Jan. 30, 1940. J. P. LANNEN 2,188,364

LOAD LIFTER AND BALANCER

Filed Jan. 7, 1938

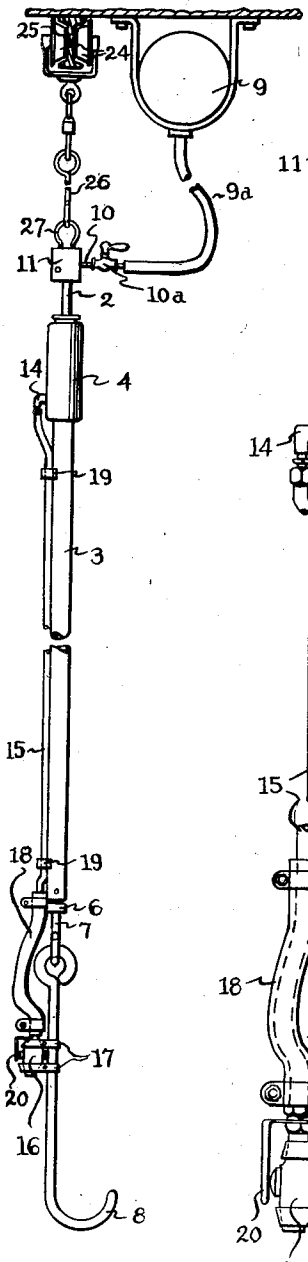


Fig. 1

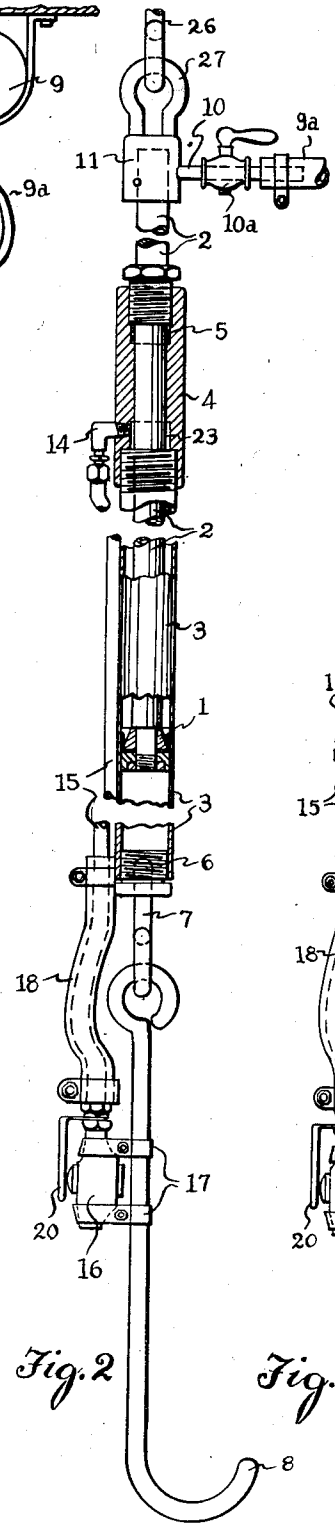


Fig. 2

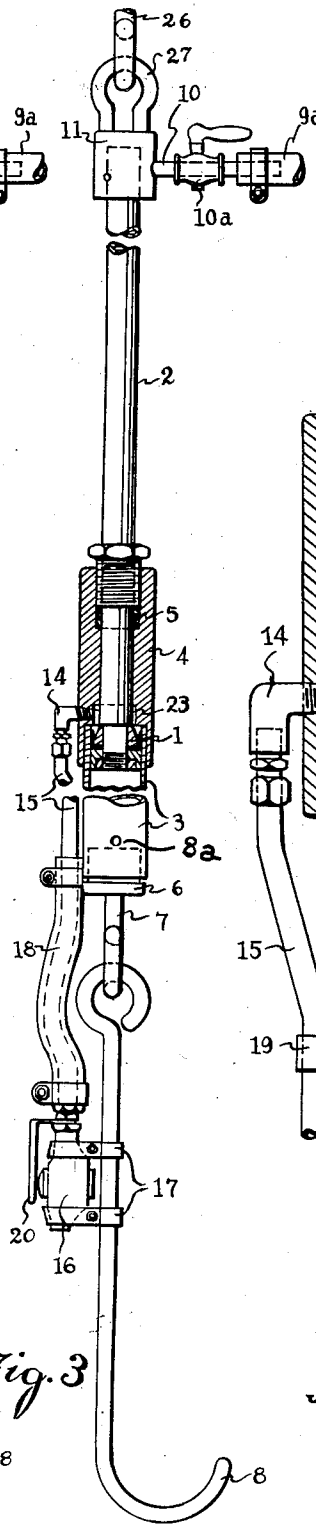


Fig. 3

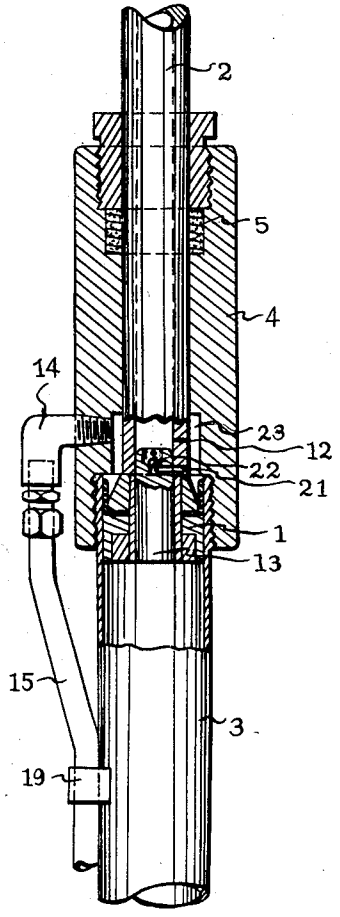


Fig. 4

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LOAD LIFTER AND BALANCER

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9 Claims. (Cl. 121—46)

This invention relates to load lifting and balancing devices, and particularly to pneumatic lifters and balancers.

An object of the invention is to provide a pneumatic device for holding a load suspended while permitting it to be readily manipulated to a considerable extent in any direction.

Another object is to provide a device adapted to be energized by compressed air to effect lifting of a load to a desired working level and adapted to be supported by compressed air at such level and manipulated freely in any direction, the arrangement being such as to derive support from a very large volume of air such as will yield quite freely to allow a considerable upward or downward manipulation of the load, without valving air.

A further object is to provide a load lifter and balancer adapted to sustain a load upon an air cushion, lowering of the load from its working position being effected by displacing air from the cushioning space, and its admission to such space being regulated solely by restricting the inlet to such space.

A further object is to employ the load-engaging hook of a pneumatic load lifter and balancer as a mounting for a valve regulating the exhaust of air from said device, thus affording a maximum convenience in exercising control.

A further object is to form a load-carrying air cushion between a piston and cylinder of a pneumatic lifter and balancer and to augment said cushion by all air in the feed line leading to said cylinder and in the tank supplying such line.

These and various other objects are attained by the construction hereinafter described and illustrated in the accompanying drawing, wherein:

Fig. 1 is a side elevational view of the lifter and balancer, showing its supply tank and feed line.

Fig. 2 is an axial sectional view of the appliance showing the load-carrying cylinder partially raised or in working position.

Fig. 3 is a similar view showing the lowermost position of the load-carrying cylinder.

Fig. 4 is an enlarged view of a portion of Fig. 3, showing the illustrated parts in greater detail.

In these views, the reference character 1 designates a piston mounted fast on the lower end of a vertically elongated pipe 2 and working in a vertically elongated cylinder 3, of greater diameter than said pipe. The upper end of such cylinder rigidly carries an elongated head 4 having a sliding fit upon the pipe 2, and packing 5, retained in the upper portion of said head, is compressed around the pipe, establishing a seal against the escape of air from the cylinder. Inserted in the lower end of the cylinder and rigidly secured therein by screw threads or other suitable means, is a head 6, rigidly and centrally carrying a downwardly projecting eye-bolt 7, whereon a lifting hook 8 is swung. In proximity to the head 6, the cylinder is vented, as indicated at 8a.

Air under suitable compression may be delivered from a tank or reservoir 9 or directly from a compressor through a hose 9a to a fitting 10 adapted to admit such air to the upper end of the pipe 2 through a cap 11 rigidly engaging and closing said end. Said fitting preferably carries a valve 10a controlling such air admission. From the lower end of said pipe, such air may laterally discharge into the cylinder, through a highly restricted passage 12. Thus air may be accumulated between the piston 1 and head 4 to lift the cylinder to a desired extent. Downward escape of air from the pipe 2 is prevented by a plug 13 tightly pressed into the lower end of the pipe.

For venting air from the cylinder to effect its lowering, the head 4 carries a pipe fitting 14 communicating with the chamber 13 and having a pipe 15 leading therefrom exteriorly down the cylinder, such pipe being connected to any suitable exhaust valve 16 clamped upon the shank of the hook 8, as indicated at 17. Preferably such connection is established through a length of flexible hose 18, joined to the pipe 15 at the lower end of the cylinder, thus affording such swinging movement of the hook as may be necessary in its functioning. At suitable vertical intervals the pipe 15 is engaged by keepers 19 welded or otherwise fixed on the cylinder, and is thus held in close proximity to the cylinder. The valve 16 is of any ordinary normally closed type and is preferably equipped with a lever 20 facilitating manual opening of such valve.

For reasons which will presently appear, it may be desirable to permit a more free flow of air into the pipe 2 from the cylinder 3 than the restricted passage 12 permits.

As a provision for such flow, a passage 21 considerably larger than the passage 12, is jointly formed in the lower portion of the pipe 2 and the upper portion of the plug 13, and communicates with the bottom of a valve chamber opening downwardly in the plug. Within such chamber a ball check valve 22 is normally seated to prevent outflow from the pipe 2 through the

passage 21 but may freely unseat to afford inflow.

When the cylinder is fully lowered the head 4 seats on the piston 1, in a surrounding relation to the passages 12 and 21, as illustrated in Fig. 3. To avoid obstruction of such passages, when the cylinder is thus lowered, a restricted chamber 23 is formed in the head 4, just above the cylinder, such chamber having an adequate upward extent to maintain communication of said passages with the cylinder when the head 4 is seated on the piston, as in Fig. 3.

The described machine is suspended at any convenient elevation, its point of support being preferably at the upper end of the pipe 2. As illustrated, the machine is suspended from a trolley 24 mounted to travel on an overhead I beam 25, a swinging link rod 26 or the like establishing the suspension and engaging an eyelet 27 rigidly surmounting the cap 11.

In use of the described appliance, the valve 10a is normally open and consequently the cylinder 3 is normally upwardly urged by compressed air admitted to the cylinder from the pipe 2 through the passage 12 and reacting between the piston 1 and head 4. It follows that the cylinder and its load-carrying hook 8 automatically assume their upper limiting position (not shown), when the machine is not loaded, such position being established by engagement of the head 6 with the piston 1. To lower the cylinder for loading the hook 8, the operator vents air by opening the exhaust valve 16, exerting at the same time a light downward pull on the hook or cylinder. During such venting of air, there is maintained an air delivery to the cylinder through the passage 12, but the volume of this delivery is too small to exercise material effect. After applying a load to the hook 8, the operator closes the exhaust valve, and air flowing through the passage 12 again accumulates above the piston and reacts against the head 4 to upwardly urge the cylinder and load. The latter is of a magnitude suited to the lifting capacity of the machine, which is designed to sustain a certain weight at any elevation permitted by its cylinder travel. Hence lifting of the load may be accomplished through application by the operator of a slight upward pull to overcome the balanced relation of air pressure and dead weight. Proximity of the piston to the head 4 in the loading position of the machine is such that there is no material delay in upward travel after closing of the exhaust valve and application of a manual lifting force. When the load has reached a desired elevation, it will be automatically maintained at that elevation, since its weight is substantially counterbalanced by the applied air pressure. Without applying any further control, the operator may now move the load as his purpose may dictate, by manually applying a very moderate force. Thus for example pressure may be applied lengthwise of the beam 25 to induce travel of the trolley 24 and thus shift the load to any desired point beneath the beam. Or the load may be swung laterally about its pivotal connection with the trolley to dispose it above a desired support. Upward manipulation of the load requires only slightly greater effort than horizontal shifting thereof since flow through the passage 12 increases the volume of air beneath the head 4 as the cylinder is raised. Lowering of the load involves a very slight effort, since displacement of air from beneath the head 4 may occur through both of the passages 12 and 21, the latter having a much greater flow capacity than the former. Obviously the machine can be just as usefully employed in lowering loads as in raising the same.

A machine of the described character has many uses, among which may be mentioned the raising and manipulation of heavy parts for loading or storing purposes or to position them for assembly in a machine or other structure, and the raising or lowering of parts requiring machining to mount them on or remove them from the work holder of a machine tool.

If energized by air at a substantially constant pressure, the described machine is suited only to handle loads of a fairly definite predetermined weight, and heavier or lighter loads will require larger or smaller machines. If, however, some provision is made for varying the pressure at which air is delivered to the machine, such pressure variation will permit of a corresponding variation in the load capacity of the machine.

A vitally important and unique feature of the described machine is the maintenance of constant communication between the air cushion chamber, underlying the head 4, and reservoir from which air is delivered to the machine. This permits utilization of the air in said reservoir, in the supply line leading therefrom, and in the pipe 2, as part of the load-sustaining air cushion, and the consequent large volume of such cushion facilitates manipulation, since it assures that only slight resistance will be encountered in displacing air from beneath the head 4 through the passages 12 and 21.

As compared to an air hoist, the described machine is much less expensive, more easily installed, more readily portable, and allows a freer and more extensive manipulation of the load.

The invention is presented as including all such modifications and changes as come within the scope of the following claims.

What I claim is:

1. A pneumatic lifter and balancer comprising an upper member, a lower member carried by and movable upwardly and downwardly on the upper member, one of said members being a cylinder closed at one end, and the other including a piston fitted in the cylinder and a rod attached to the piston and having a sliding fit in said cylinder end, a pressure chamber being formed between the piston and said cylinder end, a support from which the upper member is suspended, a load-receiving element attached to the lower member, the pressure chamber having a restricted inlet port in open communication therewith and an exhaust port of relatively large capacity opening therefrom, means for continuously delivering compressed air to the inlet port, and a manually operable valve controlling the exhaust port.

2. In a pneumatic lifter and balancer as set forth in claim 1, a valve controlling venting of the pressure chamber, secured to the load-receiving element.

3. In a pneumatic lifter and balancer as set forth in claim 1, a check valve carried by one of said members, such member having a passage affording a free flow from the pressure chamber to said air delivery means, and said check valve resisting reverse flow through such passage.

4. In a pneumatic lifter and balancer as set forth in claim 1, a compressed air tank normally in communication with the pressure chamber

through said delivery means, whereby the volume of air in the tank and delivery means supplements that in the pressure chamber in forming an air cushion.

5. A pneumatic lifter and balancer as set forth in claim 1, said rod being tubular and having constant communication with the pressure chamber, and hence adding to the volume of air effective in the pressure chamber to form an air cushion.

6. A pneumatic lifter and balancer comprising a substantially vertical rod, a support pivotally engaged by the upper end of the rod, a piston on the lower end of the rod, a cylinder operatively receiving the piston, the cylinder having a head closing its upper end and slidable on the rod, means for continuously delivering compressed air to the cylinder between said head and piston, an exhaust pipe communicating with the cylinder through said head, and extending downwardly along the cylinder, a load-receiving element attached to the lower end of the cylinder, and a valve controlling an outlet from the exhaust pipe in proximity to the load-receiving element, the capacity of said exhaust pipe and its control valve largely exceeding the capacity of said delivery means.

7. A pneumatic lifter and balancer comprising a substantially vertical pipe, having closed ends, a support, means pivotally mounting the pipe at its upper end on such support, means for delivering compressed air to the upper portion of the pipe, a piston carried by the lower portion of the pipe, a cylinder operatively receiving the piston and having a head slidable on the pipe above the piston, and forming a pressure chamber between the piston and such head, the pipe having a restricted passage adjacent to the piston for delivering air to the pressure chamber and having a relatively large passage for the displacement of air into the pipe from the pressure chamber, a check valve resisting flow through the last-mentioned passage into the pressure chamber, a load-receiving element carried by and beneath the cylinder, and means for regulably exhausting air from the pressure chamber.

8. A pneumatic lifter and balancer as set forth in claim 7, said check valve being carried by the closure engaging the lower end of the pipe.

9. A pneumatic appliance comprising a pipe forming an air duct, a piston fixed on the pipe substantially at an end thereof, a plug closing such end, a cylinder operatively receiving such piston and having a head slidably fitted on the pipe, said cylinder forming a pressure chamber between the piston and said head, a compressed air delivery line connected to the pipe exteriorly of the cylinder, two passages being provided connecting the pressure chamber and pipe, one thereof being restricted to afford a gradual flow into the pressure chamber and the other having greater capacity and providing for displacement of air into the pipe from the pressure chamber, a check valve mounted in said plug and resisting flow into the pressure chamber through the larger of said passages, and means for regularly exhausting air from the pressure chamber.

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