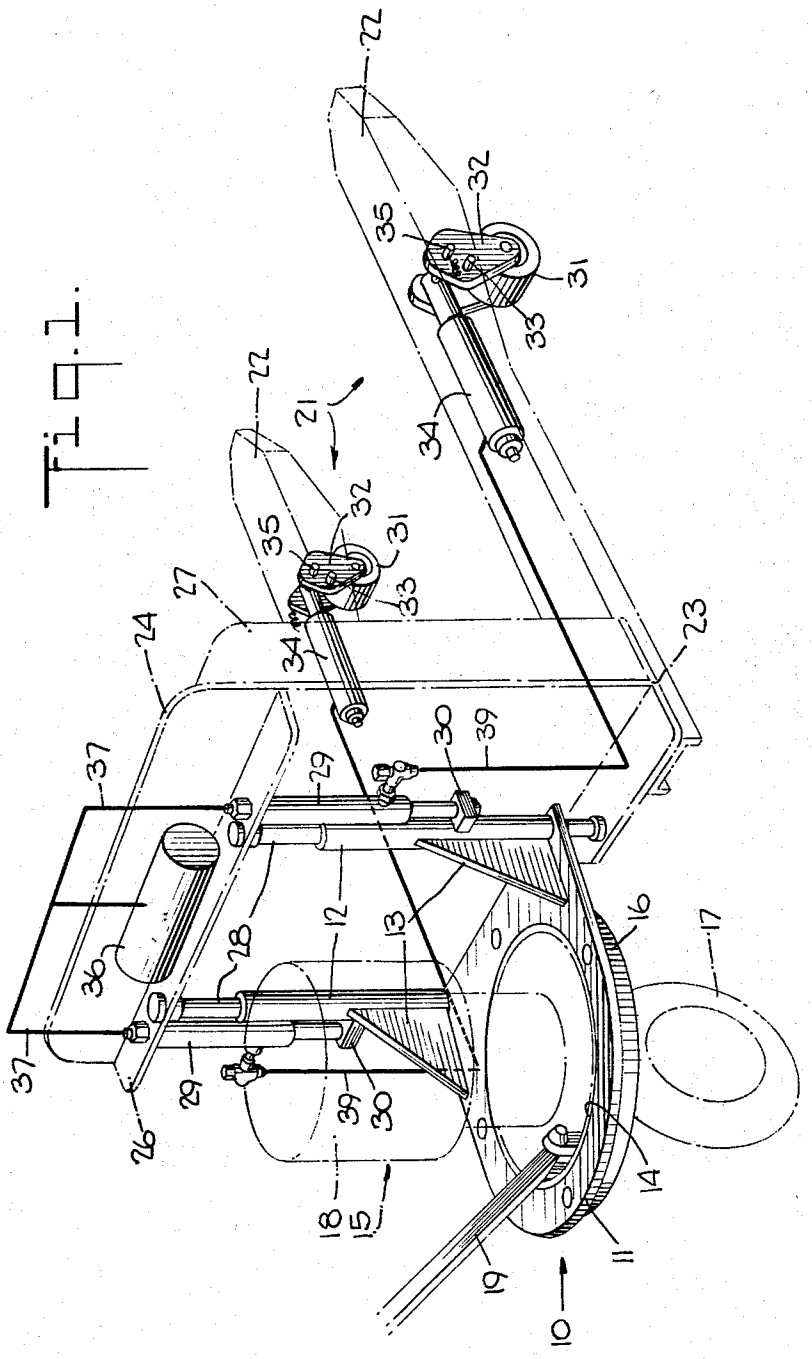
Nov. 22, 1966 B. I. ULINSKI 3,287,024

INDUSTRIAL TRUCK

Filed March 24, 1964 2 Sheets-Sheet 1

Fig. 1.



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INDUSTRIAL TRUCK

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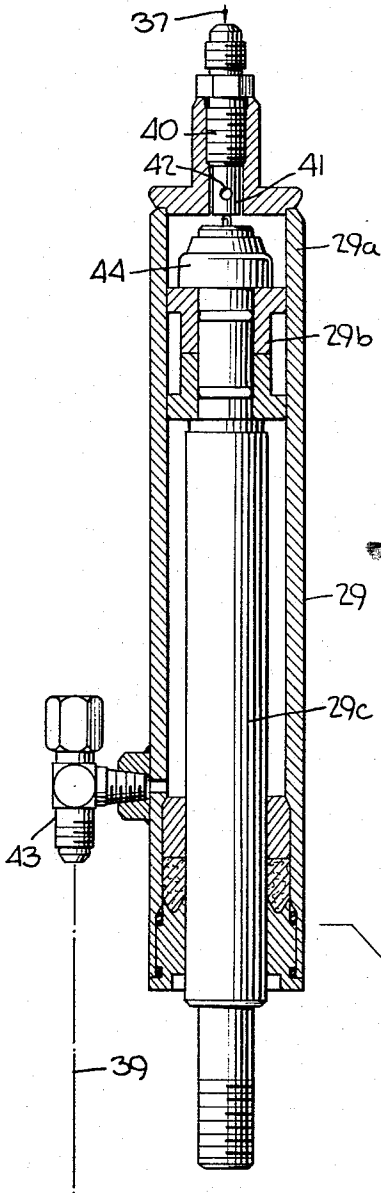


Fig. 2.

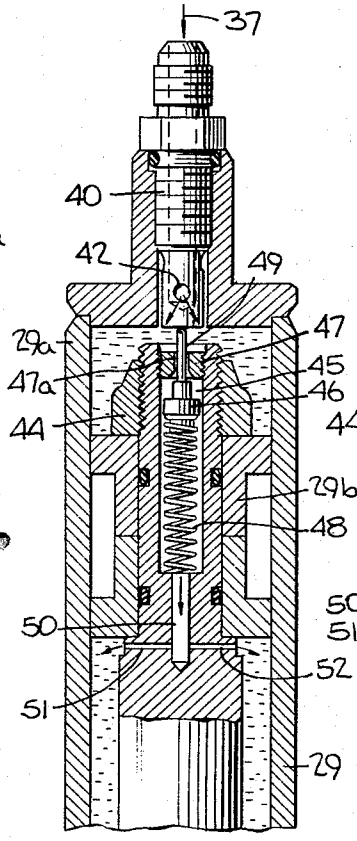


Fig. 3.

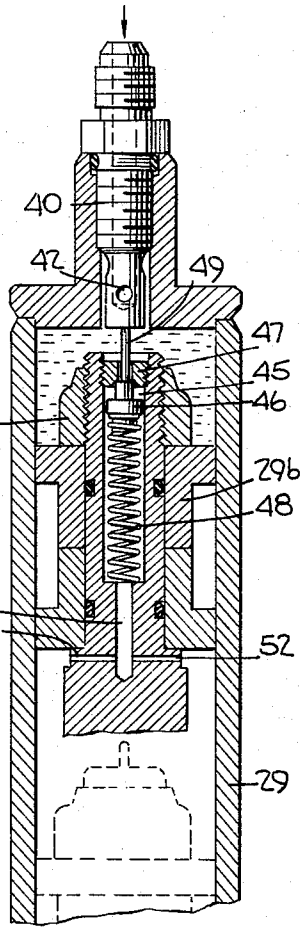


Fig. 4.

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United States Patent Office 3,287,024 Patented Nov. 22, 1966

3,287,024

INDUSTRIAL TRUCK

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Filed Mar. 24, 1964, Ser. No. 354,316
4 Claims. (Cl. 280—43.12)

My invention relates to an industrial truck for handling loaded pallets or skids.

More particularly, my invention relates to an industrial truck of the type shown in my co-pending application Serial No. 160,072, now United States Patent No. 3,188,106, filed December 18, 1961, and entitled, "Industrial Truck."

In the truck shown in that application a hydraulic ram is provided at each end of the load platform for elevating the load platform. The rams are connected in series with a source of hydraulic pressure, and when hydraulic pressure is applied to one side of one ram, to operate that ram, the other ram is simultaneously operated by flow of fluid from the one ram to the other ram through a hydraulic connection between the rams. This series arrangement of the rams insures that the load platform is maintained level during elevation regardless of the distribution of the load on the load platform.

To balance the hydraulic system in the event of leakage of fluid from the hydraulic connection between the rams, a manually operable valve is provided which can be actuated by the operator to connect the source of fluid pressure to the hydraulic connection between the rams to insure that the hydraulic connection is properly filled with fluid to provide proper operation of the two rams in series.

This arrangement permits the effective utilization of two rams for elevating the load platform, thereby obviating the necessity of using expensive mechanical linkage systems, as used in conventional trucks of this type to effect elevation of one end of a load platform while the other end is elevated by a ram. This arrangement also obviates the necessity of manufacturing and stocking linkages of various lengths for various size trucks, as the same size and shape of rams may be used in trucks of various sizes and lengths merely by shortening or lengthening the hydraulic lines which connect the rams to the source of hydraulic pressure.

The purpose of this invention is to provide an improved truck of this type, which obviates the necessity of the operator having to manually operate a valve to connect the source of fluid pressure to the hydraulic connection between the rams whereby to replenish fluid lost by leakage and balance the hydraulic system. To this end, I provide valve means actuated in response to movement of the load platform to the lowered position to connect the source of hydraulic pressure with the hydraulic connection between the rams. This insures that each time the truck is utilized, the hydraulic connection is fully filled with hydraulic fluid and the system balanced so that the load platform is maintained level during lifting.

As a feature of the invention, I provide the valve means in a passage through the piston of the ram to which the fluid pressure from the fluid pressure source is applied, and I provide abutment means within the ram which the valve engages to open the valve and allow passage of fluid from one side of the piston to the other when the piston is in a position corresponding to the lowered position of the load platform. Thus, in this position of the piston fluid from the fluid pressure source can flow from one side of the piston to the other to fill the hydraulic connection between the two rams to balance the system. As the load platform starts to elevate, the valve means in the piston is released and immediately closes whereby the two rams are thereafter connected only in series to insure that the load platform remains level during elevation.

I have thus outlined rather broadly the more important features of my invention in order that the detailed description thereof that follows may be better understood, and in order that my contribution to the art may be better appreciated. There are, of course, additional features of my invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception on which my disclosure is based may readily be utilized as a basis for the designing of other structures for carrying out the several purposes of my invention. It is important, therefore, that the claims be regarded as including such equivalent constructions as do not depart from the spirit and scope of my invention, in order to prevent the appropriation of my invention by those skilled in the art.

Referring to the drawings:

FIG. 1 is a skeletonized view of a truck constructed in accordance with the invention showing the positions of the rams and the hydraulic circuit for the rams,

FIG. 2 is a sectional view of the two rams,

FIG. 3 is a sectional view showing the valve in the piston of one of the rams in the open position to allow flow of fluid to both sides of the piston to fill the connection between the rams, and

FIG. 4 is a sectional view, similar to that of FIG. 3, but showing the piston moved a short distance in elevating the load platform, allowing the valve in the piston to close whereby the two rams are connected only in series.

Referring to the drawings, and in particular to FIG. 1, the invention is shown applied to a pallet truck of the type disclosed in my co-pending application Serial No. 160,072, filed December 18, 1961. It will be appreciated, however, that the invention can be applied to other types and styles of industrial trucks.

It is sufficient to an understanding of the invention to point out that the truck illustrated includes a lifting head **10** formed by a simple, horizontal plate **11** and a pair of elongated, vertically extending tubes **12** which are secured to and extend through the plate **11** adjacent the rear edge. The tubes **12** are suitably braced by plate gussets **13** which are welded or otherwise secured to the plate **11** and the sides of the tubes **12**.

The plate **11** is provided with an opening **14** in which a combined steering and traction unit **15** is mounted for steering rotation by means of a suitable bearing assembly **16**. Unit **15** is of the general type shown in my U.S. Patent No. 2,950,773, dated August 30, 1960, and includes a traction wheel **17** and an electric drive motor **18** which drives the wheel **17** through suitable gearing. The combined steering and traction unit **15** is adapted to be rotated by means of a pivotally mounted handle **19**, to effect steering movement of the wheel **17**.

The load platform, generally designated by the reference numeral **21**, includes transversely spaced, horizontal, channel shaped legs **22** which are adapted to be extended through a pallet. The legs **22** are welded or otherwise rigidly secured at their front ends to a transversely extending horizontal plate **23**. A transversely and vertically extended plate **24** in turn is secured at its lower edge to the plate **23**, and a second transversely extending, horizontal plate **26** is secured to the back of the transversely extending vertical plate **24**, adjacent its upper end. A suitable battery housing **27** is mounted on the rear of the vertical plate **24** and supported on the transverse plate **23**. Batteries, not shown, for driving the electric motor **18**, are enclosed within the housing **27**.

A pair of vertically extending shafts **28** are secured at top and bottom to the transversely extending horizontal plates **23** and **26**, and extend slideably through the tubes

12 to thereby support and guide the rear end of the load platform 21 for vertical movement relatively to the lifting head 10. The front end of the load platform 21 is adapted to be raised relatively to the lifting head 10 by means of a pair of hydraulic rams 29 which are attached at their lower ends to seats or brackets 30 which are welded or otherwise secured to the sides of the tubes 12, and which are attached at their upper ends to the transversely extending horizontal plate 26. Admission of fluid to the rams 29 to extend them, as shown in FIG. 1, serves to raise the front end of the load platform 21 relatively to the lifting head 10, while the front end is guided through sliding movement of shafts 28 in the tubes 12.

The rear end of the load platform 21 is supported by wheels or rollers 31 which are mounted on links 32 pivotally secured to the legs 22 adjacent the rear ends of the legs by means of pivot pins 33. Pivotal movement of the links 32, therefore serves to raise or lower the wheels 31 relatively to the legs 22 of the load platform 21 to raise or lower the rear end of the platform 21.

The rear wheels 31 are adapted to be pivoted downwardly to raise the rear end of the platform 21 by extension of horizontally disposed hydraulic rams 34 which are supported at one end on the legs 22 and pivotally secured at the other ends to the links 32 by pivots 35.

A combined electric pump and reservoir unit 36 is mounted on the plate 26 and provides a source of fluid under pressure for operating the rams 29 and 34.

Hydraulic conduits or lines 37 connect the upper ends of the rams 29 with the source of fluid pressure 36 and lines 39 connect the lower sides of the rams 29 with one end of the rams 34. Thus, when the pump and reservoir unit 36 is operated to admit pressure to the upper sides of the pistons of the rams 29 through the lines 37 to extend the rams 29 and elevate the front end of the load platform 21, fluid on the lower sides of the pistons of the rams 29 is forced through lines 39 to the rams 34 to thereby operate the rams 34 simultaneously to pivot the rollers downwardly to elevate the rear end of the platform. The dimensions of the rams 29 and 34 and the links 32 are so selected that the front and rear ends of the load platform are raised the same amount through the simultaneous operation of the rams 29 and 34. Thus assuming that there has been no leakage of fluid from the lines 39, the load platform 21 is maintained level during elevation by the rams 29 and 34.

There is, however, inherently some leakage of fluid from the lines 39 past the pistons of the rams 29 and 34. While this leakage is quite small, on continued operation of the system, sufficient fluid may be lost from the lines 39 that the load platform will not be maintained level during elevation. This invention provides a system whereby the hydraulic connection between the rams 29 and 34 formed by the lines 39 are connected with the source of fluid pressure 36 whenever the load platform 21 is in lowered position, thereby insuring that the lines 39 are properly filled with fluid before each elevation of the load platform 21. Such a system is illustrated in FIGS. 2, 3 and 4 in connection with the rams 29 and 34 on one side of the truck. While not shown, it will be appreciated that an identical system is used for the rams 29 and 34 on the other side of the truck.

Referring now to FIG. 2, the rams 29 and 34 are shown in their retracted positions, which corresponds to the lowered position of the load platform 21. The line 37 from the source of fluid pressure 36 is connected to a fitting 40 which is threaded into the upper end of the cylinder 29*a* of the ram 29. The fitting 40 has an inner end portion 41 formed with a lateral passage 42 through which fluid from the line 37 may enter the cylinder 29*a* on the upper side of the piston 29*b* to extend the piston rod 29*c*. When the piston rod 29*c* is extended, fluid on the lower side of the piston 29*b* flows through a fitting 43 provided in the lower side of the cylinder 29*a* and the line 39 to operate the ram 34.

Referring now to FIG. 3, the upper end of the piston rod 29*c* of the ram 29 extends through the piston 29*b* and a nut 44 is threaded on the upper end of the rod 29*c* to hold the piston 29*b* assembled to the end of the rod. The end of the rod 29*c* is provided with a bore 45 which slideably receives a check valve 46, and an apertured valve seat 47 is threaded in the upper end of bore 45. A spring 48 provided in the bore 45 normally urges the check valve 46 against the seat 47 to close the aperture 47*a* of the seat 47.

The check valve 46 has a stem portion 49 which extends through the aperture 47*a* of the valve seat 47 and beyond the end face of the rod 29*c*. When the piston 29*b* is in the fully retracted position as shown in FIGS. 2 and 3, which corresponds to the lowered position of the load platform 21, the outer end of the stem portion 49 contacts the inner end of the portion 41 of the fitting 40 holding the check valve 46 open against the force of the spring 48, as shown in FIG. 3. When fluid under pressure is applied to the upper side of the ram 29 through the line 37 and the fitting 40 to operate the ram 29, some of this fluid may pass through the clearance between the stem 49 and the aperture 47*a* of the valve seat 47, through the bore 45, and through an axial passage 50 and lateral passages 51 and 52 formed in the rod 29*c* to the lower side of the piston 29*b*, whereby fluid is supplied to the lower end of the cylinder 29*a* and to the connecting line 39 between the lower side of the ram 29 and the ram 34, insuring that this system is properly filled with fluid before the load platform is elevated.

As the piston rod 29*c* starts to extend under force of the fluid pressure applied to the upper side of the piston 29*b*, the force on the stem 49 is relieved and the check valve 46 closes under the force of the spring 48. Passage of fluid past the piston head 29*b* is thereby prevented, so that the ram 29 and the ram 34 thereafter are connected only in series, insuring simultaneous operation of the two rams to maintain the load platform level during elevation.

When the load platform 21 is thereafter lowered by the release of fluid pressure on the ram 29, the check valve 46 is again opened by engagement of the stem portion 49 with the inner end 41 of the fitting, so that when fluid under pressure is again applied to the ram 29 to elevate the load platform, fluid may again flow to the lower side of the piston 29*b* to fill the hydraulic connection between the rams 29 and 34 to balance the system. In this manner, it is insured that the hydraulic connection between the rams is always filled with fluid prior to elevating of the load platform 21, without any action on the part of the operator of the truck.

While a preferred form of the invention has been shown and described, it will be appreciated that changes and modifications may be made therein without departing from the spirit and scope of the invention.

I now claim:

1. In an industrial truck, a load platform, means mounting said load platform for vertical movement between a lowered position and an elevated position, two pair of rams, means connecting said rams with said load platform providing simultaneous operation of said rams to elevate said load platform, a source of fluid pressure, means for connecting one side of one pair of said rams to said source of fluid pressure to operate said rams, a hydraulic connection connecting the other side of said one pair of rams with one side of said other pair of rams whereby the rams are connected hydraulically in series and operation of said one pair of rams causes simultaneous operation of said other ram, valve means operable for selectively and simultaneously connecting said one pair of rams and said other pair of rams with said source of fluid pressure and thereby replenish fluid lost from said hydraulic connection, said valve means

being closed during elevation of said load platform to disconnect said source of liquid pressure from said hydraulic connection.

2. In an industrial truck, a load platform, means mounting said load platform for vertical movement between a lowered position and an elevated position, two pair of rams, means connecting said rams with said load platform providing simultaneous operation of said rams to elevate said load platform, each ram including a cylinder and a piston movable therein, a source of fluid pressure, means for connecting one end of the cylinders of one pair of said rams with said source of fluid pressure whereby to move the piston thereof relatively to said cylinder, a hydraulic connection between the other end of said cylinders of said one pair of rams and the cylinders of said other pair of rams whereby each pair of rams is connected hydraulically in series and movement of said pistons of said one pair of rams forces fluid through said hydraulic connection to said other pair of rams to simultaneously move the pistons of said other pair of rams, a passage through the upper ends of the piston rods of said one pair of rams for allowing the flow of fluid from one side of said pistons to the other side, valve means for said passage actuated to open said passage when said one pair of piston rods is in a position corresponding to the lowered position of said load platform to selectively and simultaneously connect said one pair of rams and said other pair of rams with said source of fluid pressure whereby to replenish fluid lost from said connection, said valve means being closed during elevation of said load platform to close said passage to disconnect said source of fluid pressure from said hydraulic connection.

3. In an industrial truck, a load platform, means mounting said load platform for vertical movement between a lowered position and an elevated position, two pair of rams, means connecting said rams with said load platform providing simultaneous operation of said rams to elevate said load platform, each ram including a cylinder and a piston movable therein, a source of fluid pressure, means for connecting one end of the cylinders of one pair of said rams with said source of fluid pressure whereby to move the piston thereof relatively to said cylinders, a hydraulic connection between the other end of said cylinders of said one pair of rams and the cylinders of said other pair of rams whereby the rams are connected hydraulically in series and movement of said piston of said one pair of rams forces fluid through said hydraulic connection to said other pair of rams to simultaneously move the pistons of said other pair of rams, a passage through the piston rods of said one pair of rams for allowing passage of fluid from one side of said pistons to the other, valve means in said passages, spring means urging said valve means to a position closing said passages to prevent flow of fluid through said passages,

means connected with said valve means engageable with a part of said cylinders of said one pair of rams to open said valve means when said pistons of said one pair of rams is in a position corresponding to the lowered position of said load platform whereby to simultaneously connect said one pair of rams and said other pair of rams with said source of fluid pressure and to replenish fluid lost from said connection, said valve means being released and closed by said spring means on initial elevation of said load platform to disconnect said source of fluid pressure from said hydraulic connection.

4. In an industrial truck, two pair of rams, each ram including a cylinder and a piston movable therein, a source of fluid pressure, means for connecting one end of the cylinders of one pair of said rams with said source of fluid pressure to move the pistons thereof relatively to said cylinders, a hydraulic connection between the other end of said cylinders of said one pair of rams and the cylinders of said other pair of rams whereby the rams are connected hydraulically in series and movement of said pistons of said one pair of rams forces fluid through said hydraulic connection to said other pair of rams to simultaneously move the pistons of said other pair of rams, a passage through each piston of said one pair of rams allowing flow of fluid from one side of said pistons to the other side, valve means in said passages, spring means urging said valve means to a position closing said passages to prevent flow of fluid through said passages, means connected with said valve means engageable with a part of said cylinders of said one pair of rams to open said valve means when said pistons of said one pair of rams is in a predetermined position relatively to said cylinders of said one pair of rams whereby there is a direct connection of said source of fluid pressure with said one pair of rams and said other pair of rams to replenish fluid lost from said connection, said valve means being closed on initial movement of said pistons away from said predetermined position to disconnect said source of fluid pressure from said hydraulic connection.

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