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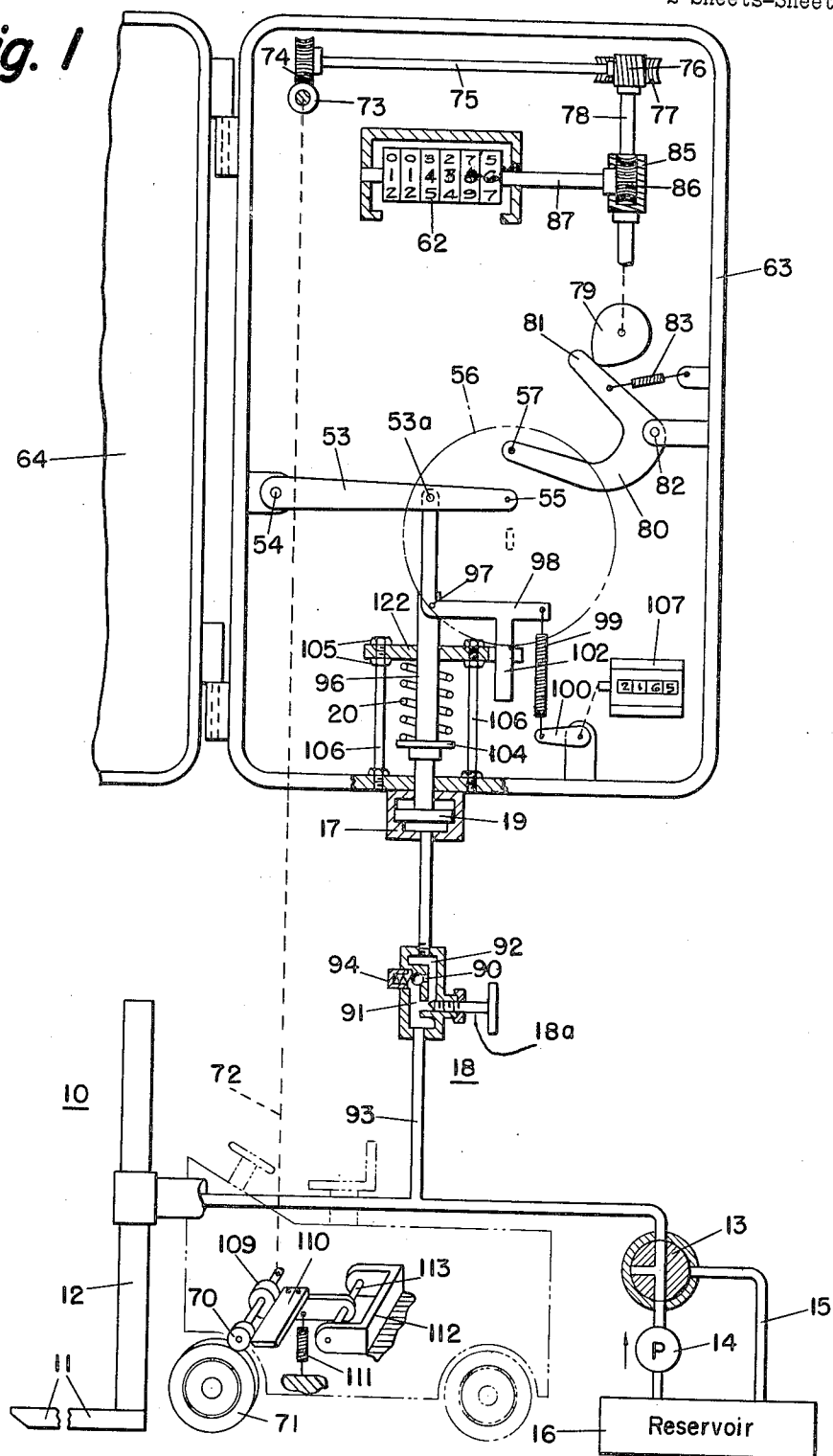
3,036,663

INDICATING SYSTEMS FOR VERTICAL LIFTING APPARATUS

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2 Sheets-Sheet 1

Fig. 1



1

3,036,663

INDICATING SYSTEMS FOR VERTICAL LIFTING APPARATUS

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This invention relates to apparatus for graphically recording the operations of a vehicle and has for an object the provision of a system by means of which there may be recorded the number of pay loads lifted by the vehicle during and in correlation with the distance traveled by the vehicle and in avoidance of the recording of apparent pay-load lifts which, in fact, have not taken place.

The present invention relates to improvements over the apparatus and system disclosed in application Serial No. 852,590, filed November 9, 1959, by Smith et al. and assigned to the same assignee as the present application.

Lift trucks and similar equipment used in handling industrial materials play an important part in the operation of factories in that assembly lines and the like frequently depend upon lift trucks for the transport of parts and equipment from storage to assembly line and the transport of finished products to storage. Trucks of the fork-lift type, as well as tractor-shovels, earth movers, and like hydraulically operated lift vehicles, play an important part in construction work, as well as in moving materials from one place to another. The efficiency of an operation as a whole can be greatly increased if the operators of lift trucks and similar equipment function with maximum efficiency and with elimination of waste motion, excess travel and inefficient loading.

Though not limited thereto, the present invention is particularly applicable to fork-lift trucks and similar equipment widely used in close quarters, such as warehouses, box cars, dock installations, ships, and in factories as described above. As well understood by those skilled in the art, such lift trucks are designed so that they may lower their lifting platforms or their lifting forks for movement beneath pay loads. By "pay load" is meant a useful load in contrast with what in terms of the recording operations will be referred to as apparent or spurious load indications. After placement of the platform or fork beneath a container or below the work itself, the load is then raised and transported to an assigned delivery point. The load is there lowered, and the operator proceeds to the next station, either with or without a further pay load. When an operator is serving presses or other types of machinery, he will frequently take raw material to the machine for operation and will remove a finished or semi-finished product. In this manner, the truck is used to maximum efficiency.

It is an object of the present invention to provide a record not only of the distance traveled by the truck, but also an accurate record of the number of true pay load lifts completed during each trip by means of a system which eliminates the recording of false lifts, that is to say, the recording of a lift of a pay load which has not in fact taken place. In many instances, the forks and unloaded pallet associated therewith weigh between about 150 pounds and 300 pounds. If a truck be operated to lift such unloaded pallet at relatively high speed, the actual weight will produce on the indicating equipment an apparent weight materially greater than that which actually exists, with the result that a lift may be falsely recorded. Another instance giving rise to difficulty is the fact that in operating a truck over rough terrain, a bump may cause a pay load to bounce. While it may not actually rise above the pallet on which it rests, the apparent weight on the truck will be greatly diminished and to a

2

point where an unloading operation may be falsely recorded. This same phenomenon may likewise produce an apparent increase in weight in the case of an unloaded pallet and by an amount which likewise may indicate a lifting operation. These examples suffice to illustrate the problems encountered in obtaining accurate information in respect to the number of pay loads lifted for a given trip of the vehicle in order that there may be achieved the maximum efficiency of use of the vehicular lifting apparatus.

In accordance with the present invention, there is provided, in conjunction with the hydraulic system for raising and lowering the lifting forks or platform, a pressure-responsive means having a recorder-actuating element displaceable from a first position to a second position upon a substantial increase of pressure on the hydraulic liquid as occurs upon the lifting of a pay load. In order to prevent the operation of exhibiting means operable under the control of that element by any cause other than the lifting of a pay load, flow restrictions are arranged in the flow-connections to the pressure-responsive means which introduce time delays in the operations. The flow restrictions retard the movement of the recorder-actuating element in both directions as a result of transient changes in the pressure of the hydraulic liquid. The "transient changes" referred to include changes in the pressure of the hydraulic liquid which may arise due to abnormal or improper lifting of a platform by its hydraulic means, or due to passage over bumps as previously referred to, or other operations which may produce to some degree the effect of lifting or releasing a pay load when in fact no true lift or release of a pay load has occurred. The transient changes of pressure will vary in character and magnitude with different lift trucks. Accordingly, the time delays are adjustable. The delay in one direction, referred to hereinafter as a lift-delay, and the time-delay in the movement of the recorder-actuating element in the opposite direction corresponding with the lowering of the fork and hereinafter referred to as the off-delay, will be selected for best operation of a particular system as used on the several types of lift trucks. There are provisions for adjustment of the time-delays through wide ranges, as from one-half to thirteen seconds, more or less. The manner in which the time-delays are selected for given operations will later be discussed in detail.

The exhibiting means preferably includes a chart to receive a permanent record of each pay load lift and in correlation with a second record showing the distance traveled by the vehicle during the time it is operated to lift pay loads and to lower said pay loads at particular destinations or stations. The exhibiting means is arranged to be operated, either with or without access thereto by the operator of the vehicle, to provide a record which may not be known to the operator until the conclusion of a particular period of work.

For further objects and advantages of the invention and for a more detailed discussion of the apparatus embodying the invention, reference is to be had to the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 schematically illustrates one embodiment of the invention;

FIG. 2 is a view of the cover of the instrument diagrammatically shown in FIG. 1 and includes a face view of the chart, together with a portion of the timing mechanism for driving the chart; and

FIG. 3 shows a modification of the resilient link of FIG. 1.

Referring now to FIGS. 1 and 2, the invention in one form has been shown applied to a lift truck 10 which

includes a fork or lifting platform 11 arranged to be raised and lowered by hydraulic means 12 of conventional design. The operator of the truck 10 by means of a control valve 13 may apply the output of a pump 14 to the lifting cylinder of the hydraulic operating means 12 to raise the platform 11. By rotating the control valve 13 through ninety degrees in a clockwise direction, he may connect the hydraulic lifting means to the discharge pipe 15 leading to a reservoir 16. It will be readily understood by those skilled in the art that the pressure produced on the hydraulic liquid by the pump 14 will depend upon the load resting upon the platform 11. By rotating the valve 13 through ninety degrees from its illustrated position, in a counterclockwise direction, the platform will be held in its then raised position and the pump 14 will discharge through valve 13 to discharge line 15. If the valve 13 be turned to its "raise" or lifting position and held there to produce rapid lifting of platform 11, it will be understood that the apparent load will be increased by reason of the inertia of the parts.

In accordance with the present invention, there is provided a pressure-responsive device 17 flow-connected to the hydraulic system, preferably by way of a flow-control valve 18 shown as of the needle-valve type. Besides serving as a means for adjusting the magnitude of the lift-delay, the restricted flow through needle valve 18 filters from or blocks transmission to device 17 of high-frequency pressure-variations which may appear in the hydraulic system connected to the operating means 12. The hydraulic pressure developed at the output of the pump 14 for operating means 12 is also applied to a piston 19 of the pressure-responsive device 17. When that pressure exceeds a predetermined value, the piston 19 overcomes the opposing bias of a spring 20 and through piston rod 96 actuates a member 98 connected to a stylus-carrying arm 53. The opposing pressure of spring 20 may be adjusted in manner later to be set forth. Preferably, the spring 20 is selected as to size, or adjusted, so as to render piston 19 ineffective to move the stylus 55 upwardly unless the pressure on the system exceeds a predetermined minimum corresponding to the weight of forks or platform 11 when empty, or when carrying merely an unloaded pallet. Such predetermined minimum pressure may be less than that due to an apparent load which may be developed during lifting of an empty platform or unloaded pallet. By "apparent load" is meant the load as it appears to the lift-sensing mechanism, including an inertia component due to acceleration, as when the predetermined minimum load is lifted at relatively high speed (in terms of maximum speed of lift of the lifting fork or platform in normal operation). Hence, notwithstanding adjustment-provisions of spring 20, such apparent load may be sufficient to effect operation of piston 19. Recording of a false lift under such circumstances, however, may be avoided by provision of a suitable time-delay factor.

The delay in the operation of the pressure-responsive device 17 is under the control of the flow-control valve 18. By rotating the adjusting element 18a of valve 18, the pointed end of the throttling element will increase or decrease the flow rate through the flow restriction to decrease or to increase the magnitude of the lift-delay. The range of adjustment is such that the lift-delay can be varied from about a second to thirteen seconds, and more. When utilized without further provisions, the throttling valve introduces a time-delay in both directions. Due to the characteristics of the hydraulic system of the lift truck 10, it is preferred that the lift-delay differ from the off-delay. In order that the off-delay on the lowering operation shall be materially less than that of the lift-delay, there is provided a check valve 90 interconnecting two passages 91 and 92 within the body of valve 18.

Assuming now that check-valve 90 is closed, as hydraulic pressure is applied from pump 14 by way of the pipe 93 through the smaller flow path of the throttling valve 18, a time-delay is interposed. The check-valve is

closed and remains closed due to the pressure on the movable element of the check-valve. When line 93 is connected through valve 13 to the reservoir 16, the pressure in channel 91 drops to a low value relative to that in channel 92. The differential of pressure on the movable element of the check-valve moves that element against the bias of the light-weight spring to open the flow path between lines or channels 91 and 92. The resultant increased flow of liquid decreases the time of the off-delay. By providing for adjustment of the check-valve, as by rotation of spring-retaining cap 94, as well as adjustment of the throttling or needle valve 18, there is provided a wide range of flexibility in the selection of the desired time delays for load lifts and for load drops. Thus, the off-delays and the lift-delays may be adjusted best to suit the characteristics of particular lift trucks in given applications. The check valve may be of the type FCV of Pneu-Trol Devices, Inc., and as shown in Frye Patent 2,841,174.

The adjustment of spring 20, which opposes upward movement of piston rod 96, is accomplished by means of the nuts 105 on threaded studs 106. These nuts 105 bear against a retaining plate 122 through which the studs 106 extend. Though only two of the studs 106 appear in FIG. 1, it will be understood that three or more may be provided. The spring 20 at one end bears against the plate 122 and at the other end bears against a collar 104 secured to piston rod 96. As the plate is lowered by loosening the lowermost nuts and tightening the outwardly located nuts, the opposing force on piston rod 96 is increased.

The stylus-actuating member 98, which is connected at 97 to piston rod 96, has a horizontal portion from which there depends an extension 102. This extension 102 extends through a slot in plate 122. The sides of the slot slidably engage the extension 102 to prevent rotational movement of the arm 98 about the axis of piston rod 96.

Connected to the horizontal extension of member 98 is a counter-actuating element or link 99. This link 99 in FIG. 1 is shown in the form of a coiled spring which provides semi-positive actuation of the crank arm 100 of a lift counting device 107. The spring 99 applies a counter-actuating force to arm 100 each time the piston rod 96 is moved to its uppermost position. The spring 99 provides a resilient link effective on the return movement of member 98 to prevent development of unduly large forces on arm 100 by reason of a greater movement of member 98 than is provided for by counter device 107. This linkage also prevents jamming of the counter on downward movement of member 98 following a partial stroke of arm 100 due to movement of piston rod 96 and member 98 to something less than their uppermost positions. The number of pay load lifts during a given period are duly recorded by the counting device 107 which may, if desired, be of the kind that can be set to zero at the beginning of each period under survey.

The member 98 is connected by pin 53a to a stylus arm 53 pivoted to the frame by pivot pin 54 and carrying at its outer, free end a stylus 55.

This stylus or chart-marking element 55 engages a chart 56 which in FIG. 1 is illustrated in phantom, by broken lines, in order to show its positional relationship in respect to the stylus 55 and also another chart-marking element or stylus 57, hereinafter described. Chart 56 is shown more in detail in FIG. 2, from which it will be seen that it is supported on the hinged cover 64 of the instrument and is driven at constant speed, in a counterclockwise direction as viewed in FIG. 2, by means of a clock mechanism indicated at 59. The chart has a rectangular center opening which fits onto a correspondingly shaped section of a shaft 60 driven by the clock mechanism. Various forms of charts, including those generally available on the market, may be employed, and usually such charts will be provided with radial markings (omitted on the drawing for simplicity) to indicate the time of day and time intervals so that elapsed time of travel of the

vehicle, either loaded or unloaded, and also idle time, may be readily observed and recorded.

In order to record the pay load lift in correlation with elapsed time and the distance traveled by the lift truck, there are provided a distance-indicating stylus or chart-marking element 57 and a distance indicator 62 both connected to an odometer drive which will now be described.

As shown in FIG. 1, a wheel 70 driven by one of the truck wheels 71 is carried by a pivoted arm 109 which has attached thereto a scraper blade 110. The arm 109 and scraper blade 110 are biased downwardly by a tension spring 111. Thus, the diameter of the friction wheel 70 is maintained constant: It is not affected by accumulation of debris because of its removal by the scraper blade 110. The arm 109 is pivoted by a pivot pin 113 to stationary bracket 112 which is itself secured to the frame. Through a suitable connection indicated by the broken line 72, there is driven a worm 73 which through worm wheel 74 drives a shaft 75. This shaft, through a worm 76, drives a worm wheel 77. The worm wheel 77 drives a shaft 78 which has secured to it an operating cam 79 for a crank arm 80, one end of which carries the stylus 57. The other arm 81 of the crank engages the cam 79, the crank arm itself being pivoted by a pin 82 and biased for clockwise rotation by a spring 83.

The shaft 78 carries a worm 85 which drives a worm wheel 86 and through a shaft 87 operates the distance indicator 62 illustrated as a conventional odometer provided with a plurality of indicating discs on which appear digits for indicating the distance traveled. These may be viewed through the opening 62a (FIG. 2) in cover 64.

In the following summary of the operation of the system of the present invention, the manner in which that system functions to take care of a number of conditions encountered in the daily operation of a lift truck will be set forth. There will first be summarized the operations which may occur with an unloaded platform, i.e., one not carrying a pay load. With the parts in the illustrated positions, particularly the valve 13 in a pressure-applying position, the hydraulic means 12 will be effective in raising the movable parts of the hydraulic system including the platform 11. Thus, the parts will be moving upwardly. If the parts are moved upwardly at relatively high speed, the apparent load (previously discussed) as registered on the pressure-responsive device 17 may be much greater than the actual load. It is for this reason that weighing systems are not suited to the purposes of the present invention. Though the spring 20 has been set to offset the pressure required from the pump 14 to overcome the dead weight of the moving parts, nevertheless upon rapid acceleration of the platform, the piston 19 if exposed to the full effect of the rapid change in pressure would be displaced against the force of the spring 20 to move stylus 55. The action of the flow-control valve 18 introduces a delay in avoidance of the described movement. This delay may be equal to or slightly less than the time interval required to raise the unloaded platform 11 to a predetermined height, such as would render the empty platform apparent to an observer. Thus, should an operator desire to attempt to produce a false indication of a lift of a pay load, it will be seen that he could not achieve that objective without raising the platform 11 to a height which would undoubtedly call attention to his effort by the foreman or other assigned observer.

If desired, the flow-control valve 18 by adjustment of element 18a may be set for a longer period of time, enough for the platform 11 to be raised to the normal height for transport of a pay load. Thus, there is considerable flexibility afforded by the system in that there can be included in the delay time a part of the travel time, or that delay time may be diminished to a lifting time corresponding with that required for achieving the aforesaid detectable height of the platform 11.

Assuming now a pay load on the platform 11, the following occurs. The truck operator manipulates valve 13

to raise the pay load. After the selected time interval of, say, one and one-half seconds, the device 107 and the stylus 55 are each actuated to record the lift. The truck will then be placed in operation to transport the load to its destination, and there will be recorded on the chart, FIG. 2, the record 57b indicating the distance traveled by the truck. It will be observed that the record 57b is one that progresses from an inner circular limit to an outer circular limit and back to the inner circular limit, this representing the movement of the stylus 57 by the cam 79. When the stylus has been displaced from the inner to the outer limit, it will be known that the truck has traveled a predetermined distance, for example, 2500 feet. When the stylus moves from the outer limit to the inner limit, it will be known that the truck has traveled another 2500 feet. Obviously, the gear ratios can be selected for the operation of the stylus between its two limits for lesser or greater distances.

What has been said above in respect to false indications of pay load lifts, likewise applies to false indications of the unloading of the platform 11. This can occur by reason of the passage of the truck 10 over a rough travel path where the wheels may drop into a depression. The dropping of the wheels together with the truck-frame will produce a drop in the pressure in the hydraulic system. The load and platform by reason of their inertia under the described conditions act to decrease the apparent load on that platform. In response to the momentary decrease in the hydraulic pressure, the stylus 55 might move. It does not move due to the time-delay introduced by the flow-control valve 18. More particularly, the flow restrictions provided by the element 18a and the check valve 90 (with the latter assumed in the open position) are such as to introduce a time-delay in the response of piston 19 to the decrease in hydraulic pressure. When that decrease causes check valve 90 to open, it will be seen the resulting off-delay will be shorter than the lift-delay above described. Nevertheless, the off-delay of the order of one-half second and above will be set to be adequately long to prevent the recording of false unloading operations.

Further in connection with the operations, it will be understood that even if the truck 10 be traveling without a pay load over rough terrain, the effect of a bump may work in both directions; that is to say, the weight of the moving parts including the platform 11 may be effective to produce a false indication of a pay load lift, as well as to indicate the descent and unloading of a pay load, when a change in pressure occurs by reason of the inertia effect of the load on the hydraulic pressure system. However, by the introduction of the time-delays, such false indications are overcome, whether due to an attempt by the operator to outwit the system or whether due to variations of hydraulic pressure because of bumps and the like.

With further reference to the control valve 13, it is to be understood that it is operable to several control positions. When it is moved to a position to interconnect the pump 14 with the discharge pipe 15, the pump will simply circulate hydraulic liquid from the reservoir 16 through the return circuit. The pipe leading to the hydraulic means 12 will then be closed to maintain the platform 11 in its elevated position. When the valve 13 is rotated to interconnect the pipe from the hydraulic means 12 with the discharge pipe 15 (the valve 13 in a position 90° clockwise from that illustrated), hydraulic liquid will be discharged through the return pipe 15 from the hydraulic system.

The foregoing operations will now be briefly summarized in terms of the resultant record on the chart 56, as shown in FIG. 2. At the beginning of a work period, it may be assumed that the point 55a on chart 56 was at the location of the stylus 55; that the stylus 57 was at the point 57a; and that both styli were coincident with radius 61 of the chart 56. Upon occurrence of the first

lift of a pay load, the stylus 55 moved radially of the chart to an outermost position at 55b. At the point 55c, the stylus 55 returned to its innermost position, indicating the unloading of the truck. By means of the odometer driving arrangement, the distance traveled may be read either from the graph 57b on chart 56 or from the distance indicator 62 visible through the opening 62a of the cover 64 of the instrument housing 63. As shown on the chart, the truck traveled "unloaded" during the appearance of the segment 55d after which it made two pay load lifts in near time-proximity one to the other. The relatively long outer section 55e shows a relatively long distance of travel with a pay load. Thus, the chart 56 provides an accurate record of the number of lifts in correlation with the distance traveled by the truck with and without pay loads.

Now that we have explained the principles of operation of our invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein and that certain features may be used in the absence of other features, all within the spirit and scope of the appended claims. More particularly, in applications where the off-time delay is to be greater than the lift-delay, the flow control valve 18 may include a relief valve which opens during application of a lifting pressure to the hydraulic means 12. This provision is readily made by reversing, turning end-for-end, the valve 18 in line 93.

To vary the time-delay with relief valve 90 open, the tension on the spring biasing the relief valve element to closed position may be varied and for larger changes, the size of the orifice of the relief valve may be changed as by insertion of a valve seat having an orifice of desired size.

As shown in FIG. 3, resilient link 99a which interconnects the member 98 and the crank arm 100 may take the form of a spring wire which during a pay load lift provides positive actuation of the counting device 107. Upon return movement of member 98, as during the unloading of the platform 11, the spring wire link 99a not only applies a restoring force to the crank arm 100 but also permits member 98 to move from one limit to a second limit, which limits may be farther apart than the limits of movement provided for the pay load lift-counting device 107. The lower bent end of link 99a for clarity has been illustrated with the spacing between upper and lower arms in greater spaced relation with the upper and lower faces of crank arm 100 than may be desirable in practice. Some lost motion between the link 99a and the arm 100, however, is readily provided by the shaping of the lower end of link 99a.

What is claimed is:

1. A recording system for use with a wheeled vehicular lifting apparatus having a lift platform, means for supplying hydraulic fluid under pressure for raising said platform, and means for driving at least one wheel of said apparatus; said recording system including two recording elements, one a stylus and the other a chart upon which said stylus may produce a record, means supporting one of said recording elements for relative movement with respect to the other for producing a record on the chart of one variable, and means for driving the other recording element for relating the record of said first variable with a second variable, pressure-responsive means having a fluid connection with said fluid-supplying means and having a member displaceable between two positions as the pressure of said fluid rises above and falls to a predetermined value, a driving connection between said member and the first of said recording elements for producing distinctive indications on the chart that a load has been lifted and lowered, and delay means for slowing down the movement of said member in at least one direction, said delay means including flow-restricting means in said flow connection from said pressure-responsive device to said fluid-supplying means, whereby there is prevented

the recording of changes in the pressure of said hydraulic fluid due to operations other than movement of a pay load by the lift platform of the vehicular apparatus.

2. The system of claim 1 in which there is provided a lift counting device having an actuating element, and means including a resilient link extending between said actuating element and said displaceable member for operating said device.

3. The system of claim 2 in which said resilient link is a spring wire.

4. The system of claim 1 in which there is provided an odometer drive extending from a supporting wheel of said lifting apparatus, and means including a stylus driven by said drive for recording on said chart a record of the distance traveled by said lifting apparatus.

5. The exhibiting means of claim 1 in which said structure comprises a relief valve for changing the magnitude of the flow restriction developed by said flow-restricting means.

6. A recording system for use with a wheeled vehicular lifting apparatus having a lift platform, means for supplying hydraulic fluid under pressure for raising said platform, and means for driving at least one wheel of said apparatus; said recording system including two recording elements, one a stylus and the other a chart upon which said stylus may produce a record, means supporting one of said recording elements for relative movement with respect to the other for producing a record on the chart of one variable, and means for driving the other recording element for relating the record of said first variable with a second variable, pressure-responsive means having a fluid connection with said fluid-supplying means and having a member displaceable between two positions as the pressure of said liquid rises above and falls to a predetermined value, a driving connection between said member and the first of said recording elements for producing distinctive indications on the chart that a load has been lifted and lowered, and delay means for slowing down the movement in both directions of said member but with a greater delay in the movement of said member in one direction than in the other, said delay means including flow-restricting means in said flow connection from said pressure-responsive device to said fluid-supplying means, whereby there is prevented the recording of changes in the pressure of said hydraulic fluid due to operations other than the lifting and lowering of a pay load carried by the lift platform of the vehicular apparatus.

7. The system of claim 6 in which said flow restricting means includes a relief valve normally closed to provide said greater delay and operable to an open position to provide the lesser delay in said movement of said member in said other direction.

8. The system of claim 6 in which there is provided a lift counting device having an actuating element, and means including a resilient link extending between said actuating element and said displaceable member for operating said device.

9. The system of claim 6 in which there is provided an odometer drive extending from a supporting wheel of said lifting apparatus, and means including a stylus driven by said drive for recording on said chart a record of the distance traveled by said lifting apparatus.

10. A recording system for use with a wheeled vehicular lifting apparatus having a lift platform, means for supplying hydraulic fluid under pressure for raising said platform, and means for driving at least one wheel of said apparatus; said recording system including means for supporting and moving a chart at a fixed speed and in correlation with the passage of time, a stylus, means supporting said stylus for producing a record on said chart, pressure-responsive means having a fluid connection with said fluid-supplying means and an element displaceable between two positions as the pressure of said liquid rises above and falls to a predetermined value, a

9

driving connection between said element and said stylus for producing distinctive indications on the chart that a load has been lifted and lowered, and delay means for slowing down the movement in both directions of said element but with a greater delay in the movement of said element in one direction than in the other, said delay means including flow-restricting means in said flow connection from said pressure-responsive device to said fluid-supplying means, whereby there is prevented the recording of changes in the pressure of said hydraulic fluid due to operations other than the lifting and lowering of a pay load carried by the lift platform of the vehicular apparatus.

11. For a wheeled vehicular lifting apparatus having a lift platform and means for selectively moving said platform in one direction or the other to raise and to lower said platform, exhibiting means for recording pay load lifts comprising pressure-responsive means having a member movable between a first and a second position, means biasing said element to said first position, applying means operable concurrently with change in the position of said platform for applying to said pressure-responsive means a greater pressure when said platform is moved in one direction than when moved in the other direction, flow-restricting means connected between said pressure-responsive means and said applying means for delaying by a selected interval the application to said

10

pressure-responsive means of a change in said pressure due to said change in said position of said platform, thereby to prevent operation of said pressure-responsive means by pressure changes occurring during time intervals insufficient in length reliably to indicate a pay load lift by said platform and a pay load descent on said platform, and indicating means actuated by said pressure-responsive means to record said pay load lifts and said descents.

12. The exhibiting means of claim 11 in which said flow-restricting means includes structure for introducing a greater delay in the application of said change of pressure to said pressure-responsive device when said pressure is changing in one direction than when changing in the opposite direction.

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