

Nov. 6, 1962

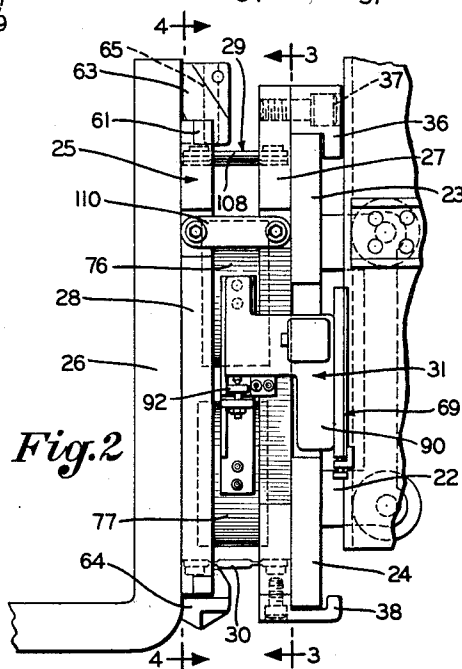
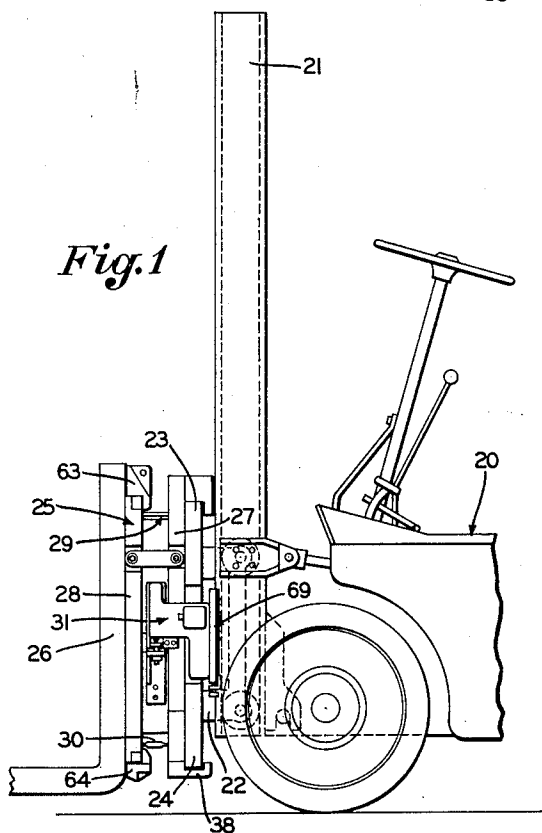
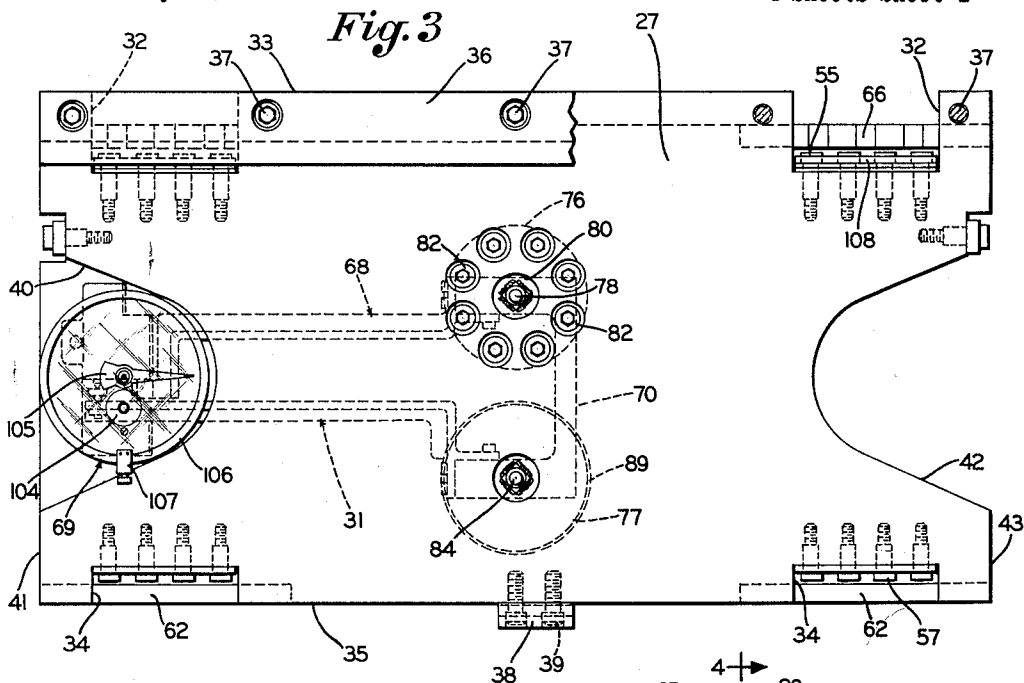
W. C. ANDERSON ET AL

3,062,308

LIFT TRUCK SCALE MECHANISMS

Filed May 16, 1958

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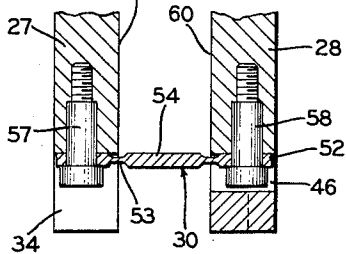
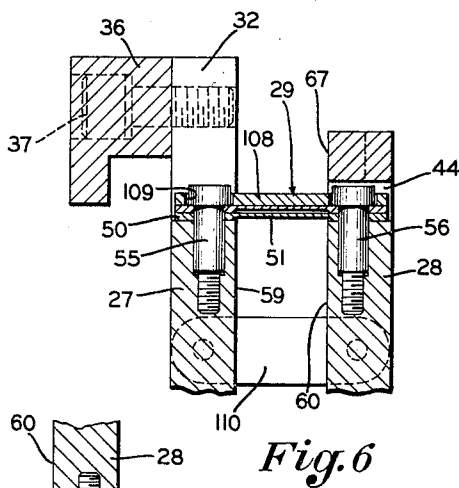
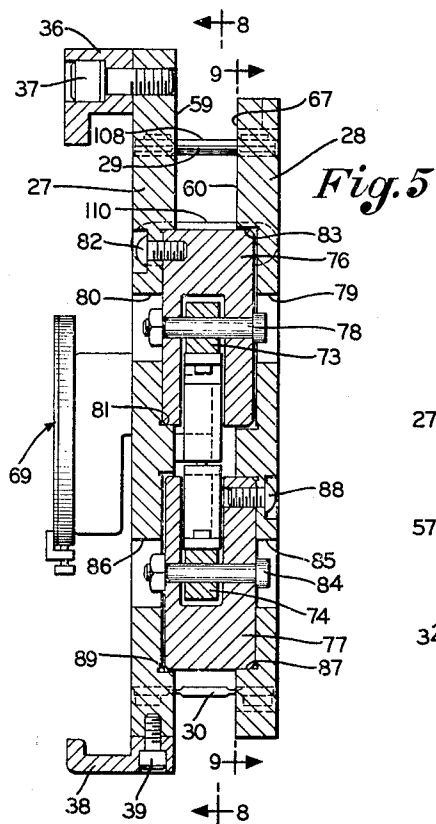
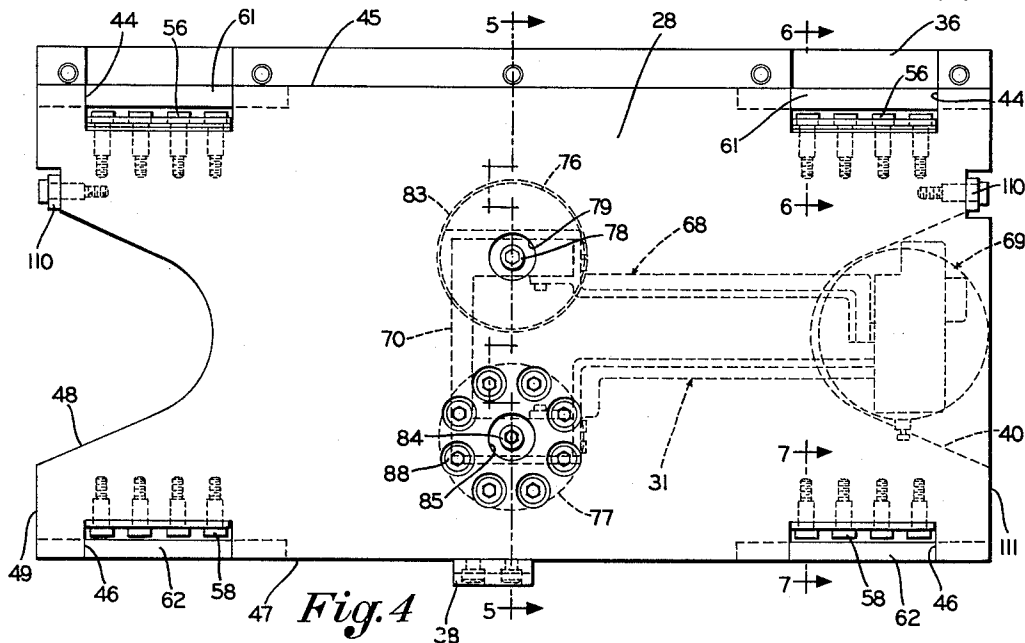


INVENTORS
W. Carl Anderson
Richard W. Lozier
 BY *Freese & Bishop*
 ATTORNEYS

3,062,308

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4 Sheets-Sheet 2



INVENTORS,
W. Carl Anderson,^a
BY Richard W. Lozier,^a
Freese & Bishop
ATTORNEYS

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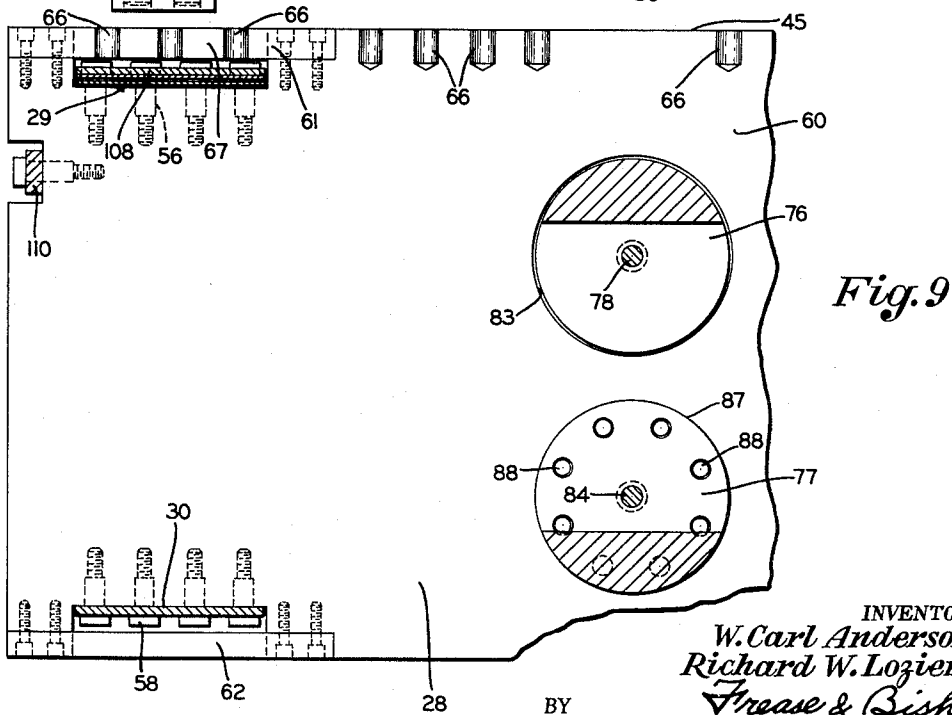
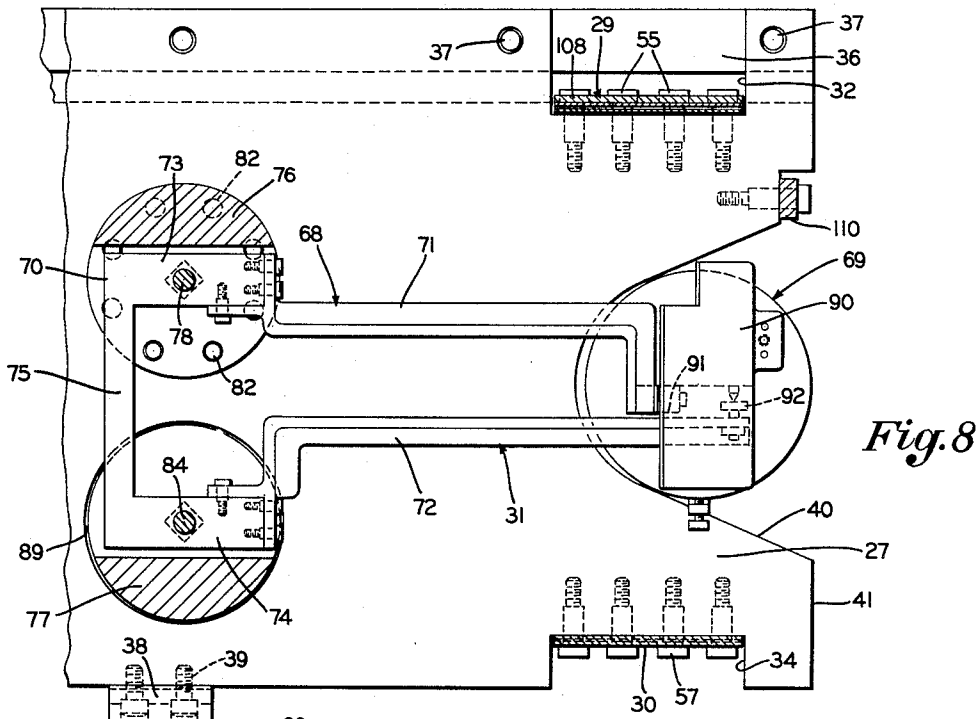
W. C. ANDERSON ETAL

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INVENTORS
W. Carl Anderson
Richard W. Lozier
Freese & Bishop
ATTORNEYS

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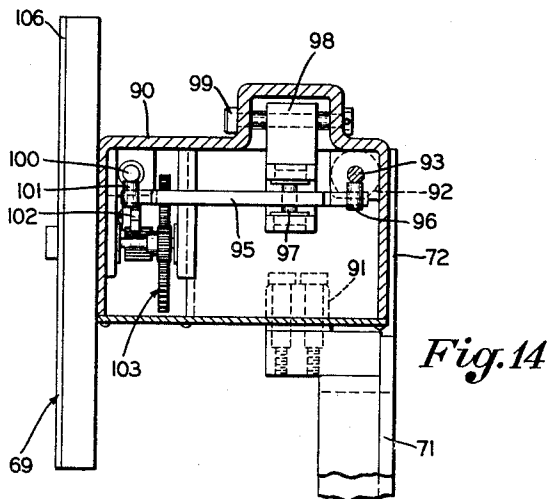
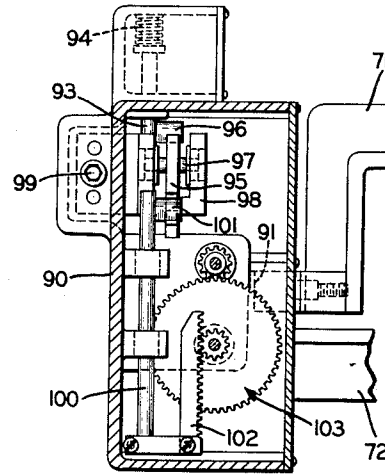
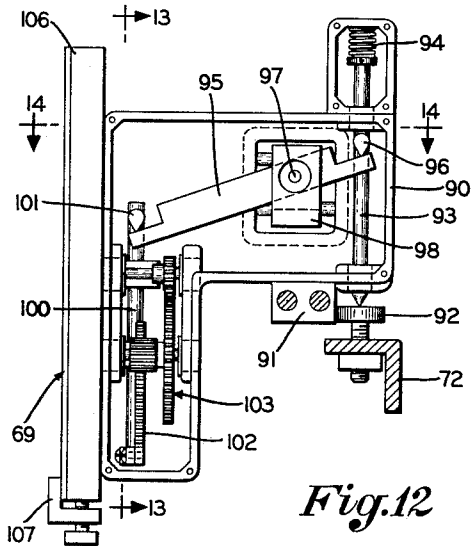
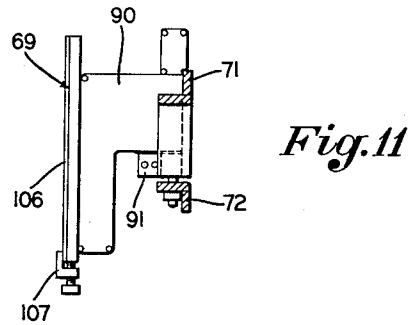
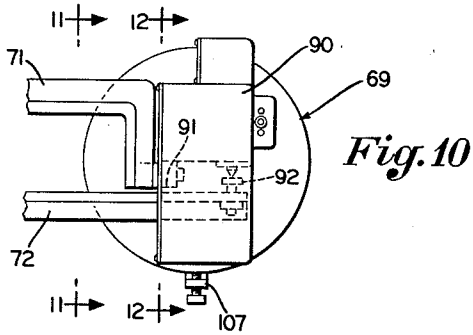
W. C. ANDERSON ETAL

3,062,308

LIFT TRUCK SCALE MECHANISMS

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BY

INVENTORS
W. Carl Anderson
Richard W. Lozier
Freese & Bishop
ATTORNEYS

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3,062,308

LIFT TRUCK SCALE MECHANISMS

W. Carl Anderson, Hartville, and Richard W. Lozier, Canton, Ohio, assignors to The Union Metal Manufacturing Company, Canton, Ohio, a corporation of Ohio

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12 Claims. (Cl. 177-229)

Our invention relates to improvements in lift truck scale mechanisms and more particularly to a scale mechanism which may be positioned between the lifting carriage of a lift truck and the cantilever type lifting platform thereof, such as between the lifting carriage and the forks

of a fork lift truck. A long felt want and need for an efficient and workable scale mechanism for lift trucks has been apparent since the advent of the wide spread use of lift trucks in modern industry for various material handling functions. Lift trucks, of course, have become an essential part of our modern mass production industrial plants for handling various materials, not only in the raw material state, but also in-process materials as well as finished materials in shipping cartons ready for final transportation to the ultimate consumers.

Further, in these modern industrial plants, it has become important during many stages of the manufacturing processes, as well as during final shipment, to record the weight of each load of material transported by these lift trucks. For example, if the exact weight of a load of substantially identical in-process mass produced parts can be recorded at a given stage of the manufacturing, by knowing the tare weight of the material handling container holding these parts, it is possible to determine within an extremely low percentage of error the number of parts being transported at that particular time, and in this manner the flow through the mass production lines can be expedited.

Also, it is important to know the weight of a given lot of materials being loaded on outside shipping conveyances, such as commercial shipping trucks, in order to be certain of the total load these commercial shipping trucks are carrying. Thus, in order to eliminate the necessity of the lift truck in each instance carrying each load of material being moved to a given weighing station having a stationary weighing scale, it is desirable and long needed to provide a lift truck scale mechanism incorporated directly as a part of a lift truck in order to automatically and immediately weigh the load of material being transported at the time this material is first picked up for transportation.

Certain prior constructions of lift truck scale mechanisms have been heretofore provided but none of these have been entirely satisfactory for a number of important and vital reasons. One important reason is that it has not been possible, prior to the present invention, to provide a workable weight indicating device incorporated as a part of such a scale mechanism which will withstand the rugged uses encountered, while still providing accurate weight readings without prohibitive maintenance expense.

Further, certain of these prior lift truck scale mechanisms have been constructed so that increased clearance is necessary between the surface from which the load is to be picked up and the under surface of the main portion of the material handling container, thereby restricting the various types of material handling containers that can be transported with a lift truck having the scale mechanism mounted thereon. Still further, since virtually all lift trucks lift and transport their various loads on cantilever type lifting platforms, such as the forks of a fork lift

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truck, the further away from the lift truck center of gravity horizontally that the load must be carried by the lift truck the less capacity that a given lift truck has, and certain of these prior lift truck scale mechanisms when attached to a lift truck have been of such horizontal dimensions so as to diminish to a prohibitive extent the working capacity of the particular lift truck.

Finally, another important aspect of lift truck scale mechanisms, again dealing with the requirement that most lift trucks carry their loads on a cantilever type lifting platform, is that the scale mechanism must be constructed to eliminate or cancel out all horizontal load components created by this cantilever loading in order to permit an accurate indication of the vertical load components, which vertical load components are, of course, the actual weight being carried by the lift truck.

Although certain of these prior constructions have been constructed with various members which in theory will provide this elimination or cancelling out of the horizontal load components of the cantilever load, from a practical standpoint and in actual use, these prior members have not been efficient nor sufficiently rugged to serve their required purpose.

Thus, in view of the obvious need for a scale mechanism for lift trucks and the difficulties with the prior constructions, it is highly desirable to provide such a scale mechanism which meets all of the requirements of size, convenience, ruggedness and accuracy under long and continued use as outlined.

It is therefore a general object of the present invention to provide a lift truck scale mechanism which meets the foregoing requirements and overcomes the difficulties and disadvantages of the prior constructions.

It is a primary object of the present invention to provide a lift truck scale mechanism which has the necessary accuracy, yet is durable in construction and will withstand long and continued rugged use.

It is a further object of the present invention to provide a lift truck scale mechanism which may be attached between the lifting carriage and lifting platform of a lift truck, and insures maximum weighing accuracy for offset or cantilever loads positioned on the lifting platform by accurately indicating vertical load components produced by the load and effectively completely eliminating from such indication any horizontal load components of such load.

It is still a further object of the present invention to provide a lift truck scale mechanism which may be attached between the lifting carriage and lifting platform of a lift truck, yet does not require special attachment means on either of the lifting carriage or platform.

It is also an object of the present invention to provide a lift truck scale mechanism which includes a unique rugged C-member weighing means supporting the major portion of the vertical load of the lift truck lifting platform and load positioned thereon, such C-member being constructed to deflect predetermined and measurable amounts under given loads.

It is an additional object of the present invention to provide a lift truck scale mechanism which is constructed to incorporate various safety devices therein eliminating any danger of the load on the lifting platform being accidentally released or damaging the scale mechanism due to an extreme overloading of the scale mechanism.

Finally, it is an object of the present invention to provide a lift truck scale mechanism which incorporates all of the above advantages, yet is relatively economical to manufacture with a great degree of accuracy.

These and other objects are accomplished by the parts, constructions, arrangements, combinations and subcombinations comprising the present invention, the na-

ture of which is set forth in the following general statement, a preferred embodiment of which—illustrative of the best mode of which applicants have contemplated applying the principles—is set forth in the following description and illustrated in the accompanying drawings, and which is particularly and distinctly pointed out and set forth in the appended claims forming a part thereof.

In general terms the lift truck scale mechanism comprising the present invention may be stated as including a back plate member, a front plate member, means securing the front and back plate members in spaced substantially parallel relation and absorbing and eliminating any horizontal load components therebetween, and weight indicating means secured to the front and back plate members indicating the greater portion of any vertical load components therebetween. The back plate member may include preferably hook-like attaching means for attaching this plate member to the usual lifting carriage of a lift truck, and the front plate member may include means for receiving the usual preferably hook-like attaching means of a usual lift truck lifting platform, such as the forks of a fork lift truck.

Further, the means between the front and back plate members, for absorbing and eliminating horizontal load components, may include spaced upper and lower, normally horizontally extending, preferably strap-like support members with the upper support members normally being tension members and the lower support members being compression members. Also, the weight indicating means between the front and back plate members may include preferably a generally C-shaped deflection member deflecting under vertical load components and indicator mechanism measuring the deflection of this C-shaped member and transferring this deflection measurement into weight indications.

Finally, the lift truck scale mechanism comprising the present invention may include safety devices attached between the front and back plate members preferably at the upper support members and at other points for maintaining the scale mechanism assembled in the event of the accidental failure of any of the support members. Also, for safety purposes, the weight indicating means C-shaped deflection member may be mounted between the front and back plate members so that the deflection of this C-shaped deflecting member is limited to a safe maximum amount.

By way of example, an embodiment of the lift truck scale mechanism of the present invention is illustrated in the accompanying drawings forming a part hereof, wherein like numerals indicate similar parts throughout the several views and in which:

FIGURE 1 is a fragmentary side elevation of the scale mechanism of the present invention mounted on the lifting carriage of a fork lift truck and having the lifting forks mounted thereon;

FIG. 2, an enlarged fragmentary view taken from FIG. 1 and showing a part of the lift truck lifting carriage, the entire scale mechanism and a part of the lifting forks;

FIG. 3, a back elevation, part in section, of the scale mechanism removed from the lift truck, looking in the direction of the arrows 3—3 in FIG. 2;

FIG. 4, a front elevation of the scale mechanism with the lift truck lifting forks removed and looking in the direction of the arrows 4—4 in FIG. 2;

FIG. 5, a vertical sectional view, part in elevation, looking in the direction of the arrows 5—5 in FIG. 4;

FIG. 6, a fragmentary sectional view, part in elevation, looking in the direction of the arrows 6—6 in FIG. 4;

FIG. 7, a fragmentary sectional view, part in elevation, looking in the direction of the arrows 7—7 in FIG. 4;

FIG. 8, a fragmentary sectional view, part in elevation, looking in the direction of the arrows 8—8 in FIG. 5;

FIG. 9, a fragmentary sectional view, part in elevation, looking in the direction of the arrows 9—9 in FIG. 5;

FIG. 10, a fragmentary back elevation of the weight indicating device;

FIG. 11, a sectional view, part in elevation, looking in the direction of the arrows 11—11 in FIG. 10;

FIG. 12, a sectional view, part in elevation, looking in the direction of the arrows 12—12 in FIG. 10;

FIG. 13, a fragmentary sectional view, part in elevation, looking in the direction of the arrows 13—13 in FIG. 12; and

FIG. 14, a fragmentary sectional view, part in elevation, looking in the direction of the arrows 14—14 in FIG. 12.

As illustrated in FIGS. 1 and 2 of the drawings, the particular embodiment of the lift truck scale mechanism comprising the present invention is shown in combination with a particular form of fork lift truck. It should be understood, however, that the principles of the present invention are not limited to the particular fork lift truck shown nor to fork lift trucks in general. Obviously, with minor changes from the embodiment of the scale mechanism illustrated, this scale mechanism may be easily adapted for use with virtually any form of material handling truck and for many other load sensing applications and such changes are contemplated within the scope of the present invention. Thus, where the terms "vertical" and "horizontal" are used in the following, it should be understood that these terms could be used interchangeably with "longitudinal" and "lateral" respectively.

Referring to FIGS. 1 and 2, a lift truck, generally indicated at 20, having the usual mast 21, is provided with the usual vertically movable lifting carriage 22, which carriage includes the upper and lower lifting bars 23 and 24. The scale mechanism of the present invention is generally indicated at 25, being attached to the lifting bars 23 and 24 and having the usual lifting forks 26 attached thereto.

The scale mechanism 25 includes the back plate member 27, the front plate member 28, the upper supporting members 29, the lower supporting members 30 and a weight indicating means, generally indicated at 31. The back plate member 27, as best seen in FIGS. 2 and 3, is provided with the spaced cut-outs 32 formed in the upper edge 33 and the spaced cut-outs 34 formed in the lower edge 35, these cut-outs being formed for a purpose to be herein after more fully described.

Further, a hook member 36 is attached by means of the spaced bolts 37 to the back plate member upper edge 33 and extending the entire width of this plate member. Also, a hook member 38 is attached centrally of the back plate member 27 at the lower edge 35 by means of a pair of bolts 39. Both of these hook members 36 and 38 extend rearwardly and are positioned to engage the lift truck lifting carriage 22 after the lifting forks 26 have been removed, with the hook member 36 engaging over the upper lifting bar 23 and the hook member 38 engaging under the lower lifting bar 24, thereby retaining the scale mechanism 25 securely on the lift truck lifting carriage 22 in lieu of the lifting forks 26.

Still further, the back plate member 27 is provided with a generally U-shaped cut-out 40 in the side edge 41 and a similar generally U-shaped cut-out 42 in the side edge 43, again for a purpose to be hereinafter described.

The front plate member 28, as seen in FIGS. 2 and 4, likewise is provided with the spaced cut-outs 44 in the upper edge 45, with the lower extremities of these cut-outs 44 normally being horizontally aligned with the lower extremities of the back plate cut-outs 32. Again, similar to the back plate member, the front plate member 28 is provided with the spaced cut-outs 46 in the lower edge 47 having the upper extremities thereof normally horizontally

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aligned with the upper extremities of the back plate cut-outs 34.

Still further, the front plate member 28 is provided with the generally U-shaped cut-out 48 in the side edge 49, similar to and normally aligned with the cut-outs 40 in the back plate side edge 41, for a purpose to be hereinafter described.

Back and front plate members 27 and 28 are positioned in generally vertically extending, spaced, substantially parallel relationship, and are retained in such relationship despite slight vertical movement of the front plate member 28 with reference to the back plate member 27 by the upper and lower supporting members 29 and 30 and the weight indicating means, generally indicated at 31. The upper and lower supporting members 29 and 30 are preferably formed from heat treated spring steel and, although the upper and lower members differ somewhat in configuration, both upper and lower sets are somewhat strap-like in overall configuration.

The upper supporting members 29 are formed with thickened end portions 50, and relatively thin center portions 51 extending between these end portions, with the overall widths of these members being substantially uniform throughout the thickened end and thinner center portions, as best seen in FIG. 6. The lower supporting members 30 are also formed with thickened end portions 52, but are provided with relatively thin intermediate portions 53 adjacent the thickened end portions 52, and thickened center portions 54. Again, the widths of these lower supporting members also are substantially uniform throughout the extent of portions 52, 53 and 54, as best seen in FIG. 7.

The upper supporting members 28 are positioned in double thickness stacks with the end portions 50 thereof received in the back plate upper cut-outs 32 and the front plate upper cut-outs 44. Further, these end portions are secured to the back plate member 27 by a series of bolts 55 and to the front plate member 28 by a series of bolts 56, with the center portions of these upper supporting members extending generally horizontally between plate members 27 and 28.

The lower supporting members 30 are likewise positioned with their end portions 52 received in the back plate lower cut-outs 34 and front plate lower cut-outs 46. Also, these end portions are secured to the back plate member by means of a series of bolts 57 and to the front plate member by a series of bolts 58, with the thinner intermediate portions 53 coinciding with the back plate front face 59 and the front plate back face 60. Finally, the lower supporting member center portions 54 extend generally horizontally between the intermediate portions 53 and plate members 27 and 28, and these lower supporting member center portions 54 are at all times substantially parallel to the upper supporting member center portions 51.

The particular configurations of these upper and lower supporting members 29 and 30 are designed to give these supporting members maximum flexibility while still serving their particular supporting functions. As will be more clearly seen at the completion of the description, the specific purpose of the upper supporting members 29 is to withstand and absorb forces between the plate members 27 and 28 tending to separate the upper portions of these plate members, thereby placing these upper supporting members in tension.

Further, the purpose of the lower supporting members 30 is to resist and absorb forces tending to move the lower portions of the plate members 27 and 28 together, thereby placing these lower supporting members in compression. Such tension and compressive forces are created by a cantilever load being placed on the lift truck lifting forks 26 and it is for this reason that it is important that these upper and lower supporting members 29 and 30 always remain substantially parallel and that the supporting members have as great a flexibility as possible while still serv-

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ing their tension and compression purposes, so as not to create any more resistance to the vertical movement of the front plate member 28 with respect to the back plate member 27 than is necessary, both of these points of construction to be hereinafter explained more clearly in detail.

As best seen in FIGS. 4 and 9, the front plate member upper cut-outs 44 are covered by the recessed engagement bars 61, the upper surfaces of which are aligned with the front plate upper edge 45 and the lower surfaces of which are spaced above the upper ends of the supporting member bolts 56. Likewise, the front plate lower cut-outs 46 are covered by the recessed engagement bars 62, with these bars having their lower surfaces aligned with the front plate lower edge 47 and their upper surfaces spaced downwardly from the lower ends of the engagement member bolts 58.

The purpose of these front plate engagement bars 61 and 62 is to provide a continuous upper and lower edge on the front plate member 28 for engagement by the lifting forks 26. Each of the lifting forks 26 is of the usual L-shaped configuration and is provided on its upright portion with the usual upper engagement hooks 63 and the lower engagement hook 64, which hooks, when the scale mechanism of the present invention is not used, would normally engage the upper lifting bar 23 and lower lifting bar 24, respectively, of the lift truck lifting carriage 22.

With the provision of the scale mechanism of the present invention, however, these fork hooks 63 and 64 engage over the front plate upper edge 45 and lower edge 47, respectively, as shown in FIGS. 1 and 2. Also, in usual construction as shown in FIG. 2, the fork upper hooks 63 are provided with the spring loaded pins 65, which pins partially engage in the rear surface of the member on which these hooks 26 are mounted in order to retain the hooks properly laterally spaced as desired.

Thus, for the purpose of receiving the spring loaded pins 65, the front plate upper engagement bars 61 are provided with a series of spaced half holes 66 at the back surfaces 67 of these bars, and these half holes continue and are formed in the front plate back face 60, as best seen in FIG. 9. With this construction, therefore, lifting forks 26 are mounted on the front plate member 28 with the upper hooks 63 engaged over the upper edge 45 or the engagement bars 61 and with the spring loaded pins 65 engaged in certain of the half holes 66. At the same time the fork lower hooks 64 are engaged over the front plate lower edge 47 or the engagement bars 62.

The weight indicating means, generally indicated at 31, includes the C-shaped spring-like deflection member 68 and the indicator mechanism 69. The deflection member 68 has the C-shaped spring portion 70, the upper extension arm 71 and the lower extension arm 72, with the spring portion 70 having an upper horizontal leg 73, a lower horizontal leg 74 and a vertical leg 75 extending vertically between legs 73 and 74, as best seen in FIG. 8.

As can be clearly seen in FIGS. 2 through 5 and 8, the deflection member 68 is telescoped between the front and back plate members 27 and 28, with the upper horizontal leg 73 of the spring portion 70 secured to the back plate member 27 through the upper clevis 76, and the lower horizontal leg 74 of spring portion 70 secured to the front plate member 28 through the lower clevis 77. The upper and lower clevises 76 and 77 are similar in shape, being generally U-shaped in cross section, as shown in FIG. 5, and having generally circular outer configurations.

The upper clevis 76 is telescoped downwardly over the spring portion upper horizontal leg 73 and is secured to this spring portion leg by means of a bolt 78, which bolt passes through the spring portion leg 73 substantially laterally midway or at least intermediate of the length of the leg 73 spaced from the vertical leg 75 and substantially laterally midway of the front and back plate members 27 and 28. Furthermore the ends of bolt 78 extend

into the clearance openings 79 and 80 in the front and back plate members respectively.

The upper clevis 76 is retained in the circular recess 81 formed in the back plate front face 59 by a series of bolts 82, and also this clevis is received in the clearance recess 83 formed in the front plate back face 60, as shown. It is important that the recess 83 provides a predetermined clearance around all portions of the clevis 76 which protrude into this recess, which clearance, coupled with the clearance around the bolt 78 provided by the clearance opening 79, permits limited vertical movement of the front plate member 28 with reference to the back plate member 27 and clevis 76.

The lower clevis 77 is similarly secured to the spring portion lower horizontal leg 74 by a bolt 84 with the ends of bolt 84 likewise extending into the clearance openings 85 and 86 in the front and back plate members. Also, lower clevis 77 is retained on the front plate member 28 in a circular recess 87 by means of a series of bolts 88 and is received in the back plate clearance recess 89.

Again, the clearance recess 89 provides a limited clearance completely around the portion of the lower clevis 77 which extends into the back plate member 27, with the clearance of this recess combined with the clearance opening 86, permitting limited vertical movement of the front plate member 28 and lower clevis 77 with respect to the back plate member 27. Thus, since the spring portion upper horizontal leg 73 is secured to the back plate member 27 and the spring portion lower horizontal leg 74 is secured to the front plate member, the front plate member is permitted to move vertically with respect to the back plate member by a sufficient vertical load being placed on the front plate member 28 to deflect the spring portion 70, such vertical movement being permitted within the limitations of the clearance between the clearance recesses 83 and 89 and the outer extremities of the upper and lower clevises 76 and 77.

Furthermore, as can be clearly seen in FIGS. 5 and 8, the spring portion 70 can be easily and evenly deflected by such vertical load due to the bolts 78 and 84 being cylindrical, as shown, and being received through cylindrical holes, as shown, in the upper and lower horizontal legs 73 and 74 of spring portion 70, to thereby provide pivotal connections between spring portion 70 and the plate members 27 and 28. Also, the deflection of the spring portion 70 is permitted by the fact that the pivotal connections between the spring portion legs 73 and 74, and the plate members 27 and 28 are at locations intermediate the horizontal lengths of legs 73 and 74, spaced from the spring portion vertical leg 75.

The upper and lower extension arms 71 and 72 are both preferably generally L-shaped in cross section, as shown in FIG. 11, with the upper extension arm 71 being secured to the spring portion upper horizontal leg 73 and extending generally horizontally to the indicator mechanism 69, as shown in FIG. 8. Further this upper extension arm 71 extends downwardly adjacent the indicator mechanism case 90 and is secured to case 90 through a block 91, as shown.

The lower extension arm 72 is secured to the spring portion lower horizontal leg 74 and likewise extends horizontally to the indicator mechanism case 90. At the end of the lower extension arm 72, adjacent the case 90, is mounted a vertically adjustable platform member 92 which abuts a vertically movable pin 93 protruding downwardly from and vertically movable with respect to the case 90.

As shown in detail in FIGS. 10 through 14, pin 93 is resiliently retained in abutting relation with the lower extension arm platform member 92 by means of the spring 94 and this pin in turn engages over one end of a pivotal beam member 95 through a knife edge 96. Beam member 95 is pivotally attached to the case 90 through a pivot pin 97 mounted in a laterally adjustable block 98.

Block 98 is threadably engaged with an adjusting screw

99, which adjusting screw is in turn received in a portion of case 90 and rotatable with respect to this case. Thus by a selective adjustment of the adjusting screw 99, block 98 may be moved to, in effect, change the pivot point of beam member 95 with respect to the remaining mechanism of the indicator mechanism 69, to thereby adjust and calibrate this indicator mechanism as required.

The end of beam member 95 opposite from the pin 93 is in turn engaged with a second vertically movable pin 100 through another knife edge 101. Finally, the pin 100 is secured to a vertical gear rack 102 which is in turn operably connected through a series of gearing, generally indicated at 103, to a usual rotatable revolutions counter 104 and dial indicator pointer 105, both the counter and pointer being shown in FIG. 3 and being contained within a dial indicator case 106.

The dial indicator case 106 may have the usual rotatable non-breakable glass face having the weight indications printed thereon. Further this case may be provided with the usual tare adjustment 107.

Thus, with the scale mechanism described, when a given load is picked up or placed on the lifting forks 26, this will create a downward vertical force on front plate member 28, which causes the spring portion 70 to deflect a predetermined amount, permitting the front plate member 28 to move a slight distance downwardly with reference to the back plate member 27. This deflection of the spring portion 70 causes the upper and lower extension arms 71 and 72 to move a slightly greater distance apart and, through the various mechanisms of the indicator mechanism 69, the deflection of the spring portion 70 is transmitted into a weight indication by the dial indicator pointer and revolutions counter 104.

Still further, this downward movement of the front plate member 28 with respect to the back plate member 27 is permitted by the upper and lower supporting members 29 and 30, while these supporting members maintain plate members 27 and 28 in proper spaced alignment. Finally, since the upper supporting members 29 are substantially parallel to the lower supporting members 30, these supporting members absorb and cancel out the turning moment placed on the front plate member 28 by the offset or cantilever load on the lifting forks 26.

As before described, the upper supporting members 29 are placed in tension by this turning moment and the lower supporting members 30 are placed in compression, with both sets of supporting members being formed sufficiently strong to resist the forces created therein by this turning moment while at the same time being sufficiently flexible so as to create as little resistance as possible to the vertical movement of the plate member 28. Also, due to the particular construction of the lower supporting member 30, as hereinbefore described, these lower supporting members are sufficiently strong in column strength or resistance to buckling for resisting and absorbing the horizontal load components urging the lower portions of the plate members 27 and 28 together, while still maintaining the foregoing vertical flexibility. Furthermore, because the upper and lower supporting members 29 and 30 extend in a general horizontal direction between the plate members 27 and 28 and because the total possible vertical movement of the front plate member 28 with reference to the back plate member 27 is sufficiently small, these supporting members can never be deflected sufficiently near a vertical position so as to transmit more than a small amount of the vertical load components between the plate members.

As shown particularly in FIGS. 1, 3 and 5, the case 90 of the indicator mechanism 69 extends rearwardly through the generally U-shaped cut-out 40 formed in the side edge 41 of the back plate member 27, so that this indicator mechanism can be conveniently observed by the operator of the lift truck 20. Furthermore, because of the generally U-shaped cut-out 42 in the back plate side edge 43 and the generally U-shaped cut-out 48 in the

front plate side edge 49, the operator of the lift truck 20 may conveniently observe the location of the lifting forks 26 so that the lift truck operator's vision is not obscured by this scale mechanism during the operation of picking up a load.

For maximum safety in the use of the scale mechanism comprising the present invention, certain safety features are inherently built into the mechanism and others are preferably included. First, as before described, the upper clevis 76 secured to the back plate 27 is received in the clearance recess 83 of the front plate member 28 and the lower clevis 77 secured to the front plate member 28 is received in the clearance recess 89 of the back plate member 27.

Thus, the downward movement of front plate member 28 with reference to back plate member 27 is limited by the clearance between these clevises and their respective clearance recesses. Furthermore, this clearance is calculated to be less than the deflection that would damage or cause the deflection member 68 to fail. In this manner, it is assured that, even though a load beyond the capacity of the scale mechanism is placed on the lifting forks 26, the deflection member 68 will not fail, since the total deflection thereof will be limited to a safe amount.

A second safety feature is preferably provided in the scale mechanism comprising the present invention by the safety plates 108, shown in FIGS. 1 through 6, 8 and 9 of the drawings. As shown, safety plates 108 are positioned resting on and covering the upper supporting members 29, also extending between the back and front plate members 27 and 28 and beneath the front plate member engagement bars 61.

Safety plates 108 are provided with a series of openings 109, which openings coincide with and receive the upper ends of the back plate engagement member bolts 55 and the front plate engagement member bolts 56, as best seen in FIG. 6. Furthermore, the plate openings 109 are sufficiently larger than the upper ends of the bolts 55 and 56 to provide clearance allowing the necessary vertical movement of front plate member 28 with reference to back plate member 27 and also to provide clearance so that no horizontal or vertical load components will be in any way absorbed or affected by these plates 108.

Thus, safety plates 108 are constructed so that, under normal operation of the scale mechanism of the present invention, this scale mechanism will properly function as if these safety plates were not present, but if through accident, the scale mechanism is overloaded to an extreme extent sufficient to cause horizontal load components beyond the tensile capacity of the upper supporting members 29 and causing these supporting members to fail, the safety plates 108 through engagement with the upper ends of the bolts 55 and 56 will prevent extreme horizontal separation of the back and front plate members 27 and 28 which could cause damage to the deflection member 68. Also, these safety plates 108 serve as a protection covering for guarding the upper supporting members 29 from being damaged by objects falling downwardly between the plate members 27 and 28 from above.

Finally, another safety feature which is preferably incorporated in the scale mechanism of the present invention is provided by the safety links 110, shown in FIGS. 1 through 4, 8 and 9. These safety links 110 are preferably positioned inset in the back plate side edges 41 and 43 and the front plate side edges 49 and 111, extending between the back and front plate members 27 and 28, as shown.

Further, safety links 110 are pivotally connected to the plate members 27 and 28, permitting free vertical movement between these plate members to the necessary extent for the proper function of the scale mechanism. Again, however, in the event of the excessive overloading of the scale mechanism causing the failure of the upper supporting members 29, the safety links 110 will pre-

vent further horizontal separation of plate members 27 and 28 and thereby prevent damage to the deflection member 68.

The most ideal lift truck scale mechanism construction, according to the foregoing description and shown in the drawings, would have upper and lower supporting members 29 and 30 between the back and front plate members 27 and 28 having sufficient flexibility so that absolutely free limited vertical movement is permitted between the back and front plate members when a load, within the capacity of the mechanism, is placed on the cantilever-type lifting forks 26. As a practical matter, however, in order to provide this scale mechanism of sufficient capacity and ruggedness for use with lift trucks in modern manufacturing plants, it has been found that these most ideal conditions cannot be met, but rather, in order to properly support the back and front plate members 27 and 28 and maintain these plate members properly spaced, it is necessary to sacrifice flexibility of the supporting members 29 and 30 to provide these supporting members with sufficient tensile and compressive strength and stiffness.

Thus, it has been found, when the upper and lower supporting members 29 and 30 are formed of sufficient strength to withstand the loads and abuse encountered, that these supporting members will actually absorb a certain percentage of the vertical load components to which the plate members 27 and 28 are subjected by a load being placed on the cantilever-type lifting forks 26. It has further been found that the percentage of vertical load components absorbed might be as high as approximately 15% of the total vertical load components created by the load on the forks.

These vertical load components absorbed in a particular assembly of the scale mechanism by these supporting members 29 and 30 are, however, measurable, and they vary at a uniform rate for an increase or decrease in load on the lifting forks. Thus, the vertical load components absorbed by the supporting members 29 and 30 may be simply and easily compensated for by an adjustment in the indicator mechanism 69.

For this reason, referring particularly to FIGS. 12 and 13 as hereinbefore described, it is merely necessary to adjust the adjusting screw 99, thereby moving block 98 to change the pivot point of the beam member 95 with respect to the remaining mechanism of the indicator mechanism, and thereby adjust and calibrate this indicator mechanism so as to compensate for the percentage of the vertical load components which are actually being absorbed by the supporting members 29 and 30. In this manner, the indicator mechanism 69 can be adjusted to give a true reading of the actual vertical load components imparted by the load on the lifting forks.

The percentage of vertical load components which will be absorbed by the upper and lower supporting members 29 and 30 will, of course, vary depending on the particular form of these supporting members. For instance, with the lower supporting members 30 being constructed with the relatively short and thin portions 53 and thickened center portions 54, thereby providing these members with increased flexibility while maintaining column strength, less vertical load components will be absorbed by these lower supporting members than if these members were formed with a continuous cross section, such as that of the thickened center portions 54.

Although the lower supporting members 30 have been shown having short intermediate portions 53 of a decreased vertical thickness from the thickened center portions 54, it should be understood that increased flexibility for these supporting members can be provided by decreasing the thickness of the relatively short intermediate portions 53 in either a horizontal or vertical direction or both, so that when the intermediate portions 53 are referred to as "thin," it is intended that this thinness may be in any direction so that these intermediate portions 53 have

a less cross sectional area than the thickened center portions 54.

A further important aspect of the scale mechanism comprising the present invention is the provision of the generally C-shaped deflection member 68 including the C-shaped spring portion 70. As before described, the upper horizontal leg 73 of spring portion 70 is secured to the back plate member 27 through the upper clevis 76 and the lower horizontal leg 74 of spring portion 70 is secured to the front plate member 28 through the lower clevis 77, so that the vertical load components of the load on the lifting forks 26 are transferred into deflection of spring portion 70, which deflection, through the upper end lower extension arms 71 and 72, is directly measured and transferred into weight indications by the indicator mechanism 69.

Thus, through the combination of the upper and lower supporting members 29 and 30 and the deflection member 68, all horizontal load components created by the cantilever loading are for all practical purposes completely cancelled out and eliminated, while the greater portion of the vertical load components is accurately transferred into a form, that is, a deflection, which can be accurately measured and indicated as weight indications. Further, this is done by rugged supporting members 29 and 30 and a rugged deflection member 68, none of which, within their various capacities, are subject to any extreme wear and all of which are capable of withstanding the rugged uses encountered by lift truck scale mechanisms, while still properly and accurately serving their required purposes.

Another important advantage which may be included in the scale mechanism of the present invention is the safety feature which prevents damage to and even possible failure under extreme overloading conditions of the deflection member 68, both by the failure of the upper supporting members 29 or merely by a deflection of member 68 beyond its capacity. As before described, in the event of failure of the upper supporting members 29, the safety plates 108 and safety links 110 will prevent excessive separation of the upper portions of the front and back plate members 27 and 28 which otherwise could result in damage to the deflection member 68.

Further the particular mounting of the upper and lower clevises 76 and 77 received in the front plate clearance recess 83 and back plate clearance recess 89, respectively, limits the extent to which the deflection member 68 can be deflected, and if an overload is encountered, these clevises 76 and 77 will engage the plate members preventing the deflection of the deflection member 68 to an extent which could possibly damage this member. Also, all of these safety features may be provided without affecting the accuracy of the scale mechanism comprising the present invention within the predetermined capacity of this scale mechanism.

Finally, another feature, which is provided by the embodiment of the scale mechanism of the present invention shown, is that this scale mechanism may be mounted on a lift truck between the lifting carriage and lifting platform or forks without the necessity of providing special fastening means and without moving the lifting platform or forks of the lift truck a prohibitive horizontal distance from the center of gravity of the truck. As illustrated and described, the hook members 36 and 38 may be conveniently engaged with the lifting bars 23 and 24 of the lift truck lifting carriage 22 and the engagement hooks 63 and 64 of the lift truck lifting forks may be conveniently engaged with the scale mechanism front plate member 28.

In the foregoing description, certain terms have been used for brevity, clearness and understanding, but no unnecessary limitations are to be implied therefrom, because such words are used for descriptive purposes herein and are intended to be broadly construed.

Moreover, the embodiment of the improved construction illustrated and described herein is by way of example

and the scope of the present invention is not limited to the exact details of construction shown.

Having now described the invention, the construction, operation and use of a preferred embodiment thereof, and the advantageous, new and useful results obtained thereby; the new and useful construction and reasonable mechanical equivalents thereof obvious to those skilled in the art are set forth in the appended claims.

We claim:

1. Scale mechanism including a first generally longitudinal suspension member, a second generally longitudinal suspension member spaced laterally from the first member, the first and second members having longitudinally spaced portions, load receiving means operably connected to the second member for receiving a longitudinally applied load, support means operably connected between the longitudinally spaced portions of the first and second members generally flexible for relative longitudinal movement between said first and second members and generally rigid for absorbing and cancelling out substantially all lateral load components imparted between said first and second members by said longitudinally applied load on said load receiving means, said support means longitudinal flexibility providing said support means incapable of absorbing at least the greater portion of any longitudinal load components to which the first and second members are subjected by said load on said load receiving means, at least certain of said support means being placed in tension by said load on said load receiving means, safety means between the first and second members operably connected normally free of tension and normally freely longitudinally pivotal for normal free relative longitudinal movement between said first and second members, said safety means being substantially rigid in tension for resisting separation of said first and second members in the event of failure of said support means placed in tension, said safety means being normally freely longitudinally pivotal and therefore normally substantially incapable of absorbing any longitudinal load components to which said first and second members are subjected by said load on said load receiving means, and weight indicating means operably connected to the first and second members for absorbing at least the greater portion of all longitudinal load components to which said first and second members are subjected by said load on said load receiving means.

2. Scale mechanism including a first generally longitudinal suspension member, a second generally longitudinal suspension member spaced laterally from the first member, load receiving means operably connected to the second member for receiving a longitudinally applied load, support means operably connected between the first and second members generally flexible for relative longitudinal movement between said first and second members and generally rigid for absorbing and cancelling out substantially all lateral load components imparted between said first and second members by said longitudinally applied load on said load receiving means, said support means longitudinal flexibility providing said support means incapable of absorbing at least the greater portion of any longitudinal load components to which said first and second members are subjected by said load on said load receiving means, a deflection member having longitudinally spaced laterally extending leg portions joined by a longitudinally extending connecting portion in generally C-shape positioned between the first and second suspension members, first connection means mounted extending laterally between one of said deflection member spaced leg portions and said first suspension member pivotally connecting said one leg portion to said first suspension member, second connection means mounted extending laterally between the other of said deflection member spaced leg portions and said second suspension member pivotally connecting said other leg portion to said second

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suspension member, the first and second connection means being operably connected to the respective deflection member spaced leg portions at locations laterally spaced from said deflection member longitudinally extending connecting portion, the deflection member absorbing at least the greater portion of all longitudinal load components to which the first and second members are subjected by said load on said load receiving means and the absorption of the longitudinal load components causing deflection of at least one of said deflection member leg portions, and means operably connected to the deflection member for indicating the deflection between the leg portions thereof.

3. The scale mechanism as defined in claim 2 in which there is means on at least one of the first and second suspension members operably positioned relative to the deflection member leg portions for limiting the deflection of the deflection member leg portions to a predetermined maximum deflection resulting from a load on the load receiving means.

4. The scale mechanism as defined in claim 3 in which the means for limiting deflection of the deflection member leg portions resulting from a load on the load receiving means includes a recess formed in the first suspension member having predetermined longitudinal limits in both longitudinal directions and being laterally aligned with the second connection means connecting a deflection member leg portion to the second suspension member, and a recess formed in the second suspension member having predetermined longitudinal limits in both longitudinal directions and being laterally aligned with the first connection means connecting a deflection member leg portion to the first suspension member; in which each of the connection means of the deflection member leg portions extends partially laterally into the respective laterally aligned recess; and in which the predetermined longitudinal limits of each of the recesses provide a predetermined clearance for the respective connection means partially received therein in both longitudinal directions to provide clearance for the predetermined maximum deflection of the deflection member leg portions resulting from a load on the load receiving means.

5. The scale mechanism as defined in claim 4 in which the means indicating the deflection of the deflection member leg portions includes an extension arm mounted on each of said leg portions, and means for indicating the deflection of said extension arms; and in which each of the first and second connection means of the deflection member leg portions is a generally U-shaped cross-section longitudinally open clevis secured to the respective first and second suspension members and pivotally connected to the respective deflection member leg portions.

6. Scale mechanism including a first generally longitudinal suspension member, a second generally longitudinal suspension member spaced laterally from the first member, the first and second members having longitudinally spaced portions, load receiving means operably connected to the second member for receiving a longitudinally applied load, generally lateral substantially parallel strap-like support means operably connected between the longitudinally spaced portions of the first and second members generally flexible for relative longitudinal movement between first and second members and generally rigid for absorbing and cancelling out substantially all lateral load components imparted between said first and second members by said longitudinally applied load on said load receiving means, said support means longitudinal flexibility providing said support means incapable of absorbing at least the greater portion of any longitudinal load components to which said first and second members are subjected by said load on said load receiving means, at least certain of said support means being placed in compression by said load on said load receiving means, the first and second members having laterally opposed

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inner faces at said support means placed in compression, said support means placed in compression having relatively short thin flexible sections adjacent said first and second member inner faces and having sections of increased thickness the remainder of and the major portion of the lateral space between said first and second members, a deflection member having longitudinally spaced laterally extending leg portions joined by a longitudinally extending connecting portion in generally C-shape positioned between the first and second suspension members, first connection means mounted extending laterally between one of said deflection member spaced leg portions and said first suspension member pivotally connecting said one leg portion to said first suspension member, second connection means mounted extending laterally between the other of said deflection member spaced leg portions and said second suspension member pivotally connecting said other leg portion to said second suspension member, the first and second connection means being operably connected to the respective deflection member spaced leg portions at locations laterally spaced from said deflection member longitudinally extending connecting portion, the deflection member absorbing at least the greater portion of all longitudinal load components to which the first and second members are subjected by said load on said load receiving means and the absorption of the longitudinal load components causing deflection of at least one of said deflection member leg portions, and means operably connected to the deflection member for indicating the deflection between the leg portions thereof.

7. The scale mechanism as defined in claim 6 in which there is means on at least one of the first and second suspension members operably positioned relative to the deflection member leg portions for limiting the deflection of the deflection member leg portions to a predetermined maximum deflection resulting from a load on the load receiving means.

8. The scale mechanism as defined in claim 7 in which at least certain of the support means are placed in tension by said load on said load receiving means; in which safety means is positioned between the first and second suspension members operably connected normally free of tension and normally freely longitudinally pivotal for normal free relative longitudinal movement between said first and second members, said safety means being substantially rigid in tension for resisting separation of said first and second members in the event of failure of said support means placed in tension; and in which said safety means is normally freely longitudinally pivotal and therefore normally substantially incapable of absorbing any longitudinal load components to which said first and second members are subjected by said load on said load receiving means.

9. The scale mechanism as defined in claim 7 in which the means for limiting deflection of the deflection member leg portions resulting from a load on the load receiving means includes a recess formed in the first suspension member having predetermined longitudinal limits in both longitudinal directions and being laterally aligned with the second connection means connecting a deflection member leg portion to the second suspension member, and a recess formed in the second suspension member having predetermined longitudinal limits in both longitudinal directions and being laterally aligned with the first connection means connecting a deflection member leg portion to the first suspension member; in which each of the connection means of the deflection member leg portions extends partially laterally into the respective laterally aligned recess; and in which the predetermined longitudinal limits of each of the recesses provide a predetermined clearance for the respective connection means partially received therein in both longitudinal directions to provide clearance for the predetermined maximum deflection of the deflection member leg portions resulting from a load on the load receiving means.

10. Scale mechanism including a first generally longitudinal suspension member, a second generally longitudinal suspension member spaced laterally from the first member, the first and second members having longitudinally spaced portions, load receiving means operably connected to the second member for receiving a longitudinally applied load, support means operably connected between the longitudinally spaced portions of the first and second members generally flexible for relative longitudinal movement between said first and second members and generally rigid for absorbing and cancelling out substantially all lateral load components imparted between said first and second members by said longitudinally applied load on said load receiving means, said support means longitudinal flexibility providing said support means incapable of absorbing at least the greater portion of any longitudinal load components to which the first and second members are subjected by said load on said load receiving means, at least certain of said support means being placed in tension by said load on said load receiving means, safety means between the first and second members operably connected normally free of tension and normally freely longitudinally pivotal for normal free relative longitudinal movement between said first and second members, said safety means being substantially rigid in tension for resisting separation of said first and second members in the event of failure of said support means placed in tension, said safety means being normally freely longitudinally pivotal and therefore normally substantially incapable of absorbing any longitudinal load components to which said first and second members are subjected by said load on said load receiving means, a deflection member having longitudinally spaced laterally extending leg portions joined by a longitudinally extending connecting portion in generally C-shape positioned between the first and second suspension members, first connection means mounted extending laterally between one of said deflection member spaced leg portions and said first suspension member pivotally connecting said one leg portion to said first suspension member, second connection means mounted extending laterally between the other of said deflection member spaced leg portions and said second suspension member pivotally connecting said other leg portion to said second suspension member, the first and second connection means being operably connected to the respective deflection member spaced leg portions at locations laterally spaced from said deflection member longitudinally extending connecting portion, the deflection member absorbing at least the greater portion of all longitudinal load components to which the first and second members are subjected by said load on said load receiving means and the absorption of the longitudinal load components causing deflection of at least one of said deflection member leg portions, means on at least one of the first and second suspension members operably positioned relative to the deflection member leg portions for limiting the deflection of the deflection member leg portions to a predetermined maximum deflection resulting from a load on the load receiving means, and means operably connected to the deflection member for indicating the deflection between the leg portions thereof.

11. The scale mechanism as defined in claim 10 in which the means for limiting deflection of the deflection member leg portions resulting from a load on the load receiving means includes a recess formed in the first suspension member having predetermined longitudinal limits in both longitudinal directions and being laterally aligned with the second connection means connecting a deflection member leg portion to the second suspension member, and a recess formed in the second suspension member having predetermined longitudinal limits in both longitudinal directions and being laterally aligned with the first connection means connecting a deflection mem-

ber leg portion to the first suspension member; in which each of the connection means of the deflection member leg portions extends partially laterally into the respective laterally aligned recess; and in which the predetermined longitudinal limits of each of the recesses provide a predetermined clearance for the respective connection means partially received therein in both longitudinal directions to provide clearance for the predetermined maximum deflection of the deflection member leg portions resulting from a load on the load receiving means.

12. Scale mechanism including a first generally longitudinal suspension member, a second generally longitudinal suspension member spaced laterally from the first member, the first and second suspension members having longitudinally spaced portions, load receiving means operably connected to the second member for receiving a longitudinally applied load, generally lateral substantially parallel strap-like support means connected between the first and second member longitudinally spaced portions generally flexible for relative longitudinal movement between said first and second members and generally rigid for absorbing and cancelling out substantially all lateral load components imparted between said first and second members by said longitudinally applied load on said load receiving means, said support means longitudinal flexibility providing said support means incapable of absorbing at least the greater portion of any longitudinal load components to which said first and second members are subjected by said load on said load receiving means, the support means connected between the first and second members at one of said first and second member longitudinally spaced portions being placed in tension by said load on said load receiving means and the support means between the other of said first and second member longitudinally spaced portions being placed in compression by said load, the first and second members having laterally opposed inner faces at said support means placed in compression, said support means placed in compression having relatively thin short flexible sections adjacent said first and second member inner faces and having relatively stiff sections of increased thickness the remainder of and the major portion of the lateral space between said first and second members, a deflection member having longitudinally spaced laterally extending leg portions joined by a longitudinally extending connecting portion in generally C-shape positioned between the first and second suspension members, first connection means mounted extending laterally between one of said deflection member spaced leg portions and said first suspension member pivotally connecting said one leg portion to said first suspension member, second connection means mounted extending laterally between the other of said deflection member spaced leg portions and said second suspension member pivotally connecting said other leg portion to said second suspension member, the first and second connection means being operably connected to the respective deflection member spaced leg portions at locations laterally spaced from said deflection member longitudinally extending connecting portion, the deflection member absorbing at least the greater portion of all longitudinal load components to which the first and second members are subjected by said load on said load receiving means and the absorption of the longitudinal load components causing deflection of at least one of said deflection member leg portions, a recess formed in the first suspension member having predetermined longitudinal limits in both longitudinal directions and being laterally aligned with the second connection means connecting a deflection member leg portion to the second suspension member, a recess formed in the second suspension member having predetermined longitudinal limits in both longitudinal directions and being laterally aligned with the first connection means connecting a deflection member leg portion to the first suspension member, each of the connection means of the deflection member leg portions ex-

tending partially laterally into the respective laterally aligned recess, the predetermined longitudinal limits of each of the recesses providing a predetermined clearance for the respective connection means partially received therein in both longitudinal directions providing a predetermined maximum clearance and thereby a predetermined maximum deflection of the deflection member leg portions resulting from a load on the load receiving means, and means operably connected to the deflection member for indicating the deflection between the leg portions thereof.

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