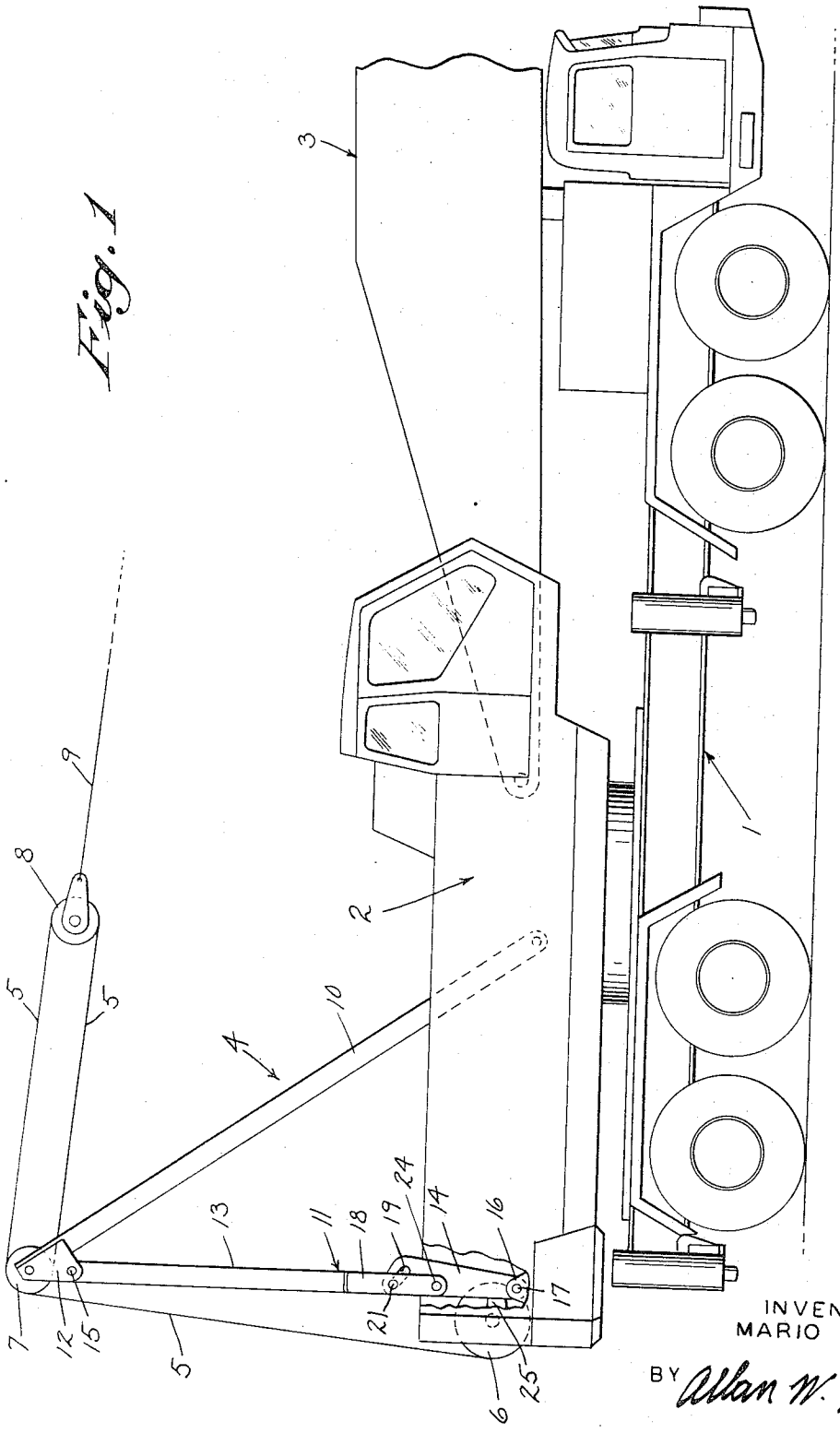
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LOWERABLE A-FRAME ASSEMBLY FOR MOBILE CRANES AND THE LIKE

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Fig. 1



INVENTOR
MARIO PEZZINI

BY Allan W. Lesser

ATTORNEY

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Fig. 3

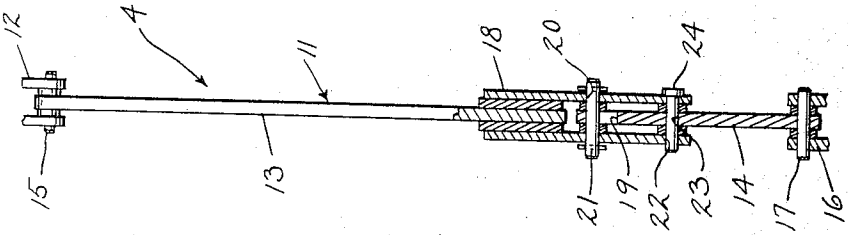
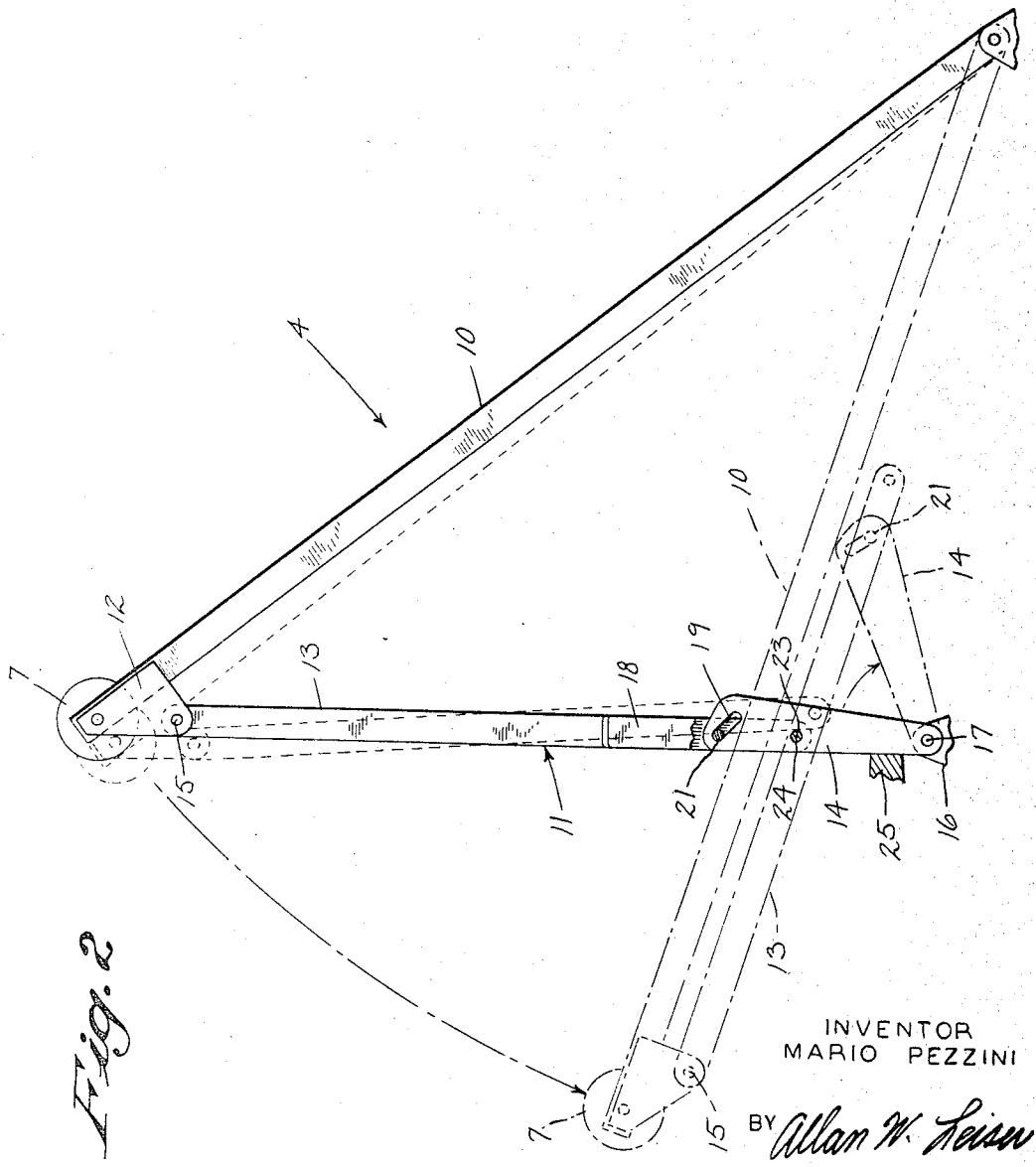


Fig. 2



INVENTOR
MARIO PEZZINI

BY Allan W. Leisen

ATTORNEY

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LOWERABLE A-FRAME ASSEMBLY FOR MOBILE CRANES AND THE LIKE

Mario Pezzini, New Berlin, Wis., assignor to Bucyrus-Erie Company, South Milwaukee, Wis., a corporation of Delaware

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This invention relates to a lowerable A-frame assembly for mobile cranes and the like; and it resides more particularly in a foldable tension leg for such an assembly which comprises upper and lower links with a pin and inclined slot connection therebetween so that upon a release of tension gravity will cause the links to begin to fold together in a desired direction.

The invention is particularly suited for, but not restricted to, mobile cranes. The A-frames of such cranes, especially larger models, are quite high; and in the absence of some means to lower the A-frame it becomes difficult if not impossible to transport them because of bridge clearances and other obstructions.

A number of lowerable A-frame arrangements have been devised, and these usually involve reducing the length of the tension legs and folding the compression legs down over them. None of the present arrangements has, however, proven entirely satisfactory. Some such arrangements, for example, include telescoping tension legs; but it is difficult to construct a telescoping leg of the required mechanical strength that is capable of being extended sufficiently to give adequate working height and retracted far enough to have sufficient lowering. In some cases, hydraulic cylinders are used as tension legs, but these have the same disadvantages as any telescoping construction and are additionally quite expensive. Other arrangements utilize flexible cables as tension legs, the cables being intended to fold out of the way as the compression legs are lowered. The resulting looped cables are, however, a nuisance and can be dangerous. Further, the flexible cables may stretch with the result that the A-frame itself does not function properly.

Still other arrangements include tension legs made up of rigid, pivotally connected links which are intended to fold together allowing the compression legs to be lowered. Such constructions overcome many of the problems of telescoping or cable-type constructions, but offer certain additional problems. The simplest and therefore most desirable arrangements of this type involve legs made up of only two pivotally connected links in aligned end to end relationship. When tension is released, however, the links, being aligned, have no particular tendency to fold, or may fold in either direction. To be certain of proper operation, therefore, it is necessary to provide some sort of outside actuator to cause the links to be thrown out of alignment in the proper direction.

It is the general object of this invention to provide a foldable tension leg for a lowerable A-frame assembly of the rigid link type in which the links begin to fold together properly in response to gravity alone.

It is one specific object of the invention to provide a leg in which proper folding is accomplished by means of a pin and inclined slot connection between the links.

It is another object of the invention to provide a leg including lock means for the links.

Other objects of the invention include the provision of a folding leg arrangement that is efficient and safe, of great mechanical strength, and relatively simple and inexpensive.

Further objects and advantages will appear from the description to follow. In the description, reference is made to the accompanying drawings, forming a part hereof, in

which there is shown, by way of illustration and not of limitation, a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a somewhat schematic partial side view, with parts shown broken away, of a mobile crane provided with a lowerable A-frame assembly according to the invention,

FIG. 2 is an enlarged fragmentary side view, with parts broken away, of the lowerable A-frame assembly of FIG. 1, alternative positions of the elements being shown in broken and phantom lines to illustrate operation, and

FIG. 3 is an enlarged fragmentary end view, with parts broken away, further illustrating the A-frame assembly of FIG. 1.

The mobile crane shown in FIG. 1 is more or less conventional in form, and its construction will be well understood by those skilled in the art to which this invention pertains. As a result, and since the invention is equally useful in other forms of excavating machines, it has not been shown and will not be described in detail herein. In general, the crane includes a carrier vehicle 1 and a working frame 2 which is rotatably supported on the bed of the carrier 1. A conventional boom 3, only the foot portion of which is shown, and an A-frame designated generally by the reference numeral 4 are mounted on the working frame 2. The crane shown is provided with a conventional boom hoist arrangement which includes a boom hoist cable 5 that extends from a boom hoist drum 6 on the frame 2 about a rear set of sheaves 7 mounted on the A-frame 4 and a forward set of sheaves 8 to a suitable anchor. Suspension pendants 9 extend from the sheave set 8 to the tip of the boom 3 (not shown). Thus, the boom 3 may be raised or lowered in usual fashion, the boom hoist arrangement also being used for lowering of the A-frame 4 as will be described. A suitable load hoist arrangement will of course also be provided, but the same is not shown herein for the sake of clarity and simplicity.

The A-frame 4 has two spaced sides, each including a forward or compression leg 10 and a tension or rear leg 11. Only one set of legs 10, 11 can be seen in the drawings, but it will be appreciated that the two sets of legs are substantially identical and function in the same manner.

The compression legs 10 are of rigid construction and are pivotally mounted at their lower ends on the frame 2 in any suitable fashion. At their upper ends, the legs 10 are provided with bifurcated fittings 12, the rear sheaves 7 being supported on a shaft extending between the two fittings 12.

The tension legs 11 are each made up of a rigid upper link 13 and a rigid lower link 14. The upper end of each link 13 is pivotally attached to a respective fitting 12 by means of a transverse pin 15, and the lower end of each link 14 is pivotally attached to a suitable fitting 16 on the frame 2 by means of a transverse pin 17, the links 13, 14 thus being capable of pivoting in a substantially common plane. The lower end of each link 13 is provided with a bifurcated extension 18 which receives the upper end of the associated link 14 so that the inner ends of the links 13, 14 face and overlap one another.

The upper end of each link 14 is provided with a transverse inclined slot 19 therethrough that extends downwardly and toward the front of the frame 2. The bifurcated extensions 18 are provided with transverse connecting pin openings 20 on either side of and in alignment with the respective slots 19, and connecting pins 21 pass through the openings 20 and slots 19 so that the links 13, 14 are pivotally connected by a pin and slot connection.

The bifurcated portions 18 extend below the openings 20 and slots 19 so that the links 13, 14 overlap in an area

beyond their pin and slot connection. In this overlap area, the links **13** are provided with transverse lock pin openings **22** and the links **14** are provided with transverse lock pin openings **23**. The respective openings **22**, **23** are in alignment when the links **13**, **14** are in the positions of FIG. 1 and removable lock pins **24** pass therethrough.

During working, the elements of the A-frame **4** are in the positions shown in FIG. 1 and in full lines in FIG. 2. The legs **10** are under a compression load, while the legs **11** are under tension load and are substantially vertical. In working position, the links **13**, **14** are aligned and vertical, and the connecting pins **21** are at the upper, rear ends of the inclined slots **19**. The lock pins **24** are in place so that the links **13**, **14** are locked in alignment. The tension load on the legs **10** can be taken by the lock pin **24** and/or the connecting pins **21**. It is preferred, however, to have the pins **21** relatively loose to allow for folding as will be described, and the lock pins **24** relatively tighter so that they take all or most of the tension load.

When the A-frame **4** is to be lowered for transporting, the boom **3** is lowered, by unwinding the drum **6**, until it is in a rest position, shown in FIG. 1, wherein it is supported by the carrier **1** or in some other appropriate fashion, and the lock pins **24** are removed.

With the boom **3** at rest and the lock pins **24** removed, the drum **6** is unwound further, which in effect removes the loads on the legs **10** and **11**. As soon as the tension on the legs **11** has been released, the upper links **13** will move downwardly in response to gravity, and the pins **21** will move downwardly and forwardly to the bottoms of the slots **19**, the position of the elements at the conclusion of this inital movement being shown in broken lines in FIG. 2.

The net effect of the initial gravity drop is to move the links **13** and **14** out of alignment by moving their only remaining connection, the pins **21**, to the right. As soon as the links **13** and **14** are thus out of alignment, the weight of the links **13**, legs **10** and appurtenant elements will cause the links **13** and **14** to have a tendency to fold together. Further unwinding of the drum **6** will, therefore, cause the links **13** and **14** to fold to the fully lowered positions shown in phantom lines in FIG. 2. The legs **10** will of course fold downwardly as the links **13** and **14** collapse, and the entire A-frame **4** is thus lowered. It will be obvious that the lengths of the legs **10** and links **13** and **14** and the locations of the various pivot points will be selected to allow for the desired full lowering. The entire lowering operation can easily be controlled by means of the cable **5** which is in effect the only support holding the A-frame **4** elevated once the boom **3** has been lowered to rest position.

Because the pins **24** move to the right, the links **13** and **14** have a tendency to fold only in the proper direction shown, the links **13** pivoting in counterclockwise fashion as seen in FIGS. 1 and 2 and the links **14** pivoting in clockwise fashion. As a further guarantee against improper folding, however, stops **25** may be provided on the frame **2** behind the links **14**. In addition, suitable stops or supports (not shown) may be provided to support the A-frame **4** in fully lowered position.

To raise the A-frame **4** to its working position, it is necessary only to take in the cable **5**, which will cause the legs **10** and **11** to be raised again to the position of FIG. 1, and reinsert the lock pins **24**.

Thus, the invention herein provides a relatively simple lowerable A-frame assembly in which only gravity force

is required. The primary feature of the invention is the pin and inclined slot conection between the links **13** and **14** afforded by the slots **19** and pins **21**. This allows for the initial gravity drop which throws the links **13** and **14** out of alignment and causes them to begin to fold in a desired manner without necessitating an outside actuator. In addition, the lock pins **24** are valuable for locking the links **13** and **14** in aligned relationship, and can also be used to take up all or most of the tension load, thus allowing the pins **21** to be loosely fitted to facilitate the initial folding action.

Although a preferred embodiment of the invention has been shown and described herein, it will be apparent that various structural modifications might be made without departure from the invention. The preferred embodiment shown, for example, has the inclined slot **19** in the lower link **14** and the pin **21** mounted by the upper link **13**, but an equivalent slot could be provided in the link **14** and the pin mounted on the link **13**, or other arrangements equivalent to the precise pin and inclined slot construction shown could be substituted. Further, although the invention has been shown incorporated in a mobile crane, it will be obvious that it could be equally useful in other excavators. As a result, the invention is not intended to be limited by the showing herein, or in any other way, except insofar as limitations appear specifically in the following claims.

I claim:

1. In a lowerable A-frame assembly for mobile cranes and the like, a foldable tension leg comprising: rigid upper and lower links with facing ends, said links being in alignment when the leg is under tension; and a pin and inclined slot connection between the links at their facing ends so that upon a release of tension on the leg the links move out of alignment and begin to fold together in a desired direction in response to gravity.

2. A foldable tension leg according to claim **1** wherein the facing ends of the links overlap beyond the pin and slot connection; and both links have a transverse lock opening in the area of overlap, the lock openings being in alignment when the links are in alignment; and there is a removable lock pin which passes through said lock openings.

3. A foldable tension leg according to claim **1** wherein the links are substantially vertical when the leg is under tension; and the facing end of one link is provided with a downwardly inclined, transverse slot therethrough; and the facing end of the other link is provided with a transverse pin opening therethrough which is in alignment with the slot; and there is a connecting pin passing through said slot and pin opening.

4. A foldable tension leg according to claim **3** wherein the links overlap beyond the pin and inclined slot connection; and both links are provided with a transverse lock opening in the area of overlap, the lock openings being in alignment when the links are in alignment; and there is a removable lock pin which passes through said lock openings.

5. A foldable tension leg according to claim **1** including releasable lock means to hold the links in alignment.

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ANDRES H. NIELSEN, *Primary Examiner.*