Aug. 22, 1944. L. M. CALDWELL 2,356,146

EQUALIZING SLING

Filed June 15, 1942 2 Sheets-Sheet 1

Fig. 1

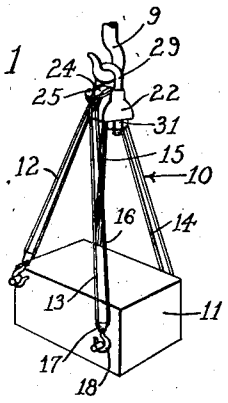


Fig. 2

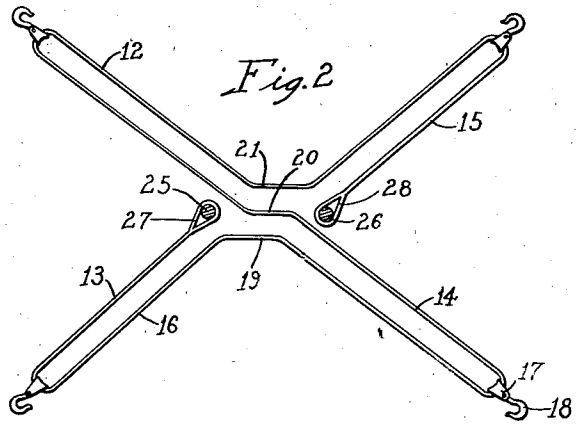


Fig. 3

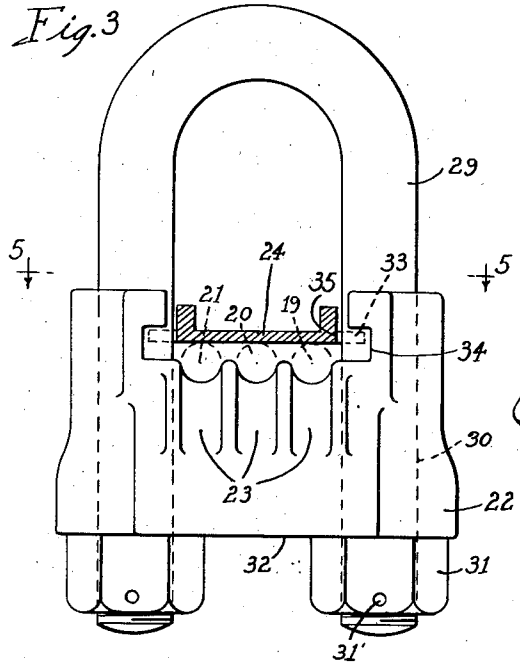


Fig. 4

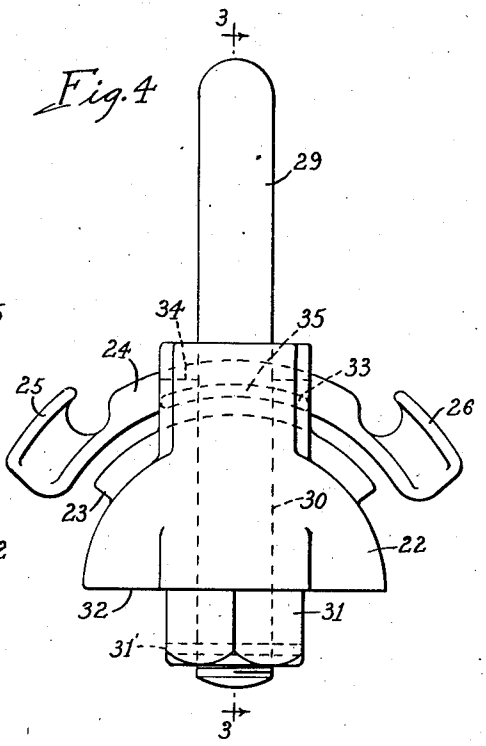
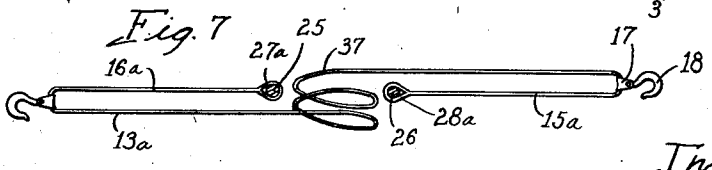


Fig. 7



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Aug. 22, 1944. L. M. CALDWELL 2,356,146

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Filed June 15, 1942 2 Sheets-Sheet 2

Fig. 5

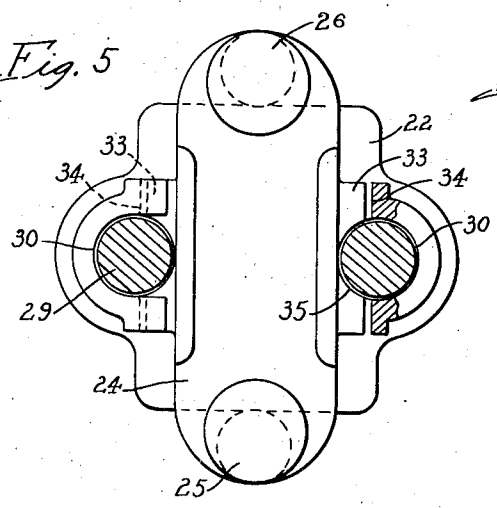


Fig. 6

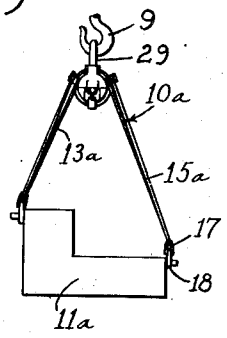


Fig. 8

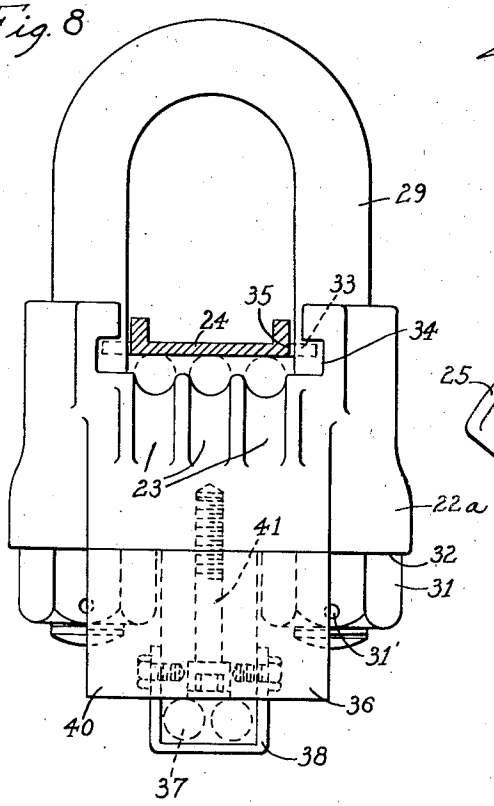
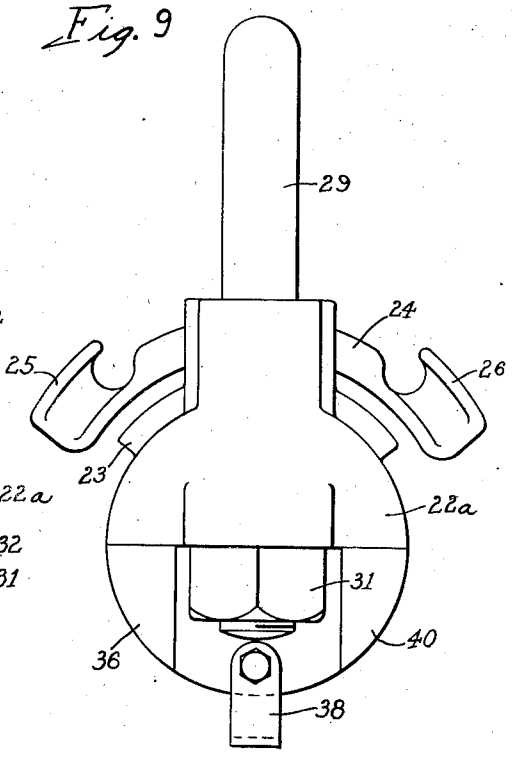


Fig. 9



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UNITED STATES PATENT OFFICE

2,356,146

EQUALIZING SLING

Leslie M. Caldwell, Rockford, Ill.

Application June 15, 1942, Serial No. 447,042

25 Claims. (Cl. 294—1)

This invention relates to slings for use with hoisting equipment generally and is more particularly concerned with an improved self-adjusting and equalizing sling.

It is well known to those familiar with hoisting equipment that the safety of a sling depends first of all upon its consistent behavior under operating conditions and upon the proper distribution of load on the several members or legs of the sling, the majority of costly failures being traceable to uneven loading. It is from that standpoint that chain slings have heretofore been conceded as having a distinct advantage over other types of slings, because of a grab hook feature permitting adjustment of length to balance uneven loads. However, wire rope is now generally preferred for sling work wherever heavy lifting is done because it can be loaded up to 60% of its breaking strength without injury and if overloaded gives warning of approaching failure long before there is actual danger of failure. The main objection to the use of wire rope slings has been the lack of adjustability, and in a four legged sling, for example, unless great care was exercised in the application of the sling to the load, there was the likelihood that three of the four legs would ultimately have to carry the load. That ever present danger of indeterminate stresses, therefore, required the use of slings having a reserve strength several times greater than would otherwise be required for the weight of the loads lifted. It is, naturally, desirable to maintain a generous safety factor wherever danger of life and property is involved, but the higher the safety factor the more cumbersome the sling, and its use often entails greater hazard than would be encountered with lighter slings. Another drawback to the use of wire rope has been that where a four legged sling was desired, for example, the individual legs had to be made separately of a specified length joined to the hooks and load links by shackles, thereby resulting in legs of fixed length, each involving splices, whereas it is generally recognized that greater safety would be secured if the sling could be made endless so as to eliminate so many splices. The only extent to which endless slings have been employed heretofore, so far as I am aware, has been in the methods of sling attachment to the load, known as "hitches," but that results in an appreciable reduction of sling efficiency and there is always too much uncertainty about the safe working loads with many types of hitches.

It is, therefore, the principal object of my invention to provide a novel type of sling in which all of the legs are formed from a single length of rope, which by reason of its self-adjusting and self-equalizing action has all of the advantages of the adjustable chain slings, and more, while retaining the desirable features of all earlier wire rope slings, without the disadvantages mentioned.

A salient feature of the sling of my invention consists in the winding of the single length wire rope back and forth over a heavy supporting saddle to form loops on opposite sides thereof defining the legs of the sling, in the bight of which the hooks for attachment to the load are carried on traveling beckets, so that the individual loops or bights can be shortened or lengthened in the adjustment of the sling to suit the load, the wire rope being slidable not only with respect to the beckets but also the saddle for all-over adjustment of the sling to adapt it to the load, and the ends of the wire rope being furthermore attached to a clamp member floatingly mounted on top of the saddle, whereby when the sling is placed under tension in the lifting of the load, the clamp is drawn down onto the intermediate portion of the wire rope wound over the saddle to clamp the wire rope and thereby resist any tendency for it to slide while the load is carried, all legs of the sling under these conditions being substantially equally loaded for greater safety and absolute stability of the load.

Another object of my invention is to provide a self-adjusting and equalizing sling of the kind mentioned, in which the wire rope is arranged to be wound around the heavy supporting saddle for one or more complete turns between the opposed loops defining the legs of the sling, whereby through the increased length of frictional engagement with the saddle, due to the snubbing action, to insure stability of the load by reason of the greatly increased resistance to creeping of the rope under load.

The invention is illustrated in the accompanying drawings, in which—

Fig. 1 is a perspective view, on a small scale, illustrating a sling made in accordance with my invention, in operation;

Fig. 2 is a diagram illustrating how the four legs of the sling are formed by a single wire rope;

Fig. 3 is a front view of the saddle and its hanger fitting, indicating in dotted lines where the wire rope winds over the saddle, the clamp being shown in cross-section on the line 3—3 of Fig. 4 over the saddle;

Fig. 4 is a side view of Fig. 3;

Fig. 5 is a horizontal section on the line 5—5 of Fig. 3;

Fig. 6 is a view similar to Fig. 1, illustrating a bridle sling made in accordance with my invention, in operation;

Fig. 7 is a diagrammatic view similar to Fig. 2, but indicating the arrangement of the single length of wire rope for the two legged or bridle sling shown in Fig. 6; and

Figs. 8 and 9 are views similar to Figs. 3 and 4 showing the modified or alternative construction of the saddle used in the sling of Fig. 6.

Similar reference numerals are applied to corresponding parts throughout the views.

Referring first to Figs. 1 to 5, the reference numeral 9 designates a crane hook in connection with which the sling of my invention, designated generally by the reference numeral 10, is used for lifting and carrying a load, indicated diagrammatically at 11. The sling 10 comprises four legs, numbered 12 to 15, all formed from a single length of braided wire rope 16, as illustrated in Fig. 2. The legs 12, 13, 14, and 15 are adjustable in length to suit different requirements, and for purposes of illustrating the adjustability of the sling, the legs 12 and 13 in Fig. 1 are shown of different lengths and attached to the load 11 at different elevations. It will soon appear, however, that the sling 10 is self-adjusting and adapts itself to the particular load to be lifted and under given conditions all four legs may be of the same length and under other conditions they may all be of different lengths. In each leg of the sling a traveling becket 17 is provided carrying a hook 18 which may be hinged to the becket or rigid therewith, as desired. The hooks are for attachment of the sling to the load, and the beckets permit sliding of the wire rope with respect to the hooks in the shortening or lengthening of the loops forming the several legs of the sling. Of course, it is conceivable that under special circumstances the loops will be attached directly to the load, each loop forming an independently adjustable "basket hitch." In the adjustment of the sling to the load, the wire rope is arranged to slide at the intermediate points 19, 20, and 21, between the opposed pairs of loops 12—13 and 14—15, where it is wound back and forth over the heavy supporting saddle or lift member 22. The saddle is generally semi-cylindrical in form and has arcuate channels 23 provided on the half round top thereof, in substantially parallel relation, to keep the three passes of rope spaced apart, as clearly indicated in dotted lines at 19, 20 and 21 in Fig. 3. A clamp member 24 is provided of arched form to conform generally to the curvature of the half round top of the saddle 22, as shown in Fig. 4, and is floatingly mounted on top of the saddle to bear on top of the intermediate portions 19, 20, and 21 of the wire rope laid in the channels 23 and clamp these portions so as to resist creeping of the wire rope with respect to the saddle as the load is lifted. The clamp member 24 has hooks 25 and 26 on the opposite ends thereof onto which the opposite ends of the wire rope are adapted to be attached by means of eyes 27 and 28 formed on said end portions, as indicated in Fig. 2. In that way the pull on the legs 13 and 15 of the sling is transmitted to the clamp member to draw it down tightly onto the wire rope in the channels 23 to hold the rope and resist any tendency for it to creep. The saddle 22 is supported on a U-shaped hanger bolt 29, the two ends of which extend through parallel holes 30 in the saddle and have large nuts 31 threaded on the projecting ends thereof against the flat bottom 32 of the saddle and suitably locked in place by pins 31'. The clamp member 24 extends between the arms of the U-shaped hanger bolt and has arcuate flanges 33 on opposite sides thereof, which fit loosely in horizontal grooves 34 provided in the top portion of the saddle on opposite sides of the group of channels 23, whereby to limit upward displacement of the clamp member and keep the intermediate portions 19, 20, and 21 of the wire rope 16 threaded in the channels 23. The flanges 33 are notched out intermediate their ends, as indicated at 35, to receive the legs of the U-shaped hanger bolt and prevent angular displacement of the clamp member with respect to the saddle.

In operation, the hooks 18 are attached to the load 11 at the four corners, as shown in Fig. 1, and in the initial upward movement of the crane hook 9 the four legs 12, 13, 14, and 15 of the sling will shorten and lengthen with respect to one another, as previously described, to adjust the sling to the load. There is, therefore, no question whatsoever that at the time the load is lifted all four legs will be placed under substantially the same tension and each leg will carry approximately one-fourth of the load. The sliding of the wire rope in the beckets 17 and with respect to the saddle 22 stops substantially the instant the load is lifted, because at that time all of the legs of the sling are placed under substantially the same ultimate tension, and at the same time the clamp member 24 is drawn down tightly onto the intermediate portions 19, 20, and 21 of the wire rope so that the rope is locked between the clamp member 24 and the saddle 22. The load carried by the legs 13 and 15 of the sling is transmitted to the clamp member 24 by reason of the connection of those legs with the hooks 25 and 26. It should be clear from the foregoing that the load is carried safely and is not free to tilt or teeter. The fact that the weight is equalized on the various legs of the sling enables the use of lighter and less cumbersome slings for the same safety factor. While the ends of the channels 23 are illustrated as straight, it will be understood that I may curve the ends of the outermost channels outwardly so as to provide neatly rounded guides in which the rope will slide easily in its adjustment relative to the saddle. Such guides are more or less necessary where there is much divergence of the rope from the saddle to the opposite ends of a large load.

In the modified or alternative construction disclosed in Figs. 6 to 9, the heavy supporting saddle 22*a* has its intermediate portion 36 built up to cylindrical form by the bolting on of a substantially semi-cylindrical block 40, as indicated at 41. In that way the intermediate portion 37 of the wire rope 16*a* may be wound around the saddle for two complete turns, or even more, the opposite end portions of the wire rope forming loops 13*a* and 15*a* which define the two legs of the sling, similarly as the legs 13 and 15 in the sling first described. The end portions of the wire rope 16*a* form eyes 27*a* and 28*a* for connection with the hooks 25 and 26 on the clamp member 24. The clamp member 24 keeps the three passes of the wire rope engaged in the channels 23, similarly as in the other form described, and a yoke 38 is preferably provided on the block 40 to confine the two passes of the wire rope in

close enough relation to the periphery of the cylindrical portion 36 of the saddle 22a so that there will be no danger of one of these turns of the wire rope getting crossed over the other when the rope is slack.

The operation of this sling 10a is generally similar to the operation of the sling 10 previously described, in so far as adjustment of the legs 13a and 15a to adapt the sling to the work 11a is concerned. There is, of course, more frictional drag on the movement of the wire rope with respect to the saddle 22a not only because of the additional length of bearing engagement but also because of the snubbing action. While that is not sufficient to interfere with the automatic adjustment of the sling in the initial upward movement of the crane hook 9, it is nevertheless sufficient to reduce considerably whatever tendency there may be for the wire rope to creep with respect to the saddle 22a as the load is lifted, it being, of course, understood that the clamp 24 in this sling performs the same clamping or locking function as in the other sling previously described, namely, to resist any tendency for the wire rope to shift in relation to the saddle after the load is lifted. It should also be clear that when it is not desired to wind the wire rope around the saddle 22a, as just described, it may be passed over the saddle in the channels 23 in the same way as in the sling 10, thus making it possible to provide either a four legged or two legged sling using the same saddle 22a and clamp member 24. That variation is thought to be clear enough from a study of Figs. 1 to 5. The saddle 22a, without the block 40 thereon, is the same as the saddle 22.

It is believed the foregoing description conveys a good understanding of the objects and advantages of my invention. The appended claims have been drawn to cover all legitimate modifications and adaptations.

I claim:

1. A sling of the class described comprising a load carrying saddle, and a single continuous length of rope slidably supported on the saddle and defining loops depending on opposite sides of the saddle for suspension of the load, said rope being slidable endwise on the saddle to permit lengthening of a certain loop or loops and shortening of another or others to adjust the loops for uniform and stable suspension of the load thereby, and a rope clamping member loosely mounted on top of said saddle to ride on and resist sliding movement of the rope relative to the saddle and having the ends of said rope attached thereto.

2. A sling of the class described, comprising a load carrying saddle, a single continuous length of rope for attachment to the load at one or more points wound back and forth in three passes over the saddle and defining four loops depending in pairs on opposite sides of the saddle for suspension of the load, said rope being slidable endwise on the saddle to permit lengthening of a certain loop or loops and shortening of another or others to adjust the loops for uniform and stable suspension of the load thereby, and a clamp member loosely mounted on top of said saddle to ride on and resist sliding movement of the rope relative to the saddle, said clamp member having the ends of said rope attached thereto.

3. A sling of the class described, comprising a load carrying saddle, a single continuous length of rope for attachment to the load at one or more points wound around the saddle one or more turns and defining a pair of loops depending on opposite sides of the saddle for suspension of the load, said rope being slidable endwise on the saddle to permit lengthening of one loop and shortening of the other to adjust the loops for uniform and stable suspension of the load thereby, and a clamp member loosely mounted on top of said saddle to ride on and resist sliding movement of the rope relative to the saddle, said clamp member having the ends of said rope attached thereto.

4. A sling of the class described, comprising a load carrying saddle, a single continuous length of rope for attachment to the load at one or more points wound back and forth over the saddle and defining loops depending on opposite sides of the saddle for suspension of the load, said rope being slidable on the saddle to permit lengthening of a certain loop or loops and shortening of another or others to adjust the loops for uniform and stable suspension of the load thereby, and a clamp member loosely mounted on top of said saddle to ride on and resist sliding movement of the rope relative to the saddle, said clamp having the free ends of the rope attached thereto, whereby the clamp is caused to lock the rope under a pressure proportionate to the load lifted.

5. A sling of the class described, comprising a load carrying saddle, a single continuous length of rope for attachment to the load at one or more points wound around the saddle one or more turns and defining loops depending on opposite sides of the saddle for suspension of the load, said rope being slidable on the saddle to permit lengthening of a certain loop or loops and shortening of another or others to adjust the loops for uniform and stable suspension of the load thereby, and a clamp member loosely mounted on top of said saddle to ride on and resist sliding movement of the rope relative to the saddle, said clamp having the free ends of the rope attached thereto, whereby the clamp is caused to lock the rope under a pressure proportionate to the load lifted.

6. A sling of the class described, comprising a load carrying saddle, a single continuous length of rope slidably supported on the saddle and defining loops depending on opposite sides of the saddle for suspension of the load, said rope being slidable endwise on the saddle to permit lengthening of a certain loop or loops and shortening of another or others to adjust the loops for uniform and stable suspension of the load thereby, a rope clamping member loosely mounted on top of said saddle to ride on and resist sliding movement of the rope relative to the saddle and having the ends of said rope attached thereto, and travelling beckets slidably mounted on the rope in said loops and having load attaching members depending therefrom.

7. A sling of the class described, comprising a load carrying saddle, a single continuous length of rope for attachment to the load at one or more points wound back and forth in three passes over the saddle and defining four loops depending in pairs on opposite sides of the saddle for suspension of the load, said rope being slidable endwise on the saddle to permit lengthening of a certain loop or loops and shortening of another or others to adjust the loops for uniform and stable suspension of the load thereby, travelling beckets slidably mounted on the rope in said loops and having load attaching members depending therefrom, and a clamp member loosely mounted on

top of said saddle to ride on and resist sliding movement of the rope relative to the saddle, said clamp member having the ends of said rope attached thereto.

8. A sling of the class described, comprising a load carrying saddle, a single continuous length of rope for attachment to the load at one or more points wound around the saddle and defining a pair of loops depending on opposite sides of the saddle for suspension of the load, said rope being slidable endwise on the saddle to permit lengthening of one loop and shortening of the other to adjust the loops for uniform and stable suspension of the load thereby, travelling beckets slidably mounted on the rope in said loops and having load attaching members depending therefrom, and a clamp member loosely mounted on top of said saddle to ride on and resist sliding movement of the rope relative to the saddle, said clamp member having the ends of said rope attached thereto.

9. A sling of the class described, comprising a load carrying saddle, a single continuous length of rope for attachment to the load at one or more points wound back and forth over the saddle and defining loops depending on opposite sides of the saddle for suspension of the load, said rope being slidable on the saddle to permit lengthening of a certain loop or loops and shortening of another or others to adjust the loops for uniform and stable suspension of the load thereby, travelling beckets slidably mounted on the rope in said loops and having load attaching members depending therefrom, and a clamp member loosely mounted on top of said saddle to ride on and resist sliding movement of the rope relative to the saddle, said clamp having the free ends of the rope attached thereto, whereby the clamp is caused to lock the rope under a pressure proportionate to the load lifted.

10. A sling of the class described, comprising a load carrying saddle, a single continuous length of rope for attachment to the load at one or more points wound around the saddle and defining loops depending on opposite sides of the saddle for suspension of the load, said rope being slidable on the saddle to permit lengthening of a certain loop or loops and shortening of another or others to adjust the loops for uniform and stable suspension of the load thereby, travelling beckets slidably mounted on the rope in said loops and having load attaching members depending therefrom, and a clamp member loosely mounted on top of said saddle to ride on and resist sliding movement of the rope relative to the saddle, said clamp having the free ends of the rope attached thereto, whereby the clamp is caused to lock the rope under a pressure proportionate to the load lifted.

11. A sling fitting, comprising a load carrying saddle, a hanger therefor, said saddle having a rope receiving channel on the top thereof for a load supporting sling rope, and a clamp loosely mounted on top of said saddle in position to bear on the rope in said channel and having means for attaching the ends of the sling rope thereon.

12. A sling fitting, comprising a load carrying saddle, a hanger therefor, said saddle having a rope receiving channel on the top thereof, and a clamp loosely mounted on top of said saddle in position to bear on the rope in said channel, the clamp having means on the opposite ends thereof on opposite sides of the saddle for attaching the ends of the rope thereon.

13. A sling fitting, comprising a load carrying saddle, a hanger therefor, said saddle having a rope receiving channel on the top thereof for a load supporting sling rope, and a clamp loosely mounted on top of said saddle in position to bear on the rope in said channel and having means for attaching the ends of the sling rope thereon, the channel portion on top of said saddle being of substantially half round section and the clamp being of arcuate section to conform thereto approximately.

14. A sling fitting, comprising a load carrying saddle, a hanger therefor, said saddle having a rope receiving channel on the top thereof, and a clamp loosely mounted on top of said saddle in position to bear on the rope in said channel, the channel portion on top of said saddle being of substantially half round section and the clamp being of arcuate section to conform thereto approximately, the clamp having means on the opposite ends thereof on opposite sides of the saddle for attaching the ends of the rope thereon.

15. A sling fitting, comprising a load carrying saddle of substantially cylindrical form, a hanger therefor, said saddle having a rope receiving portion for a load supporting sling rope, and a clamp loosely mounted on top of said saddle in position to bear on the rope having means for attaching the ends of the sling rope thereon, the clamp being of arcuate section to conform approximately to the upper portion of said saddle.

16. A sling fitting, comprising a load carrying saddle of substantially cylindrical form, a hanger therefor, said saddle having a rope receiving portion for a load supporting sling rope, and a clamp loosely mounted on top of said saddle in position to bear on the rope, the clamp being of arcuate section to conform approximately to the upper portion of said saddle, the clamp having means on the opposite ends thereof on opposite sides of the saddle for attaching the ends of the rope thereon.

17. A sling fitting, comprising a load carrying saddle of substantially cylindrical form, a hanger therefor, said saddle having a rope receiving portion for a load supporting sling rope, and a clamp loosely mounted on top of said saddle in position to bear on the rope having means for attaching the ends of the sling rope thereon, the clamp being of arcuate section to conform approximately to the upper portion of said saddle, the lower portion of said saddle having a yoke thereon extending transversely relative to the rope receiving portion and in closely spaced substantially parallel relation to the periphery of the saddle, for the purpose described.

18. A sling fitting, comprising a load carrying saddle of substantially cylindrical form, a hanger therefor, said saddle having a rope receiving portion for a load supporting sling rope, and a clamp loosely mounted on top of said saddle in position to bear on the rope, the clamp being of arcuate section to conform approximately to the upper portion of said saddle, the lower portion of said saddle having a yoke thereon extending transversely relative to the rope receiving portion and in closely spaced substantially parallel relation to the periphery of the saddle, for the purpose described, the clamp having means on the opposite ends thereof on opposite sides of the saddle for attaching the ends of the rope thereon.

19. A sling, comprising, in combination, a lift member, a load supporting sling rope adapted to bear on the lift member, said rope being passed back and forth over the lift member to form a plurality of sling loops on opposite sides of the

lift member for suspension of the load, and a clamp member superimposed on the rope over the lift member and held against lateral movement with respect to the lift member, while guided for movement toward and away from the lift member, and attached to the free ends of the rope, whereby the rope is free to adjust itself with respect to the lift member in the initial upward movement thereof before the load is lifted, and whereby when the load is lifted the clamp member is held down on the rope under tension of the rope to resist further adjustment of the rope with respect to the lift member.

20. A sling as set forth in claim 19, including traveling beckets slidably mounted on the rope in the loops thereof and having means for attachment to the load.

21. A sling, comprising, in combination, a lift member, a load supporting sling rope adapted to be wound intermediate its ends on the lift member and to form loops in the end portions thereof on opposite sides of the lift member, and a clamp member superimposed on the rope over the lift member and held against lateral movement with respect to the lift member, while guided for movement toward and away from the lift member, and attached to the free ends of the rope, whereby the rope is free to adjust itself with respect to the lift member in the initial upward movement thereof before the load is lifted, and whereby when the load is lifted the clamp member is held down on the rope under tension of the rope to resist further adjustment of the rope with respect to the lift member.

22. A sling as set forth in claim 21, including traveling beckets slidably mounted on the rope in the loops thereof and having means for attachment to the load.

23. A sling of the class described comprising a load carrying saddle, a single continuous length of rope slidably supported on the saddle and defining loops depending on opposite sides of the saddle for suspension of a load, said rope being slidable endwise on the saddle to permit lengthening of a certain loop or loops and shortening of another or others to adjust the loops for uniform and stable suspension of a load thereby, and means actuated in response to the tensioning of the loops in the lifting of the load for clamping the rope on the saddle in adjusted relation to the saddle to prevent further adjustment when the load is lifted.

24. A sling of the class described, comprising a load carrying saddle, a single continuous length of rope slidably supported on the saddle and defining loops depending on opposite sides of the saddle for suspension of a load, said rope being slidable endwise on the saddle to permit lengthening of one loop and shortening of another or others to adjust the loops for uniform and stable suspension of a load thereby, and means connected to the ends of the rope so as to be actuated in response to the tensioning of the rope in the lifting of the load for clamping the rope on the saddle in adjusted relation to the saddle to prevent further adjustment when the load is lifted.

25. A sling of the character described, comprising, in combination, a frame, a load carrying member and a brake member on said frame, one of said members being movable toward and away from the other, and a load carrying rope passed over said load carrying member and arranged to be connected to a load at points on opposite sides of said frame, the rope being normally movable freely relative to said load carrying member but its movement being resisted when the brake member and load carrying member are brought into braking contact, the movable member being operatively associated with said rope so as to be moved into braking contact in response to tensioning of the rope under load.

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