Oct. 17, 1967 H. ENGELEN ETAL 3,347,327

PNEUMATIC LIFTING DEVICE AND WEIGHING MEANS FOR FLAT GOODS

Filed Oct. 21, 1964 3 Sheets-Sheet 1

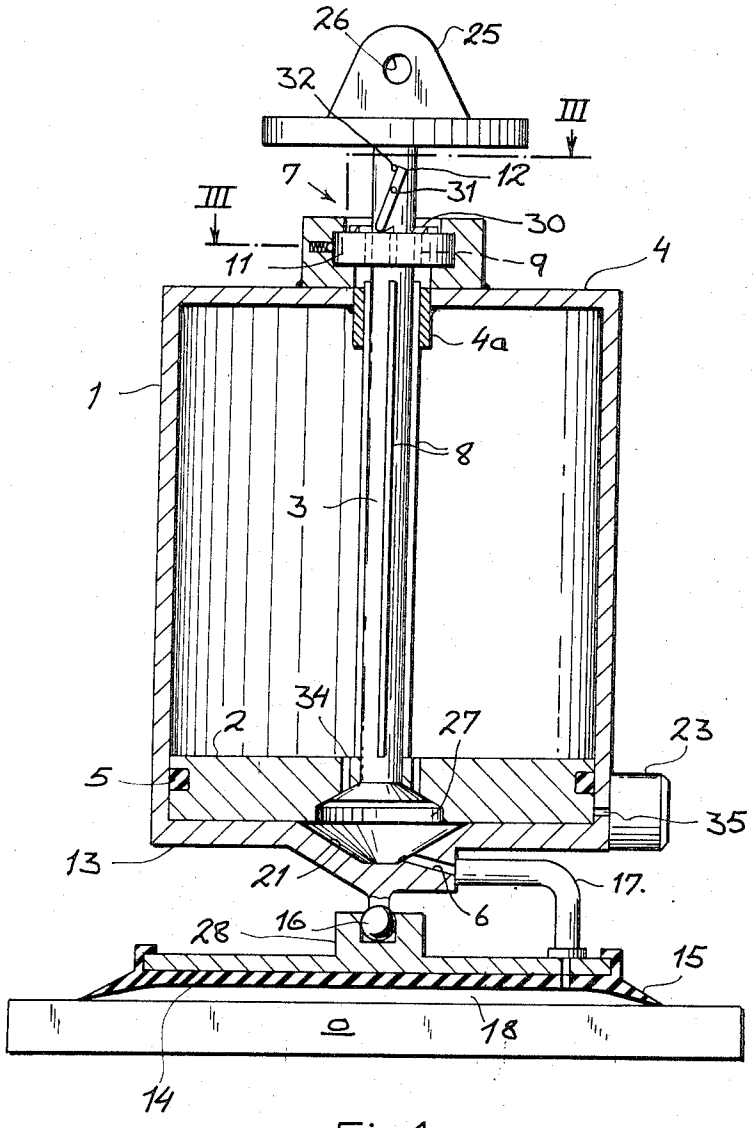

Fig. 1

Heinz Engelen
Helmut Dischler
Günter Albert
INVENTORS.

BY

Karl G. Ross

AGENT

Oct. 17, 1967 H. ENGELEN ETAL 3,347,327

PNEUMATIC LIFTING DEVICE AND WEIGHING MEANS FOR FLAT GOODS

Filed Oct. 21, 1964

3 Sheets-Sheet 2

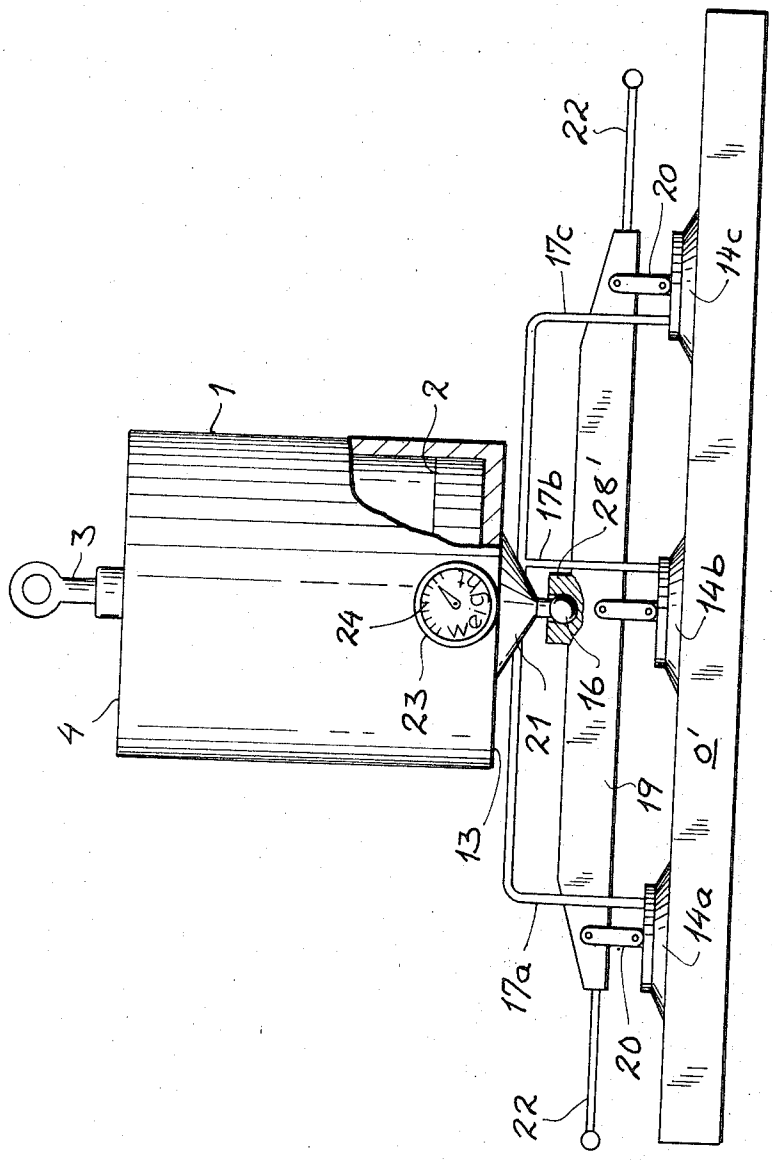

Fig. 2

Heinz Engelen
Helmut Dischler
Günter Albert
INVENTORS.

BY

Karl F. Ross

AGENT

Oct. 17, 1967 H. ENGELEN ETAL 3,347,327

PNEUMATIC LIFTING DEVICE AND WEIGHING MEANS FOR FLAT GOODS

Filed Oct. 21, 1964

3 Sheets-Sheet 3

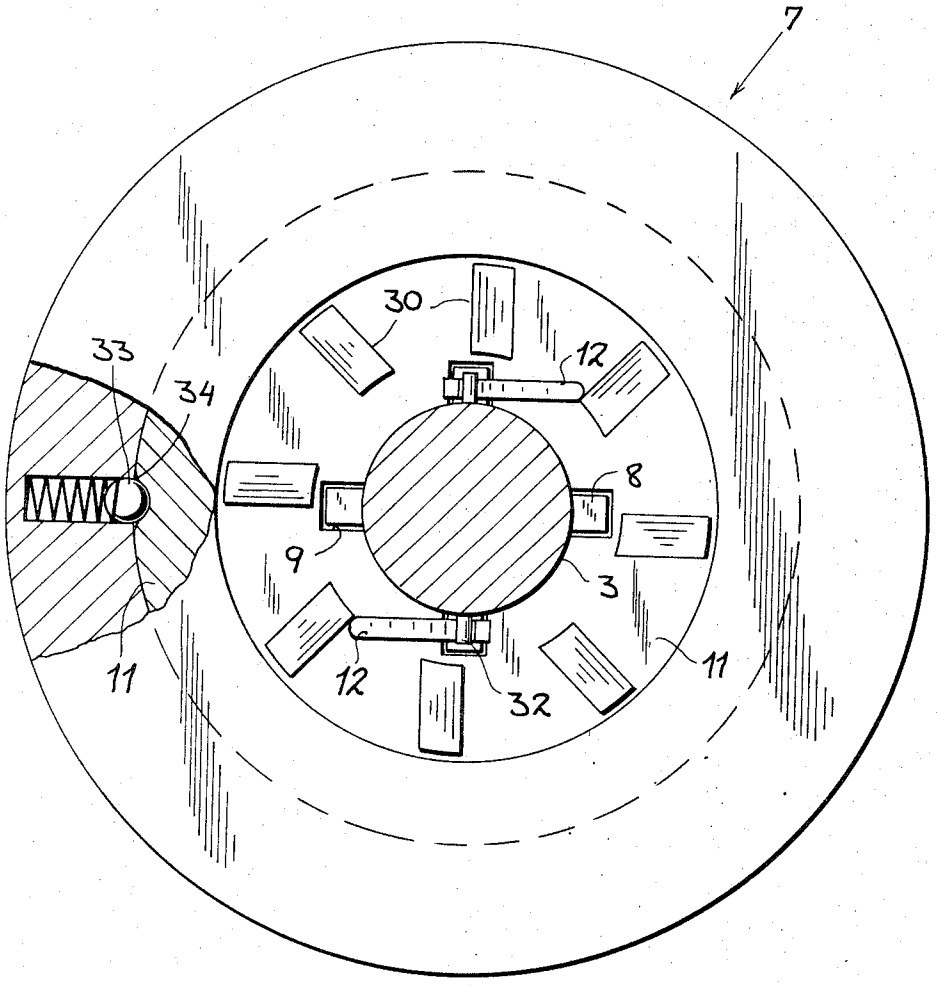

Fig. 3

Heinz Engelen
Helmut Dischler
Günter Albert
INVENTORS.

BY

Karl F. Ross

AGENT

United States Patent Office

3,347,327

Patented Oct. 17, 1967

3,347,327

PNEUMATIC LIFTING DEVICE AND WEIGHING MEANS FOR FLAT GOODS

Heinz Engelen, Dusseldorf, Helmut Dischler, Neuss-Udesheim, and Günter Albert, Dusseldorf, Germany, assignors to Maschinenfabrik Hasenclever AG., Dusseldorf, Germany, a corporation of Germany

Filed Oct. 21, 1964, Ser. No. 405,394
Claims priority, application Germany, May 15, 1964, M 61,015
9 Claims. (Cl. 177—208)

ABSTRACT OF THE DISCLOSURE

Lifting device for flat boards, plates, etc., wherein a rod is lifted upwardly with respect to a cylinder to draw a piston head in the cylinder away from its bottom and into a partial vacuum in a suction head dependent from the cylinder and adherent under the reduced pressure to the flat goods. A valve controlled by the rod in the piston head permits blocking of the venting of the suction chamber when the rod is lifted but opens the vent when the rod is permitted to fall to restore the original condition of the device. The cylinder is hinged to the suction head by a ball-and-socket joint and a plurality of suction heads can be provided. The rod and cylinder are provided with a ratchet-and-pawl device for rotating the rod relatively to the cylinder and bring an abutment connection into play in alternate lifting and descending movements of the rod.

Our present invention relates to a device for lifting or upwardly deflecting boards, sheet-metal plates and other flat goods.

An object of the invention is to provide a device of this type which readily accommodates itself to a variety of positions slightly inclined with reference to the horizontal which the goods may originally occupy.

Another object of our invention is to provide a device of this character which can be conveniently and preferably automatically deactivated to perform an idle lifting stroke, e.g., during every other cycle, so as to release the goods previously picked up and deposited.

A lifting device according to our invention comprises a cylinder with a substantially vertical axis in which a piston head is axially movable, the piston head being engaged by a rod which passes into the cylinder form above and serves as a suspension means for elevating first the piston head and thereafter the cylinder itself as a result of a partial vacuum developing between the rising piston head and the cylinder bottom. This partial vacuum is communicated, through an opening in the cylinder bottom, to one or more suction cups which are supported on the cylinder directly or indirectly, e.g., through the intermediary of a horizontal bar in the case of several such cups; the connection between the cylinder and the suction cup or cups, according to a more specific feature of our invention, includes a hinge, advantageously constituted by a ball-and-socket-type swivel joint, by which the single cup or the cup-supporting bar or other carrier is attached to the underside of the cylinder.

The means for automatically and periodically deactivating the lifting mechanism may include a pawl-and-ratchet coupling between the cylinder and the piston rod adapted to step an abutment, which may be part of the ratchet itself, into periodic alignment with a cooperating formation on the piston rod whereby the stroke of the latter relatively to the cylinder is limited and the creation of the partial vacuum is substantially prevented.

The above and other objects and features of our invention will be described in greater detail with reference to the accompanying drawing in which:

FIG. 1 is an axial sectional view of a lifting device according to the invention;

FIG. 2 is an elevational view of a device similar to that of FIG. 1, representing a modified embodiment; and

FIG. 3 is a cross-sectional view taken on the line III—III of FIG. 1.

The device shown in FIG. 1 comprises a vertical cylinder **1** with a piston head **2** suspended from a rod **3**, the latter projecting upwardly through a central boss **4***a* in the top **4** of the cylinder and depending from a bracket **25** having a hole **26** for engagement by a crane hook or other hoisting apparatus. The rod **3** terminates at its lower end in an enlarged extremity **27** receivable in a depression **21** of the cylinder bottom **13**. A packing ring **5** insures fluidtight contact between the periphery of head **2** and the inner cylinder wall. Depression **21** communicates with an opening **6** which leads into a flexible tube **17** whose other end opens into the recessed underside **18** of a suction cup **14**; the bottom recess **18** of the suction cup is defined by an annular flange **15** of resiliently deformable material (e.g., rubber) of outwardly tapering cross-section. Suction cup **14** has a neck **28** which forms a socket around a ball **16** centrally depending from cylinder bottom **13**; the swivel joint **16**, **28**, together with the flexibility of suction tube **17**, thus enables the cup **14** to adjust itself to the position of a flat object O to be engaged by its flange **15**.

The rod **3** is formed with a plurality of longitudinal ribs or splines **8** (here four in number) which are equispaced about its periphery and are receivable in grooves **9** of a collar **11** forming part of a stepping mechanism **7** for alternately blocking and unblocking the ascent of the rod relative to cylinder **1**. Mechanism **7** also includes a pair of pawls **12** engageable with ratchet teeth **30** of collar **11**, each of these pawls being freely swingable about a pivot pin **31** and cooperating with a stop pin **32** on the unsplined upper end of rod **3**. The eight ratchet teeth **30** define as many rotary positions of collar **11** in which the latter is indexable by a spring-loaded ball check **33** engaging peripheral notches **34** of the collar; in four of these positions the grooves **9** are aligned with the splines **8** of the rod, whereas in the intervening four positions the continuous bottom of collar **11** forms an abutment for these splines which prevents the raising of rod **3** for more than a short distance above its lowermost position. In that lowermost position the enlarged extremity **27** of rod **3** enters depression **21** of cylinder bottom **13** so as to unblock a pair of venting channels **34** whereby the pressure above and below piston head **2** is equalized.

A manometric device **23**, bearing a scale **24** calibrated in units of weight (e.g. pounds or kilograms) as shown in FIG. 2, is mounted on the outside of cylinder **21** and communicates with its interior at a level just above bottom **13** through an orifice **35**.

In the operation of the device shown in FIGS. 1 and 3, the bracket **25** is initially lowered to deposit the suction cup **14** on the subject O to be lifted. It will be assumed that, at this instant, the grooves **9** are aligned with the splines **8** so that a subsequent hoisting of bracket **25** elevates the rod **3** sufficiently to cause a substantial separation of piston head **2** from cylinder bottom **13**. This separation creates, well before the head **2** approaches the top **4** of the cylinder, a partial vacuum which through opening **6** and tube **17** is communicated to the recess **18** of suction cup **14** whereby the object O is firmly held in contact with that cup. A further rise of bracket **25** and rod **3** eventually results in the upward entrainment of cylinder **1** either because of the partial vacuum in the

lower cylinder portion or by reason of physical contact between piston head **2** and the central boss *4a* of the upper cylinder wall **4**, with consequent lifting of the object O from its foundation. When the assembly is thereafter lowered again, object O comes to rest on its previous or some other supporting surface and the continued descent of rod **3** and head **2** cancels the partial vacuum within cylinder **1**; this restoration of normal pressure is completed when the bottom end **27** of piston rod **3** enters the depression **21** to open the vents **34**.

As the rod **3** approaches its bottom position, each pawl **12** engages the steep flank of the nearest ratchet tooth **30** and steps the collar **11** through an angle of 45°. This aligns the grooves **9** with the splines **8** into contact with the underside of collar **11** and lifts the entire device off the object O without the creation of suction. The relative axial motion between rod **3** and cylinder **1** is then just sufficient to let the pawls **12** clear the engaged teeth prepatorily to another stepping of the ratchet when the hoisting mechanism lowers the device again upon an object to be gripped.

In FIG. 2 we have shown the plurality of suction cups **14***a*, **14***b*, **14***c*, all joined via articulated linkages **20** to a horizontal bar **19** having a boss **28'** in swiveling engagement with ball **16**. Flexible suction tubes **17***a*, **17***b*, **17***c* link the cups **14***a*, **14***b*, **14***c* with the depressed part **21** of cylinder **1**. Bar **19** is also shown provided with laterally extending handles **22** to facilitate manual positioning of an object O' engaged by the suction cups **14***a*, **14***b*, **14***c*.

The manometric scale **23**, **24** enables direct observation of the weight of the load O or O' so that the operator may determine whether it is safe to continue the hoisting operation without risking a disengagement of the rod from its supporting suction cup or cups. The same meter also indicates the existence of a leak if its pointer fails to move at the expected rate when the hoist is operated.

Naturally, the number of suction cups may be varied according to requirements and their support, such as bar **19** of FIG. 2, may correspondingly assume a variety of forms. These and other modifications of the specific arrangement described and illustrated are deemed to come within the spirit and scope of our invention as defined in the appended claims.

We claim:

1. A lifting device for flat goods, comprising a cylinder with a substantially vertical axis, a piston head axially movable in said cylinder, suspension means for said cylinder including a rod slidably extending axially into said cylinder from above and engaging said piston head, said cylinder having a bottom provided with an opening, and at least one suction head supported by said cylinder, said suction head communicating with said opening for developing a partial vacuum upon separation of said piston head from said bottom in response to a lifting force exerted upon said rod, said bottom being provided with a depression in line with said rod, said opening terminating in said depression, said rod slidably traversing said piston head and terminating in an enlarged lower extremity engageable with the underside of said piston head, said extremity being receivable in said depression, said piston head being provided with at least one venting channel blocked by said extremity upon contact thereof with said underside and unblocked upon a lowering of said extremity into said depression.

2. A lifting device as defined in claim **1** wherein said cylinder is provided with manometer means communicating with the interior of said cylinder at a level close to said bottom, said manometer means being calibrated in units of weight.

3. A lifting device as defined in claim **1** wherein said suction head is provided with an elastically deformable peripheral flange of outwardly tapering cross-section.

4. A lifting device for flat goods, comprising a cylinder with a substantially vertical axis, a piston head axially movable in said cylinder, suspension means for said cylinder including a rod slidably extending axially into said cylinder from above and engaging said piston head, said cylinder having a bottom provided with an opening, hinge means on the underside of said cylinder, and at least one suction head supported by said hinge means, said suction head communicating with said opening for developing a partial vacuum separation of said piston head from said bottom in a response to a lifting force exerted upon said rod.

5. A lifting device as defined in claim **4** wherein said hinge means comprises a ball-and-socket joint.

6. A lifting device for flat goods, comprising a cylinder with a substantially vertical axis, a piston head axially movable in said cylinder, suspension means for said cylinder including a rod slidably extending axially into said cylinder from above and engaging said piston head, said cylinder having a bottom provided with an opening and a bar horizontally hinged to the underside of said cylinder, a plurality of suction heads supported by said bar, said suction heads communicating with said opening for developing a partial vacuum upon separation of said piston head from said bottom in response to a lifting force exerted upon said rod.

7. A lifting device as defined in claim **6** wherein said bar is provided with handle means laterally projecting therefrom.

8. A lifting device for flat goods, comprising a cylinder with a substantially vertical axis, a piston head axially movable in said cylinder, suspension means for said cylinder including a rod slidably extending axially into said cylinder from above and engaging said piston head, said cylinder having a bottom provided with an opening, at least one suction head supported by said cylinder, said suction head communicating with said opening for developing a partial vacuum upon separation of said piston head from said bottom in response to a lifting force exerted upon said rod, and abutment means on said cylinder positively engageable by said rod upon an upward movement thereof for limiting said separation and suppressing said partial vacuum, said rod and said cylinder being provided with co-operating means for aligning said abutment means with said rod upon alternate reciprocations of said rod relatively to said bar, said co-operating means comprising pawl means on said rod and ratchet means on said cylinder adapted to be rotatively stepped by said pawl means, said abutment means being rigid with said ratchet means.

9. A lifting device for flat goods, comprising a cylinder with a substantially vertical axis, a piston head axially movable in said cylinder, suspension means for said cylinder including a rod slidably extending axially into said cylinder from above and engaging said piston head, said cylinder having a bottom provided with an opening, hinge means on the underside of said cylinder, at least one suction head supported by said hinge means, said suction head communicating with said opening for developing a partial vacuum upon separation of said piston head from said bottom in response to a lifting force exerted upon said rod, and abutment means on said cylinder positively engageable by said rod upon an upward movement thereof for limiting said separation and suppressing said partial vacuum.

References Cited

UNITED STATES PATENTS

897,060	8/1908	Cash	294—64
2,198,976	4/1940	Rober	294—64 X
2,274,304	2/1942	Perry	294—64 X
2,969,968	1/1961	Miller	177—208 X
3,230,001	1/1966	Hirt	294—64

FOREIGN PATENTS

122,139	8/1927	Switzerland.

RICHARD B. WILKINSON, *Primary Examiner.*

ROBERT S. WARD, JR., *Assistant Examiner.*