Title of the Invention: Improvements to load spreading assemblies
Abstract Title: Load spreader with a beam and four load-bearing parts

A load spreading assembly for a crane, comprising a beam 1 and four load bearing parts 9, 19 for securing lifting cables. The load bearing parts are arranged in pairs, one pair at each end of the beam, each pair of load bearing parts 10, 11 are fixed relative to the beam 1 and are arranged symmetrically with a load bearing part 10, 11 either side of the beam 1. Each load bearing part comprises a retaining element 21, 22 arranged to retain a lifting cable 18 on the load bearing part 10, 11. Preferably, each of the pairs supported by a fixture 4 at either side of the beam 1. The fixtures may comprise a shaft 9, which is held in place by mechanical means such as keep plates [23, 24, figure 5] which engage with grooves in the shaft 9.
IMPROVEMENTS TO LOAD SPREADING ASSEMBLIES

The present invention relates to lifting equipment and particularly to a lifting fixture for a load spreading assembly.

Load spreading assemblies are used to spread the load from a single lifting point on the hook of a crane between multiple lifting points which may be widely spaced to provide a more stable lifting arrangement and to spread the load and lifting forces in the load being lifted. The load spreader assembly is typically attached to the crane hook using cables and the load to be lifted is attached to the load spreader assembly using further cables. The cables are normally attached to the load spreader assembly using fixtures such as shackles which are attached to the beams. A problem with shackles is that they can be difficult to open and close around the cables, especially for large loads, and are expensive to produce.

Accordingly the invention provides a load spreading assembly comprising a beam and four load bearing parts for securing lifting cables, wherein the load bearing parts are arranged in pairs, one pair at each end of the beam, each pair of load bearing parts are fixed relative to the beam and are arranged symmetrically with a load bearing part either side of the beam, and wherein each load bearing part comprises a retaining element arranged to retain a lifting cable on the load bearing part. Each load bearing part may project in a direction perpendicular to the beam.

The load spreading assembly may further comprise two fixtures, wherein each fixture may be connected to a respective end of the beam and each fixture may support one of the pairs of load bearing parts with one of the loading bearing parts on each side of the beam. Each fixture may comprise a body which is connected to an end of the beam and the body may support a shaft which extends through the body and load bearing parts may be parts of the shaft on either side of the body.

The beam may have a central longitudinal axis which extends in a direction aligned with the length of the beam and the shaft of each fixture may be arranged to pass through the central axis in a direction perpendicular to the longitudinal axis. A separate lifting cable may be attached to each load bearing part, the cables may extend above the beam and support the beam in use. A second separate lifting cable may be
attached to each load bearing part, the cables may extend below the beam to support a load in use. At each end of the beam, two lifting cables from a lifting hook may support one of the fixtures at points equidistant from the central axis and two lifting cables to a load may be supported on one of the fixtures at points equidistant from the central axis.

The retaining element may be a pin which passes through a hole in the shaft, e.g. at the free end of the shaft, and protrudes either side of the hole e.g. in a T shaped configuration with the shaft.

Each fixture may comprise connecting means arranged to mechanically connect the shaft to the body. The connecting means may substantially prevent rotation and lateral movement of the shaft relative to the body.

The connecting means may comprise a pair of keep plates fixed to the body which engage with grooves formed in the shaft. Each fixture may further comprise securing means which attach between the retaining elements and the body which prevent lifting cables being removed from the fixture.

The invention further provides a fixture for a load spreading assembly comprising a load bearing shaft supported by a body, wherein the load bearing shaft is connected to the body via connecting means, wherein the connecting means is arranged to mechanically connect the shaft to the body and to substantially prevent rotation and lateral movement of the shaft relative to the body. The connecting means may comprise a keep plate which engages with a groove formed in the shaft. The keep plate may comprise two angled surfaces. Each angled surface may be arranged to substantially prevent rotation of the shaft and each angled surface may prevent rotation in a direction opposite to that of the other angled surface. The two angled surfaces of the keep plate may meet at a point and form an obtuse angle. Each angled surface of the keep plate may be arranged to engage with the base of the groove in the shaft. The load bearing shaft may extend through a hole in the body and two pairs of keep plates may be provided, one pair on each side of the body where the shaft enters and exits the body.
The invention further provides a fixture for a load spreading assembly comprising a pair of load bearing parts supported by a body, wherein the pair of load bearing parts are fixed relative to the body and are arranged symmetrically with a load bearing part either side of the body, wherein the body is arranged to be connected to the end of a load spreading beam, and wherein each load bearing part comprises a retaining element arranged to retain a lifting cable on the load bearing part.

The lifting fixture may further comprise, in any combination, any one or more of the features of the preferred embodiments of the invention which will now be described, by way of example only, with reference to the accompanying drawings.

Figure 1 shows a load spreader assembly in use lifting an item of cargo;

Figure 2 shows a load spreader assembly according to an embodiment of the invention with lifting cables attached;

Figure 3 shows a lifting fixture according to an embodiment of the invention;

Figure 4 shows the lifting fixture of Figure 3 with the lifting cables removed;

Figure 5 shows a side elevation view of the lifting fixture shown in Figure 4;
Figure 6 shows a front elevation view of the lifting fixture shown in Figures 4 and 5;

Figure 7 shows top view of the lifting fixture shown in Figures 4, 5 and 6;

Figure 8 shows an enlarged view of a keep plate shown in Figure 5;

Figure 9 shows an alternative collar which may replace the keep plates shown in Figure 8, and

Figure 10 shows a section view through the keep plates of Figures 5 and 8 when under load.

Figures 1 and 2 show a load spreading assembly which is formed from a first beam section 2 and a shorter second beam section 3 and two lifting fixtures 4a, 4b. Both
beam sections have a circular cross section and have flanges 2a, 2b, 3a and 3b around the circumference at either end. The first and second beams 2, 3 are arranged coaxially on a central axis which extends along the length of the beams and are bolted together via opposing flanges 2a and 3b. The first and second beam sections together form a central beam 1 which separates the two lifting fixtures 4. Any number of beam sections may be used to form the central beam 1, or a single beam section may be used. The central beam extends along the central axis from a first end to a second end and a lifting fixture 4 is attached at each end.

The lifting fixtures 4 are shown in more detail in figures 2 to 7. The lifting fixtures 4 each comprise a body 8 which has an end plate 7 with bolt holes 5 arranged around the circumference of the plate for bolting the lifting fixture 4 to a flange 2b or 3a on the central beam 1. The body 8 supports a shaft 9 which is horizontal in use and perpendicular to the central axis of the central beam 1. The body 8 comprises two parallel plates 12, 13 which extend parallel to the central axis of the central beam 1 in a vertical plane. One end of each parallel plate 12, 13 is welded to the end plate 7, the parallel plates 12, 13 are cantilevered from the end plate 7 and are joined together by a nose plate 14 welded at the free end. Small triangular bracing plates 15 are welded between the parallel plates 12, 13 and the end plate 7 to reduce the stresses in welds between those plates. A central lifting plate 16 is positioned in between the parallel plates 12, 13 and is welded between them increasing their stiffness. A lifting eye 17 is attached to the lifting plate 16 in a central position on the lifting fixture enabling the lifting fixture to be lifted in a balanced horizontal position.

Two concentric holes are formed in the parallel plates which support the shaft 9. The shaft protrudes on either side of the parallel plates forming two trunnions, one on each side of the body. The trunnions each provide a mount with a load bearing part 10, 11 around the circumference of the shaft 9 for a lifting cable 18. The shaft 9 is sized according to the lifting capacity of the load spreader beam 1 but for example it may be formed of high strength steel and have a diameter of 80mm or greater. A hole is formed near each end of the shaft 9, each hole passes through the surface of the load bearing part 10, 11.

Retaining pins 21 and 22 are secured in the holes through each end of the shaft 9, one pin in each hole. The retaining pins are supported parallel to the body 8 and the
central axis of the beam 1. The retaining pins protrude out of the hole in a T shaped configuration with the shaft 9. The retaining pins are spaced from the body 8 so that a length of shaft extends between the retaining pins and the body on which lifting cables 18 are secured. A hole is formed in each end surface of the shaft which extends down and into the retaining pin. Locking pins 19 are fitted within the holes with an interference fit preventing movement between the retaining pins 21, 22 and the shaft 9.

Securing chains 20 are removably attached between the ends of the retaining pins 21, 22 and the body 8. One end of each retaining pin has a security chain 20 attached which extends to the nose plate 14 on the body 8 and the other end of the retaining pin has a security chain attached which extends back to the parallel plates approximate to the end plate 7. The chains are attached with rings which are screwed into the ends of the pins, the nose plate and the parallel plates.

Four lifting cables 18a, 18b, 18c, 18d support the load spreader beam on the lifting hook 32 of a crane, two cables support each end of the load spreading beam, each cable being equally spaced from the central axis of the beam 1 such that the beam is held in a balanced horizontal position. Each cable is attached at one end to one of the trunnions, one cable is provided for each trunnion. The lifting cables 18 have loops formed at each end of the cable. At the trunnion the cables are attached by looping the loop of the cable over the retaining pins 21, 22 and onto the load bearing parts 10, 11, so that the cable 18 is looped around the shaft 9 of the lifting fixtures 4. Each trunnion also has a further lifting cable 18e, 18f, 18g, 18h attached which extends below the beam 1 to support a load 27. Therefore each trunnion has two lifting cables fitted, one connecting the lifting hook 32 to the trunnion and the other connecting the load 27 to the trunnion. In this embodiment the cables from the lifting hook are attached to the trunnions first and are therefore on the inside of the cables attached to the load. Alternatively, the cables attaching the load may be attached to the trunnions first so that they are arranged on the inside of the cables attached to the hook. In either case at each end of the beam, the two cables from the lifting hook support the fixture at points equidistant from the central axis and the two cables to the load are supported on the fixture at points equidistant from the central axis.
Two pairs of keep plates 23, 24, 25, 26 are positioned above and below the shaft 9 and are welded to the parallel plates 12, 13, one pair on each side of the body 8. Each pair are in a parallel arrangement with the central axis of the central beam. A pair of grooves are formed in the shaft where it emerges from the parallel plates on either side of the body. Each pair of grooves are arranged in the same plane and parallel to the parallel plates 12, 13. Each groove is formed in the curved surface of the shaft and has a flat base. The bases of each pair of grooves provide two opposing flat surfaces on the surface of the shaft. The keep plates engage within the grooves in the shaft, each plate being a sliding fit within the corresponding groove. The location of the keep plates within the grooves in the shaft prevents lateral movement of the shaft relative to the parallel plates of the body. An enlarged view of a keep plate 24 is shown in Figure 8 which is the same as the other keep plates 23, 25 & 26. The surface of the keep plate 24 which engages with the shaft has two tapered sides 28, 29 either side of a central point 27. As can be seen in Figure 8 the taper is very gentle and the central point forms a large oblique angle of approximately 175 degrees. Alternatively the point may be in the range of 150-179 degrees. The tapered sides 28, 29 of the keep plates are arranged to engage with the base of the corresponding groove in the shaft 9. The shaft can rotate through a small angle equal to 180 degrees minus the oblique angle formed at the central point 27. The shaft rotates between two positions, in which one or other of the tapered sides 28, 29 is in contact with the base of the groove.

In use the lifting fixtures 4 are bolted on either end of the central beam 1 forming a load spreading assembly. The lifting fixtures 4 are aligned so that the shafts 9 on each lifting fixture are parallel. Two lifting slings or cables extend between either end of the load spreading beam 1, one on each side of the lifting fixtures. The trunnions on either side of the body allow the load spreading beam to be supported by the two lifting slings in a balanced position in which the shafts 9 and the retaining pins 21, 22 are horizontal. Four lifting cables extend down from the load spreading beam to support a load 27. The sling and lifting cables are prevented from slipping off the trunnion by the retaining pins 21, 22 protruding at the ends of the shafts. The cables or slings are secured on each trunnion by the securing chains to prevent the possibility of the lifting cables slipping over the pins and becoming detached from the trunnion.

When load is applied to the load spreading beam through the lifting cables torque is generated around the shafts 9 of the lifting fixtures 4 causing the shafts to rotate in the
direction of the torque until the rotation is opposed by one of the tapered surfaces 28, 29 on each keep plate contacting the base of the groove in the shaft 9. The tapered surfaces of the keep plates allows surface to surface contact 33, 34 between the keep plate and shaft rather than point loading which would otherwise occur in the shaft at corner 35, 36 if the keep plates were flat and not tapered. The keep plates therefore substantially prevent rotation of the shaft without causing point loading in the shaft.

There are a number of advantages of the keep plates as opposed to welding the shaft to the body. The shaft 9 being made of a high strength steel is difficult to weld without heat treatment which would involve extreme temperature pre and post welding treatment, the keep plates therefore provide a simpler method of manufacture. Welding can create stress concentrations in the material which can cause failure under high loading. Welds also require more non-destructive testing to ensure their integrity. The keep plates therefore provide a means of mechanically fixing the shaft to the body which overcomes the problems of welding and greatly reduces the cost of manufacture.

An alternative arrangement for the keep plates 23, 24, 25, 26 of the first embodiment of the invention is shown in Figure 9. In this embodiment of the invention a collar 30 surrounds the shaft on either side of the body 8. The collar 30 has two protruding fingers 30a, 30b which are arranged either side of a pin 31. The collar 28 is securely fixed to the shaft 9 so that any rotation of the shaft will cause rotation of the collar. The pin 31 protrudes either side of the body and is rigidly attached to the body 8. Any torque applied to the shaft 9 tends to cause a rotation of the collar 28 which reacts against the pin 31 preventing movement at that part.

It will also be appreciated that although the lifting fixtures are shown in the embodiments of the invention being a separate bolt on unit to the central beam, the lifting fixtures may be integrated into the central beam so that the beam directly supports the trunnions.

It will also be appreciated that the retaining elements may have an alternative form for example rather than the pin arrangement shown in the embodiments of the invention a disk may be fitted to the end of the shaft for the same purpose.
CLAIMS

1. A load spreading assembly comprising a beam and four load bearing parts for securing lifting cables, wherein the load bearing parts are arranged in pairs, one pair at each end of the beam, each pair of load bearing parts are fixed relative to the beam and are arranged symmetrically with a load bearing part either side of the beam, and wherein each load bearing part comprises a retaining element arranged to retain a lifting cable on the load bearing part.

2. A load spreading assembly according to claim 1 further comprising two fixtures, wherein each fixture is connected to a respective end of the beam and each fixture supports one of the pairs of load bearing parts with one of the load bearing parts on each side of the beam.

3. A load spreading assembly according to claim 2 wherein each fixture comprises a body which is connected to an end of the beam and the body supports a shaft which extends through the body and the load bearing parts are parts of the shaft on either side of the body.

4. A load spreading assembly according to claim 2 wherein the beam has a central axis which extends in a direction aligned with the length of the beam and the shaft of each fixture is arranged to pass through the central axis in a perpendicular direction.

5. A load spreading assembly according to any preceding claim wherein a separate lifting cable is attached to each load bearing part, the cables extending above the beam and supporting the beam in use.

6. A load spreading assembly according to claim 5 wherein a second separate lifting cable is attached to each load bearing part, the cables extending below the beam to support a load in use.

7. A load spreading assembly according to claim 4, wherein at each end of the beam, two lifting cables from a lifting hook support one of the fixtures at points equidistant from the central axis and two lifting cables to a load are supported on one of the fixtures at points equidistant from the central axis.
8. A load spreading assembly according to claim 3 wherein the retaining element is a pin which passes through a hole at the free end of the shaft and protrudes either side of the hole in a T shaped configuration with the shaft.

9. A load spreading assembly according to claim 3 wherein each fixture comprises connecting means arranged to mechanically connect the shaft to the body, and wherein the connecting means substantially prevents rotation and lateral movement of the shaft relative to the body.

10. A load spreading assembly according to claim 9 wherein the connecting means comprises a pair of keep plates fixed to the body which engage with grooves formed in the shaft.

11. A load spreading assembly according to claim 3 wherein each fixture further comprises securing means which attach between the retaining elements and the body to prevent lifting cables being removed from the fixture.

12. A fixture for a load spreading assembly comprising a load bearing shaft supported by a body, wherein the load bearing shaft is connected to the body via connecting means, wherein the connecting means is arranged to mechanically connect the shaft to the body and to substantially prevent rotation and lateral movement of the shaft relative to the body.

13. A fixture according to claim 12 wherein the connecting means comprises a keep plate which engages with a groove formed in the shaft.

14. A fixture according to claim 13 wherein the keep plate comprises two angled surfaces and wherein each angled surface is arranged to substantially prevent rotation of the shaft and each angled surface prevents rotation in a direction opposite to that of the other angled surface.

15. A fixture according to claim 14 wherein the two angled surfaces of the keep plate meet at a point and form an obtuse angle.
16. A fixture according to claim 15 wherein each angled surface of the keep plate is arranged to engage with the base of the groove in the shaft.

17. A fixture according to any one of claims 12 to 16 wherein load bearing shaft extends through a hole in the body and two pairs of keep plates are provided, one pair on each side of the body where the shaft enters and exits the body.

18. A fixture for a load spreading assembly comprising a pair of load bearing parts supported by a body, wherein the pair of load bearing parts are fixed relative to the body and are arranged symmetrically with a load bearing part either side of the body, wherein the body is arranged to be connected to the end of a load spreading beam, and wherein each load bearing part comprises a retaining element arranged to retain a lifting cable on the load bearing part.

19. A load spreading assembly or fixture for a load spreading assembly substantially as described herein with reference to the accompanying drawings.
Application No: GB1515206.9  
Claims searched: 1-19  
Examiner: Mr Michael Shaw  
Date of search: 3 February 2016

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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<th>Category</th>
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<th>Identity of document and passage or figure of particular relevance</th>
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<td>X</td>
<td>1-9, 12, 18</td>
<td>WO 99/67166 A [KHATCHATURIAN] see figures 1-4</td>
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC: X

Worldwide search of patent documents classified in the following areas of the IPC

B66C

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

International Classification:

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