United States Patent [19]

Ward

[11] **3,764,032**

[45] **Oct. 9, 1973**

[54] **CONTAINER HANDLING DEVICE**

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[73] Assignee: **Clark Equipment Company**, Buchanan, Mich.

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[21] Appl. No.: **206,354**

[52] **U.S. Cl.**..... **214/621**, 214/730, 294/67 DA, 294/81 SF

[51] **Int. Cl.**..... **B66f 9/16**

[58] **Field of Search**..... 214/621, 730; 294/67 DA, 81 SF

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Primary Examiner—Gerald M. Forlenza
Assistant Examiner—Kenneth Noland
Attorney—Kenneth C. Witt et al.

[57] **ABSTRACT**

An attachment device especially for lift trucks adapted to engage, lift and transport large freight containers. A support frame is provided for attachment to the lift carriage on the mast of a lift truck so that the horizontal portion of the frame extends forwardly of the truck. An elongated transverse lifting frame is suspended from corner portions of the horizontal portion of the support frame. A pair of oppositely disposed hydraulic cylinder actuators are connected at their one ends to the horizontal frame portion and extend diagonally in opposite directions for operative connection at their other ends to the lifting frame so that the lifting frame may be side shifted in either direction relative to the truck by energizing one or the other of the cylinders.

14 Claims, 10 Drawing Figures

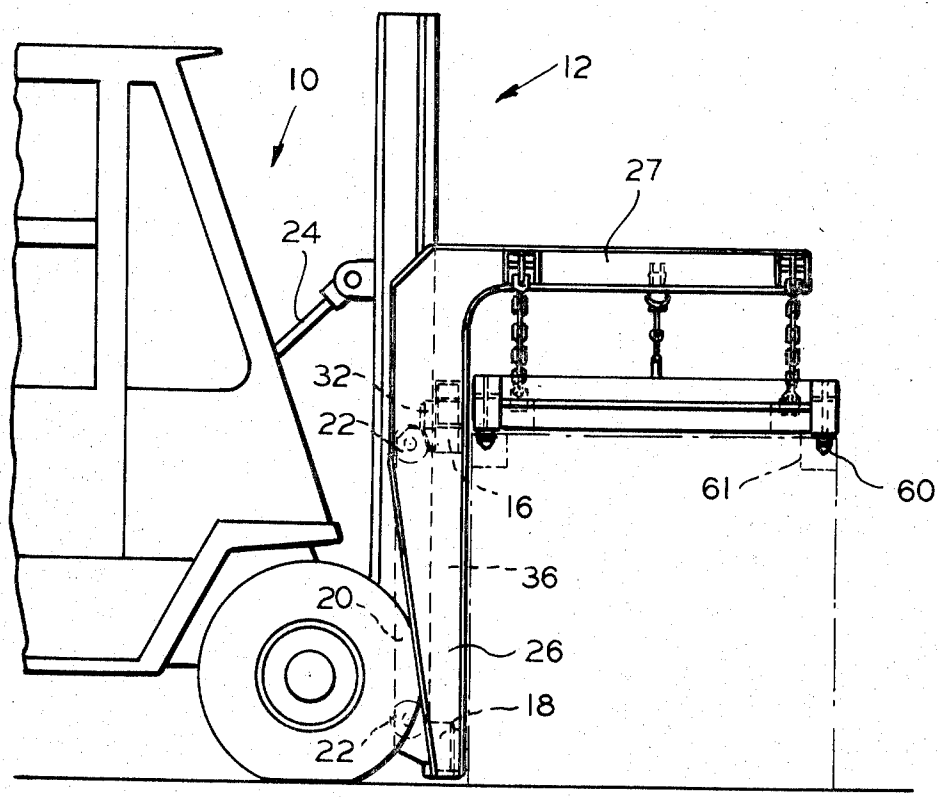


FIG. 1

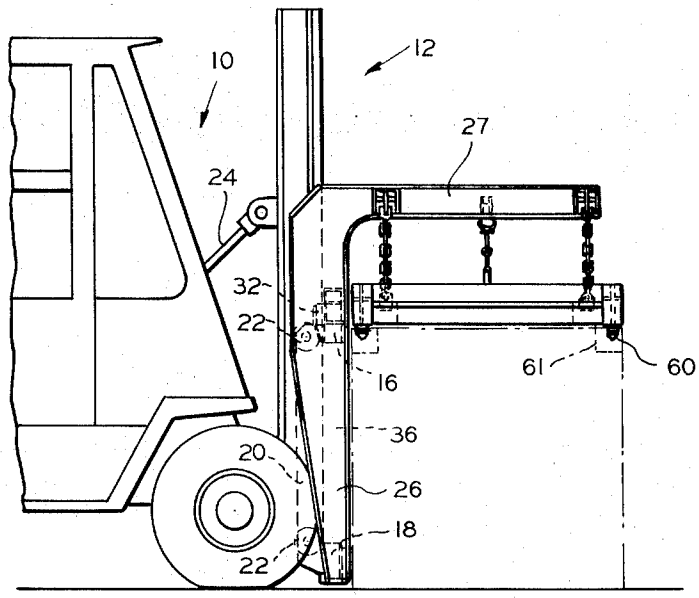
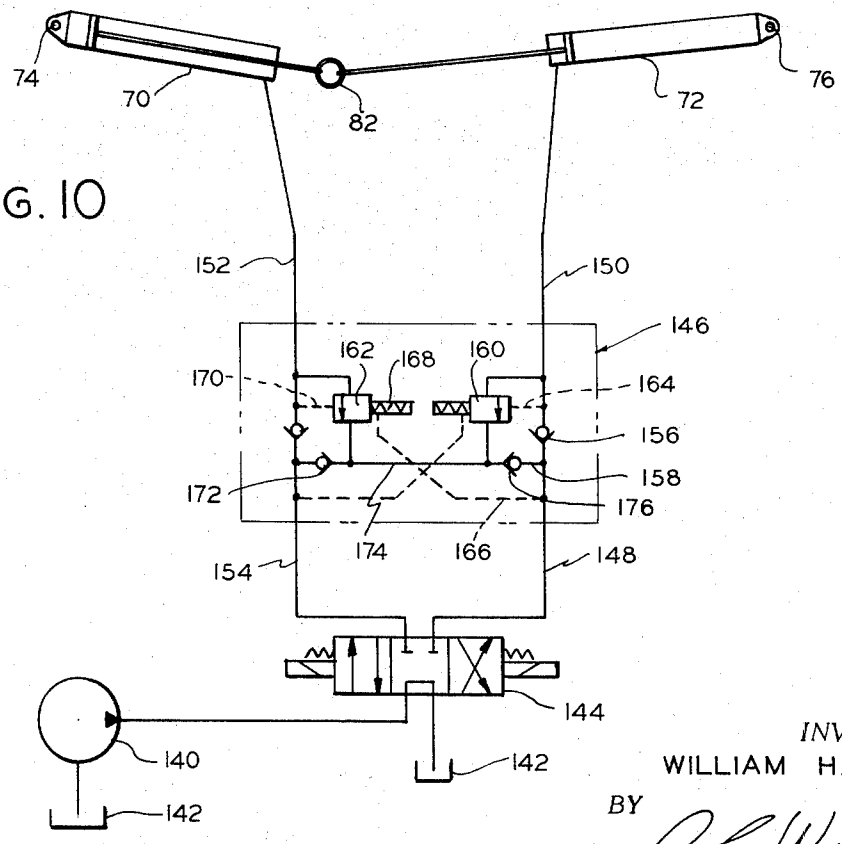


FIG. 10



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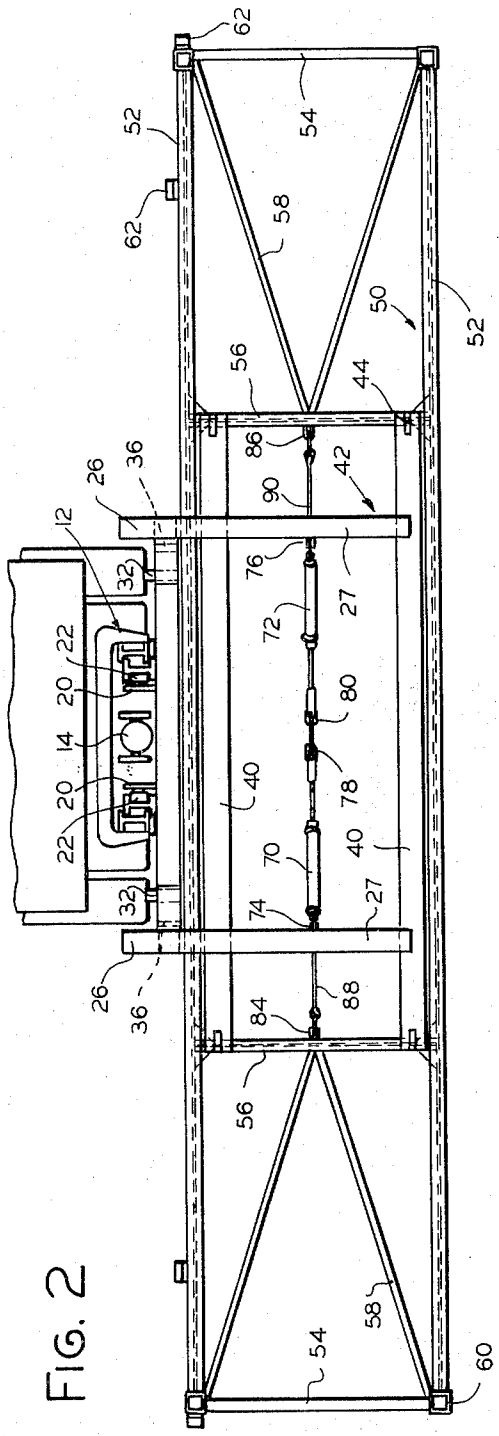

FIG. 2

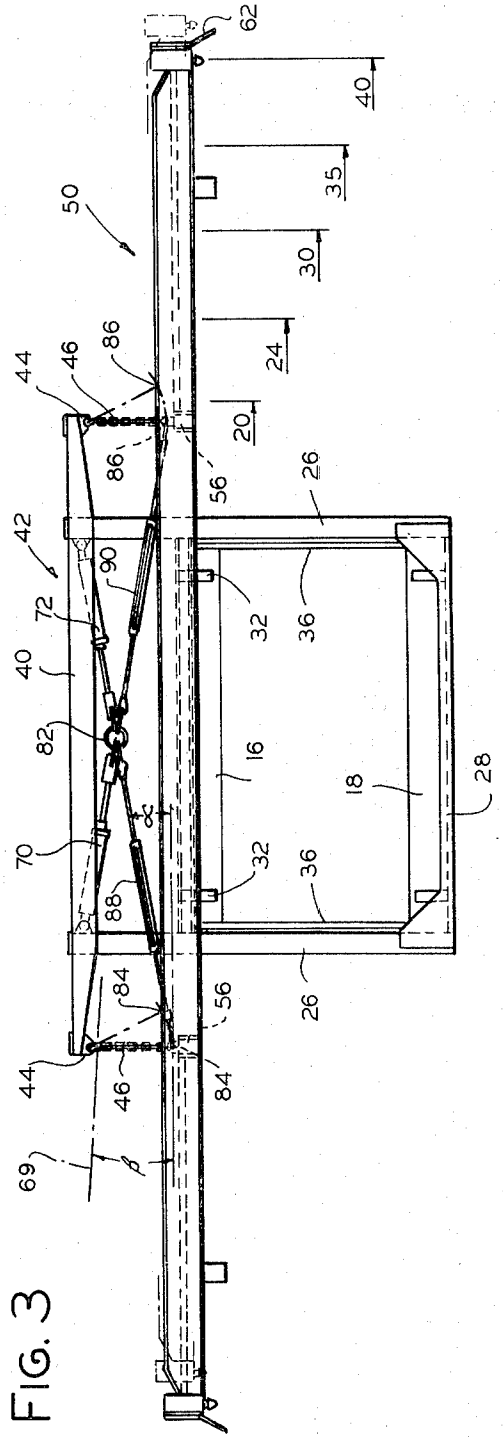

FIG. 3

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FIG. 4

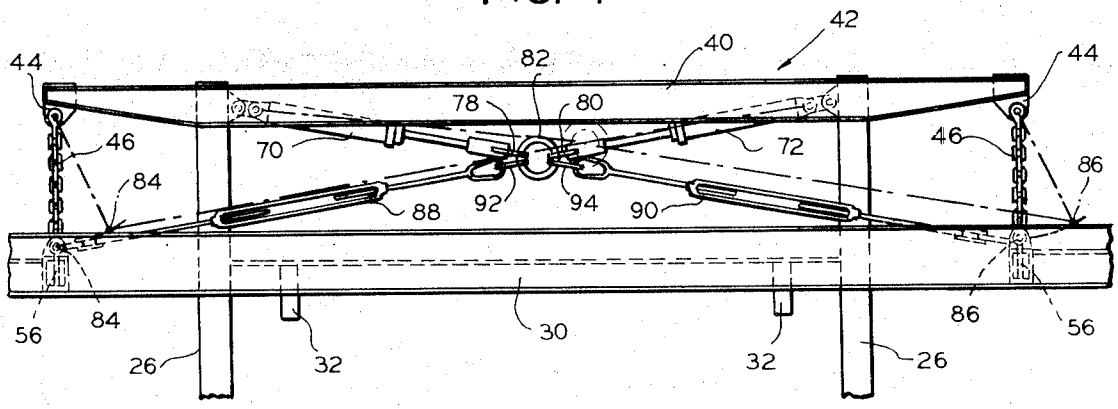
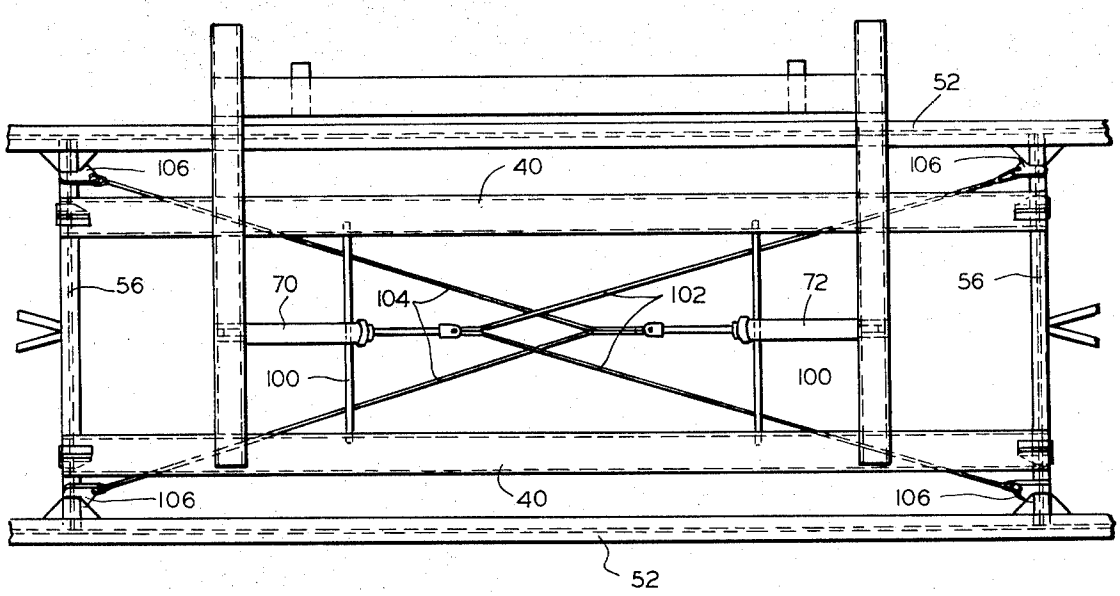


FIG. 5



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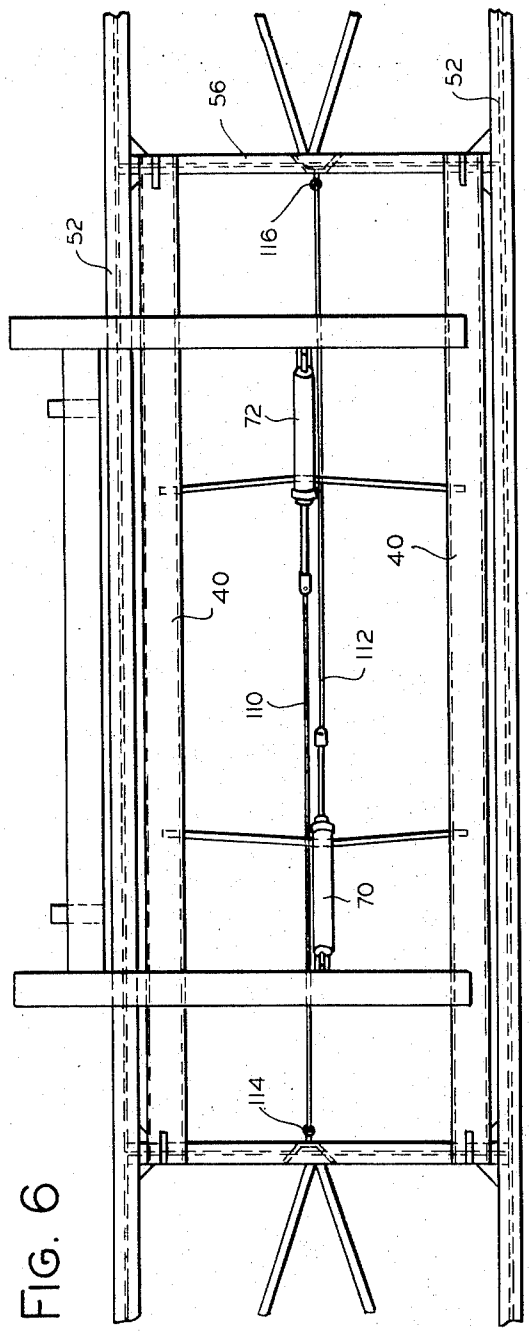

FIG. 6

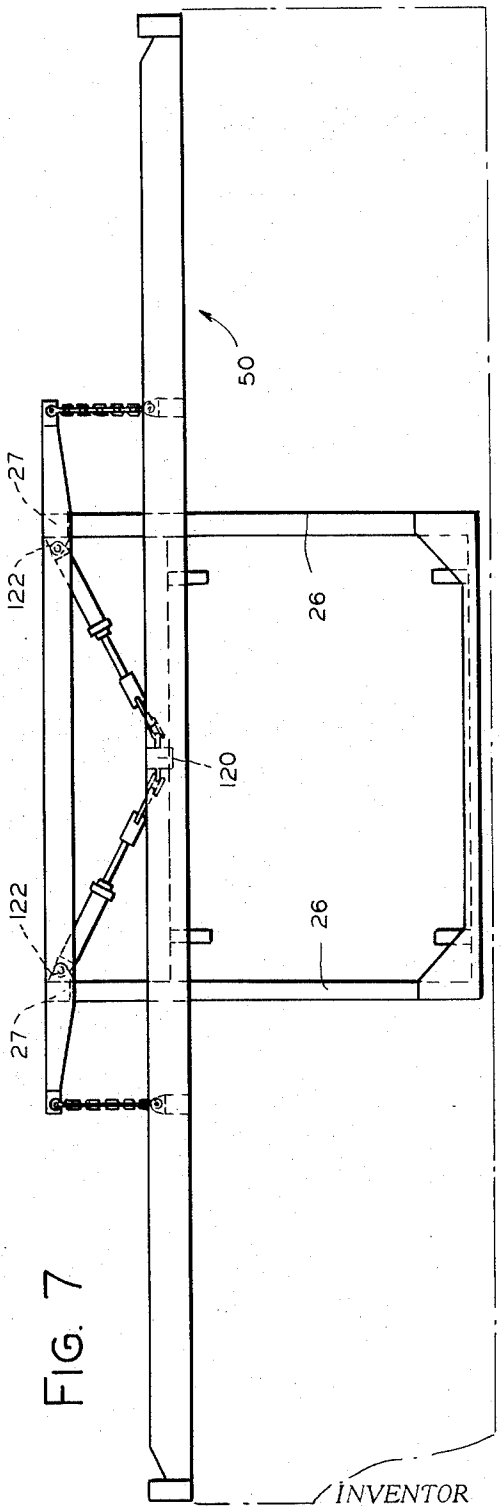

FIG. 7

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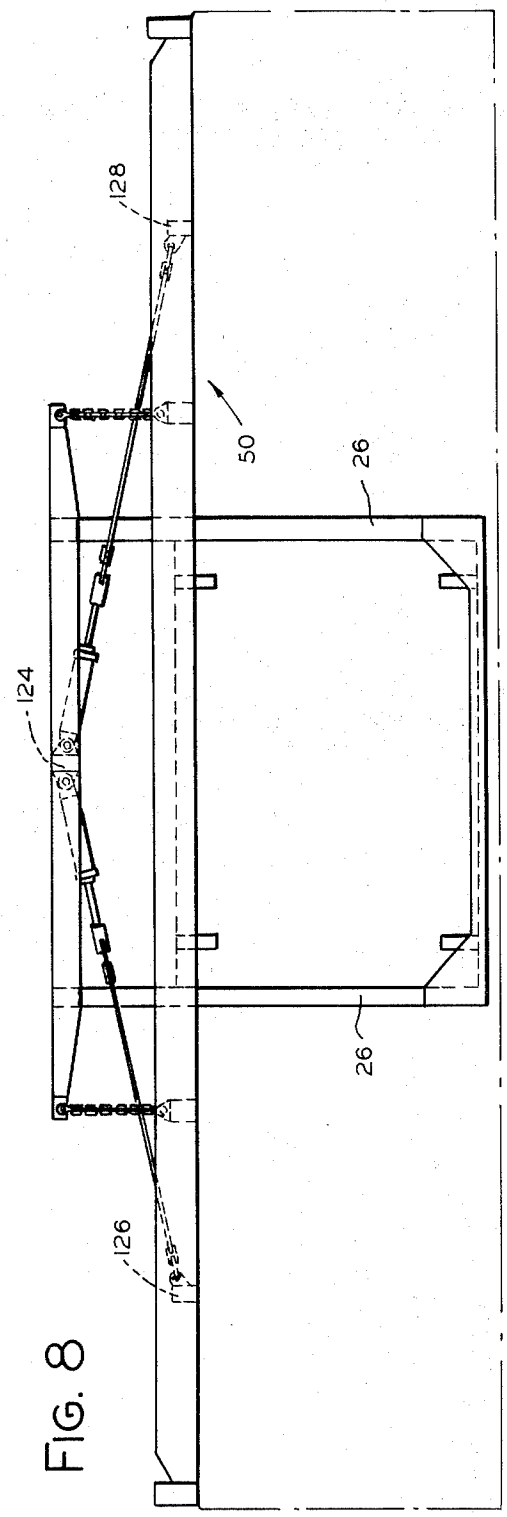

FIG. 8

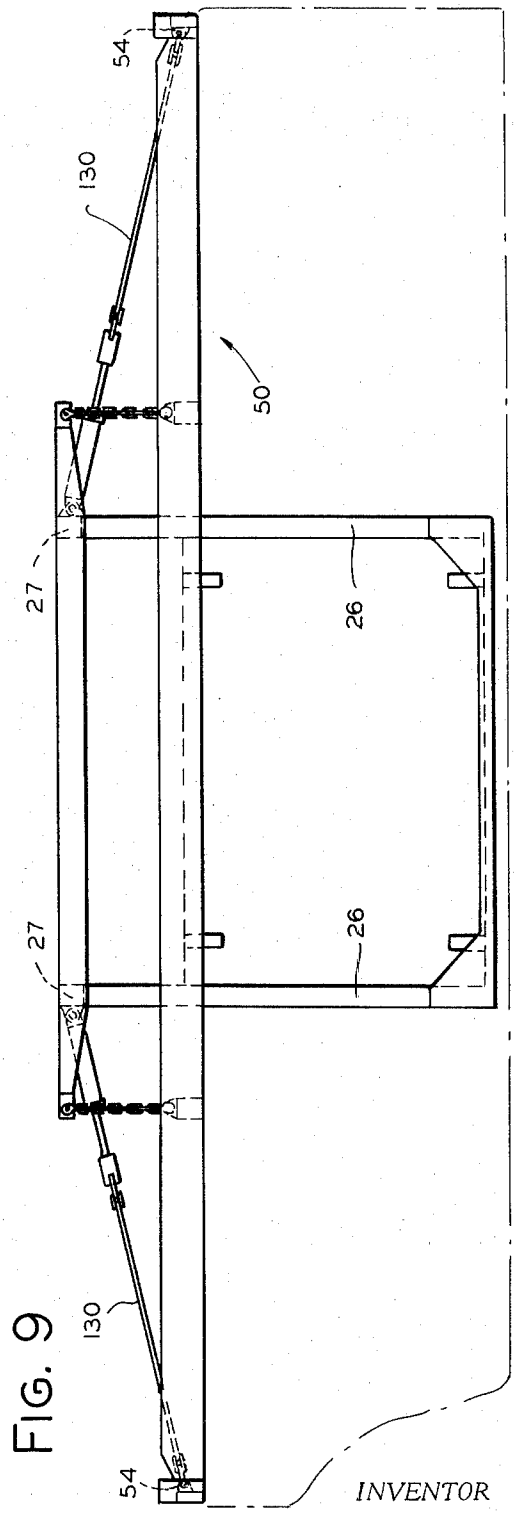

FIG. 9

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CONTAINER HANDLING DEVICE

BACKGROUND OF THE INVENTION

The field of art to which the invention pertains relates to handling devices for large freight containers, and more particularly to container handling lifting frames for attachment to lift trucks.

Large fully enclosed cargo containers in lengths varying between 20 and 40 feet have become a staple of that part of the freight transportation industry which is frequently referred to as "containerization". With the advent of such cargo containers came the need for specialized vehicles adapted to efficiently handle and transport them between major freight transport facilities such as railroads, overland trucks, cargo airplanes, and marine freighters.

It will be realized that when shipment involves passage on various types of such transporting means, transfer and transshipment of the containers is necessitated, and various types of prior art machines for lifting and loading such cargo containers to and from one means of transport to another includes cranes and derricks of various forms, straddle lift van carriers, and lift trucks having specialized attachments.

Both the dimensions of such cargo containers and the corner fittings thereof have been standardized whereby hooks and shackles of standardized dimensions will suitably engage said containers. A twist lock of a safety type has been standardized for use in engaging the corner fittings of such containers. The standardized corner fittings, twist lock latching means and container dimensions are set forth in a publication of The American National Standards Institute Inc., 1430 Broadway Street, New York, entitled "Specifications for Cargo Containers"; the publication designation is MH5.1-1965.

Various lift truck attachments have been developed heretofore for handling such cargo containers, but all are subject to certain deficiencies. One such attachment engages the four corners of a cargo container which faces it along one vertical side of the container. It will be appreciated that if the cargo container is picked up from one side thereof, the great weights involved may overstress the container frame and severe twisting and racking of the container and frame may occur.

Other types of such attachments include a lifting frame adapted to engage and lift such containers by the more standard means of engaging the four upper corner castings thereof by twist lock latch means located on the lifting frame. One of the problems inherent in the latter type attachment has been to devise suitable means for shifting the lifting frame a limited amount to either side of a centered position relative to the lift truck. It will be appreciated that the handling of such large cargo containers requires large heavy duty vehicles which must be maneuvered both into a position to engage and lift such containers for transport and also to locate such containers accurately in relation to other containers in and around loading and docking areas and upon transport means of various kinds such as flatbed trailers and rail cars. Substantial savings in time may be effected if the container is movable or maneuverable to a limited extent relative to the handling vehicle, thus reducing the maneuvering requirements of the handling vehicle itself in engaging and spotting such containers.

Heretofore side shifting of such lifting frames has been accomplished by suspending it from roller mounted trolleys which are mounted in and adapted to be shifted along I-beam rails which are in turn supported from the support frame in a direction transverse of the vehicle.

SUMMARY

The present invention provides a lift frame for cargo containers which is adapted as an attachment for use on fork lift trucks and which is capable of lifting the cargo container at the four upper corners thereof, while at the same time being capable of being shifted a limited amount from side to side relative to the lift truck for facilitating the engagement with and spotting of such containers. The lifting frame is suspended from a fixed overhead lifting bridge portion or support frame of the attachment, and the means for shifting the lifting frame from side to side is operatively connected between the lifting frame and the support frame. My invention is capable of a number of different embodiments or forms, but in essence comprises a simple and effective hydraulic actuator means capable of pulling the lift frame to one side or the other relative to the lift truck and support frame by opposed diagonally extending actuators connected between the bridge and the lift frame, and preferably so connected to form a generally X-shaped connection as viewed in front elevation.

It is a principle object of the invention to provide an attachment for use with vehicles such as lift trucks for engaging, transporting and spotting cargo containers, including improved means for shifting the container sidewise relative to the vehicle.

It is another object of the invention to provide a lifting frame which is suspended from a support frame for lifting cargo containers from the top four corners and which is adapted to be mounted as an attachment on a fork lift vehicle, the lifting frame being side shiftable relative to the support frame by actuating means which are oppositely diagonally connected between the support frame and the lifting frame.

Further objects and advantages of the invention will become apparent to persons skilled in the art from the specification and claims taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a side view of one embodiment of the attachment shown mounted on the mast of a partially illustrated lift truck vehicle;

FIG. **2** is a plan view of the attachment shown in FIG. **1**;

FIG. **3** is a front view of the above attachment;

FIG. **4** is an enlarged view of a portion of FIG. **3**;

FIG. **5** is a partial plan view of a modified form of the attachment;

FIG. **6** is a partial plan view of another modified form of the attachment;

FIGS. **7**, **8** and **9** are front elevational views of three other modified forms of the attachment; and

FIG. **10** is a schematic view of a hydraulic system for use with the attachment.

DESCRIPTION OF THE INVENTION

Referring first to FIGS. **1–4**, the front portion of a lift truck is shown generally at numeral **10** having mounted thereon a conventional lifting mast or upright assembly

12, which may be of the type disclosed in U.S. Pat. No. 3,213,967, from which upright is supported the attachment of the present invention.

The attachment is supported in known manner for elevation on the upright **12** by the usual lift cylinder, sprockets and chains, illustrated generally at numeral **14** in FIG. **2.** A lift carriage connects the attachment to the upright for elevation, and comprises generally upper and lower tranversely spaced fork bars **16** and **18** connected together by a pair of transversely spaced rearwardly extending fork brackets **20** which support the carriage from inner telescopic upright I-beams by means of pairs of guide rollers **22.** The upright is mounted from the front axle of the truck in known manner for limited tilting movement fore and aft by means of tilt cylinder actuators, the rod of one of which is shown at **24.**

The attachment includes a pair of generally inverted L-shaped beam assemblies **26** having forwardly extending elevated support arms **27** which are spaced transversely outwardly of opposite sides of the upright, the vertical support legs of which are rigidly secured together by a pair of vertically spaced transversely extending beams **28** and **30.** A pair of transversely mounted, downwardly opening hook members **32** are secured to the back side of beam **30** and are adapted to hook over and support the entire attachment assembly from the upper fork bar **16.** The fork bars **16** and **18** are also secured together by a pain of vertically extending end plates **36.** Pairs of side thrust roller means, not shown, are supported from portions of the carriage framework are adapted to engage side edge portions of the inner telescopic I-beams of the upright for minimizing the effect on the upright of eccentric loading of the attachment during operation.

Secured to the forwardly projecting arms **27** of beam assemblies **26** are a pair of spaced transversely extending beams **40** which are secured to arms **27** and together with which form the overhead bridge or support frame designated generally by the numeral **42.** The transverse beams **20** extend in both directions transversely outwardly of arms **27** and have mounted at each end thereof a shackle block **44** from which is mounted a suspension chain **46.**

A lifting frame is designated generally at numeral **50** and is adapted to be suspended from the ends of the four chains **46.** The lifting frame comprises a pair of parallel spaced transversely extending I-beams **52** connected at their opposite ends by beams **54** to form a rectangular framework reenforced by a spaced pair of intermediate I-beams **56** secured rigidly at the opposite ends to the web portions of beams **52,** and having an outwardly diverging V-shaped strut **58** secured at the apex centrally of each beam **56** and at the outer ends to the corners formed between the respective beams **52** and **54** of the lifting frame.

The lifting frame is of generally conventional configuration and is preferably made available in various lengths adapted to handle the various lengths of containers for which such attachments may be adapted. At each corner of the lifting frame is mounted a twist lock latching device **60** of well-known design which is registrable with a complementary corner casting **61** formed in each upper corner of such containers and lockable by conventional hydraulic actuating means, not shown, in the corner castings for lifting the container with the attachment on the upright. A plurality of outwardly flared, downwardly extending guide members **62** are connected adjacent the rear corners of the lifting frame and at spaced locations along rear beam **52** to aid in the proper positioning of the lifting frame upon the top of a container at the time of engagement therewith. The upright **12** may be raised and lowered such that the lifting frame is capable of engaging containers which are, for example, located at ground level, or on flatbed trailers or rail cars, or stacked to a height of three containers. In FIG. **1** is represented the lifting frame in engagement with a container **66** at ground level.

The attachment may be readily disconnected from the lift truck as by storing the same in a suitable rack or stand and then lowering the lift truck carriage downwardly away from the connecting hook portion **32** following the disconnection of quick disconnect pin members, not shown. The lift truck may then be used for other purposes with a conventional fork or other attachments. In this regard, the hydraulic lines all utilize quick disconnect couplings, not shown, which are detachable at the carriage when the attachment is removed therefrom.

It will be appreciated that in the use of the attachment the suspension of the lifting frame from the chains **46** enables the lifting frame to accomplish a self-leveling function when it is lowered upon a container to be engaged since the suspension of the lifting frame from the support frame is flexible at each container corner location. The sloped broken line **69** in FIG. **3** illustrates an angle β displaced from a horizontal position of the lifting frame which represents the maximum slope condition in which a container can be disposed and still be engaged by the lifting frame for the length of suspension chains **46** as illustrated at the distance therebetween.

It will also be appreciated that manuevering to engage and spot containers would be much simpler and would require less of an operator's skill and time if means are available for manipulating the lifting frame separate from maneuvering the lift truck. Accordingly, I have provided extremely simple and novel means for enabling the operator to side shift the lifting frame a limited amount in either direction relative to the bridge portion, thus enabling the operator to manuever the lift truck to quickly locate approximately the lifting frame in relation to a container to be engaged, or to locate a container approximately in relation to a precise location at which it is to be spotted, and then to adjust as required to one side or the other the lifting frame or container for a final adjustment before engagement or spotting of the container.

In providing this desirable function I utilize hydraulic cylinder actuating and connecting means connected diagonally between the support and lifting frames at preselected locations, preferably so as to form relatively acute angles between the horizontal frames and the said means. The actuating and connecting means is so constructed and controlled hydraulically as to accomplish the side shifting function by swinging the lifting frame along arcs defined by the lower ends of suspension chains **46,** said means being controlled to side shift the lifting frame always in a direction of pulling in relation to the hydraulic actuators. Furthermore, the construction is simply and effectively devised to prevent undesirable swinging of the lifting frame as suspended from chains **46** during operation except as the operator elects in side shifting.

There are a number of alternative constructions available within the scope of the invention; the preferred concept which embodies the invention projects in a vertical plane a generally X-shaped configuration of the hydraulic actuating and connecting means as connected between the support and lifting frames. Within this preferred concept of the invention are also a number of constructional variations, as will be described below in respect of FIGS. 2–6.

As will be observed in FIGS. 1–3, the base ends of a pair of hydraulic cylinder assemblies 70 and 72 are pivotally mounted from a pair of brackets 74 and 76 which are secured generally centrally of the pair of overhead support arms 27, and which extend in converging relation towards each other for connection at the respective rod ends by oval brackets 78 and 80 to a centrally located metal ring 82. Pivotally connected by rings and eye bolts 84 and 86 located centrally of opposite lifting frame members 56 are a pair of longitudinally adjustable connecting members 88 and 90 (turnbuckles as shown) which at their opposite ends are connected by oval brackets 92 and 94 to ring 82 generally diametrically opposite the connectors 80 and 78 respectively. The cylinders and respective turnbuckle connectors may be, but are not necessarily, substantially coaxial. The actuating and connecting assembly including ring 82 projects a generally X-shaped configuration as seen in FIG. 3. The turnbuckles are preferably adjusted so that they project in a vertical plane with the respective cylinder assemblies relatively straight diagonal lines between the points of connection to the support and lifting frames, and so that the components thereof are in tension and ring 82 is located midway between the pairs of connector brackets 74, 76 and 84, 86.

Operation of cylinders 70 and 72, which are single acting, is under the control of the vehicle operator who controls the flow of fluid pressure to the rod ends of the cylinders, as shown, in order to shift the lifting frame in a swinging motion to the right or to the lift. My invention does not permit uncontrolled swinging movement of the lifting frame at any time to the right or to the left, but maintains the frame suspended from chains 46 at all times in a controlled, fixed lateral position. The hydraulic control means, as will be described below in detail in conjunction with FIG. 9, is operative to simultaneously pressurize the rod end of one cylinder to side shift the lifting frame in the direction of retraction of that cylinder and to also restrict the outflow from the rod end of the other non-actuating cylinder as it extends. In other words, if it is desired to shift the lifting frame to the right, as seen in FIGS. 3 and 4 wherein brackets 84 and 86 illustrate the swing shifted position of chains 46, this is accomplished by pressure actuating cylinder 72 to retract to pull upon turnbuckle 88 causing the lifting frame to swing shift, while at the same time resistance pressure is applied to cylinder 70 to the degree necessary to maintain the desired relationship of the parts of the actuating assembly in tension. Thus, the rod of cylinder 70 extends under controlled resistance pressure as cylinder 72 retracts and the relationship of the actuating parts changes from the solid line centered position of FIGS. 3 and 4 to the broken line right-hand shifted position. Because of the geometry of the arcs through which the cylinders swing during shifting movement, the retracting cylinder which performs the work of shifting the lifting frame retracts a slightly greater distance than does the opposite cylinder extend as resistance pressure fluid is maintained in said extension cylinder and the non-operative turn-buckle 90 (in the shift condition illustrated) takes up a certain amount of play available between the oval ring and bracket connections thereof with main ring 82 and bracket 86.

It is desirable in such a design to utilize actuating cylinders 70 and 72 of a relatively small or medium size sufficient to produce the requisite side shifting forces to handle a fully loaded container on the lifting frame from the present minimum 20 foot long container to the present maximum 40 foot long container. The various and presently available lengths of containers which are operational in container handling systems are represented by the 20', 24', 30', 35' and 40' legends appearing in FIG. 3 in respect of the length of the lifting frame which is used with each of said different length containers, all other parts of the attachment being preferably the same as is shown in FIGS. 2 and 3 for the purpose of standardization of parts. Of course, the smaller the hydraulic shifting force required, the smaller and less costly are the various components of the hydraulic system supplying cylinders 70 and 72.

In FIG. 3 is shown a configuration of the actuating and connecting assembly which conforms to preferred criteria of design. The hydraulic force required at cylinders 70 and 72 to shift the lifting frame is a function of the cosine of the projected angle α. Therefore, it will be apparent that as the length of either connecting diagonal is increased and/or as the length of the support chains 46 is decreased that the force requirement is decreased, and it has been found that the design as illustrated provides a good compromise in this regard between competing criteria.

It will be understood that other connecting means, such as cable or chain, can be substituted for the turnbuckles 88 and 90, although the turnbuckles are preferred for a number of reasons, including lower cost, the inherent adjustability to a centered taut condition as shown in FIG. 3, which is not as readily available with other connecting means, and the fact that the turnbuckle link remains rigid even though the non-force transmitting link is in a functionally slack condition.

Referring now to FIG. 5, a modification is shown in plan view which is functionally similar in result to the preferred embodiment described above, and wherein similar parts are numbered as in FIG. 2. As shown, the actuator cylinders 70 and 72 are connected at the rod ends to the respective opposite corner portions formed between the longitudinal rails 52 of the lifting frame and the transverse beams 56 thereof. The cylinders converge downwardly and inwardly as in the previous embodiment and are supported at the gland ends by a pair of support hangers 100 which are connected between beams 40 of the support frame. As shown, the rod ends are connected by pairs of cables 102 and 104 to respective corner brackets 106 of the lifting frame. These pairs of cables, which project as shown in the horizontal plane as V-shaped connections, project in the vertical plane together with the actuator cylinders as a generally X-shaped configuration, similar to that of the previous embodiment.

Another modification is shown in FIG. 6 wherein the parts are the same as in previous embodiments except that cylinders 70 and 72, which are supported by hanger members 100 as in FIG. 5, are connected by sin-

gle cables, **110** and **112** (which could as well be adjustable turnbuckle links) to brackets **114** and **116** located centrally of beam members **56** of the lifting frame. It will be noted that the diagonal connecting means of FIG. **6** are independent of each other, i.e., are not connected through a central ring such as ring **82**. When projected in a vertical plane a generally X-shaped configuration of the actuator and connecting assembly is present.

An important feature of the present invention involves a pair of diagonally extending actuator and connecting means located between the support and lifting frames at a relatively acute angle to moderate the force required to side shift a loaded lifting frame. It will be apparent that various other configurations within the scope of the invention are feasible. While the basic projected X-shaped configuration is preferred for reasons discussed above, it is feasible to utilize actuator and connector assemblies which project in a vertical plane either a V-shaped configuration, an inverted V-shaped configuration, or diagonal actuators separated longitudinally of the lifting frame, and such other modifications are illustrated in FIGS. **7, 8** and **9.**

In FIG. **7** the apex of the V-shaped actuator assembly is connected to a central transverse beam **120** of the lifting frame and the cylinders diverge upwardly and outwardly for connection at the base ends of the cylinders at **122** centrally of arms **27** of the support frame.

Contrariwise, the inverted V-shaped actuator assembly of FIG. **8** is connected at its apex to a central beam **124** of the support frame and at its opposite ends to transverse beams **126** and **128** of the lifting frame.

In FIG. **9** is shown a modification wherein the cylinder base ends of the actuator and connector assemblies are connected to the central portions of arms **27** of the support frame from which they and turnbuckle connectors **130** extend oppositely diagonally outwardly to connect to opposite end beams **54** of the lifting frame forming, in effect, a truncated inverted V-shaped configuration.

Illustrated schematically in FIG. **10** is a hydraulic system which would be suitable for use with any of the foregoing embodiments. As represented it is shown operating with the actuator cylinders of the main embodiment of FIGS. **2–4.** The actuator cylinders **70** and **72** are shown in positions such that ring **82** is actuated left of its centered position, the opposite to that shown in FIG. **4**; i.e., cylinder **70** is retracted and cylinder **72** is extended. As shown, a fluid pump **140** is connected to a reservoir **142** and is adapted to be connected to the rod ends of single-acting cylinders **70** and **72** by way of an operator controlled directional control valve **144,** in neutral position as shown and holding cylinder **70** and **72** in the positions illustrated, and a motion control and lock valve assembly shown within the broken line area at numeral **146.** The latter type valve is manufactured by Fluid Controls, Inc., Mentor, O., and may be in accordance with their Model IEEC-11.

In order to shift the cylinders rightwardly, valve **144** is shifted left to apply pressure fluid to conduits **148** and **150,** while fluid is ejected from cylinder **70** to reservoir **142** by way of conduits **152** and **154,** all under the control of valve means **146.** Pressure fluid in conduit **148** flows through a one-way check valve at **156** to conduit **150** and cylinder **72,** to the holding side of a one-way check valve **176,** and through lines **164** and **166** to apply pilot pressure to pilot assisted release valves **160** and **162,** respectively, the pilot pressure at relief valve **162** tending to open the valve against spring **168.** Cylinder **70** generates a pilot pressure also at valve **162** by way of conduit **152** and connection **170.** The forces of the two pilot pressures are thereby applied to valve **162** to open the valve, allowing fluid to flow from cylinder **70** back to reservoir through valve **162,** a check valve **172,** conduit **154** and valve **144,** while maintaining a predetermined back pressure on cylinder **70.**

When control valve **144** is centered during such rightward movement of the lifting frame the pilot signal disappears and relief valve **162** tends to close thereby decelerating the load and the lifting frame and acting as a pure relief valve. Under these circumstances, oil flowing out of cylinder **70** through relief valve **162** enters conduit **174** and flows along the line of least resistance through check valves **176** and **156** to the cylinder **72.**

It will be apparent to those skilled in the art that various changes in the structure, components and relative arrangement of parts may be made without departing from the scope of my invention.

I claim:

1. A cargo container handling device comprising an upright frame, a pair of outwardly extending arms secured rigidly to the upper portion of the frame and forming a part of an elevated support frame, an elongated lifting frame having container engaging means for engaging fittings in a cargo container, means suspending said lifting frame from said support frame for limited swingable side shifting movement of the lifting frame, and a pair of diagonal connecting means connected to said support frame and to said lifting frame and extending in diagonally opposed directions therebetween for side shifting said lifting frame, said connecting means including a pair of diagonally oppositely extending hydraulic cylinders.

2. A container handling device as claimed in claim **1** wherein said suspension means is flexible and support said lifting frame normally generally parallel to said support frame, said lifting frame being enabled by said flexible suspension means to engage a container which is located on a surface in non-parallel relation to the lifting frame, said suspension means being actuated arcuately with the lifting frame about the locations of connection of the suspension means on the support frame during side shifting movement by said diagonal connection means.

3. A container handling device as claimed in claim **1** wherein bracket means are connected to the upright frame for attaching the lift frame to the fork carriage of a lift truck.

4. A container handling device as claimed in claim **1** wherein the pair of diagonal connecting means projects a generally X-shaped configuration in a vertical plane.

5. A container handling device as claimed in claim **1** wherein said pair of hydraulic cylinders operate such that the effective force applied to the lifting frame which controls the side shift position thereof in either direction is only applied by the cylinder effective to exert a pulling force on the lifting frame.

6. A container handling device as claimed in claim **5** wherein a controlled fluid pressure is applied to the cylinder opposed to the cylinder operative to side shift the lifting frame such that a controlled force opposes side shifting as required to maintain a continuous taut con-

dition of the diagonal connecting means, the side shifting cylinder being operative in retraction and the opposed cylinder in extension.

7. A container handling device as claimed in claim **1** wherein a relatively sharp angle is formed between the diagonal connecting means and the planes of the support and lifting frames, respectively, the force required to side shift the lifting frame being a function of the cosine of said angle.

8. A container handling device as claimed in claim **4** wherein each of said diagonally extending hydraulic cylinders is pivotally connected at one end to said support or lifting frame and at the opposite end to a common suspended connector element and a member connected to the suspended connector element and at a remote location to the lifting or support frame.

9. A container handling device as claimed in claim **8** wherein said connector element comprises a closed loop element, and each of said members comprises an adjustable turnbuckle.

10. A container handling device as claimed in claim **8** wherein remote ends of the opposed cylinders are pivotally connected to opposite side portions of the support frame, said pair of cylinders at all times applying opposed forces to said suspended connector element whereby to maintain the connector element in continuous tension during operation of the handling device and maintaining with said connector members an operator controlled position of the lifting frame.

11. A container handling device as claimed in claim **8** wherein the pair of diagonal connecting means are essentially coplanar in a vertical plane.

12. A container handling device as claimed in claim **1** wherein the pair of diagonal connecting means projects a generally V-shaped configuration in a vertical plane.

13. A container handling device as claimed in claim **1** wherein the pair of diagonal connecting means projects a generally inverted V-shaped configuration in a vertical plane.

14. A container handling device as claimed in claim **1** wherein the pair of diagonal connecting means projects a generally truncated inverted V-shaped configuration in a vertical plane.

* * * * *