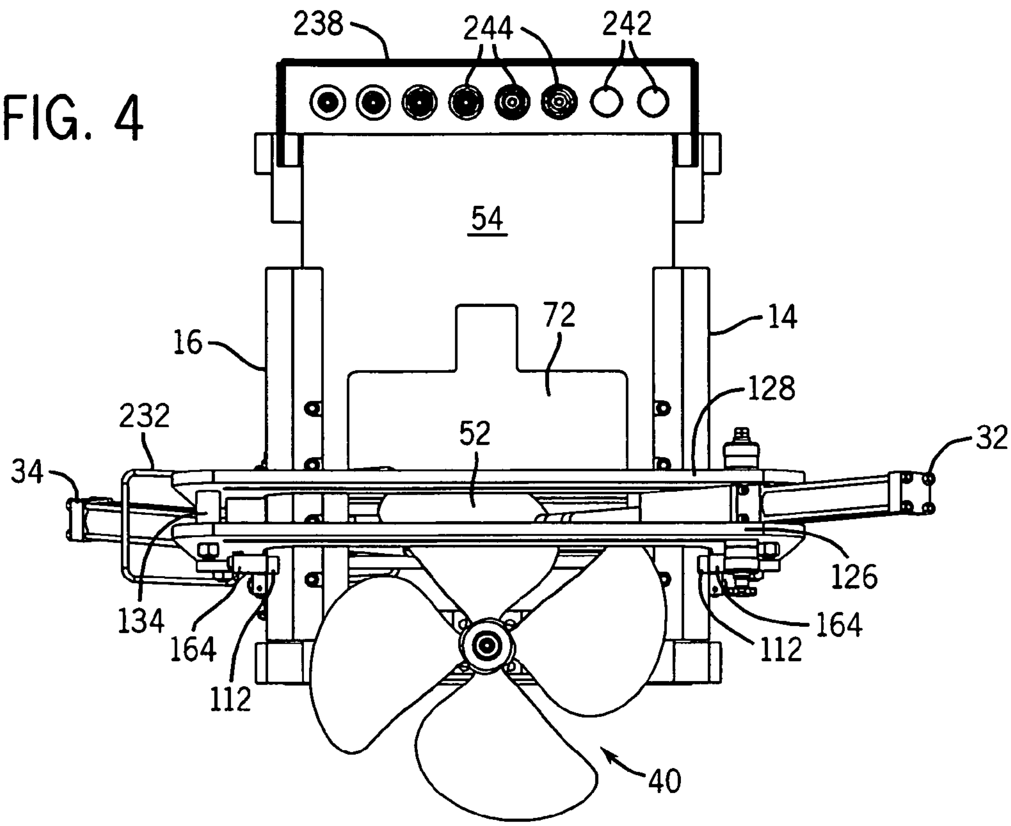
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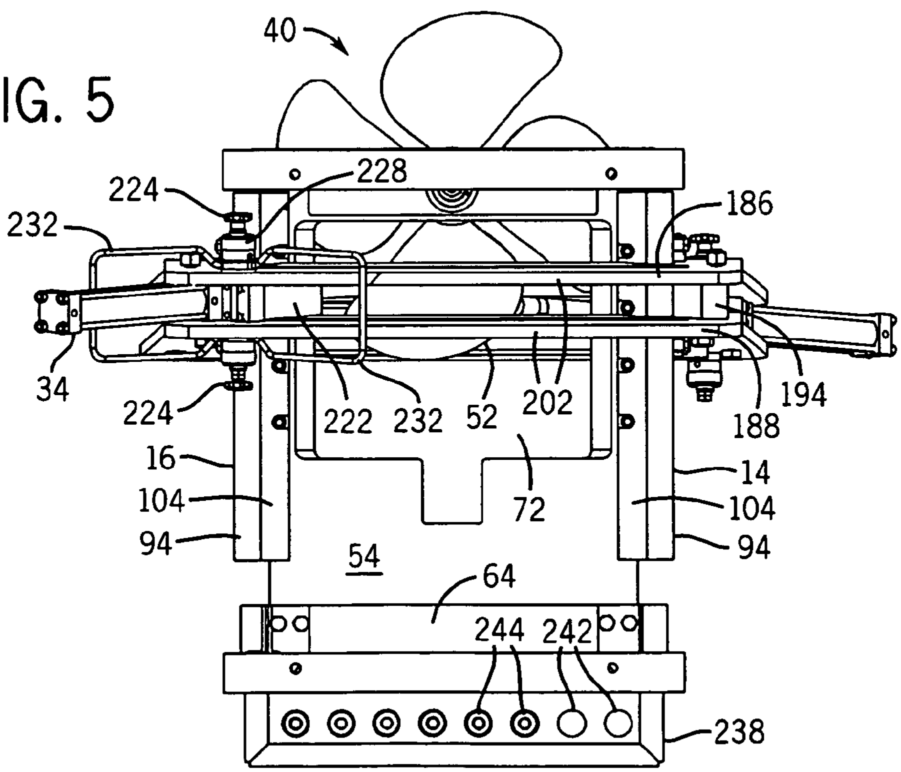
FIG. 5


40
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34
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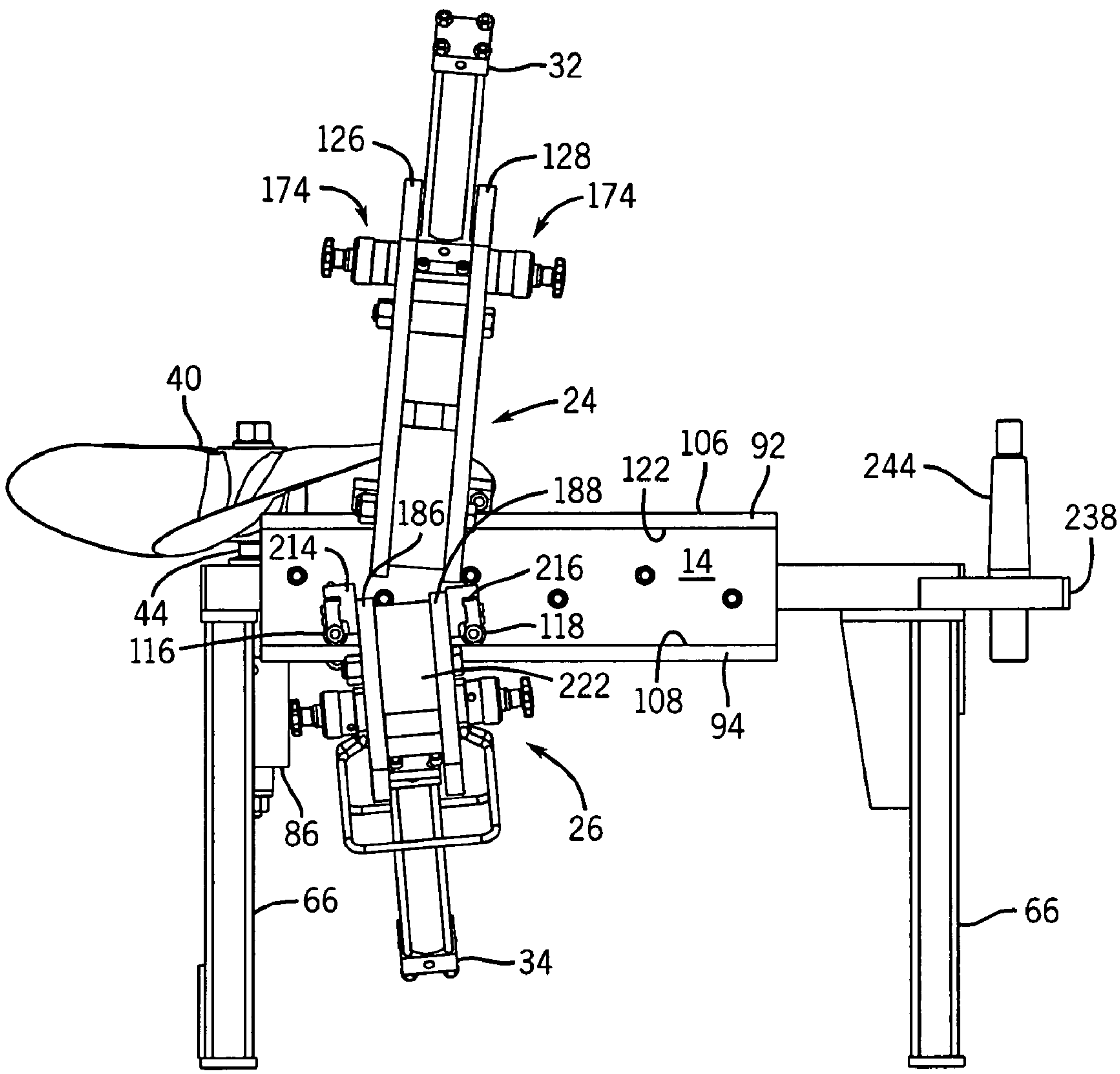

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FIG. 6

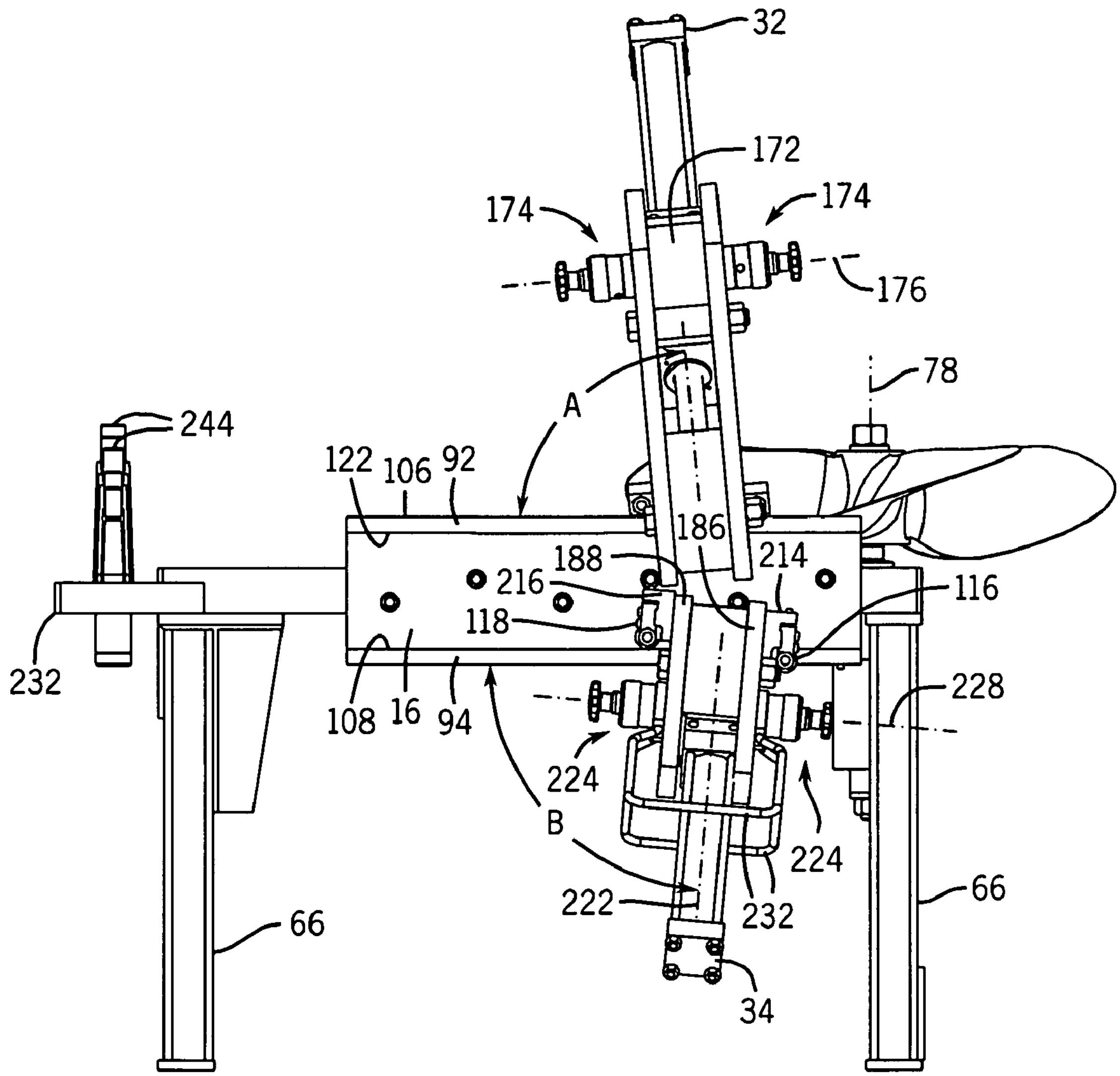
32
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FIG. 7

FIG. 8

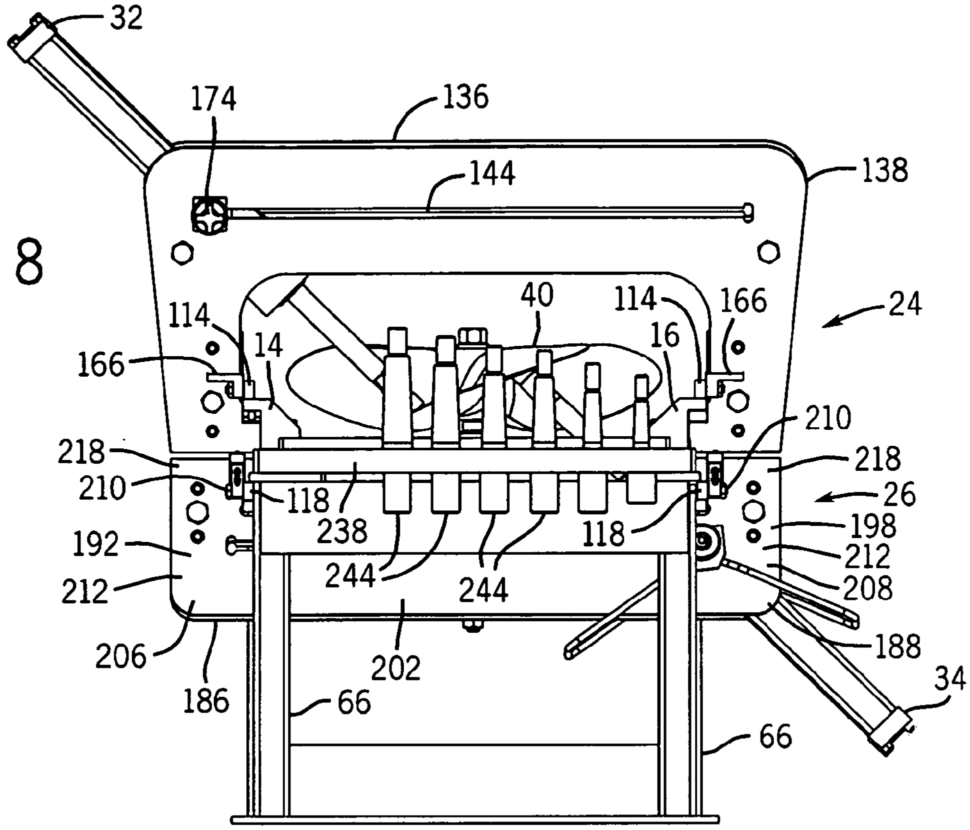
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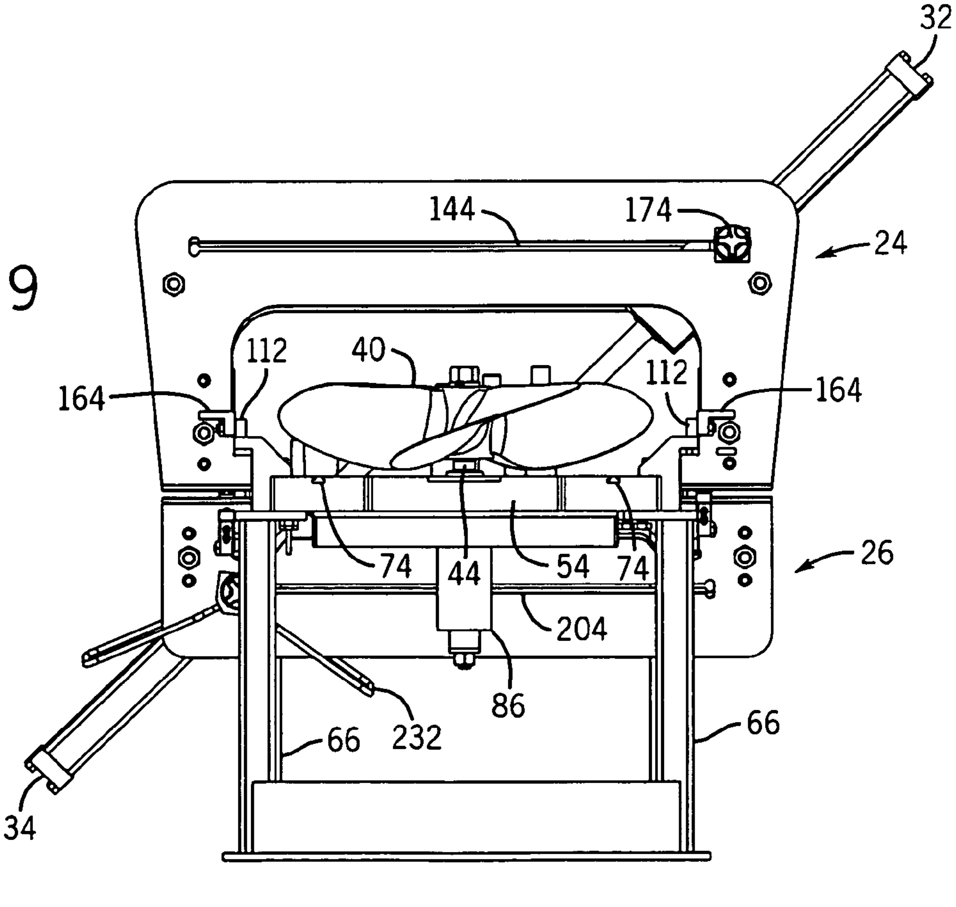
FIG. 9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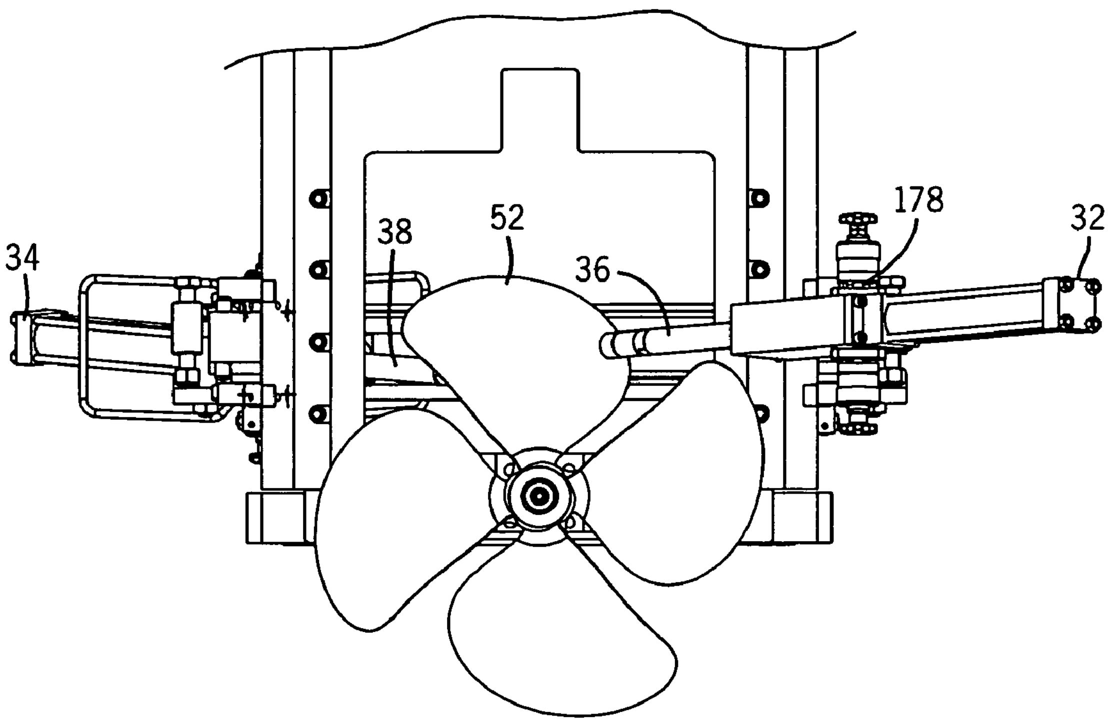

FIG. 10

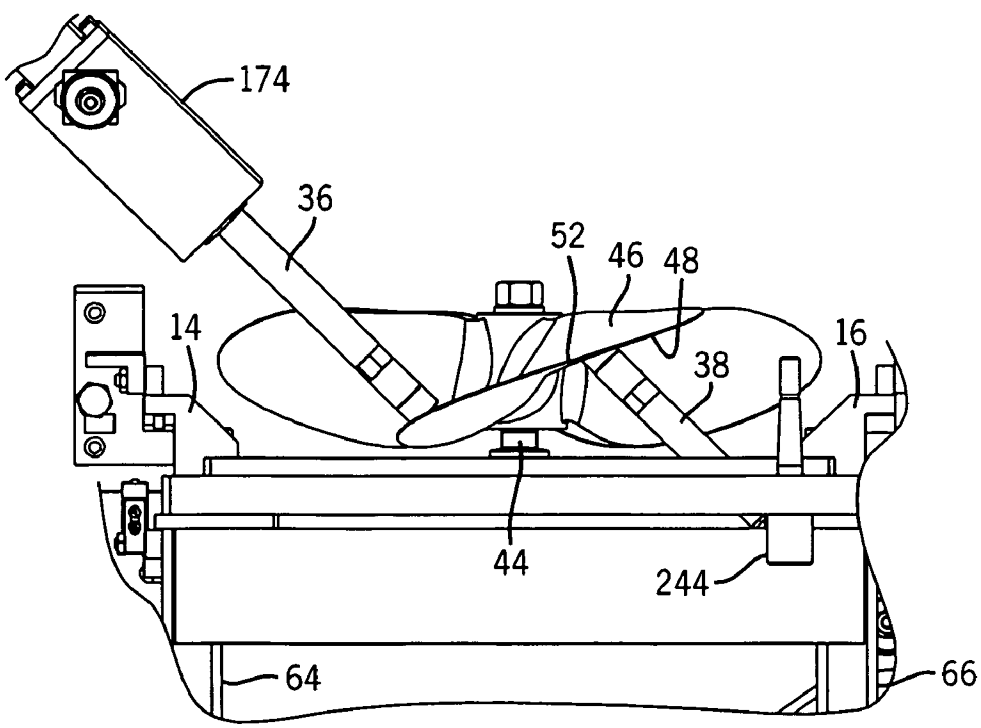

FIG. 11

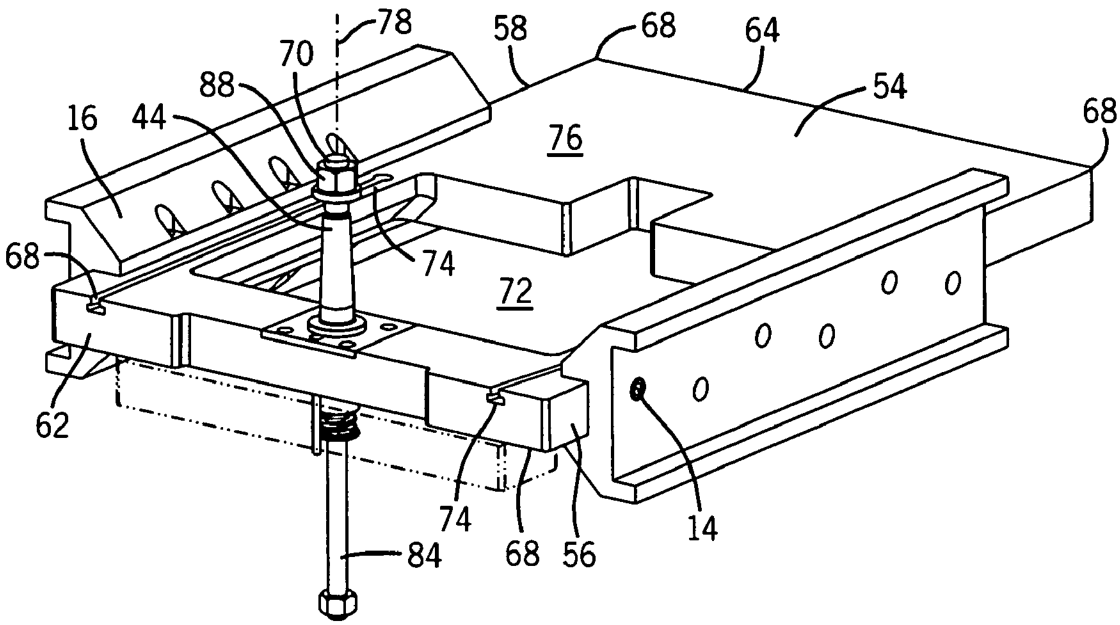
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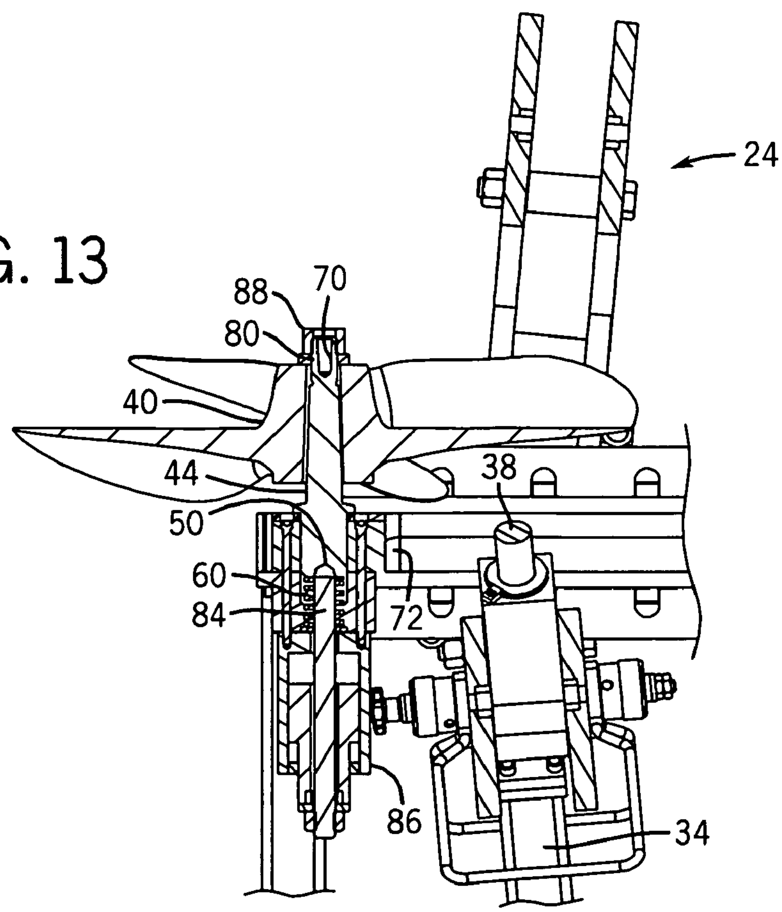
FIG. 12

FIG. 13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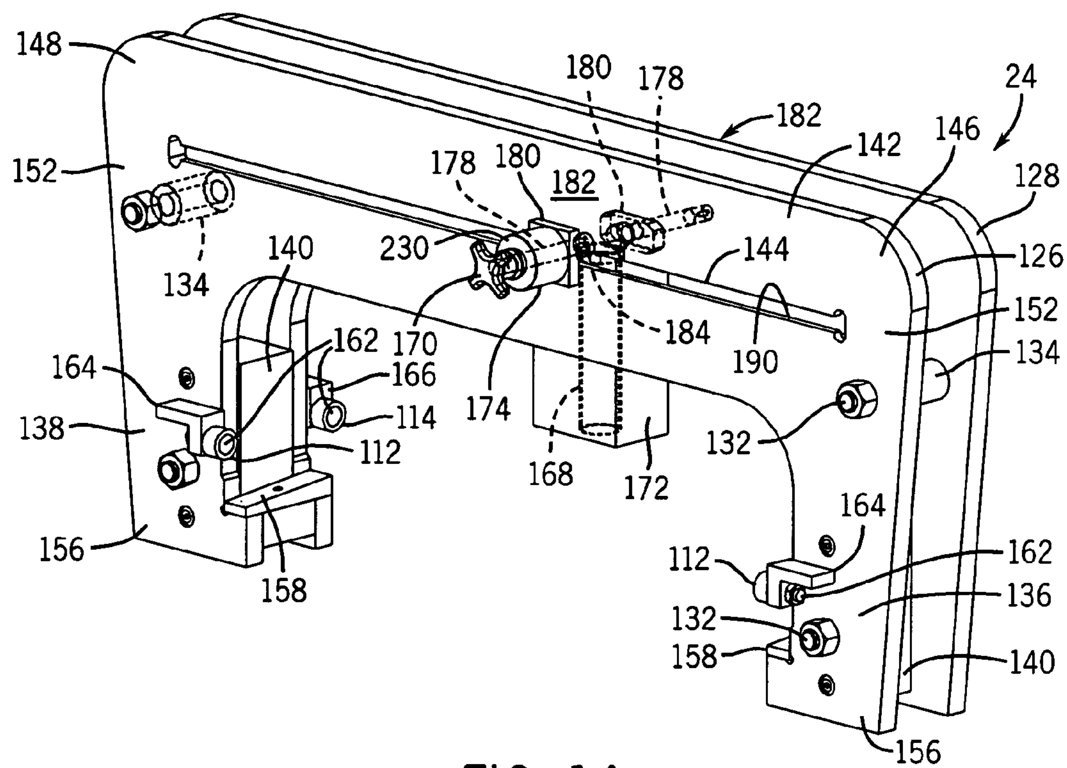
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FIG. 14

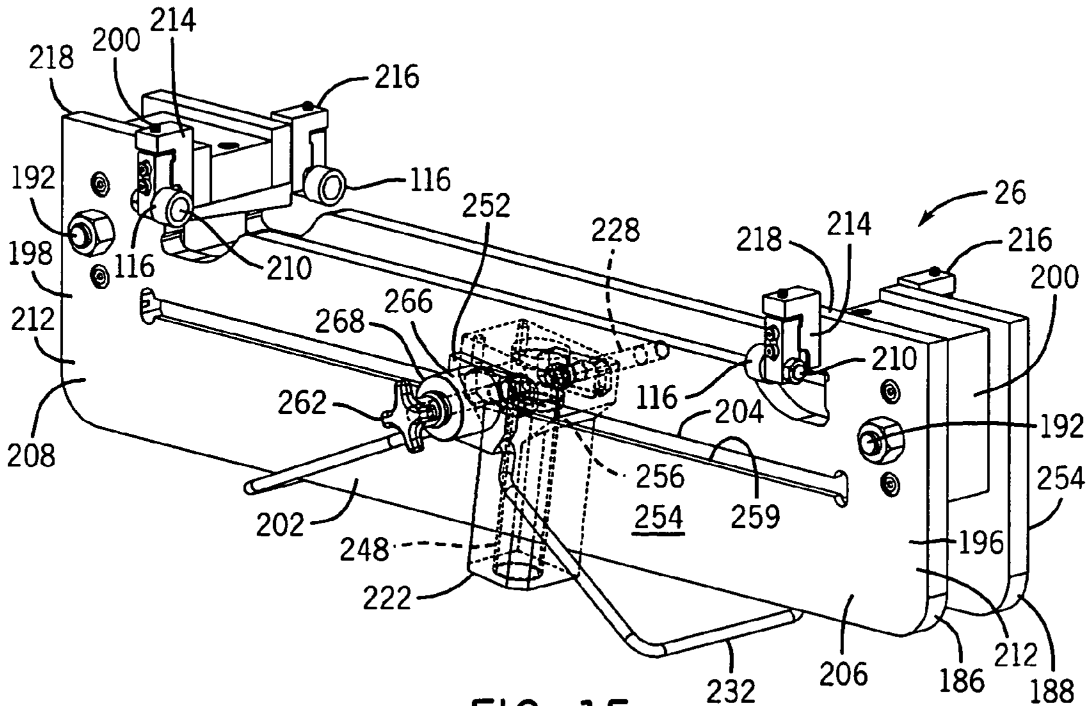
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FIG. 15

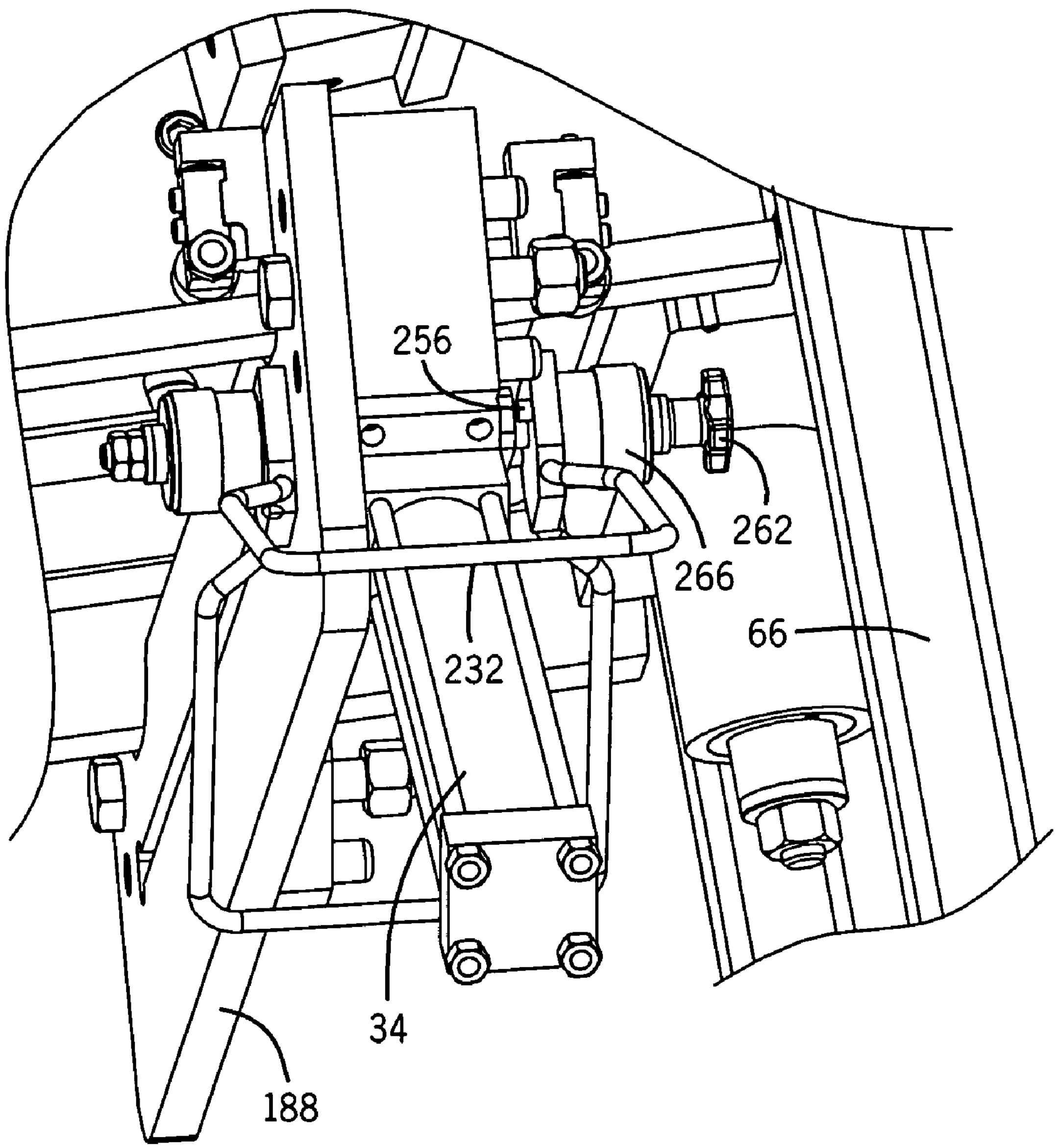

FIG. 16

PROPELLER REPAIR APPARATUS

CROSS REFERENCES TO RELATED APPLICATIONS

Not Applicable.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

Not Applicable.

TECHNICAL FIELD

This invention relates to propeller repair equipment, and in particular to a propeller repair apparatus including at least one actuator having a ram engagable with a propeller and mounted on a movable frame.

DESCRIPTION OF THE BACKGROUND ART

Marine propellers are often damaged during use by striking objects in the water, such as rocks, lake bed bottoms, and the like. Moreover, the performance of a marine propeller can be changed by modifying the pitch of the blades of a propeller. Repairing a propeller or changing the pitch of a propeller blade often requires bending a portion of the blade a desired amount. This is often accomplished by pounding on the blade using a hammer. Unfortunately, using a hammer can impart too much or too little force on the blade resulting in too much or too little bending. As a result, repairing a blade or changing the blade shape using a hammer is often a long a tedious process requiring a great deal of trial an error.

One known apparatus, disclosed in U.S. Pat. No. 5,315,856, incorporates an arbor press having a single actuator that can be used to bend a very large propeller blade still affixed to a ship. The arbor applies a constant force to the propeller blade. Unfortunately, this particular apparatus is of little use for blades forming part of smaller propellers, such as propellers having a diameter less than 42 inches, or propellers that have been removed from the vessel.

Another known apparatus incorporates opposing actuators that are movable in both X and Y directions. The opposing actuators, however, extend in parallel directions only. Thus limiting the direction of the forces that can be imparted onto the propeller blade. A complex system that simultaneously rotates the opposing actuators about the propeller attempts to overcome this deficiency. Unfortunately, the complex system significantly increases the cost and complexity of this apparatus. Accordingly, a need exists for a propeller repair apparatus that is simple and inexpensive, yet can impart non-parallel opposing forces on propeller blade.

SUMMARY OF THE INVENTION

The present invention provides a simple propeller repair apparatus suitable for repairing and changing the pitch of a propeller. The apparatus includes a first rail parallel to, and spaced from, a second rail. A tapered shaft extends upwardly between the first and second rails for mounting a propeller thereon. A first frame extending between the first and second rails is movably mounted on the first and second rails for movement along the first and second rails. In one embodiment, a first actuator is pivotally mounted to the first frame

and includes an extendible ram engagable with a propeller mounted on the tapered shaft.

A general objective of the present invention is to provide a simple propeller repair apparatus that can impart a controlled force on a propeller blade. This objective is accomplished by providing a propeller repair apparatus having an actuator that imparts a controlled force on the propeller blade.

Another objective of the present invention is to provide a simple propeller repair apparatus that can impart a force on a propeller blade from multiple directions. This objective is accomplished by mounting the actuator on a frame that is movable relative to the propeller, and in one embodiment, the actuator is pivotable relative to the frame.

The foregoing and other objectives and advantages of the invention will appear from the following description. In the description, reference is made to the accompanying drawings which form a part hereof, and in which there is shown by way of illustration a preferred embodiment of the invention. Such embodiment does not necessarily represent the full scope of the invention, however, and reference is made therefore to the claims herein for interpreting the scope of the invention.

BRIEF SUMMARY OF THE DRAWINGS

FIG. **1** is a rear, right end perspective view of a propeller repair apparatus incorporating the present invention;

FIG. **2** is a front, left end perspective view of the apparatus of FIG. **1**;

FIG. **3** is a front, right end perspective view of the apparatus of FIG. **1**;

FIG. **4** is a top view of the of the apparatus of FIG. **1**;

FIG. **5** is a bottom view of the apparatus of FIG. **1**;

FIG. **6** is a rear view of the apparatus of FIG. **1**;

FIG. **7** is a front view of the apparatus of FIG. **1**;

FIG. **8** is a left end view of the apparatus of FIG. **1**;

FIG. **9** is a right end view of the apparatus of FIG. **1**;

FIG. **10** is a top view of the apparatus of FIG. **1** with the top frame removed;

FIG. **11** is an enlarged left end view of the apparatus of FIG. **1** with some of the spare tapered shafts and both frames removed;

FIG. **12** is a rear, right perspective view of the work platform of FIG. **1**;

FIG. **13** is a sectional view along line **13-13** of FIG. **1**;

FIG. **14** is a right perspective view of the upper frame of FIG. **1**;

FIG. **15** is a right perspective view of the lower frame of FIG. **1**; and

FIG. **16** is a detailed view of the lower frame of FIG. **1** with one lower frame plate removed.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of a propeller repair apparatus **10** shown in FIGS. **1-11** includes a work table **12** supporting a pair of parallel horizontal rails **14**, **16**. Upper and lower frames **24**, **26** movably mounted on the rails **14**, **16** support upper and lower opposing actuators **32**, **34**. Each actuator **32**, **34** includes a ram **36**, **38** engageable with a propeller **40** mounted on a tapered shaft **44** extending upwardly between the rails **14**, **16**. Advantageously, the rams **36**, **38** are independently positionable relative to the propeller **40** to engage opposite surfaces **46**, **48** of a propeller blade **52** of the propeller **40** to repair the propeller **40** and/or change the pitch of the blade **52**.

As shown in FIGS. **1-12**, the work table **12** includes a horizontal work platform **54** having front and rear sides **56**, **58** joined by right and left ends **62**, **64**. The work platform **54** is supported above the floor by legs **66** extending downwardly from each work platform corner **68**. The lower actuator ram **38** extends through an opening **72** formed through the work platform **54** to engage a downwardly facing surface **48** of the blade **52** forming part of the propeller **40** mounted on the tapered shaft **44**. Clamp T-slots **74** formed in an upper surface **76** of the work platform **54** on opposing sides of the opening **72** can be provided for mounting clamps or jigs to the work platform **54**. Advantageously, the work platform **54** provides a convenient surface for placing tools and the like when setting up the apparatus **10** for working on the propeller **40**.

The tapered shaft **44** extends upwardly along a tapered shaft axis **78** from the work platform **54** between the opening **72** and the right end **62** of the work platform **54**. Preferably, as shown clearly in FIG. **12**, the tapered shaft **44** includes a longitudinal blind threaded hole **50** open to a bottom end **60** of the tapered shaft **44**. A threaded stub **70** extending upwardly from an upper end **80** of the tapered shaft **44** threadably engages a prop nut **88** to secure the propeller **40** on the tapered shaft **44**. The blind threaded hole **50** threadably engages a threaded ram **84** extending upwardly from a hold down actuator **86** mounted to the work platform **54**.

The propeller **40** is secured relative to the upper and lower frames by threadably engaging the tapered shaft blind threaded hole **50** with the threaded ram **84**. The propeller **40** is slipped onto the tapered shaft **44** and secured thereto by the prop nut **88** threadably engaging the threaded stub. The prop nut **88** urges the propeller **40** tightly onto the tapered shaft **44**. The hold down actuator **86** is then actuated to retract the threaded ram **84** and draw the tapered shaft **44**, downwardly toward, and securely against, the work platform **54**.

Referring back to FIGS. **1-11**, the parallel rails **14**, **16** movably support the upper and lower frames **24**, **26** for movement across the opening **72** between the work platform ends **62**, **64**. Each rail **14**, **16** is mounted to one side **56**, **58** of the work platform **54** using methods known in the art, such as bolts, welding, and the like, and includes outwardly extending upper and lower flanges **92**, **94**. In a preferred embodiment, each rail **14**, **16** includes an inner channel **96** that receives one side **56**, **58** of the work platform **54** to mount the rail **14**, **16** to the work platform **54**, and an upper and lower inner edge **102**, **104** of each rail **14**, **16** is tapered. Advantageously, tapering the upper inner edge **102** of each rail **14**, **16** provides clearance between the rail **14**, **16** and the propeller **40** mounted on the tapered shaft **44**. In addition, tapering the lower inner edge **104** of each rail **14**, **16** provides clearance for the lower actuator **34** at extreme outward settings (i.e. a lower actuator **34** position close to one of the rails **14**, **16**).

Each rail upper and lower flange **92**, **94** includes a substantially horizontal upper surface **106**, **108** extending substantially perpendicular to the tapered shaft axis **78**. Each flange upper surface **106**, **108** engages rollers **112**, **114**, **116**, **118** mounted to one of the upper and lower frames **24**, **26** to movably support the upper and lower frames **24**, **26** relative to the work platform **54**. In a preferred embodiment, the upper flange **92** also includes a lower surface **122** that engages the upper frame **24** to lock the upper frame **24** in position when the upper actuator **32** is actuated.

As shown in FIGS. **1-11** and **14**, the upper frame **24** supports the upper actuator **32** above the work platform **54**, and is movably mounted on the rails **14**, **16** for movement along the rails **14**, **16** between the work platform ends **62**, **64**. In a preferred embodiment, the upper frame **24** includes a pair of spaced apart parallel plates **126**, **128** joined together by bolts **132** extending through cylindrical spacers **134** and spacing blocks **140**. The spacers **134** and spacing blocks **140** space the plates **126**, **128** a predetermined distance that allows the upper actuator **32** to fit therebetween. Although an upper frame **24** formed from spaced plates **126**, **128** is preferred, any frame structure, such as formed from beams, tubes, and the like, that can support the upper actuator **32** can be used without departing from the scope of the invention.

Each upper frame plate **126**, **128** has a pair of legs **136**, **138** supporting a cross member **142** above the work platform **54**. Each upper frame plate cross member **142** includes a slot **144** extending between the legs **136**, **138** that slidably mounts the upper actuator **32** for slidable movement between the rails **14**, **16**. Each upper frame plate leg **136**, **138** extends downwardly from one end **146**, **148** of the upper frame plate cross member **142** toward one of the rails **14**, **16** to support the upper frame plate cross member **142** above the work platform **54**. Preferably, the cross member **142** and legs **136**, **138** of each upper frame plate **126**, **128** are formed as an integral piece, such as cut from a single steel plate.

Each upper frame plate leg **136**, **138** has an upper end **152** supporting the upper frame plate cross member **142** and a lower end **156** movably mounted on one of the rails **14**, **16**. Preferably, a roller **112**, **114** rotatably mounted to each upper frame plate **126**, **128** proximal the lower end **156** engages the upper surface **106** of the upper flange **92** to movably mount the legs **136**, **138**, and thus the upper frame **24**, on the rails **14**, **16** for movement between the work platform ends **62**, **64** above the opening **72** in the work platform **54**. A hook **158** extending inwardly from each leg lower end **156** beneath the upper flange **92** engages the lower surface **122** of the upper flange **92** when actuating the upper actuator **32** and engaging the upper actuator ram **36** with the propeller blade **52** to lock the upper frame **24** in place while repairing the propeller **40** or changing the propeller blade pitch.

In a preferred embodiment, each roller **112**, **114** engaging the upper flange upper surface **106** is rotatably mounted on an axle **162** extending inwardly from a bracket **164**, **166** fixed to one of the upper frame plates **126**, **128**. Preferably, the brackets **164** on one upper frame plate **126** and spaced from the upper end **152** of each leg **136**, **138** a distance different from the brackets **166** on the other upper frame plate **128** to movably mount the upper frame **24** at a non-perpendicular angle A relative to the upper flange upper surface **106**, and thus an acute angle relative the tapered shaft axis **78**. Advantageously, movably mounting the upper frame **24** at an angle A (shown in FIG. **7**) allows the upper actuator **32** to engage the propeller blade **52** at an angle more closely approximating the angle of the blade **52** of the propeller **40** mounted on the vertical shaft **44**. In the embodiment disclosed herein, the brackets **164**, **166** are fixed to the upper frame plates **126**, **128**, using methods known in the art, such as welding. Of course, the brackets **164**, **166** can be detachably fixed relative to the upper frame plates **126**, **128**, using mechanical fasteners, such as bolts, to adjust the angle A of the upper frame **24** without departing from the scope of the invention.

The upper actuator **32** is pivotally mounted to the upper frame **24** between the upper frame plate cross members **142** and movable between the rails **14**, **16** to position the upper actuator ram **36** at a desired location on the propeller **40**.

Preferably, the upper actuator **32** is a double acting hydraulic cylinder that allows controlled extension and retraction of the upper actuator ram **36**. Hydraulic hoses supplying hydraulic fluid to the upper actuator **32** and other hydraulic components are not shown to provide a clear view of the apparatus components. Of course, one skilled in the art can route hydraulic hoses to the upper actuator **32**, as desired, without interfering with the operation of the apparatus **10**. Moreover, other actuators, such as single acting hydraulic cylinders, screw jacks and the like, can be used without departing from the scope of the invention.

The upper actuator **32** is fixed to one end of an upper actuator mounting block **172** slidably mounted between the upper frame plate cross members **142** which pivotally mounts the upper actuator **32** relative to the upper frame plate cross members **142**, and thus the upper frame **24**. The upper actuator extends through a longitudinal through hole **168** formed through the upper actuator mounting block **172**. In one embodiment, a bronze bushing (not shown) disposed in the through hole **168** supports radial loads acting on the upper actuator ram **36**, such as caused by side loading and upper actuator ram **36** bending, to protect bearings and seals within the upper actuator **32** and minimizes friction between the upper actuator ram **36** and the upper actuator mounting block **172**. Upper pivot rods **178** (shown in FIG. **10**) extending from opposite sides of the upper actuator mounting block **172** through the slots **144** formed through each upper frame plate cross member **142** define the pivot axis **176** (shown in FIG. **7**) of the upper actuator **32**. A handle **170** fixed to the exposed end **220** of each upper pivot rod **178** provides a grasping point for moving the upper actuator mounting block **172**, and thus the upper actuator **32**, between the rails **14**, **16**.

A slide block **180** axially slidably mounted on each pivot rod **178** adjacent an outwardly facing surface **182** of each upper frame plate **126**, **128** engages the respective upper frame plate **126**, **128** to fix the upper actuator mounting block **172**, and thus the upper actuator **32**, relative to the upper frame **24** when working on the propeller **40**. Preferably, a roller **184** rotatably mounted on an axle (not shown) extending inwardly from at least one of the slide blocks **180** engages a lower surface **190** of the adjacent slot **144** to reduce the effort necessary to slide the upper actuator mounting block **172** between the rails **14**, **16**.

When working on the propeller **40**, the upper actuator mounting block **172**, and thus the upper actuator **32**, is rigidly fixed to the upper frame **24** by two opposing upper hydraulic clamps **174**. Each upper hydraulic clamp **174** is fixed to one of the upper pivot rods **178**, and includes a clamp hydraulic actuator **230** which urges one of the slide blocks **180** axially into engagement with the adjacent upper frame plate **126**, **128** to secure the upper actuator mounting block **172** relative to the upper frame **24** at a desired angle and position along the upper frame plate cross members **142**. Advantageously, the upper hydraulic clamps **174** can be fixed to the respective upper pivot rod **178** using methods known in the art, such as threadably engaging the upper hydraulic clamp **174** with a threaded portion of the upper pivot rod **178**, welding the upper hydraulic clamp **174** to the upper pivot rod **178**, and the like, without departing from the scope of the invention. Moreover, although hydraulic clamps are disclosed, the clamps disclosed herein can be any known clamp suitable for the particular application. For example, pneumatic or manual clamps may be used if the anticipated forces generated by the actuators engaging the propeller dictate that hydraulic clamps are not necessary.

As shown in FIGS. **1-11** and **15**, the lower frame **26** supports the lower actuator **34** below the work platform **54**, and is movably mounted on the rails **14**, **16** for movement along the rails **14**, **16** between the work platform ends **62**, **64**. In a preferred embodiment, the lower frame **26** includes a pair of spaced apart parallel plates **186**, **188** joined together by bolts **192** extending through spacer blocks **200**. The spacer blocks **200** space the lower frame plates **186**, **188** a predetermined distance that allows the lower actuator **34** to fit therebetween. Although a lower frame **26** formed from spaced plates **186**, **188** is preferred, any frame structure, such as formed from beams, tubes, and the like, that can support the lower actuator **34** can be used without departing from the scope of the invention.

Each lower frame plate **186**, **188** has a pair of legs **196**, **198** supporting a cross member **202** beneath the work platform **54**. Each lower frame plate cross member **202** includes a slot **204** extending between the legs **196**, **198** that slidably mounts the lower actuator **34** for slidable movement between the rails **14**, **16**. Each lower frame plate leg **196**, **198** extends upwardly from one end **206**, **208** of the lower frame plate cross member **202** toward one of the rails **14**, **16** to support the lower frame plate cross member **202** beneath the work platform **54**. Preferably, the cross member **202** and legs **196**, **198** of each lower frame plate **186**, **188** are formed as an integral piece, such as cut from a single steel plate.

Each lower frame plate leg **196**, **198** has a lower end **212** supporting the lower frame plate cross member **202** and an upper end **218** movably mounted to one of the rails **14**, **16**. Preferably, a roller **116**, **118** rotatably mounted to each lower frame plate **186**, **188** proximal the upper end **218** engages the upper surface **108** of the lower flange **94** of the rails **14**, **16** to movably mount the legs **196**, **198**, and thus the lower frame **26**, on the rails **14**, **16** for movement between the work platform ends **62**, **64** beneath the opening **72** in the work platform **54**.

In a preferred embodiment, each roller **116**, **118** engaging the lower flange upper surface **108** is rotatably mounted on a spring loaded axle **210** extending inwardly from a bracket **214**, **216** fixed to one of the lower frame plates **186**, **188**. Preferably, the brackets **214** on one lower frame plate **186** are spaced from the lower end **212** of each leg **196**, **198** a distance different from the brackets **216** on the other lower frame plate **188** to movably mount the lower frame **26** at a non-perpendicular angle B (shown in FIG. **7**) relative to the lower flange upper surface **108**, and thus an acute angle relative to the tapered shaft axis **78**. Advantageously, movably mounting the lower frame **26** at an angle B allows the lower actuator **34** to engage the propeller blade **52** at an angle more closely approximating the angle of the blade **52** of the propeller **40** mounted on the vertical shaft **44**. In the embodiment disclosed herein, the brackets **214**, **216** are fixed to the lower frame plates **186**, **188**, using methods known in the art, such as welding. Of course, the brackets **214**, **216** can be detachably fixed relative to the lower frame plates **186**, **188**, using mechanical fasteners, such as bolts, to adjust the angle B of the lower frame without departing from the scope of the invention.

The lower actuator **34** is pivotally mounted to the lower frame **26** between the lower frame plate cross members **202** and movable between the rails **14**, **16** to position the lower actuator ram **38** at a desired location on the propeller **40**. Advantageously, the lower actuator **34** is pivotable independent of the upper actuator **32** which allows the lower actuator **34** to impart a force on the blade **52** in a direction not parallel to the force imparted by the upper actuator **32**. Preferably, the lower actuator **34** is a double acting hydraulic cylinder that allows controlled extension and retraction of the lower actuator ram **38**. Hydraulic hoses supplying hydraulic fluid to the lower actuator **34** are not shown to provide a clear view of the apparatus components. Of course, one skilled in the art can route hydraulic hoses to the lower actuator **34**, as desired, without interfering with the operation of the apparatus **10**. Moreover, other actuators, such as single acting hydraulic cylinders, screw jacks and the like, can be used without departing from the scope of the invention.

The lower actuator **34** is fixed to one end of a lower actuator mounting block **222** slidably mounted between the lower frame plate cross members **202** which pivotally mounts the lower actuator **34** relative to the lower frame plate cross members **202**, and thus the lower frame **26**. The lower actuator **34** extends through a longitudinal through hole **248** formed through the lower actuator mounting block **222**. In one embodiment, a bronze bushing (not shown) disposed in the through hole **248** supports radial loads acting on the lower actuator ram **38**, such as caused by side loading and lower actuator ram **38** bending, to protect bearings and seals within the lower actuator **34** and minimizes friction between the lower actuator ram **38** and lower actuator mounting block **222**. Lower pivot rods **228** (shown in FIG. **5**) extending from opposing sides of the lower actuator mounting block **222** through the slots **204** formed through each lower frame plate cross member **202** define the pivot axis **226** (shown in FIG. **7**) of the lower actuator **34**.

A lower slide block **252** slidably mounted on each lower pivot rod **228** adjacent an outwardly facing surface **254** of each lower frame plate **186**, **188** engages the respective lower frame plate **186**, **188** to fix the lower actuator mounting block **222**, and thus the lower actuator **34**, relative to the lower frame **26** when working on the propeller **40**. Preferably, a roller **256**, shown best in FIG. **16**, rotatably mounted on an axle (not shown) extending inwardly from at least one of the slide blocks **252** engages a lower surface **259** of the adjacent slot **204** to reduce the effort necessary to slide the lower actuator mounting block **222** between the rails **14**, **16**. A handle **262** fixed to the exposed end **264** of each lower pivot rod **228** provides a grasping point for moving the lower actuator mounting block **222**, and thus the lower actuator **34**, between the rails **14**, **16**.

When working on the propeller **40**, the lower actuator mounting block **222**, and thus the lower actuator **34**, is rigidly fixed to the lower frame **26** by two opposing lower hydraulic clamps **266**. Each lower hydraulic clamp **266** is fixed to one of the lower pivot rods **228**, and includes a clamp hydraulic actuator **268** which urges one of the slide blocks **252** into engagement with the adjacent lower frame plate **186**, **188** to secure the lower actuator mounting block **222** relative to the lower frame **26** at a desired angle and position along the lower frame plate cross members **202**. Advantageously, the lower hydraulic clamps **266** can be fixed to the respective lower pivot rod **228** using methods known in the art, such as threadably engaging the lower hydraulic clamp **266** with a threaded portion of the lower pivot rod **228**, welding the lower hydraulic clamp **266** to the lower pivot rod **228**, and the like, without departing from the scope of the invention. Moreover, although hydraulic clamps are disclosed, the clamps disclosed herein can be any known clamp suitable for the particular application. For example, pneumatic or manual clamps may be used if the anticipated forces generated by the actuators engaging the propeller dictate that hydraulic clamps are not necessary.

In the embodiment shown herein, handles **232** rigidly fixed relative to the lower slide blocks allow a user to easily pivot the lower actuator mounting block **222** about a rotational axis of the lower slide block rollers **256** to move the lower actuator mounting block **222**, and thus the lower actuator **34** between the rails **14**, **16** relative to the lower frame **26**. Although the handles **232** are shown for moving the lower actuator **34** relative to the lower frame **26**, the handles **232** can be omitted without departing from the scope of the invention.

A shaft tray **238**, shown in FIGS. **1-11**, fixed to the left end **64** of the work platform **54** includes a plurality of holes **242** for storing additional tapered shafts **244** for use with the threaded ram **84** extending upwardly from the hold down actuator **86**. Preferably, the additional tapered shafts **244** have different diameter ranges for use with different sized propellers.

In use, the tapered shaft **44** suitable for use with the propeller **40** being repaired is selected from the shaft tray **238** and fixed to the threaded ram **84** extending upwardly from the hold down actuator **86**. The propeller **40** is then slipped onto the tapered shaft **44** with the blade **52** being repaired positioned over the opening **72** formed in the work platform **54**. The prop nut **88** is threaded onto the threaded stub **70** extending upwardly from the tapered shaft **44** to secure the propeller **40** to the tapered shaft **44**. The hold down actuator **86** is then actuated to draw the tapered shaft **44** downwardly against the work platform **54**.

Once the propeller **40** is positioned and secured, the upper frame **24** is moved over the propeller blade **52** to align the upper actuator **32** with a plane containing a desired location on the upwardly facing surface **46** of the propeller blade **52** extending over the opening **72** formed in the work platform **54**. The upper actuator ram **36** is then aligned with the desired location on the upwardly facing surface **46** of the propeller blade **52** by sliding the upper actuator **32** parallel to the upper frame plate cross members **142** and/or pivoting the upper actuator **32** above the upper actuator pivot axis **176**. The upper actuator **32** is then actuated to extend the upper actuator ram **36** into engagement with the propeller blade **52** and lift the upper frame **24** to engage the upper frame plate hooks **158** with the lower surface **122** of the upper flanges **92** of the rails **14**, **16** and hold the upper frame **24** in place.

Once the upper frame **24** is secured in place, the lower frame **26** is moved beneath the propeller blade **52** to align the lower actuator **34** with a plane containing a desired location on a downwardly facing surface **48** the propeller blade **52** extending over the opening **72** formed in the work platform **54**. The lower actuator ram **38** is then aligned with the desired location on the downwardly facing surface **48** of the propeller blade **52** by sliding the lower actuator **34** parallel to the lower frame plate cross members **202** and/or pivoting the lower actuator **34** above the lower actuator pivot axis **226**. The lower actuator **34** is then actuated to extend the lower actuator ram **38** into engagement with the propeller blade **52** at the desired location on the downwardly facing surface **48** of the propeller blade **52**.

Once both the upper and lower actuator rams **36**, **38** are engaging the propeller blade **52**, one or both of the actuators **32**, **34** are actuated to urge the propeller blade **52** in a desired direction to repair the blade **52** or change the blade pitch. Advantageously, the upper and lower actuators **32**, **34** can be easily disengaged and moved to different locations on the blade **52** by repeating the above steps.

The present invention is not limited to the above described applications, and one skilled in the art will be able to incorporate the present invention into other applications that fall within the scope of the claims. Moreover, while there has been shown and described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention defined by the appended claims.

We claim:

1. A propeller repair apparatus suitable for repairing and changing the pitch of a propeller, said apparatus comprising:

a first rail;

a second rail spaced from said first rail and parallel to said first rail;

a tapered shaft extending upwardly between said first and second rails for mounting a propeller thereon;

a first frame extending between said first and second rails, said frame being movably mounted on said first and second rails for movement along said first and second rails, and

a first actuator pivotally mounted to said first frame, said first actuator including an extendible ram engagable with a propeller mounted on said tapered shaft;

a second frame extending between said first and second rails, said second frame being movably mounted on said first and second rails for movement along said first and second rails; and

a second actuator pivotally mounted to said second frame, said second actuator including an extendible ram engagable with a propeller mounted on said tapered shaft.

2. The apparatus as in claim **1**, in which said first actuator is movably mounted to said first frame for movement between said first and second rails.

3. The apparatus as in claim **1**, in which said first actuator is mounted above said rails, and said second frame is mounted below said rails.

4. The apparatus as in claim **1**, in which said second actuator is movably mounted to said second frame for movement between said first and second rails.

5. The apparatus as in claim **1**, including a work platform extending between said first and second rails.

6. The apparatus as in claim **1**, in which said tapered shaft defines an axis, and said first frame defines an acute angle relative to said axis.

7. The apparatus as in claim **1**, in which at least one of said first frame and said second frame includes a pair of spaced parallel plates, and said first actuator is disposed between said plates.

8. The apparatus as in claim **1**, including a work platform extending between said first and second rails.

9. The apparatus as in claim **1**, in which said first and second rails are horizontal.

10. A propeller repair apparatus suitable for repairing and changing the pitch of a propeller, said apparatus comprising:

a first rail;

a second rail spaced from said first rail and parallel to said first rail;

a tapered shaft extending upwardly between said first and second rails for mounting a propeller thereon;

an upper frame extending between said first and second rails above said tapered shaft, said upper frame being movably mounted on said first and second rails for movement along said first and second rails;

an actuator movably mounted to said upper frame for movement between said first and second rails, said actuator including an extendible ram engagable with a propeller mounted on said tapered shaft;

a second frame extending between said first and second rails, said second frame being movably mounted on said first and second rails for movement along said first and second rails; and

a second actuator movably mounted to said second frame, said second actuator including an extendible ram engagable with a propeller mounted on said tapered shaft.

11. The apparatus as in claim **1**, in which said actuator is pivotally mounted to said upper frame.

12. The apparatus as in claim **10**, in which said first actuator is mounted above said rails, and said second frame is mounted below said rails.

13. The apparatus as in claim **10**, in which said second actuator is pivotally mounted to said second frame for movement between said first and second rails.

14. The apparatus as in claim **10**, including a work platform extending between said first and second rails.

15. The apparatus as in claim **10**, in which said tapered shaft defines an axis, and said first frame defines an acute angle relative to said axis.

16. The apparatus as in claim **10**, in which at least one of said upper frame and said second frame includes a pair of spaced parallel plates, and said first actuator is disposed between said plates.

17. The apparatus as in claim **10**, including a work platform extending between said first and second rails.

18. The apparatus as in claim **10**, in which said first and second rails are horizontal.

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