May 7, 1968 W. B. HULLHORST 3,381,440

METHOD AND APPARATUS FOR HANDLING AND PACKAGING MATERIAL

Filed May 18, 1965 3 Sheets-Sheet 1

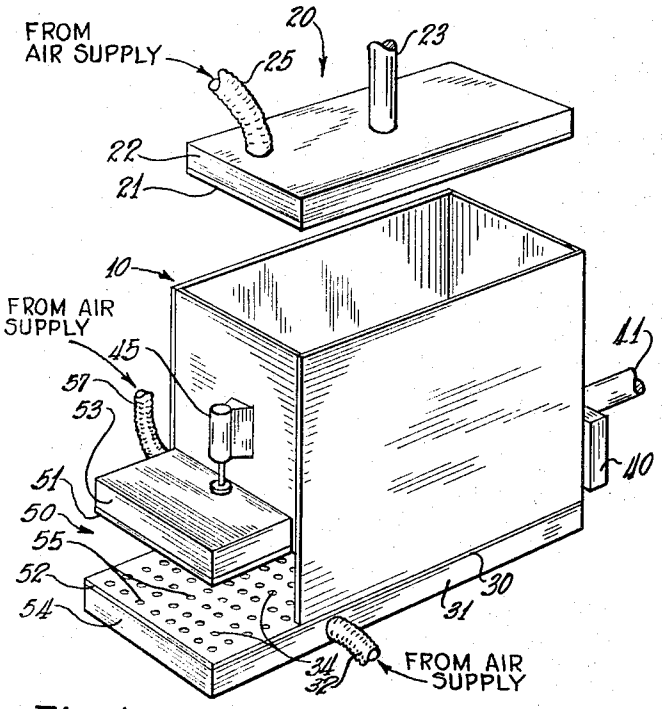


Fig. 1

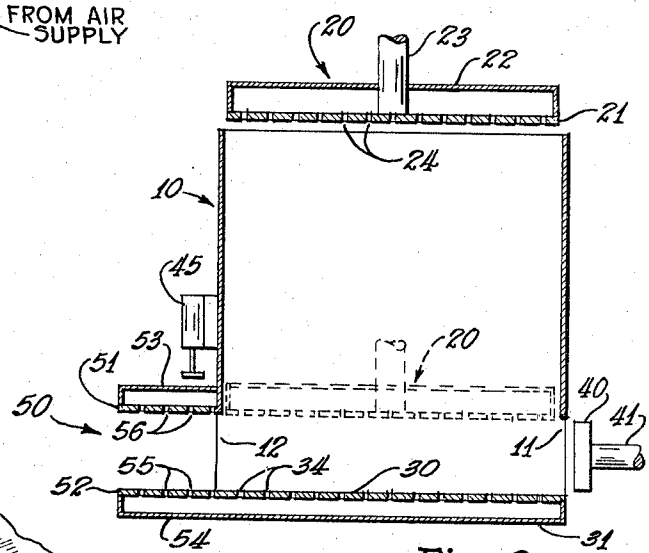


Fig. 2

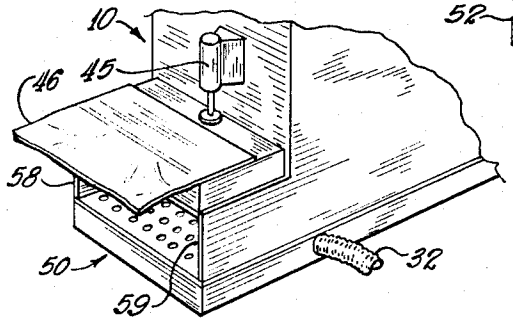


Fig. 3

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METHOD AND APPARATUS FOR HANDLING AND PACKAGING MATERIAL

Filed May 18, 1965 3 Sheets-Sheet 2

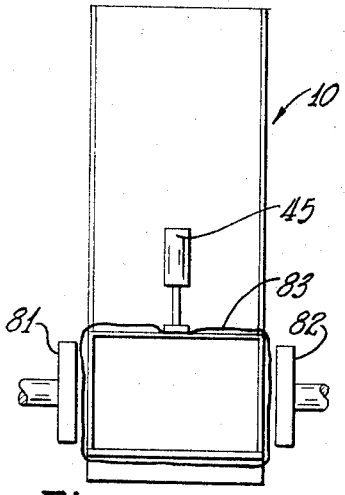


Fig. 5

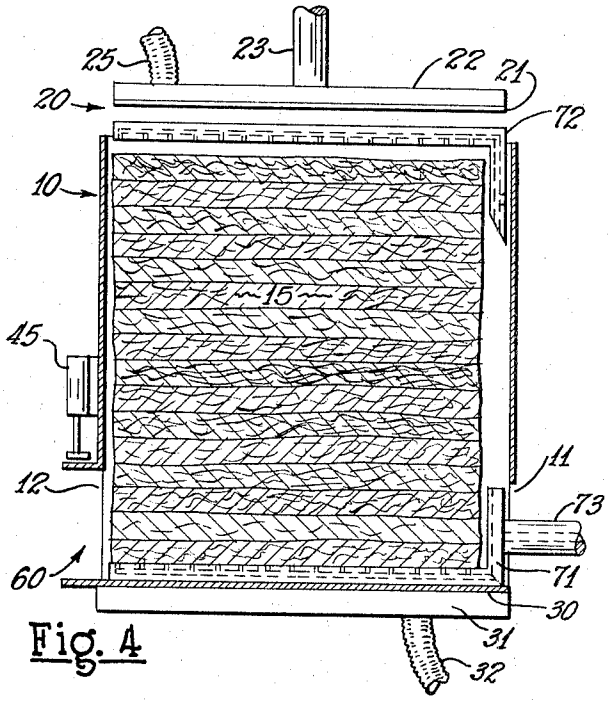


Fig. 4

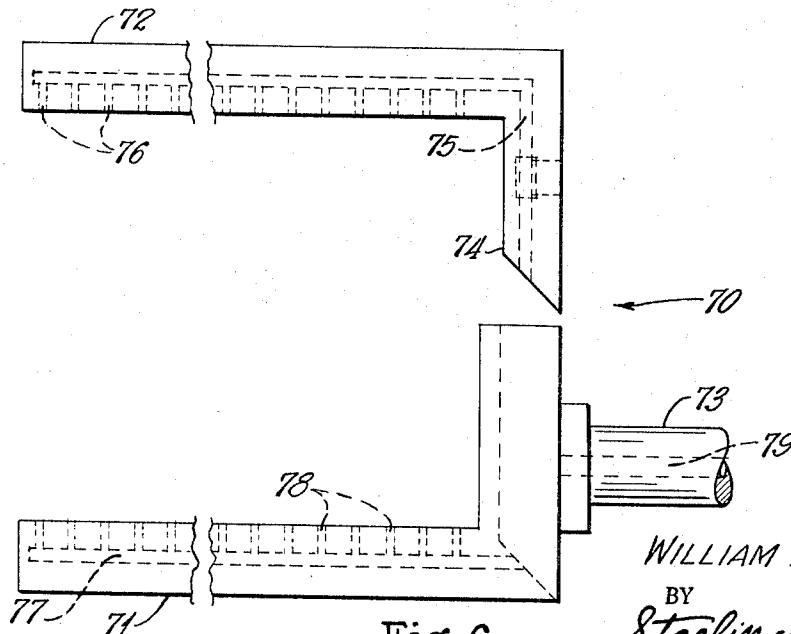


Fig. 6

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METHOD AND APPARATUS FOR HANDLING AND PACKAGING MATERIAL

Filed May 18, 1965 3 Sheets-Sheet 3

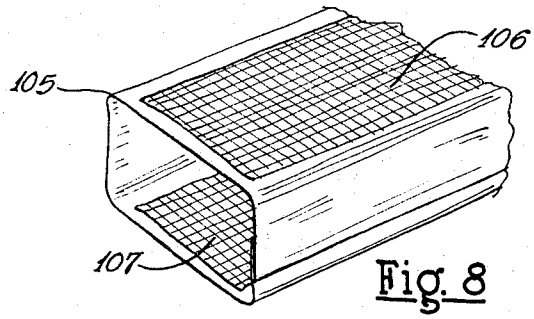


Fig. 8

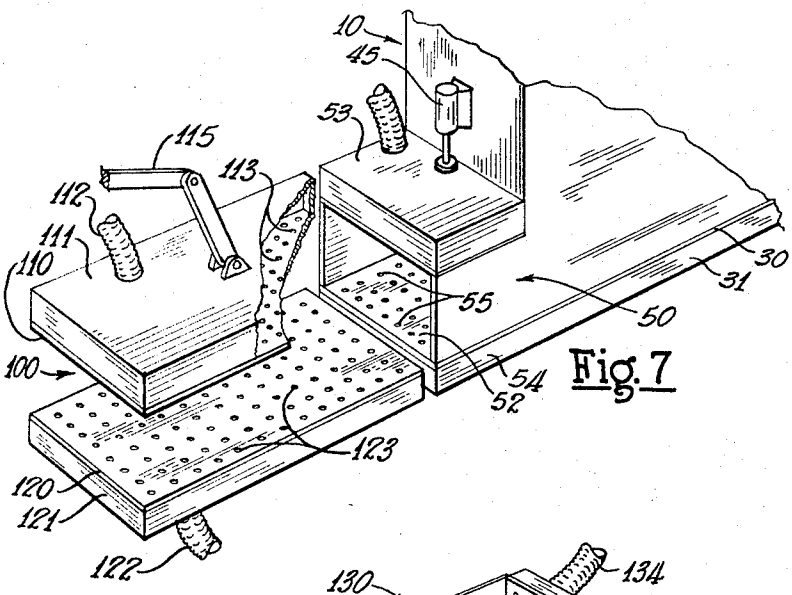


Fig. 7

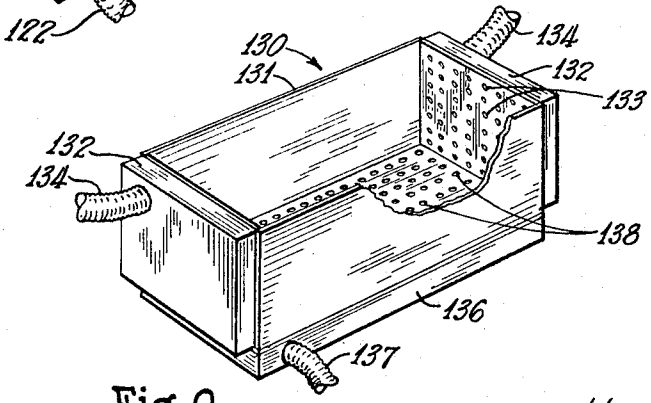


Fig. 9

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3,381,440

METHOD AND APPARATUS FOR HANDLING AND PACKAGING MATERIAL

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10 Claims. (Cl. 53—24)

ABSTRACT OF THE DISCLOSURE

Method and apparatus for packing a mass of material by compressing the material between two surfaces, providing an air film between the two surfaces and the compressed material, cross-ramming the compressed material from between the two surfaces into a package, and providing air film bearing surfaces inside the package to reduce the friction of insertion of the compressed material into the package.

It has been conventional practice in packaging or preparing fibrous materials, as for example, materials formed of glass fibers, especially usable for insulation purposes, to stack predetermined lengths of fibrous mats in contiguous relation, compress the stack or assembly of mat lengths in a direction normal thereto and insert the compressed assembly into preformed paper bags or containers which are sealed or stapled to enclose the assembly. This method of packaging or conditioning fibrous mats for handling and shipment has been quite expensive for the reasons among others that the bags, being necessarily fabricated of heavy material, are costly and manual handling involves a large amount of labor. The bags or enclosures for the fibrous material must have a comparatively high tear strength to adequately withstand rough handling during packaging or insertion of the mats into the bag.

Such bats or mats when compressed and cross rammed into a packaging sleeve sometimes suffer fiber damages so that some of the bats do not recover full resiliency. Cross ramming causes longitudinal bat compression and a buckling which is detrimental. Also the upper and lower bats of the compressed stacks experience a shearing action due to friction between the moving bats and platen surfaces as stacks are forced across the packager into the waiting sleeve, thereby causing severe fiber damage.

It is, accordingly, an object of this invention to provide an improved means and method for handling and packaging materials.

It is another object of this invention to provide an improved means and method for packaging fibrous material which enables the packaging of more fibrous material within the same volume occupied by similar previous packages without breaking or mechanically damaging the fibers and thus not reducing the insulating value nor the resiliency of such material so that the fibers will spring back to their normal expanded condition when the package is removed.

The above objects are accomplished in this invention through a novel method featuring a method of handling compressed material that is expanded against containing surfaces which comprises the step of providing an air film between the package and one or more of the containing surfaces. That is, a novel method is disclosed herein which comprises the step of providing an air film bearing surface between the package and a supporting surface so that one may be moved relative to the other without damage to the material.

More specifically, the method may include compressing material between two surfaces, providing an air film between the surfaces and the compressed material, and cross ramming the compressed mats from between the two surfaces into a package. The invention advantageously includes a step of providing means to maintain the package in an open position and retaining the package in substantially the same form as the compressed material has when the material is rammed into the package. The package is advantageously perforated on opposing sides so that an air film bearing surface or surfaces may be provided inside the package via the perforated sides from the surfaces of the package retainer to reduce the friction of insertion into the package.

If the material being compressed is so porous to air circulation that an air film bearing surface may not be established, then steps may be utilized which include the placing of substantially air impervious sheets or barriers between the compressing surfaces and the material so that the air film bearing surfaces may be established and the material cross rammed without damage to the fibers.

The invention also features apparatus for packaging a mass of material which comprises means for compressing the material between two surfaces, means for providing an air film between each of the surfaces and the compressed material, and means for cross ramming the compressed material from between the two surfaces into a package. Chute means are advantageously provided to maintain the package open to receive the compressed material. It is desirable to also provide the chute means with means for providing an air film bearing surface to the compressed material as it proceeds between the chute surfaces. To avoid fiber rupture as the package expands from the chute into the sleeve, a length of flexible plastic may be interposed between the chute and the package surrounding the chute. The length of the plastic may be sufficient to extened past the chute and part of the way into the package to aid the insertion of the material into the package.

As disclosed in a second embodiment the invention features apparatus for packaging a mass of material which comprises opposed platen means on each side of the mass, means for compression ramming the platen means together to compress the mass, means for interlocking the platen means together when a desired compression is achieved into a substantially U-shaped carrier, means for cross ramming the carrier into a package, and means for providing an air film bearing surface between the platen means and the surfaces of the compression ram means to assist in the cross ramming. Once the material is within the package inside the U-shaped carrier, means may be provided for gripping the sides of the compressed mass in the package, normal to the U-shaped carrier, to allow withdrawal of the carrier from the package and leave the material in the package. To assist in the withdrawal of the carrier from the package, air film bearing surfaces may be provided between the platen means and the compressed material, or the platen means and the package sides, or both.

Other objects, advantages and features of this invention will become apparent when the following description is taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a view in perspective of apparatus embodying the teachings of this invention;

FIGURE 2 is a side elevational view of the apparatus of FIGURE 1 taken in vertical section;

FIGURE 3 is an enlarged view of the chute means of the apparatus of FIGURE 1 showing an modification thereof;

FIGURE 4 is a side elevational view of a second em-

bodiment of the teachings of this invention partially taken in vertical section;

FIGURE 5 is an end elevational view of the apparatus of FIGURE 4 taken from the left;

FIGURE 6 is an enlarged view of components of the apparatus of FIGURE 4;

FIGURE 7 is a view in perspective illustrating a third embodiment of the teachings of this invention;

FIGURE 8 is a view in perspective of a package or sleeve which may be utilized in conjunction with the apparatus illustrated in FIGURE 7; and

FIGURE 9 is a view in perspective of apparatus illustrating a fourth embodiment of the teachings of this invention.

Referring now to FIGURES 1 and 2, there is illustrated a first embodiment of the teachings of this invention. A box-like container **10** is shown which is generally similar to those that have been utilized in the past for compressing a stack of fibrous bats or other material. A vertical compression ram means **20** includes a platen **21** and a shaft **23** which is to be connected to any suitable driving means. A plenum **22** is secured to the upper side of the platen **21** and receives air under pressure via flexible conduit **25** from an air supply, not shown. Air under pressure is provided to the compression surface of the platen **21** via perforations **24** formed therein and communicating with the plenum **22**.

The bottom **30** of the box-like container or compression chamber **10** is supported to assist in the compression of the vertical stack of bats. Such support means are not shown here nor a part of the invention. Plenum **31** is secured to bottom **30** and communicates with the compression surface of bottom **30** via perforations **34**. A flexible conduit **32** connects the plenum **31** to an air supply, again not shown. A cross ram **40** is positioned at the right of the compression chamber **10** and is adapted to be guided through aperture **11** formed in chamber **10** by shaft **41**, which is driven by any suitable means known in the prior art, to cross ram a compressed stack of material from between the upper ram means **20** (shown in its fully compressed position in dotted lines in FIGURE 2) and the lower platen or bottom of the compression chamber **30**.

An aperture **12** is formed in the compression chamber opposite the aperture **11** to allow the compressed material to be cross rammed into a package. A chute means **50** is advantageously formed around the aperture **12**. The chute means **50** comprises an upper lip **51** and the lower lip or flange **52** over and around which a package may be positioned. A clamping means **45**, either electrical or hydraulic, may be utilized to hold the sleeve, bag or other package in position on the chute means **50**. A plenum **53** is attached to the upper side of the chute lip **51** and communicates with the package side of the chute lip **51** via perforations **56**. A flexible conduit **57** connects the plenum **53** to a suitable air pressure supply. The lower chute lip **52** also has a plenum **54** connected therewith which may advantageously be an extension of the plenum **31** already serving the body of the compression chamber or the lower platen **30**. Perforations **55** provide communication between the plenum portion **54** and the package side of the chute lip **52**.

In operation the apparatus of FIGURES 1 and 2 compresses a mass of material or a stack of fibrous bats between the compression ram means **20** and the bottom **30** of the compression chamber **10**. When the upper compression ram **20** arrives at the position shown in dotted lines in FIGURE 2, the cross ram means **40** operates to push the compressed stack out through aperture **12** and chute **50** into a package or sleeve attached to chute means **50**. To this point the operation of the apparatus is the same as that in the prior art, but the harsh treatment of the bath or other compressed mass under compression damages fibers so that the material does not recover full resiliency. Cross ramming as practiced in the prior art causes longitudinal bat compression and a buckling which is detrimental. Also the uppermost and lowermost bats of the compressed stacks experience a shearing action due to friction between the moving bats and the platen surfaces as stacks are forced across the compression chamber into the waiting sleeve or package, thereby causing severe fiber damage. For example, it is not unusual when cross ramming a stack of compressed bats 48 inches in length to have that length reduced to 41½ inches as a result of the frictional forces involved.

In the embodiment of the invention illustrated in FIGURES 1 and 2, means are shown for providing an air film bearing surface between the upper and lower platens **21** and **30**. That is, air under pressure is provided to plenums **22** and **31** and exits via perforations **24** and **34** to provide air film bearing surfaces between the upper and lower sides of the compressed stack. Experiments conducted with this apparatus have shown that shear forces on the upper and lower surfaces of the stack are practically non-existent, while there is no reduction in length of the stacks due to cross ramming. In addition, the use of the invention illustrated in FIGURES 1 and 2 allows the compression of 25% more material or bats into the same package without any damage. This substantially reduces handling costs, shipping costs, storage costs, losses due to damages, etc.

As was noted hereinbefore, the package sides of the chute lips **51** and **52** are also constructed to provide air film bearing surfaces. The plenums **53** and **54** are connected to a positive air pressure supply and air exits via perforations **56** and **55** to provide an air film bearing surface between the chute lips **51** and **52** and the compressed material. Therefore, the chute itself does not provide any damaging frictional characteristics for the ramming of the material into the package.

Referring to FIGURE 3, there is shown an enlarged view of the chute means of the apparatus of FIGURE 1 in which the following modifications have been made. Side walls **58** and **59** have been added to the chute means **50** to assist in holding the sides of the package or sleeve out of the way of the cross ramming as well as to confine the air escape from the compression chamber **10** so that it tends to exit through the sleeve and assist the insertion of the compressed material into the sleeve itself. Further, a length of flexible material **46**, preferably palstic and advantageously that type of plastic sold under the trade name Teflon, is adhered to the upper chute lip so that the sheet or length of plastic is interposed between the package or sleeve surrounding the chute **50** and the chute. This assists the guiding of the expanding material into the package or sleeve.

It should be recognized that throughout the description of this invention that air film bearing surfaces are shown as being provided by plenums and perforations connecting the plenums with the surfaces in question. However, this is done solely for the purpose of clarity and it will be recognized that there are other methods that are more suitable structurally, such as the formation of longitudinal air passages or small plenums directly in a platen or chute with communicating apertures between the longitudinal passages and the surface. This affords more structural advantages without the bulkiness of the plenums as shown in the drawings and/or concern about the ability of the plenum construction to support forces to which they might be subject. Further, it should be noted that although the cross ram means has been shown as operable to enter an aperture formed in the side of the compression chamber, that the scope of this invention includes the construction of a compression chamber in which a cross ram is nested in a side thereof and recessed to prevent interference with the stacking of the bats in the chamber.

Referring to FIGURES 4, 5 and 6, there is shown a second embodiment of the teachings of this invention. Since certain items in the apparatus of FIGURES 4, 5 and 6 are identical to that previously shown, they have

been designated with the same reference characters to avoid repetition of description. A compression chamber **10** is positioned beneath a vertical compression or ram means **20** having a platen **21**, a plenum **22** secured thereto, a conduit **25** for supplying air to plenum **22**, and a shaft **23** connected to suitable driving means. The bottom of the compression chamber **10** comprises the bottom wall or platen **30** having the plenum chamber **31** attached thereto and the flexible conduit **32** for providing air pressure to the plenum **31**. Apertures **11** and **12** are provided for the cross ram and for the exiting of the compressed material.

The apparatus of FIGURES 4, 5 and 6 differs from that shown previously in that when a stack of mats **15** is placed within the compression chamber **10**, a separate upper platen **72** is rested upon the top of the mats. A separate lower platen **71** rests upon the bottom of the chamber **30**. A tongue or flange **74** depending from the upper separate platen **72** is adapted to interlock with an upwardly extending portion of the lower platen **71** to form a U-shaped carrier when the vertical compression ram **20** compresses the stack of mats **15** and thus the platens **71** and **72** toward each other. The interlocking means is connected to a shaft **73** which is driven by any suitable means. The lower platen **71** has air passages **77** formed therein which communicate with the surface of the package side of the platen **71** via perforations or apertures **78**. The upper platen **72** has similar air passages **75** formed therein which communicates via apertures **76** with the package side of the platen **72**. Although a number of means are suitable there is shown in this instance an air passage **78** formed in shaft **73** which will connect with the passages **75** and **77**, when the platens **72** and **71** are interlocked, to provide air through the perforations **76** and **78**.

In operation, when the platen **72** is compressed to interlock with the platen **71**, positive air film bearing surfaces now exist between platens **30** and **71** and platens **22** and **72**. The driving source connected to shaft **73** may now move the interlocked platens, which form a U-shaped carrier for the compressed stack of mats, into a package connected to a chute means **60** formed around the aperture **12**. It is to be noted in this instance that the chute means **60** need be nothing more than a support surface for the package **83** and a place for the clamping means **45** to be operative to retain package **83** in place.

Since an air film bearing surface has been provided as shown, there is no appreciable friction between the U-shaped carrier, including the platens **71** and **72**, and the upper and lower vertical compression means.

Referring to FIGURE 5, in particular, it will be noted that when the U-shaped carrier has been moved into a sleeve or other package **83** that gripping means **81** and **82** may be moved toward each other to grip the compressed stack through the sides of the package, in a direction normal to the U-shaped carrier, to allow the U-shaped carrier to withdraw leaving the material in the package. In order to assist the withdrawal of the U-shaped carrier, positive air pressure is supplied so that an air film bearing surface is provided from the perforations **78** and **76** of the U-shaped carrier. This air film bearing surface allows a virtually frictionless withdrawal of the U-shaped carrier **70** from the package **83**. To further assist the withdrawal of the U-shaped carrier **70** from the package **83** the perforations or apertures **78** and **76** may be extended through the platens **71** and **72** of the U-shaped carrier **70** so that an air film bearing surface is provided between the sides of the package **83** and the U-shaped carrier.

While the apparatus shown in FIGURES 4, 5 and 6 is adaptable for use with any material to be compressed, it may be more advantageously utilized with the more delicate materials that would suffer most severely from end compression effects.

Referring to FIGURES 7 and 8, there is shown a further embodiment and modification of the teachings of this invention.

The apparatus to the right of FIGURE 7 may be identical to that illustrated in FIGURES 1 and 3. However, in addition, shroud means **100** may be provided to maintain the package compressed so that it may be easily removed from the chute means **50**. That is, an upper shroud member **110** and a lower shroud member **120** may be supported by suitable means such as knee brace apparatus **115** which holds the shrouds **110** and **120** in place as the package is being filled. This prevents the expansion of the material upwardly and downwardly against the package and pulling the sides of the package still on the chute means **50** so tightly against the chute means that the package cannot be removed.

In order to further assist the insertion of the compressed material into the package, a new method and a new type of package **105** (FIGURE 8) have been devised. As will be noted the package **105** has upper and lower surfaces **106** that are comprised of a mesh or other foraminous material which will admit air under pressure. A package **105** is placed around chute **50** and shrouds **110** and **120** are positioned as they have been in the prior art.

The upper shroud **110** has a plenum chamber **111** attached thereto and a flexible conduit **112** to be connected to an air pressure supply. The plenum **111** communicates with the package side of the shroud **110** via perforations **113**. Similarly, the lower shroud **120** has a plenum **121** secured thereto to be supplied with air under pressure via flexible conduit **122**. The plenum **121** communicates with the package side of the shroud **120** via perforations **123**.

In operation, the shrouds are properly positioned on the upper and lower side of the package **105** which is clamped on chute means **50**. As the compressed material is being cross rammed from the compression chamber **10** into the package **105**, air under pressure is supplied via perforations **113** and **123** to the inside of the package **105** through the perforated or foraminous upper and lower sides **106** and **107** of the package **105**. Thus an air film bearing surface is provided for each of the upper and lower surfaces of the compressed material as it is being cross rammed into the package **105**. This, as with the other modifications shown hereinbefore, reduces the shear damage for the uppermost and lowermost bat of the stack of compressed material and reduces the friction so that the end compression of the compressed stack is virtually non-existent.

Referring to FIGURE 9, there is illustrated still another embodiment of the teachings of this invention. It has been discovered that fibrous mats may have the air evacuated from a mass of fibrous materials and greater compression is attained without the breakage of the fibers comprising the mats. A series of mats may be delivered by conveyor or other means to the packaging apparatus illustrated generally at **130**. The packaging apparatus **130** comprises a box-like container **131** having one or more plenums **132** attached at one or more sides to container **131**. The plenums **132** communicate with the interior of the container **131** via a plurality of perforations **133**. It is to be noted that slots or other air passages may be utilized with equal effectiveness as a substitute for the perforations shown herein. The plenums **132** are connected via air exhaust conduits **134** to a suction source not shown herein. A motor-driven exhaust fan may perform satisfactorily for most applications.

The mats are conveyed into or manually placed in the container **131** and air is evacuated from the mass of fibrous materials via perforations **133** and plenums **132**. As the air is evacuated the mats are compressed and successive mats may be placed in the container until a desired size package is created.

A sheet of kraft paper may be placed in the container **131** prior to the stacking and compressing of the mats therein. When a full package is attained, a first fold of the sheet of kraft paper may be placed over the top of

the uppermost mat and it will closely adhere to the upper surface of the package because the air exhaust is still pulling through the perforations 133. Thus, the other fold of the sheet may be placed over the first fold and secured by adhesive, staples, etc. The air exhaust via conduits 134 is now shut off and the package is complete.

To assist in removing the package from the container 131, a plenum 136 is connected to one wall of the container 131, preferably the bottom wall thereof, and communicates with the interior of the container via perforations 138. The plenum 136 is connected to a gated pressure source (not shown) via conduit 137. When the package is ready for removal, the pressure source is gated to plenum 136 via conduit 137 and the air flow through perforations 138 creates an air film on the interior surfaces of the container 131 allowing the package to be readily removed. The air pressure may be increased to a point where the package acts as a piston in the box-like container 131. The air pressure then acts as a hydraulic fluid and assists in removing or drives the package from the container 131. However, the air film bearing surface created on the bottom and the sides of the package in the container 130 make the removal of the package very easy since friction is greatly reduced on the sides and ends of the container.

It is to be noted that the characterization of the material to be packaged as mats, batts, etc., is not intended to be limiting but rather a generic description of material gathered together for compressing. The material may be loose or in an integrated layer. Further, fibrous material is meant to include porous materials such as glass fibers, rock wool, felt, cotton, etc., as well as other synthetic compositions such as sponge rubber, foamed products, etc., especially those having interconnected or communicating air or gas pockets or passages.

While the invention is fully operable with all of the materials discussed hereinbefore, it may be desirable, when working with material that does not have a closed cell composition or has not been compressed sufficiently to approach a closed cell composition, to provide a substantially air or gas impervious barrier between the material and the air film bearing surfaces. As examples of such barriers, sheets of plastic or paper could be utilized. The position of such barriers would be the same as platens 71 and 72 in FIGURE 4. That is, a sheet of paper would be placed above and a sheet placed below the material being compressed. After compression and upon actuation of the air or gas pressure, the bearing surface would be created between the compressing surfaces and the barriers or sheets. Operation thereafter would be the same as described hereinbefore.

It should also be noted that although the apparatus and process has been described in conjunction with the use of air, that other gases or fluids may be used or desirable in certain environments.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than is herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variation thereof.

I claim:

1. A method of packaging a mass of material comprising the steps of compressing said material between two surfaces, providing an air film between said surfaces and said compressed material, cross-ramming said compressed material from between said two surfaces into a package, and providing air film bearing surfaces inside said package to reduce the friction of insertion of said material into said package.

2. A method of packaging a mass of material comprising compressing said material between two surfaces, providing an air film between said surfaces and said compressed material, cross-ramming said compressed mass from between said two surfaces into a package, providing means to maintain said package in an open position, perforating said package on opposing sides, retaining said package in substantially the same form as said compressed material has when said material is rammed into said package, and providing air film bearing surfaces inside said via said perforated sides from surfaces of said retainer to reduce the friction of insertion into said package.

3. Apparatus for packaging a mass of material comprising means for compressing said material between two surfaces, means for providing an air film between each of said surfaces and said compressed material, means for cross-ramming said compressed material from between said two surfaces into a package, and means for providing air film bearing surfaces between said compressed material and the interior of said package.

4. Apparatus as defined in claim 3 in which chute means are provided to maintain said package open to receive said compressed material, said chute means having means for providing air film bearing surfaces to said compressed material in said chute means and in the interior of said package.

5. Apparatus for packaging a mass of material comprising opposed platen means on each side of said mass, means for compression ramming said platen means together to compress said mass, means for interlocking said platen means together when a desired compression is achieved into a substantially U-shaped carrier, means for cross-ramming said carrier into a package, and means for providing an air film bearing surface between said platen means and the surfaces of said compression ram means to assist in said cross-ramming.

6. Apparatus as defined in claim 5 which further includes means for gripping the sides of said compressed mass in said package, normal to said U-shaped carrier to allow withdrawal of said carrier from said package without said material.

7. Apparatus as defined in claim 5 which further includes means for providing air film bearing surfaces between said platens comprising said carrier to assist removal of said carrier from said package.

8. Apparatus as defined in claim 7 which further includes means for providing air film bearing surfaces between said platens and said package to assist in removal of said carrier from said package.

9. Apparatus as defined in claim 5 which further includes means for providing air film bearing surfaces between said platens and the sides of said packages to assist in removal of said carrier from said package.

10. Apparatus for packaging a mass of material comprising means for compressing said material between two surfaces, means for providing an air film between each of said surfaces and said compressed material, means for cross ramming said compressed material from between said compressing surfaces into a package, chute means for holding said package open and guiding said material into said package, said package having perforations formed therein on the sides against which the material will attempt to expand, means for maintaining said package and said material compressed so that said package may be removed from said chute means, and means for providing air film bearing surfaces within said package via said perforated sides of said package from said maintaining means to reduce the friction of insertion into said package.

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