TENSION EQUALIZER

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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 3/1951 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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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 univ- ersally 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
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 outwardly and upwardly 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 transferring 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 1/8 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 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
3 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 88 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 pliable 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 30 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 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 elongated 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 is 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 sidely disposed within and through the conical shaped bore 68 of the rectangular plate member 64. One end of the rod 116 is provided with an 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 journaled 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 Doenecke, 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 place 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 36. 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 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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