United States Patent [19]

Lambert et al.

[11] **3,853,235**

[45] **Dec. 10, 1974**

[54] **APPARATUS FOR OPENING AND EMPTYING A CONTAINER**

[75] Inventors: **Gerard L. Lambert; Charles A. Greenlay,** both of Asbestos, Quebec, Canada

[73] Assignee: **Johns-Manville Corporation,** Greenwood Village, Arapahoe County, Colo.

[22] Filed: **Apr. 20, 1973**

[21] Appl. No.: **353,041**

Related U.S. Application Data

[62] Division of Ser. No. 228,001, Feb. 22, 1972, Pat. No. 3,757,973.

[52] **U.S. Cl.** **214/305**

[51] **Int. Cl.** **B65g 65/00**

[58] **Field of Search** 214/304, 305

[56] **References Cited**

UNITED STATES PATENTS

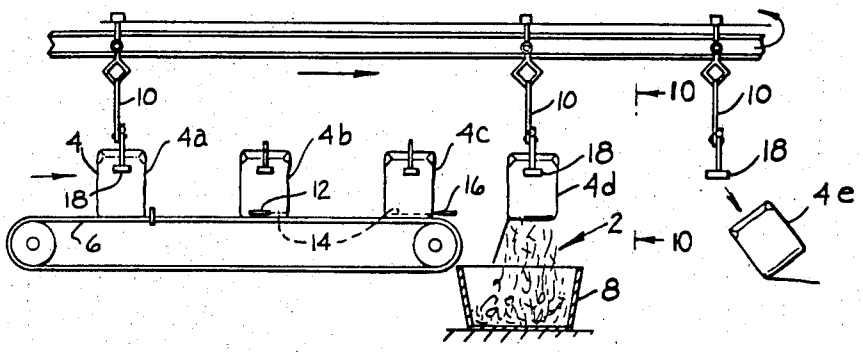
2,002,419	5/1935	Stogsdill	214/305
2,729,885	1/1956	Wahl et al.	214/305
3,022,912	2/1962	Vincent	214/305
3,447,706	6/1969	Moriarty	214/305
3,664,530	5/1972	Takiguchi	214/305
3,690,484	9/1972	Harlan et al.	214/305

Primary Examiner—Robert J. Spar
Assistant Examiner—Lawrence J. Oresky
Attorney, Agent, or Firm—Robert M. Krone; John H. Miller

[57] **ABSTRACT**

A method is described for opening closed, perforable, flexible containers. The containers are perforated along lines parallel to and transverse to their direction of travel along a conveyancing device. They are then moved to a position overlying a hopper where the weight of the contents causes the container to open along the lines of perforation, thus emptying the contents into the hopper. Apparatus for performing the method is also described.

13 Claims, 11 Drawing Figures



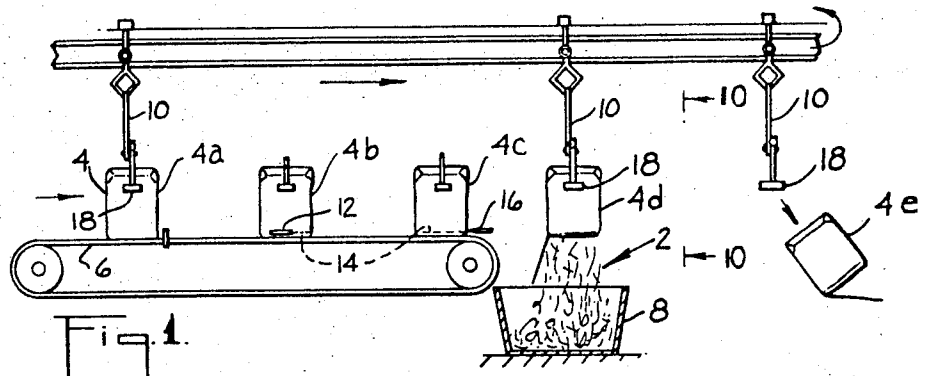


Fig. 1.

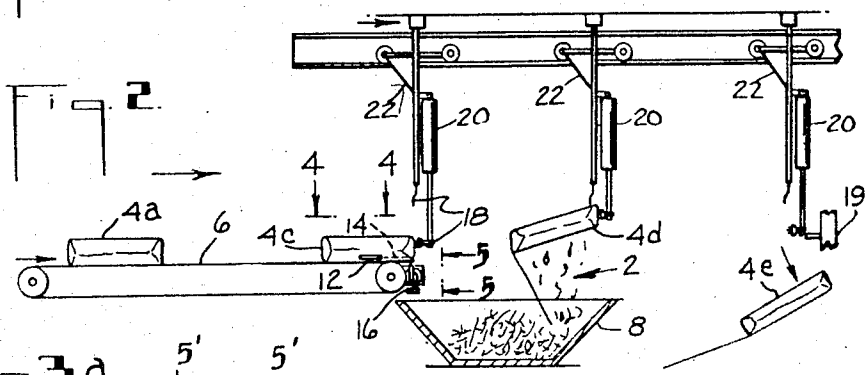


Fig. 2.

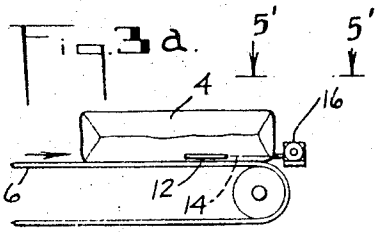


Fig. 3a.

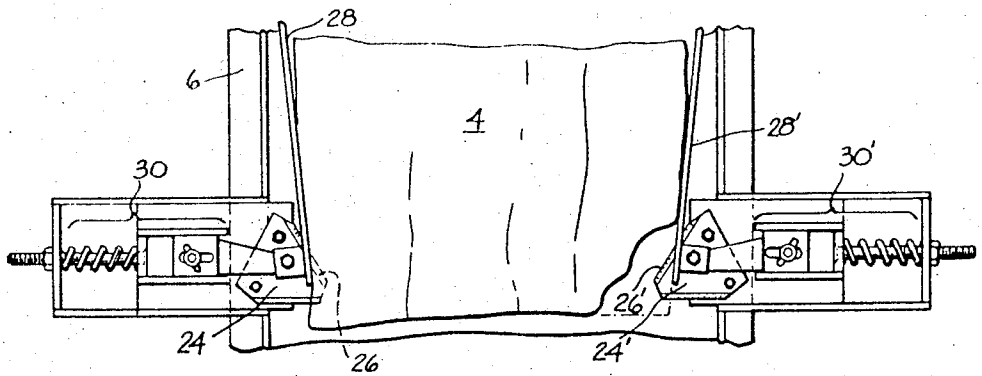


Fig. 4.

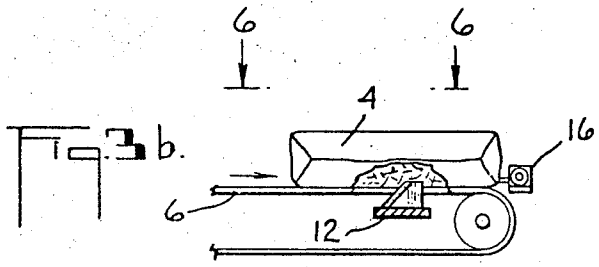


Fig. 3b.

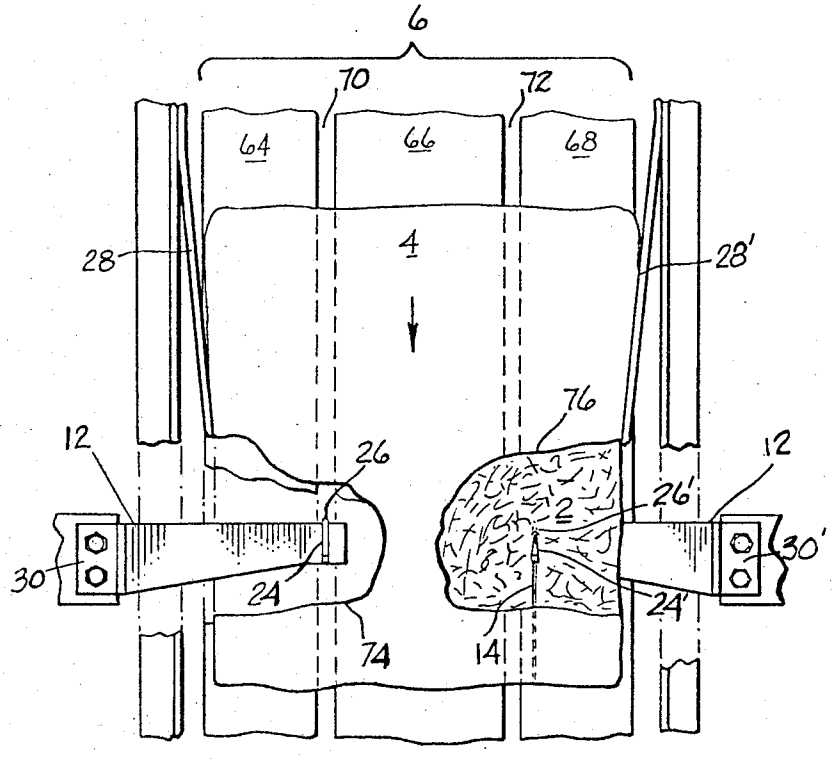


Fig. 6.

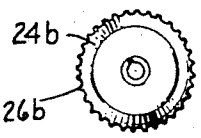


Fig. 8.

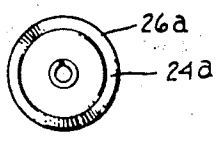


Fig. 7

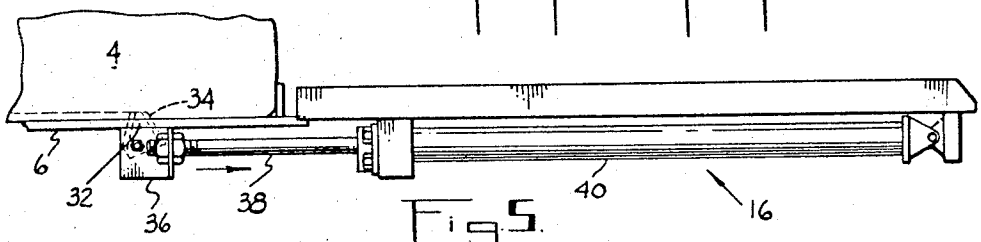


Fig. 5.

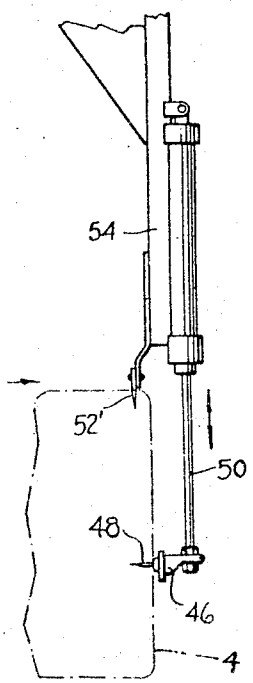


Fig. 10.

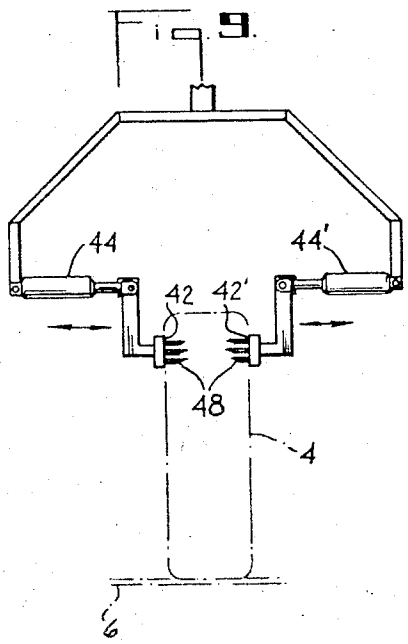


Fig. 9.

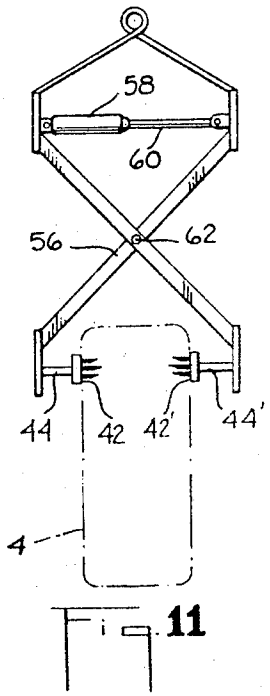


Fig. 11

APPARATUS FOR OPENING AND EMPTYING A CONTAINER

CROSS REFERENCE TO RELATED APPLICATIONS

This is a division of application Ser. No. 228,001, filed Feb. 22, 1972 which issued on Sept. 11, 1973 as U.S. Pat. No. 3,757,973.

BACKGROUND OF THE INVENTION

This application concerns a method of opening closed containers and removing the contents therefrom. More particularly, it relates to a method of opening closed containers and then removing the contents of the containers at a location remote from the point at which the container was opened. Additionally, this invention relates to a method for handling container contents which are readily dispersed in the air in the form of dust or other particles.

A wide variety of particulate, granular or fibrous solid materials are commonly packaged in paper, cloth, cardboard or similar bags and cartons for shipment and storage. These include such diverse materials are grain, comminuted minerals and metals, sawdust and the like. When these containers are opened, it is quite common for a certain portion of the particulate contents to be drawn out and dispersed into the atmosphere by the pressure gradients and currents of the container itself. Because of their small size, many of these particles remain dispersed in the local air for a considerable period of time. (As frequently used herein, the term "particle" is intended to include not only particles, but other small, similar bits of material, such as granules, fibers, etc. Similarly, the term "particulate" is intended to include "granular," "fibrous" and other descriptive adjectives of the like meaning.) When a substantial number of containers are opened over a short period of time in the same location, the air in the immediate vicinity of that location will often become quite contaminated with these particles.

In the past a number of devices have been developed to open containers automatically while the device operator remains at a location remote from the contaminated atmosphere. These devices have, however, generally suffered from one or both of two types of deficiencies. First, some of these devices have had no provision for automatically feeding the container into the opening device. Rather, each container must be individually placed in the apparatus by the operator, and the operator must then withdraw to the remote location before the bag opening operation can begin. This obviously limits severely the number of containers which can be opened in a given time period. The second and more serious deficiency of prior art devices lies in their requirement that the bag contents be removed at the same position at which the bag has been opened. This means that the bag contents are generally in contact with the operating machinery of the device and are quite prone to cause apparatus malfunctions due to abrasion or clogging of the operating parts of the device.

SUMMARY OF THE INVENTION

We have now invented a novel means for opening closed containers and removing the contents therefrom which does not suffer from the disadvantages of the prior art processes and devices. Our process and the associated apparatus therefor may be operated rapidly and automatically and afford maximum protection from the detrimental effects of contaminated local atmosphere. They also substantially prevent any significant extension of localized contamination. Finally, since the contents of the container are emptied at a location removed from the location of the actual bag perforating apparatus, disruption of that apparatus by abrasion, corrosion or other effects of extensive contact with the bag contents is essentially avoided.

This invention is (1) a method of opening a closed, perforable, flexible container and (2) the apparatus therefor. The method comprises moving the container on a support toward a hopper; perforating the container along a plurality of generally parallel lines each substantially aligned with the direction of travel of the container on the support, and with at least one pair of the plurality of generally parallel lines being disposed with one line, respectively, proximate to each of the transverse extremity portions of the container, the transverse extremity portions being determined with reference to the direction of travel of the container on the support; perforating the container along at least one line extending transversely across the container from a point adjacent one of the pair of generally parallel lines proximate to one of the transverse extremity portions to a point adjacent the other of the pair of generally parallel lines proximate to the other of the transverse extremity portions of the container; all the while maintaining the container in a substantially closed configuration; and then releasably gripping and moving the perforated, but substantially closed, container to a position overlying the hopper. The perforations are made sufficiently extensive that the weight of the contents forces the container open as it overlies the hopper, thus causing the contents to fall freely into the hopper. The empty bag is then moved away from the hopper, released and discarded.

The apparatus of this invention comprises a support; a hopper adjacent the support; means for moving the container on the support toward the hopper; means for perforating the container along a plurality of generally parallel lines each substantially aligned with the direction of travel of the container on the support, with at least one pair of the plurality of generally parallel lines being disposed with one line respectively, proximate to each of the transverse extremity portions of the container; means for perforating the container; means for perforating the container along at least one line extending transversely across the container from a point adjacent one of the pair of generally parallel lines proximate to the transverse extremity portions to the other of the pair of generally parallel lines proximate to the other of the transverse extremity portions; means for releasably gripping the container and moving it into a position overlying the hopper; and means for moving the empty container away from the hopper and releasing it for discard. The entire apparatus may be enclosed in a housing which has openings for input of the filled containers and outlet of the emptied contents and discarded containers. The outlet for the contents will normally be appurtenant to the hopper.

Each "parallel perforation" (i.e., those along the generally parallel lines) will be made in the bottom of the container (i.e., the face in contact with the support), or it may be either side (i.e., a face extending upwardly from the bottom and disposed parallel to the di-

rection of travel of the container). Alternatively, parallel perforations may be made in a combination of sides and/or bottom. The "transverse perforation" will be made in either the bottom or an end (i.e., a leading or trailing transverse surface extending upwardly from the bottom). It is to be understood that as used herein, the terms "bottom," "side," "end," "face," and the like are used generally; a surface so denominated need not be planar, if the container has an irregular shape, and in some cases the exact line of demarkation between, say, a "side" and an "end" will be only generally, but not exactly determined.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 illustrate schematically two embodiments of the apparatus and method of this invention. In each view the containers are shown being transported on the support, perforated, emptied and released. FIG. 1 illustrates the configuration in which the sides and leading face of the container are perforated, and FIG. 2 illustrates the configuration in which the sides and bottom of the container are perforated.

FIGS. 3*a* and 3*b* are elevation views illustrating, respectively, an embodiment in which the leading face and the sides of the container are perforated and an embodiment in which the bottom and the leading face of the container are perforated.

FIG. 4 illustrates one embodiment of the means for perforating the sides of the container and is a partial plan view taken on plane 4—4 of FIG. 2.

FIG. 5, a partial end elevation view taken on plane 5—5 of FIG. 2 illustrates one embodiment of a means for transversely perforating the bottom of a container. FIG. 5 may also be considered to be a representation of one means of transversely perforating the leading face of the container. In this case, the view of the apparatus is the partial plan view take on plane 5—5 of FIG. 3*a*.

FIG. 6 is a partial plan view, taken on plane 6—6 of FIG. 3*b*, and partially in cut-away, illustrating one embodiment of the means for perforating the bottom of a container.

FIGS. 7 and 8 are plan views illustrating two embodiments of perforating means. FIG. 7 illustrates a circular, power-driven blade, which will make a continuous cut in the contaner. FIG. 8 illustrates, a power-driven perforating cutter, which will make a series of separated perforations along the side or end of the container.

FIGS. 9, 10, and 11 are elevation views, illustrating three embodiments of the means by which the perforated container is releasable grasped and moved to a position overlying the hopper dumping of the contents.

DETAILED DESCRIPTION OF THE INVENTION

We have now invented a process for opening containers which contain particulate material, and emptying that particulate material. Apparatus for accomplishing this method is also part of our invention.

Our invention substantially overcomes the many deficiencies found in prior art processes and apparatus. As noted above, a principal problem with prior art processes and devices is that they produce substantial air contamination by the dust produced upon opening the container. Our process and its associated apparatus provide for substantial reduction of the contamination. Further, what dust may be present in the immediate vicinity of the apparatus is essentially completely prevented from any extensive distribution, thus eliminating widespread contamination.

Further, this process and the associated apparatus are significantly less susceptible to equipment malfunctions due to extensive contacts with abrasive, corrosive, or otherwise detrimental container contents. The reliability of the equipment as well as its useful life are thus both considerably enhanced.

Finally, our process and apparatus are readily adaptable to essentially completely automatic operation. Skilled workers may thus be freed to handle other operations, thus substantially improving manpower utilization. The automatic operation also may be accomplished much more rapidly than those prior art processes requiring manual attention, thus significantly increasing the volume throughput attainable by the process.

This invention is a method for emptying the contents of a closed, perforable flexible container and apparatus therefor. The method comprises first moving a closed, flexible container on a support toward a hopper. Thereafter, the perforated container is maintained in a substantially closed position, so that a minimum, if any, of the contents of the container are released prior to the step of moving the container to a position overlying the hopper. As the container is moved into position overlying the hopper, the weight of the contents will force open the container along the lines of perforation; the contents are then emptied into the hopper. This opening is a direct result of the perforating steps, for the perforations have been made sufficiently extensive that the weight of the contents exerts sufficient tearing force on any container material remaining along the lines of perforation to substantially completely tear that material substantially all along the lines of perforation. Similarly, when the transverse line of perforation reaches a point adjacent to a parallel perforation, but does not actually contact that parallel perforation, the small amount of unperforated material lying between the closest points on the two lines will also be torn by the tearing force exerted by the weight of the container contents. The lower section of the container, being thus freed of any support, falls free and the contents empty from the open container. Finally, the empty container is moved away from the position overlying the hopper and is released and discarded.

The apparatus of this invention comprises a support; a hopper positioned adjacent to the support (preferably at the end thereof); means for perforating the container along a plurality of generally parallel lines each substantially aligned with the direction of travel of the container on the support, with at least one pair of the plurality of generally parallel lines being disposed with one line, respectively, proximate to each of the transverse extremity portions of the container with the transverse extremity portions being determined with reference to the direction of travel of the container on the support; means for perforating the container along at least one line extending transversely across the container from a point adjacent one of the pair of generally parallel lines proximate to one of the transverse extremity portions to a point adjacent to the other of the pair of generally parallel lines proximate to the other of the transverse extremity portions of the container; means for releasably gripping the container and moving it from the sup-

port to a position overlying the hopper; and means for moving the empty container away from the position over the hopper and releasing it.

The individual steps of the method of this invention and the various components of the apparatus of the invention are most advantageously described by reference to the drawings.

FIGS. 1 and 2 show schematically two embodiments of the overall operation of the process. The particulate material 2 is initially encased in closed container 4. (Container 4 is designated 4*a*, 4*b*, 4*c*, 4*d*, and 4*e* to indicate views at successive stages in the method of this invention.) Container 4 is placed on support 6 by conventional means not shown. These means may include manual placement of the container on the support or mechanized transfer from some conveyor means such as a conveyor belt, rollers, etc. Support 6 may comprise any type of device capable of supporting container 4 and actively or passively participating in the movement of the container toward hopper 8. Support 6 may, for instance, be an inclined plane or chute or an inclined set of rollers down which container 4 moves by gravity. Alternatively, support 6 may be a platform or series of rollers or belts, level or inclined, along which container 4 is moved by some external motive means, such as overhead carriage 10 in FIG. 1. As another and preferable alternative, support 6 comprises one or more powered conveyor belts or rollers which actively move container 4 in the direction of hopper 8. It is also possible, of course, to combine two or more types of supports to form support 6. For instance, an inclined set of idle rollers or a chute could be used to direct container 4 into the first perforating mechanism described below and then a powered level set of rollers could be used to carry the partially perforated bag into position for the second perforation. All these types and combinations of transporting and conveyancing devices are conventional and have not been illustrated in detail in FIGS. 1 and 2.

As container 4 moves along support 6 toward hopper 8, it comes into contact with first cutting means 12. First cutting means 12 makes the "parallel perforations" of the container along parallel lines adjacent to the transverse extremities of the container. First cutting means 12, which will be described in more detail below, generally comprises a perforating device such as a knife blade or perforating wheel adapted to contact and to perforate the side or the bottom of container 4. First cutting means 12 will perforate each side of the opposite edges of the bottom of the container along a line extending from the leading edge to the trailing edge of the container (as determined with reference to the direction of travel of container 4 on support 6). A portion of the line of perforation is shown in FIGS. 2 and 3 and is designated 14. The perforations may be continuous in the form of a slit or may be spaced apart as a series of holes spearated by a small amount of unperforated container material in the manner of the perforations found in a sheet of postage stamps.

In one embodiment of this invention, as illustrated in FIG. 1, the parallel perforations are completed prior to transverse perforation of container 4. FIG. 1 illustrates the parallel perforation step at position 4*b*. Thereafter, the partially perforated container is moved to position 4*c*, where it engages transverse cutting means 16. In FIG. 1, transverse cutting means 16 is illustrated in position to cut a line of perforation transversely across the leading face of container 4. Transverse cutting means 16 is described in more detail below in connection with FIGS. 3*a*, 3*b*, and 5. Transverse cutting means 16 will contain a blade or other perforating device generally adapted to extend transversely completely across container 4 and perforate the container transversely across its entire breadth from a point adjacent one line of parallel perforations to a point adjacent the line of perforations on the opposite side of the container; i.e. from the area of one transverse extremity to the area of the other transverse extremity. When, as in this embodiment, transverse cutting means 16 acts on the leading face of container 4, the line of transverse perforations will preferably extend from the point at which one line of parallel perforations terminates at the leading face to the equivalent point at the opposite side of the leading face.

Alternatively, transverse cutting means 16 may be located so as to contact and perforate the trailing face of container 4. In this particular embodiment (not shown), the respective orientation and positioning of the transverse perforating line and the parallel perforating lines would be with respect to that trailing face. It is prefered that the transverse perforation be across the leading face or the leading edge of the bottom of container 6.

In the embodiment of this invention illustrated in FIG. 2 the parallel perforations and the transverse perforation occur in part simultaneously. As container 4 reaches position 4*c*, parallel perforation of the sides along line 14 with first cutting means 12 begins. As the container reaches the end of support 6, transverse cutting means 16, in this embodiment located below the end of support 6, engages the bottom of container 4 and cuts a transverse line of perforation across the breadth thereof extending from a point adjacent to the line of parallel perforations on one side to a similar point on the opposite side. This transverse perforation may be made while the container is stationary or it may be made while the container is moving along support 6 and simultaneously having the sides and/or bottom perforated.

It will immediately be evident that the positioning of the components in these two embodiments is not mutually exclusive. In other words, in FIG. 1, transverse cutting means 16 could be positioned so as to cut the bottom of container 4 rather than the leading or trailing face, and similarly, in FIG. 2 transverse cutting means 16 could be positioned so as to cut the leading or trailing face of container 4 rather than the bottom. The same interchangeability of positioning applies to first cutting means 12 in combination with transverse cutting means 16.

Following the preforating of container 4, the container is grasped and moved to position 4*d* overlying hopper 8. The complete perforation of container 4 may result in either a continuous slit on all perforated surfaces, a continuous slit along any or more of those surfaces combined with a series of discrete perforations of the remaining surfaces, or all lines of perforation may comprise a series of small perforations separated by unperforated container material. In any case, the perforations will be sufficiently extensive that the amount of unperforated container material, if any, remaining between adjacent perforated portions along the lines of perforation or between the closest points of any two adjacent lines of perforation will have less resistance to

tearing than the tearing force exerted on such unperforated material when container 4 containing the enclosed contents 2 is removed from support 6.

Perforated container 4 is grasped by releasable gripping means 18. Three embodiments of releasable gripping means 18 are illustrated in, respectively, FIGS. 9, 10, and 11, and will be discussed in detail in connection with those figures. Releasable gripping means 18 may comprise pins, clamps, suction devices, and the like, which act directly upon the container, or may comprise special grasping devices adapted for particular containers and/or contents: e.g., an electromagnetic device adapted for use when the contents 2 are magnetic materials such as iron filings. Releasable gripping means 18 may be adapted to grasp perforated container 4 at any position on the container, except in that region of the sides, leading or trailing faces, and/or bottom which lies downwardly of and below the lines of perforation. This is necessary because in a subsequent step of the process of this invention the weight of the contents will force these portions of the container downward so that the contents can be emptied into the hopper. It is apparent that if the container were being gripped in this area, release of the contents into the hopper would be substantially impaired. Container 4 may, however, be gripped at any other convenient location, such as on opposite sides as in FIG. 1, on one end and the top as in FIG. 2, or on any other feasible combination of sides, leading or trailing faces, and/or top.

Releasable gripping means 18 is itself (or is attached to) means for moving container 4 off support 6 and positioning it in position 4d overlying hopper 8. Typical means are illustrated by overhead conveyor 10 (FIG. 1) or 22 (FIG. 2). In FIG. 2 retractor mechanism 20 acts to cause the various portions of releasable gripping means 18 to grip the container as well as lifting the bag slightly from the support. Such lifting is not necessary where hopper 8 is positioned substantially below the plane of support 6. Lifting may, however, help to tear the unperforated portions of container 4 along the lines of perforation, particularly where the lifting is abrupt, and may, therefore, be preferable in some circumstances.

Following the emptying of contents 2 of container 4 into hopper 8, the emptied container is removed from position 4*d* overlying the hopper 8 by means 22 and is discarded as shown at position 4*e*. Container 4 is released from releasable gripping means 18 by release mechanism 19. (Note that several portions of the apparatus, e.g., structural features 10, 18, 20 and 22, are shown in repeated veiws in FIGS. 1 and 2. These repeated views illustrate the respective positions in connection with positions 4*a*, 4*b*, etc. of container 4.) Hopper 8 is shown in FIGS. 1 and 2 as having an enclosed bottom. In this configuration, hopper 8 must be separately emptied when a sufficient amount of contents 2 has been dumped in to fill the hopper. Such a hopper may, if desired, be mounted on wheels for ease of removal from the vicinity of support 6 for subsequent dumping or other emptying. Alternatively, hopper 8 as shown may be one of series of similar hoppers adapted to be positioned sequentially at the end of support 6. Such an arrangement might include, for instance, a string of small hopper cars on a track aligned transverse to support 6, or it might include a series of hoppers positioned at the outer edge of a horizontal turntable, which could be rotated such that each hopper is positioned sequentially as shown. Alternatively (and preferably, where particulate, granular, or fibrous contents are involved), hopper 8 is at least partially open at the bottom, and positioned directly below the opening in the bottom of hopper 8 are means for continuously emptying form the hopper the contents 2. Such devices include belt conveyors, screw conveyors, rams, incline chutes, pneumatic conveying lines, etc. These are conventional and have not been illustrated here.

The operations of the method of this invention may be carried out under manual control or may be operated automatically. With manual control, of course, the operator would activate the various cutting means, gripping means, and conveying means as the containers reach the proper position. With automatic control, sensing devices such as electric eyes, mechanical sensors, or limit switches could be used to determine the sequential positions of the containers and activate the appropriate perforating, gripping or conveying means. Such sensing and activating systems are well within the ability of those skilled in the art and, therefore, will not be further discussed here.

When the contents of container 4 are such that the emptying ordinarily produces an unacceptable amount of dust contamination in the air, the entire apparatus of this invention may be enclosed in an essentially continuous housing. This housing will ordinarily have openings (other than closable service or access openings) only for input of the containers 4 and outlet of the emptied contents 2 and the discarded containers 4*e*. Controls external to the housing should be provided unless automatic operation is involved, although even in this situation, an alternative set of external manual controls is desirable. Where external controls are used, sensing devices should be installed such that there is an external indication of container location. Alternatively, viewing ports may be provided in the housing, so that the operator may visually determine bag location, or some other means of visually observing the progress of the bag (such as by closed circuit television) may be used. A housing of this type may also be provided when the noise of the operating process is deemed to create an unacceptable noise level in the immediate vicinity. In such case, of course, the housing would normally include integral sound absorbing means.

FIG. 3*a* illustrates in greater detail the side and end perforating operation shown in FIG. 2. In this elevation view container 4 is shown being conveyed along support 6 (which in this embodiment is shown as a continuous conveyor belt) into engagement with first cutting means 12. As container 4 moves past first cutting means 12, the parallel lines of perforation 14 (only one of which is shown) are produced. As container 4 reaches the end of support 6 it comes into engagement with transverse cutting means 16. The operation of transverse cutting means 16 is further detailed in connection with the discussion of FIG. 5 below.

The embodiment in which the bottom and leading face of container 4 are perforated is shown in greater detail in the elevation view of FIG. 3*b*. In this embodiment the container passes over first cutting means 12, which perforates parallel lines in the bottom of the container. These parallel lines will be positioned at or near the transverse extremities of the container (i.e., the outer edges). It is not necessary that the actual portion of the bottom of the container which is perforated by first cutting means 12 be a portion which rests directly

upon support 6; rather it only need be positioned close to support 6 to permit first cutting means 12, which extends upwardly above the surface of support 6, to engage and perforate the bottom of container 4. For example, where the transverse cross sectional configuration of container 4 is oval, eliptical, or some other shape in which it cannot be said unequivocally that the entire bottom contacts the support, the first cutting means 12 may extend upwardly a sufficient distance to perforate the container along a line lying transversely outward of the outermost point of contact of the container with the support. In FIG. 3*b* it will be observed that container 4 is being in part simultaneously perforated by both first cutting means 12 and transverse cutting means 16. As noted above, these operations may be carried out sequentially rather than simultaneously. In such an embodiment first cutting means 12 would be positioned along support 6 as shown in FIG. 1 (with of course the blade or other perforating means positioned vertically rather than horizontally as shown in FIG. 1).

FIG. 4 illustrates in detail one embodiment of first cutting means 12, as adapted to cut the sides of container 4. In the partial plan view, taken on plane 4—4 of FIG. 2, a portion of container 4 is shown in a cut-away view. A pair of blades 24 and 24′ having respective cutting edges 26 and 26′ are mounted parallel to support 6 and extend inwardly from the edges of support 6 a sufficient distance to contact and perforate the sides of container 4. Guide rails 28 and 28′ are angled inwardly from the outer edges of support 6 to position container 4 properly with respect to blades 24 and 24′ and cutting edges 26 and 26′. Use of such guides obviates the need for precise positioning of container 4 when it is initially placed on support 6. Blades 24 and 24′ are attached respectively to adjusting means 30 and 30′; adjusting means 30 and 30′ provide sufficient control to maintain cutting edges 26 and 26′ in position against the tendency of container 4 to force blades 24 and 24′ outward. Positioning means 30 and 30′ each may comprise, for instance, a heavy calibrated spring, a threaded rod, or other device which will resist compression.

FIGS. 7 and 8 illustrate two other configurations of either or both blades 24 and 24′. In FIG. 7 blade 24 (here designated 24*a*) is a circular blade having cutting edge 26*a* comprising the entire circumference. This blade is mounted horizontally and is preferably power driven to act in the manner of a circular saw blade. The blade may be straight or serrated as desired and/or dictated by the type of container material which is to be cut. A motor operating intermittently or continuously may be directly attached to the shaft of the blade or may be geared, belted or otherwise joined forming a powered coupling.

Shown in FIG. 8 is another alternative form of blades 24 and/or 24′ (here 24*b*). This is a circular perforating wheel adapted to perforate discrete separate holes in the container. Here the cutting edge comprises protrusions 26*b* of blade 24*b*. This blade would be positioned in the embodiment of FIG. 4 such that only the perforating projections engage container 4. The number and size of the various protrusions 26*b* will be such that the resulting series of perforations will be sufficiently closely spaced such that the remaining unperforated container material along the line of perforation will be torn apart when the container is lifted from the support, as described above. This blade, as the blade of FIG. 7, is also preferably powered in a manner similar to that of the latter.

FIG. 5 illustrates in detail one embodiment of the transverse perforating means 16. This device includes a blade 32 having a cutting edge 34. This may be a fixed blade as shown in FIG. 5, or it may be a circular blade or perforating wheel of the type shown in either FIGS. 7 or 8. The blade is mounted on traveling head 36 which may be moved back and forth completely across the breadth of support 6. In the embodiment of FIG. 5 such motion is provided by shaft 38 which moves in and out of housing 40. As shown in FIG. 5 traveling head 36 is adapted to pass back and forth under the plane of support 6 with only the blade 34 projecting above the plane to engage and perforate the bottom of container 4, which is shown in an end view.

Alternatively, the apparatus may be aligned horizontally such that traveling head 36 passes above and parallel to the top plane of support 6 and perforates the leading or trailing face of container 4. In this configuration the apparatus would be aligned as viewed on plane 5′—5′ of FIG. 3*a*.

The methods of providing the reciprocating motion of traveling head 36 are conventional and are not shown; the means may be pneumatic, electromagnetic, hydraulic, or mechanical. In this portion of the apparatus, it is preferable that blade 32 be a fixed blade rather than a powered blade of the type shown in FIGS. 7 or 8; this is because the reciprocating motion of traveling head 36 raises the problem of providing power for a powered blade 32. While such power could be provided by, for instance, a flexible shaft, the added complexity of the apparatus and extra expense required are not generally justified on the basis of the results obtained.

FIG. 6 illustrates in detail one embodiment of the means for perforating the bottom of container 4. In this partial plan view, taken on plane 6—6 of FIG. 3*b*, container 4 is shown passing along support 6 in the direction indicated by the arrow. In this embodiment support 6 is shown to be comprised of three parallel conveyer belts 64, 66, and 68 having small gaps 70 and 72 between the respective adjacent pairs. Gaps 70 and 72 are of sufficient width that blades 24 and 24′ of the first cutting means 12 can extend upwardly therethrough and contact the bottom of container 4. Alternatively, in place of the trio of conveyer belts, rollers could be used, with full length rollers at all points except where first cutting means 12 projects inwardly from the outer edges of support 6. At this point one or more shortened rollers lying between the blades 24 and 24′ would be used to support the container while yet leaving sufficient clearance for the perforating apparatus.

In FIG. 6 two different views of the perforating apparatus are shown. In a fully cut-away section 74, first cutting means 12 is illustrated to show positioning below support 6. In a partial cut-away section 76, first cutting means 12 is shown with blade 24′ perforating the bottom of container 4 and projecting inwardly into the space occupied by contents 2. In each case cutting edges 26 and 26′, guide rails 28 and 28′, and the adjusting means 30 and 30′ are as described in connection with FIG. 4 above. Similarly, blades 24 and 24′ may be stationary or powered, circular or straight, as described in connection with FIGS. 4, 7, and 8 above.

FIGS. 9, 10, and 11 illustrate three embodiments of the releasable gripping means 18. In FIG. 9, an end elevation view, the container is gripped on opposite sides by a pair of gripping faces 42 and 42'. The surfaces that engage the container itself will be such as to maintain a firm grip on the container. Such may be accomplished by having a roughened face, or by having such devices as pins, suction cups, magnets, or the like attached to the face and providing the means of contacting and gripping the container. In FIG. 9 the faces are shown studded with pins which perforate the sides of the container. Gripping faces 42 and 42' are intermittently put in contact with the sides of the container by mechanisms 44 and 44' respectively. Mechanisms 44 and 44' contain means for moving surfaces 42 and 42' in an essentially horizontal plane on a line transverse to the direction of travel of the containers 4. Such devices may be pneumatic, electromagnetic, hydraulic, or mechanical, and include such apparatus as pneumatic plungers and lead screws. Mechanisms 44 and 44' are attached to an overhead carriage is adapted to be moved in a plane parallel to the plane of support 6 and extending over and beyond hopper 8 as illustrated in FIG. 1. Such a carriage, its linkage to mechanisms 44 and 44' and its motive power are conventional and are not further described herein. If desired, there may be a series of these devices running on a continuous track, with each device moving forward with a single container and then returning to contact another container in sequence. Alternatively, a single device may be used which carries one container forward, releases it following emptying of the contents and returns to pick up the next following container.

FIG. 10 illustrates in a side elevation view another embodiment of the releasable gripping means. The device of FIG. 10 is adapted to grip the container by one end and the top. Gripping face 46, which is surfaced with pins 48, suction cups or the like as described above, is extended downward by extension arm 50. Extension arm 50 is adapted to move gripping surface 46 in a vertical plane extending upward from support 6 and lying essentially along the center line of support 6. As the container 4 moves along support 6, it comes into contact with gripping surface 46 (and/or pins, suction cups, etc. 48) which is positioned in downward extension. Once firm contact has been established, extension arm 50 is retracted, lifting the end of container 4 as shown at position 4*d* in FIG. 2, where the top surface of container 4 contacts gripping means 52. Gripping means 52 comprises additional pins, suction cups, magnets, etc., attached to support 54. Extension arm 50 is also attached to support 54 through its operating mechanism. As described above in connection with FIG. 9, the extension arm 50 may be operated by any conventional means.

Support 54 is attached to a carriage mechanism, such as that described above in connection with FIG. 1. Once container 4 is firmly gripped by gripping means 46 and 52, the carriage is moved forward carrying container 4 over hopper 8 in the manner described in connection with FIG. 9. Again a single mechanism may be used which carries each bag individually over the hopper, or a series of devices may be used running on a continuous track and sequentially picking up containers to be dumped.

FIG. 11 illustrates, also in an end elevation view, a modification of the device of FIG. 9. The gripping faces 42 and 42' and horizontal supports 44 and 44' are moved alternately into engagement with and away from container 4 by means of scissors mechanism 56. This mechanism is actuated by cylinder 58 and its extension arm 60 and pivots around center bolt 62. It is attached at the top to a carriage similar to the ones described above.

The apparatus and method of this invention may be used with any closed, flexible perforable container. The containers may be of paper, cardboard, cloth, rubber, synthetic film, etc. They may be pressure-packed to be substantially rectangular in cross section or may be loosely packed so as to provide sides and faces which are only generally planar. Similarly, they may be multi-walled bags with glued or sewn ends, cartons with pasted tops and bottoms, or other configurations. The only requirements are that the sides and faces be sufficiently rigid so as to maintain contact with the perforating blades, that the container material be of a perforable type, and that is be sufficiently flexible (and, where the perforations are not continuous, tearable) that once having been perforated, it may be opened and depressed by the weight of the contents within.

The apparatus of this invention may be constructed of any suitable materials. Conventionally, the device would be made of steel or other relatively inexpensive, easily fabricated material. Where the container contents, however, are of a corrosive, abrasive, or reactive nature, those parts of the device which come in contact with the contents may be of resistant metals or alloys.

Among the materials which may be emptied from their containers by the apparatus of this invention are the following (which are intended to be merely illustrative and not limiting): aluminum sulfate, ammonium bircarbonate, ammonium molydate crystals, ammonium phosphate, arsenic pentoxide, asbestos fibers, aspirin granules, barytes, calcium carbonate, calcium chloride, cellulose, coal chippings, coal dust, cobalt sulfate, copper sulfate, crushed mineral ores, diatomaceous earth, glass powder mix, grain, malt, magnesium oxide, nylon chips, polymer granules, powdered resin, rice, sand, sodium chloride, sugar, and the like.

Numerous other embodiments of the apparatus and method of this invention, which are not specifically set forth above, but which are clearly within the scope and spirit of the invention, will be immediately evident to those skilled in the art or will become immediately apparent upon practice of the invention. Consequently, this invention is to be limited solely by the appended claims.

What we claim is:

1. A device for emptying the contents of a closed, flexible container, which comprises:
   a. a support;
   b. a hopper adjacent said support;
   c. means for moving said container on said support toward said hopper;
   d. means for perforating said container along a plurality of generally parallel lines each substantially aligned with the direction of travel of said container on said support, with at least one pair of said plurality of generally parallel lines being disposed with one line, respectively, proximate to each of the transverse extremity portions of said container, said transverse extremity portions being deter-

mined with reference to said direction of said container on said support;

e. means for perforating said container along at least one line extending transversely across said container from a point adjacent one of said pair of generally parallel lines proximate to one of said transverse extremity portions to a point adjacent the other of said pair of generally parallel lines proximate to the other of said transverse extremity portions of said container;

f. means for releasably gripping the perforated container above the lines of perforations;

g. a conveyor means for moving said releasable gripping means, said means for releasably gripping the perforated container extending beneath said conveyor means and into engagement with said container,

h. said conveyor means and releasable gripping means adapted to move the gripped container from said support to a position overlying said hopper, whereby the motion progressively deprives the bottom of said container of support, and the weight of said contents causes said container to open along said lines of perforation and leaving the opened portion of the container attached to the remaining portion of the container, thereupon releasing said contents from said container and depositing said contents in said hopper;

i. said conveyor means adapted to move the empty container away from said hopper and further including means for releasing the grip on said container, and

j. wherein all of said means for releasably gripping and for moving said gripped container are located above said generally parallel lines whereby the contents released from said container do not contact said gripping and moving means.

2. The device of claim **1** wherein said means for perforating said container along a plurality of generally parallel lines comprises a plurality of knife blades.

3. The device of claim **2** wherein said knife blades have essentially straight cutting edges.

4. The device of claim **2** wherein said knife blades have curved cutting edges.

5. The device of claim **2** wherein said means for perforating said container along a plurality of generally parallel lines comprises a blade having a series of perforating protrusions.

6. The device of claim **1** wherein said means for perforating said container along a line extending transversely across said container comprises a knife blade.

7. The device of claim **6** wherein said knife blade is disposed in an essentially horizontal plane and is adapted to contact and perforate a face of said container, said face extending upwardly above said support and being disposed essentially transverse to said direction of travel of said container.

8. The device of claim **7** wherein said face is the leading face of said container.

9. The device of claim **6** wherein said knife blade is disposed in an essentially vertical plane and is adapted to contact and perforate the bottom of said container.

10. The device of claim **1** wherein said gripping means comprises at least two opposed gripping faces that are adapted to move towards one another to grip the container therebetween and to reverse said movement to release said container.

11. The device of claim **10** wherein the gripping faces are studded with pins which perforate the sides of the container.

12. A device according to claim **1** wherein said gripping means are adapted to grip the container by one end and the top and comprises a vertically movable gripping face for gripping an end of said container and a gripping face for gripping the top of said container.

13. A device according to claim **12** wherein gripping faces are studded with pins which perforate the container.

* * * * *