July 19, 1949. R. F. MANKE 2,476,380

LIFTING MECHANISM

Filed Sept. 17, 1943 4 Sheets-Sheet 1

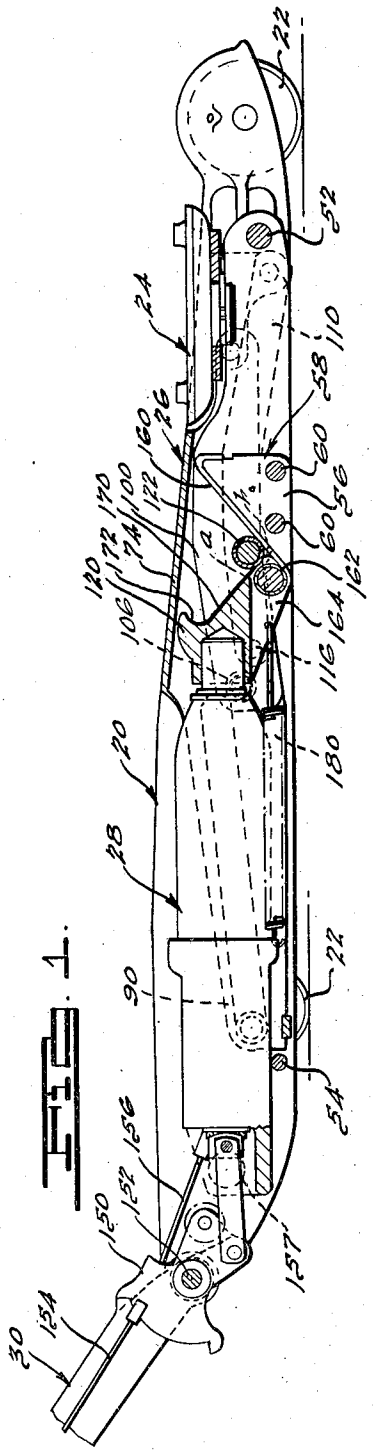


Fig. 1.

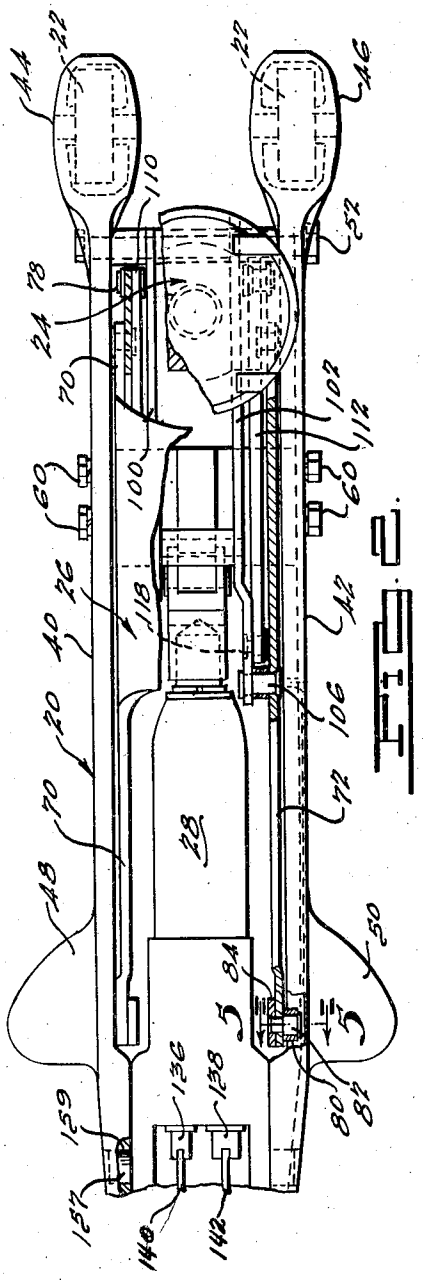


Fig. 2.

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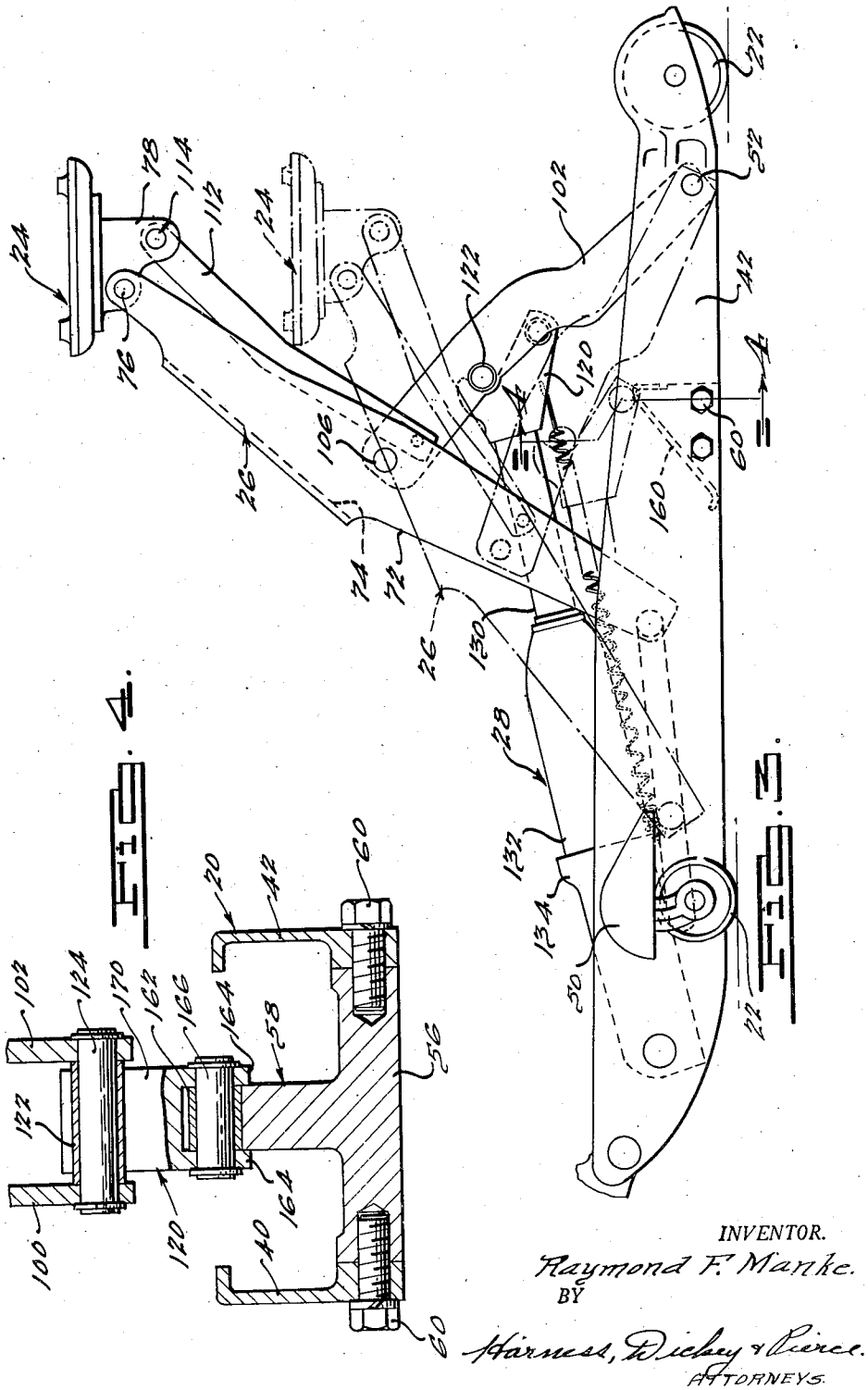


FIG. 4.

FIG. 5.

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LIFTING MECHANISM

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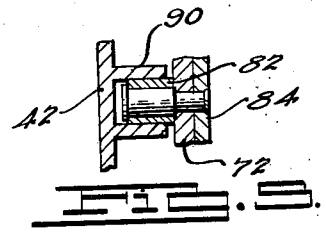


FIG. 5.

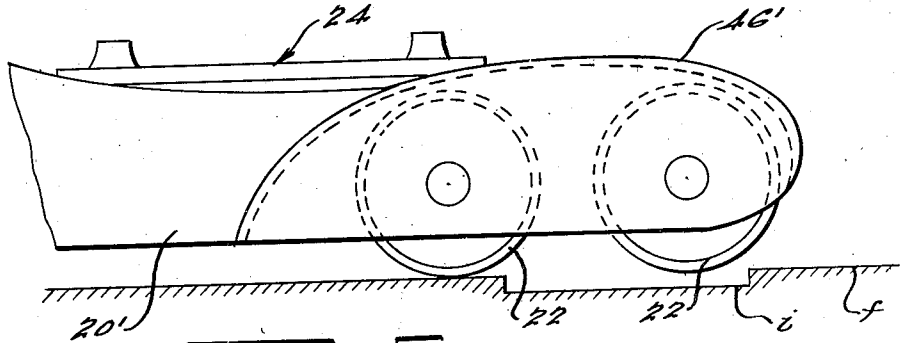
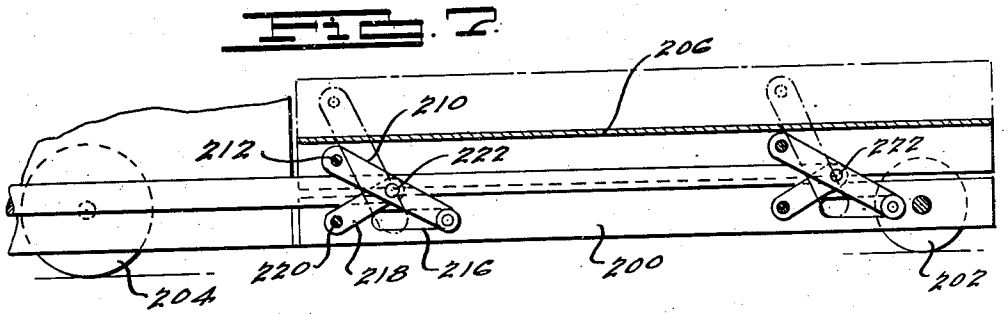


FIG. 6.

FIG. 7.



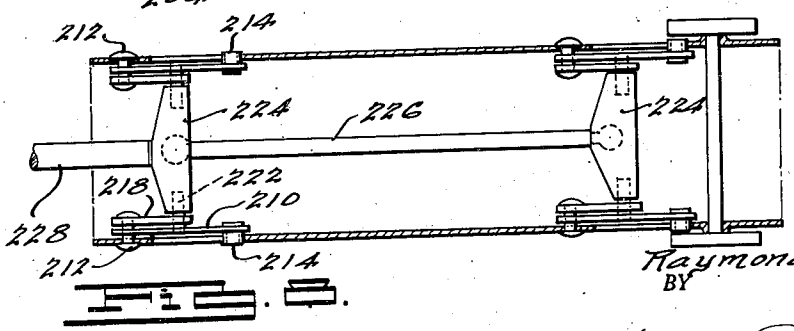


FIG. 8.

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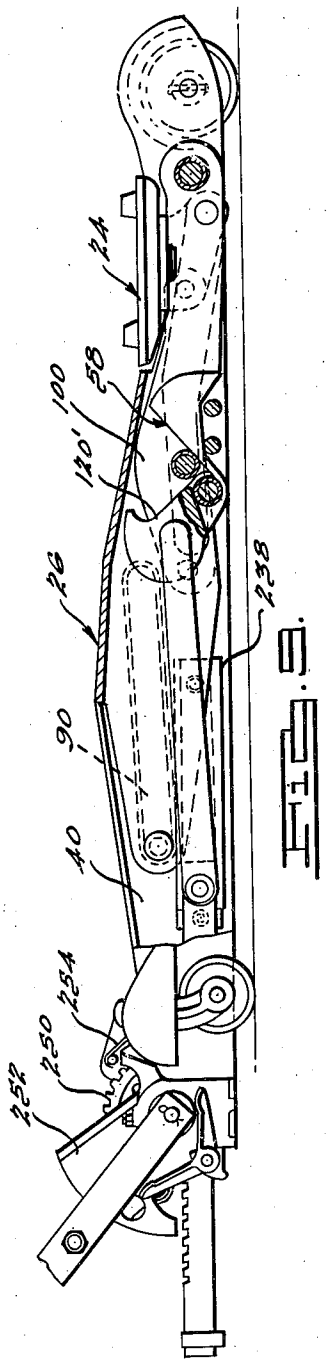


Fig. 9.

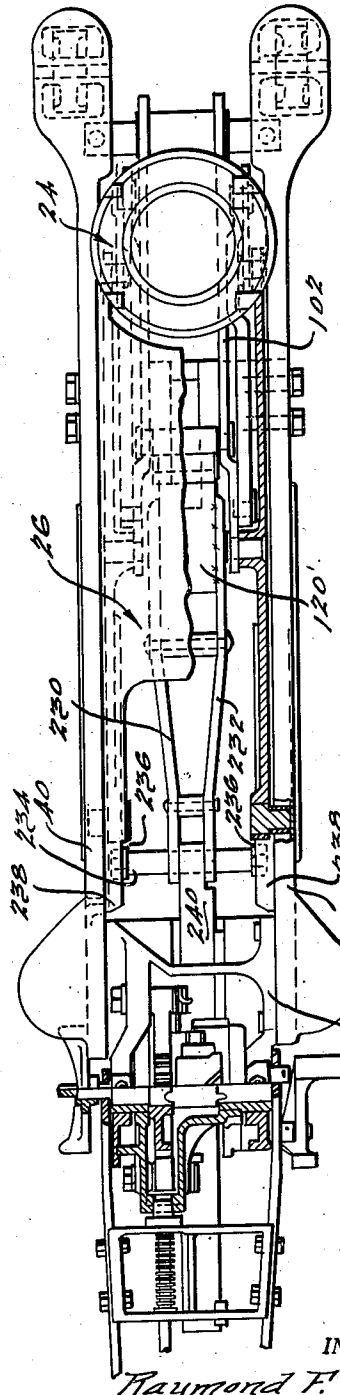


Fig. 10.

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UNITED STATES PATENT OFFICE

2,476,380

LIFTING MECHANISM

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Application September 17, 1943, Serial No. 502,780

4 Claims. (Cl. 254—2)

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The present invention relates to lifting mechanisms, and in the herein disclosed embodiments, provides improved lifting mechanisms for use in portable jack structures, industrial trucks and the like.

The principal objects of the present invention are to provide lifting mechanisms, which may be readily and economically manufactured and assembled and which are reliable and efficient in operation; to provide such structures embodying improved arrangements of lifting elements, which can be collapsed into a relatively small space, thereby minimizing the necessary height and length of the structure; to provide such a structure wherein a substantially vertical lift may be imparted to a load engaging element by means of a power applying member which moves in a generally horizontal path; to provide such structures embodying a lifting arm, which carries a load engaging element and which is both swung and moved bodily so that the load engaging element moves in a substantially linear vertical path; to provide such structures including supplemental lifting elements, herein illustrated as comprising inclined planes, which function during and facilitate the initial lifting movement; to provide such structures incorporating an improved arrangement of supporting wheels, which facilitates the use of the structure on irregular surfaces; and to provide an improved and simplified construction and arrangement of lifting mechanisms.

With the above as well as other and more detailed objects in view, which appear in the following description and in the appended claims, preferred but illustrative embodiments of the invention are shown in the accompanying drawings, throughout the several views of which corresponding reference characters are used to designate corresponding parts and in which:

Figure 1 is a view in side elevation, with certain of the parts broken away, of a portable floor jack embodying the invention;

Fig. 2 is a plan view, with certain of the parts broken away, of the structure of Fig. 1;

Fig. 3 is a view corresponding generally to Fig. 1, but showing the structure in the fully and partially elevated positions;

Fig. 4 is a view in vertical section, taken along the line 4—4 of Fig. 3;

Fig. 5 is a fragmentary view in vertical section, taken along the line 5—5 of Fig. 2;

Fig. 6 is a fragmentary view of a further embodiment of the invention;

Figs. 7 and 8 are views, respectively, in side

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elevation, with certain of the parts broken away, and in horizontal section, of a further embodiment of the invention; and

Figs. 9 and 10 are, respectively, views in side elevation and in plan, with certain of the parts broken away, of an embodiment of the invention which corresponds generally to the embodiment of Figs. 1 through 5, with the exception that a different power applying mechanism is used.

It will be appreciated from a complete understanding of the present invention that the improvements thereof may be embodied in lifting structures intended for widely differing uses, and incorporating widely differing structural arrangements. Preferred applications of the invention are in connection with floor jacks, industrial trucks and the like, and in an illustrative but not in a limiting sense, the invention is so disclosed herein.

Referring first to Figs. 1 through 5, the illustrated portable floor jack comprises generally a frame structure 20, which is supported by a series of four wheels 22; a lifting cap 24, which is carried at the forward end of a lifting arm 26, for movement between the retracted position shown in Figs. 1 and 2, and the fully elevated position shown in Fig. 3; and a power applying element 28, herein illustrated as a conventional hydraulic ram and pump unit, which responds to rocking movements of a usual handle structure 30.

The frame 20 is constituted by a pair of longitudinally extending, laterally spaced, similar, but oppositely presenting members 40 and 42, which, as best appears in Fig. 4, are of channel-shaped form throughout the major portions of their length. Adjacent their front ends, the members 40 and 42 are formed to define hoods 44 and 46, within which the front wheels 22 are conventionally received. Adjacent their rear ends, the members 40 and 42 are provided with similar shields 48 and 50, which, respectively, receive the rear wheels 22. As will be understood, the rear wheels 22 may, if desired, be carried by swivel arms. The members 40 and 42 may be maintained in rigid unitary relation to each other in any suitable way. As shown, this is accomplished by front and rear stay bolts 52 and 54, and by the base 56 (Fig. 4) of the hereinafter described fixed plane 58. The base 56 is secured to the respective members 40 and 42 by corresponding pairs of studs 60.

The lifting arm 26 is constituted by a pair of laterally spaced legs 70 and 72, which are connected together, throughout a portion of their length, by web 74. The front ends of the legs

70 and 72 are pivotally connected, by a pin 76, to a cap adapter 78, to which the cap 24 is rotatably secured. The rear ends of the respective legs 70 and 72 are provided with rollers 80, one of which is shown in Fig. 2. Each roller 80 is rotatably journalled upon a pin 82, and is supported in place thereon between the enlarged head of the pin and the outer face of the corresponding arm 70 or 72. Each pin 82 is provided with a reduced inner end, which passes through the corresponding arm 70 or 72, and also through a reinforcing plate 84, carried at the inner side of such arm. As will be understood, in assembly the pin is passed through the arm and reinforcing plate, after which the inner end of the pin is radially enlarged to retain the parts in assembled relation.

The respective rollers 80 ride in grooves or guideways 90 individual thereto, one of which is shown in Fig. 5, as comprising upper and lower portions which are integral with and project inwardly from the web of the side frame member 42. The guide or runway for the roller associated with arm 70 is similarly arranged, as will be understood. As also appears in Fig. 1, the front and rear ends of the runways 90 are closed, so that these runways may be utilized to limit the extent of movement of the rear end of the lifting arm 26.

The lifting force is applied to the lifting arm 26 by means of laterally spaced, radius or stabilizer arms 100 and 102. The lower ends of arms 100 and 102 are pivotally connected to the frame by means of the previously mentioned front tie rod 52, which may, if desired, be provided with spacing sleeves or other means to maintain the arms 100 and 102 in proper position lengthwise of the tie rod. The upper ends of the arms 100 and 102 are pivotally connected to the corresponding legs 70 and 72 of the lifting arm 26, by means of pins 104 and 106. The pin 106 is shown in detail in Fig. 2 and pin 104 is similarly associated with leg 70 and arm 100.

In order to stabilize the cap 24 and maintain its upper surface in a substantially horizontal position throughout the travel of the lifting arm 26, a pair of similar, laterally spaced stabilizing arms 110 and 112 are pivotally connected at their outer ends to the cap adapted 78, as by pin 114, and are pivotally connected at their inner ends to the corresponding radius arms 100 and 102, by pins 116 and 118. It will be appreciated that the pivotal connections of the lifting arm 26 and the stabilizing arms 110 and 112 to the cap adapter 78 and to the radius arms 100 and 102 are so located, relative to the paths of movement of the lifting arm and the radius arms, as to maintain the cap 24 in a substantially horizontal position throughout its travel.

The lifting force is applied to the radius arms 100 and 102 by means of the head 120, which operatively engages a roller 122. Roller 122 is rotatably supported upon the pin 124, which is secured to and extends between the radius arms 100 and 102. The head 120 is rigidly secured at the outer end of the ram 130 which, in the embodiment now being described, constitutes the piston rod of the previously mentioned hydraulic ram and pump unit 28.

The unit 28 may be and preferably is conventionally constructed and, consequently, does not require detailed description. It is noted, however, that this unit comprises rigidly interconnected cylinder and pump portions 132 and 134. As shown, the pump structure embodies both speed and power elements, which, in turn, are provided with rearwardly projecting piston portions 136 and 138, which are pivotally coupled to operating links 140 and 142. The operating links 140 and 142, in turn, are pivotally connected to an operating segment 150. Segment 150 is pivotally supported between the side frame members 40 and 42 by means of a pin 152. The pin 152 also serves to pivotally support the previously mentioned operating handle 30, which, in accordance with usual practice, is releasably connectible to the segment 150 in any of a plurality of relative rotative positions of the segment and handle, thereby enabling adjustment of the arcuate path of travel of the handle. In addition to the releasable latch 154, which controls the last-mentioned connection, the handle 30 may be and preferably is provided with a valve controlling element 156, which may be operated to permit a return or retracting movement of the ram unit 28. In the present embodiment, the ram and pump unit partakes of a pivotal movement during the movement of the load engaging cap 24, and to accommodate this pivotal movement, the unit 28 is pivotally connected to the frame 20. As shown, this pivotal connection is afforded by providing the rear end of the unit 28 with outwardly projecting trunnions 157, which are received in corresponding sockets 159 provided in the side frame members 40 and 42. As thus far described, it will be appreciated that the parts normally occupy the positions shown in Figs. 1 and 2, in which the lifting arms, the radius arms and the stabilizer arms are collapsed within the confines of the frame members 40 and 42, and in which the cap 24 occupies a position substantially level with the upper surface of the frame. Under these conditions, the collapsed lifting arm, radius arms and stabilizer arms all occupy substantially horizontal positions, thereby enabling the over-all height of the jack structure to be kept at a very low value. As thus far described, also, it will be appreciated that a rightward movement of the head 120, as influenced by the ram 28, causes the radius arms 100 and 102 to pivot about the pin 52 in a clockwise direction. Through the pins 104 and 106, this movement of the radius arms is communicated to the lifting arm 26 and causes the latter to swing in a counterclockwise direction. Since the axis of the pins 104 and 106 moves to the right during the swinging of the arms 100 and 102, the lifting arm 26 is also caused to move bodily towards the right, during which movement the rollers 82 move to the right within the guide sleeves 90 provided therefor. The disposition of the slots 90 is such, relative to the path of the pins 104 and 106, as to substantially compensate for the tendency of the rightward movement of the pins 104 and 106 to cause rightward movement of the cap 24, and for the tendency of the counterclockwise rotation of arm 26 to cause leftward movement of the cap 24. The resultant cap movement is, consequently, in a substantially linear vertical path. The many advantages resulting from this latter feature will be apparent, it being recognized that with conventional cantilever type jack structures, the lifting movement involves either a shift in the position of the load, or a shift in the position of the jack.

Coming now to a description of the supplemental lifting elements comprising the fixed, inclined plane 58 and the cooperating, movable, inclined plane afforded by the head 120, it will be appreciated that when the lifting elements comprising the lifting arm 26 and the radius arms 100 and 102 are in their collapsed positions, these

elements and the ram 130 lie substantially parallel to each other, so that a given rightward force exerted by the ram 130 against the lifting elements has only a relatively small vertical component of force. It is the purpose of the supplemental lifting elements to elevate the previously described lifting elements to such a height that the angle between the ram and the radius arms is sufficient to enable the ram unit to complete the elevating movement without the expenditure of an undue amount of force.

More particularly, the previously mentioned fixed, inclined plane 58 is provided with an inclined surface 160, which may either be formed integrally therewith or may be separately formed and thereafter fixed in place thereon. The surface 160 affords a supporting runway for a roller 162, which is supported between the bifurcated legs 164 on the head 120, by means of a pin 166.

The head 120 is provided along its forward face with an inclined surface 170, having curved or socket portion 172 at its upper end. The surface 170 is coextensive in width with the head 120 from the socket 172 down to the point *a* in Fig. 1. From the point *a* to the point *b* in Fig. 1, the surface 170 is constituted by the upper surfaces of the previously mentioned legs 164.

In the normal or retracted position of the structure, the parts occupy the positions shown in Fig. 1, in which the roller 162 is seated upon the extreme lower and slightly curved end of the inclined surface 160, and in which the roller 122 is seated upon the extreme lower end of the inclined plane surface 170. The parts are normally retained in these positions, as will be understood, by a usual tension spring 180, which is connected between the head 120 and the cylinder portion of the ram and pump unit 28. A rightward movement of the head 120, as influenced by the ram and pump unit 28, causes the roller 162 to ride upwardly along the inclined surface 160, which movement has a substantial vertical component. The rightward movement of the head 120 also causes the inclined surface 170 to move to the right relative to the pin 122, and cam the latter upwardly. The vertical movement of the pin 122 is, of course, directly transmitted to the radius arms 100 and 102 and, consequently, to the lifting arm 26, it being noted that the net vertical movement of the pin 122 is equal to the sum of the vertical movements of the head 120 and the vertical movement of the pin 122 relative to the head 120.

As indicated by the dotted line positions in Fig. 3, just before pin 160 reaches the upper end of the inclined surface 160, the pin 122 seats in the socket 172. Further relative movement between the ram 130 and the arms 100 and 102 thus takes place about the fixed center afforded by the pin 122 and the permanent socket 172.

It will be appreciated that the lifting movement of the ram and pump unit as influenced by the rocking movements of the handle 30 transfers hydraulic fluid, such as oil, from a reservoir (not shown but contained, for example, within the ram cylinder) to the space behind the ram piston, the power and speed pumps affording a quick lift until the load is engaged and a powerful but slower lift thereafter. When it is desired to lower the load, the control 156 may be operated to enable a retransfer of the liquid from the space behind the piston to the reservoir, at a desired regulated rate, under the influence of the return bias afforded by the load and by the spring 180.

It will be noticed that the very low over-all height of the above-described jack structure involves the use of relatively small wheels. In connection with the above, as well as other small wheeled structures, which are intended for use on irregular floor surfaces, the arrangement of Fig. 6 is very advantageous. In this figure, a lifting cap 24 is associated with a frame structure 20', which may and preferably does duplicate the previously described frame structure 20 with the exception that the hoods, such as 46', which house the front wheels at the respectively opposite sides of the frame, are elongated so as to accommodate a pair of front wheels 22 at each side of the frame. Both pairs of wheels are in advance of the axis of the load, and the center distance spacing between the wheels of each pair is preferably proportioned to be somewhat in excess of the width of the normal irregularities in the associated floor *f*. One such irregularity is indicated at *i*. Accordingly, in moving the jack structure along the floor, during the time that the foremost front wheels 22 are passing over the irregularity, the rearmost wheels 22 are still engaged with the normal floor surface and support the jack structure. By the time the rearmost wheels 22 encounter the leading edge of the irregularity, on the other hand, the foremost wheels 22 have passed thereover and have become effective to support the jack structure. The jack is, consequently, enabled to pass over the irregularity without bumping. It will be appreciated that the double wheel arrangement may, if desired, be used in connection with the rear end of the jack, although in many cases this is not found necessary in view of the fact that the front wheels carry the major portion of the load.

Linkages embodying the arrangement described above with reference to the lifting arm 26 and the radius arms 100 and 102 may also be used to considerable advantage in instances where the initial lift afforded by the inclined planes is not needed. An illustrative such arrangement in connection with an industrial truck structure is shown in Figs. 7 and 8. In these figures, a frame structure 200 supported by suitable pairs of front and rear wheels 202 and 204 also supports a movable platform 206. The frame 200 and platform 206 may partake of various different constructions, but are illustrated herein as being, respectively, of upwardly presenting and downwardly presenting boxlike forms.

The platform and frame are connected together by similar pairs of linkages arranged adjacent the front and rear ends of the platform, the individual linkages of each pair also being similar. More particularly, each linkage comprises a lifting arm 210, which is pivotally connected to the platform at its upper end by means of a pin 212, and which is provided at its lower end with a roller 214, which rides in a slot 216 provided in the side wall of the frame 200. Each linkage also comprises a radius arm 218, which is pivotally connected at its lower end to the frame 200 by means of a pin 220 and which is pivotally connected to the corresponding lifting arm 210 by means of a pin 222. Each pin 222 is connected to the corresponding pin of the immediately opposite linkage by means of a cross-head 224, and two cross-heads 224 are in turn interconnected by a push rod 226, having a connection 228 to any suitable source of power. In the illustrated structure, the power applying member 228 extends to the left of the cooperating linkages and, consequently, a pulling force is required to be applied thereto in order to rock the radius arms 218 in a counterclockwise or lifting direction. As in the previous instance, such coun-

terclockwise rotation of the radius arms 218 causes the lifting arms 210 to move bodily and to also swing in a clockwise or lifting direction. As is also true of the above-described structure, the lifting arms 210 are positively guided and supported throughout their full lifting movements by the connection thereof to the slots 216 and to the pins 222, and cause the platform to travel in a substantially linear vertical path.

It will be noticed that in Figs. 7 and 8, the front and rear pairs of linkages form a parallel link system, which is effective to maintain the platform 206 in a horizontal position throughout the lifting movement. It will further be appreciated that if it is desired to collapse the linkages of Figs. 7 and 8 to such a point that the normal angle between the lifting arms and radius arms is too small for efficient lifting purposes, supplemental lifting means, such as the inclined planes of Figs. 1 through 6, may be incorporated in the structure of Figs. 7 and 8.

It will be appreciated that in the broader aspects of the invention, various sources of power other than the hydraulic ram and pump unit 28 of Figs. 1 through 6 may be utilized to apply the lifting force. An illustrative ratchet operated mechanism is shown in Figs. 9 and 10. In these figures, the arrangement is the same as described in connection with Figs. 1 through 6, with the exceptions noted below. In this instance, the head 120' is rigidly secured at the forward end of a push rod which is constituted by a pair of laterally spaced arms 230 and 232. The front end of this push rod and the head 120' cooperate with the inclined plane 58 and with the radius arms 100 and 102 in the previously described manner. The rear end of this push rod assembly is supported by a pin 234, the opposite ends whereof are provided with rollers 236, which ride in supplemental guideways 238, which are either formed integrally with or are rigidly secured to the side frame members 40 and 42 immediately below the runways 90, associated with the lifting arm 24. A rack member 240, which is suitably supported upon a web 242, extends between and is secured to the frame members for reciprocating movement between the left-hand limit position shown in Figs. 9 and 10 and a corresponding position to the right of the illustrated position. The front end of the rack 240 is pivotally connected to the pin 234 between the two push rod legs 230 and 232. Conventional lifting mechanism comprising the gear wheel 250 and the operating segment 252 associated therewith are provided to advance the rack 240 in step-by-step fashion. As will be understood, a counterclockwise movement of the segment 252 enables a usual pawl associated therewith, but not shown, to advance the gear wheel 250 in a counterclockwise direction. A holding pawl 254 serves to hold the gear wheel 250 in its advanced position, enabling the segment 252 to be moved clockwise to a position behind a succeeding gear tooth. Since ratchet operated mechanisms for causing a linear movement of a push rod member, such as the rack 240, and for controlling a retracting movement thereof, are well known, it is believed that a more detailed description of the present ratchet operated mechanism is unnecessary. It will be noted that the right-ward or lifting movement of the rack 240 causes a substantially linear vertical movement of the load engaging cap 24 in the same manner as such a movement is afforded in the structure of Figs. 1 through 6.

Although only several specific embodiments of the invention have been described in detail, it will be appreciated that various further modifications in the form, number and arrangement of the parts may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. In a lifting mechanism, a load engaging element to be moved through a predetermined path, motive means for effecting said movement, means interposed between the motive means and the element for translating forces applied to the motive means into lifting force on said element, said means including a plurality of members and a plurality of cam surfaces engaged by said members, the camming effect caused by movement between one said cam surface and its engaged member being applied to another of said cam surfaces and its engaged member, movement of said motive means causing camming movement between said surfaces and members, the slopes of said camming surfaces being such that the camming movements between said surfaces and members each cause substantial components of lifting movement of said element, said components being cumulative.

2. In a lifting mechanism, a load engaging element to be moved through a predetermined path, motive means for effecting said movement, means interposed between the motive means and the element for translating forces applied to the motive means into lifting force on said element, said means including a motive member to which force is applied in a direction transverse to said path and a lifting arm, cam means engaged by the motive member for camming it in a direction to lift said element, and cam means acting between the motive member and the lifting arm for camming the lifting arm in a direction to lift said element.

3. The structure of claim 2 wherein said lifting arm is pivotally mounted and wherein means are provided which effect a pivotal connection between the lifting arm and the motive member at the conclusion of a predetermined amount of camming action therebetween.

4. The structure of claim 2 wherein said lifting arm is pivotally mounted and wherein means are provided which effect a pivotal connection between the lifting arm and the motive member at the conclusion of a predetermined amount of camming action therebetween and wherein said lifting arm is connected to said element through an arm which is disposed to pivot about a center which moves during the pivoting of said lifting arm.

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