Feb. 10, 1970 TOYOTARO SUMIDA 3,494,491

MATERIALS HANDLING VEHICLE

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FIG. 1

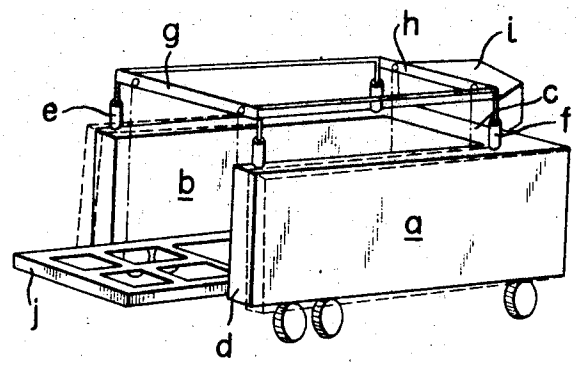
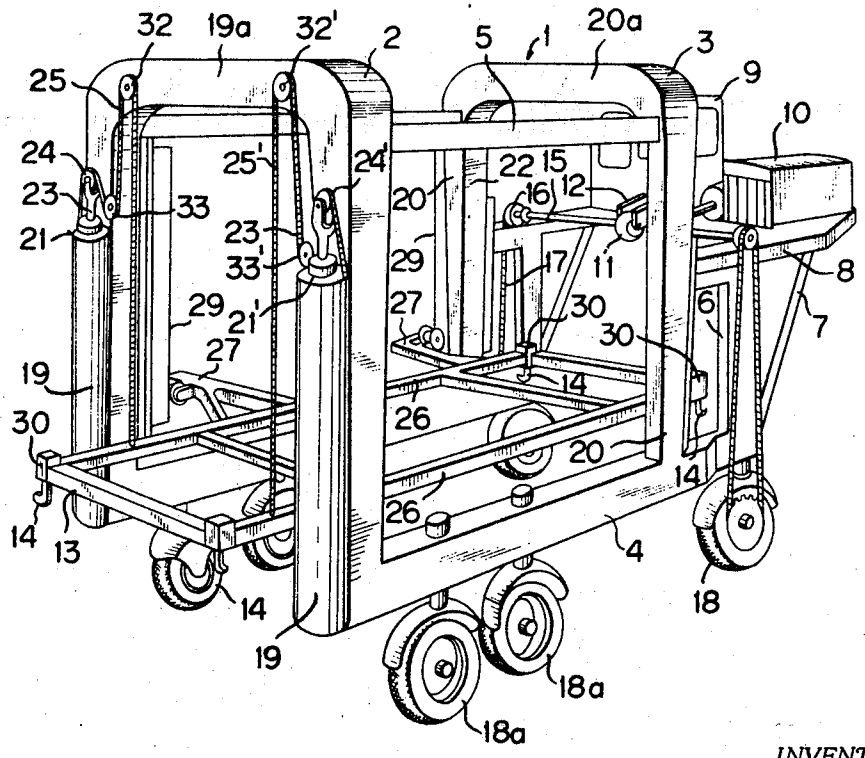


FIG. 2



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MATERIALS HANDLING VEHICLE

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FIG. 3

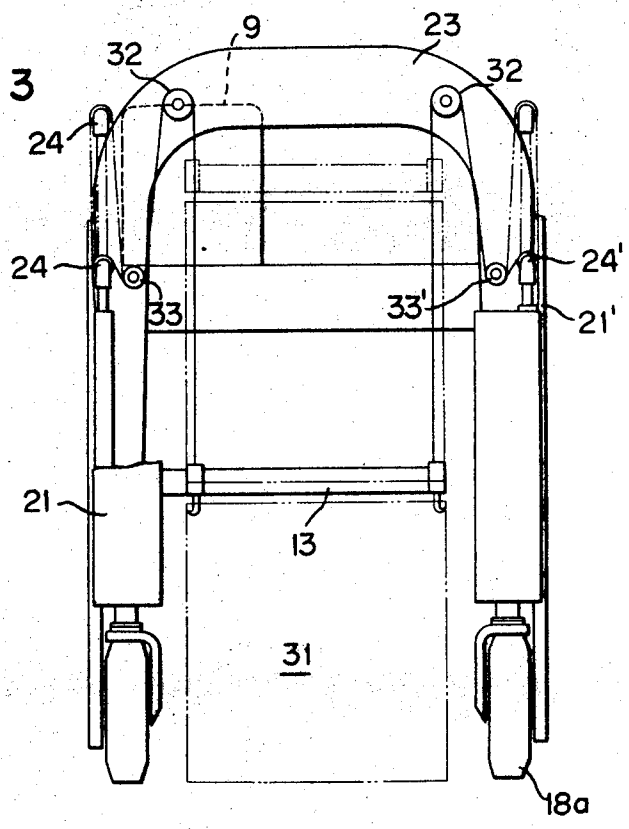
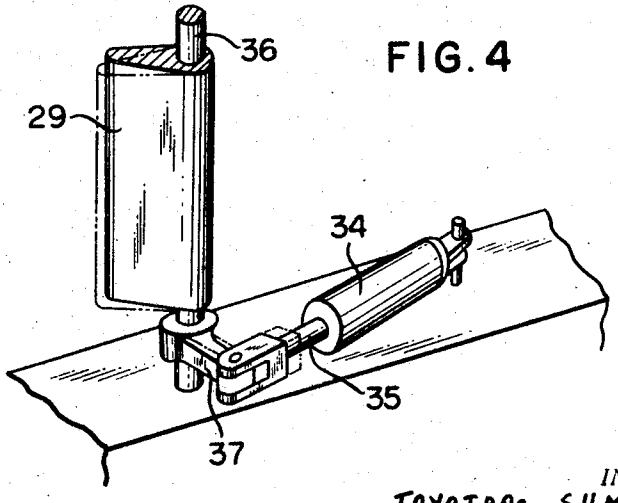


FIG. 4



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MATERIALS HANDLING VEHICLE

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FIG. 5

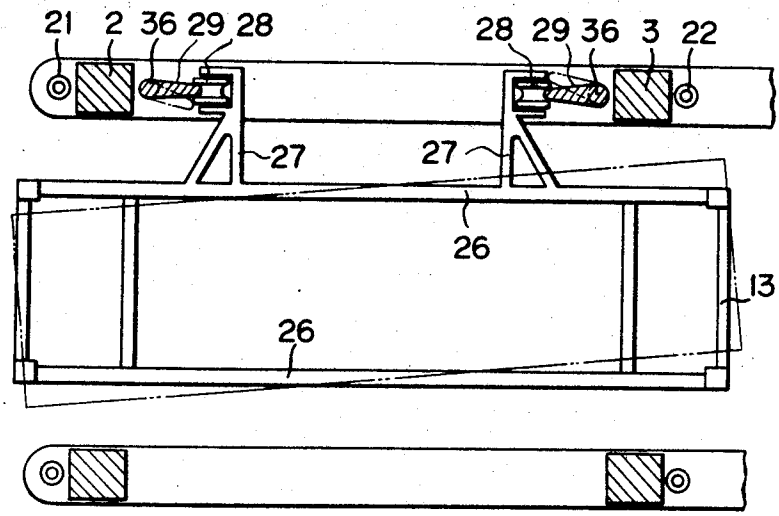


FIG. 7

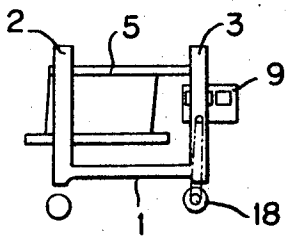
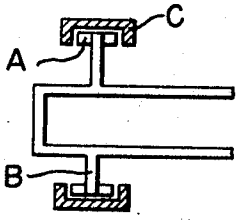


FIG. 8



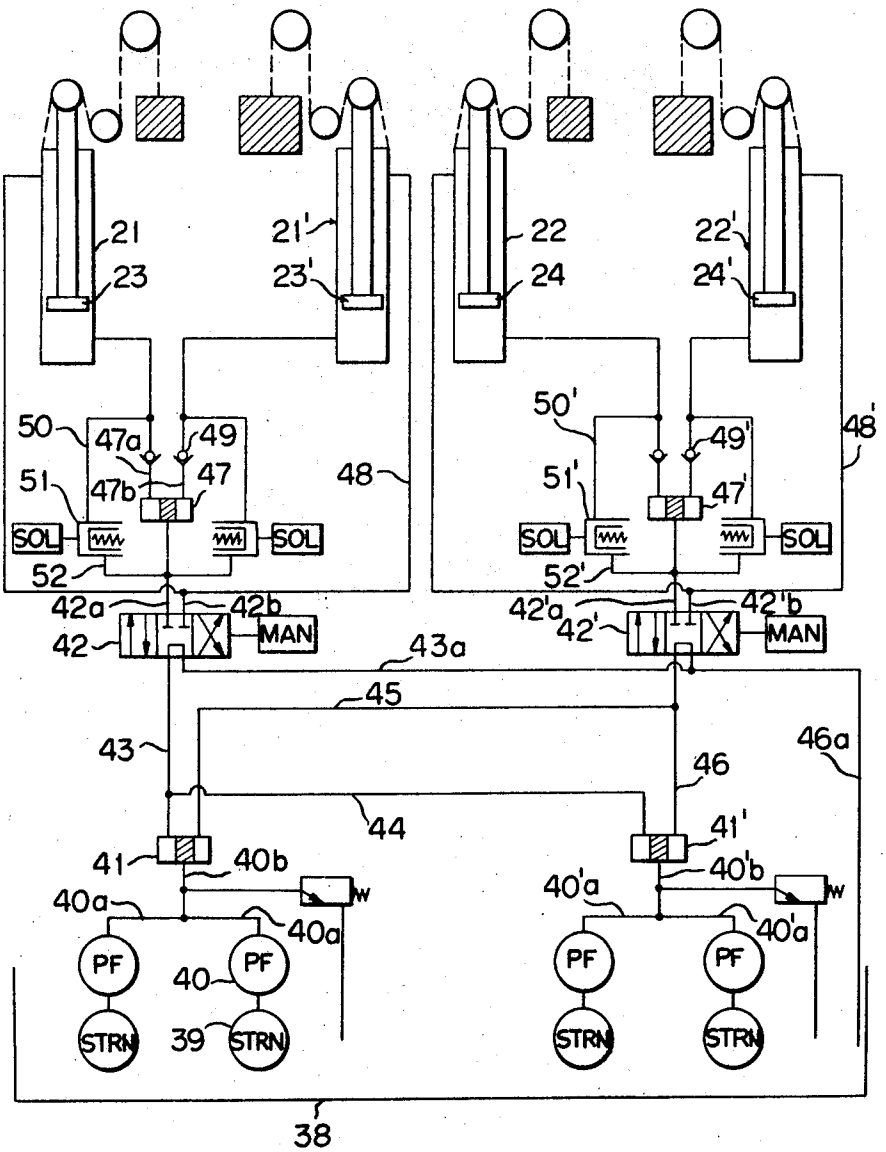
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MATERIALS HANDLING VEHICLE

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FIG. 6



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3,494,491

MATERIALS HANDLING VEHICLE

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Claims priority, application Japan, Oct. 29, 1966, 41/71,222
Int. Cl. B60p 1/02; B66d 3/08; B66c 5/02
U.S. Cl. 214—394 9 Claims

ABSTRACT OF THE DISCLOSURE

A materials handling vehicle is comprised of a support frame arranged to afford the operator a clear unobstructed view in the operation of the vehicle particularly in lifting and transporting material. In a preferred arrangement, the support frame is formed of two spaced inverted U-shaped end frames connected by upper and lower side members. The construction of the frame permits movement of the vehicle over materials to be lifted and also provides a vertically extending open space within the frame for lifting the materials. A lifting member is located within the open space and is movable not only upwardly and downwardly, but also laterally. Lifting means such as hydraulic piston cylinders are located on the upright members of the end frames for the vertical movement of the lifting member. Additionally, the lifting member is secured to vertical guide rails located on one side of the frame and means are provided for laterally displacing the guide rails and, in turn, laterally positioning the lifting member which is secured to the rails. A cab for the operator is located at one end of the vehicle and contains not only the means for driving the vehicle but also control means for regulating the vertical movement of the lifting member. With the control means an equal flow of hydraulic fluid is provided to the various hydraulic piston cylinders for assuring simultaneous raising and lowering of the lifting member though the load may be unevenly distributed.

SUMMARY OF THE INVENTION

The present invention is directed to improvements in materials handling vehicles and, more particularly, to providing a vehicle construction which provides the optimum unobstructed view for the operator and improved means for lifting materials to be transported.

In conventional materials handling vehicles, the vehicle is positioned over the materials to be transported, then the materials are lifted, moved to a predetermined place, and then lowered and released. To perform these operations, the vehicle is generally provided with a vertically extending open space within its frame. However, in known vehicles of this type the following drawbacks have been noted:

(1) to provide the required open space for handling various materials the side and cross frames of the vehicle have been unsubstantial and the ends of the side frame have had the tendency to move relative to one another when the vehicle is turning;

(2) the location of the hydraulic motor for lifting the materials and of the cross support members has often made it difficult for the driver to obtain an unobstructed view of the lifting operation.

(3) the means used for laterally positioning the lifting member has provided further obstacles in the path of the driver's vision; and

(4) the mechanically or hydraulically driven lifting apparatus often has been inadequate and has required excessive down time for repairs.

A primary object of the invention is to provide a materials handling vehicle in which any limitations on the field of vision of the operator are maintained to a minimum.

Another primary object of the invention is to produce a control arrangement for the lifting means whereby the lifting frame may be maintained in a plane parallel to the surface on which the vehicle is positioned in spite of any uneven distribution of load on the lifting frame.

Another object of the invention is to supply equal quantities of hydraulic fluid to each of the lifting devices in the vehicle.

Still another object of the invention is to afford means for moving the material to be lifted laterally as well as vertically.

Therefore, the present invention is directed to a materials handling vehicle having a frame structure providing an open space for receiving and handling the materials to be transported. Preferably, the support frame comprises a pair of spaced end frames of inverted U-shaped configuration formed of a pair of spaced upright members secured at their upper ends by an integrally attached cross member. Side members secured to the end frames provide additional rigidity without encroaching on the open space within the frame or obstructing the view of the operators. A lifting member is located within the open space in the frame and is adapted to extend generally parallel with the surface on which the vehicle is positioned. The lifting member is arranged to be moved laterally as well as upwardly and downwardly within the open space. Lifting means are mounted on the upright members of the end frames for raising and lowering the lifting member. In addition, control means are provided for the lifting means to assure that the lifting member is maintained in a position substantially parallel to the surface on which the vehicle is positioned during lifting, regardless of any uneven distribution of load upon the lifting member.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a perspective view of a somewhat schematic arrangement showing a conventional type of materials handling vehicle used in the prior art;

FIG. 2 is a perspective view of a materials handling vehicle embodying the present invention;

FIG. 3 is a rear view of the vehicle shown in FIG. 2 with a container shown in phantom arranged to be lifted by the vehicle;

FIG. 4 is a partial perspective view of the vehicle illustrating a device for laterally positioning a lifting member;

FIG. 5 is a partial sectional top view of the lower portion of the vehicle shown in FIG. 2;

FIG. 6 is a schematic arrangement showing a control apparatus for the lifting devices on the vehicle shown in FIG. 2;

FIG. 7 shows another arrangement of the wheels for the vehicle;

FIG. 8 is a partial sectional top view showing another arrangement of the means for laterally displacing the lifting member.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1 an arrangement is shown of a conventional materials handling vehicle, as known in the art, comprising

a pair of side frames *a, b* and a cross frame *c* at one end. In transporting material, as the vehicle turns the rear ends *d* of the side frames *a, b* have a tendency to move either apart or toward one another since there is no means for adequately spacing them and the side frames are not sufficiently rigid to assure that they will remain in proper spaced parallel relationship. The hydraulic lifting cylinders *e* and *f* located at either end of the vehicle and the gate or cross frame members *g* and *h* form obstructions in the line of sight of the operator of the vehicle as he sits in its cab *i*. Additionally, the cross frame *c* is another obstruction which makes it difficult for the operator to see the materials being handled within the open space in the vehicle. Where a motor unit or other apparatus is provided for laterally positioning the lifting frame *j*, this also obstructs the vision of the operator.

In the materials handling vehicle **1**, shown in FIGS. 2 to 6, a vertically extending open space is formed within the frame construction of the vehicle. The vehicle frame is comprised of two spaced end frames **2** and **3** having a generally inverted U-shaped configuration. The end frames **2** and **3** are interconnected by longitudinally extending lower beams **4** and upper beams **5**. The lower and upper beams do not encroach on the vertical open space within the frame. The end frames **2** and **3** are formed of upright members **19** and **20** and cross members **19***a* and **20***a*, respectively. Since the end frame is formed of an integral construction, it is sufficiently rigid to withstand the various forces exerted on it in lifting and in the movement of the vehicle. Moreover, since there are no cross members below the upper members **19***a*, **20***a*, there is no obstruction in the open space within the frame for the vertical movement of materials to be transported.

Extending upwardly from the lower beams **4**, outwardly from the uprights **20** of the end frame **3**, are a pair of vertical support members **6** and knee brace members **7** which support a horizontally arranged plate **8**. A cab **9** for the operator of the vehicle is located on the plate **8** as well as a motor **10** and differential gear **11** for driving the vehicle. A cantilever support member **12** extends from the plate toward the end frame **3** and support the differential gear **11**. It will be noted that there is no cross member of the vehicle disposed in the path of the differenial gear. With this arrangement the operator has an unobstructed view from his cab into the open space within the frame of the vehicle wherein the materials liftingly device is located. The operator is able to view the entire lifting frame **13** as well as the hooks **14** which are located at its corners.

The differential gear **11** is mounted on a shaft **15** and drives sprocket wheels **16** at the outer ends of the shaft which in turn transmit the driving motion through chains **17** downwardly to driving wheels **18** located at the lower end of the frame. Other wheels **18***a* for the vehicle are secured to the lower beam **4** and are located between the end frames **2, 3**. The driving mechanism just described does not form an essential part of the present invention, accordingly, further detailed explanation of its construction is not set forth.

Each end of the vehicle has a pair of double acting hydraulic piston cylinders **21, 21'** and **22, 22'**, a separate cylinder is positioned on each of the uprights **19, 20** of the end frames **2, 3**. As shown in FIG. 2, the cylinders **21, 21'** have vertically movable pistons **23, 23'** provided with wheels **24, 24'** on the upper ends of the piston arms. Chains **25, 25'** are secured to the hydraulic cylinders and extend over the wheels **24, 24'**.

Within the vertically extending open space in the frame, a lifting member or open frame body **13** is positioned substantially parallel to the surface on which the vehicle rests. At each of its ends, the lifting member **13** is attached to the chains **25, 25'** extending downwardly from the cross member **19***a* of the end frame. The support or lifting chains **25, 25'** extend vertically upward from the lifting member and pass over wheels **32, 32'** located on the

cross member **19***a*, of the end frame and then passes downwardly around another wheel **33, 33'** mounted on the uprights **19, 19'** of the end frame **2**. From the wheels **33, 33'**, which are located below the wheels **24, 24'** in their lowermost position in the hydraulic cylinders **21, 21'**, the chains pass upwardly over the wheel **24, 24'** and then, as mentioned previously, are secured to the body of the hydraulic cylinder **21, 21'**. A similar lifting chain arrangement (not shown) is provided for the opposite end of the lifting member **13**. With this chain and wheel arrangement, the lifting member **13** is designed to move vertically at the rate of 2 to 1 compared with the movement of the piston within the hydraulic cylinder.

In the hydraulic system, a hydraulic fluid equalizer is provided, as will be explained subsequently, to assure an equal feed of hydraulic fluid to each of the hydraulic cylinders on the vehicle. Due to the manner in which the hydraulic fluid is fed through to each of the cylinders, the lifting member **13** will be moved upwardly and downwardly in a plane substantially parallel to the plane in which the vehicle is positioned.

As can be seen in FIGS. 2 and 5, a pair of spaced support brackets **27** extend laterally outward from one of the longitudinally extending members **26** of the lifting member or frame **13**. Near the outer end of each bracket a grooved wheel **28** is positioned. Mounted on the vehicle frame are a pair of vertically extending guide rails **29** with which the grooved wheels are engaged.

As shown in FIG. 4, a double-acting piston **34** having a piston rod **35** is connected through an arm **37** to the shaft **36** on which the laterally movable guide rail **29** is mounted. By displacement of the piston arm, the shaft **36** is rotated and the end of the rail in contact with the grooved wheel **28** can be moved laterally either outwardly from or inwardly toward the frame of the vehicle.

At each corner of the lifting member **13**, a box member **30** is provided with a hook **14** depending downwardly from the lifting member. In FIG. 3, a container **31** is shown in phantom and the hooks **14** are designed to engage a recess component (not shown) provided in the top corners of the container **31**. The construction of the hook for such a use is well known and further description is not considered essential to the disclosure of the present invention.

When the lifting member **13** and any load attached to it are raised or lowered, the member is lifted by the chains **25, 25'** and is guided in its vertical path with a low fictional resistance by the rollers or grooved wheels **28** and the vertical guide rails **29** provided on one side of the lifting member.

In its normal position within the vehicle, the lifting member **13** is symmetrically arranged with respect to the sides of the vehicle, as shown in full line in FIG. 5. If, in a lifting operation, the vehicle **1** is symmetrically arranged with respect to the container **31** to be lifted, then the lifting member **13** is lowered on the lifting chains until its hooks **14** engage the recessed components on the container. However, if the vehicle is not symmetrically arranged with respect to the container **31**, as is often the case, then the position of the lifting member **13** can be adjusted in the horizontal plane by means of controls located in the cab **9** of the vehicle. By means of these controls, the vertical guide rails **29** can be displaced laterally so that the hooks are properly positioned over the container. An example is shown in FIG. 5 where the right hand guide rail is moved outwardly (see the dashed lines), and the lefthand guide rail is moved inwardly whereby the lifting frame assumes an oblique position with respect to the sides of the vehicle.

In addition to affording the correct positioning of the lifting member over a container to be transported, as shown in FIG. 5, the means for laterally moving the lifting member may also be employed when the container is in a lifted position for placement on another container or for proper placement in a new location. Further, the

control means for operating the piston cylinder **34**, which moves the vertical guide rails, can be employed to lock the position of the lifting member **13** so that it does not move during the transporting operation.

During the lifting operation, the pistons within the hydraulic cylinders are uniformly set in motion using a hydraulic fluid quantity equalizer. If the center of gravity of the container **31** or other materials to be lifted are displaced closer to one end of the vehicle, then to the other, then the pistons on one end would be subjected to more load than those at the other end. Even in such a case, however, the hydraulic fluid is fed equally to each of the cylinders by means of a divider valve arrangement so that all four pistons have the same relative motion. Moreover, the hydraulic fluid quantity equalizer apparatus contains means whereby a single hydraulic cylinder can be operated by the driver of the vehicle.

In FIG. 6, the arrangement of the hydraulic fluid quantity equalizer apparatus is illustrated. A container **38** forms a reservoir of hydraulic fluid for the operation of the lifting member **13**. From the reservoir **38**, the hydraulic fluid is taken into the equalizer apparatus by means of two pair of strainers **39** and oil pumps **40**. The number of pumps employed is dependent upon the hydraulic fluid quantity required for the apparatus and the capacity of the pumps. Branch pipes **40***a*, **40**′*a* extend from each of the pumps **40** and combine in a single delivery pipe **40***b*, **40**′*b* which extends to a flow divider valve **41**, **41**′. The hydraulic fluid leaves the flow divider valve **41**, **41**′ through two outlets and the quantity of hydraulic fluid is equal at each outlet. Accordingly, even if a difference in pressure exists within the discharge passages from the outlets, the quantity of hydraulic fluid fed from the valve is equal. Downstream of each of the flow divider valves **41**, **41**′ is four way valve **42**, **42**′. These four way valves **42**, **42**′ control the movement of the piston in the two cylinders **21**, **21**′ at one end of the vehicle while the other valve **42**′ controls the movement of the piston in the other cylinders **22**, **22**′ at the opposite end of the vehicle. The four way valves **42**, **42**′ normally are controlled by the operator from the vehicle cab.

A conduit **43** is connected to the lefthand outlet of the valve **41** and extends to the four way valve **42** and similarly, a conduit **46** extends from the righthand outlet of the valve **41**′ to the four way valve **42**′. From the other or righthand outlet of the flow divider valve **41**, a conduit **45** extends to the conduit **46** and similarly from the lefthand outlet of the flow divider valve **41**′ another conduit **44** extends into connection with the conduit **43**. Accordingly, due to the arrangements of the flow divider valves **41**, **41**′, the quantity of hydraulic fluid flowing through the passages **43** and **45** from one of the valves is equal to that flowing through the conduits **44**, **46** from the other valve, regardless of any difference in pressure in these conduits. Because of this conduit arrangement, the quantity of hydraulic fluid entering each of the fourway valves **42**, **42**′ is equal.

The four way valves **42**, **42**′ have three positions for controlling the pistons in the hydraulic cylinders. When the piston is to remain stationary, the hydraulic fluid flowing from the divider valves **41**, **41**′ through the passageways **43**, **46** to the four way valves **42**, **42**′ is bypassed through the lines **43***a*, **46***a* to the reservoir **38**. With the flow bypassed, there is no passage of hydraulic fluid into the cylinders and the position of the piston remains unchanged. If the pistons **23**, **23**′ or **24**, **24**′ are to be moved upwardly the hydraulic fluid from the four way valves **42**, **42**′ is fed into the lines **42***a*, **42**′*a* and passes upwardly through another flow divider valve **47**, **47**′ into the cylinders. At the same time, the hydraulic fluid on the opposite side of the piston flows out through the upper end of the cylinder passes through the conduit **48** and returns into the four way valve.

If the pistons in the cylinders are to be moved downwardly, then the hydraulic fluid passes through the conduits **42***b*, **42**′*b* into the passageways **48**, **48**′ and thence into the upper ends of the cylinders, and the oil or hydraulic fluid contained at the opposite side of the piston is forced out through the lines **47***a*, **47***b* and returns to the four way valve in a manner to be described subsequently.

In the path of flow of the hydraulic fluid from the four way valve **42** to the lower ends of the cylinders **21**, **21**′, it passes through the flow divider valve **47** which separates the fluid into two halves for passage through the lines **47***a*, **47***b* to the cylinders **21**, **21**′.

Accordingly, an equal amount of hydraulic fluid is delivered to each of the cylinders **21**, **21**′. A similar flow divider valve **47**′ is provided for the fluid passing from the four way valve **42**′ to the cylinders **22**, **22**′ and the hydraulic fluid delivered to each of these cylinders is equal. Due to the arrangement of the hydraulic fluid equalizer apparatus passing first through the flow divider valves **41**, **41**′ and then through the flow divider valves **47**, **47**′ an equal quantity of fluid is fed into each of the four cylinders and the pistons can therefore be moved upwardly within the cylinders at the same speed.

Though flow divider valves **47**, **47**′ are provided in the path of flow of the hydraulic fluid from the four way valves to the lower ends of the cylinder **21**, **21**′, **22**, **22**′ there is no such divider valve in the path of the hydraulic fluid to the upper ends of the cylinders. Accordingly, the flow through the cylinders has to be controlled to assure proper operation. For controlling the flow of the fluid through the cylinders when the piston is being moved downwardly, the hydraulic fluid instead of flowing through the flow divider valves **47**, **47**′ is blocked by the check valves **49**, **49**′ and passes through the bypass conduits **50**, **50**′ and flow limiting valves **51**, **51**′ and then through the conduits **52**, **52**′ into the four way valves. In normal operation, the flow limiting valves **51** are closed by means of springs to prevent any passage of hydraulic fluid through them. If, however, the hydraulic fluid pressure is applied to the upper sides of the pistons **23**, **23**′ then this pressure plus a pressure due to the weight of the piston exerts a pressure in the conduits **50**, **50**′ which is sufficiently high to overcome the spring action within the flow limiting valve **51**, **51**′. As a result, a small piston within the valve is shifted and the hydraulic fluid is fed to the four way valve through the conduit **52**. The position of the small piston within the flow limiting valves **51**, **51**′ is designed so that the passage of hydraulic fluid may be regulated whereby the quantity of the fluid flowing through the valve **51**, **51**′ is dependent on the cross sectional area of the valve opening and in this way, the four pistons may be moved at the same speed regardless of the load which is being supported. Therefore, the pistons within the cylinders may be moved upwardly or downwardly in a uniform fashion by employing the flow divider valves **47**, **47**′ or the flow limiting valves **51**, **51**′ depending on the direction of travel.

There may be instances where less than the full number of four cylinders are to be used and in such a case the circuit illustrated in FIG. 6 operates in the following manner. For purpose of explanation it will be assumed that cylinder **21** is the only one to be used. The operator sets the four way valve **42** in the desired position and also actuates one of a series of buttons (not shown) for the flow limiting valve **51**. Four of these buttons are provided in the cab of the vehicle and are connected to the four flow limiting valves respectively. An electric current is supplied to each of the valves when its corresponding button is actuated and solenoid is operated which withdraws the small piston which limits the flow through the valve. In this way, the hydraulic fluid passage in the bypass about the flow divider valve **47** is opened.

Since only the cylinder **21** is to be used, the flow of hydraulic fluid is opened between the lower end of the cylinder and the four way valve **42**. Further, the passage or conduit **48** extending from the upper end of the cylinder **21** to the four way valve is also opened for pas-

sage of the hydraulic fluid therethrough. However, the cylinder **21'** which receives hydraulic fluid from the same four way valve is subjected to resistance to flow in its return passage by means of the divider valve **47**, the flow limiting valve **51** and the check valve **49**. Because of this arrangement the hydraulic fluid which is discharged from the four way valve only enters the cylinder **21** and directs the piston in the desired direction.

It is to be understood that the present invention is not limited to the various embodiments illustrated and various modifications may be possible within the scope of the invention.

Other possible modifications employing the basic arrangement of the invention, as disclosed above, are to arrange the end frames directly over the wheels of the vehicle as is shown in FIG. 7. In such an arrangement, the support member **6** and knee brace member **7**, for the cab, as shown in FIG. 2, are eliminated, and the cab **9** is supported directly from the end frame **3** and the driving wheels **18** are aligned below the end frame.

In another variation, the vertical guide rail **29** may be replaced by a movable channel member C secured to the side of the vehicle as shown in FIG. 8. Instead of a grooved roller, a roller A is fixed on the outer end of a laterally extending arm B of the lifting member **13** and rolls within the vertically arranged channel C.

In view of the foregoing, it will be appreciated that the present invention as compared with the conventional apparatus shown in FIG. 1 has the following advantages.

(1) As the integral end frame members are connected to each other by means of both upper and lower beams, the vehicle body is strong in construction; and because of this construction, any deformation or relative movement of its side members at the rear of the vehicle is limited to a point where it is not in any way a problem to the operation of a vehicle. This construction is particularly useful for the design of large sized materials handling vehicles.

(2) The position of the lifting cylinders on the upright members of the frame provide an unobstructed path of view for the operator in handling materials.

(3) Since the hydraulic fluid quantity equalizer apparatus moves the pistons equally, the location of the lifting member is maintained in a plane parallel with the surface in which the vehicle is positioned and smooth operation is achieved during the transportation of the materials.

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A materials handling vehicle comprising a support frame having a pair of opposite ends and being open at least at one end and having an upwardly extending open space within said frame, said frame adapted for movement over the material to be lifted within the open space in the frame, a lifting member located in the open space within said frame and adapted to extend generally parallel to the surface on which the vehicle is positioned, said lifting member being arranged to be moved upwardly and downwardly in the open space within said frame, a plurality of separate lifting means positioned at spaced locations on said support frame and secured to said lifting member for raising and lowering said lifting member, each of said lifting means comprises a double-acting hydraulic piston cylinder having a piston arm extending therefrom, means for operating said lifting means comprising a container forming a reservoir for hydraulic fluid, conduit means extending between said container and said hydraulic piston cylinders, and valve means in said conduit means for feeding equal quantities of hydraulic fluid to each of said cylinders; said valve means comprising a pair of first flow divider valves arranged in parallel for receiving hydraulic fluid from said reservoir, a pair of four-way valves arranged in said conduit means to receive hydraulic flow from said flow divider valves, and said conduit means including a first conduit member extending between one of said flow divider valves and one of said four-way valves, a second conduit member extending between the other one of said flow divider valves and the other one of said four-way valves, a third conduit member extending between said one of said flow divider valves and said second conduit member, and a fourth conduit member extending between said other one of said flow divider valves and said first conduit member for assuring an equal quantity of hydraulic fluid flowing from said flow divider valves to said four-way valves, whereby said lifting member is raised and lowered in a position substantially parallel to the surface on which the vehicle is positioned regardless of any uneven distribution of the load on the lifting member.

2. A materials handling vehicle, as set forth in claim **1**, wherein each of said four-way valves is in communication with a different pair of said double-acting hydraulic piston cylinders, said conduit means including a tubular assembly interconnecting said four-way valves and the first ends of said piston cylinders and tubular members interconnecting said four-way valves and the second ends of said piston cylinders, said four-way valves arranged for regulating the path of hydraulic fluid through one of said tubular assembly and tubular members for selectively positioning said piston in said piston cylinder.

3. A materials handling vehicle, as set forth in claim **2**, wherein a second flow divider valve is disposed in said tubular assembly, said tubular assembly comprising a first tubular section extending between said four-way valve and said flow divider valve, and a pair of second tubular sections each extending from said flow divider valve to a different one of said first ends of said piston cylinders for providing an equal quantity of hydraulic fluid to each of said cylinders.

4. A materials handling vehicle, as set forth in claim **3**, wherein a check valve is located in each of said second tubular sections between said flow divider valve and said first ends of said piston cylinders.

5. A materials handling vehicle, as set forth in claim **4**, wherein a bypass line is connected to each of said second tubular members and to said first tubular section for bypassing the back flow of hydraulic fluid from the first ends of said cylinders about said flow divider valve.

6. A materials handling vehicle, as set forth in claim **5**, wherein a flow limiting valve is located in each of said bypass lines for regulating the flow of hydraulic fluid therethrough.

7. A materials handling vehicle, as set forth in claim **1**, wherein said conduit means includes a return flow member communicating between said four-way valves and said reservoir of hydraulic fluid.

8. A materials handling vehicle comprising a support frame having a pair of opposite ends and being open at least at one end and having an upwardly extending open space within said frame, said frame adapted for movement over the material to be lifted within the open space in the frame, a lifting member located in the open space within said frame and adapted to extend generally parallel to the surface on which the vehicle is positioned, said lifting member being arranged to be moved upwardly and downwardly in the open space within said frame, a plurality of separate lifting means positioned at spaced locations on said support frame and secured to said lifting member for raising anl lowering said lifting member, and means for operating said lifting means whereby said lifting member is raised and lowered in a position substantially parallel to the surface on which tse vehicle is positioned regardless of any uneven distribution of the load on the lifting member, a frame member being located at each of the opposite ends of said support frame, each

frame member having an inverted U-shaped configuration and comprising a pair of spaced upright members connected at the upper ends thereof by an integral cross member, an upper linking member and a lower linking member located on each side of said support frame and secured to and extending between the upright members at the opposite ends of the side of said support frame whereby the open space within said support frame extends at least longitudinally between said portal members at the opposite ends of said support frame and transversely between said upright members of said portal frame member, said lifting means comprising a double-acting hydraulic piston cylinder located on each of said upright members, and a piston arm positioned within said cylinder and adapted to move upwardly and downwardly therein, said lifting member comprising an open framework having a shape generally conforming to the shape of the open space within said support frame in the plane of said lifting member and having a width less than the width of said open space whereby said framework is movably displaceable laterally of said support frame, and each of said lifting means including a chain member attached to said lifting member and to one said piston cylinder, a first wheel positioned on said piston arm, a second wheel mounted on said upright member below the first wheel at its lowermost position on said piston arm in said piston cylinder, a third wheel mounted on said cross member, said chain member serially extending about said first, second and third wheels whereby as the piston arm is extended upwardly from the piston cylinder the lifting member is raised within said open space and when said piston arm is lowered the lifting member is lowered.

9. A materials handling vehicle comprising a support frame having a pair of opposite ends and being open at least at one end and having an upwardly extending open space within said frame, said frame adapted for movement over the material to be lifted within the open space in the frame, a lifting member located in the open space within said frame and adapted to extend generally parallel to the surface on which the vehicle is positioned, said lifting member being arranged to be moved upwardly and downwardly in the open space within said frame, a plurality of separate lifting means positioned at spaced locations on said support frame and secured to said lifting member for raising and lowering said lifting member, and means for operating said lifting means whereby said lifting member is raised and lowered in a position substantially parallel to the surface on which the vehicle is positioned regardless of any uneven distribution of the load on the lifting member, a frame member being located at each of the opposite ends of said support frame, each frame member having an inverted U-shaped configuration and comprising a pair of spaced upright members connected at the upper ends thereof by an integral cross member, an upper linking member and a lower linking member located on each side of said support frame and secured to and extending between the upright members at the opposite ends of the side of said support frame whereby the open space within said support frame extends at least longitudinally between said portal members at the opposite ends of said support frame and transversely between said upright members of said portal frame member, said lifting means comprising a double-acting hydraulic piston cylinder located on each of said upright members, and a piston arm positioned within said cylinder and adapted to move upwardly and downwardly therein, said lifting member comprising an open framework having a shape generally conforming to the shape of the open space within said support frame in the plane of said lifting member and having a width less than the width of said open space whereby said framework is movably displaceable laterally of said support frame, a pair of upright guide rails being located at spaced locations on one side of said support frame, a pair of spaced support brackets extending laterally outward from one side of said lifting member, a grooved roll being mounted on said bracket and extending into rolling engagement with one of said guide rails for guiding the lifting member in its upright path of travel, and means being mounted on said support frame for laterally displacing said guide rails whereby said lifting member interconnected to said guide rails by means of said groover rollers is also laterally displaceable relative to the position of said guide rails.

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