Oct. 10, 1961 W. W. GRIDLEY 3,003,746

LOAD LIFTING APPARATUS

Filed Jan. 23, 1957 3 Sheets-Sheet 1

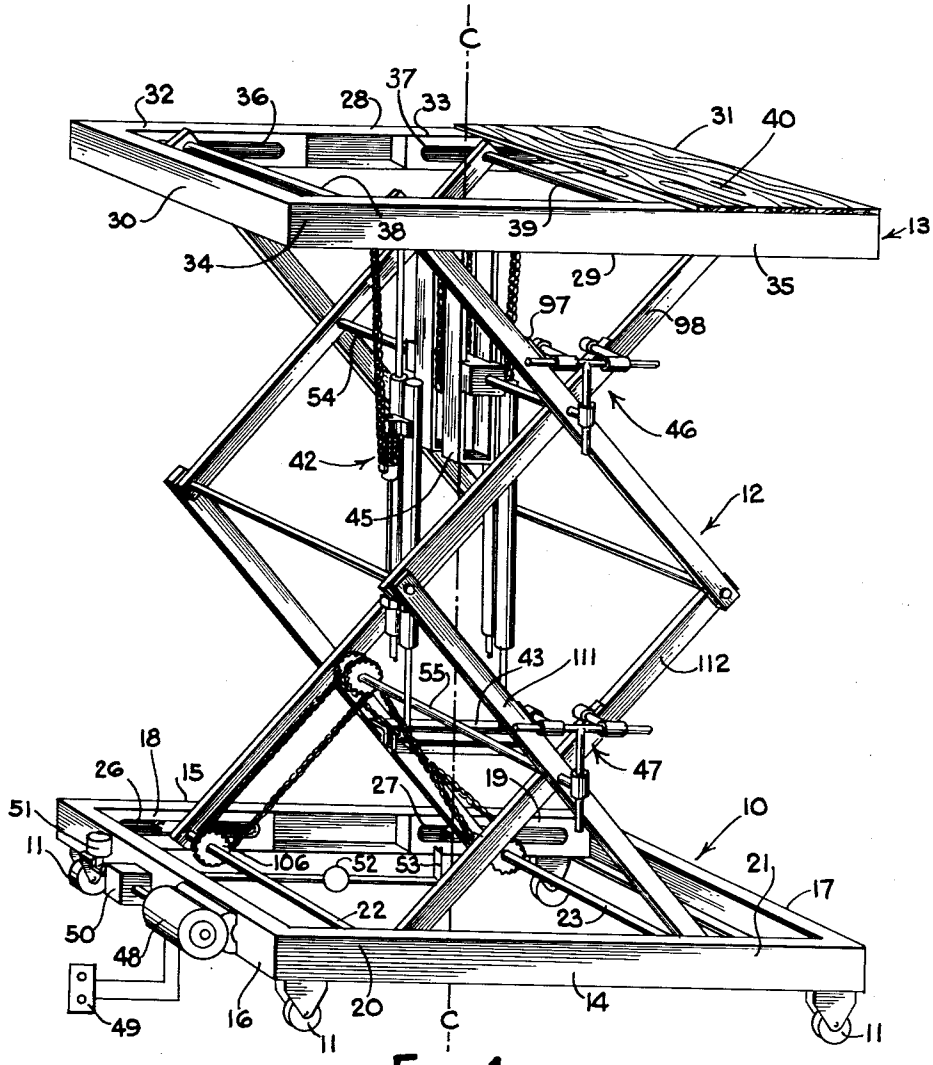


FIG. 1

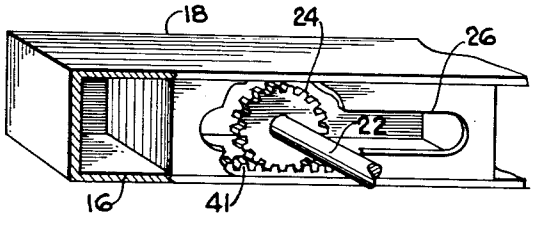


FIG. 2

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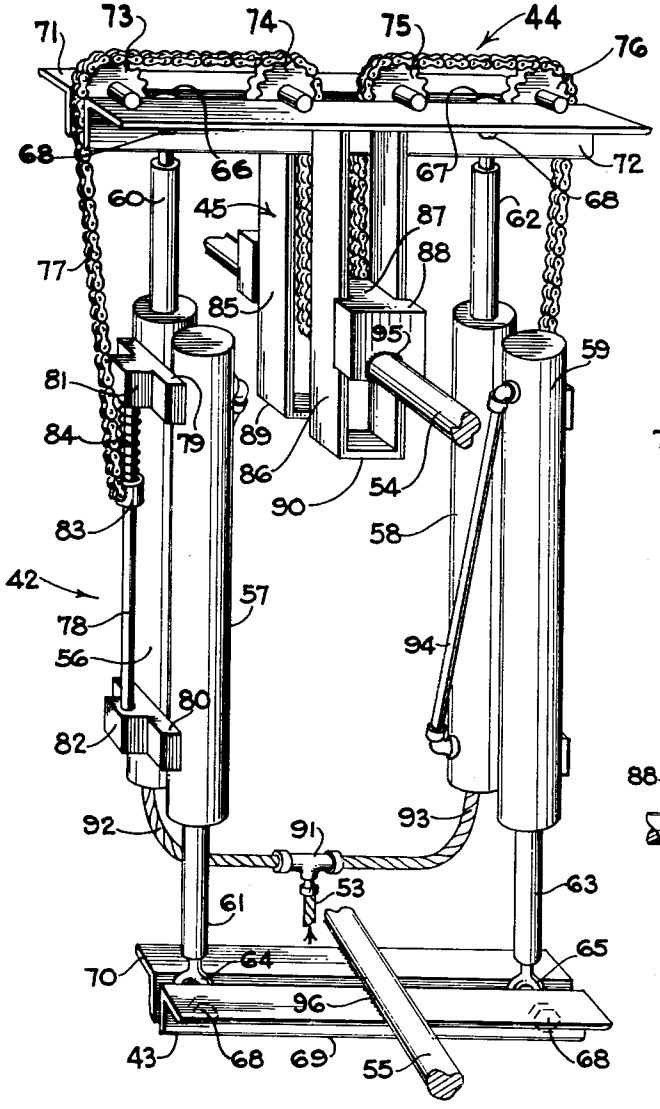


FIG. 3

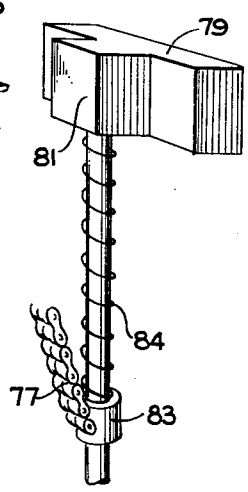


FIG. 4

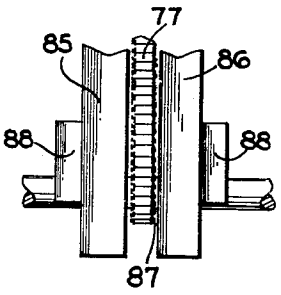


FIG. 5

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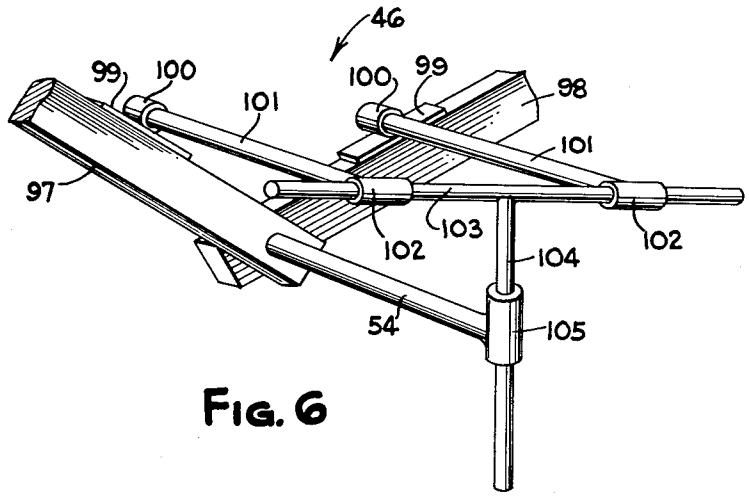


FIG. 6

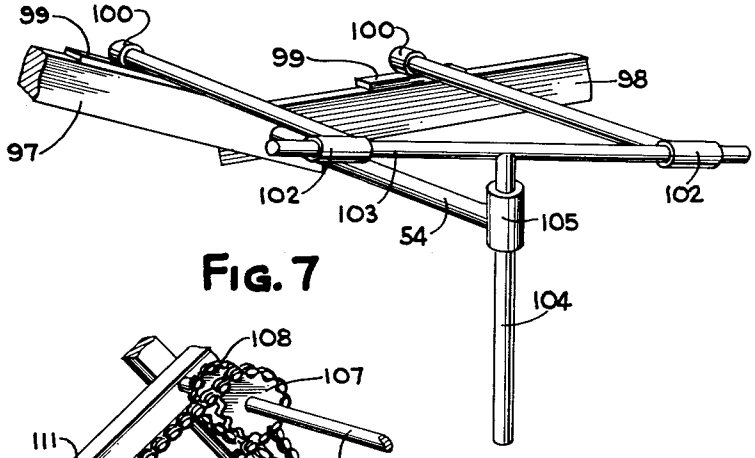


FIG. 7

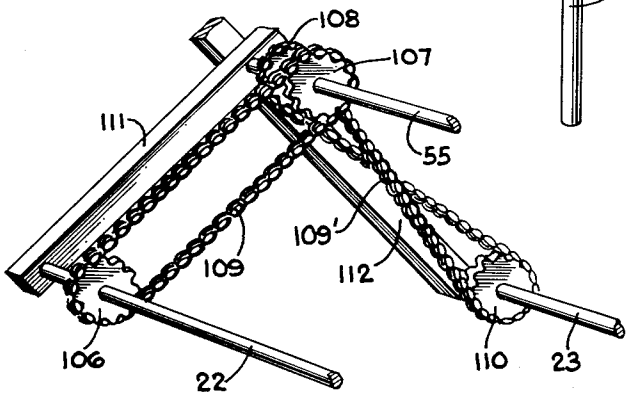


FIG. 8

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3,003,746

LOAD LIFTING APPARATUS

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Filed Jan. 23, 1957, Ser. No. 635,844
6 Claims. (Cl. 254—9)

This invention generally relates to load lifting apparatus and more particularly to a portable hoist which may be used indoors or outdoors for elevating materials and equipment together with men to locations adjacent working areas.

At the present time, particularly in the residential and industrial construction trades, it is oftentimes necessary to raise heavy material such as beams, girders, roofing materials, and the like to a considerable height above the ground level for their use in the upper portion of the structure being built. Although elevators and other types of hoisting equipment are available and used in connection with multi-story building and larger industrial buildings, a need has arisen for a simple, portable hoist which may be used with conventional one or two story homes and smaller business properties. In fabricating such buildings, most contractors at the present time use manual power or improvised pulley arrangements as a means of lifting materials to proper positions for fabricating roofs or forming the second story of buildings.

Certain efforts have been made towards developing a suitable hoist or load lifting apparatus to conform to the requirements outlined above; however, such devices up to the present time have not been satisfactory in view of their bulkiness, their heavy weight, and certain unsafe and unstable portions of their construction. In addition, the hoists which are presently available are not susceptible of economical manufacture and low operational cost.

It is, therefore, an object of the present invention to provide a load lifting apparatus which is extremely stable and safe in its operation and yet which may be manufactured at a minimum cost so as to be available to the conventional contractor in the building business.

Another object of the present invention is to provide a load lifting apparatus which requires very little power to operate, and yet which is capable of lifting the maximum loads encountered in normal construction work.

Another object of the present invention is to provide a load lifting apparatus having a minimum overall height in a collapsed position.

A still further object of the present invention is to provide a load lifting apparatus in accordance with the previous objects which is portable and is of such dimensions that it may be moved to convenient locations both indoors and outdoors for elevating materials and equipment to working areas.

Although the invention will primarily be described from the standpoint of its application in the home building and industrial building trades, it will be appreciated that this load lifting apparatus will have other applications in numerous fields where similar requirements are desirable.

Generally, the objects and advantages of the present invention are achieved by providing a lower frame or carriage suitably supported on wheels, above which is spaced a second frame or load carrying platform. Interposed between the lower frame and the upper frame is a crossed levers structure of conventional form, which is coupled for movement to the lower frame and upper frame, whereby upon expansion it will cause the upper frame to move upwardly a given distance.

The crossed levers structure includes at least two spaced pivot axles on a given center line of the apparatus. Ram means are interposed between and coupled to the pivot axles for forcing the pivot axles apart and in turn expanding the crossed levers structure to raise the load carrying platform.

For actuating the ram means, fluid pressure means are suitably connected thereto which function to force the ram pistons out from the ram cylinders.

An important feature of the present invention resides in the provision of guiding means which are coupled to the crossed levers structure and to at least one of the frame members so as to insure uniform movement of both sides of the crossed levers structure with respect to the center line of the apparatus as the structure is expanded or contracted by the fluid pressure means.

In a preferred embodiment, another important feature of the present invention resides in the use of ram balancing means, which are particularly advantageous in applications where a plurality of rams are employed. The ram balancing means controls the relative movement of the rams and the interrelated movement of the crossed levers structure as the load lifting apparatus is expanded or contracted. It will be appreciated that the ram balancing means and co-operative guiding means enable the load lifting apparatus of the present invention to be extremely safe and stable in operation, as will be more apparent as the specification proceeds.

A better understanding of the present invention will be had by reference to the drawings, in which a preferred construction is shown, and in which:

FIGURE 1 is an oblique drawing of the load lifting apparatus of the present invention shown in an expanded position;

FIGURE 2 is an enlarged oblique view, partially broken away, of a box-like portion of one of the side members of the lower frame of the device shown in FIGURE 1;

FIGURE 3 is an enlarged oblique view of the ram means and interrelated structure of the load lifting apparatus shown in FIGURE 1;

FIGURE 4 is an enlarged view of the chain retaining means shown in FIGURE 3 with the spring means employed being shown in an expanded position when the apparatus is in a lowered or contracted position;

FIGURE 5 is a side view of the guide block shown in FIGURE 3;

FIGURE 6 is an enlarged oblique view of one of the ram balancing means units shown in FIGURE 1; said means being shown in position after actuation of the crossed levers structure to an expanded position;

FIGURE 7 is a view of the ram balancing means shown in FIGURE 6 after the crossed levers structure of FIGURE 1 has been collapsed; and

FIGURE 8 is an enlarged view of the guiding means for insuring uniform relative movement of the crossed levers structure about its center line, as shown in FIGURE 1.

Referring now to the drawings, there is shown in FIGURE 1 a load lifting apparatus or portable hoist according to the present invention including a carriage or lower frame **10** supported on conventional caster wheels **11**. Disposed above the lower frame **10** is a crossed levers structure generally designated by the numeral **12**, which is coupled to the lower frame **10** and to a load supporting platform or upper frame **13**.

The lower frame **10** may be fabricated, as shown, with channel, U-shaped members comprising side members **14** and **15**, and end members **16** and **17**. The side member **15** has its end portions **18** and **19** closed to form box-like sections; similarly, the side member **14** has its end portions **20** and **21** identically constructed. All the box-like sections, **18**, **19**, **20**, and **21** are of similar structure and may be more clearly understood by reference to FIGURE 2 where an enlarged view of the section **18** is shown.

The crossed levers structure **12** is provided with lower

axles 22 and 23 adapted to extend into respective opposed box sections 18, 20, and 19, 21. Towards this end, the axles 22 and 23 are provided, respectively, with opposing gears 24 which ride within the box sections of the side members in a manner which will become clearer as the specification proceeds. One of the gears 24 may be seen by reference to FIGURE 2. In order to accommodate the horizontal movement of the axles 22 and 23 upon expansion or contraction of the crossed levers structure 12, slots 26 may be provided in the box sections 18 and 20 and similar slots 27 in the box-like sections 19 and 21. Again, reference is had to FIGURE 2 wherein one of the slots 26 is more clearly shown.

The upper load carrying platform or frame 13 is constructed similarly to the carriage or lower frame 10. The upper frame 13 includes side members 28 and 29, and end members 30 and 31. In addition, box-like sections are provided at the respective end portions of the side members 28 and 29, and are identified by the numerals 32 and 33, and 34 and 35, respectively. The box sections 32 and 34 include slots 36; correspondingly the box sections 33 and 35 include slots 37. The slots 36 are adapted to accommodate movement of an upper axle 38; and the slots 37 of an upper axle 39. The axles 38 and 39 are similarly provided with opposing gears 24, as shown in FIGURE 2, which function similarly to the gears 24 attached to axles 22 and 23. In addition, the upper frame desirably includes planking 40 or the like (shown partially for illustrative purposes) for supporting the particular materials or equipment being lowered or raised into position.

The gears 24 attached to the axles 22, 23, 38 and 39, travel in the box-like sections and are constructed to rotate along a flat gear track 41 as shown in FIGURE 2, which is disposed in each of the box-like sections 18 through 21 in the lower frame and 32 through 35 in the upper frame. The intermeshing of each gear 24 with the adjacent track 41 provides a limited amount of friction and ratchet-like stability for guiding movement of the lazy tongs structure 12 as it expands or contracts. In addition, by providing the gears 24 at the ends of the axles, the axles are caused to rotate in accordance with the raising or lowering of the apparatus, whereby a guiding means (to be hereafter described) may be employed to insure uniform movement of the various axles involved.

The crossed levers structure 12 is adapted to be actuated by a generally designated ram means 42 disposed therein, which is in turn coupled to a lower cross frame 43 and an upper cross frame 44, the upper cross frame 44 being more clearly shown in the view of FIGURE 3. In addition, the upper cross frame 44 includes a downwardly extending vertical frame generally designated by the numeral 45 which functions as part of a unique structure in decreasing the overall height of the apparatus when it is in a collapsed position. The importance of the vertical frame 45 will be more evident as the specification proceeds.

Referring again to FIGURE 1, the crossed levers structure 12 has connected thereto an upper ram balancing means designated by the numeral 46 and a lower ram balancing means designated by the numeral 47. The ram balancing means 46 and 47 function as an important feature of the present invention in compensating for any tendency of any uneven movement of the particular rams employed in the ram means 42 during expansion or contraction of the crossed levers.

The ram means 42 may be actuated in a conventional manner by fluid pressure means shown secured to the side members 16. In this regard, in one form, an electric motor 48 may be provided to be controlled by a start-stop switch 49, and in turn drive a pump 50 to pressurize fluid from a reservoir source 51. The fluid may then pass through a valve 52 into a line 53 which will connect with lines to the individual rams of the ram means 42. The valve 52 may be a suitable solenoid or equivalent valve which will permit the passage of the fluid through the line 53 as the ram means 42 are actuated to expand the crossed levers structure 12. On the other hand, the valve 52 would be designated to limit flow of the fluid through the line 53 during contraction of the crossed levers structure 12 when the structure is collapsing under its own weight.

The ram means 42 is supported from and adapted to actuate center pivot axles 54 and 55, shown in the views of FIGURE 1 and more clearly in FIGURE 3. More specifically, the pivot axle 54 is adapted to move within the vertical frame 45 supported from the cross frame 44, and the other pivot axle 55 is adapted for movement with the lower cross frame 43. In this regard, the lower pivot axle 55 is welded or otherwise rigidly secured to the lower frame 43. The pivot axles are constructed so as to be positioned on the center line of the apparatus as indicated in FIGURE 1.

In the preferred embodiment shown in FIGURE 3, the ram means 42 comprises a set of four rams denoted by the numerals 56, 57, 58, and 59; the aforementioned rams, respectively, include actuating piston rods 60, 61, 62, and 63, provided with corresponding eyelet ends 64, 65, 66, and 67. The ends 64 and 65 of the piston rods 61 and 63 are secured to the lower frame 43, as with bolts 68. Similarly, the ends 66 and 67 of piston rods 60 and 62 are secured to the upper cross frame 44 with bolts 68.

The lower cross frame 43 may be constructed with a pair of spaced angle members 69 and 70, which are positioned apart sufficiently to accommodate the interposition of the eyelet ends 64 and 65 of the corresponding rams. Similarly, the cross frame 44 may be correspondingly constructed of two angle members 71 and 72. However, it is desirable to space the angle members 71 and 72 of the cross frame 44 a greater distance apart in order to accommodate the interposition of sprockets 73, 74, 75, and 76. These sprockets are designed to carry a chain or the like 77, which has its ends secured, respectively, to a pair of retaining means, each including a guide rod 78, one of which is disposed on each pair of rams 56, 57, and 58, 59. Only one rod 78, positioned adjacent the rams 56 and 57, is shown in FIGURE 3, although the retaining means on the rams 58 and 59 is identical. The rod 78 is secured between an upper stop 79 and a lower stop 80, the stops being suitably welded or otherwise fixed to the rams.

As shown in FIGURE 3, the stop 79 includes a projection member 81; similarly the lower stop 80 is provided with a projection member 82. The guide rod 78 interconnects the members 81 and 82 and a sleeve 83 is secured to an end of the chain 77 for slidable movement thereon. It is additionally desirable to provide a spring 84 on the rod 78 to normally bias the sleeve 83 away from the projection 81.

Prior to actuation of the crossed levers structure 12 to an extended position, the sleeve 83 is normally disposed as shown in FIGURE 4 with the spring 84 biasing it downwardly towards the lower retaining means 80. The chain 77 may be suitably welded or otherwise secured to the sleeve 83 such that the sleeve 83 will move upwardly in response to similar movement of the chain 77.

The vertical frame 45 within which the axle 54 moves upwardly and downwardly is comprised of two channel members 85 and 86 spaced a sufficient distance apart from each other to accommodate the looping of the chain 77 down around a guide block 87 extending through the channel members 85 and 86. This construction is more clearly shown in the view of FIGURE 5 where it will be noted that the guide block 87 includes end portions 88 extending beyond the edges of the respective channel members 85 and 86. The end sections 88, as shown in FIGURE 3, are of wider dimensions than the channel members 85 and 86 such that the guide block

87 is confined therein for sliding movement within the vertical frame 45. The channel members 85 and 86, of course, must be closed off at their lower ends as indicated at 89 and 30.

As described with reference to FIGURE 1, the pump 50 forces fluid through the line 53 to the ram means 42. More specifically, as shown in FIGURE 3, the line 53 may, for example, connect through a T connection 91 to convey fluid through lines 92 and 93, respectively, to rams 56 and 58. It will be appreciated that rams 56 and 58 have their respective piston rods 60 and 62 connected to the upper cross frame 44, whereas rams 57 and 59 have their respective rods 61 and 63 connected to the lower cross frame 43. Thus, by conveying the pressurized fluid from the line 93, for example, through a diagonal piping 94 connecting the lower part of the ram 58 with the upper part of the ram 59, the fluid passing through the line 93 will actuate both the ram 58 and the ram 59. Similarly, a piping 94 (not shown) is provided for conducting the fluid from line 92 up to the top of ram 57. With such an arrangement, all four rams 56, 57, 58, and 59 are in parallel and subjected to the same degree of fluid pressure.

It will be evident from the view of FIGURE 3 that the ram means 42 is supported and, as previously mentioned, adapted to actuate the center pivot axles 54 and 55. In this regard, the pivot axle 54 is rigidly secured to the guide block 87 at 95 so that with movement of the guide block 87 in a vertical direction, similar movement will be effected in the axle 54. Also, when the axle 54 reaches the upper limits of its movement within the vertical frame 45 as determined by the guide block 87 coming into contact with the bottom portion of the cross frame 44, thereafter the axle 54 will be acting directly with the cross frame 44 as it is raised by the piston rod 60 and 62.

The lower axle 55, as previously mentioned, is welded to the cross frame 43 as at 96, although in the alternative it it might be secured with a bracket or other rigid means.

Another important feature of the present invention resides in the particular ram balancing means employed for compensating for any tendency for unbalanced movement of the ram piston rods 60, 61, 62, and 63. The ram balancing means comprise T-shaped structures which have been generally indicated by the numerals 46 and 47 in FIGURE 1. A clearer understanding of the operation of the ram balancing means may be had by reference to FIGURES 6 and 7 in which the balancing means 46 is shown in detail. In these figures it is shown that linkage arms 97 and 98 of the crossed levers structure 12 each have secured thereto a bracket 99 including a bearing member 100. Each bearing 100 is designed to enable angular movement to each respective rod 101. The rod 101, in turn, is limited to horizontal movement in view of its terminating in a sleeve member 102 slidably connected to a cross bar or horizontal rod 103. The horizontal rod 103, in turn, has a stem or a vertical rod 104 extending therefrom and passing through a vertical sleeve 105 rigidly fastened to the pivot axle 54. With such a construction, as shown in FIGURE 7, as the arms 97 and 98 are collapsed, the sleeve members 102 will move outwardly on the rod 103 and the sleeve member 105 will move upwardly on the rod 104. It will be noted, however, that with such a construction rotation of the axle 54 is prevented with the result that any possible unequal movement of the piston rods 60 and 62 (in FIGURE 3) will be compensated for by the ram balancing means 46. Ram balancing means 47 is constructed identically to the balancing means 46 and functions in a similar manner.

It is additionally desirable to provide guiding means tending to assure uniform movement of the crossed levers structure 12 as a whole. In this respect, reference is had to FIGURE 8 illustrating one form of a differential that might be used to assure expansion and contraction of the crossed levers structure 12 uniformly along its center

line. For this purpose, a sprocket 106 is secured to the lower axle 22, and similar sprockets 107 and 108 are coupled together and are rotatably secured for rotation relative to the center pivot axle 55. With such a construction a chain 109 may pass over the sprocket 106 and connect with, for example, the sprocket 107 on the axle 55. Similarly, another chain loop 109' with a reverse loop, in this instance, would pass over sprocket 108 and connect with a sprocket 110 on the opposite axle 23. Thus, with any movement of axle 22 inwardly or outwardly, a similar movement would be effected in axle 23 in view of the fact that sprockets 107 and 108 are connected to the same axle 55. Of course, it is conceivable that other types of differentials might be employed, for example, bevel gears could be secured to the axles 22 and 23 and shafts having matching bevel gears could intermesh therewith to transmit the movement to the center axle 55 and thereby compensate for uneven movement. With such a construction the pivot arms 111 and 112 would thus be caused to move equal distances inwardly or outwardly and effect a uniform rate of expansion or contraction of the overall crossed levers structure 12.

A further consequence of the chain loop differential construction is that the load lifting apparatus is always stabilized against shifting back and forth with respect to the frame 10. Thus, if the sprocket 106 rotates in a counter-clockwise direction as a result of corresponding rotation of axle 22 the sprocket 110 must rotate in a clockwise direction. It is evident, therefore, that axles 22 and 23 will not turn unless the apparatus is being raised or lowered.

The overall operation of the hoist or load lifting apparatus of the present invention will be quite evident from the foregoing description although it is believed that certain features should additionally be emphasized. The hoist is first rolled into position so as to be disposed below the desired working area. Thereafter, the switch 49 is actuated to cause the pump 50 to force fluid from the reservoir 51 into the line 53, and thereafter through the lines 92 and 93 into the rams 56, 57, 58, and 59. As a consequence, the rods 60 and 62 will exert an upward force on the cross frame 44, and the rods 61 and 63 will exert a downward force on the cross frame 43. It will be appreciated that in FIGURES 1 and 3 the ram means 42 are shown in their extended position.

In their initial or collapsed position, the guide block 87 will be resting on the bottom ends 89 and 90 of the vertical frame 45. As the rods 60 and 62 move upwardly, the cross frame 44 will in turn be forced upwardly to cause the chain 77 to move upwardly equal increments along the guide rods 84 and within the vertical frame 45. It should be noted that the chain 77 is fixed against rotation to the guide block 87 such that any given upward movement of the chain 77 will effect a similar upward movement of the guide block 87. As the cross frame 44 continues to move upwardly and to draw the guide block and attached axle 54 also upwardly, the chain 77 will gradually force the sleeve 83 on each of the guide rods 84 upwardly towards the stop member 81. When the sleeve 83 is at the upper limit of its movement in view of the stop member 81, it will then be seen that the guide block 87 will be forced upwardly twice as fast as the cross frame 44 until and if the guide block 87 comes in contact with the bottom of the cross frame 44. Thus, it will be seen with this type of construction that the vertical frame 45 serves as a means of allowing full expansion of the tongs structure and yet at the same time permitting the axles 54 and 55 to be brought relatively close to each other in a collapsed position to reduce the minimum overall height of the load lifting apparatus.

After the material has been removed from the load carrying platform 13 the switch 49 may be actuated to open the valve 52, which as previously stated is designed to permit limited back flow, to allow the crossed levers structure 12 to collapse slowly under its own weight. As

the apparatus collapses, the guide block **87** will first move down towards the closed ends **89** and **90** of the vertical frame **45**, and thereafter the chain **77** will be forced downwardly by the biasing springs **84** to a position shown in FIGURE 4.

From the foregoing, it is apparent that the load lifting apparatus of the present invention provides a safe, relatively inexpensive, and yet extremely stable and rugged structure of particular usefulness to the construction industry. Although the invention has been shown in a preferred embodiment for illustrative purposes, it will be appreciated that it may be constructed in other forms with changes and modifications well known to those skilled in the art.

What is claimed is:

1. A load lifting apparatus comprising: a first frame; a second frame; a crossed levers structure interposed and coupled between said first frame and said second frame; said crossed levers structure having only two linearly movable spaced pivot axles on a given center line of said apparatus; ram means interposed and coupled to said pivot axles; fluid pressure means connected to said ram means, whereby said fluid pressure means may be actuated to effect expansion or contraction of said ram means to cause proportionate movement of said crossed levers structure; and, ram balancing means secured to said crossed levers structure and said pivot axles, respectively, to prevent rotative movement of said pivot axles during expansion and contraction of said crossed levers structure, thereby assuring equal angular movement of said levers relative to said pivot axles.

2. A load lifting apparatus comprising: a first frame; a second frame; a crossed levers structure interposed and coupled between said first frame and said second frame, said crossed levers structure having only two linearly movable spaced pivot axles on a given center line of said apparatus; ram means interposed between and coupled to said pivot axles; fluid pressure means connected to said ram means, whereby said fluid pressure means may be actuated to effect an expansion or contraction of said ram means to cause proportionate movement of said crossed levers structure; guiding means coupled to said crossed levers structure and to said first frame to control uniform movement of said crossed levers structure with respect to the center line of said apparatus; and independent, ram balancing means secured to said crossed levers structure at each said pivot axle to prevent rotative movement of each said pivot axle during expansion and contraction of said crossed levers structure, thereby assuring equal angular movement of said levers relative to said pivot axles.

3. A load lifting apparatus comprising: a lower frame having spaced lower side members; an upper frame having spaced upper side members aligned with said lower side members; a crossed levers structure interposed between said first frame and said second frame and having at least one upper pivot axle and one lower pivot axle on a given center line of said apparatus, said crossed levers structure also having a lower pair of end axles adapted to ride in said lower frame between said lower side members, and an upper pair of end axles adapted to ride in said upper frame between said upper side members; ram means interposed between and coupled to said upper pivot axle and said lower pivot axle; fluid pressure means connected to said ram means, whereby said fluid pressure means may be actuated to effect an expansion or contraction of said ram means to cause proportionate movement of said crossed levers structure; guiding means coupled to said crossed levers structure and to said first frame to control uniform movement of said crossed levers structure with respect to the center line of said apparatus, said guiding means comprising members interconnected, respectively, between said lower pivot axle and each of said pair of lower end axles, whereby a given vertical movement of said lower pivot axle will effect a proportionate equal and opposite movement of each of said pair of lower end axles, respectively.

4. A load lifting apparatus according to claim 3, in which said ram means comprises: at least one ram vertically disposed on either side of said center line, and ram balancing means secured to said crossed levers structure and said pivot axles to prevent rotative movement of said pivot axles during expansion and contraction of said crossed levers structure, thereby assuring equal angular movement of said levers relative to said pivot axles.

5. A load lifting apparatus according to claim 4, in which said ram balancing means comprises: at least one rigid T-shaped member having a stem and cross bar disposed in a vertical plane parallel and adjacent to a pair of linkage arms of said crossed levers structure; a sleeve adapted for vertical movement on said stem and rigidly connected to one said pivot axle; and, a pair of sleeves disposed on said cross bar for horizontal movement thereon, each of said pair of sleeves being coupled for relative rotation, respectively, to each of said pair of linkage arms of said crossed levers structure.

6. In a load lifting apparatus including a crossed levers structure interposed between a lower frame and an upper frame; an upper pivot axle and a lower pivot axle of said crossed levers structure spaced apart on a given center line of said apparatus; a first cross frame secured to said lower pivot axle; a second cross frame positioned above said upper pivot axle and a downwardly depending vertical frame member coupled to said upper pivot axle to enable limited vertical movement of said upper pivot axle a given distance relative to said second cross frame; ram means interposed and coupled between said first cross frame and said second cross frame; and, flexible means connected to said upper pivot axle and to said second cross frame, said flexible means functioning to effect movement of said upper pivot axle through said given distance upon expansion of said ram means.

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