United States Patent

[11] 3,545,636

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[21] Appl. No. **794,552**
[22] Filed **Jan. 28, 1969**
[45] Patented **Dec. 8, 1970**
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[54] **MULTI-ELEMENT LATERALLY MOVABLE LIFTING APPARATUS**
7 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** **214/731,** 214/730
[51] **Int. Cl.** **B66f 9/14**
[50] **Field of Search** ..... 214/730, 731, 655, 650—653; 254/(Inquired)

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ABSTRACT: Apparatus for handling pipe or conduit sections, concrete blocks or the like or for handling long flexible sheet objects or the like. The apparatus preferably is in the form of a prong attachment for attaching to the lift carriage of an industrial forklift truck. The apparatus preferably includes a left and right series of load engaging prongs arranged generally horizontally coplanar and symmetrically on opposite left and right sides of the lift truck vehicle centerline. The apparatus includes progressional movement lazy tong type linkage means operably interconnecting the load engaging prongs of the left and right series of prongs for convergingly divergingly adjustably moving the prongs toward and away from the centerline of the lift truck thereby changing the incremental spacing between the lift prongs while maintaining uniform equal incremental spacing between each adjacent two prongs of the left and right series of prongs. The lift carriage apparatus is particularly useful for handling a gang or batch of apertured load objects arranged in stacks of load objects. The incremental spacing between the series of prong projections of the multiprong lifting apparatus may be adjusted to correspond with the spacing between the apertured load objects of a stack of load objects. The multiplicity of prong projections may be simultaneously inserted in the apertures of the load objects for handling or manipulating simultaneously a batch or series of load objects.

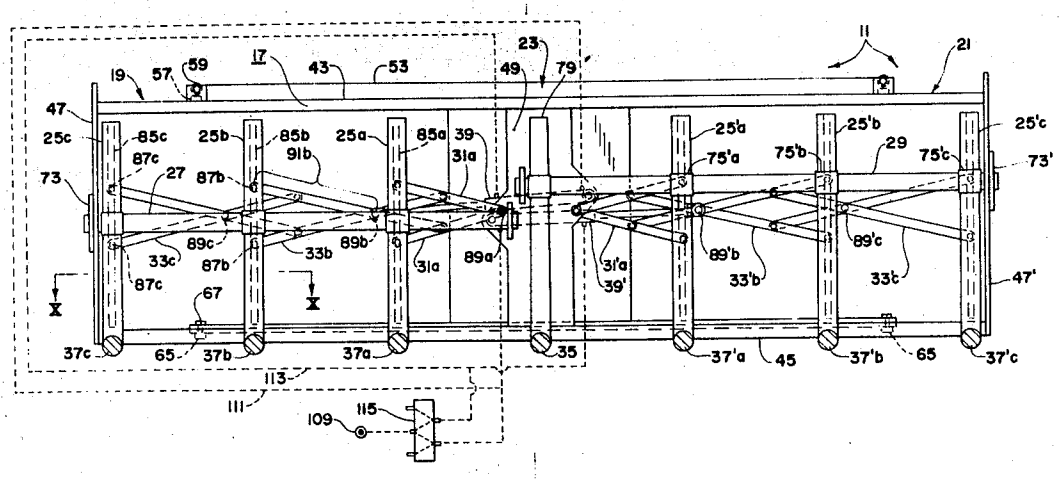


FIG. 1

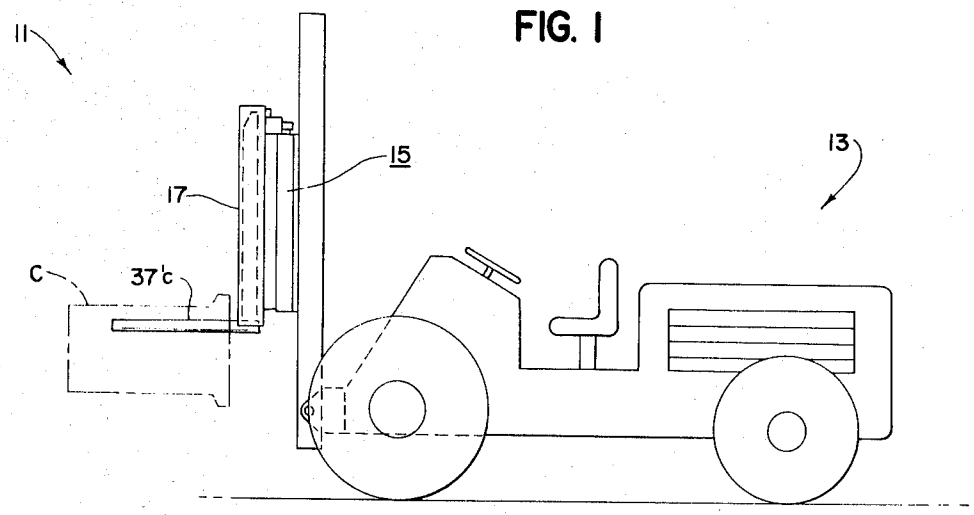
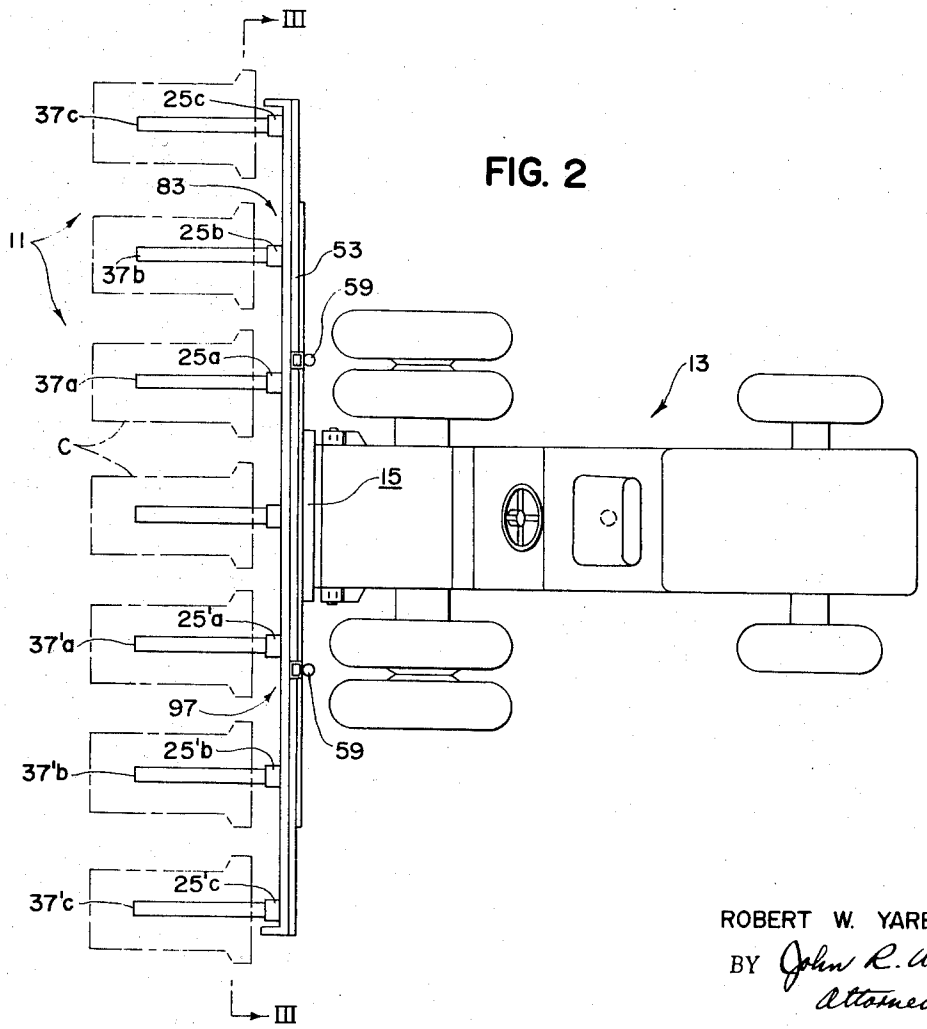


FIG. 2



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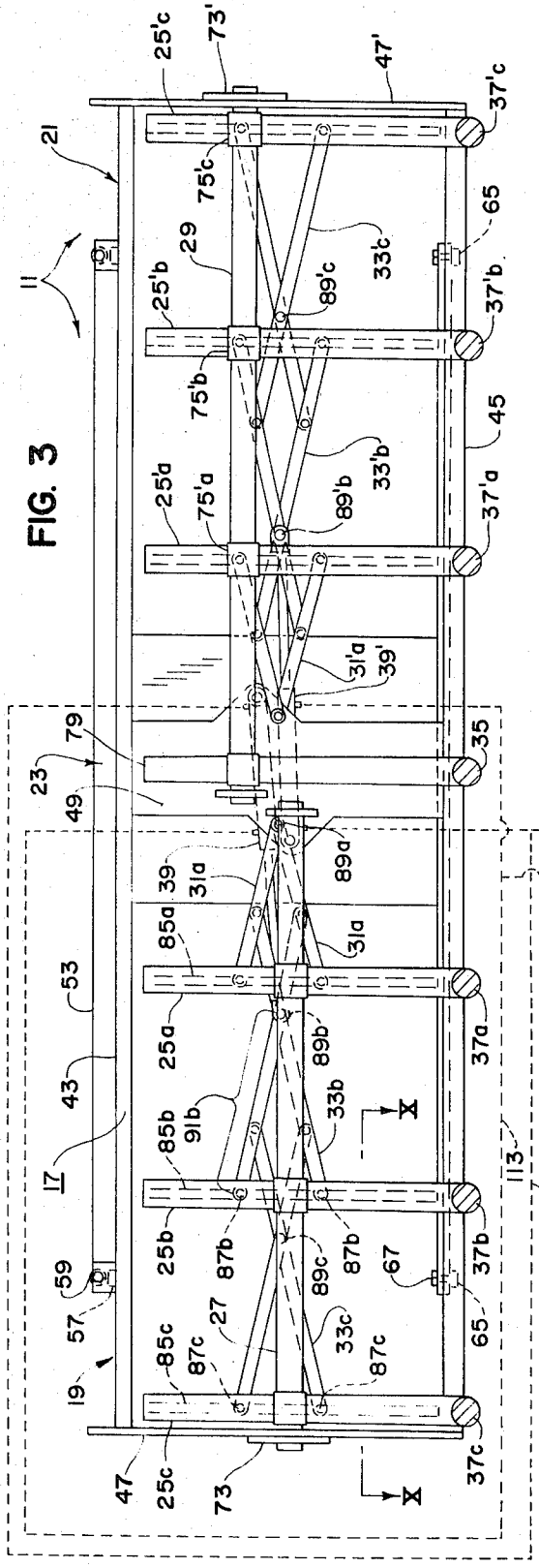


FIG. 3

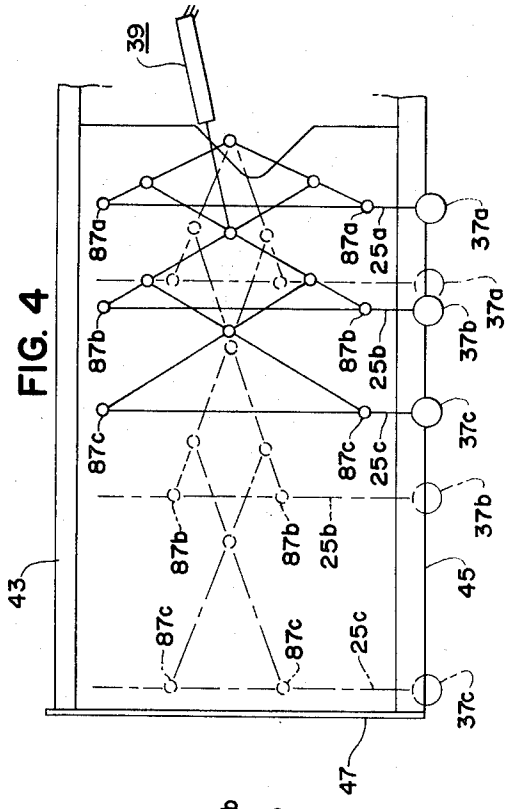


FIG. 4

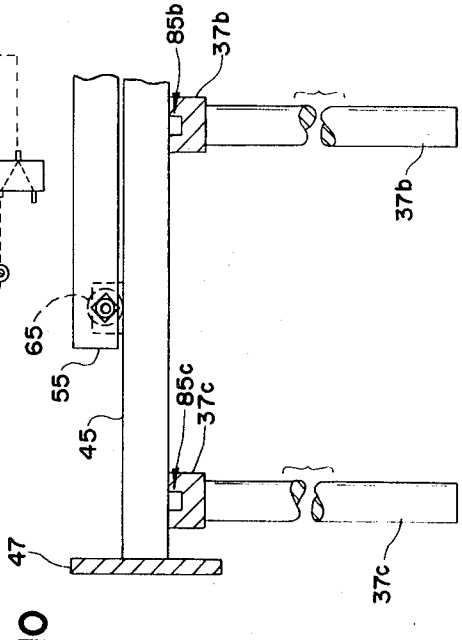


FIG. 10

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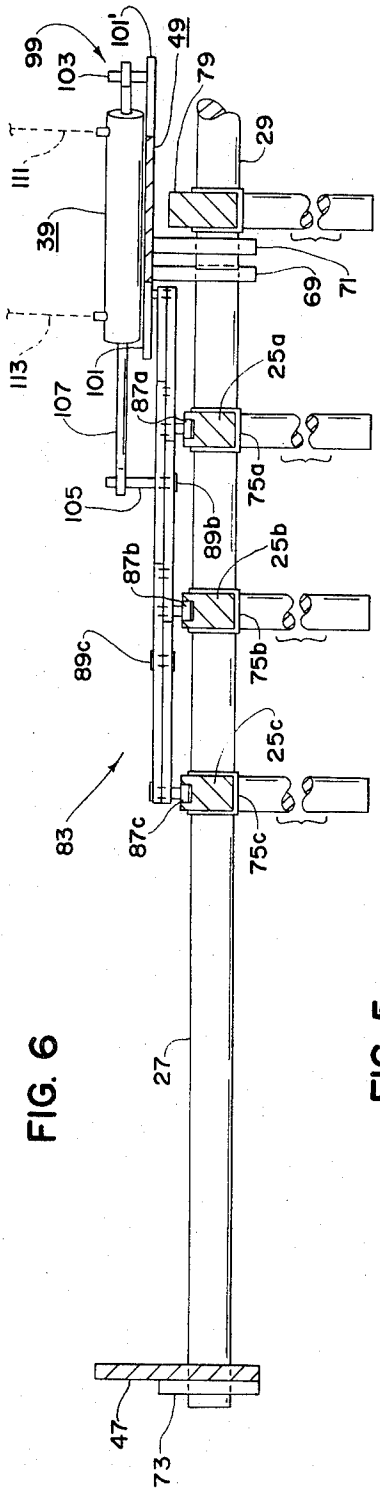


FIG. 6

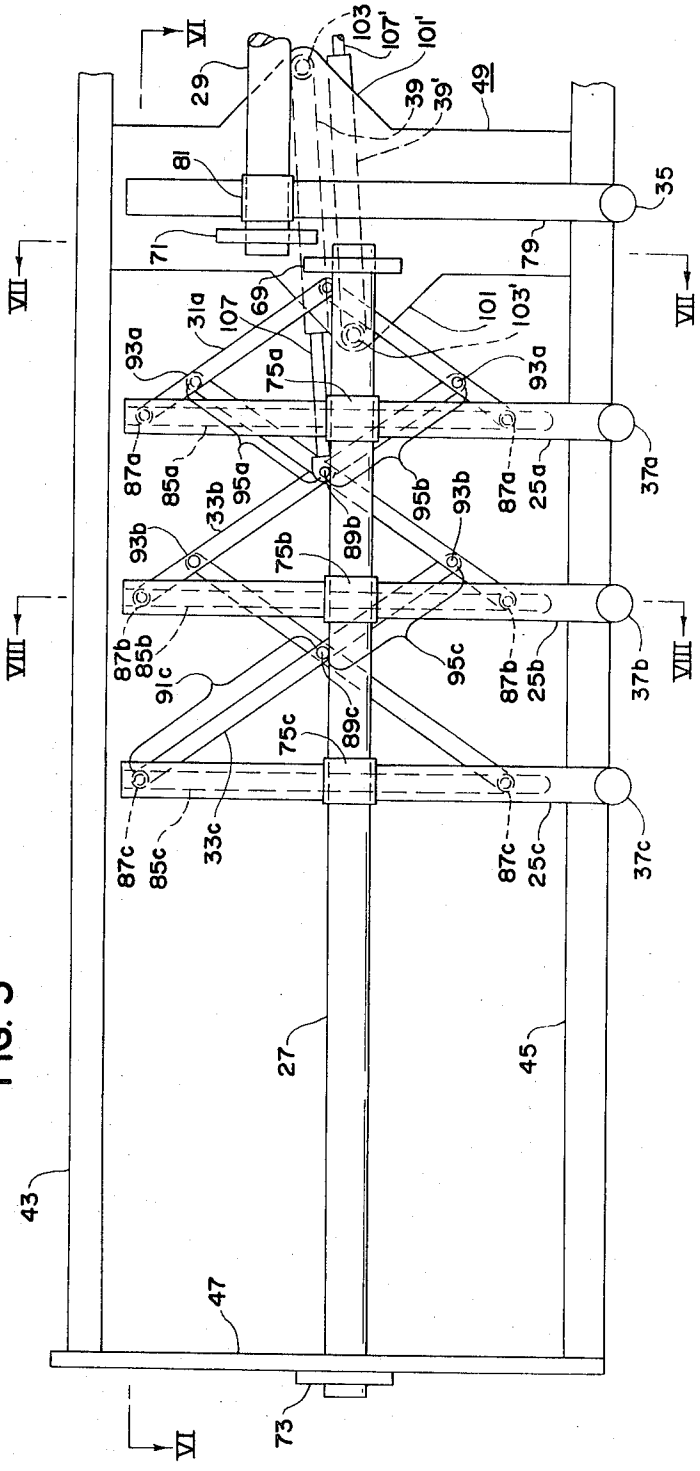


FIG. 5

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FIG. 9

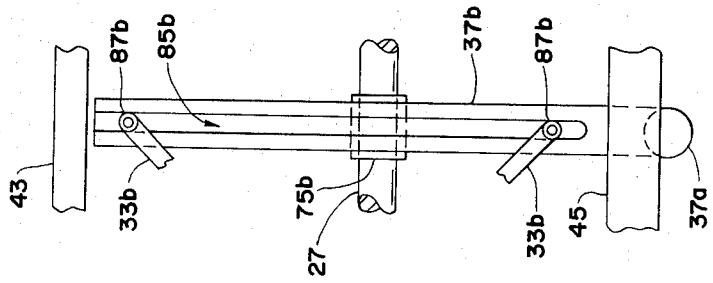


FIG. 8

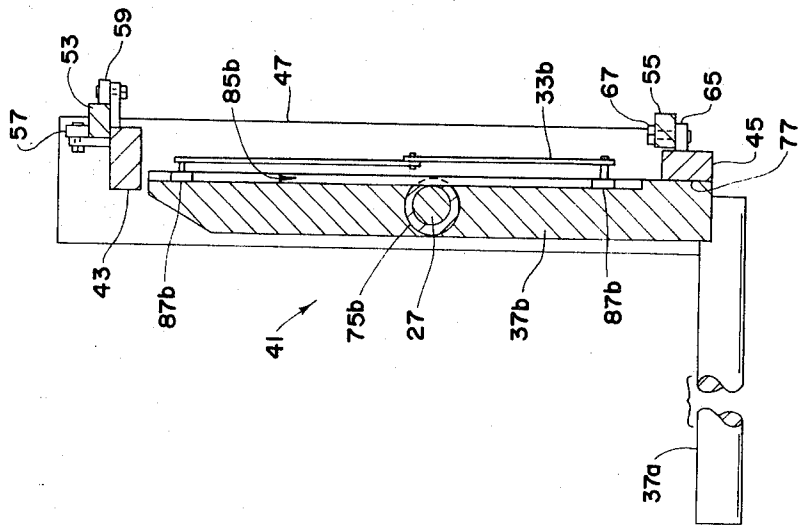
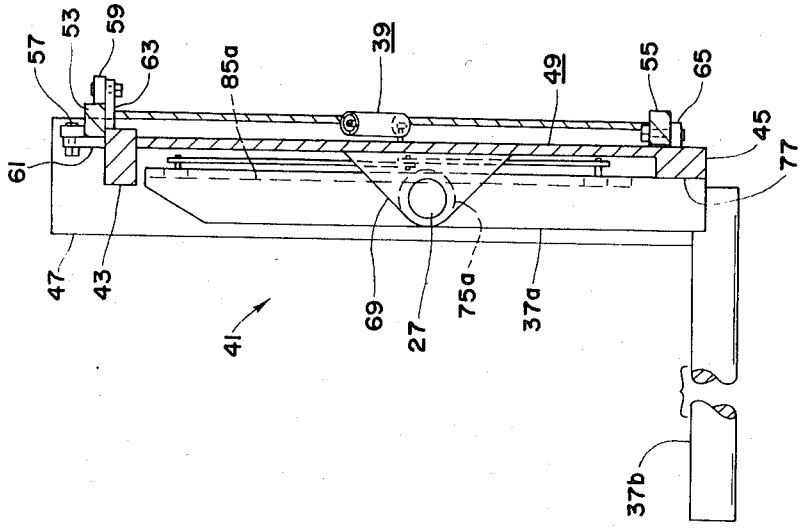


FIG. 7



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MULTI-ELEMENT LATERALLY MOVABLE LIFTING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to material handling apparatus generally and particularly relates to multiprong or multilift element apparatus adapted for simultaneously lifting and manipulating a multiplicity of load objects.

2. Description of the Prior Art

Apparently the prior art does not show design or construction of a multiprong lifting apparatus having means for simultaneously adjusting uniformly the incremental spacing between adjacent two prongs of the multiplicity of prongs. The art with which I am familiar mainly concerns means for laterally adjusting the tines or prongs of a typical two prong lift truck: U.S. Pat. Nos. 2,483,745 and 2,748,966 illustrate respectively means for laterally adjusting or changing the spacing between a pair of prongs. The mechanical movement problems involved in designing prong adjustment means in a multiprong lift apparatus is very different from the mechanical movement problems involved in designing prong adjustment means in a dual prong lift apparatus. Moreover, the general concept of providing means affording uniform incremental spacings between left and right series of prong means and converging diverging movement of the prong means toward and away from the center axis of a lift vehicle is believed to be a unique concept.

SUMMARY OF THE INVENTION

The multielement lifting apparatus includes a left and a right series of horizontally alined load engaging elements arranged respectively symmetrically on opposite sides of a vertical lift axis or center line of a vertical lift carriage means. A left and right series of horizontally alined load engaging elements are convergingly divergingly shiftable toward and away from the lifting axis thereby affording a balanced load carry of a batch of horizontally arrayed load objects. Left and right progressional movement linkage means operatively connected respectively to the left and right series of load engaging elements provide progressional movement means for simultaneously moving the left and right series of load engaging elements toward and away from the lifting axis of the lifting apparatus while maintaining uniform incremental spacing respectively between the multiplicity of load engaging elements. The incremental spacing respectively between adjacent two load engaging elements of the multiplicity of elements is quickly and easily adjusted for handling different load objects or for handling the same load objects stacked or arranged in tiers of load objects having different incremental spacing between the objects of each tier of objects or having apertures at different horizontal incremental spacings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevational view of a preferred form of the multielement lifting apparatus of the present invention shown operably mounted on a typical industrial type lift truck.

FIG. 2 is a top view of the lifting apparatus and lift truck of FIG. 1.

FIG. 3 is a vertical plane sectional view of the lifting apparatus taken as on the line III–III of FIG. 2 and shows schematically the hydraulic power means for diverging converging actuation of the load object engaging lift prongs.

FIG. 4 is a schematic illustration of the left side only of the lifting apparatus illustrating the progressional inward outward movement of the series of load engaging prongs.

FIG. 5 is a view of the left side of the lifting apparatus illustrating the left prongs in partially contracted dispositions.

FIG. 6 is a horizontal plane sectional view taken as on the line VI–VI of FIG. 5.

FIG. 7 is a vertical plane sectional view taken as on the line VII–VII of FIG. 5.

FIG. 8 is a vertical plane sectional view taken as on the line VIII–VIII of FIG. 5.

FIG. 9 is a backside view of a section of the lifting apparatus generally as viewed from the right of FIG. 8.

FIG. 10 is a vertical plane sectional view taken as on the line X–X of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment of the invention is indicated by numeral **11** and is adapted to be incorporated in an industrial type lift truck **13**. The preferred embodiment of the invention is adapted to be mounted on the vertically liftable horizontally shiftable carriage **15** of lift truck **13**. The preferred embodiment preferably includes a multiplicity of load engaging lift elements or prongs projecting forwardly of lift truck **13**.

Embodiment **11** includes a generally rectangular frame **17** including left, right and medial frame portions **19, 21, 23**; a left series of support members **25***a*, **25***b*, **25***c* arranged respectively on left section **19** of frame **17**; a right series of support members **25′***a*, **25′***b*, **25′***c* arranged respectively on right section **21** of frame **17**; left guide rail means including guide rail member **27** operably supporting left series of support members **25***a*, **25***b*, **25***c*; right guide rail means including right guide rail member **29** operably supporting respectively right series of support members **25′***a*, **25′***b*, **25′***c*; left progressional movement linkage means including V-arranged links **31***a* and crossed links **33***b*, **33***c* operably connected respectively to support members **25′***a*, **25′***b*, **25′***c*; load engaging means including a stationary load engaging prong **35** and left and right series of movably load engaging prongs **37***a*, **37***b*, **37***c* and **37′***a*, **37′***b*, **37′***c* arranged respectively on opposite sides of prong **35**; and actuating means including left and right ram means **39**, **39′** operative for expanding or contracting left and right series of load engaging prongs **37***a*, **37***b*, **37***c*, **37′***a*, **37′***b*, **37′***c* toward and away from stationary prong **35** supported on frame medial section **23**.

Frame **17** preferably is generally in the form of a transversely elongated rectangle arranged vertically and with a generally planar horizontally directed front face or area **41** facing forwardly of lift truck carriage **15**. Frame **17** generally is of openwork construction and includes raillike parallel arranged upper and lower horizontal members **43, 45** and plate like left, right and medial members **47, 47′, 49** rigidly interconnecting respectively the left, right and medial portions of upper and lower horizontal members **43, 45**. Left and right end members **47, 47′** are parallel arranged and fixedly secured abuttingly on opposite end portions of horizontal members **43, 45**. Platelike medial member **49** faces fore and aft and is fixedly secured bridgingly between upper and lower raillike horizontal members **43, 45** (see FIGS. 3 and 7).

Although not specifically a part of this invention, the means for mounting frame **17** on lift truck carriage **15** preferably is by means of the following structure: Lift truck carriage **15** preferably includes a pair of horizontal vertically spaced apart raillike members **53, 55** adapted to shiftably support frame **17**. Means shiftably mounting frame **17** on carriage **15** may include paired rollers **57, 59** fixedly journaled from upper horizontal frame member **43** by bracket means **61, 63** and includes roller means **65** fixedly journaled from lower frame member **45** by bolt means **67**. Paired rollers **57, 59** provide respectively horizontal and vertical thrust roller means runningly engaging respectively opposite end portions of carriage rail **53**. Lower roller means **65** (two roller means being shown in FIG. 3) runningly engage backside surfaces respectively of opposite end portions of lower carriage rail **45**. Selectively operative hydraulic ram means (not shown) interconnect carriage **15** and frame **17** for shiftably moving frame **17** horizontally relative to the carriage and for shiftably moving load engaging prong elements **35, 37***a*, **37***b*, **37***c*, **37′***a*, **37′***b*, **37′***c* horizontally laterally relative to the longitudinal centerline of lift truck **13**.

Guide rail members **27, 29** supporting respectively right and left series of support members **25***a*, **25***b*, **25***c*, **25′***a*, **25′***b*, **25′***c* extend horizontally oppositely from frame medial member **49** and constitute also rigid supporting structure of the frame.

Horizontal guide rails 27, 29 are mutually offset vertically with the respective inward end portions being supported on triangular brackets 69, 71 (see FIG. 5) fixedly secured on the forward outward surface of medial member 49 of frame 17. The oppositely arranged outward end portions respectively of guide rail members 27, 29 extend through left and right end members 47, 47' and reinforcing plates 73, 73' fixedly secured on the outside surfaces respectively of end plate members 47, 47'.

Sleeve bearings 75*a*, 75*b*, 75*c*, 75'*a*, 75'*b*, 75'*c* fitted respectively crosswise in support members 25*a*, 25*b*, 25*c*, 25'*a*, 25'*b*, 25'*c* and slidably received respectively on left and right rail members 27, 29 provide means for translational displacement respectively of the left and right series of support members toward and away from frame medial section 23. Circular interior and exterior coacting surfaces respectively of sleeve bearings 75*a*, 75*b*, 75*c*, 75'*a*, 75'*b*, 75'*c* and guide rail members 27, 29 permit rotational movement respectively of support members 25*a*, 25*b*, 25*c*, 25'*a*, 25'*b*, 25'*c* or slight upward canting movement of prong members 37*a*, 37*b*, 37*c*, 37'*a*, 37'*b*, 37'*c*, as for example when one or more of the load engaging prongs rests on the ground or a supporting surface. Each prong-support member assembly (as for example, 37*a*, 25*a*forms a rigid right angular assembly which is fulcrumed through downward pivotal movement of the assembly against the forwardly facing surface 77 of lower frame member 45; the weight of the prong portion of each prong-support member assembly 37*a*, 25*a* urges the backside surface of the support member 25*a* aga • , the forward surface 77 of lower frame member 45. Translational horizontal movement of each respective prong-support member assembly 37*a*, 25*a* causes the backside lower end portion of the respective support member 25*a* to slide against the forward face surface 77 of frame member 45.

Right guide rail member 29 is longer than guide rail member 27 and in addition to providing support means for right series of supporting members 25'*a*, 25'*b*, 25'*c* also provides support means for a basic or stationary support member 79 supporting basic or stationary prong 35 (see FIG. 5). Although defined as being stationary, prong-support member assembly 79, 35 preferably is slightly adjustable laterally leftward or rightward relative to the longitudinal centerline of lift truck carriage 15. A sleeve bearing 81 is crosswise fitted in support member 79 and supported on the inward end portion of right guide rail 29; the sleeve bearing mounting of transverse member 79 permits limited left or right adjustable movement of stationary prong 35 and permits limited up and down pivotal movement of the prong about guide rail member 29.

Left progressional movement linkage means, indicated by numeral 83, is operative for simultaneously moving left series of load engaging prongs 37*a*, 37*b*, 37*c* toward and away from stationary prong 35 thereby causing a decrease or increase in the incremental spacing between each adjacent two left prongs 37*a*, 37*b*, 37*c* while maintaining equal incremental spacing between each adjacent two prongs. The progressional movement linkage means of left series of prongs 37*a*, 37*b*, 37*c* in addition to paired link members 31*a*, 33*b*, 33*c* additionally includes thrust means for causing translational horizontal thrusting action on prong-bearing support members 25*a*, 25*b*, 25*c*; left series of support members 25*a*, 25*b*, 25*c* each includes structure defining a backwardly opening U-sectioned channel 85*a*, 85*b*, 85*c* adapted to runningly receive paired rollers 87*a*, 87*b*, 87*c* journaled respectively on paired links 31*a*, 31*b*, 31*c*. Roller pair 87*a*, 87*a* journaled respectively on distal end portions of V-arranged links 31*a*, 31*a* are runningly received in vertical channel 85*a* of support member 25*a*; scissorlike vertical movement of links 31*a*, 31*a* about pivot 89*a* and converging-diverging movement of paired rollers 87*a*, 87*a* is operative for causing translational horizontal movement of support member 25*a* toward and away from frame medial section 23. Paired rollers 87*b*, 87*b* are journaled respectively on the distal end portions of major projections 91*b*, 91*b* of link pair 33*b* and are runningly received in channel 85*b* of support member 25*b*. In like manner, rollers 87*c*, 87*c* are journaled respectively on the distal end portions of major projections 91*c*, 91*c* of link pair 33*c*. Scissorlike vertical movement of link pairs 33*b*, 33*c* respectively about pivot pin means 89*b*, 89*c* causes translational movement of support members 25*b*, 25*c* along left guide rail 27. Paired pivot pins 93 93*a*, 93*a* fitted on the distal end portions of minor projections 95*b*, 95*b* of link pair 33*b* and secured respectively on the intermediate portion of V-arranged links 31*a*, 31*a* relays movement from link pair 31*a* to link pair 33*b*. In like manner, pivot pins 93*b*, 93*b* fitted on the distal end portions of minor projections 95*c*, 95*c* relays movement from crossed link pair 33*b* to crossed link pair 33*c*.

Converging movement of V-arranged link pair 31*a*, operative through crossed links 33*b*, 33*c* causes progressively increasing outward movement of support members 25*a*, 25*b*, 25*c* with outward support member 25*c* moving further and faster than inward members 25*b* and 25*a*. The progressively increasing movement corresponds generally with the mechanical movement of the familiar crossed link lazy tong mechanism. The crossed link type mechanical linkage means of the apparatus permits prong-bearing support members 25*a*, 25*b*, 25*c* to be moved inwardly or outwardly relative to frame medial section 23 while maintaining substantially equal incremental spacing between the respective support members and load bearing prongs.

Right progressional movement linkage means is indicated by numeral 97 and is substantially the same in form and function as the above described left progressional movement linkage means 83, the principal distinction being that right progressional movement linkage means 97 operates in a direction contrary to linkage means 83. Thus, the above description of left linkage means 83 will suffice also as a description of right linkage means 97.

Hydraulic ram members 39, 39' are arranged in vertically spaced apart disposition adjacent the backside of frame medial member 49 and function respectively for convergingly divergingly actuating left and right series of load engaging prongs 37*a*, 37*b*, 37*c*, and 37'*a*, 37'*b*, 37'*c*. Base end 99 of ram 39 is supported on a right angular protrusion 101' of upright frame medial member 49 by pin means 103 (see FIGS. 5 and 6). The plunger end of ram 39 is supported on a pin projection 105 formed substantially of an extension of pivot pin 89*b* of crossed links 33*b*. Extending-retracting movement of plunger 107 of double-acting ram 39 is operative through cross link pivot means 89*b* for causing expanded or contracted movement toward and away from frame medial member 49. Ram 39', operative for actuating the right series of load engaging prongs is arranged subjacently of ram 39. The base end of ram 39' is supported on a pin 103' fixed on a protrusion 101 of frame medial member 49. The distal end of ram plunger 107' is pivotally mounted on a pin projection (not shown) projecting rearwardly and forming substantially an extension of crossed link pivot pin means 89'*b* of link pair 33'*b*. Hydraulic fluid supply means 109 connected through conduit means 111, 113 and valve means 115 provide selectively operative hydraulic flow means for energizing rams 39, 39' (see FIG. 3). Although ram means 39, 39' are shown connected in parallel through conduit means 111, 113, and are shown as being controlled through a single valve means 115, it will be understood that in certain applications of the apparatus it may be desirable to have two valve means (115, 115) and suitable conduit means for causing separate or individual actuation of the left or right series of load engaging prongs.

FIGS. 1 and 2 illustrate the apparatus as being utilized for simultaneously manipulating or positioning a multiplicity of conduit sections C: Considering that conduit sections C are arranged in vertically spaced apart horizontal tiers of conduits, the operator of lift truck 13 may maneuver the lift truck forwardly and to a position with the load engaging lift prongs being in confronting arrangement with the conduits. The operator, by actuation of valve means 11[illegible], may then aline the series of lift prongs to correspond with the openings of conduit C. After alining the prongs with the conduit openings, the

operator pilots the lift truck forwardly and actuates the lift truck carriage **15** upwardly thereby lifting conduits C. The operator may then maneuver the lift truck and position the conduits at a desired place.

Although the invention is illustrated and described as being incorporated in a typical industrial type lift truck, only slight modification in the disclosed structure is necessary for incorporating the multielement lifting apparatus in lifting means other than the described vehicular lift truck means: With but slight modification in the described structure, the multielement lifting apparatus may be incorporated in tension line, crane or trolley type overhead lifting means. By utilizing sling or hook type load object engaging means in lieu of the load object engaging prong means hereinabove described, the apparatus may be utilized for lifting by sling means a multiplicity of pipe conduits or other elongated load objects. Frame **17** may be readily suspended in a horizontal balanced disposition and with the right and left series of support members arranged horizontally. Sling means or other load object engaging means may readily be attached in a depending disposition from the right and left series of support members for readily obtaining incremental spacing between the load engaging elements while maintaining a balanced disposition or a balanced load carry. The multielement lifting apparatus of the invention may readily be fitted with suitable load engaging means and optionally fitted either on a lift truck carriage or on the tension line of an overhead lifting apparatus.

I claim:

1. Multilift element lifting apparatus for use with powered lifting means including elevatable lifting structure, said lifting apparatus comprising a longitudinally extending frame having a medial section relative to the longitudinal extension of said frame, and left and right frame sections projecting oppositely from said frame medial section, means connecting said frame on the lifting structure of said lifting means, a left and right series of parallel arranged support members arranged respectively leftward and rightward of said frame medial section, left and right guide rails means supported on said frame left and right sections guidingly constraining respectively said left and right series of support members in converging-diverging movement toward and away from said frame medial section, said left and right guide rail means guidingly constraining each support member individually in horizontal translational movement respectively toward and away from said frame medial section, left progressional movement linkage means for simultaneously moving said left series of support members toward and away from said frame medial section respectively for causing a decrease or increase in the incremental spacing between each adjacent two left support members while maintaining substantially equal incremental spacing between each adjacent two members of said left series of support members, right progressional movement linkage means for simultaneously moving said right series of support members toward and away from said frame medial section respectively for causing a decrease or increase in the incremental spacing between each adjacent two right support members while maintaining substantially equal incremental spacing between each adjacent two members of said right series of support members, a left and a right series of load engaging elements operably connected respectively to said left and right series of support members, selectively operative actuating means connected respectively with said left and right progressional movement linkage means for causing converging-diverging movement of said left and right series of support members.

2. The lifting apparatus of claim **1** which additionally includes a basic load engaging element and means stationarily supporting said basic load engaging element on the medial section of said frame.

3. The lifting apparatus as defined in claim **1** wherein each progressional movement linkage means for moving a respective series of support members toward and away from said frame medial section includes a plurality of pairs of crossed links articulatingly connected together in a series of pairs of crossed links, each pair of links being generally scissorlike and including central pivot pins means and major and minor paired projections projecting in V-arrangement oppositely from said central pivot pin means, the distal end portions of said minor projections of a pair of crossed links being pivotally connected to the intermediate portion of the major projections of an adjacent pair of crossed links, and including thrust channel means supported on each support member and a plurality of pairs of thrust rollers mounted each pair of thrust rollers respectively on a pair of crossed links and journaled respectively on the distal end portions of the major extensions of each pair of crossed links, each pair of thrust rollers being runningly received in the thrust channel means of a respective support member and operative upon pivotal action of the plurality of pairs of crossed links for causing horizontal progressional movement of said left and right series of support members convergingly-divergingly relative to said frame medial section.

4. The lifting apparatus as defined in claim **3** wherein said frame is generally configured rectangular, arranged vertically and with a generally planar horizontally directed front, and wherein said support members of said left and right series of members each are arranged vertically, and further wherein each load engaging element of said left and right series of load engaging elements is in the form of a prong projection rigidly supported on and projecting horizontally cantilever fashion from a respective support member and defining a multiplicity of parallel spaced apart horizontal prongs defining fork means projecting horizontally outwardly from the frame front and adapted to simultaneously engage and lift a multiplicity of load objects.

5. Lifting apparatus as defined in claim **4** which additionally includes a basic load engaging prong projection and means stationarily supporting said basic prong projection on said frame with said basic prong projecting rigidly cantilever fashion from the medial section of said frame and arranged symmetrically of and between said left and right series of load engaging elements.

6. The lifting apparatus as defined in claim **5** wherein said actuating means for causing converging-diverging movement of said left and right series of transverse members includes left and right hydraulic ram means each being operatively interconnected between said frame and respectively a central pivot pin means of said plurality of pairs of crossed links respectively of said left and right progressional movement linkage means, and includes selectively operative hydraulic flow means for energizing said left and right hydraulic ram means.

7. Multilift element lifting apparatus for use with powered lifting means including movable lifting structure, and lifting apparatus comprising a frame means mounted on said lifting structure, a plurality of parallel load engaging elements, means movably mounting said load engaging elements on said frame means, and means operably coupled to said load engaging elements for selectively causing a decrease or increase in the incremental spacing between each adjacent load engaging elements while maintaining substantially equal incremental spacing between each adjacent load engaging elements.