July 12, 1966 D. A. HARRIS 3,260,392

LOAD ENGAGING MECHANISM OF INDUSTRIAL LIFT TRUCK

Filed Dec. 16, 1963 2 Sheets-Sheet 1

Fig. 1

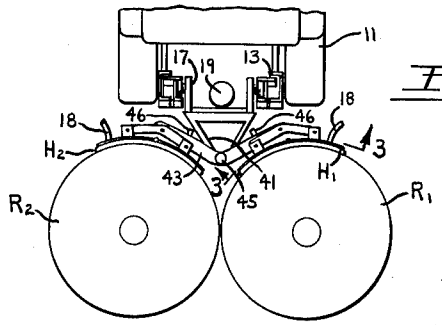


Fig. 2

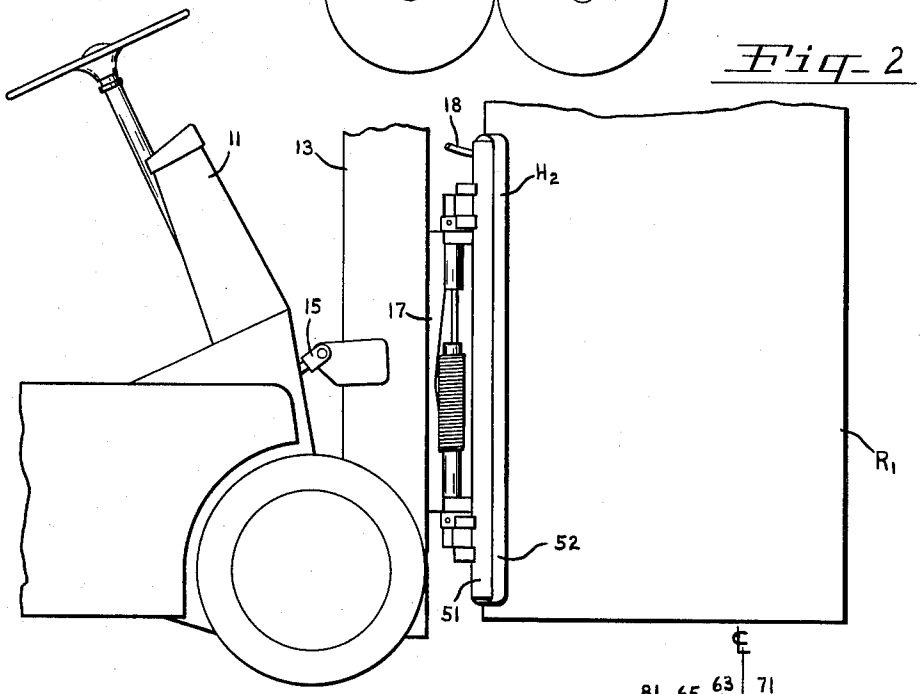
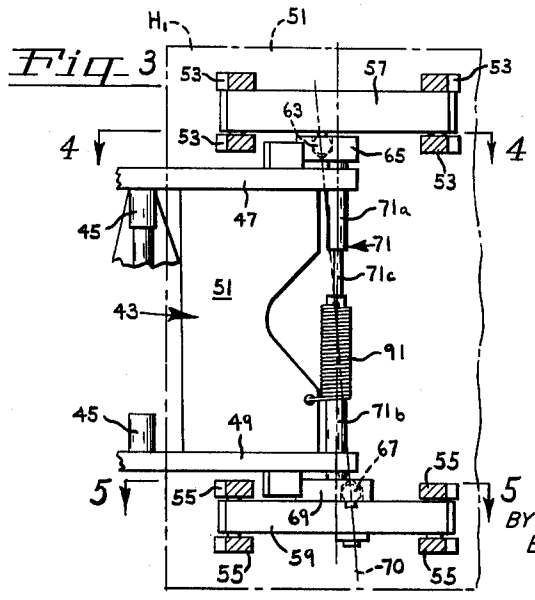


Fig. 3



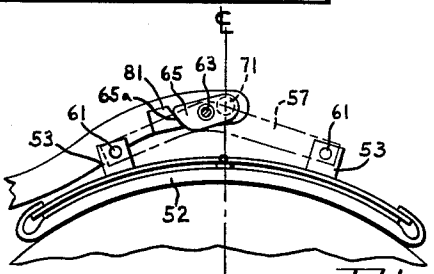


Fig. 4

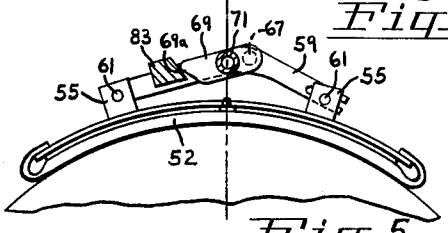


Fig. 5

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July 12, 1966 D. A. HARRIS 3,260,392

LOAD ENGAGING MECHANISM OF INDUSTRIAL LIFT TRUCK

Filed Dec. 16, 1963 2 Sheets-Sheet 2

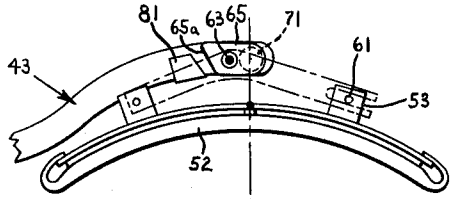


Fig. 6

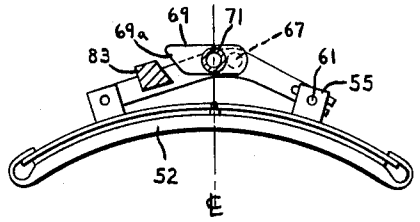


Fig. 7

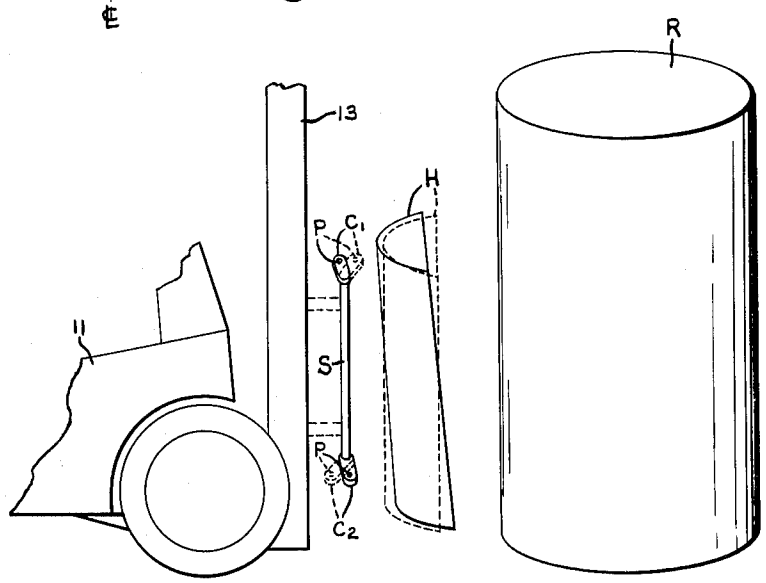


Fig. 8

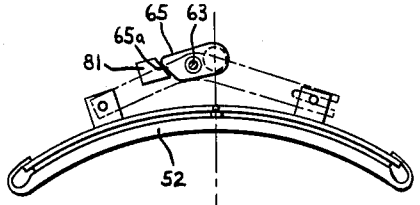


Fig. 9

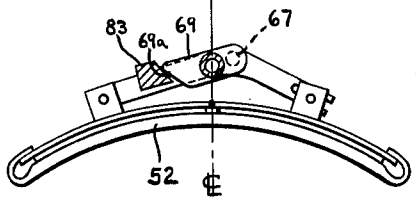


Fig. 10

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United States Patent Office 3,260,392 Patented July 12, 1966

3,260,392

LOAD ENGAGING MECHANISM OF INDUSTRIAL LIFT TRUCK

Donald A. Harris, Vancouver, Wash., assignor to Hyster Company, Portland, Oreg., a corporation of Nevada

Filed Dec. 16, 1963, Ser. No. 330,854
13 Claims. (Cl. 214—652)

This invention relates to improvements in the load engaging mechanism of an industrial lift truck. More particularly, the invention relates to improvements in a suction type load engaging mechanism of an industrial lift truck.

In a lift truck having a suction type load engaging mechanism, it is necessary for the sealing member of the suction head of the mechanism to have full contact with the load at the time of picking up a load, to enable a subatmospheric pressure to be created in the head. Thus, it is necessary that the position of the head conform to that of the load, and yet for the head to be stabilized after the load is picked up and during travel of the truck from place to place.

In the application of John E. Olson entitled "Vacuum Type Load Handling Apparatus," Serial No. 246,629, filed December 21, 1962, now Patent No. 3,207,348, there is disclosed an industrial lift truck having a suction head mounted for self-adjusting movement to enable it to adjust its position to that of a load. The head is so mounted that after the load is picked up, the head is stabilized in a manner to resist wobbling movement thereof.

It is a main object of the present invention to provide a truck having a load engaging mechanism which is self-adjusting to enable it to adjust its position to that of a load, and which self-adjustment occurs under light contact pressure with the load, and which mechanism is stabilized in an even better manner than is the device of the above mentioned application.

A further object of the invention is to provide such a mechanism particularly adapted to pick up two rolls of paper, or other loads, and which is operable when the rolls are picked up to cause them to swing inwardly into contact with one another for better load stabilization.

Another object of the invention is to provide a self-adjusting load engaging mechanism of the type above described in which the dead weight of the suction head is counterbalanced so that there is minimum contact pressure with the load, so that the wear on the sealing member of the head is held to a minimum.

A more specific object of the invention is to provide a self-adjusting load engaging mechanism having an upright shaft so connected to the head, that the head is permitted to adjust its position to that of the load rapidly and easily.

Various other objects of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a plan view of a front portion of a lift truck having a load engaging mechanism of the present invention;

FIG. 2 is a side view in elevation of the structure in FIG. 1, shown on an enlarged scale;

FIG. 3 is a vertical sectional view taken along line 3—3 of FIG. 1, FIG. 3 being on the same scale as FIG. 2;

FIG. 4 is a horizontal sectional view taken along line 4—4 of FIG. 3;

FIG. 5 is a horizontal sectional view taken along line 5—5 of FIG. 3;

FIG. 6 is a view similar to FIG. 4, but showing the vacuum head prior to engagement with a load;

FIG. 7 is a view similar to FIG. 5 showing the vacuum head prior to engagement with a load;

FIG. 8 is a diagrammatic view showing the manner in which a suction head is self-adjusting; and

FIGS. 9 and 10 show a modified form of the invention.

Referring particularly to FIGS. 1, 2 and 8, the truck **11** has a mast **13** at the front end thereof which is tiltable back and forth under the influence of a tilting mechanism **15** (FIG. 2). Guided for vertical movement along the mast **13** is a load carriage **17** which is raised and lowered by a suitable power means such as, for instance, a hydraulic ram **19** (FIG. 1). Supported by the carriage **17** is a suction pickup mechanism of the present invention which is shown as picking up paper rolls R_1 and R_2 in FIG. 1, whereas only a single roll R is shown in the diagrammatic view of FIG. 8. The invention, however, is not intended to be limited to picking up paper rolls.

The suction mechanism as shown in FIGS. 1 and 2, includes a pair of suction heads H_1 and H_2 which are brought into engagement with the load, in this case the rolls R_1 and R_2, whereupon a subatmospheric pressure is created within the heads through hoses **18** to enable them to pick up the load. The hoses **18** lead to a source of vacuum on the truck much as in the manner shown in application Serial No. 246,629, previously referred to.

It is apparent from FIGS. 1 and 2 that the positions of the heads must conform to that of the rolls to insure a proper fit of each head against its roll, or else a vacuum can not be drawn. The mechanism of the present invention so mounts the heads that they are self-adjusting and can adjust their positions to that of the load, under light contact pressure, when brought into engagement with the load.

Before going into a detailed description of the mechanism, reference will be made to FIG. 8 which shows certain critical features of the mechanism of my invention. The mechanism includes an upright shaft S which is mounted for turning movement about its own axis and has a pair of cranks C_1 and C_2 secured to its opposite ends and projecting in opposite directions from the shaft. It is evident that these directions are in transverse relation to the truck and are generally parallel to the plane of the mast **13**. The outer or free end of each crank is pivotally connected at P to the head H in FIG. 8, with the upper crank C_1 being connected to the upper portion of the head H and the lower crank C_2 being connected to the lower portion of the head.

A spring, to be described, urges the shaft S to turn in such a direction that when the head H is unloaded (not carrying a load) it will assume a predetermined position relative to the mast **13**, which position is shown in solid lines in FIG. 8. If the mast is vertically disposed, as shown in FIG. 8, the undoaded head H will be slightly rearwardly inclined, with the lower portion of the head disposed forwardly of the upper portion thereof. The inclination of the head is exaggerated in FIG. 8 for clarity in illustration.

As the head H approaches the load, with the mast and head so disposed, the lower portion of the head will first contact the roll R. The resulting contact pressure will force the lower portion of the head rearwardly to pivot the crank C_2 rearwardly. Such pivoting movement will cause the crank C_1 to pivot forwardly to thrust the upper portion of the head H forwardly to cause the head to assume the broken line position shown, that is, a position in vertical conformity with the position of the load R. It is further pointed out that both the pivots P and rotation of the vertical shaft permit the head to rock from side to side to enable it to properly conform to the position of the load R in a lateral direction.

As the suction head is elevated to elevate the roll R, the weight of the roll R will pivot the crank C_1 forwardly and pivot the crank C_2 rearwardly. This movement of the cranks will cause them to engage a pair of stops, not

shown in FIG. 8, to stabilize the load against movement about the axis of shaft S. Other means are used to stabilize the head against pivoting movement about the pivots P.

Now for a more detailed description, reference will be made to FIGS. 1 to 5, where the carriage **17** is shown as having a forwardly projecting bracket structure **41** (FIG. 1). A frame **43** is pivotally mounted at its center at **45** to the bracket structure to enable pivoting movement of the frame about a vertical axis. This will enable the load engaging mechanism to pivot so that the heads H_1 and H_2 can properly engage two rolls despite the fact that one roll is positioned further forwardly from the truck than the other. Stop lugs **46** on the frame limit pivoting movement of the frame.

The frame **43** is shown as including spaced upper and lower arm members **47** and **49** (FIG. 3) connected by a web **51**. The frame is indented in a vertical direction (FIG. 1) at the central portion thereof so that the rolls R_1 and R_2 will be disposed as close to the mast **13** as possible.

The suction heads H_1 and H_2 are of identical construction so that the detail description of the construction of one will suffice. Head H_1 includes a suction cup member **51**, which is curved about a vertical axis. The cup member may be of the articulated type shown in the copending application of John E. Olson, Serial No. 268,257, filed March 27, 1963, entitled "Vacuum Head Construction and Method" or it may be of the plain or unarticulated type. In any event, the cup member has an elastomer sealing member **52** around the peripheral margin of the cup member for engaging a load and forming a seal therewith.

At the upper portion of the rear side thereof, the cup member has two spaced pairs of ears **53**, and at its lower portion has two spaced pairs of ears **55**. A pair of bent arms **57** and **59** are connected by pivots **61** to the ears, and if the cup member is articulated, one end of each arm is slotted to provide for articulation of the cup member.

The upper arm **57** is pivotally connected by a universal joint **63** (FIG. 3) to an upper crank **65** intermediate the ends of the latter, while the arm **59** is pivotally connected by universal joint **67** to an end portion of a lower crank **69**. Cranks **65** and **69** are rigidly secured to the ends of an upright shaft **71** (FIG. 3) which is rotatably mounted on one set of end portions of the arm members **47** and **49** of the frame **43**. It is apparent from FIGS. 3 to 5 that the upper end of the shaft **71** is connected to an end of the crank **65**, while the lower end of the shaft is connected to an intermediate portion of the crank **69**. As shown in FIG. 3, the cranks **65** and **69** project in opposite directions from the shaft toward the universal joints **63** and **67**, respectively. Thus, the joints establish a tilting axis **70** for the cup member, which axis is oblique to the axis of the shaft **71**, and is askew relative to the periphery of the cup member **51**.

Upper crank **65** projects to the left, as the parts are shown in FIG. 4, beyond the joint **63** to provide a stop engaging portion **65***a* for engaging a stop **81**. The stop is fixed to the upper arm member **47**. Lower crank **69** also projects to the left to provide a stop engaging portion **69***a* for engaging a stop **83** which is fixed to the lower arm member **49** (FIG. 3).

A center line, labeled ℄, is provided in FIGS. 4 and 5 and extends through the axis of the shaft **71** in each figure to facilitate ready understanding of the movement of the cranks **65** and **69**. A center line is also provided in FIGS. 6 and 7, and in FIGS. 9 and 10 for the same reason.

It is apparent that the relationship of the cranks **65** and **69** to the shaft **71** and the stops **81** and **83** is such that, as the parts are shown in FIGS. 4–7, a rearward movement of the upper portion of the cup member **51** will cause the upper crank **65** to move away from the stop **81**. This will turn shaft **71** in a clockwise direction to swing the lower crank **69** away from its stop, to move the lower portion of the cup member forwardly. In fact, any movement either forwardly or rearwardly which is imparted to either the upper or lower portion of the cup member will cause an opposite movement of the other portion. As will be shown hereinafter, when the cup member is unloaded, the cranks are spaced from the stops **81** and **83**, as shown in FIGS. 6 and 7, so that the cranks are free to turn in either direction so that it does not matter whether the upper portion or the lower portion of the cup member first engages the load.

The adjusting movement of the vacuum cup **51** permitted by the shaft **71** and its cranks is generally in a vertical, longitudinal plane of the truck. It is also pointed out that the vacuum cup can pivot on the universal joints **63** and **67** about the axis **70** to permit the cup to properly face the roll or other load in a lateral direction.

Since the center of gravity of the cup member **51** is forwardly of the axis of the shaft **71** (FIG. 4), even when the cup member is unloaded, the dead weight of the cup member will urge the cup member to tilt forwardly to bring the upper crank **65** against its stop **81** and cause the lower crank **69** to engage its stop **83**. In fact, since the cup member **51** has substantial weight, it would require a not inconsiderable force to move the upper part of the cup member rearwardly.

To make the cup member self-adjusting under a light contact pressure with the load, the cup member is counterbalanced by a coil spring **91** (FIG. 3) which is secured at its opposite ends of the shaft and the web **51**. The spring is sufficiently stressed so as to counterbalance the cup member so that the cup member, when unloaded, is in a balanced condition and requires very little force to move it one way or the other. In fact, the stress in the spring is preferably such that when the cup member is unloaded, the spring will cause the cranks **65** and **69** to assume positions separated from their stops **81** and **83**, respectively, as shown in FIGS. 6 and 7. In these positions of the cranks, the vacuum cup member is self-adjusting regardless of whether its upper or lower portion first contacts the load.

If desired, the stress in the spring **91** can be adjusted so that the cranks remain in light contact with their stops even when the cup is unloaded, as shown in FIGS. 9 and 10. With this arrangement, it is important that the cup member be arranged so that its upper portion will first engage the load, because if the lower portion first engaged the load, the force applied against the lower portion would only press the lower crank against its stop with an increased pressure, without effecting any adjustment of the position of the cup member.

Preferably the shaft **71** is divided into two tubular sections **71***a* and **71***b* which are connected by a torsion bar **71***c*. Thus, if the manufacturing and assembly tolerances are such that when one crank is against its stop, the other crank is slightly spaced from its stop, rather than being in contact with such stop, the shaft can twist under load to enable the latter crank to also contact its stop. It is pointed out that the torsion bar could be eliminated by providing a shaft and frame sufficiently sturdy to stand up under the stresses imposed thereon by the load, even though only one crank is against its stop, but the form of the invention shown in FIGS. 6 and 7 is preferred.

Now, turning to FIGS. 1 and 3, it is apparent that the axis **70** through the universal joints **63** and **67** of head H_1 is inclined upwardly to the left, as the parts are shown in FIG. 3. The construction of the head H_2 is such that the axis through its universal joints will extend upwardly to the right so that the two axes extend upwardly in a converging relationship.

Since the center of gravity of the two suction cups of heads H_1 and H_2 and the center of gravity of the loads carried by these cups is disposed forwardly of the askew axes of the heads H_1 and H_2, it is apparent that both cups

will tend to pivot inwardly toward one another so that the rolls R_1 and R_2 will be brought into engagement with one another to stabilize the load against pivoting movement about such askew axes. It is pointed out that the stops **81** and **83** in no way interfere with pivoting movement of the suction cup members about such askew axes and in fact the only limitation on such pivoting movement is the contact of such suction cup members with the arm members **47** and **49** of the frame **43**.

It is further pointed out that even with a single suction head, a stabilized condition of the load in a lateral direction will be effected by the oblique nature of its askew axis, because the load will cause the cup member to pivot into engagement with frame **43** (which thus functions as a stop) so that the cup member is stabilized against free wobbling movement in a lateral direction. This pivoting movement of the cup member and load serves to locate the center of gravity of the load closer to the front wheels of the truck. In such location, the load adds to the stability of the truck during travel of the truck from place to place.

Having described the invention in what is considered to be the preferred embodiment thereof, it is desired that it be understood that the invention is not to be limited other than by the provisions of the following claims.

I claim:

1. In a lift truck having a mast and a carriage structure movable along said mast,

a suction cup member for engaging a load disposed forwardly of said carriage structure,

mounting means mounting said suction cup member on said carriage structure for self-adjusting movement to enable said member to adjust its position to that of the load for face-to-face contact therewith,

said mounting means including an upright shaft mounted for turning movement about its axis,

two cranks secured one to each of the opposite ends of said shaft,

said cranks extending generally parallel to the plane of said mast and transversely of said truck and projecting in opposite directions from said shaft,

each crank being pivotally connected to said head, with such connections being on the opposite sides of and spaced from said shaft.

2. In a lift truck having a mast and a carriage structure movable along said mast,

a suction cup member for engaging a load disposed forwardly of said carriage structure,

mounting means mounting said suction cup member on said carriage structure for self-adjusting movement to enable said member to adjust its position to that of the load for face-to-face contact therewith,

said mounting means including an upright shaft mounted for turning movement about its axis,

two cranks secured one to each of the opposite ends of said shaft,

said cranks extending generally parallel to the plane of said mast and transversely of said truck and projecting in opposite directions from said shaft,

universal joints means pivotally connecting each crank to said suction cup member,

and stop means to limit turning movement of said shaft.

3. In a lift truck having a mast and a carriage structure movable along said mast,

a suction cup member for engaging a load disposed forwardly of said carriage structure,

mounting means mounting said suction cup member on said carriage structure for self-adjusting movement to enable said member to adjust its position to that of the load for face-to-face contact therewith,

said mounting means including an upright shaft mounted for turning movement about its axis,

two cranks secured one to each of the opposite ends of said shaft,

said cranks extending generally parallel to the plane of said mast and transversely of said truck and projecting in opposite directions from said shaft,

universal joints means pivotally connecting each crank to said suction cup member,

stop means to limit turning movement of said shaft,

and means for engaging said cup member to limit pivoting movement thereof about an axis extending through said joints.

4. In a load engaging mechanism having

a pair of upright suction cup members for engaging a pair of separate loads,

first mounting means mounting one cup member for pivoting movement about a first upright axis,

second mounting means mounting said other cup member for pivoting movement about a second upright axis,

said upright axes being oblique to the vertical and converging in an upward direction so that said cup members are urged by the force of gravity to swing in directions to bring into engagement the loads carried thereby whereby to stabilize said loads,

further mounting means for each cup member mounting each cup member for tilting movement about a transverse axis whereby said cup members can conform their positions to that of the loads to be carried thereby,

and means for limiting such tilting movement about such transverse axes,

each further mounting means including an upright rotary shaft carrying a crank on each end thereof,

the cranks extending generally parallel to a plane which is normal to the direction in which the associated cup member faces,

said cranks being connected to said cup member at places disposed on opposite sides of said shaft.

5. In a lift truck having a mast and a carriage structure movable along said mast,

a suction cup member for engaging a load disposed forwardly of said carriage structure,

mounting means mounting said suction cup member on said carriage structure for self-adjusting movement to enable said member to adjust its position to that of the load for face-to-face contact therewith,

said mounting means including an upright shaft mounted for turning movement about its axis,

two cranks secured one to each of the opposite ends of said shaft,

said cranks extending generally parallel to the plane of said mast and transversely of said truck and projecting in opposite directions from said shaft,

each crank being pivotally connected to said head, with such connections being on the opposite sides of and spaced from said shaft,

said cup member being disposed forwardly of said shaft so that the force of gravity urges said cup member to tilt in a forward direction,

and counterbalancing spring means urging said shaft in a direction opposite to the direction it is urged by the weight of said cup member so that said cup member will adjust its position under light contact pressure with said load.

6. In a lift truck having a mast and a carriage structure movable along said mast,

a suction cup member for engaging a load disposed forwardly of said carriage structure,

mounting means mounting said suction cup member on said carriage structure in generally a vertical position and for self-adjusting movement to enable said member to adjust its position to that of the load for face-to-face contact therewith,

said mounting means including an upright shaft mounted for turning movements about its axis,

two cranks secured one to each of the opposite ends of said shaft in spaced relation with respect to one another,

said cranks extending generally parallel to the plane of said mast and transversely of said truck and projecting in opposite directions from said shaft,

means pivotally connecting each crank to said suction cup member,

stop means for each crank, to limit turning movement of said shaft,

means for effecting engagement between said cranks and stop means in the loaded condition of said cup member,

said cranks and thus said stop means being spaced from one another by a distance at least greater than one-half the height of said cup member so that such substantial spacing insures that the cup member will be stabilized against a tendency to float in the loaded condition of said cup member.

7. In a lift truck having a mast and a carriage structure movable along said mast,

a suction cup member for engaging a load disposed forwardly of said carriage structure,

mounting means mounting said suction cup member on said carriage structure for self-adjusting movement to enable said member to adjust its position to that of the load for face-to-face contact therewith,

said mounting means including an upright shaft mounted for turning movement abouts its axis,

two cranks secured one to each of the opposite ends of said shaft,

said cranks extending generally parallel to the plane of said mast and transversely of said truck and projecting in opposite directions from said shaft,

universal joints means pivotally connecting each crank to said suction cup member,

stop means for each crank engageable therewith to limit turning movement of said shaft,

said shaft having a reduced portion intermediate its ends so that said shaft may twist under a load to assure engagement of both cranks with their stop means.

8. In a lift truck having a mast and a carriage structure movable along said mast,

a suction cup member for engaging a load disposed forwardly of said carriage structure,

mounting means mounting said suction cup member on said carriage structure for self-adjusting movement to enable said member to adjust its position to that of the load for face-to-face contact therewith,

said mounting means including an upright shaft mounted for turning movement about its axis,

two cranks,

shaft means mounting said cranks for pivoting movement on said carriage structure in spaced parallel relation with respect to one another,

means pivotally connecting each crank to said suction cup member,

stop means for each crank,

means to cause said crank to move toward said stop means when said cup member is loaded,

said shaft means being flexible under torsional stresses an extent such as to enable both cranks to be in concurrent engagement with said stop means even though in the absence of such flexing only one stop would engage its stop means leaving the other stop means spaced therefrom an appreciable though small extent.

9. A load engaging mechanism for a lift truck comprising,

a suction cup member for engaging a load,

mounting means for mounting said cup member on a load carriage for self-adjusting movement to enable said member to adjust its position to that of the load for face-to-face contact therewith,

said mounting means including an upright shaft mounted for turning movement about its axis,

two cranks secured one to each of the opposite ends of said shaft,

said cranks extending generally parallel to a plane which is normal to the direction in which said cup member faces,

universal joint means pivotally connecting each crank to said suction cup member,

stop means to limit turning movement of said shaft,

and means for engaging said cup member to limit pivoting movement thereof about an axis extending through said joints.

10. In a lift truck having a mast and a carriage structure movable along said mast,

a suction cup member for engaging a load disposed forwardly of said carriage structure,

mounting means mounting said suction cup member on said carriage structure for self-adjusting movement to enable said member to adjust its position to that of the load for face-to-face contact therewith,

said mounting means including an upright shaft mounted for turning movement about its axis,

two cranks secured one to each of the opposite ends of said shaft,

said cranks extending generally parallel to the plane of said mast and transversely of said truck and projecting in opposite directions from said shaft,

each crank being pivotally connected to said head, with such connections being on the opposite sides of and spaced from said shaft,

stop means for each crank,

said cup member being disposed forwardly of said shaft so that the force of gravity urges said cup member to tilt in a forward direction to move said cranks toward said stop means,

and counterbalancing spring means urging said shaft in a direction opposite to the direction it is urged by the weight of said cup member so that said cup member will adjust its position under light contact pressure with said load,

said counterbalancing spring means being of sufficient strength so that in the unloaded condition of said cup member, said cranks will be spaced from said stop means so that said cup is floating and may freely adjust its position to that of a load which it contacts.

11. In a lift truck having an upright mast and a carriage movable along said mast,

an upright forwardly directed suction cup disposed forwardly of said carriage,

mounting means connected to said carriage for mounting said cup, said mounting means being rotatable at its connection to said carriage about a first upright axis,

universal joint means connecting said cup to said mounting means at points on laterally opposite sides of said first upright axis establishing a second upright axis oblique to said first upright axis,

said oblique axis being swingable relative to said first upright axis upon rotation of said mounting means such that pivoting of said mounting means about said first axis enables both a forwardly and rearwardly tilting movement of the upper and lower portions of said cup, and a lateral pivoting movemnet of said cup so that said cup can conform its position to that of a load upon engagement with said load.

12. A lift truck having a front end, a rear end, an upright mast at said front end, and a carriage movable along said mast,

a pair of suction heads disposed in front of said carriage,

means mounting each said suction head on said carriage for universal movement prior to engaging a load so that said heads are caused to conform their positions

to those of a pair of loads upon engagement with said loads,

said means establishing a first vertical shaft means about which one of said heads can swing,

said means establishing a second vertical shaft means about which the other of said heads can swing,

said means establishing a third axis oblique to said first vertical shaft means about which said one head can swing,

said means establishing a fourth axis oblique to said second vertical shaft means about which said other head can swing,

means limiting swinging movement of said heads about their respective vertical shaft means without preventing swinging movement of said heads about their respective oblique axes so that upon picking up a load said heads are caused by gravity to swing about said oblique axes but are prevented from swinging about their vertical shaft means,

said oblique axes converging in an upward direction so that upon said heads picking up their respective loads, said heads are caused to swing inwardly about their oblique axes toward the longitudinal centerline of said truck until said loads are mutually engaged and said cups thereby stabilized.

13. A lift truck having a front end, a rear end, an upright mast at said front end, and a carriage movable along said mast,

a suction head disposed in front of said carriage,

means including a vertical shaft mounitng said suction head on said carriage,

means mounting said vertical shaft for swinging movement about its axis,

means pivotally mounting said suction head to said vertical shaft at positions on laterally opposite sides of said shaft establishing a second axis oblique to the axis of said shaft, so that said cup is caused to conform its position to that of a load upon engagement with a load,

and stop means limiting swinging movement of said shaft about its axis without limiting rotation of said head about said oblique axis so that upon picking up a load said head is caused to swing by gravity in a predetermined transverse direction about said oblique axis to a stabilized position.

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