United States Patent

Sinclair

[15] **3,698,755**

[45] **Oct. 17, 1972**

[54] **VACUUM HEAD MAGNETIC VALVE CONSTRUCTION FOR PALLET LOADER**

[72] Inventor: **Gordon J. Sinclair,** East Syracuse, N.Y.

[73] Assignee: **Diebold, Incorporated,** Canton, Ohio

[22] Filed: **April 29, 1971**

[21] Appl. No.: **138,556**

[52] **U.S. Cl.** .....**294/65,** 214/6 FS

[51] **Int. Cl.**.....**B66c 1/02**

[58] **Field of Search**.....294/64, 65, 65.5; 214/1 BS, 214/1 BT, 6 FS, 8.5 D, 650 SG; 248/362, 363

[56] **References Cited**

UNITED STATES PATENTS

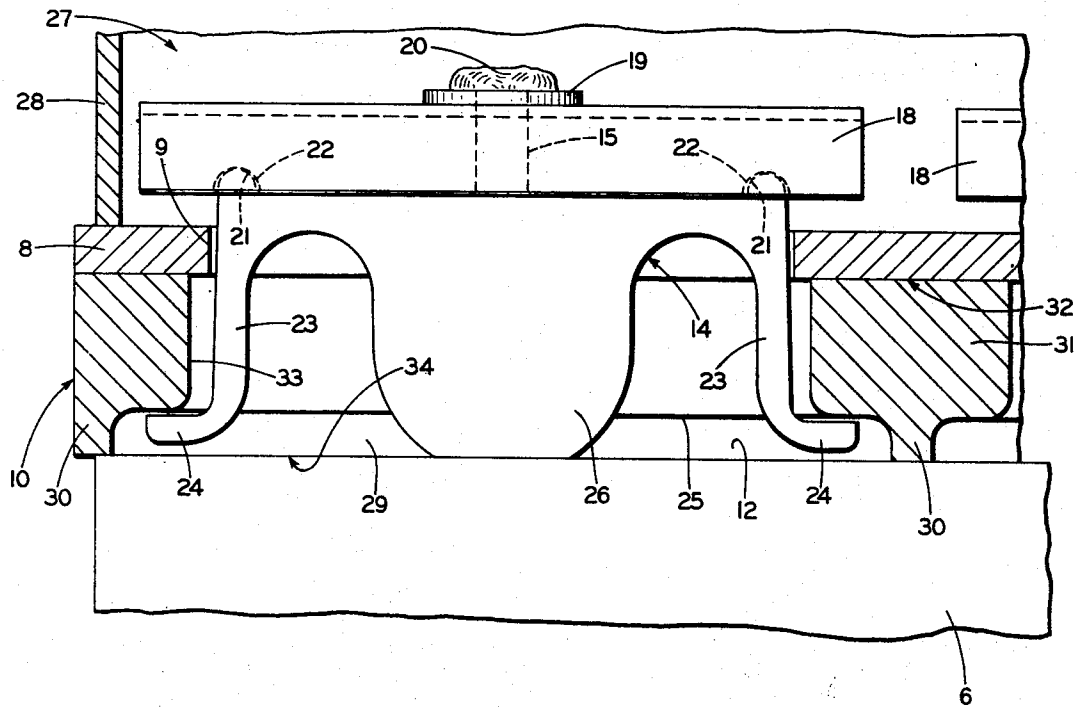
3,598,439	8/1971	Dahlquist	294/65
3,602,543	8/1971	Sjodin	294/64 R
3,610,672	10/1971	Olson	294/65

Primary Examiner—Evon C. Blunk
Assistant Examiner—Johnny D. Cherry
Attorney—Frease & Bishop

[57] **ABSTRACT**

A magnetic valve vacuum head construction for pallet loaders, for hoisting, or lifting rigid, sealed cartons, packages, boxes, or cases to transfer them to or from and to load or unload them to or from pallets for palletized material handling. The vacuum head has lift plate means with a work-engaging face communicating through a series of box-like cells and a mask plate to the plenum chamber of a blower mounted on the head supplying the suction. A series of orifices in the mask plate each form airflow passages between the cells and the plenum chamber. Each valve has a magnetic metal plate of larger dimensions than those of the controlled orifice and an actuator connected to the magnetic plate formed of nonmagnetic material. The actuator extends through the orifice and normally projects below the work-engaging face of the vacuum head to engage the cartons to be hoisted for opening the magnetic valve.

17 Claims, 8 Drawing Figures



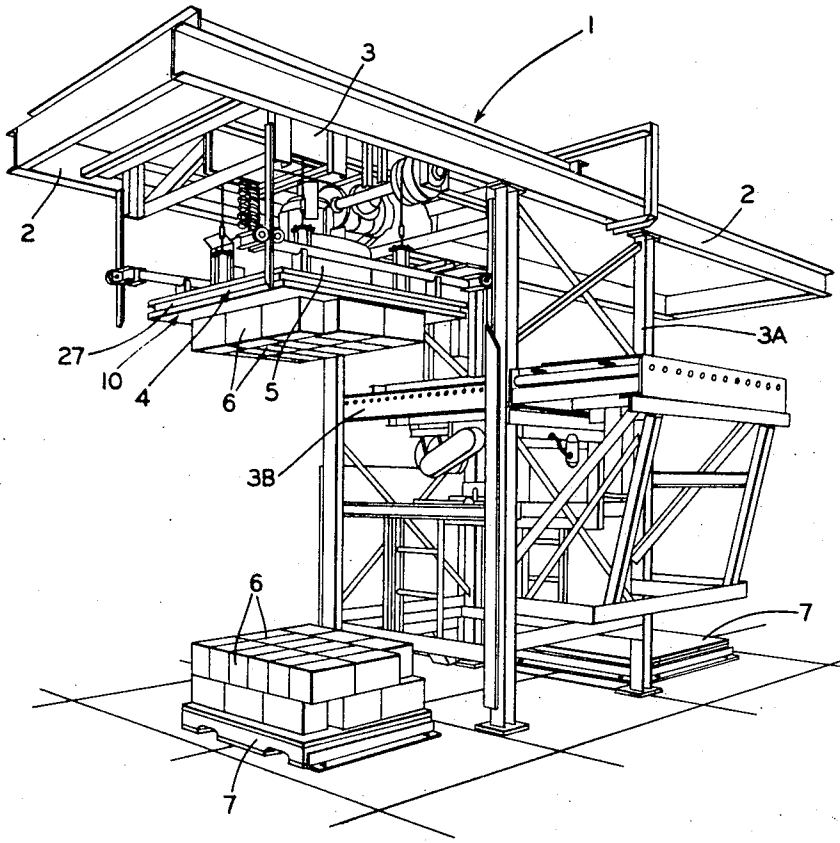


Fig. 1

Fig. 8

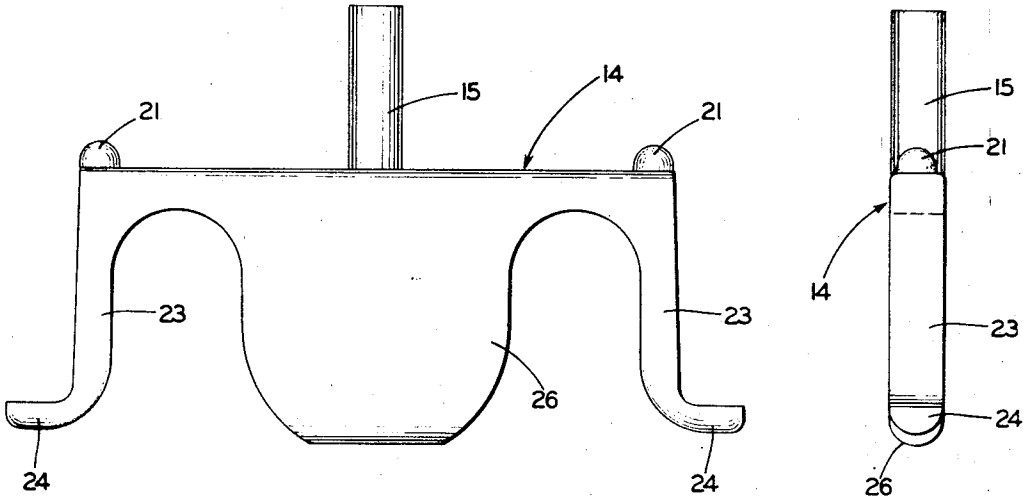


Fig. 7

INVENTOR.
Gordon J. Sinclair
BY
Frease & Bishop
ATTORNEY

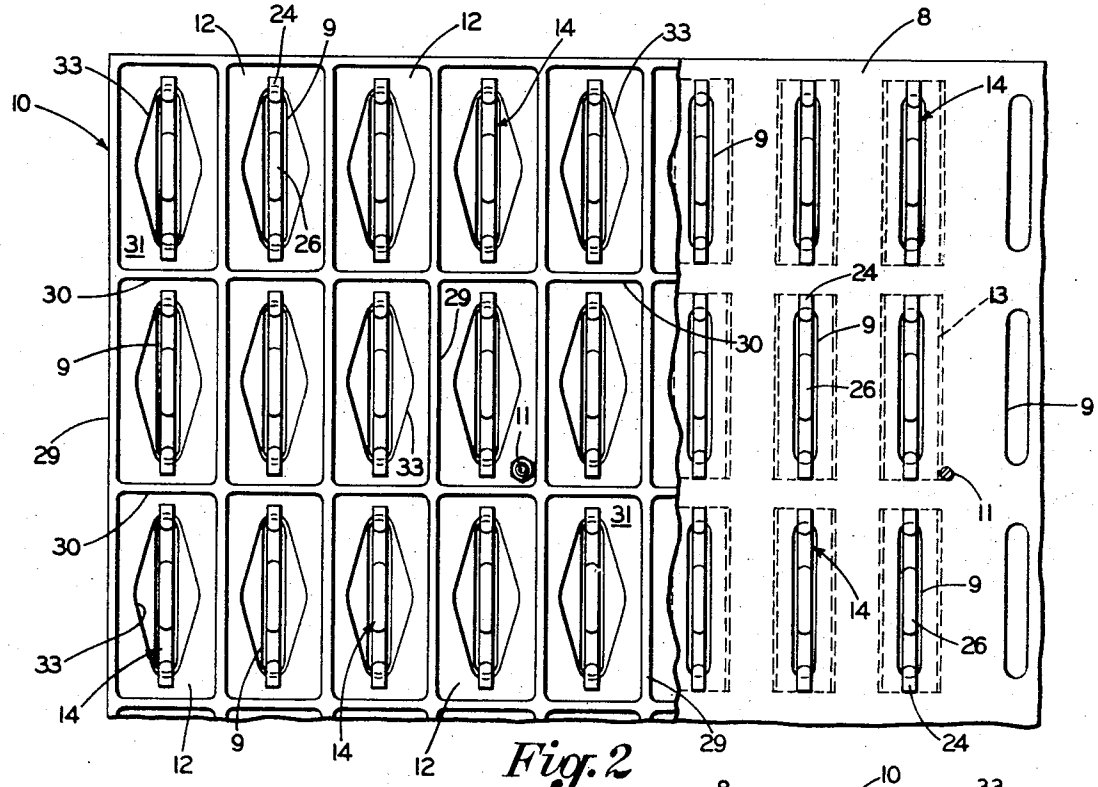


Fig. 2

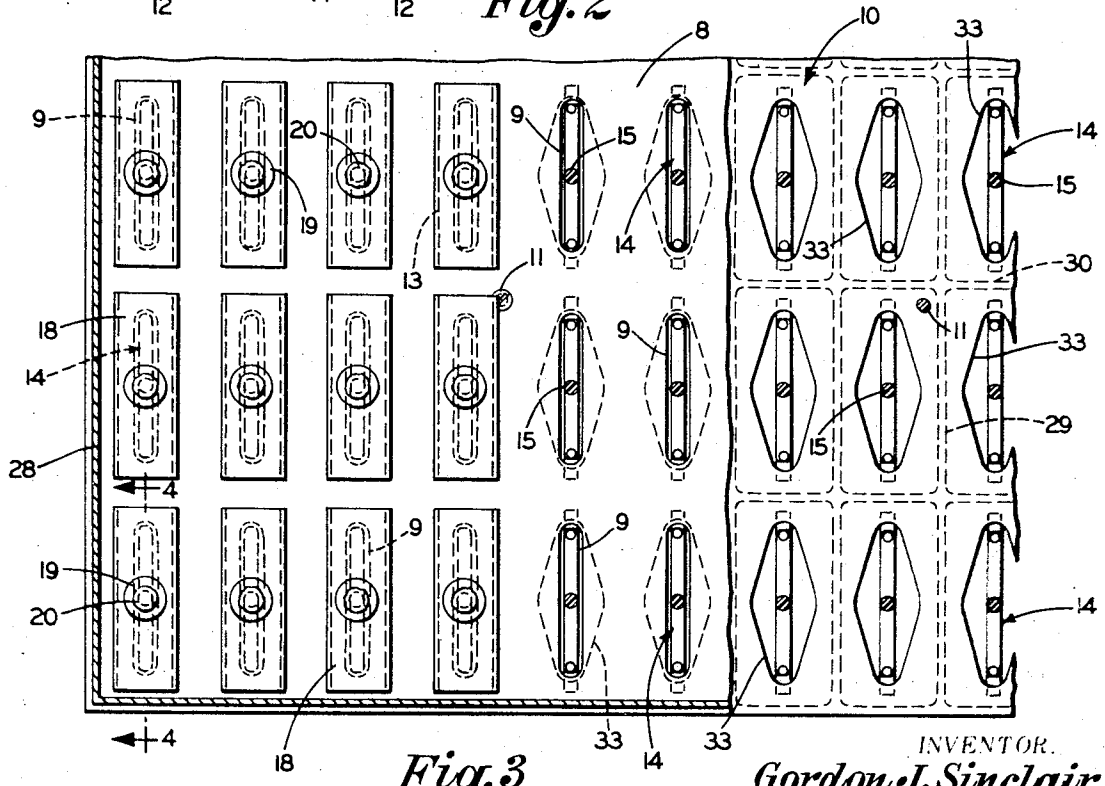


Fig. 3

INVENTOR.
Gordon J. Sinclair
BY
Frease & Bishop
ATTORNEY

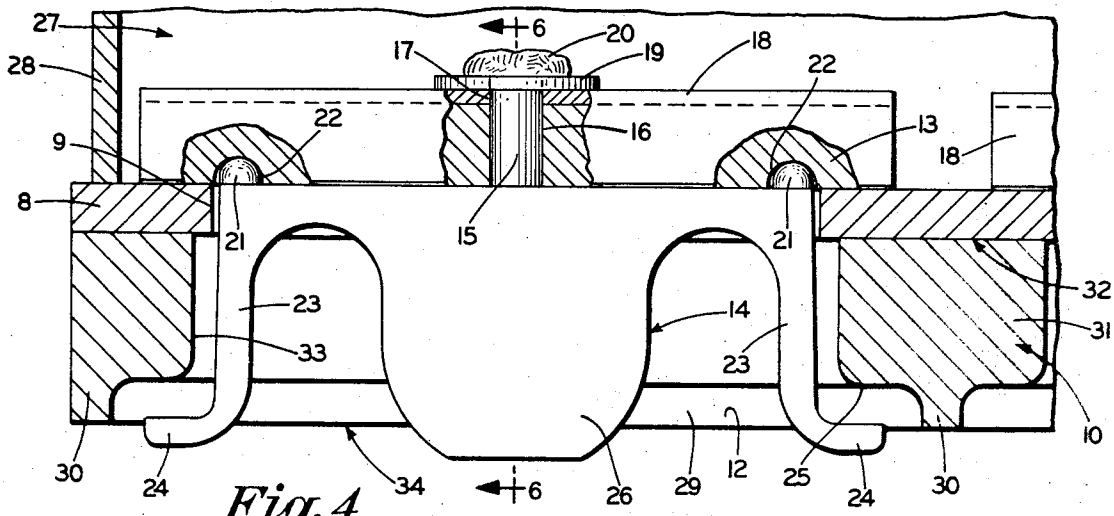


Fig. 4

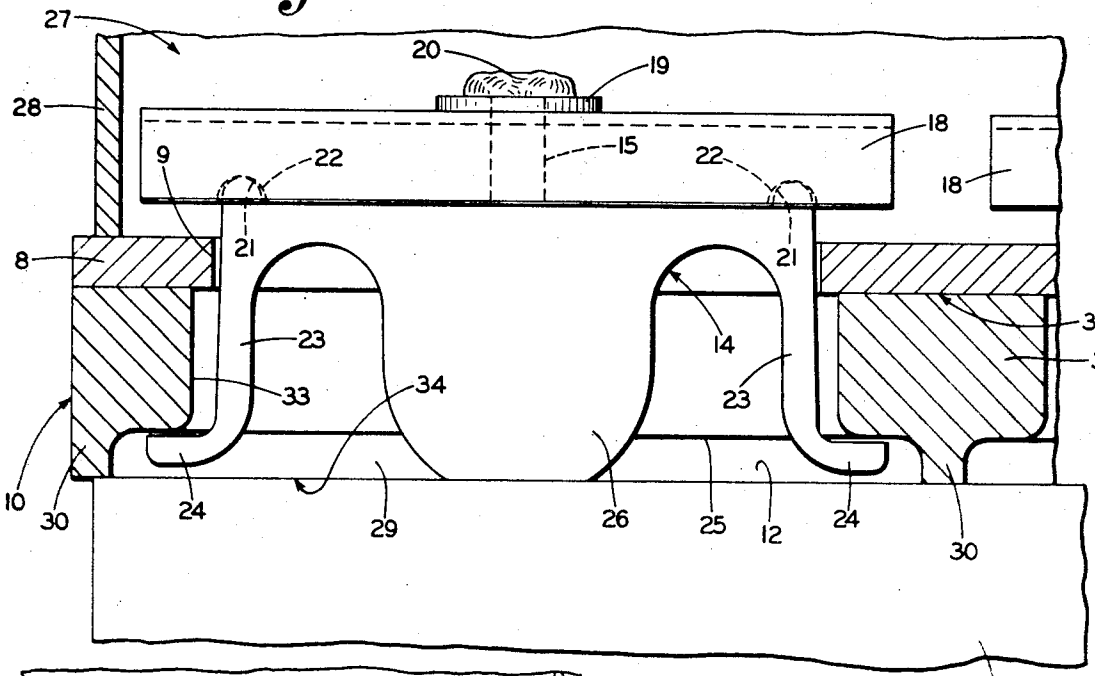


Fig. 5

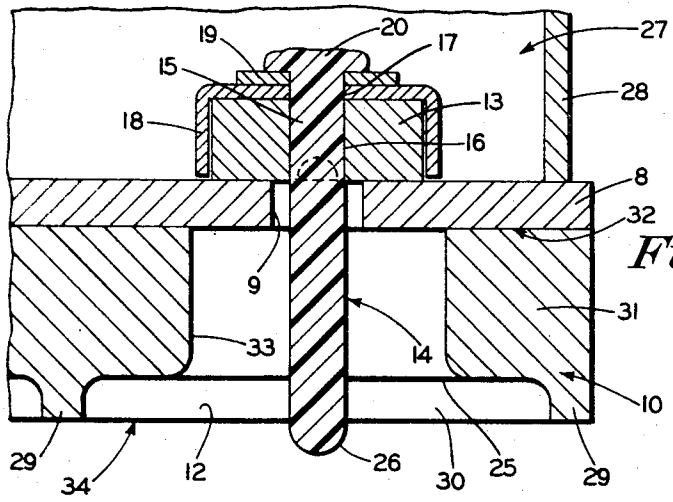


Fig. 6

INVENTOR.
Gordon J. Sinclair
BY
Frease & Bishop
ATTORNEY

VACUUM HEAD MAGNETIC VALVE CONSTRUCTION FOR PALLET LOADER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to pallet loader vacuum heads and more particularly to a magnetic valve construction for such vacuum heads. Especially the invention relates to a universal vacuum head construction for pallet loaders adapted to handle different package patterns for palletizing the packages in overlapping tiers or layers wherein a series of magnetic valves normally closed are opened by contact with the packages to be hoisted or handled by the vacuum head to supply airflow providing the package lifting force.

2. Description of the Prior Art

The work contact or lift faces of pallet loader vacuum heads have had special partitioned patterns for each particular pattern of a carton layer to be handled by the head. Masks were used for the partitioned lift faces having sealing strips corresponding to zones between adjacent cartons in the pattern. Such masks essentially are rubber gaskets defining the sealing strip pattern as well as the outer edges or perimeter of the head. A separate mask has been required for each pattern and the masks must be changed when patterns are changed. The operation of such pallet loader vacuum head equipment required a high vacuum, with low volume airflow, say, 400 cu. ft. of air per minute passing through a centrifugal blower-exhauster mounted on the head and maintaining a vacuum of 4 inches of mercury.

Another vacuum head construction has used a subway-grating type grill or cellular structure to form the work-engaging member providing the lift face of the vacuum head. Such heads have operated on high volume, low vacuum airflow through the exhauster of about 1400 cubic feet of air per minute at a vacuum of 2 inches of mercury. Such a head can accept different patterns without changing the mask. Where one mask is used for different patterns, areas not contacting a carton to be lifted are blocked out with a sheet metal plate.

High volume, low vacuum heads accommodating various patterns, preferably have used valves for each cell of the grill structure. Hundreds of valves may be involved and it is impractical to remotely control such valves because this would involve a complicated procedure to select the proper valves to be opened and closed in order to change patterns to accept a particular pattern.

Thus, automatically operated valves have been used to provide universal vacuum heads which automatically accept any carton pattern, and wherein the valves are closed by the vacuum airflow in each cell of the vacuum head not covered by a carton to be lifted.

Various types of valves have been used including spring-loaded valves, flexible spring material valves, weighted valves, etc. Some of these valves are actuated by contact with the cartons. Where weighted valves are used the weight of the valves becomes part of the load to be lifted and increases the power requirements, and such increase of power requirements should be minimized.

Flexible spring material valves have not proven entirely satisfactory since it is difficult to provide hundreds of flexible spring elements with identical spring characteristics, which result in nonuniform actuation of the valves under existing airflow conditions because of nonuniform spring characteristics.

Similarly, spring-loaded valves require close tolerances to be maintained in manufacture and use if uniform operating characteristics are to be present in the multitude of cells.

Insofar as I am aware, no prior art pallet loader vacuum head valve construction has been entirely satisfactory for controlling the flow of air through airflow orifices in heads having cellular work-engaging faces.

SUMMARY OF THE INVENTION

Objectives of the invention include providing a magnetic valve construction for the vacuum head of a pallet loader; providing such valves for automatically controlling the flow of air through orifices in a cellular vacuum head; providing a pallet loader vacuum head, the lifting face of which is divided into cells formed by a subway-grating type grill, with an airflow orifice connected to each cell, and a magnetic valve normally closing each orifice; providing a magnetic valve formed of a magnetized metal plate larger than the airflow orifice to be closed and a plastic material actuator attached to the plate and slidably movable through its orifice between open and closed valve positions; providing such a magnetic valve with stop means on its actuator which engages a portion of the grill to limit opening movement of the valve; providing an elongated slot to form each orifice and depending legs at the ends of the actuator which extend through the slots, with feet on the legs which engage the grill to limit opening movement of the valve; providing each actuator with a centrally located guide vane spaced between its legs slidably movable through the central portion of its corresponding orifice slot; providing the actuator with a centrally located, upwardly disposed stem connected to the magnetized metal plate; providing an upwardly disposed projection at each end of the actuator received in cavities in the magnetized metal plate to maintain assembly of the actuator and magnet without relative movement; and providing a universal vacuum head magnetic valve construction which is inexpensive to manufacture, easy to assemble, sturdy and durable in use, and which eliminates difficulties heretofore encountered, achieves the objectives indicated and solves problems and satisfies needs existing in the art.

These objects and advantages are obtained by the vacuum head magnetic valve construction for pallet loaders including a subway-grating-type cellular grill structure forming a plurality of cells, the grill having a work-engaging or lift face and a back face, a metal mask plate mounted on the back face of the grill; a plurality of elongated slots formed in the mask plate, one slot communicating with each cell forming a limited airflow orifice for each cell; magnetic valve means normally closing each slot; each valve preferably comprising a magnetized metal plate larger than the slot controlled by the valve, and an actuator formed of nonmagnetic preferably plastic material connected to the plate; the actuator being slidably movable through its slot; the grill having stop shoulder means formed in each cell; stop means formed on each actuator engage-

able with the cell shoulder means to limit the opening movement of the valve; the actuator being flat and having a thickness less than the width of the slot for free movement in the slot; the actuator having a depending leg at each end forming the stop means and a central guide intermediate and spaced from the legs; the actuator having an upwardly disposed stem connected with the plate; projections at each end of the actuator engaged in suitable cavities in the plate to maintain assembly of the plate and actuator without relative movement; the head also including a centrifugal blower-exhauster, walls forming a plenum chamber for the exhauster, the mask plate comprising a wall portion of the plenum chamber walls, the mask plate slots communicating with the plenum chamber, and the magnetized plates being located within the plenum chamber; the valve plates normally magnetically seating on the mask plate closing their respective cell orifice slots to prevent vacuum airflow loss through the slots when the exhauster is operating; the actuator feet projecting from the lifting face of the grill when the valves are normally closed; and the actuator guide being engaged with cartons to be lifted upon lowering the vacuum head onto such cartons and actuated by pressure of cartons to open the valves and establish vacuum airflow through said slots into the plenum chamber to provide lifting power for holding the cartons to be lifted.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention — illustrative of the best mode in which applicant has contemplated applying the principles — is set forth in detail in the following description, is illustrated in the accompanying drawings, and is particularly and distinctly pointed out and set forth in the appended claims.

FIG. 1 is a perspective view of a pallet loader equipped with a vacuum head provided with the improved magnetic valve construction;

FIG. 2 is an enlarged bottom plan of a corner portion of the magnetic valve vacuum head grill;

FIG. 3 is an enlarged top plan view of the corner portion of the grill shown in FIG. 2;

FIG. 4 is a further enlarged longitudinal sectional view taken on the line 4—4, FIG. 3, showing one of the magnetic valves in normally closed position;

FIG. 5 is a view similar to FIG. 4 showing the magnetic valve actuated to open position by contact of the valve actuator with a carton to be lifted by the vacuum head;

FIG. 6 is a transverse section taken on the line 6—6, FIG. 4;

FIG. 7 is a side elevation of one of the plastic valve actuators before assembly; and

FIG. 8 is an end view of the actuator shown in FIG. 7.

Similar numerals refer to similar parts throughout the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A typical pallet loader 1 includes overhead track rails 2 upon which a carriage 3 is movable, from which a vacuum head generally indicated at 4 is suspended for raising and lowering.

A centrifugal blower, air-exhauster 5 is mounted on vacuum head 4. Carriage 3 may be moved along the track 2 between several positions, one at left end of track 2, one at right end of track 2, and a third intermediate position at the top of the tower 3A, above sections of a conveyor 3B where cartons to be loaded are delivered and arranged in a desired pattern to form a layer of a palletized load.

Carriage 3 may be moved to a position above an assembled layer of cartons 6 on conveyor section 3B, the vacuum head 4 then is lowered and the layer 6 picked up. Then head 4 is raised and carriage 3 is moved to a position such as shown in FIG. 1 above pallet 7, whereupon it may be lowered to place the carton layer 6 upon other layers located on pallet 7 as shown in FIG. 1. When the desired number of layers 6 have been deposited on pallet 7 the cartons are strapped to pallet 7 to form a palletized load handled in the usual manner. The pallet loader construction thus far described is typical and forms no part of the invention.

Vacuum head 4 has walls forming a plenum chamber or vacuum chamber or suction manifold 27 for exhauster 5, a side wall being diagrammatically indicated at 28 in FIGS. 4 and 5. The mask plate 8 forms the bottom wall of plenum chamber 27. Plate 8 has a great multiplicity of airflow orifices formed therein in the form of relatively long narrow slots 9. A grill or lift plate 10 is secured to the bottom surface of the plate 8 as by bolts 11.

Grill 10 may have a subway-grating type cellular structure with a series of cells 12. As shown, grill 10 may be a metal casting formed with a series of box-like cells 12 having side walls 29 and end walls 30, many of which are common to adjacent cells 12. Each cell 12 also has a thick bottom wall 31 and the cell walls 31 are coextensive in the casting. The upper surface 32 of the cell walls 31 is clamped against the lower surface of mask plate 8 by the bolts 11.

Each cell 12 is formed with a diamond-shaped opening 33 in its bottom wall 31 extending between the upper surface 32 and the shoulder 25 which surrounds opening 33 and extends outward from opening 33 to cell walls 29 and 30. The face of shoulder 25 in effect is the lower surface of cell bottom wall 31. Each diamond-shaped opening is located beneath a slot 9 in mask plate 8 and is slightly longer than slot 9 as well shown in FIGS. 2–6. Thus, the airflow orifices formed by slots 9 are continued and enlarged in the diamond-shaped openings 33 in the assembled mask plate 9 and grill 10. The undersurface of grill 10, that is the lower edges of cell walls 29 and 30, forms the work-engaging surface 34 of the vacuum head 4, sometimes referred to as the lift face.

The improved magnetic valve controls airflow through each orifice 9 and is normally closed (FIG. 4). The magnetic valve includes a magnetized metal plate 13 which may be a permanent magnet and plate 13 has a larger area than that of slot 9. An actuator 14 preferably formed of suitable plastic material is connected to plate magnet 13 and extends through slot 9, through diamond-shaped opening 33, and through cell 12.

Actuator 14 preferably is connected to the plate magnet 13 by an integral centrally located upwardly disposed stem 15 which extends through a central opening 16 in plate 13 and through a similar opening 17 in the sheet metal channel member 18 which

preferably surrounds the top and side edges of the magnetic plate 13 (FIG. 6).

A washer 19 surrounds the upper end of stem 15 and the upper end of the plastic material stem may be upset or riveted, as indicated at 20, to connect the actuator 14 to the magnetic plate 13.

Upwardly disposed projections 21 are formed at the ends of the actuator 14 and engage in cavities 22 formed in the underside of the plate 13 for holding the assembled actuator 14 and plate 13 against relative movement.

An integral depending leg 23 is formed at each end of the actuator 14 and extends below the lift face 34 of grill 10 when the magnetic valve plate 13 is in closed position as shown in FIG. 4. An outturned foot 24 is formed at the lower end of each leg 23 which is adapted to contact grill shoulder 25 to limit opening movement of the valve as shown in FIG. 5. A depending guide blade 26 is formed on actuator 14 intermediate the legs 23 and spaced from the legs. Guide 26 has a greater length than that of the legs 23 so as to contact a carton 6 when the vacuum head is lowered upon a carton. Such contact moves actuator 14 to open the valve as shown in FIG. 5.

Actuator 14 (FIGS. 4, 5 and 6) is not as long in length as slot 9 and has considerably less thickness than the width of slot 9 (FIG. 6) so that when actuator 14 is moved to open position (FIG. 5) sufficient clearance is present to permit rapid flow of air through slot 9 around actuator 14 and beneath magnetic plate 13 into plenum chamber 27 to apply a suction or vacuum lifting force to a carton contacted by the lift face 34 of vacuum head 4 at each cell 12 defined by cell walls 29 and 30 and the undersurfaces thereof (FIGS. 4 and 6).

The flow of air also is facilitated when any valve is in open position by the spaces (FIGS. 4 and 5) between the actuator legs 23 and the guide blade 26. When guide blade 26 is engaged by any carton 6 to open the valve substantial tilting of any actuator is limited. For example, tilting in a seesaw manner (FIG. 5) is prevented by engagement of either of the feet 24 at the ends of actuator 14 either with the shoulder 25 or the top of the carton 6. Rotative tilting, viewing FIG. 6, of the actuator 14 again is limited by the feet 24 engaging shoulder 25 and by one or the other lower corner of the assembly of magnet 13 and channel member 18 engaging the top of mask plate 8.

This loose mounting permitting free movement of actuator 14 in any slot 9 and within the cells 12 and diamond-shaped openings 33 avoids the necessity of maintaining close tolerances in the manufacture of the valve components. The actuator 14 being formed of plastic material is light in weight. Actuators 14 carry the weight of the magnetic plates 13 directly on the cartons to be lifted when the vacuum head 4 is lowered upon a layer of cartons. Thus the necessity of providing sufficient vacuum to sustain the load of the movable magnetic valve elements 13 and 14 is avoided.

Furthermore, there is sufficient flexibility in the plastic material forming the actuators 14 to permit the legs 23 to be sprung for inserting an actuator 14 through a slot 9 in the mask plate 8 for assembling the valves in their airflow slots to be opened and closed by the valves.

The improved vacuum head magnetic valve construction enables the head to handle any carton pattern without the necessity of using a special mask for each pattern. All magnetic valves remain closed until automatically opened by contact with cartons to be handled.

Magnetic valves whose actuators are not contacted by cartons will remain closed, eliminating airflow loss or leakage therethrough. Those valves which are opened by contact with cartons result in sealing the lift face of the head against such cartons by the vacuum airflow through the opened valves.

OPERATION

In the operation of a pallet loader equipped with the improved magnetic valve construction, when a layer of cartons to be handled is assembled in the desired pattern at conveyor location 3B, the carriage 3 is moved on rails 2 in a usual manner until the vacuum head 4 is located over the layer of cartons, and then the head 4 is lowered until the magnetic valves are opened by contact of their actuators 14 with the cartons 6. Meanwhile the exhauster 5 exhausts air from the vacuum head and plenum chamber and opened valves, and the grill 10 is sealed against the layer of cartons.

Then, in the usual manner, the vacuum head 4 is raised, and the carriage 3 is moved upon the rails 2 to a position over a pallet 7, such as the left-hand pallet in FIG. 1. The vacuum head then is lowered placing the layer of cartons on the pallet 7, or upon layers of cartons previously placed thereon, two deposited layers being shown in FIG. 1.

Airflow suction to the plenum chamber then is cut off and the seal with the layer of cartons held by the head is broken. As the vacuum head is raised the layer of cartons remains on the pallet and the magnetic valves automatically close. The operation may be repeated until the desired number of cartons have been placed upon a pallet.

Accordingly, the improved vacuum head magnetic valve construction provides a universal vacuum head for pallet loaders which is adapted to handle different package patterns for palletizing the packages, in which the magnetic valves automatically control the flow of air providing the lifting force so that contact of the head with the article to be lifted opens a normally closed valve and exerts suction on the article to be lifted at a multitude of locations on the lifting face of the head; provides simple and efficient magnetic valves which are easy and inexpensive to manufacture, assemble and operate; and provides a construction which incorporates the new and advantageous features described, overcoming the prior art difficulties an solving problems existing in the art.

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

Moreover, the description and illustration of the invention is by way of example, and the scope of the invention is not limited to the exact details shown or described such as the size of the cells, of the orifice slots, and of the magnetic plates.

Having now described the features, discoveries and principles of the invention, the manner in which the improved vacuum head magnetic valve construction is constructed and used in a pallet loader, the characteristics of the construction, and the advantageous, new and useful results obtained, the new and useful structures, devices, elements, arrangements, parts and combinations, are set forth in the appended claims.

I claim:

1. In a pallet loader vacuum head of a type having a lift face, having walls forming a plenum chamber, and having an exhauster communicating with the plenum chamber; the combination of one plenum chamber wall being formed with a multiplicity of airflow orifices for communication between the lift face and the plenum chamber; a magnetic valve normally closing each orifice; and each valve including a magnetized metal plate located in the plenum chamber larger than the orifice closed thereby, and an actuator connected to the plate, and extending outward through the orifice, and projecting beyond the lift face, and adapted to contact an article to be lifted when the head is lowered to engage the lift face with such article; whereby contact of the actuator with such article moves the valve plate out of valve-closing position to permit airflow through said orifice to the plenum chamber when the exhauster is operating to provide suction force to lift such article.

2. The construction defined in claim 1 in which the actuator is formed of nonmetallic material.

3. The construction defined in claim 1 in which the actuator is formed of plastic material.

4. The construction defined in claim 1 in which said one plenum chamber wall includes grill means formed with a multiplicity of cells, in which an airflow orifice communicates through each cell with the lift face, and in which the actuator for each valve extends through the corresponding cell.

5. The construction defined in claim 4 in which each actuator has a depending leg at each end, in which each leg has a foot, and in which shoulder means is formed in each cell engaged by said feet to limit valve opening movement of the actuator.

6. The construction defined in claim 4 in which each actuator has a depending leg at each end, and in which a central guide vane of greater length than said legs projects downward intermediate of and spaced from said legs.

7. The construction defined in claim 1 in which said one plenum chamber wall comprises a mask plate and a grill; in which the orifices are formed in the mask plate; in which each orifice comprises a narrow elongated slot; and in which the grill is formed with a plurality of cells, one cell communicating with its corresponding slot.

8. The construction defined in claim 6 in which each orifice comprises a narrow elongated slot, in which the actuator legs and guide vane have common lateral parallel faces spaced to provide uniform thickness less than the width of the slot through which the actuator extends.

9, The construction defined in claim 1 in which the magnetic valve plate has a central opening, in which the actuator has a central upwardly projected neck extending through said plate opening, and in which means is provided connecting said neck to said plate.

10. The construction defined in claim 9 in which means is provided at the ends of each actuator interlocking with the plate to prevent relative movement between the plate and actuator.

11. Vacuum head construction for a pallet loader including walls forming an exhauster plenum chamber, lift plate means forming one of the plenum chamber walls; the lift plate means including a grill structure and a metal mask plate; the grill structure being formed with a plurality of cells and having a lift face and a back face; the mask plate having a chamber face and an outer face; the grill structure and mask plate being connected with the grill back face adjacent the mask plate outer face; a plurality of elongated airflow slots formed in the mask plate, one slot communicating with each cell; magnetic valve means normally closing each slot including a magnetic plate and a flat actuator connected to the magnetic plate; the magnetic plate being larger than the slot closed thereby and held in contact with the mask plate chamber face by magnetic attraction when in valve-closed position; and the actuator extending through the slot and its corresponding cell and projecting beyond the grill lift face; whereby when the vacuum head is lowered to engage its lift face with articles to be lifted, all projecting actuators contacting such articles are moved incident to such contact and the lowering of the head and move the valves to open position to permit airflow through the cells and valve-opened slots to the plenum chamber providing suction to lift such articles.

12. The construction defined in claim 11 in which the actuator is formed of plastic material and is smaller in cross section than the elongated slot through which it extends; and in which interengageable stop means are provided on the actuator and cell walls to limit valve opening movement of the actuator.

13. The construction defined in claim 11 in which each flat actuator has a thickness less than the width of the slot through which it extends for free slidable movement through such slot and to permit airflow around the actuator and through the slot when the valve is in open position.

14. The construction defined in claim 11 in which the grill structure has walls forming the cells; in which the walls of each cell have a stop shoulder formed therein intermediate the grill lift and back faces; and in which the actuator in each cell has projecting feet engageable with said stop shoulder to limit opening movement of the actuator.

15. The construction defined in claim 11 in which each actuator has legs at each end extending through its corresponding slot and cell; in which the actuator has a central guide member of greater length than the legs extending through the cell spaced from the legs; and in which the guide member engages an article to be lifted for moving the actuator to open the valve.

16. The construction defined in claim 11 in which the grill structure has subway-grating-type cellular box-like side and end walls forming the plurality of cells, in which each cell has a thick bottom wall in which a diamond-shaped opening is formed in each bottom wall communicating with the corresponding mask plate slot, and in which the magnetic valve actuator extends through said diamond-shaped opening.

17. The construction defined in claim **16** in which the cell bottom wall has a shoulder face intermediate the grill lift and back faces extending between the diamond-shaped opening and the cell side and end walls.

* * * * *