MOLDING MACHINE

Filed Dec. 12, 1957 3 Sheets-Sheet 1

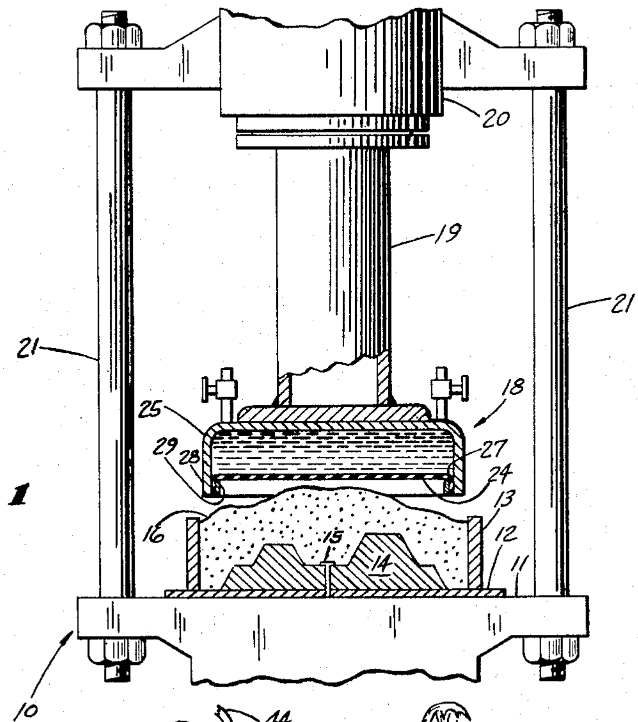

Fig. 1

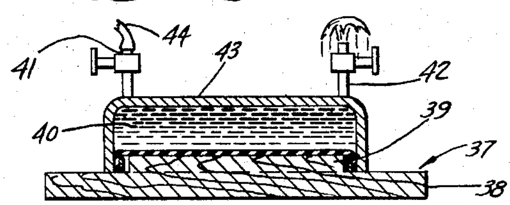

Fig. 2

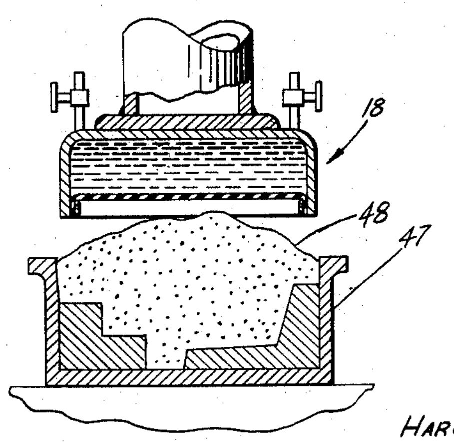

Fig. 3

INVENTOR.
HAROLD L. REKART
BY Henry Kozak
ATTORNEY

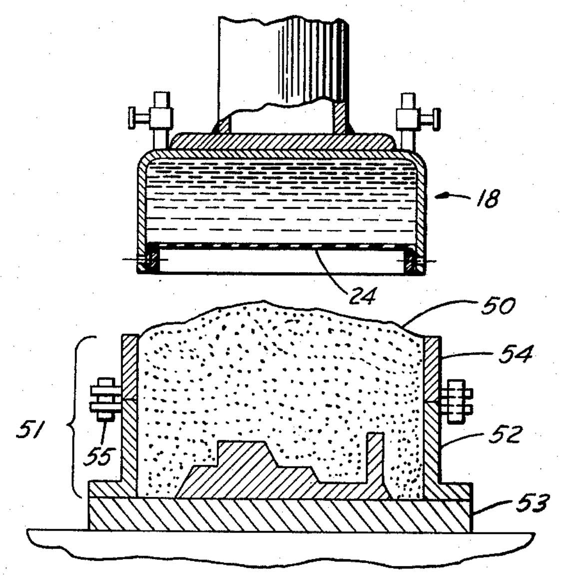

Fig. 4

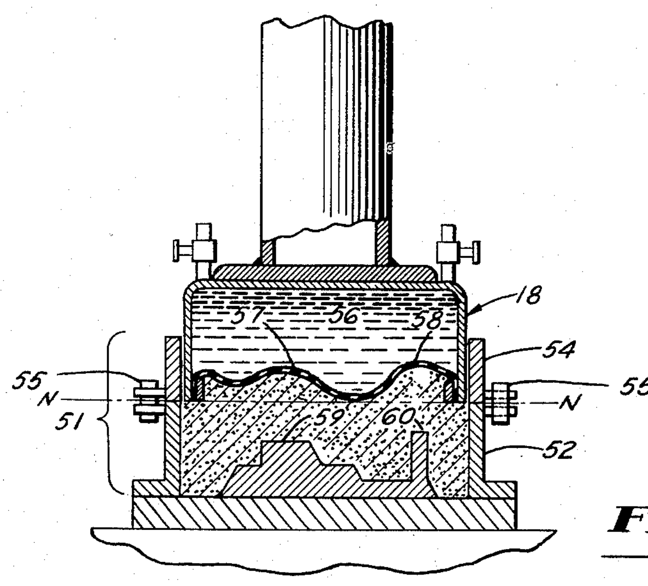

Fig. 5

INVENTOR.
HAROLD L. REKART

BY Henry Kozak
ATTORNEY

Dec. 6, 1960 H. L. REKART 2,962,775

MOLDING MACHINE

Filed Dec. 12, 1957 3 Sheets-Sheet 3

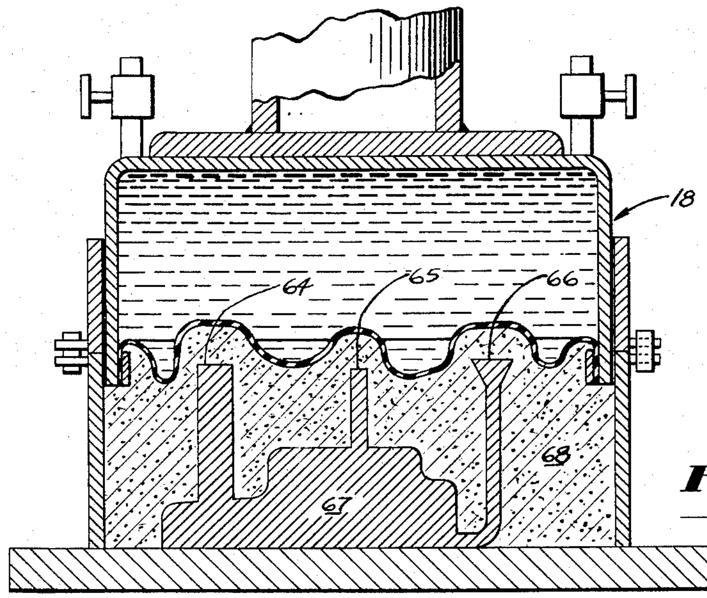

Fig. 6

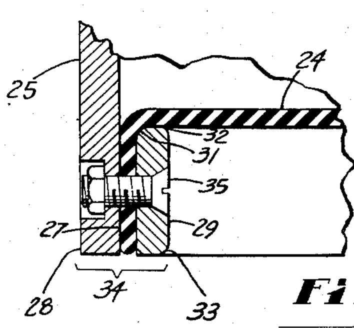

Fig. 7

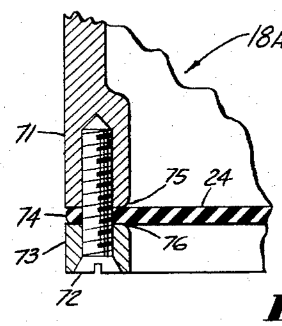

Fig. 8

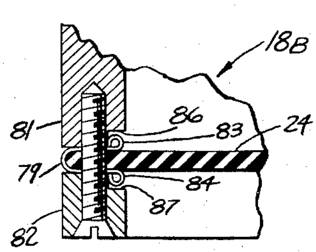

Fig. 9

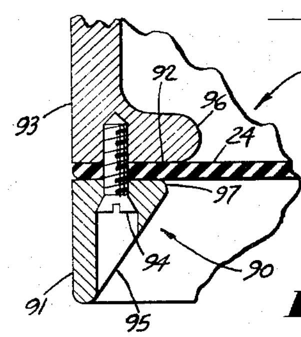

Fig. 10

INVENTOR.

HAROLD L. REKART

BY Henry Kozak

ATTORNEY

United States Patent Office

2,962,775

Patented Dec. 6, 1960

1

2,962,775

MOLDING MACHINE

Harold L. Rekart, Elmhurst, Ill., assignor to National Malleable and Steel Castings Company, Cleveland, Ohio, a corporation of Ohio

Filed Dec. 12, 1957, Ser. No. 702,308

9 Claims. (Cl. 22—42)

This invention relates to apparatus for making molds, cores or other self-supporting articles from a particulate, cohesible material, such as a molding sand, i.e., a damp mixture of sand and one or more ingredients which provide a binder for the sand.

In making a sand mold for foundry use, for example, a pattern is placed on a mold board and surrounded by a flask of which the lower edge also rests on the mold board. Sand is placed in the flask and packed or compressed tightly within the wall of the flask and around the pattern. The ramming may be done by hand, but in commercial foundry practice it is done generally by machines for either "jolting" the assembly for forming the mold, "squeezing" the sand by applying a pressure member to the upper surface of the sand exposed by the open top of the flask, or by a sand slinger. There are also machines in use capable of both jolting and squeezing operations.

A disadvantage of the practice of jolting that becomes very evident in the light of the present invention is the need for heavy equipment, which may vary in size, to lift and withstand the dropping impact of loads varying from several hundred pounds to several tons. Other disadvantages are: the need for flasks of extra weight and sturdiness to withstand the impact wear of jolting for a reasonable service period; the relatively high rate of attrition of equipment; difficulty in maintaining plant cleanliness; and noise.

The "squeezing" operation, as now practiced, may be accomplished by pressure-packing the sand by either a rigid platen ("squeeze plate") operated, e.g., by a pneumatic or hydraulic cylinder, or a fluid-expandable diaphragm. In the operation of a "squeezer" equipped with a rigid squeezing plate, a well-recognized disadvantage is the variation in the packing or firmness obtained in the sand along the surface of the pattern, particularly when portions of the pattern vary considerably in height. Moreover, there is always the danger of the squeeze plate engaging and breaking higher portions of the pattern, such as portions for forming the risers or the downsprue. The type of "squeezer" which utilizes an expandable diaphragm requires appreciable time for movements of the "squeezing head" and for inflation and deflation of the chamber comprising the diaphragm immediately before and after, respectively, the packing operation. With the advent of the present invention, it is also obvious that present diaphragm-type machines are relatively complicated as a result of the fluid supply and control systems necessary to coordinate the diaphragm operation with the other movements of such machines.

It is a primary object of this invention to provide improved apparatus for packing and molding a particulate, cohesible material into self-supporting articles.

Another object is to provide simplified apparatus for forming molds and cores, such as used in the manufacture of metal castings.

A further object is to provide an improved apparatus of the so-called "squeezer" type, which is practical for carrying out mold-forming operations that have been heretofore preferably performed on jolting or sand slinger machines.

Ancillary to the above object, it is desirable to form large molds in a single pressing operation with relatively inexpensive apparatus requiring no massive foundations or heavy flasks, and with unusually low wear on equipment.

Still another object is to provide a squeezer-type machine for making molded articles, such as sand molds used in metal-casting, having a pressure member capable of exerting full packing pressure on the surface of the medium being molded while engaging pattern portions which may protrude through the medium without damage to either the pattern or the pressure member.

An important object is to generally reduce the cost and increase the rate of producing molds and cores for the metal casting industry.

Various other objects, features, and advantages will become apparent as the invention is described.

Briefly stated, the invention resides primarily in molding equipment comprising an open-top container having a rigid, vertical, wall of substantially uniform internal periphery as measured along any horizontal plane within the wall, and a pressing member having an external periphery complementary to the internal periphery of the container adapting the member to enter the open-top of the container and to move vertically therewithin. The pressing member defines a sealed chamber and comprises (1) a rigid pressure-resistant lateral wall portion having the above-mentioned external periphery, (2) a lower downwardly-facing work-engaging wall portion consisting of a flexible elastic diaphragm joined with the rigid wall portion along its internal periphery and adjacent its lower extremity, and (3) a liquid filling said chamber fixed as to quantity to cooperate with the atmospheric pressure in supporting the diaphragm along a generally horizontal plane disposed upwardly within the member with respect to a lowermost flange-like extremity thereof during a work-free condition of the member.

The chamber of the pressing member may be permanently sealed and is used without any addition to or subtraction from its contents during pressing operations. The chamber of a preferred form of the pressing member contains a liquid (hence, a non-compressible medium). Thus, the work-engaging surface of the member, as provided by the diaphragm, may yield rearwardly of its normal plane while thrusting forwardly of the plane at areas of less-resistance on the surface of the particulate cohesible material being molded, entirely by application of uniform pressure along all portions of the diaphragm as obtained by movement of the member as a whole toward the work.

A press utilizing a pressing member having a liquid-backed diaphragm comprises a base or frame on which the pressing member and the work-supporting member are supported in relatively movable relationship for movement toward and away from each other. In the broader aspect of the invention, the pressing member may be movable relative to a stationary work-supporting member, vice-versa, or both members may be movably supported by the base.

In the drawing, with respect to which the invention is described below in detail:

Fig. 1 is a fragmentary schematic elevation, partly in section, of a press, a mold flask, and a pattern in position for beginning a pressing operation for forming a sand mold;

Fig. 2 is a sectional diagrammatic view illustrating the filling of a pressing head with liquid;

Fig. 3 is a diagrammatic elevation, partly in section, of a press and a core box in position for forming a sand core;

Fig. 4 is a fragmentary schematic elevation, partly in section, of a press, a flask, a pattern and an upset frame in position for forming a mold;

Fig. 5 is a fragmentary schematic elevation of the apparatus of Fig. 4 at the completion of the pressing stroke;

Fig. 6 is a fragmentary schematic elevation of a press and mold-forming assembly at the completion of a pressing stroke illustrating the deformation of the diaphragm around portions of the patterns; and

Figs. 7 to 10 are enlarged sectional fragmentary elevations of different arrangments for attaching the diaphragm of a pressing member to its rigid wall portion.

Fig. 1 schematically illustrates a hydraulic press **10** typical of a "squeezer" used in forming sand molds and cores for casting metal. On the upward-facing surface of a work-supporting member or platform **11** is positioned a molding board **12**. An open-topped flask **13** rests by its lower edge on the molding board. A pattern **14** rests on the molding board inside the flask and is normally secured to the board as by a fastener **15**. At the stage shown in Fig. 1, unpacked loose molding sand **16** covers the pattern and fills the flask **13**.

For packing the sand **16**, the press further comprises a hollow pressing member **18** mounted on the lower end of a ram **19** actuated by a hydraulic cylinder **20**. As shown, the press **10** is designed to absorb all tensile and compressive forces developed in a pressing operation within the press itself through connection of the cylinder **20** with the work-supporting platform **11** by columns **21**. Hence, as the operation of the press does not involve impact or shock forces of consequential nature, the press is substantially self-sufficient as to support and may be placed on any ordinary floor capable of sustaining its weight without reinforcement for shock or vibrational loads.

The structure of the pressing head or member **18** provides the major feature of the present invention and is based on the provision of a flexible elastic work-engaging wall portion, as provided by a diaphragm **24** of rubber or other elastic flexible material backed by a non-compressible fluid medium, such as a liquid or extremely fluid solid, contained within a rigid wall portion **25** cooperating with the diaphragm to provide a sealed container.

In the preferred construction, the periphery of the diaphragm joins with the rigid mold portion along a plane so that, in its normal work-free condition, the diaphragm is supported by a vacuum against the liquid contained by the pressing member in a flat condition, approximately in the above-named plane of juncture of the diaphragm with the rigid wall portion. As shown in Figs. 1 and 7, the diaphragm is sealed to withstand the hydraulic pressure of the liquid, e.g., pressure up to 100 pounds per square inch or more, by securing an entire peripheral margin **27** of the diaphragm to a continuous lower edge section **28** by a ring element **29**. Rounded edges **31** and **32** (Fig. 7) are provided on the element **29** to prevent cutting or chafing of the diaphragm. A rounded edge **33** is provided on the element **29** to facilitate penetration of the molding material by the flange-like extension **34** of the pressing member consisting of the edge **28**, diaphragm margin **27**, and the ring element **29**. Fasteners, such as a plurality of bolts **35**, extend through the extension **34** under sufficient tension to provide a leak-proof joint. Preferably, the holes for such fasteners are countersunk to receive the enlarged ends (e.g., bolt heads and nuts) because of the flush lateral surface of the pressing head desired for clearance with the inner periphery of the flask, and the freedom from caking of molding material desired along the inner periphery of the flange extension **34**.

The diaphragm is readily provided from any one of the many elastomers commercially available. Any natural or synthetic rubber composition, providing good flexibility and elongation without permanent deformation may be used. Although the overall elongation of the diaphragm would possibly never exceed 100 percent, the desired elongation without permanent deformation should preferably be at least 400% in order to insure serviceability under conditions of localized stretching of several hundred percent. The thickness of the diaphragm may be of the order of ⅛ to ¼ inch, although this is not a critical range.

Fig. 2 illustrates the manner in which the pressing member **18** may be prepared for service. As shown, the member **18** is positioned on a templet **37** having a base portion **38** and a raised portion **39**. The latter is raised above the base portion approximately the width of the ring element **29** (or the height of the flange extension **34**) in order to support the diaphragm in a plane when the undersurface of the flange extension rests on the base portion of the templet. Valves **41** and **42** are attached to the top wall portion **43** of the member **18** and communicate with the interior of the member. With both valves open, all that is necessary for filling the member is to attach a liquid-supply hose **44** to one valve and fill the chamber **40** until liquid is discharged through the other valve. Thereafter both valves are closed. The chamber **40** now contains a fixed volume of water and on account of its non-compressibility, the volume of the chamber **40** remains constant regardless of the deformation of the diaphragm, except if there be undesired leakage. Filling, in the event of leakage, may be readily done in the same manner, with the pressing member mounted on the press as shown in Fig. 1, since the templet is readily substituted for flask pattern and molding board assembly on the platform surface **11**.

Fig. 3 illustrates the use of pressing member **18** for forming cores. Member **18** is shown suspended over a core box **47** filled with sand **48**. As required in the forming of molds (see Fig. 1), the external periphery of the member **18** is complementary to, but slightly smaller than, the internal periphery of the core box **47**, in order that the member **18** may pass into and out of the top of the core box with a clearance in the order of from ⅛ to ⅜ inch. To be taken into account in providing clearance is the internal taper with which core boxes are ordinarily formed to allow release of the core formed therein.

Figs. 4 and 5 illustrate the use of the member **18** in forming molds when the original charge of loose sand **50** is placed in an enclosing means **51** comprising a flask **52** resting on a molding board **53**, and an upset **54** secured to the flask (as by C clamps **55**) with its top edge in complementary engaged relation with the upper edge of the flask. In order that sufficient sand is provided for the mold to prevent the packing thereof below the top edge of the flask **52** at the ends of the pressing stroke, it is recommended that the height of the upset **54** be at least 60 percent of the height of the flask.

Fig. 5 depicts the compression stroke as completed with some of the packed sand disposed above a plane N–N which contains the top edge of the flask **52**. The sand above this plane is in excess and may be "struck off" with any suitable means, such as a straight-edged blade or a taut wire, using the top edge of the flask as a guide.

The unevenness in contour of the diaphragm, as shown in Fig. 5, is illustrative of the manner in which uniform hydraulic pressure exerted by the liquid **56** and transmitted to the sand by the diaphragm **24** allows the diaphragm to yield in encountering areas which are more resistant to packing than others. For example, the areas **57** and **58** are depressed inwardly from the normal plane of the diaphragm by the increased resistance encountered in the sand overlying the pattern protrusions **59** and **60**. However, on account of the non-compressibility of the liquid, any depression of the diaphragm must be matched by equal forward bulging of the diaphragm.

Fig. 6 is further illustrative of the manner in which the diaphragm conforms to the varying resistance encountered at the top surface of the molding sand. It is also illustrative of the protection the presently disclosed pressing member provides against damage to pattern parts, e.g., portions **64**, **65**, **66** which protrude inwardly from the main body of the pattern **67** into a region below which some portions of the top surface of the sand **68** recede in being compressed by the diaphragm **24**. Hence, the use of the elastic diaphragm is advantageous as a protection against damage to the pattern resulting from insufficient charging of sand to the enclosing means for the sand. The practice illustrated by Fig. 6 may be purposely adopted where necessary, and additional sand added to the depressions left after withdrawing the member **18** to provide a cope or drag having a level top or bottom surface, respectively.

Figs. 8, 9 and 10 illustrate, in fragmentary manner, pressing heads **18A**, **18B** and **18C**, embodying different arrangements of attaching the diaphragm to the rigid lateral wall portion of the pressing member. In accordance with Fig. 8, the rigid wall of a pressing member **18A** terminates in a lower enlarged edge-portion **71** providing threaded holes for a plurality of screws **72** used to clamp a ring element **73** against a peripheral margin **74** of the diaphragm **24**. The corners of the wall **71** and element **73** are rounded at **75** and **76** to avoid chafing of the diaphragm.

In the embodiment **18B**, shown in Fig. 9, a metallic channel **79** is vulcanized to the peripheral margin of the diaphragm **24**. The channel, when strongly bonded to the diaphragm edge, constrains the deformation of the diaphragm material under compression between the downwardly facing edge-surface of the rigid wall **81** and the ring element **82** as compared to a diaphragm not provided with such a channel. The channel permits greater clamping pressure to be used thereon without injury to or permanent deformation of the diaphragm periphery. To assure against leakage, the upper surface of the channel **79** may be coated with a gasket cement. For protection of the diaphragm against chafing, the channel may be provided with rolled edges **83** and **84**. The wall portion **81** and the element **82**, as shown, are recessed at **86** and **87** to accommodate the rolled edges, although this is an optional construction as the member **18B** may be constructed without recesses and the channel formed to dispose the rolled edges along the inner surfaces of the wall **81** and the ring **82**.

Pressing member **18C**, as illustrated in Fig. 10, is provided with a tapered flange portion **90** characterized primarily by a ring element **91** of downwardly tapered cross-section used in securing the diaphragm **24** against the downwardly-facing surface **92**. The pressure with which the diaphragm is squeezed between the rigid lateral wall **93** and the element **91** is determined by adjustment of a plurality of screws **94**. The essential purpose of the taper of the ring element **91** is to avoid excessive pressure and packing of the sand which tends to develop underneath a relatively broad undersurface of a square-contoured flange extension. As the sand tends to pack and be pushed upwardly along the inclined surface **95** during a pressing stroke, the wall **93** is rounded at **96** to protect the diaphragm. For further protection of the diaphragm, the ring element **91** is rounded at **97** as the diaphragm may at times be caused to buckle outwardly along its joint with the rigid wall.

In the drawing and the foregoing description, the invention is embodied in an extremely simplified combination of elements without reference to the many devices and methods that are available in the mold-making art by which the handling and the processing of material to be molded, molded products, and elements of equipment may be facilitated before and after the pressing operation on which the present invention is essentially focused. Within the pressing operation itself, other obvious mechanical arrangements may be provided from the prior art for movement of the pressing member relative to the work material, or vice versa, or to effect simultaneous or successive movements of both.

The terms and expressions which have been employed are used as terms of description and not of limitation and there is no intention of excluding such equivalents of the invention described or of the portions thereof as fall within the purview of the claims.

What is claimed is:

1. Molding equipment comprising: an open-top container having a vertical wall of substantially uniform internal periphery as measured along any horizontal plane within the wall; a pressing member having an external periphery complementary to said internal periphery adapting the member to enter the open top of the container and to move vertically therewithin; said pressing member defining a sealed chamber and comprising: a rigid pressure-resistant lateral wall portion having said external periphery, a lower downwardly-facing work-engaging wall portion consisting of a flexible elastic diaphragm, means for joining the diaphragm to the rigid wall portion in sealed relation therewith along its internal periphery in a generally horizontal plane disposed upwardly from the lower end surface of a lowermost flange-like extremity of the member, and a liquid filling said chamber fixed as to quantity to cooperate with the atmospheric pressure in supporting the diaphragm along said plane during a work-free condition thereof.

2. The molding equipment of claim 1 wherein: a peripheral downturned margin of the diaphragm is secured between a lower marginal inwardly-facing surface of the rigid wall portion and a rigid ring in engagement with the inwardly-facing surface of said margin of the diaphragm for holding the margin of the diaphragm in continuous sealed relation with the rigid wall portion.

3. The molding equipment of claim 1 wherein: a rigid wall portion terminates in a lower downwardly-facing edge surface; said member comprises a ring element shaped to provide an upper surface approximately complementary to said edge surface; a continuous peripheral marginal portion of the diaphragm is disposed between the ring element and said edge surface; and means connects the rigid wall portion and the ring element with said marginal portion of the diaphragm clamped tightly therebetween.

4. The molding equipment of claim 1 wherein: the rigid wall portion has a downwardly facing edge surface; said diaphragm comprises a sheet of elastic flexible material and a thin-walled metallic channel vulcanized to, and enclosing, a peripheral margin of the sheet material; said channel on the diaphragm being shaped to fit along said edge surface; a rigid ring element having an upper surface substantially complementary to said edge; and fastening means extending through the ring element and the channel and anchoring in said rigid portion places the channel and the diaphragm margin under compression.

5. The molding equipment of claim 1 comprising: a rigid flange-like extension tapering downwardly from the entire periphery of the diaphragm and providing a downward projection of the outer lateral surface of the pressing member.

6. The molding machine of claim 1 wherein: a peripheral margin of the diaphragm is secured between a downwardly-facing surface of the rigid wall portion and a rigid ring element having an upwardly-facing surface generally complementary to said lower edge surface; said ring element tapering downwardly from said upper surface thereof.

7. The molding equipment of claim 1 wherein: said outer periphery of the pressing member is shaped at a clearance from about ⅛th to about ¼th inch with respect to the said inner periphery of said container

when said member occupies an operative position within the container.

8. The molding equipment of claim 4 wherein: the channel has rolled edges.

9. The molding equipment of claim 8 wherein: said edge surface and said element are recessed to receive said rolled edges.

References Cited in the file of this patent

UNITED STATES PATENTS

386,951	Adams	July 31, 1888

2,519,661	Johnson	Aug. 22, 1950
2,575,734	Schulman	Nov. 20, 1951
2,632,215	Lee	Mar. 24, 1953
2,698,976	Taccone	Jan. 11, 1955
2,805,455	Whitesell	Sept. 10, 1957

FOREIGN PATENTS

10,436	Great Britain	July 22, 1884