United States Patent [19]

Smith

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[54] **DOCKBOARD SAFETY STOP**

[75] Inventor: **Vernon O. Smith,** Ashley, Ohio

[73] Assignee: **Overhead Door Corporation,** Dallas, Tex.

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[52] **U.S. Cl.** **14/71**

[51] **Int. Cl.** **B65g 11/00**

[58] **Field of Search** 14/71, 72; 16/66, 52, 51; 188/88

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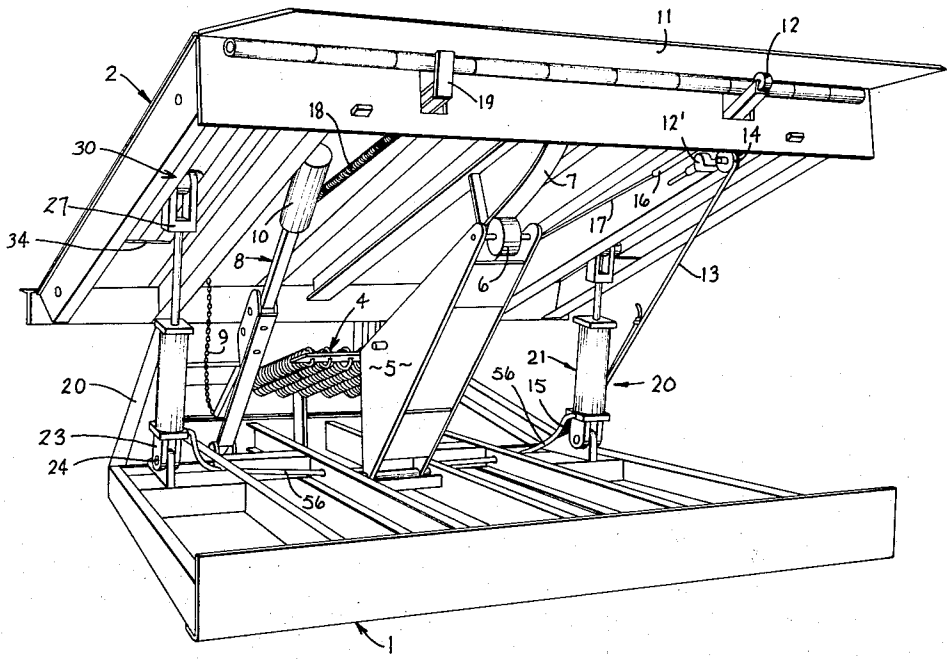
Primary Examiner—Nile C. Byers, Jr.

Attorney, Agent, or Firm—Woodhams, Blanchard and Flynn

[57] **ABSTRACT**

A dock leveler having a swingable ramp or deck positioned for engagement with a truck bed. The deck is freely swingable through a selected angle, both above and below a horizontal position, to accommodate and compensate for various bed heights. To prevent the deck from falling in the event a load is positioned on the deck and the truck pulls away from the deck, an improved safety stop device is positioned for coaction with the deck. The safety stop device, in a preferred embodiment of the invention, comprises a pair of closed and self-contained hydraulic stop cylinders positioned for engagement with the opposite edges of the deck. The stop cylinders are load sensing and permit free swinging movement of the deck under light loads, but positively prevent free swinging movement of the deck when same is heavily loaded.

21 Claims, 9 Drawing Figures



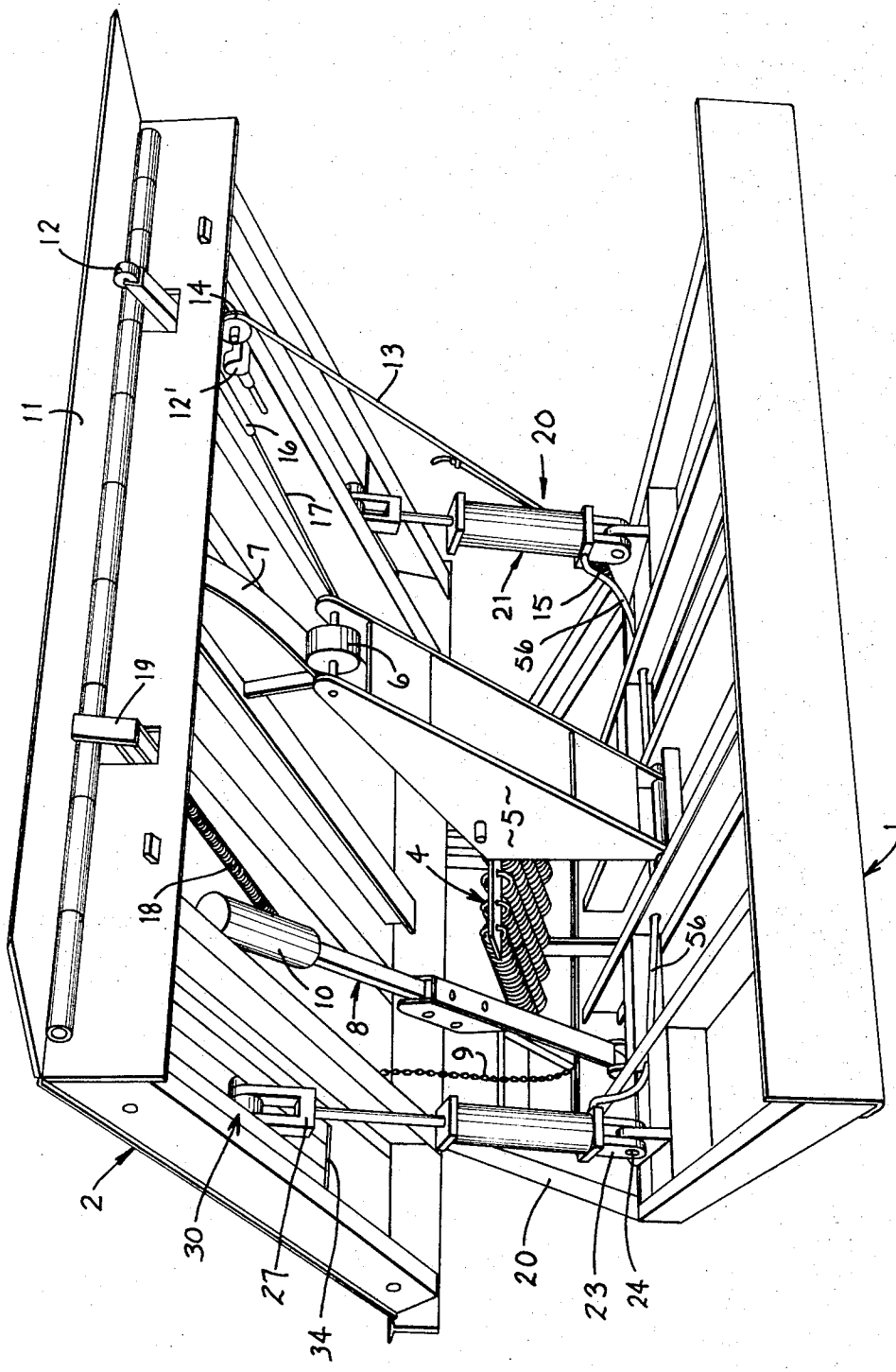

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Fig. 1

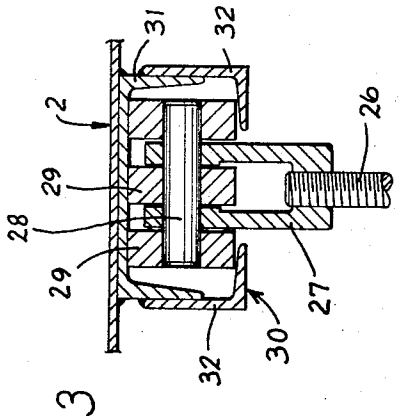

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Fig. 3

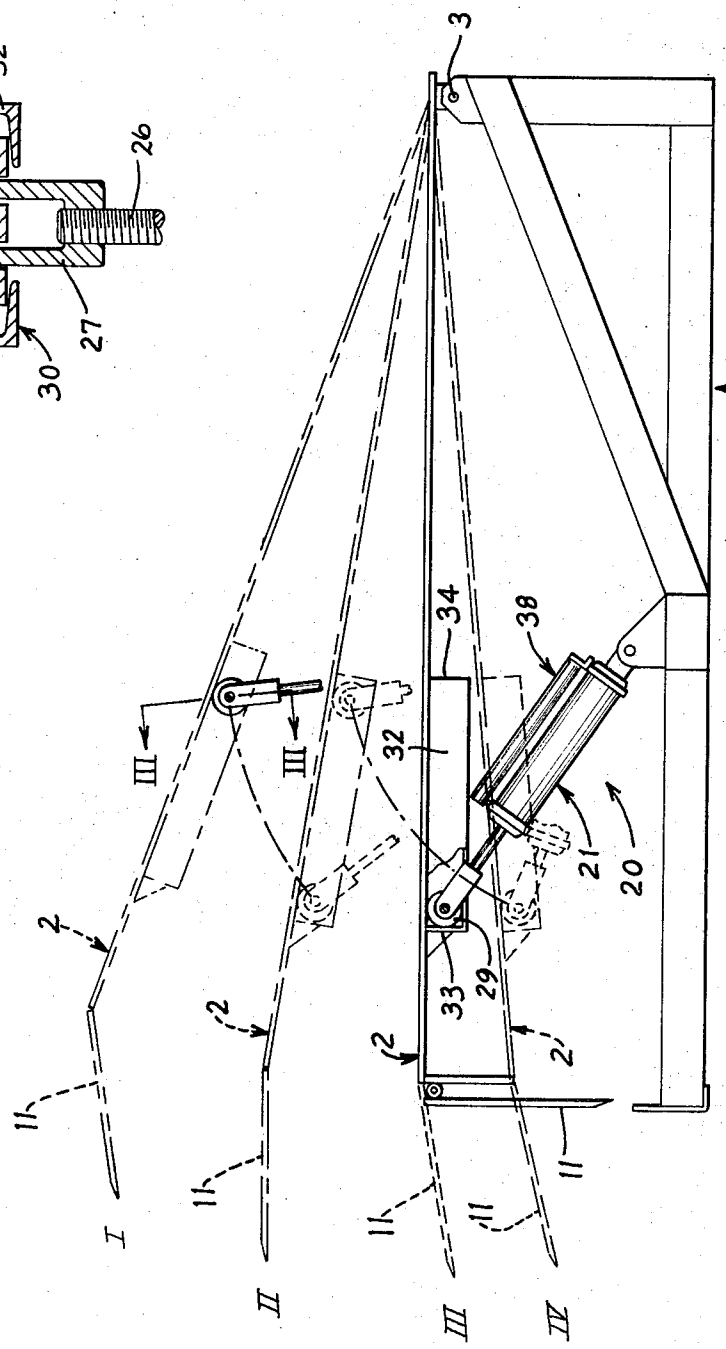
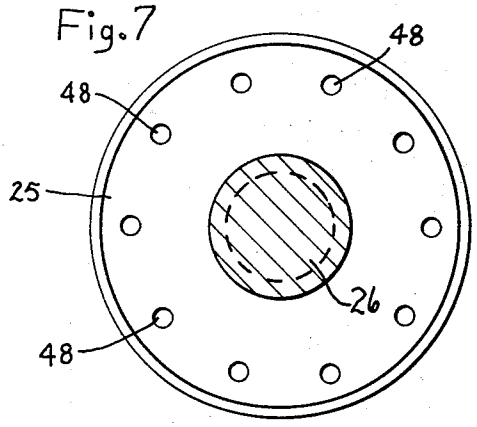

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Fig. 2

Fig. 7



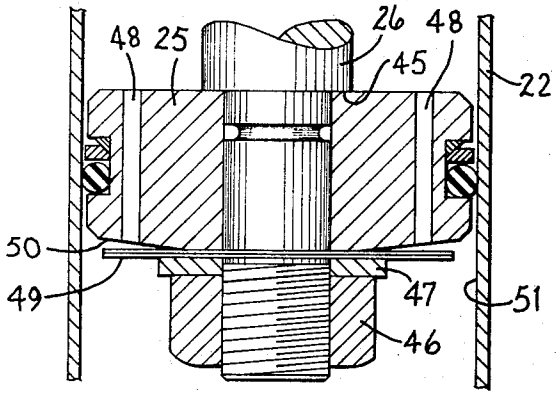


Fig. 6

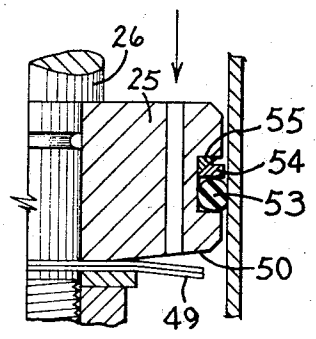


Fig. 8

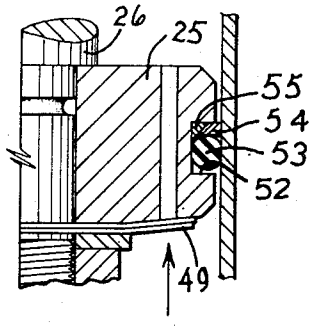


Fig. 9

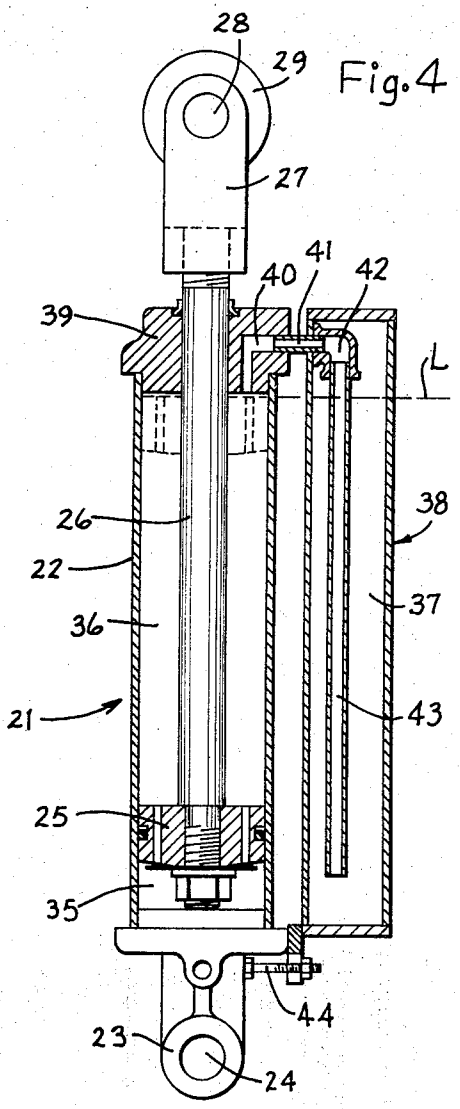


Fig. 4

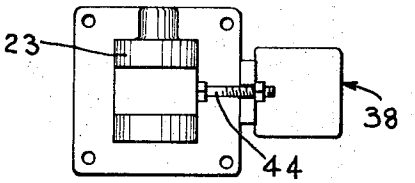


Fig. 5

DOCKBOARD SAFETY STOP

FIELD OF THE INVENTION

This invention relates to a dock leveler and, more particularly, to an improved safety stop device for maintaining a loaded ramp in its previous position in the event that the truck vehicle is pulled away from the ramp.

BACKGROUND OF THE INVENTION

Adjustable dockboards or dock levelers adapted for installation on loading docks to span the gap between the dock and the bed of a truck or other carrier, which carrier is in position to be loaded or unloaded, are widely used. Dockboards of this type have a ramp or deck which is hingedly mounted at its rear edge, the front edge of the deck having an extension lip hinged thereto to rest upon the bed of the truck. The entire dock leveler structure is normally positioned within a shallow pit so that the rear hinged edge of the deck is flush with the top of the dock, with the deck normally being maintained in a position flush with the dock when not in use. However, when in use, the deck may be angularly inclined upwardly or downwardly relative to the dock to accommodate trucks of different bed heights. To use the dockboard, the truck or carrier to be loaded or unloaded is backed into position adjacent the front of the dockboard, the rear edge of the bed being adjacent but slightly spaced from the dock. The hold down device of the dockboard is then released so that the deck is raised upwardly, as by means of a spring mechanism, which upward swinging of the deck also causes the extension lip to be raised after it has cleared the rear end of the truck bed. With the deck in its raised position, the operator then walks out onto the deck to lower it. This causes the extension lip to move downwardly into engagement with the bed, whereupon the lip and hence the front of the deck are supported by the bed of the carrier. The ramp, with its extension lip, thus bridges the gap between the dock and the carrier bed, even though the carrier bed may be above or below the dock level. Also, the deck will readily float up and down with the changing height of the carrier bed as the loading or unloading proceeds.

Dock levelers of the above-mentioned type have also been provided with a safety device, often referred to as a panic stop, for preventing undesired dropping or downward swinging of the deck when same is heavily loaded. For example, since the deck must freely float when disposed in engagement with the truck bed, it has been discovered that the deck will suddenly and rapidly swing downwardly if the deck is heavily loaded, such as having a forklift thereon, and the truck pulls outwardly away from the deck so as to eliminate the support at the forward edge thereof. In this situation, the deck drops rapidly downwardly and can cause tipping of the forklift and serious injury to the operator thereof. Another situation where potential injury and damage can result occurs when the deck is not being utilized, but is positioned substantially flush with the dock. If the deck is not properly latched, then if a forklift or the like is accidentally driven over the deck, it will rapidly swing downwardly which can then result in a rather serious accident. For this reason dock levelers have generally been provided with safety stop devices for preventing movement thereof when a heavy load is imposed on the deck and the deck is in an unsupported position.

While known safety stop devices have minimized the serious accidents which might occur when a heavy load is imposed on an unsupported deck, nevertheless the known safety stop devices have not proven totally satisfactory under all operating conditions. More specifically, most known safety stop devices have utilized an inertia-actuated mechanical stop mechanism for preventing the free-fall of a heavily loaded deck. However, these known inertia-operated stop devices necessarily require that the deck attain a predetermined velocity in order to result in the development of sufficient inertia to permit actuation of the safety stop device. This thus results in the deck undergoing a substantial pivotal travel to gain the required actuation velocity before the stop device will actuate. In some situations, the stop device requires that the deck travel downwardly as much as 3 to 4 inches before the safety stop device is actuated. Needless to say, this rather large amount of downward travel can itself be damaging inasmuch as it may cause a tipping of the load positioned on the deck.

Further, the known inertia or gravity-actuated mechanical stop devices are also subject to other conditions which effect the dependability of their operation. For example, such mechanical devices are extremely subject to corrosion, icing, and other physical abuse which occurs to dock equipment due to the fact that same is generally positioned outside and is thus exposed to all of the changing environmental conditions. Further, dock equipment is heavily abused due to the nature of the loading and use of the same in conjunction with trucks. Further, many of the known mechanical stop devices utilize springs for controlling the selected inertia level and, since the spring tension is generally preset in the factory, it is not always proper for the actual conditions encountered during usage.

Many of the known mechanical stop devices have been designed to require a pair of devices for coaction with the deck. In this situation, the mechanical stop devices are generally disposed adjacent the opposite front corners of the deck. However, since the devices are actuated by inertia or gravity, they are each independently actuated under an emergency situation. However, due to the independent actuation of same, the pair of mechanical lock devices rarely lock at the same instant since they can never be exactly identical as to positioning, spring biasing, corrosion, tolerances and moment of impact. Therefore, it is discovered that in most situations, only one of the inertia devices locks, thereby leaving the other device unactivated. This results in a canted deck since all of the load is carried by a stop mechanism located adjacent one front corner of the deck. This canting of the deck may still result in the load on the deck being tipped or spilled sideways, and may also warp or deform the deck so as to require extensive repair or replacement.

A still further disadvantage associated with the known stop devices relates to the manner in which they are positioned under the deck. In many situations, the stop device is vertically mounted in a hole located in a pit. The providing of such a hole in the pit is both difficult and expensive. Further, such holes tend to collect moisture which is susceptible to freezing in the winter, and this may abort the mechanical function of the safety device and also accelerates corrosion of same. Also, such holes tend to readily collect dirt which can also abort the function of the device.

Still a further disadvantage of the known inertia-actuated safety devices is the fact that they generally require mechanical adjustment of same in order to result in optimum operation. This mechanical adjustment must be made at the installation site so that the device will function in the optimum manner in association with the overall dockboard structure. This on-the-site adjustment is obviously undesirable since it is costly and requires the use of skilled personnel. Further, the provision of such adjustment structure often results in unskilled persons adjusting the device, so that the stop device thus often does not function in the optimum manner or, in the extreme, does not function at all.

In an attempt to eliminate the disadvantages associated with mechanical stop devices, hydraulic stop devices have been utilized. However, all of the known hydraulic stop devices have utilized extremely complex hydraulic circuitry involving the use of pumps, motors, shuttle valves, check valves, and the like. Further, these known hydraulic systems have also often provided adjustable orifices for controlling flow and stop rates. The complexity of these systems has made the systems extremely costly and thus undesirable. Further, this complexity also results in the system requiring substantial maintenance so that the reliability of the system is totally unsatisfactory. These known systems, by possessing adjustable orifices and the like, have also required on-the-site adjustment which makes usage of same undesirable, since such orifices can be, and often are, improperly adjusted.

Accordingly, it is an object of the present invention to provide an improved safety stop device for a dock leveler which overcomes the numerous above-mentioned disadvantages. Particularly, it is an object of the present invention to provide:

1. A safety stop device, as aforesaid, which is positive and instantaneously acting for holding the deck in position when a rather large load is substantially instantaneously imposed thereon, while at the same time the device will permit free movement of the deck when the load imposed thereon is less than a predetermined magnitude.
2. A safety stop device, as aforesaid, which is load-sensing and does not permit any appreciable movement of the deck prior to activation of the stop device.
3. A safety stop device, as aforesaid, which comprises a totally self-contained and closed hydraulic unit so as to not require any complex external circuitry or external power supply, wherein the unit is totally enclosed and sealed so as to prevent air and dirt from gaining access thereto, and wherein the use of persons skilled in hydraulics is not required for the installation of same.
4. A safety stop device, as aforesaid, which instantly locks both sides of the deck during an emergency condition to prevent canting and distortion of the deck.
5. A safety stop device, as aforesaid, which will not only stop the fall of a loaded deck, but which will also hold the heavily loaded deck in its previous position for an extended period of time.
6. A safety stop device, as aforesaid, which is totally closed and is adequately adjusted and tested by experienced personnel before shipment from the factory, and has no external adjustment structure to thus preclude inexperienced personnel from adjusting same and disrupting the optimum operation thereof.
7. A safety stop device, as aforesaid, which requires no special preparation of the pit and which can be sold as a kit for installation on existing dock levelers.
8. A safety stop device, as aforesaid, which is fully self-contained, which operates substantially the same under all loading and environmental conditions, and is not susceptible to corrosion, icing or other external usage or environmental abuses.
9. A safety stop device, as aforesaid, which is substantially maintenance-free, easy to install and economically marketable.

Other objects and purposes of the present invention will be apparent to persons acquainted with devices of this type on reading the following specification and inspecting the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a dock leveler, same being illustrated in its raised position and incorporating thereon the improved safety stop device of the present invention.

FIG. **2** is a side elevational view of the dock leveler and illustrating the various positions of the deck.

FIG. **3** is an enlarged, fragmentary sectional view taken substantially along the line III—III in FIG. **2.**

FIG. **4** is a central sectional view of the safety stop cylinder of the present invention.

FIG.**5** is a view illustrating the lower end of the stop cylinder of FIG. **4.**

FIG. **6** is an enlarged fragmentary sectional view illustrating the piston structure.

FIG. **7** is a view illustrating the end face of the piston structure.

FIG. **8** is a fragmentary sectional view similar to FIG. **6** and illustrating the piston structure when the safety stop cylinder is being extended during upward movement of the deck.

FIG. **9** is a view similar to FIG. **8** and illustrating the valve associated with the piston structure in a closed position so that the stop cylinder is in a locked condition.

Certain terminology will be used in the following description for convenience in reference only and will not be limiting. For example, the words "rightwardly" and "leftwardly" will refer to directions in the drawings to which reference is made. The words "upwardly" and "downwardly" will not only refer to directions in the drawings, but will also refer to the direction of movement of the dockboard deck. The words "front" and "rear" will have reference to the front and rear ends of the dockboard structure, as illustrated on the left and right sides, respectively, of FIG. **2.** The words "inwardly" and "outwardly" will refer to the geometric center of the dockboard structure and designated parts thereof. Such terminology will include the words above specifically mentioned, derivatives thereof and words of similar import.

SUMMARY OF THE INVENTION

The objects and purposes of the present invention are met by providing a dock leveler having a deck vertically swingably mounted on a base which is adapted to be positioned within a pit. A spring mechanism coacts between the base and the deck for normally urging

same upwardly. A lip plate is hingedly mounted on the front edge of the deck and is adapted for engagement with the bed of a carrier or truck. A safety stop device coacts between the deck and the base for preventing undesired downward swinging movement of the deck in situations where the deck is in an unsupported or unlocked condition and has a rather large load imposed thereon . The safety device of the present invention is weight-actuated in that it permits free swinging movement of the deck when the load on the deck is below a predetermined magnitude, but it positively locks and maintains the deck in its previous position when the load on the unsupported deck exceeds said predetermined magnitude. The safety stop device includes a totally closed self-contained hydraulic stop cylinder. In a preferred embodiment, a pair of identical stop cylinders are disposed for engagement with the opposite edges of the deck and are hydraulically interconnected, as by means of a conduit, so that the two stop cylinders are simultaneously actuated.

DETAILED DESCRIPTION

FIG. 1 illustrates therein an in-pit type dock leveler consisting of a rigid base or frame 1 and a ramp or deck section 2 which adjacent its rear edge is pivotally mounted on the base 1 by means of hinge pins 3. When in a stored or inactive position, the deck section 2 is normally maintained in a substantially horizontal position wherein it is substantially flush with the surrounding loading dock. This stored horizontal position corresponds to position III as illustrated in FIG. 2. For this purpose, the dock leveler is provided with a releasable latch mechanism (not shown) of conventional construction for locking the deck section in position III. When the latch mechanism is released, then the deck section 2 is normally urged upwardly by means of an extension spring device 4 which has its rearward end affixed to the rear of the base 1 and its forward end affixed to a lifting arm 5. The lifting arm 5 has its lower end pivotally mounted on the base 1 and has a roller affixed at its upper end disposed in rolling engagement with a cam 7 affixed to the underside of the deck section 2. The spring mechanism 4 thus resiliently urges the deck section 2 to swing upwardly (clockwise in FIG. 2) so that the deck section assumes an uppermost raised position designated as position I in FIG. 2. The force generated by the spring mechanism 4 is sufficient to sustain the deck section 2 in position I, but is not sufficient to sustain a 150 pound weight mounted on the deck section adjacent the forward edge thereof. Thus, the deck section 2 may be walked down from position I to one of its lower positions, such as one of positions II, III or IV, by a man of approximately 150 pounds walking on the deck section from the rear to the front thereof so as to overcome the force generated by the spring mechanism 4.

The dock leveler also includes a mechanical hold down unit 8 which is affixed by clevis means between the deck section 2 and the base 1. This hold down unit consists of a serrated bar and a serrated pawl which are spring-loaded to engage each other so that they are slidable in one direction only. As the deck section 2 is walked down, the serrations slip over each other. However, after the deck is walked down to the proper position and the weight removed therefrom, then the deck section is held in the selected position by the pawl lockingly engaging the serrated bar. To release the deck section for upward travel, chain 9 is pulled by the operator to disengage the pawl from the rack bar. Upon release of the chain 9, the pawl re-engages the rack bar. A further feature of this hold down unit is the provision of a compression spring disposed in housing 10, which is the connecting link between the hold down unit 8 and the deck section 2. This structure is provided so that if the deck 2 is resting on a truck bed and said bed rises approximately six inches while being unloaded, then the compression spring in housing 10 will compress.

The dock leveler, in a conventional fashion, is also provided with a lip plate 11 hinged to the forward edge of the deck section 2, which lip plate normally hangs downwardly in a pendent gravity position, substantially as illustrated in position III of FIG. 2. The lip plate 11 is actuated to swing outwardly into an extended position when the deck section swings upwardly and approached its upper position I. The upward swinging movement of lip plate 11 is caused by means of a rollered slide bar 12 which slides forward in a housing 12' affixed to the undercarriage of the deck section 2. The slide bar 12 is urged forwardly by means of a cable 13 which extends over a pulley 14 and is attached to the rearward end of the slide bar 12. The other end of cable 13 is connected to an extension spring 15, which is affixed to the base 1. As deck 2 is rapidly raised, the cable 13 becomes taunt, extending spring 15 which urges the slide bar 12 to push lip plate 11 outwardly to its open position and sustain it there. As the dock leveler is walked down, lip 11 remains outward, resting on the slide bar and by its own weight resting on the angular juncture of the slide bar. To retract the slide bar 12, an extension spring 16 and cable 17 are affixed between the slide bar 12 and the lift arm 5. As the deck is walked down, the point of connection of the cable 17 to the lifting arm 5 moves further away from the slide bar, thus extending spring 16 and urging slide bar 12 rearwardly. However, due to the friction between the lip plate 11 and the slide bar 12, the slide bar 12 is prevented from moving rearwardly until the lip plate 11 makes contact with the truck bed, whereby the frictional resistance is relieved so that the spring 16 then retracts the slide bar 12 into the housing 12'. The swinging movement of the lip plate 11 is further assisted by means of a counterbalance mechanism which, as illustrated in FIG. 1, comprises compression spring 18 which has its rearward end affixed to the deck section and its forward end affixed to an arm 19, which arm 19 is affixed to and projects downwardly from the lower side of the lip plate 11. The compression spring 18 partially counterbalances the weight of the lip plate 11 so that the slide bar 12 can thus function to easily swing the lip plate outwardly and upwardly.

The structure of the dock leveler, as briefly described above, is substantially conventional and further description of same is thus not believed necessary. Reference is made to U.S. Pat. No. 3,235,896, issued Feb. 22, 1966, to W. O. Riggs, wherein much of the above-mentioned structure is described in detail.

Before considering the remaining structure of the dock leveler, it should first be noted that positions II and IV, as illustrated in FIG. 2, define the normal upper and lower positional limits of the deck section 2 when same is disposed for coaction with the bed of a truck. More specifically, position II illustrates the deck section swung upwardly from its horizontal position and

disposed so that the edge of the lip plate is approximately 12 inches above the dock level, which dock level corresponds with the horizontal position of the deck section (namely position III). Position IV, on the other hand, illustrates the deck section when swung downwardly from the horizontal position and disposed so that the free edge of the lip plate is disposed substantially 12 inches below the dock level. It has been discovered that this range of movement between positions II and IV is sufficient to enable the dock leveler to accommodate and coact with the beds of various trucks or carriers.

To prevent free falling of the deck section 2 when a rather large load is substantially instantaneously imposed thereon when same is in an unlocked and unsupported condition, the present invention provides a safety stop device **20** for sustaining the deck section and the load thereon in its previous position. The safety stop device **20** includes a telescopic fluid pressure cylinder means **21** which is positioned beneath the deck section 2 and is disposed for coaction between the deck section 2 and the base **1.** In the preferred embodiment, the safety stop device **20** utilizes two fluid pressure cylinder means **21** disposed for coaction with the opposite edges of the deck section **2,** substantially as illustrated in FIG. **1.** Since the fluid pressure cylinder means **21** are identical, only one of these cylinder means will be described in detail.

The fluid pressure cylinder means **21,** as illustrated in FIGS. **2–4,** includes a cylinder housing **22** having a clevis **23** secured to the lower end thereof, which clevis is hingedly connected to the base **1** as by a hinge pin **24.** A piston **25** is slidably disposed within the cylinder housing **22** and is connected to a piston rod **26** which extends outwardly from the upper end of the housing **22** and is provided with a clevis **27** on the free end thereof. A pin or axle **28** is supported on the clevis **27** and in turn supports thereon a plurality of rollers **29** The rollers **29** are rollingly supported within and confined by a guide track **30** which is fixedly secured to the underside of the deck section **2.** The guide track **30,** as illustrated in FIG. **3,** includes an elongated downwardly opening channel-shaped member **31** disposed so as to partially surround and confine the rollers **29.** A pair of angle members **32** are fixedly secured to the member **31** and positioned so as to extend under the rollers **29,** whereby members **31** and **32** thus provide upper and lower elongated guide surfaces for confining the rollers **29** therebetween. The opposite ends of the guide track **30** are suitably closed by means of end plates **33** and **34** so that rollers **29** are thus appropriately confined within the track **30,** which track is of a predetermined length to enable the rollers **29** to rollingly move therealong through a selected distance.

Considering now the cylinder means **21,** the housing **22** thereof defines therein a compartment in which is slidably positioned the piston **25,** same dividing the compartment into a compression chamber **35** located between the piston **25** and the bottom of the housing, and a suction chamber **36** located between the piston **25** and the upper end of the housing. The chamber **36** in turn communicates with a reserve chamber **37** which is formed within an accumulator **38** secured to the side of the housing **22.** The upper head plate **39** of the housing **22** has a passage **40** formed therein, which in turn communicates with a nipple **41** which extends between and fixedly connects the accumulator **38** to the head plate **39.** The nipple **41** is fixed to an elbow **42** which is fixed to the upper end of a suction tube **43.** Suction tube **43** is disposed within the reserve chamber **37** and has the lower open end thereof disposed closely adjacent the lower end of the chamber **37.** The lower end of the accumulator **38** is also fixed to the housing **22** as by means of a releasable threaded fastener device **44.**

The piston **25** is fixedly mounted on a reduce diameter portion formed on the lower free end of the piston rod **26,** the piston **25** being clampingly held between the piston rod shoulder **45** and a nut **46.** A washer **47** is provided between the nut and the piston.

Piston **25** also has a plurality of small metering holes **48** extending axially therethrough for providing communication between the chambers **35** and **36.** The holes **48** are disposed in a circular pattern disposed around the piston rod as illustrated in FIG. **7.** The flow through the holes **48** is controlled by a valve **49** which, in the illustrated embodiment, comprises a pair of platelike metal wafers disposed in surrounding relationship to the piston rod **26** and having a diameter slightly greater than the diameter defined by the outside periphery of the circular pattern of holes **48.** The wafers defining the valve **49** are affixed directly adjacent the lower end face **50** of the piston **25,** being clamped between the piston **25** and the washer **47** by means of the lock nut **46.** The center portion of the piston **25** is provided with a substantially flat lower face thereon which is disposed in abutting engagement with the center portion of the valve **49.** However, the lower compression face **50** of the piston **25** has the outer portion thereof formed with a tapered or conical configuration so that the compression face **50** thus extends at a small angle relative to a plane which is perpendicular to the axis of the piston rod. In the illustrated embodiment, the tapered portion of the face **50** extends at an angle of approximately 6° relative to the perpendicular plane. Further, the lower ends of the metering holes **48** terminate in the tapered portion of the compression face **50** and, since the valve **49** is normally disposed within a perpendicular plane, the inner ends of the holes **48** are normally spaced from the valve **49.** The valve **49** is normally maintained in an open position substantially as illustrated in FIG. **6.** The operation of the valve **49** in relation to the operation of the cylinder means **21** will be considered in detail hereinafter.

The piston **25** is also provided with a resilient seal structure associated therewith for creating a sealed relationship with the inner wall **51** of the cylinder housing **22.** For this purpose, the piston **25** is provided with an annular groove **52** containing therein a conventional elastomeric O-ring **53** of circular cross section. Groove **52** includes therein a further backup ring structure which consists of two split rings **54** and **55** which are installed on the opposite side of the O-ring **53** from the compression chamber **35.** The split rings **54** and **55** are angled at their junction due to one ring being provided with a tapered ramplike surface thereon. These split backup rings **54** and **55** do not normally touch the inner cylinder wall **51** but, as pressure builds up in the compression chamber **35,** O-ring **53** is moved axially into engagement with the split ring **54,** which ring then rides upwardly and outwardly along the ring **55** and is thus expanded into tight sealing engagement with the cylinder wall **51.** The backup ring **54** provides a substantially flat surface of plastic for the O-ring **53,** thereby

enabling the O-ring **53** to readily resiliently deform so as to seal the clearance between the cylinder wall **51** and the piston **25.** The use of the backup rings **54** and **55** is highly desirable since it prevents the elastomeric O-ring **53** from being extruded through the clearance between the piston and the cylinder wall and also prevents the O-ring **53** from being cut due to the high pressure forcing same against the metal finish of the groove **52.** In the construction of the piston **25,** groove **52** is machined deeper than normal so that only a slight pressure is normally compressing the O-ring **53,** thereby allowing the piston **25** to work freely in the bore defined by the cylinder wall **51.** This thus minimizes the frictional effect of the cylinder means **21.** While some of the fluid contained within the cylinder means will thus flow past the O-ring **53** at low pressure levels, due to the aforementioned excessive clearance, nevertheless at higher pressures the O-ring **53** will deform as shown in FIG. **9** due to the provision of the backup seal ring structure to thus successfully seal the piston relative to the surrounding housing. In this respect, the O-ring **53** reacts to the pressure in the compression chamber **35** in substantially the same manner as the valve **49,** as explained hereinafter.

OPERATION

The operation of the dock leveler constructed according to the present invention will be briefly described to insure a complete understanding thereof.

Before considering the overall operation of the dock leveler, it should be noted that the fluid pressure cylinder means **21** is preferably filled with a predetermined quantity of a substantially incompressible fluid, such as hydraulic fluid. The cylinder is filled with sufficient fluid so that the chambers **35** and **36** are totally filled with said fluid at all times. Further, the reserve chamber **37** is also partially filled with a sufficient quantity of said fluid so that the lower open end of suction pipe **43** is always immersed within the fluid irrespective of the position of the piston **25** within the housing **22.** Particularly, the reserve chamber **37** is filled with said fluid to a level at least equal to the level designated L, which level corresponds to the lower face of the piston **25** when the piston is in its uppermost position. In this manner, the level of fluid in the reserve chamber **37** will always seek its own level within the suction chamber **36,** thereby positively preventing the entry of air into the cylinder means **21.** The upper portion of the reserve chamber **37** contains a gas (preferably air) therein, which gas is compressed when the piston rod **26** contracts into the cylinder due to the flow of fluid from chamber **36** into reserve chamber **37.** The gas compressed within the upper end of reserve chamber **37** assists in forcing the fluid from chamber **37** back into the chamber **36** wherein the piston rod **26** is extended.

It will first be assumed that the dock leveler is positioned substantially as illustrated by solid lines in FIG. **2,** wherein the deck section **2** is substantially horizontal and flush with the surrounding loading dock, and that the rollers **29** associated with the safety stop device **20** are positioned adjacent the forward end plate **33.** When it is desired to utilize the dock leveler in conjunction with the bed of a truck or carrier, then the latching mechanism (not shown) is manually released whereupon the spring mechanism **4** raises the deck section **2** upwardly into position I. During the swinging movement of the deck section **2** from position III toward position I, the rollers **29** initially roll rearwardly of the guide track **30** until they are positioned adjacent the end plate **34.** Further upward swinging movement of the deck section **2** toward position I causes the piston rod **26** to be extended upwardly. As the deck section **2** closely approaches position I, the mechanism associated with slide bar **12** causes actuation of same whereby lip plate **11** is swung outwardly and upwardly into its extended position.

During the above-mentioned extension of piston rod **26,** which is accompanied by an upward displacement of piston **25,** fluid flows from suction chamber **36** through the metering openings **48** into the compression chamber **35,** which flow of fluid also causes a resilient deflection of the valve **49** into a more fully open position substantially as illustrated in FIG. **8,** thereby permitting free flow of fluid from chamber **36** into chamber **35** and thus enabling free upward movement of piston **25** and piston rod **26** at a rather rapid rate. However, during the upward movement of piston **25,** the volume increase in compression chamber **35** is greater than the volume decrease in suction chamber **36** due to the provision of the piston rod **26** in the chamber **36.** Thus, a larger quantity of fluid must be supplied to compression chamber **35** than is displaced from suction chamber **36.** This extra fluid necessary for supply to the compression chamber **35** is provided by the accumulator **38,** so that fluid flows by gravity from the reserve chamber **37** through the suction tube **41** into the suction chamber **36.** Thus, the chambers **35** and **36** are maintained full of fluid at all times, while at the same time the valve **30** permits a rather fast extension of the piston rod **26** relative to the housing **22** to enable a rather rapid upward swinging movement of the deck section into position I. When the deck section **2** reaches position I, the piston **26** is substantially fully extended.

After the deck section **2** has reached its raised position I, then an operator walks outwardly on the deck section **2** toward the free edge thereof causing the deck section **2** to slowly swing downwardly until the lip plate **11** comes into engagement with the bed of a truck. During the downward swinging of the deck section from position I to position II, the piston rod **26** remains in its substantially fully extended position but the rollers **29** are rollingly displaced along the guide track **30** from a position adjacent end plate **34** to a position adjacent end plate **33** when the deck section reaches position II. When the deck section reaches position II, the rollers **29** abut the end plate **33** so that further downward swinging of the deck section, such as from position II toward position IV, causes the piston rod **26** to be retracted within the cylinder housing **22** whereby piston **25** is likewise moved downwardly toward the bottom of the housing **22.** If this additional downward swinging movement of deck section **2** from position II toward position IV occurs under a relatively light load, such as a load substantially less than 1,000 pounds (such as would be caused by a man walking out on the deck section), then the pressure created by this load on the fluid within the stop cylinder **22** is of such a low magnitude that it is unable to move the valve **30** to a closed position. The valve **30** thus remains in its normally open position, as illustrated in FIG. **6,** whereupon fluid flows from compression chamber **35** around the edge of the valve wafers **49** and through the metering

openings **48** into the chamber **36.** Since the volume of fluid displaced from the compression chamber **35** is greater than the increase in volume in the suction chamber **36,** which difference is due to the presence of the piston rod **26,** some of the fluid in suction chamber **36** necessarily flows through the tube **43** into the reserve chamber **37.** Thus, the stop cylinder **21** will permit a slow downward swinging movement of the deck section **2** below position II so long as the load on the unsupported deck section does not exceed (and is preferably substantially less than) a predetermined value, which predetermined value is normally in the order of 1,000 pounds. The stop cylinder **22** thus enables the deck section **2** to be readily walked downwardly so that the lip plate **11** moves into engagement with the truck bed when same is disposed at an elevation located between positions II and IV.

When the lip plate **11** moves into engagement with the truck bed so to provide support for the deck section, then the deck section is maintained in its lowered position and prevented from returning to its upper position by means of the hold down unit **8.** This unit **8** does, however, permit the deck section to swing further downwardly such as may occur when a truck is being loaded, and likewise the compression spring contained within housing **10** permits the deck section to pivotally swing upwardly a limited amount such as may occur when the bed of a truck rises as during unloading.

During utilization of the dock leveler of the present invention, the loads which are transmitted across the deck section **2** are normally transmitted to the base **1** through the hinge pin **3** and to the truck bed through the lip plate **11.** Further, these loads are generally in the range of between 1,000 and 20,000 pounds and thus exceed the preselected value of 1,000 pounds below which the stop cylinders **21** are not activated. If the bed of a truck is accidentally removed from beneath the lip plate **11** while the deck section **2** had a load in excess of 1,000 pounds thereon, then the unsupported deck section is substantially instantaneously subjected to a heavy load which tends to swing the deck section downwardly. However, this undesirable downward swinging of the deck section is positively prevented due to the stop cylinders **21,** which cylinders **21** are in at least a partially extended position when the deck **2** is located at or between positions II and IV. In this situation, the instant the heavily loaded deck section **2** becomes unsupported, the load on the deck section **2** is immediately transmitted to the rollers **29** (which are positioned adjacent end plate **33**) and through each piston rod **26** and piston **25** onto the incompressible fluid located within the compression chamber **35.** This fluid is thus substantially instantaneously pressurized which causes the outer periphery of valve **49** to resiliently flex into snug engagement with the conical face **50,** thereby closing the lower ends of the metering holes **48.** At the same time, the pressure fluid within compression chamber **35** causes the seal structure surrounding the piston to be deformed substantially as illustrated in FIG. **9.** In this manner, the fluid within chamber **35** is totally trapped so that the fluid is able to develop a rather large pressure, thereby totally locking the cylinder means **21** in its predetermined position so that the cylinder thus not only withstands and supports the large load which exists on the deck **2,** but also prevents the deck from moving downwardly.

The safety stop device **20** of the present invention is thus substantially load sensing in that the fluid pressure stop cylinder **21** is responsive to and locks up when the load imposed on same exceeds a predetermined magnitude. Further, the stop cylinder can positively and substantially instantly act so as to lock the loaded deck section **2** in its predetermined position without the deck section undergoing any appreciable downward swinging movement prior to lockup of the cylinder **21.** Further, the device is capable of not only stopping downward swinging of the deck, but is also capable of sustaining large loads for long periods of time since the larger the load, the greater is the pressure developed within the compression chamber **35,** which pressure in turn acts against the valve **49** so as to seal same against the face **50.** Further, when the load is removed from the platform, then this relieves the pressure within the chamber **35** so that the valve **49** again opens, thereby enabling the dock leveler to automatically return to its normal mode of operation without requiring any special release mechanism.

While the stop cylinder **21** is primarily load sensing, as explained above, it has been discovered that same is also inertia sensing since imposition of a sudden shock load on the deck section **2** tending to swing same downwardly also cause a corresponding sudden downward movement of the piston **25.** However, the inertia of the valve **30** deflects the valve into a closed position wherein it overlaps the lower ends of the holes **48,** thereby providing a momentary lockup of the cylinder **21** for preventing excessive downward swinging movement of the deck section due to imposition thereon of a shock or impact load.

As noted above, the present invention preferably provides a pair of stop cylinders **21** adjacent the opposite longitudinal edges of the deck section **2.** Further, the compression chambers **35** of the pair of cylinders **21** are interconnected and in communication with one another by means of an intermediate hose or conduit **56.** The compression chambers **35** of the pair of cylinders **21** are thus always in free communication with one another to permit instant pressure equalization between the two compression chambers. In this manner, the two power cylinders **21** simultaneously and instantaneously act as a single unit so that both cylinders **21** lock up at substantially the same time to thus provide substantially uniform support under the opposite edges of the deck section **2.**

The stop cylinders **21,** which are constructed so as to be load sensitive in compression only, are totally self-contained and closed system so that they do not require any maintenance or adjustment. The cylinders, by being load responsive, thus substantially instantaneously lock on both sides of the deck section so as to prevent any significant deck movement. The cylinders thus not only stop the fall of the deck, but hold the deck in its previous position. Further, the stop cylinders can be installed on the leveler at the factory and can thus be adequately installed and tested prior to shipment of the leveler. Further, the device can easily be installed on existing load levelers, and does not require one skilled in the art of hydraulics to perform the installation since the stop cylinders constitute a totally closed and self-contained system. Since the system is totally closed and self-contained, and utilizes no external valves, pumps, motors and the like, the reliability and dependability of the system is extremely high.

In the previous description, reference has been made to the safety stop device of the present invention as being capable of sustaining the deck in its previously assumed position when the unsupported deck has a substantially instantaneous load of large magnitude imposed thereon. It must be recognized that this type of loading situation can exist in several ways. For example, if the unsupported deck is positioned substantially flush with the loading dock and if a fork lift is driven on the unsupported deck, this will result in the unsupported deck being subjected to a large load which will cause activation of the safety stop device. Similarly, if the lip plate of the deck is resting on the bed of the truck and a rather large load is on the deck section, then if the truck should pull away from the lip plate so as to instantaneously leave the deck unsupported, then this also results in the unsupported deck being substantially instantaneously loaded so as to cause activation of the stop cylinder.

With respect to the use of the track structure **30** as provided on the deck section **2,** this track structure is highly desirable since it enables the deck section to angularly move between positions I and II without requiring any addition extension of the cylinder means **21.** Use of the track **30** thus enables the maximum stroke of the cylinder means **21** to be minimized so as to ocrrespond to the angular displacement correspond the deck encountered under loading conditions, the upper limit of which is defined by position II. The size, weight and cost of cylinder means **21** is thus minimized.

Although a particular preferred embodiment of the invention has been disclosed above for illustrative purposes, it will be understood that variations or modifications thereof which lie within the scope of the appended claims are fully contemplated.

The embodiment of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An adjustable dockboard for spanning the gap between a loading dock and a floor of a carrier disposed in a loading or unloading position adjacent the dock, said dockboard having a ramp with front and rear edges and means at its front edge to rest on the floor of a carrier and means hingedly connecting the rear edge of the ramp relative to the dock so that the ramp may rise and fall as the height of the carrier changes, and safety means for supporting the ramp in the event the carrier pulls away from the dock and leaves the ramp unsupported at its front edge, comprising the improvement wherein said safety means includes closed and self-contained telescopic fluid pressure cylinder means acting solely as a safety stop and coacting with said ramp for stationarily supporting same when the load on said ramp exceeds a predetermined magnitude, said cylinder means including wall means defining a substantially closed chamber containing therein a predetermined quantity of a substantially incompressible fluid, said wall means defining a pair of compartments containing therein said incompressible fluid, said cylinder means also including piston means slidably movable relative to said wall means, said piston means defining one of the boundaries of at least one of said compartments, flow passage means extending between said pair of compartments and providing the sole communication therebetween, and valve means associated with said flow passage means for totally closing same and preventing flow between said compartments when a sudden load is imposed on said ramp in excess of said predetermined magnitude and said ramp is unsupported, said valve means remaining closed for holding said piston means stationary relative to said wall means so long as said load remains on said ramp.

2. A dockboard according to claim **1,** wherein said cylinder means includes a cylinder housing defining an elongated piston chamber therein and said piston means being slidably positioned within said housing and slidable longitudinally thereof, said piston means dividing said chamber into said pair of compartments, and said cylinder means further including accumulator means defining therein a reservoir chamber, and means defining a passageway between said reservoir chamber and one of said compartments, said piston and reservoir chambers and said passageway interconnecting same defining a closed system, and said predetermined quantity of substantially incompressible fluid being disposed in said system and completely filling said piston chamber and only partially filling said reservoir chamber, and said passageway always being filled with said fluid.

3. A dockboard according to claim **2,** wherein said piston means has said flow passage means extending therethrough for permitting flow of said fluid between said compartments, and said valve means being mounted on said piston means and associated with said passage means for preventing flow through said passage means from the other compartment to said one compartment when the pressure of the fluid within said other compartment exceeds a predetermined value.

4. A dockboard according to claim **2,** wherein said piston means has a tapered surface formed on one end thereof, wherein said passage means terminates at said tapered surface, and said valve means comprising a platelike valve member mounted on said piston means adjacent said tapered surface, said valve member being resiliently deflectable into engagement with said tapered surface for closing the terminal end of said passage means.

5. A dockboard according to claim **1,** wherein said ramp has track means of predetermined length formed on the lower side thereof, said track means extending longitudinally in a direction from the rear edge toward the front edge of said ramp, the opposite ends of said track means being closed by stop means, and said fluid pressure cylinder means having slide means mounted on one end thereof and disposed for movement along said track means for enabling said ramp to undergo a limited amount of swinging movement without causing extension or retraction of said cylinder means.

6. In combination, a vertically swingable dockboard ramp and a safety stop device for preventing free downward swinging of the dockboard ramp when the ramp is unsupported and has a load disposed thereon, said safety stop device comprising:

telescopic fluid pressure cylinder means adpted for coaction with said ramp and capable of locking up when a load in excess of a predetermined magnitude is imposed thereon for stationarily holding the ramp, said cylinder means including a substantially closed cylinder housing defining therein an elongated bore and a piston slidably disposed within said bore and dividing same into a compression chamber and a suction chamber, a piston rod fixedly secured to said piston and extending through one of said chambers and outwardly from

one end of said cylinder housing, accumulator means disposed adjacent said cylinder housing and defining therein a reserve chamber and means defining a passageway providing communication between said reserve chamber and said suction chamber, said reserve, suction and compression chambers and said passageway defining a closed system containing therein a predetermined quantity of a substantially incompressible fluid, said reserve chamber as defined by said accumulator means having only a portion thereof filled with said fluid, the remaining volume of said reserve chamber containing trapped therein a predetermined quantity of a compressible gas, said passageway providing communication with the portion of said reserve chamber containing said fluid therein, said suction and compression chambers and said passageway and said portion of said reserve chamber always being filled with said fluid, flow control passage means providing the sole communication between said suction chamber and said compression chamber, and load-responsive valve means associated with said flow control passage means for totally closing same and preventing flow of fluid from said compression chamber to said suction chamber when a load in excess of said predetermined magnitude is imposed on the unsupported ramp.

7. A combination according to claim **6,** wherein said flow control passage means extends through and interconnects the opposite end faces of said piston, and said valve means comprising a valve member mounted on said piston and disposed for coaction with said flow control passage means.

8. A combination according to claim **6,** wherein said flow control passage means comprises a plurality of small metering holes formed in said piston and extended axially therethrough for providing communication between said compression chamber and said suction chamber, said plurality of holes being disposed in a circular pattern generated about the axis of said piston, and said valve means comprising a platelike valve disc having the center portion thereof fixedly mounted on said piston and having the annular peripheral portion thereof disposed for overlapping said holes, the annular peripheral portion of said valve disc and the adjacent end face of said piston wherein said holes terminate being angularly inclined relative to one another by means of a small intermediate angle, and the annular peripheral portion of said valve disc being resiliently deflectable so as to move into engagement with the adjacent end face of said piston for covering said holes when the pressure in said compression chamber exceeds a predetermined value.

9. A safety device according to claim **6,** wherein said cylinder means is disposed so as to always extend at least partially in the vertical direction, and said compression chamber being disposed adjacent the lower end of said cylinder housing and said piston rod extending upwardly from said piston and through said suction chamber, said accumulator means comprising an elongated hollow tubular member disposed directly adjacent said cylinder housing and fixedly connected thereto and extending substantially longitudinally thereof, and said passageway comprising conduit means providing communication between the upper end of said suction chamber and the lower end of said reserve chamber, said conduit means including an elongated pipe member disposed within said reserve chamber and having the lower open end thereof disposed adjacent the lower end of said reserve chamber, said flow control passage means being formed within said piston and extending axially therethrough for providing communication between said suction chamber and said compression chamber, and said valve means comprising a valve member mounted on said piston and disposed for coaction with said passage means extending therethrough, said valve member being disposed so as to be acted upon by the pressure fluid contained within said compression chamber.

10. In an adjustable dockboard for spanning the gap between a loading dock and the bed of a carrier disposed in a loading or unloading position adjacent the dock regardless of the relative height of the dock and the bed of the carrier, said dockboard having a base, a decklike ramp pivotally connected adjacent the rearward edge thereof to said base, a lip plate hingedly connected to the front edge of said ramp and adapted for engagement with the bed of said carrier, spring means coacting between said base and said ramp for normally swingably urging said ramp upwardly into an uppermost position wherein the front edge of said ramp is disposed a substantial distance above the rear edge of said ramp, and safety stop means coacting between said ramp and said base for preventing downward swinging movement of said ramp when same is unsupported and has a large load imposed thereon, the improvement wherein said safety stop means comprises:

extendible and contractible fluid pressure cylinder means coacting between said base and said ramp, said cylinder means including load sensing means associated therewith for positively locking said cylinder means in a determined position so as to prevent further telescopic movement thereof when the ramp is unsupported and has a load in excess of a predetermined magnitude imposed thereon, first connecting means structurally interconnecting one end of said cylinder means to said base, and second connecting means operatively interconnecting the other end of said cylinder means to said ramp, one of said first and second connecting means including lost motion means associated therewith for permitting said ramp to be angularly swung downwardly through a predetermined angle from its uppermost position without causing any telescopic movement of said cylinder means.

11. In a dockboard according to claim **10,** further including stop means associated with said one connecting means and coacting with said cylinder means for causing telescopic movement of said cylinder means when the downward swinging movement of said ramp from its uppermost position exceeds said predetermined angle.

12. In a dockboard according to claim **10,** wherein said first connecting means pivotally connects the lower end of said cylinder means to said base and said second connecting means connects the upper end of said cylinder means to said ramp, said second connecting means including means permitting relative pivotal movement between said cylinder means and said ramp and said lost-motion means permitting limited linear displacement of the upper end of said cylinder means relative to said ramp in a direction substantially perpendicular to the front edge of said ramp for permitting angular swinging movement of said ramp through said

predetermined angle without causing any telescopic movement of said cylinder means.

13. In a dockboard according to claim **12**; wherein said lost motion means includes an elongated guide track of predetermined length fixedly secured to the underside of said ramp, said guide track extending in a direction substantially perpendicular to the front and rear edges of said ramp and having stop means associated with at least one end thereof, and the upper end of said cylinder means having slide means associated therewith and coacting with said guide track for pivotally interconnecting the upper end of said cylinder means to said ramp while also enabling relative linear movement therebetween through said predetermined length.

14. In a dockboard according to claim **10**; wherein said fluid pressure cylinder means includes a cylinder housing defining therein a piston compartment and piston means positioned within said compartment and slidably disposed in sealing engagement with the walls of said cylinder housing for dividing said compartment into first and second chambers, said piston means including a piston rod projecting through one of said chambers and slidably supported on and projecting outwardly of said cylinder housing, wall means defining a reserve chamber and conduit means defining a passageway providing communication between said first chamber and a portion of said reserve chamber, said plurality of chambers defining a closed system containing therein a predetermined quantity of a substantially incompressible pressure fluid, said pressure fluid completely filling said first and second chambers and said passageway and only partially filling said reserve chamber, said pressure fluid in said reserve chamber filling said portion thereof, and a predetermined quantity of a compressible gas located in the remaining portion of said reserve chamber whereby said reserve chamber and said passageway communicating between said reserve chamber and said one chamber always results in said first chamber being filled with said pressure fluid without requiring the use of pumps or the like, said cylinder means including a flow control passage providing for flow of said fluid between said first and second chambers, and valve means associated with said flow control passage for controlling the flow therethrough, said valve means being automatically moved to a closed position when the pressure in a selected one of said first and second compartments exceeds a predetermined maximum for causing said cylinder means to lock up.

15. In a dockboard according to claim **14,** wherein said flow control passage is formed in and extends axially through said piston means, and wherein said valve means comprises a valve member mounted on said piston means.

16. In a dockboard according to claim **15,** wherein said wall means defining said reserve chamber comprises a closed elongated tubular housing disposed directly adjacent and extending longitudinally along said cylinder housing, said tubular housing being fixedly mounted on said cylinder housing, the fluid level in said tubular housing always being at least equal to the uppermost fluid level in said cylinder means irrespective of the position of said piston means within said cylinder means so as to permit the gravity flow of fluid from said reserve chamber into said cylinder means for maintaining said first and second chambers completely filled with fluid.

17. In a dockboard according to claim **10,** wherein said cylinder means comprises a pair of closed and self-contained telescopic fluid pressure cylinders disposed adjacent the opposite edges of said ramp, each of said telescopic fluid pressure cylinders being disposed for coaction between said ramp and said base, and conduit means connected between said pair of fluid pressure cylinders and providing communication between the second chambers disposed within said cylinders for causing said cylinders to act substantially as a single unit.

18. In a dockboard having a loading ramp for vertical swinging movement, an actuating mechanism coacting with the loading ramp for causing at least upward swinging movement of said ramp, and a safety mechanism coacting with said ramp for preventing undesired downward swinging movement of said ramp when same has a load of at least a predetermined magnitude imposed thereon, the improvement wherein said safety mechanism comprises telescopic fluid pressure cylinder means utilizing therein a substantially incompressible fluid and coacting between said ramp and a stationary support surface, said fluid pressure cylinder means being totally independent of said actuating mechanism.

19. In a dockboard according to claim **18,** wherein said cylinder means includes wall means defining at least a pair of chambers containing said fluid therein, said cylinder means including piston means movable relative to said wall means and defining at least one of the boundaries of at least one of said chambers, movement of said piston means relative to said wall means causing flow of fluid between said chambers, and movement of said piston means relative to said wall means being caused solely by and responsive to swinging movement of said ramp.

20. In a dockboard according to claim **18,** wherein said ramp is swingably movable into a first uppermost position wherein said ramp extends upwardly at a substantial angle relative to a horizontal plane, said ramp being moved into said first position by said actuating mechanism, said ramp also being swingably movable into a second position wherein said ramp projects downwardly relative to said horizontal plane, said ramp also being positionable in the third intermediate position which is spaced between said first and second positions, said ramp when in said third position extending at least slightly upwardly relative to said horizontal plane, said third position being spaced a substantial angular extent from said first position, and said telescopic fluid pressure cylinder means coacting with said ramp for stopping downward swinging of same only when said ramp is located in or between said second and third positions, said fluid pressure cylinder means being ineffective to prevent downward swinging movement of said ramp as said ramp is being moved from said first position to said third position.

21. In a dockboard according to claim **20,** wherein said cylinder means includes a cylinder housing defining therein a piston chamber and piston means slidably disposed within said piston chamber and dividing same into suction and compression compartments located on opposite sides of said piston means, means defining a flow passage for normally permitting fluid communication between said suction and compression compart-

ments, and load responsive valve means coacting with said passage for totally closing same to positively prevent transfer of fluid between said compartments when the pressure within said compression compartment exceeds a preselected value, closing of said valve means causing entrapment of the fluid within said compression compartment for causing locking of said piston means in its previous position to positively prevent movement of said ramp.

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