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Auxer

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[54] **TENSION EQUALIZER**

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[52] **U.S. Cl.** **212/65**; 267/70

[51] **Int. Cl.** **B66c 23/88**

[58] **Field of Search** ..... 254/135 CE, 165, 166, 172, 254/162; 267/70, 137; 403/54, 57; 280/492; 180/52, 53; 212/65; 214/127

[56] **References Cited**

UNITED STATES PATENTS

739,955	9/1903	DeVou	212/65
1,465,120	8/1923	Fair	267/70
1,656,301	1/1928	Stevens	267/137
1,884,981	10/1932	Otto	267/70
2,057,658	10/1936	Bryant	280/492
2,551,456	5/1951	Oerman	267/70
2,851,904	9/1958	Banek	267/70
2,852,958	9/1958	Banek	267/70
3,411,809	11/1968	Kampert et al.	280/492
3,552,695	1/1971	Liesegang	267/70
3,731,750	5/1973	Brazell	280/492

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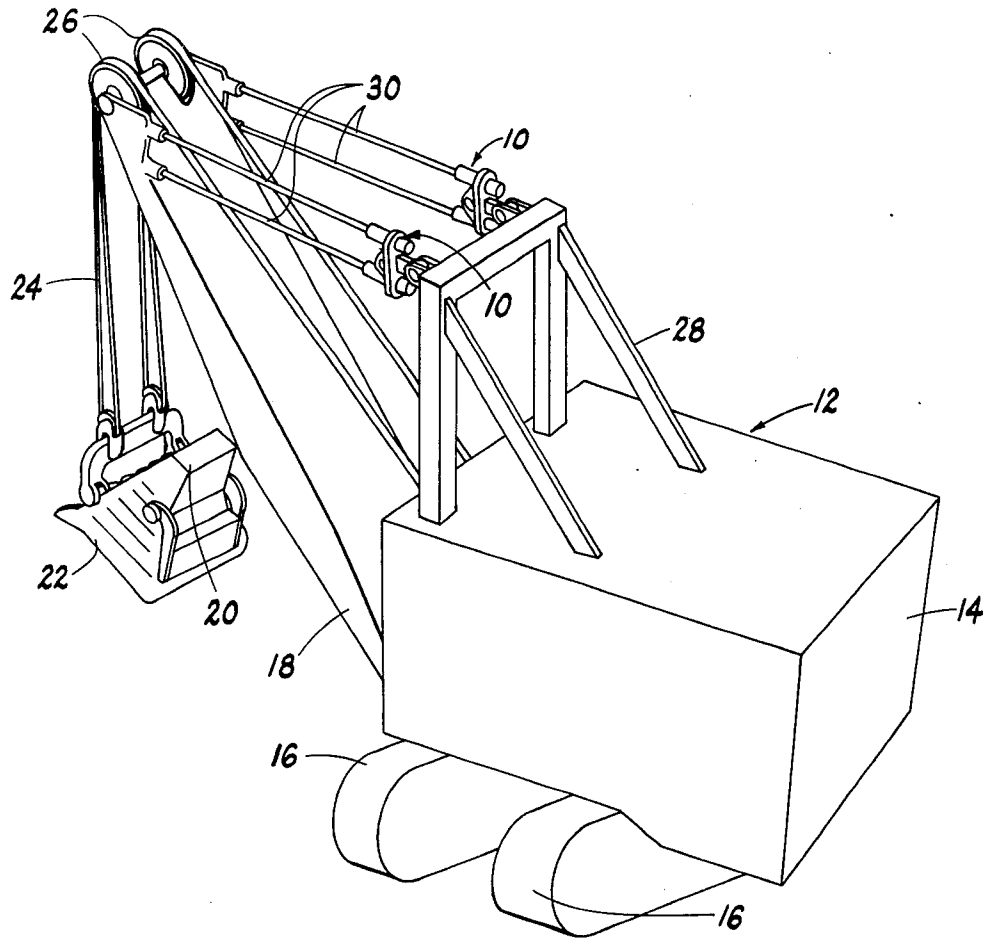
[57] **ABSTRACT**

A tension equalizer device for use with large excavating machines having a boom member, gantry means and multiple jib lines connected therebetween, the said tension equalizer device comprising an elongated connector arm having one end thereof pivotally connected to the gantry means, a yoke member universally pivotally connected to the opposite end of the connector arm, a plurality of oppositely disposed yieldable connector means pivotally connected to the outer extremities of the yoke member, each of the said yieldable connector means being connected to one end of a jib line for maintaining substantially equal tension between the said jib lines.

6 Claims, 4 Drawing Figures



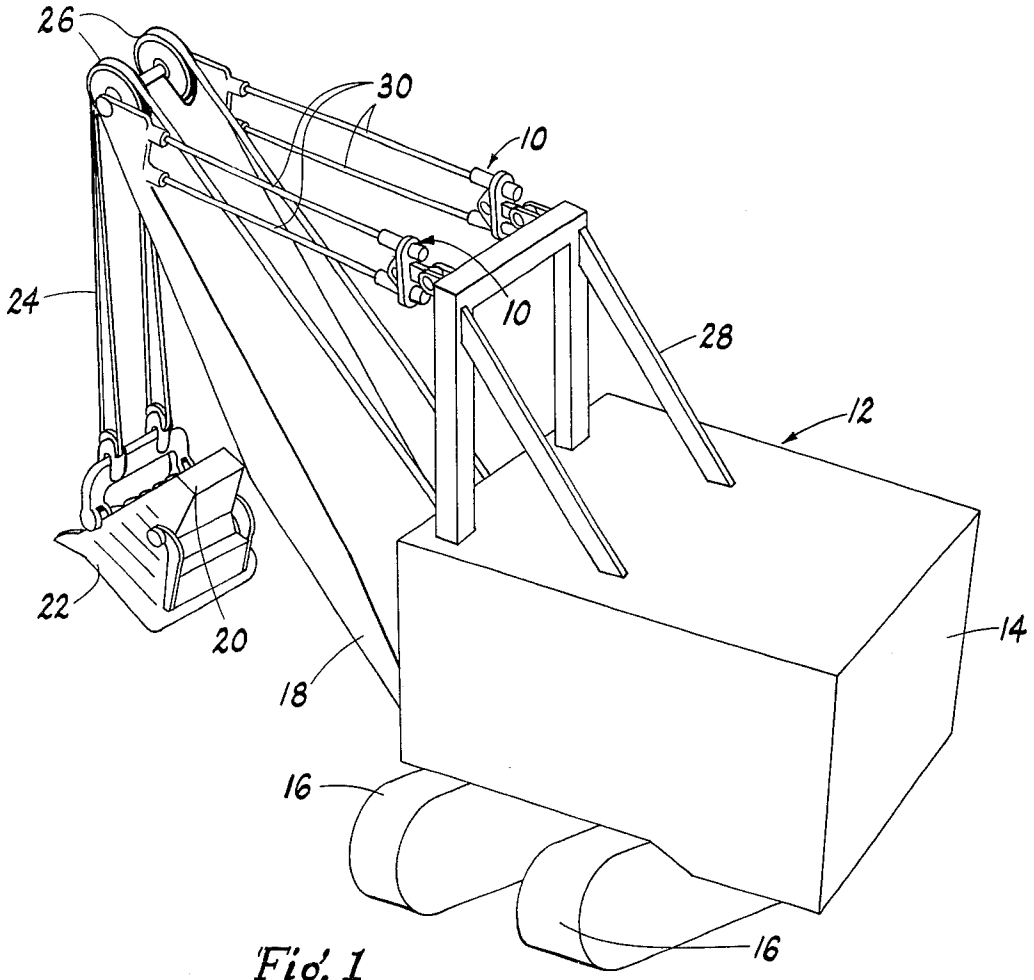

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Fig. 1

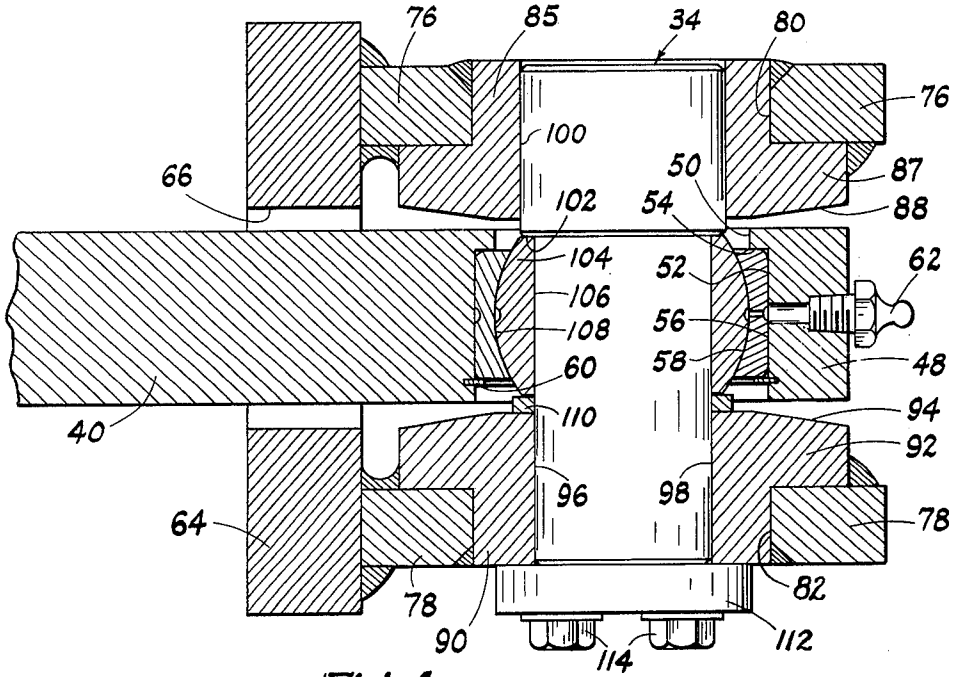
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Fig. 4

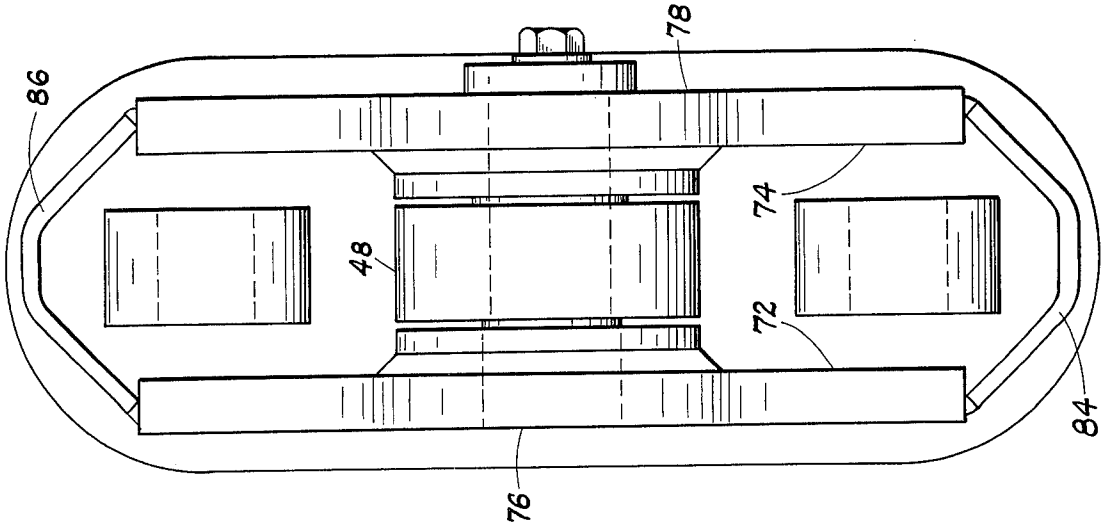
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Fig. 3

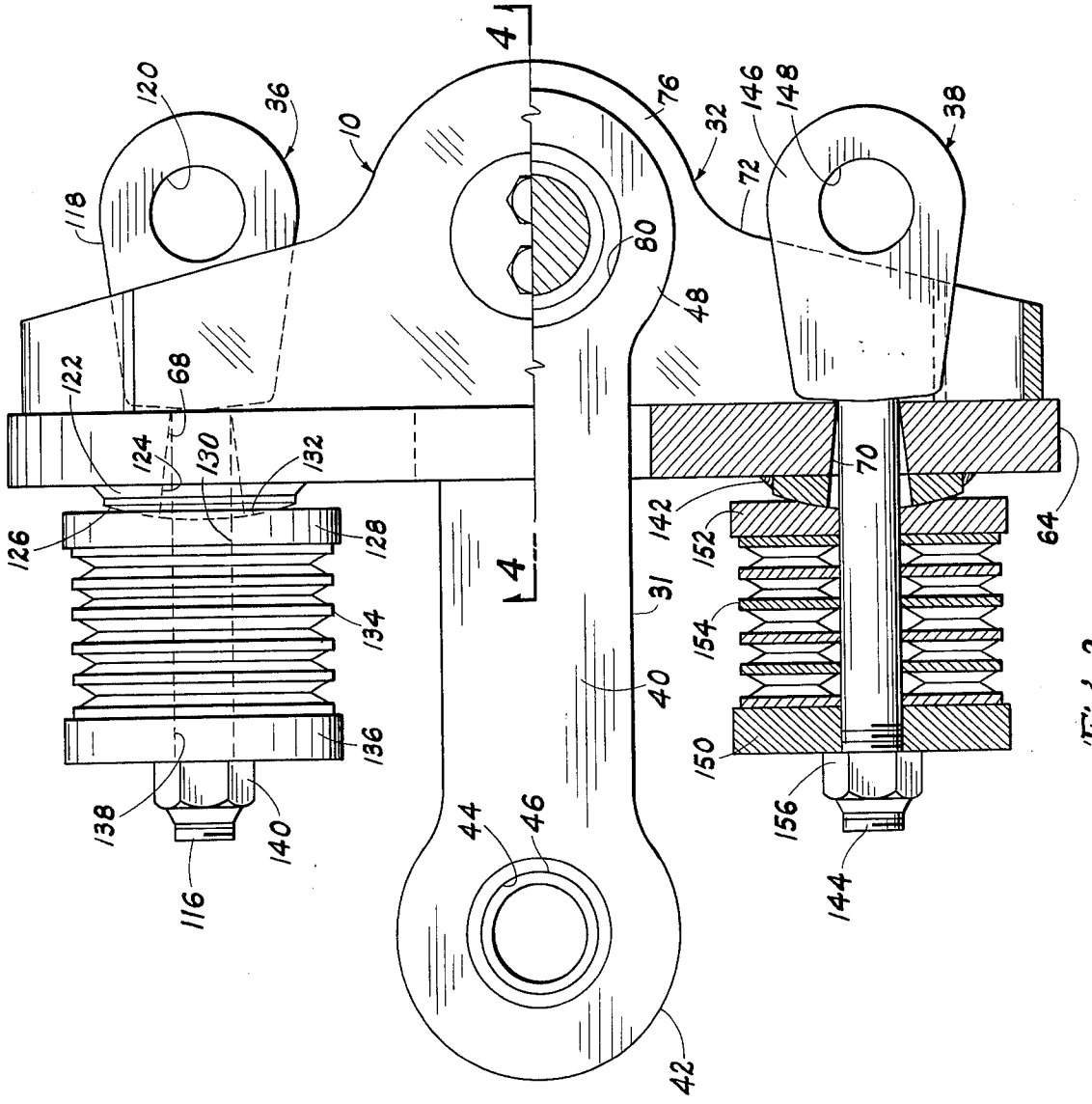
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Fig. 2

TENSION EQUALIZER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a multiple line tension equalizer device and more particularly but not by way of limitation to a tension equalizer device for maintaining substantially equal tension among a plurality of jib lines connected between an excavating machine gantry and an outwardly and upwardly extending boom member, the said device also serving to absorb shocks due to rapidly changing loads exerted on the said boom member.

2. Description of the Prior Art

Heretofore, large excavating machines, electric shovels and the like, which utilize a massive boom structure have required the use of a plurality of jib lines to provide support for the outwardly extending boom member. Normally, these electric shovels comprise a housing member swivelly mounted on mobile track means, the said housing being provided with a heavy duty vertically extended gantry means. An extremely large heavy duty boom member is pivotally secured to the base of the housing and extends upwardly and outwardly therefrom. A shovel having an elongated shovel arm member is pivotally secured to the boom member near the midpoint thereof. To provide support for the boom member, a plurality of jib lines are connected between the outer end of the boom member and the upper portion of the gantry means.

In order for the plurality of jib lines to provide sufficient support for the boom member, it is necessary that substantially equal tension be maintained therebetween. In the past this equal tension has been maintained by very strictly controlling the length of the jib lines, in that if one of the jib lines happens to be too short, substantially all of the load is transferred to that jib line which many times causes failure of the said jib line thereby abruptly transfering all of the load to the remaining jib lines. This often causes catastrophic failure of the boom support means. Catastrophic failure of the boom support means often results in damage to the shovel itself or to vehicles being loaded by the shovel and greatly endangers the workmen in the area.

In an attempt to overcome this problem each pair of jib lines have been connected to opposite ends of a swivel plate or bar member, the said bar member being pivotally secured to the gantry means so that when too much tension is present in one of the jib lines the bar means is swivelled thereby tightening the opposite jib line which in turn tends to equalize the tension therebetween. This attempted corrective measure has been somewhat successful in that the swivel plate does tend to equalize the tension between pairs of jib lines.

However, the use of the swivel plate still has certain disadvantages. It has been found that even with the use of a swivel plate it is necessary to control the lengths of the jib lines to as close as ⅛ inch tolerance in order to effectively equalize the tension between the jib lines. This solution still results in substantially hard mounting thereby causing the jib lines to be subject to extreme shock loads during rapid movements of the shovel or when the shovel member encounters hard substances during the operation thereof.

SUMMARY OF THE INVENTION

The present invention contemplates a novel tension equalizer device designed and constructed for overcoming the above disadvantages. The tension device is provided with a connector arm which is pivotally secured to the gantry means and a yoke member which is universally pivotally connected to the opposite end of the connector arm. A plurality of oppositely disposed yieldable connector means are pivotally connected to the yoke member on opposite sides of the connector arm, each said yieldable connector means being secured to one end of a jib line. Since each jib line is connected to a yieldable connection arm, it is no longer necessary to hold the length of the said jib lines to such close tolerances since the yieldable connector arm will compensate for small differences in the lengths of the said jib lines. The universally pivotally mounted yoke member will serve to equalize the tension between the jib lines that are connected thereto in a manner similar to the afore-described swivel plate.

Also since the jib lines are connected to yieldable connector means this will serve as a shock mounting for the jib lines to compensate for rapid changes in load occurring when the shovel is jarred or encounters hard materials during the shovelling operation.

DESCRIPTION OF THE DRAWINGS

Other and further advantageous features of the present invention will hereinafter more fully appear in connection with a detailed description of the drawings in which:

FIG. **1** is a perspective view of an electric shovel apparatus provided with jib line tension equalizers embodying the present invention.

FIG. **2** is an elevational view of a tension equalizer device embodying the present invention, the said view being partially in section for purposes of clarity.

FIG. **3** is an elevational end view of the tension equalizer of FIG. **2.**

FIG. **4** is a sectional view of the pivotal mounting of the yoke member of FIG. **2** taken along the broken lines **4—4** of FIG. **2.**

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings in detail, reference character **10** generally indicates a tension equalizer device for use with a heavy duty earth moving or excavating device **12.** The excavating machine **12** is typical of machines used on mammoth construction jobs, near surface mining operations and may be barge mounted for heavy dredge work. The excavating machine shown in FIG. **1** generally comprises a housing **14** which is rotatably mounted on vehicle track means **16.** An elongated boom means **18** is pivotally secured to the lower portion of the housing **14** and extends upwardly and outwardly therefrom. A shovel connecting arm **20** (the lower end of which is shown only) is pivotally secured to the boom member **18** at a location near the midpoint of the said boom **18** (in a manner considered conventional and, hence, not shown). The connecting arm **20** is disposed generally outwardly and downwardly from the boom **18.** A shovel member **22** is pivotally secured to the outer end of the connecting arm **20** and is operably connected to the housing by means of a plurality of cables **24** which extend from the shovel member **22** over a plurality of sheaves **26,** the opposite end of the

said cables **24** being operably connected to a motor driven wench or the like, (not shown) located on the housing **14.** The housing **14** is also provided with an upwardly extending gantry means **28** which is rigidly secured to the top of the housing **14.** In order to provide the boom member **18** with sufficient support to maintain the said boom member at the desired angle with respect to the housing **14** a plurality of jib lines **30** are connected between the outer end of the boom member **18** and the gantry means **28.** In order to provide proper support for the said boom member **18,** the jib lines **30** are constructed and attached in a manner which will equally distribute the tension between the said jib lines.

The tension equalizer device **10** generally comprises a elongated connector arm **31** having one end thereof pivotally secured to the gantry means **28.** An elongated yoke member generally indicated by reference character **32** is universally pivotally secured to the opposite end of the elongated connector arm **31** by means of a ball joint assembly generally indicated by reference character **34.** A yieldable connector means generally indicated by reference character **36** is pivotally secured to the yoke member **32** and spaced from the ball joint connector assembly **34.** The yieldable connector means **36** is operably connected to one of the jib lines **30** of the excavating machine **12.**

A second substantially identical yieldable connector means generally indicated by reference character **38** is pivotally connected to the yoke member **32** on the opposite side of the ball joint connector assembly and is operably connected to a second jib line **30** of the excavating machine **12.**

The elongated connector arm **31** comprises an elongated flat plate **40** having an enlarged portion **42** at one end thereof. The enlarged portion **42** is provided with a centrally disposed bore **44** therein, the axis thereof being perpendicular to the plain of the flat bar **40.** A suitable bearing member **46** is disposed within the bore **44** for pivotally attaching the said bar **40** to the gantry means **28.** The orientation of the connector arm **31** depends on the orientation of the jib lines to be connected to the tension equalizer device **10.** The connector arm **31** should be connected to the gantry **28** in such a way that the flat bar **40** lies in the plane formed by the two jib lines that are to be connected to the tension equalizer device **10.**

The opposite end of the bar **40** is provided with an enlarged portion **48** having a centrally disposed bore **50** therethrough. A second bore **52** is provided in the enlarged portion **48** of the bar **40** part way through the said enlarged portion **48** and disposed in concentric alignment with the bore **50** thereby forming an annular shoulder **54.** The shoulder **54** is disposed adjacent to one surface of the enlarged portion **48** of the bar **40,** for a purpose that will be hereinafter set forth. An annular shaped ball race or socket member **56** having a substantially spherical concave inner surface **58** is disposed within the partial bore **52** of the enlarged portion **48** of the bar **40.** The race **56** is disposed against the annular shoulder **54** and is held in place by an annular retainer ring **60** which is secured to the inner surface of the bore **52.** A grease zerk **62** being in open communication with the interior of the race **56** for applying lubricant to the interior surface **58** of the said ball race **56.**

It is noted that the race **56** must be either split or constructed of a plyable material for installation of a ball which will be hereinafter described.

The yoke member **32** comprises an elongated rectangular shaped plate **64** having a centrally disposed rectangular aperture **66** for loosely receiving the elongated connector arm **31** therethrough. The width of the aperture **66** must be sufficient to allow either the enlarged portion **48** or the enlarged portion **42** of the connector arm **31** to pass therethrough for installation. A first conical shaped bore **68** is provided in the plate **64** and is spaced from the rectangular aperture **66** to allow pivotal installation of the yieldable connector member **36** in a manner that will be hereinafter set forth. A second substantially identical conical shaped bore **70** is provided in the plate **64** and is spaced from the rectangular aperture **66** on the opposite side of the said aperture **66** from the conical shaped bore **68.** The conical shaped bore **70** is provided for pivotally mounting the yieldable connector means **38** in a manner that will be hereinafter set forth.

A pair of spaced yoke plates **72** and **74** are secured along one edge thereof to the plate **64** and extend outwardly therefrom. The said yoke plates **72** and **74** are provided with centrally disposed enlarged portions **76** and **78** respectively, the said enlarged portions **76** and **78** being provided with centrally disposed concentric bores **80** and **82,** respectively. The yoke plates **72** and **74** are connected at each end by oppositely disposed substantially U-shaped strengthening members **84** and **86** to aid in holding the said plates **72** and **74** in substantially parallel alignment with respect to each other.

The ball joint assembly **34** comprises a sleeve member **85** which is disposed within the bore **80** of the yoke plate **76.** The sleeve member **85** is provided with an annular shaped outwardly extending flange member **87** which is disposed against the yoke plate **76** between the yoke plate **76** and the yoke plate **78.** The inner surface of the flange member **87** is provided with an external bevel **88** for a purpose that will be hereinafter set forth. A substantially identical oppositely disposed sleeve member **90** is disposed within the bore **82** of the yoke plate **78,** the said sleeve member **90** also being provided with an annular shaped outwardly extending flange member **92** which is disposed against the inner surface of the yoke plate **78** between the said yoke plate **78** and the yoke plate **76.** The flange member **92** is likewise provided with an annular shaped external bevel **94** around the inner surface thereof for a purpose that will be hereinafter set forth.

An elongated cylindrical shaped pin member **96** has one end thereof disposed within the inner surface **98** of the sleeve member **90,** the opposite end of the pin member **96** being provided with an enlarged cylindrical segment **100** thereby providing an annular shaped shoulder **102** at the joint between the pin member **96** and the cylindrical segment **100.** A torus shaped ball member **104** having an outer substantially spherical surface **108** and an elongated bore **106** therethrough for receiving the pin member **96** therethrough is disposed on the said pin member **96** with one end thereof being disposed against the shoulder member **102** of the pins **96** and **100.** The spherical surface **108** is disposed in sliding engagement with the annular shaped ball race **56** for universal movement with respect thereto.

An annular shaped retainer ring **110** is secured around the pin member **96** adjacent to the opposite end

of the ball member **104** for securing the said ball member **104** in place against the annular shaped shoulder surface **102.** A retaining plate **112** is secured to the outer end of the pin member **96** by a plurality of bolts **114** for holding the said pin member in place with respect to the yoke **32.**

It is readily apparent that when the enlarged portion **48** of the connector arm **40** having the ball race **56** installed is connected to the yoke member **32** having the ball joint assembly **34** secured thereto, substantially universal movement is provided between the connector arm **40** and the yoke assembly **32.** The yoke assembly **32** is provided with substantially free rotational movement about an axis defined by the pin members **96** and **100** and is provided with pivotal freedom at right angles to the axis defined by the pin members **96** and **100** to the extent allowed by the bevels **88** and **94** provided in the sleeve members **85** and **90** respectively.

The yieldable connector means **36** comprises an elongated rod **116** which is slidably disposed within and through the conical shaped bore **68** of the rectangular plate member **64.** One end of the rod **116** is provided with enlarged portion **118** having a centrally disposed bore **120** therethrough. The enlarged portion **118** is generally disposed between the yoke plate members **76** and **78.** The bore **120** through the enlarged portion **118** is for the purpose of being connected to a jib line **30** of the excavating device **12.** An annular shaped pivot plate **122** is secured to the rectangular plate **64** in concentric alignment with the conical shaped bore **68** therethrough. The pivot plate **122** is provided with a conical shaped bore **124** therethrough which in effect serves as an extension of the conical shaped bore **68** in the plate **64.** The plate **122** is disposed on the opposite side of the plate **64** from that of the yoke plates **76** and **78** and is provided with a substantially spherical shaped outer surface **126** thereon for purposes that will be hereinafter set forth.

A substantially cylindrical shaped plate member **128** having a centrally disposed bore **130** therethrough is journalled on the elongated rod **116** and disposed adjacent to and in contact with the substantially spherical surface **126** of the plate **122.** The plate **128** is provided with a substantially spherical shaped recess **132** which is disposed in sliding contact with the spherical surface **126** of the pivot plate **122.** Heavyduty yieldable compression pad means **134** is slidably disposed on the elongated rod **116** having one end thereof disposed against or secured to the plate member **128.** The compression pad means may be similar to that provided by the heavy-duty pad members in the patent to Doennecke, Ser. No. 3,307,855 issued in 1967 and entitled "Lateral Suspension Mounting". A second cylindrical shaped retaining plate **136** having a bore **138** therethrough is slidably disposed on the elongated rod **116** and is disposed against or secured to the opposite end of the yieldable compression pad means **134.** The retaining plate members **128** and **130** and associated yieldable pad means **134** therebetween are held on the elongated rod **116** by a nut member **140** which is threadedly secured to the outer end of the elongated rod **116.**

It is readily apparent, from the foregoing that when a jib line **30** is connected to the enlarged portion **118** of the elongated rod **116,** tension or longitudinal shock along the jib line is partially absorbed by means of the reciprocal movement of the elongated rod through the plate member **64** the said movement being resisted by the compression pad means **134.** Any lateral tension applied to the jib line **30** may be taken out by means of the conical shaped bore **68** allowing the elongated rod **16** and the yieldable compression pad means **134** to have somewhat universal pivotal freedom about the spherical shaped pivot plate **122.**

The yieldable connector means **38** is substantially identical to the connector means **36** and generally comprises a pivot plate **142** which is substantially identical to the pivot plate **122** of the yieldable connector means **136.** An elongated rod **144** is reciprocally disposed through the conical shaped bore **70** of the plate **64** and is provided with an enlarged portion **146** at one end thereof, the said enlarged portion **146** being provided with a bore **148** for connecting one end of a jib line **30** thereto. A pair of spaced retainer plates **150** and **152** are slidably disposed on the elongated rod **144,** the plate **152** being disposed in sliding engagement with the pivot plate **142.** Yieldable compression means **154** is slidably disposed on the rod **144** between the plates **150** and **152** and may be secured thereto. The retainer plates **150** and **152** with their associated yieldable means **154** disposed therebetween are held in place on the elongated rod **144** by means of a nut **156** which is threadedly secured to the outer end of the elongated rod **144.**

In operation, the tension equalizer device **10** is pivotally connected to the gantry means **28,** one tension equalizer device for each pair of jib lines **30** being utilized on the excavating machine **12.** If the device **10** is used on a machine similar to that shown in FIG. **1,** the enlarged portion **42** of the connector arm **40** is pivotally secured to the gantry means **28** in a manner so that the yoke assembly **32** will generally lie in a plane formed by the pair of jib lines to be connected thereto. One of the jib lines **30** is then connected to the enlarged portion **118** of the yieldable connector means **36,** the other jib line **30** being connected to the enlarged portion **146** of the yieldable connector means **38.** Since the tension equalizer device **10** is pivotally mounted to the gantry means **28** as hereinbefore described it will automatically align itself in a direction coinciding with the general alignment of the jib lines **30.** This feature will also allow the opposite end of the jib lines **30** to be connected to substantially any part of the outwardly extending boom member **18** or by the changing of jib lines allow the boom member **18** to be positioned at any desired angle with respect to the housing **12.**

Also, since the yoke assembly **32** is freely pivotal around the axis of the bore **80,** the said yoke plates **76** and **78** with their associated rectangular plate **64** will automatically align itself to compensate for any differences in length of the said jib lines. Therefore, if during the operation of the excavating for some reason the tension on one jib line becomes greater than the tension in the second jib line, the yoke assembly **32** will tend to rotate thereby transferring tension in an equal amount to the opposite jib line constantly keeping equal tension between the said jib lines which serves to equally distribute the load thereon.

Further, any misalignment of the jib lines with respect to the connector arm **40** will be compensated for by the universal ball joint assembly **34** of the yoke assembly **32.** Also any misalignment of the jib lines with respect to each other is compensated for by the substantially universal pivotal movement of the yieldable

connector means **36** and **38.** It is also obvious that shock loads present in the jib lines **30** will be absorbed by the yieldable compression pad members **134** and **154** of the yieldable connector means **36** and **38,** respectively.

From the foregoing, it will be apparent that the present invention provides a tension equalizer device particularly designed and constructed for equalizing the tension in two load carrying jib lines utilized in large excavating machines or cranes as hereinbefore described. The novel tension equalizer device is economical and durable in construction and simple and efficient in operation.

Whereas, the present invention has been described in particular relation to the drawings attached hereto, it should be understood that other and further modifications, apart from those shown or suggested herein, may be made within the spirit and scope of this invention. For example, several tension equalizer devices as hereinbefore described may be connected in a whipple tree fashion to the gantry means so that tension equalization may be accomplished for several jib lines.

What is claimed is:

1. In a large excavating machine of the type having a boom member, a gantry means, a first plurality of jib lines connected from one side of said gantry means to one side of said boom member, and a second plurality of jib lines connected from an opposite side of said gantry means to an opposite side of said boom member in spaced relation to the first-mentioned plurality of jib lines; a tension equalizer device for each plurality of jib lines, each tension equalizing device comprising an elongated connector arm having one end thereof pivotally connected to the gantry means, a yoke member, pivotal yoke attachment means for universally and pivotally connecting the yoke member to the opposite end of the connector arm, a plurality of spaced yieldable connector means disposed on opposite sides of the yoke attachment means, means for pivotally attaching the yieldable connector means to the yoke member, said plurality of yieldable connector means being connected respectively to the ends of a plurality of jib lines for maintaining substantially equal tension among the said jib lines.

2. In a large excavating machine of the type having a boom member, a gantry means, at least one pair of jib lines connected from one side of said gantry means to one side of said boom member and at least one pair of jib lines connected from an opposite side of said gantry means to an opposite side of said boom member in spaced relation to the first-mentioned pair of jib lines; a tension equalizer device for each pair of jib lines, each tension equalizer device comprising an elongated connector arm having one end thereof pivotally connected to the gantry means, a yoke member, pivotal yoke attachment means for universally and pivotally connecting the yoke member to the opposite end of the connector arm, a spaced pair of yieldable connector means disposed on opposite sides of the yoke attachment means, means for pivotally attaching the yieldable connector means to the yoke member, said pair of yieldable connector means being connected respectively to the ends of a pair of jib lines for maintaining substantially equal tension between the said jib lines.

3. A tension equalizer device as set forth in claim **2** wherein the elongated connector arm comprises an elongated bar having a bore through one end thereof, bearing means disposed within the bore for pivotally attaching one end of the said bar to the gantry means, the opposite end of the said bar being provided with a second bore therethrough the said second bore having a center axis parallel to the first bore for accepting the yoke attachment means therein.

4. A tension equalizer device as set forth in claim **2** wherein the yoke member comprises an elongated bar, a pair of spaced substantially parallel yoke plate members secured to the elongated bar, a pair of centrally disposed aligned bores provided in the spaced yoke plate members for securing the yoke attachment means therein, and means for pivotally attaching the yieldable connector means to the yoke member being provided on the elongated bar.

5. A tension equalizer device as set forth in claim **2** wherein the yoke attachment means comprises a ball assembly which is rigidly secured to the yoke member and a ball race member which is rigidly secured to the elongated connector arm, the said ball race member being in sliding engagement with the ball assembly for providing substantially universal pivotal movement between the connector arm and the yoke member.

6. A tension equalizer device as set forth in claim **2** wherein each yieldable connector means comprises an elongated connector rod which is reciprocally connected to the yoke member, one end of the said connector rod being provided with attachment means for securing a jib line thereto, the opposite end of the connector rod being provided with removable retainer means, and yieldable compression pad means slidably disposed on the connector rod and interposed between the retainer means and the yoke member whereby upon tension being applied in the jib line the said retainer member is moved toward the yoke member, the said movement being resisted by the yieldable pad means interposed between the retainer member and the yoke member.

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