US 20070194043A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2007/0194043 A1

Mank et al. (43) Pub. Date: Aug. 23, 2007

(54) PRESS FOR REMOVING SUPERNATANT FROM A FLEXIBLE VESSEL

(76) Inventors: **James F. Mank**, Dublin, OH (US); **Herbert S. Bresler**, Columbus, OH (US)

Correspondence Address:
BATTELLE MEMORIAL INSTITUTE
505 KING AVENUE
COLUMBUS, OH 43201-2693 (US)

(21) Appl. No.: **10/572,241**

(22) PCT Filed: **Sep. 21, 2004**

(86) PCT No.: **PCT/US04/30784**

§ 371(c)(1),
(2), (4) Date: **Dec. 19, 2006**

Related U.S. Application Data

(60) Provisional application No. 60/504,854, filed on Sep. 22, 2003.

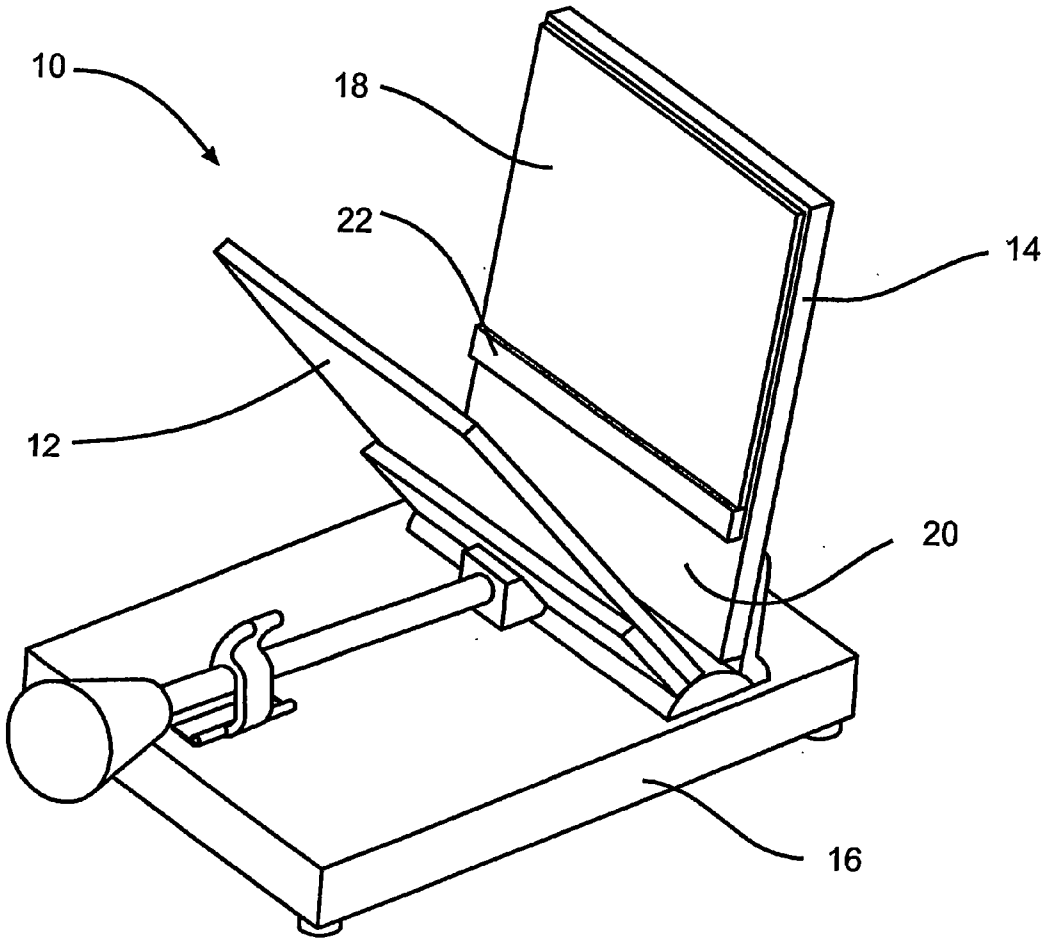
Publication Classification

(51) **Int. Cl.**
B65D 35/28 (2006.01)

(52) **U.S. Cl.** **222/103**

(57) **ABSTRACT**

A press for removing supernatant from a flexible vessel includes cooperating press members having an open position to insert the vessel between them, and a closed position to compress the vessel between them. At least one of the press members has a compliant pad on its press surface. The compliant pad compensates for variable thickness of the vessel when it is compressed. The press is constructed to compress a first or lower portion of the vessel less than a second or upper portion of the vessel. Preferably, the press additionally includes a barrier structure that creates a barrier between the lower portion of the vessel and the upper portion of the vessel when the vessel is compressed. The press can also include a vessel holder having a structure for adjusting the position of the vessel within the press.



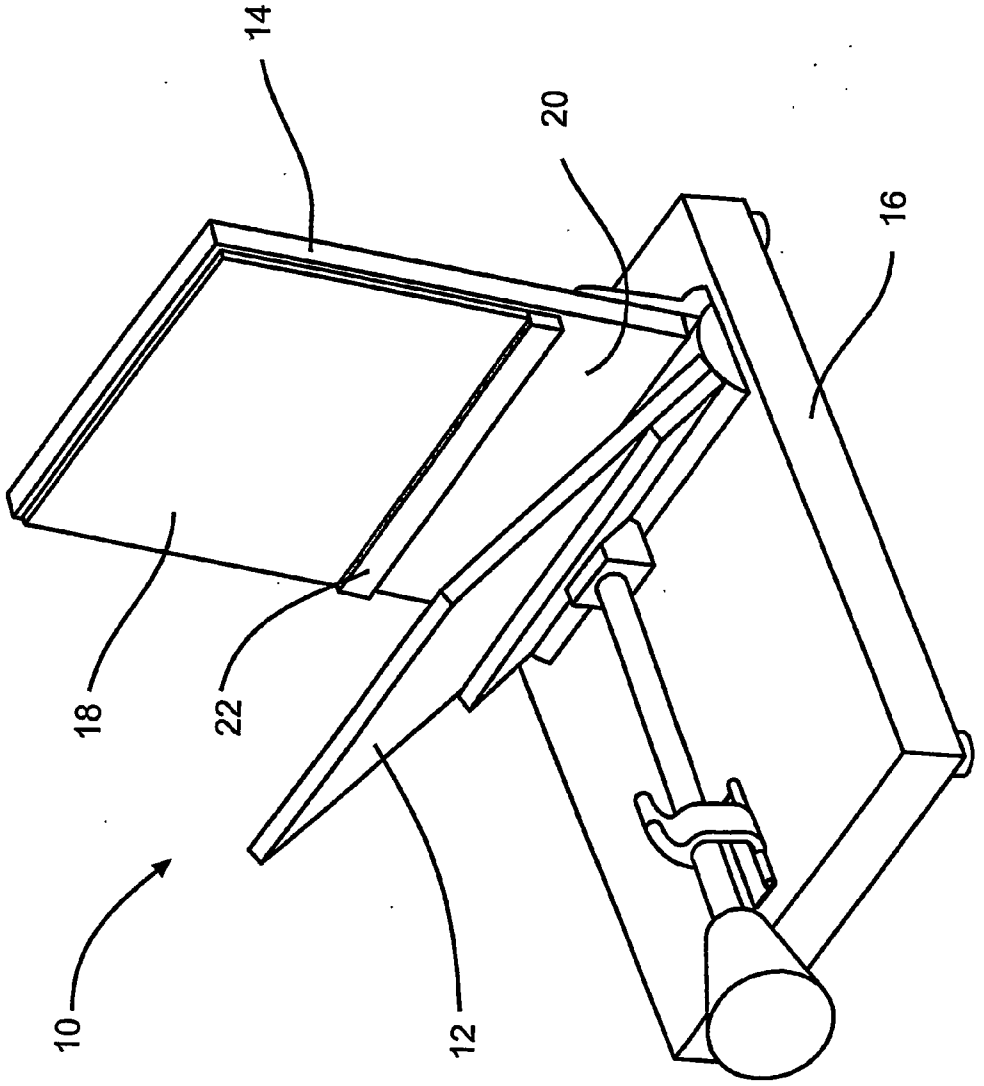


FIG. 1

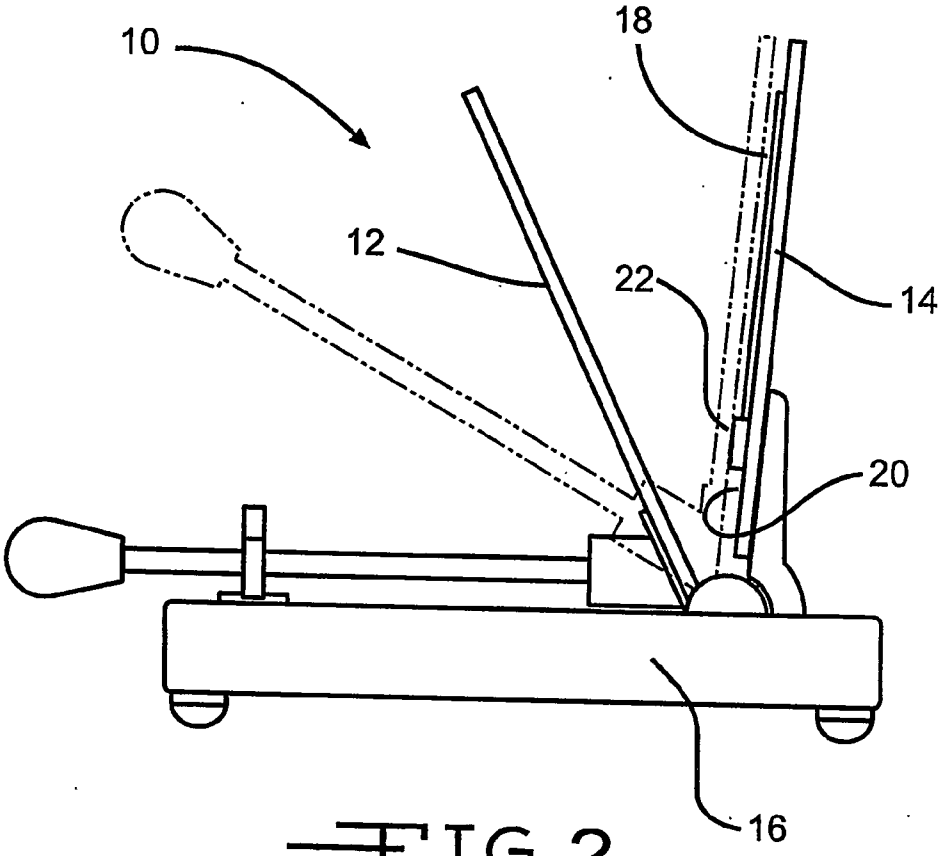


FIG. 2

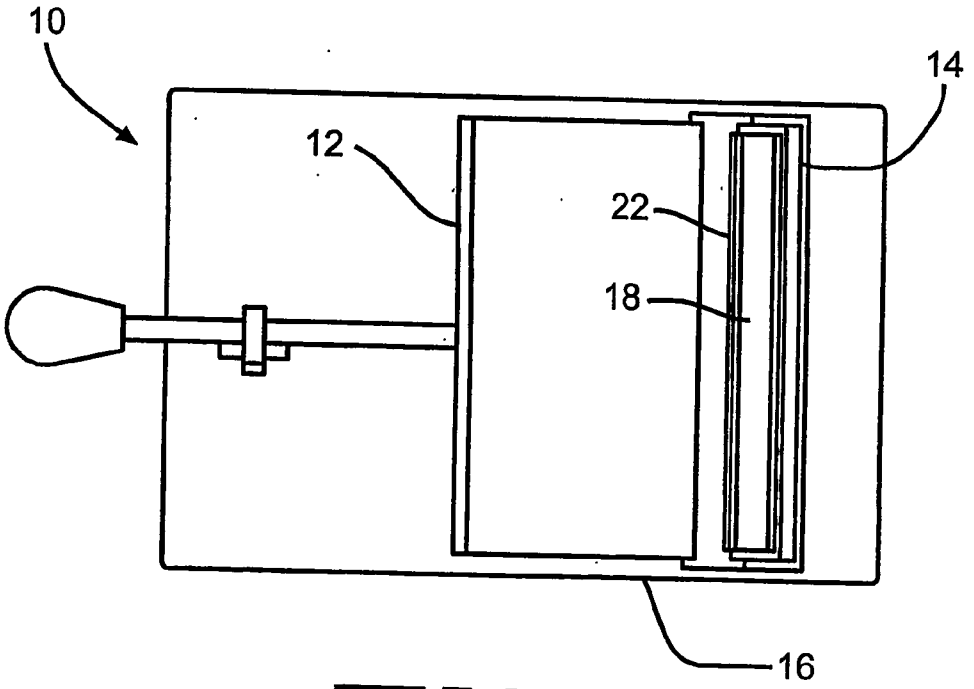
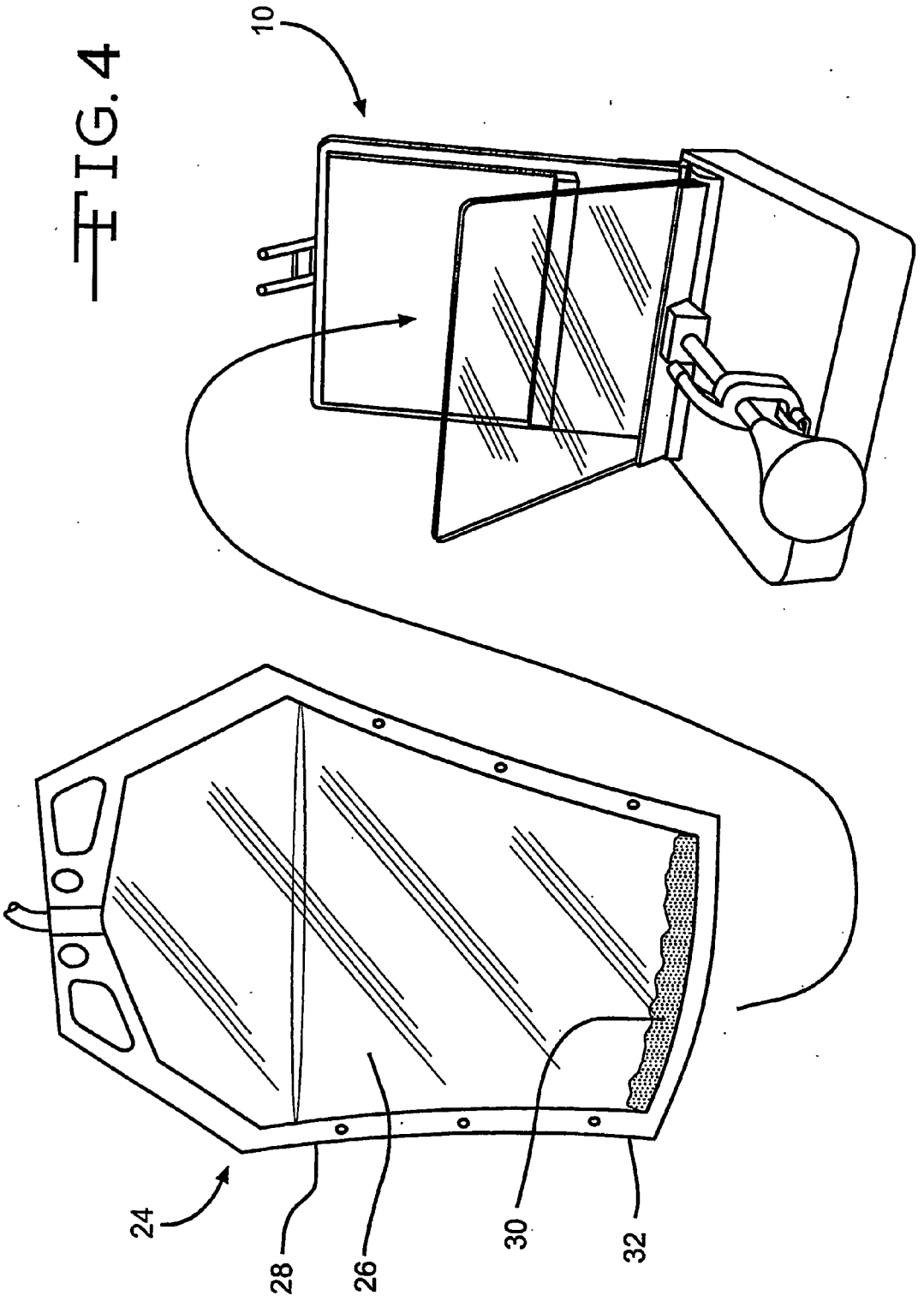


FIG. 3

FIG. 4



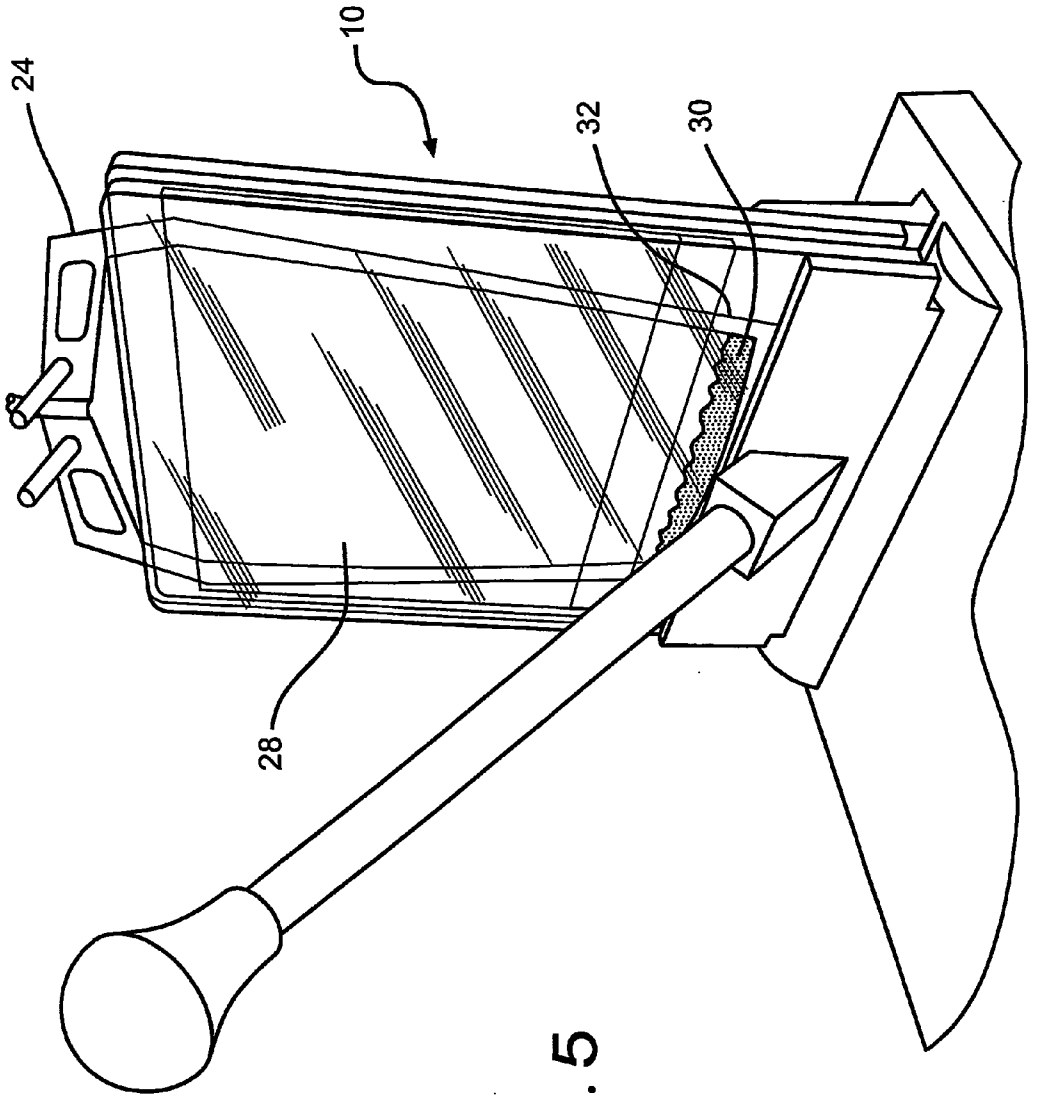


FIG. 5

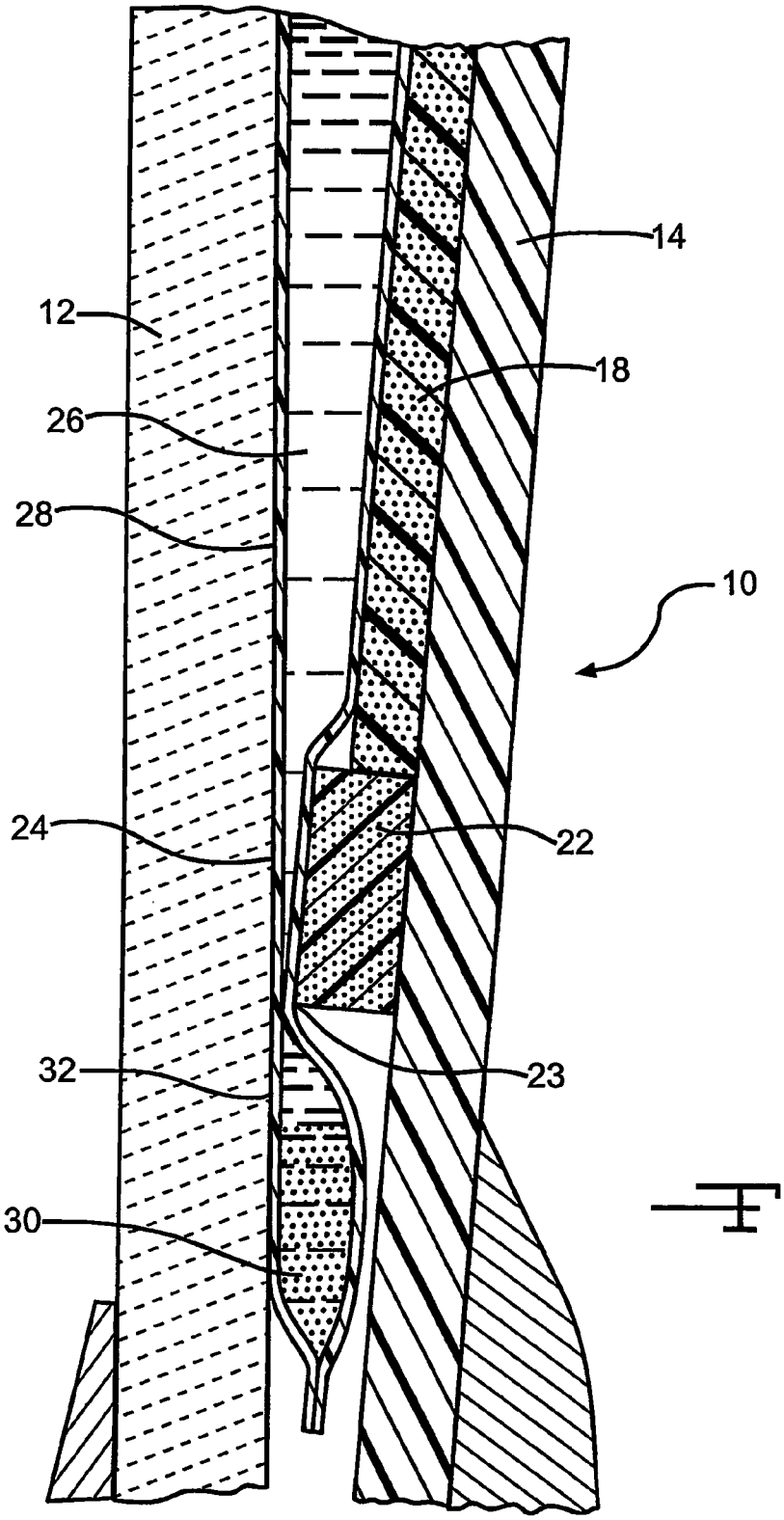


FIG. 6

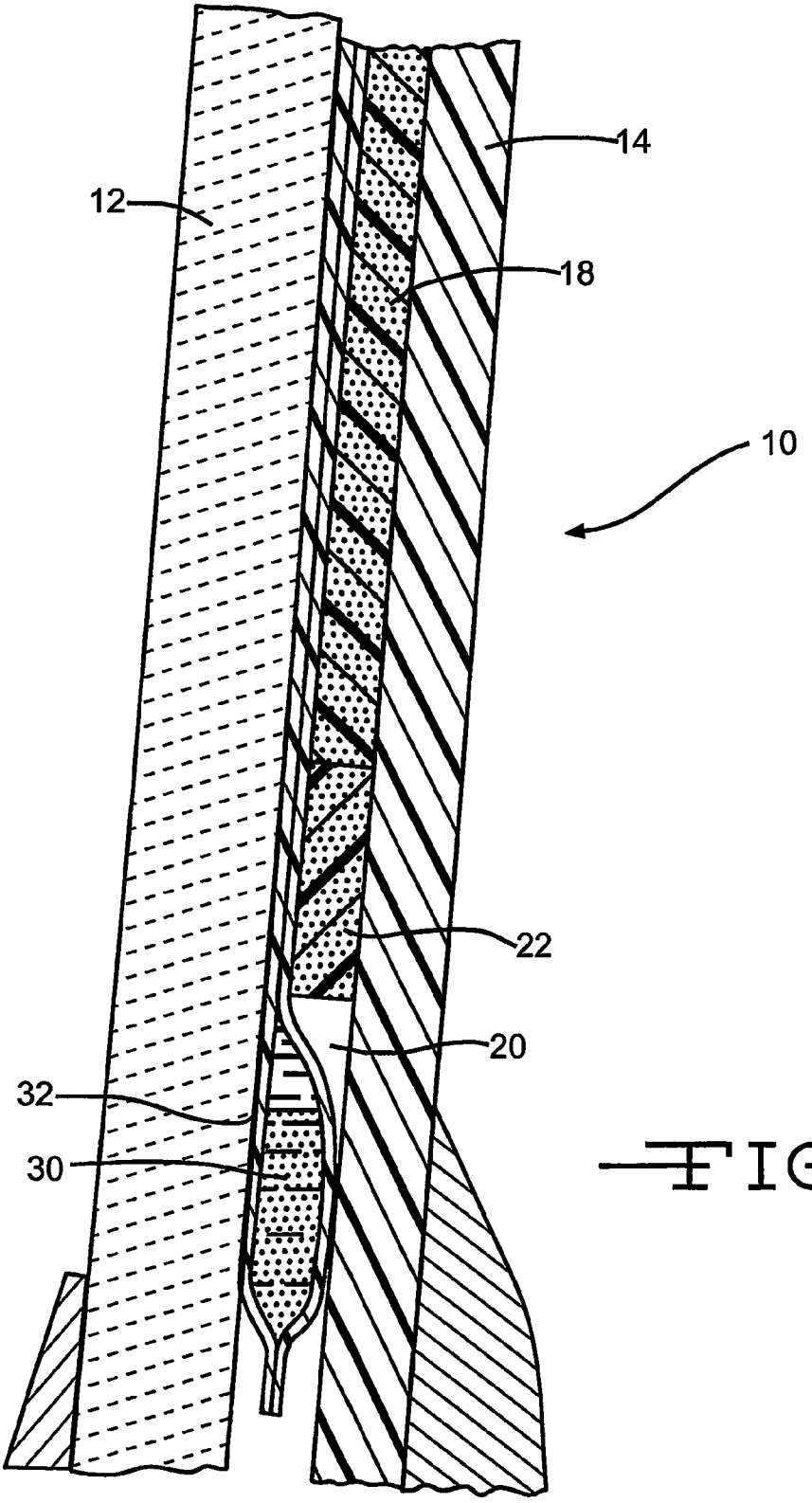


FIG. 7

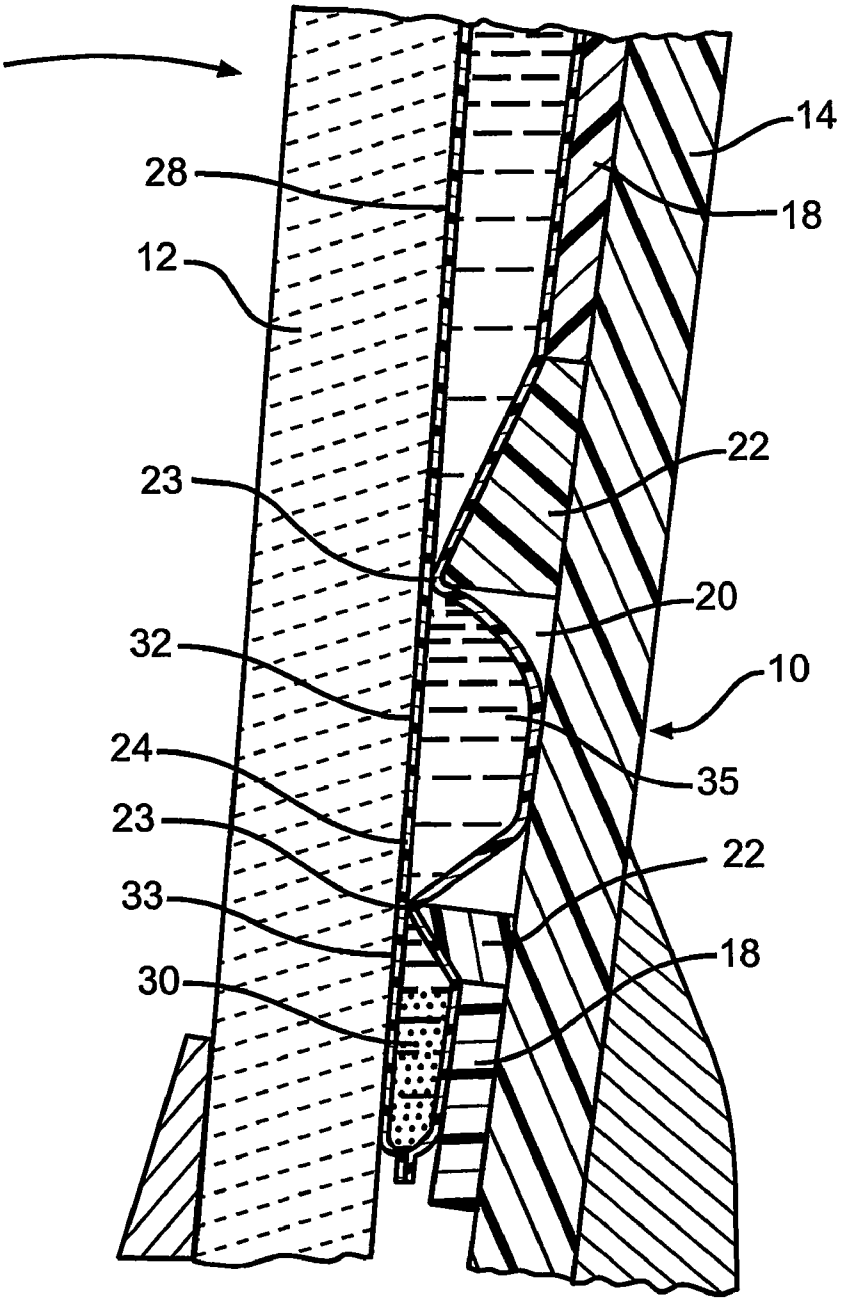


FIG. 8

PRESS FOR REMOVING SUPERNATANT FROM A FLEXIBLE VESSEL

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. provisional application Ser. No. 60/504,854, filed Sep. 22, 2003.

BACKGROUND OF THE INVENTION

[0002] This invention relates in general to medical laboratory devices, and in particular to a press for removing supernatant or fluids of different density from a flexible vessel after the vessel has been centrifuged.

[0003] Flexible vessels, similar to blood bags, can be used in biological suspension processing systems. Process requirements may require centrifugation of the vessel contents to separate cells or other relatively dense material from the carrier medium and subsequent removal of the supernatant. Centrifugation in the flexible vessel can be an attractive alternative to using traditional centrifugation tubes because the suspension can be left in the vessel. However, current techniques for transferring the suspension from a flexible vessel to centrifuge tubes introduce the possibility of contaminants entering the suspension or exposing the laboratory operator to the suspension during the transfer process. This is highly dependent on operator skill and is labor, equipment and time intensive.

[0004] When traditional centrifuge tubes are utilized, supernatant is typically removed by manually pipetting the liquid out of the tube until the cell pellet/supernatant interface has been reached as determined by visual observation. This process works reasonably well but has the disadvantage of requiring careful implementation by a trained operator. Hand-controlled insertions of a pipette introduce the possibility of operator error and disturbance and resuspension of the cell pellet.

[0005] In some cases a density gradient fluid, such as Ficoll, is added to a starting fluid that is to be centrifuged, and upon centrifugation creates a defined band which separates layers of the starting fluid, and facilitates removal of a desired layer after centrifugation.

[0006] If a flexible centrifuge vessel is used, the supernatant can be pipetted, pumped or squeezed out of the vessel. The vessel's flexibility will cause it to compress or reduce in size as supernatant is removed. When the vessel compresses, cells in the cell pellet will move toward the exit opening, and some of the cells may be lost during removal of the supernatant.

[0007] The Baxter Plasma Extractor® is a commercially available press for squeezing plasma from a flexible blood bag. The blood bag is hung in the press between movable and stationary surfaces. The movable surface is released against the bag to squeeze out the liquid plasma. In normal operation, the press is allowed to close against a blood bag in which components have been separated. The press operator watches the material in the bag during the pressing operation. When the material to be retained in the bag visually moves up the bag to the exit, the operator closes a clamp on the exit tubing or grasps the movable press place handle to manually stop the flow of material. Although this process works well for the plasma extraction application, it may not be suitable for an application (such as processing cells for a therapy) where a maximum number of cells must be retained in the bag because there is a band of material where cells and supernatant are mixed together when the cell pellet is compressed and partially resuspended.

[0008] Presses for blood bags are also disclosed in the patent literature. For example, U.S. Pat. No. 4,663,032 to Loos et al., issued May 5, 1987, discloses a press for driving plasma and buffy coat out of a centrifuged blood bag while leaving the red blood cells in the bag. The press includes a stationary plate and upper and lower movable plates. An elastic cushion is bonded between the upper plate and the piston that moves the plate. The press also includes a horizontal clamping element that extends between the upper and lower plates. The clamping element is extended against a cushion in the stationary plate to cut off the red blood cells from the buffy coat and plasma, in order to retain the red blood cells in the bag when it is compressed by the upper plate to drive out the buffy coat and plasma.

[0009] U.S. Pat. No. 5,874,208 to Unger, issued Feb. 23, 1999, discloses an extractor for pressing out plasma and buffy coat from a collapsible blood container in which blood has been centrifuged. The extractor has a stationary support surface and a movable pressing member between which the blood container is suspended and pressed. The extractor has one or more inflatable cushions arranged on the support surface or the pressing member or both on the same level as the top section of the blood container, and a device for pulsating the pressure in the cushions. The pulsating pressure creates a suction that helps to completely remove the buffy coat from the container.

SUMMARY OF THE INVENTION

[0010] This invention relates to a press for removing supernatant from a flexible vessel, such as a flexible biological suspension process vessel. The press includes cooperating press members, such as press plates, having an open position to insert the vessel between them, and a closed position to compress the vessel between them. At least one of the press members has a compliant pad on its press surface. Either or both the press members can be made from a transparent material so the flow of material out of the vessel can be observed. As well, the compliant pad could be transparent. The compliant pad compensates for variable thickness of the vessel when it is compressed. As shown in the illustrated embodiment, the press is constructed to compress a lower portion of the vessel less than an upper portion of the vessel, for example by forming a space in a lower portion of the press. The compliant pad can be located on an upper portion but not on a lower portion of the press surface, with the space being formed below the pad. Alternatively, a recessed area can be included in the plate that does not have the compliant material attached, thus creating a clearance pocket for the lower portion of the vessel so that portion would be uncompressed. Preferably, the press additionally includes a barrier structure that creates a barrier between the lower portion of the vessel and the upper portion of the vessel when the vessel is compressed. The barrier structure can be useful, for example, to prevent cells from migrating from the lower portion of the vessel into the upper portion of the vessel during the pressing operation, for controlling generally where cells migrate during the pressing operation,

for preventing or controlling the loss of cells during the pressing operation, or to standardize or control the volume remaining in vessel.

[0011] The press can also include a vessel holder having a structure for adjusting the position of the vessel within the press. For instance, the vessel holder can be a vertically adjustable hanger or other positioning device to allow for adjusting where the barrier structure makes contact with the vessel. The press can also include a mechanism for adjusting the location of the compliant pad and/or the barrier structure.

[0012] The present invention reduces the labor, equipment and time needed to separate a desired portion of a biological material and eliminates the possibility of introducing contaminants into the material or exposing a laboratory operator to the contents during a transfer process. As well, processing of biological materials using the present invention is less dependent on operator technique to achieve repeatable results.

[0013] Various advantages of this invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiments, when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** is a perspective view of a press for removing supernatant from a flexible vessel according to the invention.

[0015] FIG. **2** is a side view of the press of FIG. **1**.

[0016] FIG. **3** is a top view of the press of FIG. **1**.

[0017] FIG. **4** is a perspective view showing a flexible biological suspension processing vessel after centrifugation, and ready to be placed into a press according to the invention.

[0018] FIG. **5** is a perspective view showing the flexible vessel of FIG. **4** having been compressed in the press to remove the fluid or supernatant from the upper portion of the vessel.

[0019] FIG. **6** is an enlarged side view of the lower portion of the flexible vessel of FIG. **5** before the press is completely closed, showing that a barrier line is created between the second or upper portion of the vessel and the first or lower portion of the vessel.

[0020] FIG. **7** is an enlarged side view of the lower portion of the flexible vessel of FIG. **5** after the press is completely closed, showing that the supernatant has been removed from the upper portion of the vessel, and that the lower portion of the vessel containing the cell pellet remains substantially uncompressed.

[0021] FIG. **8** is an enlarged side view of the lower portion of the flexible vessel of FIG. **5** before the press is completely closed, showing two compliant strips creating two barrier lines that define first, second and third portions of the vessel.

DETAILED DESCRIPTION OF THE INVENTION

[0022] The present invention relates to a press that has the capability of removing supernatant from a flexible vessel after a cell suspension has been centrifuged. The press features maximize the amount of cells retained in the bag without operator intervention.

[0023] The press includes cooperating press members having an open position to insert the flexible vessel between them, and a closed position to compress the vessel between them. Any suitable configuration and number of press members can be used. In the embodiment shown in FIGS. **1-3**, the press **10** includes two press plates **12** and **14** that come together to press supernatant out of a flexible bag placed between them. FIG. **1** shows the press plates in the open position, and FIG. **2** shows the press plates in both the open position (solid lines) and the closed position (broken lines).

[0024] The press plates can both be movable, or one of the press plates can be movable while the other is stationary. In the illustrated embodiment, the second press plate **14** is mounted on the base **16** of the press in stationary position, and the first press plate **12** is pivotally mounted on the base. The plates could be hinged, tracked or otherwise movable, and may close from bottom to top as shown in the illustrated embodiment, from top to bottom, or from side to side. Any suitable structure can be used for the basic pressing mechanism. The movable plate(s) can be moved by spring operation or other means known in the art.

[0025] The press plates can be made from any suitable material, such as plastic, metal or wood. Preferably, at least one of the press plates is transparent to allow viewing of the vessel during the pressing operation. In the embodiment shown, the first press plate **12** is made from a transparent plastic material, although both of the press plates may be transparent. The press and the press plates are constructed and sized to hold and press supernatant from a flexible vessel, preferably a vessel for processing a biological suspension or fluid. The press can be used with different sizes and types of vessel, and the plates can be shaped to match design features of the vessel.

[0026] At least one of the press members has a compliant pad on its press surface. In the illustrated embodiment, the second press plate **14** has a layer of a compliant pad **18** on its press surface. The pad's compliance automatically compensates for the variable thickness in the vessel that typically occurs at the seams along the edges. This compliance allows the press to completely flatten the main body of the flexible vessel, causing essentially all of the liquid to be discharged. If the compliant pad is not used, the variation in vessel thickness holds the press slightly open, which prevents removal of some of the liquid. Any suitable material can be used for making the compliant pad. Preferably, the compliant pad is made from a foam material, such as a closed cell silicone foam. Many other compliant materials such as open cell or closed cell polyurethane, polyethylene and PVC could also be used. Materials other than foam such as soft rubber or a gas or fluid filled bladder can also serve as the compliant material.

[0027] The press is constructed to compress the lower portion of the vessel less than the upper portion. Any suitable structure can be used for this purpose. In a preferred embodiment, the press in the closed position forms a space in the lower portion of the press so that the lower portion of the vessel is compressed less than the upper portion. The space can be formed in any suitable manner. Preferably, as shown in FIG. **2**, the space **20** is formed by locating the compliant pad **18** on the upper portion of the press surface

and not on the lower portion. A space **20** equal to the pad thickness exists between the two press plates below the pad's bottom edge. Alternative press configurations can also be used so the lower portion of the vessel is uncompressed. Foam of adequate thickness could be attached to the upper portion of both press surfaces, creating an uncompressed space for the lower portion of the vessel. A recessed area can also be included in the plate that does not have the compliant material attached, thus creating a clearance pocket for the lower portion of the vessel so that portion would be uncompressed.

[**0028**] Reference to upper and lower portions of the vessel or press or components thereof, is only for convenience and understanding in view of the illustrated embodiment. The press plates may be designed to operate from top to bottom or side to side, and the vessel positioned for the desired operation. Thus, "lower" and "upper" might equally be referred to as "first" and "second".

[**0029**] The purpose of this construction is so that the upper portion of the vessel is compressed as much as possible while the lower portion of the vessel is left relatively uncompressed. Preferably, the press in the closed position substantially completely compresses the upper portion of the vessel while leaving the lower portion of the vessel substantially uncompressed.

[**0030**] In a biological suspension process vessel that has been centrifuged, a pellet of cells forms at the bottom and the supernatant, which may be unwanted, is above the cell pellet or other higher density biological material. Reference to a "cell pellet" herein is illustrative of a higher density biological material, and is not intended to limit the application. Further, the reference to a "supernatant" is illustrative of any fluid of lower density to be removed from the flexible vessel. The supernatant referred to herein is removed material, wanted or unwanted by the user. To remove the supernatant as completely as possible, the upper portion of the vessel can be pressed completely flat. The lower portion of the vessel where the cell pellet is located can be left uncompressed as much as possible so the pellet remains undisturbed by the pressing operation. The space allows the vessel portion below the pad to balloon out and remain uncompressed so the cell pellet remains undisturbed. The design distance from the bottom of the pad to the bottom of the vessel depends on the size of the cell pellet, the desired retained volume, and the vessel's material stiffness. The volume can be controlled by design of the compliant pad **18** and the compliant strip **22** to squeeze the vessel earlier or later during compression, or by choice of the compliant strip and pad profiles (rectangular, curved or other shapes). Stiffer vessel materials will move together earlier during the pressing operation than more compliant materials, so it may be appropriate for the bottom of the compliant pad to be positioned further from the bottom of the vessel than for a more flexible vessel. Similarly for a vessel containing a relatively large cell pellet, the bottom of the compliant pad may be positioned further from the bottom of the vessel than for a vessel containing a small cell pellet. As described below, the height of the vessel within the press can be adjusted to achieve a similar effect.

[**0031**] During the pressing operation, it is preferable to seal off the lower portion of the vessel, where the cell pellet is located, from the upper portion of the vessel to prevent cell migration up the vessel and loss out the exit opening during the pressing operation. Consequently, a preferred press includes a barrier structure that creates a barrier between the lower portion of the vessel and the upper portion of the vessel when the vessel is compressed. This can be accomplished in any suitable manner. For example, the barrier structure can firmly squeeze the vessel between the upper and lower portions of the vessel. The barrier is created early in the pressing operation, before the majority of supernatant is pressed from the upper portion of the vessel.

[**0032**] Any suitable structure can be used for this purpose. In the illustrated embodiment, the barrier structure comprises a compliant strip **22** that is thicker than the compliant pad **18**, and that is located along the bottom edge of the pad. Optionally, the compliant strip could be tapered or rounded. The compliant strip can have any suitable thickness, for example about twice the thickness of the pad. The barrier structure could be on one plate while the compliant pad is on the other plate. During the pressing operation, the compliant strip **22** squeezes firmly against the vessel to create a line of pressure against the vessel that forms a barrier before all of the supernatant is discharged from the upper portion of the vessel. The thicker compliant strip will be compressed more than the compliant pad when the press is fully closed to provide a higher force against the vessel at the barrier line than exists over the upper portion of the vessel where the supernatant is located. The resulting higher squeeze on the vessel at the barrier line seals the vessel between the cells and the supernatant and prevents cell migration up the vessel and loss of cells. The use of the compliant strip **22** thus helps minimize the loss of cells, maximize supernatant removal and maximize cell viability by not disturbing the desired materials.

[**0033**] Another suitable barrier structure could be a portion of the compliant pad that is stiffer than the remaining portion of the pad. Another barrier structure could be a strip portion of the compliant pad, along the lower edge of the pad, that is thicker than the remaining portion of the pad. The strip portion of the pad could have any suitable shape, such as a wedge shape or rounded shape. Another suitable structure could be an inflatable bladder that inflates from the bottom up, which could function as both the compliant pad and the barrier structure.

[**0034**] In the illustrated embodiment, the bottom ends of the press plates **12** and **14** are mounted close to each other, so that during the pressing operation the barrier structure squeezes the vessel to form a barrier between the bottom of the vessel and the top before the top of the vessel is compressed. Any other suitable structure of the press plates could be used to achieve this.

[**0035**] Centrifuged suspensions frequently have different cell concentrations. Consequently, similar suspension volumes yield different sized cell pellets. A variant that could be added to the press is a structure for adjusting the height of the vessel within the press (not shown). For example, the height adjustment structure could be a vertically adjustable hanger or other positioning device at the top of the press. The vessel height could be adjusted so a specific distance is achieved between the top edge of the cell pellet and the bottom edge of the compliant pad. This adjustability will help minimize the amount of supernatant left in the bottom portion of the vessel below the barrier line and maximize the amount of supernatant removed from the vessel. The press

can also include a mechanism for adjusting the location of the compliant pad and/or the location of the barrier structure, to adjust for the vessel size or the pellet size. The press can further include a mechanism other than a hanger for adjusting the location of the vessel. By way of example and not limitation, alternative positioning devices (not shown) may include devices such as clips or clamps or straps; releasable adhesive surfaces; or Velcro surfaces, interlocking profiles or zippered closures on the vessel that combine with one of a plurality of mating profiles or zipper elements on an opposing surface and other adjustable positioning devices.

[0036] FIGS. **4-7** illustrate a pressing operation using the press of the invention. In FIG. **4**, a flexible biological suspension processing vessel **24** is shown after centrifugation. The vessel **24** contains supernatant **26** in the upper portion **28** of the vessel and a cell pellet **30** in the lower portion **32** of the vessel. The vessel is ready to be placed into an open press **10**. In FIG. **5**, the vessel **24** has been compressed in the press **10** to remove the supernatant from the upper portion **28** of the vessel. The lower portion **32** of the vessel containing the cell pellet **30**, which is located in the space **20**, is substantially uncompressed.

[0037] FIG. **6** shows the press just before it is completely closed. It is seen that the compliant strip **22** contacts the vessel **24** to create a barrier line **23** between the first or lower portion **32** of the vessel and the second or upper portion **28** of the vessel, before the supernatant **26** has been pressed out of the upper portion of the vessel. This ensures that the cell pellet **30** in the lower portion of the vessel does not leave with the supernatant.

[0038] It may be understood by reference to FIG. **6** that the compliant strip **22** could be shaped so as not to create a barrier line until a certain level of compression of the vessel is reached. As well, it may be designed to create a barrier line at the outset, as shown, at the end of the pressing step, or at some intermediate time during the pressing step.

[0039] FIG. **7** shows the press in a closed position with the supernatant removed. The lower portion **32** of the vessel is ballooned out in the space **20** and remains uncompressed so that the cell pellet **30** remains undisturbed.

[0040] As well, different density gradients of biological materials, not necessarily positioned at the bottom of the vessel, may be of interest. In a further embodiment of the present invention shown in FIG. **8**, two compliant strips **22** may be provided to define the first portion **32** between the second portion **28** and the third portion **33** and to isolate an intermediate density gradient **35** containing biological material in the first portion. Supernatant and higher density material that is not desired to remain in the vessel can be exhausted from above and below the intermediate density gradient **35** through exhaust ports on the ends or lateral exhaust ports on the sides of the vessel (not shown). Where fluid is to be pressed through an exhaust port the compliant pad **18** can be contoured to so direct the fluid as the press is closing. For example, where fluid is exhausted through a lateral exhaust port, the compliant pad **18** can be wedge shaped from side to side or otherwise contoured to encourage the liquid movement toward the lateral exhaust port. As may be understood, several portions of the vessel could be isolated in this way where more than one density gradient of the biological material is of interest. The compliant strips **22** may be of different heights and profiles (by way of example and not limitation, flat, pointed, rounded, wedge-shaped) as needed to compress the vessel and isolate the density gradient of interest. In this embodiment, adjustment of the vessel position or adjustment of the compliant strip positions may also help maximize the percentage capture of cells or other biological material of interest and minimize the volume in which they are captured. This approach to separation of biological material also renders the process less dependent on operator technique.

[0041] The press could be automated to achieve maximum efficiency of operation. The automated press could include sensors to detect conditions related to the pressing operation such as volume or location of the cell pellet or other biological material of interest, degree of compression, and completion of supernatant removal. The use of a transparent material for at least one of the press plates makes it possible for a sensor to detect the progress of the pressing operation. The sensor could cause an adjustment in the vessel hanging device or the compliant pad positioning device. A pressure sensor, a limit switch or a position switch could be used to determine when the pressing is complete. An optical sensor could be used to determine when all the supernatant has been removed from the upper portion of the vessel. The press could be rotated to allow supernatant to drain.

[0042] The present invention also relates to a method of using a closed process for removing supernatant from a flexible process vessel. The method involves the steps of: (1) providing a sterilized and sealed flexible vessel containing a biological fluid that has been centrifuged; (2) placing the vessel into a press for removing supernatant from the vessel, the press including cooperating press members having an open position to insert the vessel between them, and a closed position to compress the vessel between them, at least one of the press members having a compliant pad on its press surface, the compliant pad compensating for variable thickness of the vessel when it is compressed, and the press being constructed to compress a lower portion of the vessel less than an upper portion of the vessel; and (3) pressing the vessel to remove the supernatant from the vessel and transfer it aseptically to a container, the vessel and the container being connected in a closed system. For example, the container can be a waste container or other process container. In a preferred embodiment, the process includes the additional step, before step (1), of centrifuging the sterilized and sealed vessel.

[0043] Any suitable components can be used in the closed system in addition to the flexible vessel and the container, as long the components are sterilized and as long as they keep the system closed. For example, the components can include sterile connecting devices (SCD) such as SCD tubing and a SCD tubing welder to make connections asceptically between the vessel and the container. The vessel and the container can each have connections that are compatible with the SCD tubing.

[0044] Batch biological laboratory processes are often performed in a sterile biological safety cabinet to protect product sterility as various fluids, necessary to the process, are utilized and to protect the operator if the product is hazardous. The closed process of the invention allows biological processes to be performed in a non-sterile laboratory environment, thereby saving time and money.

[0045] In accordance with the provisions of the patent statutes, the principle and mode of operation of this inven-

tion have been explained and illustrated in its preferred embodiments. However, it must be understood that this invention may be practiced otherwise than as specifically explained and illustrated without departing from its spirit or scope.

What is claimed is:

1. A press for removing fluid from a flexible vessel, the press including cooperating press members having an open position to insert the vessel between them, and a closed position to compress the vessel between them, at least one of the press members having a compliant pad on its press surface, the compliant pad compensating for variable thickness of the vessel when it is compressed, and the press being constructed to compress a first portion of the vessel less than a second portion of the vessel.

2. A press according to claim 1 wherein the press in the closed position forms a space in a first portion of the press proximate to the first portion of the vessel so that the first portion of the vessel is compressed less than the second portion of the vessel.

3. A press according to claim 2 wherein the compliant pad is located on the second portion of the press surface and not on the first portion of the press surface, and defines the space in the first portion of the press.

4. A press according to claim 1 wherein the press additionally includes a barrier structure that creates a barrier between the first portion of the vessel and the second portion of the vessel as the vessel is compressed.

5. A press according to claim 1 wherein the press additionally includes a barrier structure that creates a barrier between the first portion of the vessel and the second portion of the vessel when the barrier is at least partially under compression.

6. A press according to claim 4 wherein the barrier structure seals the vessel between the second and first portions of the vessel.

7. A press according to claim 6 wherein the barrier structure comprises a compliant strip that is thicker than the compliant pad.

8. A press according to claim 6 wherein the barrier structure comprises a portion of the compliant pad that is stiffer than the remaining portion of the pad.

9. A press according to claim 1 wherein the compliant pad comprises a foam pad.

10. A press according to claim 7 wherein the compliant strip comprises a foam strip.

11. A press according to claim 1 wherein the press in the closed position substantially completely compresses the second portion of the vessel while leaving the first portion of the vessel substantially uncompressed.

12. A press according to claim 1 wherein the press members comprise a pair of press plates.

13. A press according to claim 12 wherein at least a portion of one or more of the press plates is transparent to allow viewing of the vessel during the pressing operation.

14. A press according to claim 12 wherein during the pressing operation the press plates come together first toward the edge of the vessel farthest from the second portion and come together last at an edge farthest from the first portion of the vessel.

15. A press according to claim 1 further comprising two barrier structures that each create a barrier line, and wherein the compliant pad defines a substantially uncompressed portion between the barrier lines, and at least one substantially compressed portion outside the portion between the barrier lines, when the press is in a closed position.

16. A press according to claim 12 wherein the press additionally includes a base, and wherein one of the press plates is mounted in stationary position on the base and the other of the press plates is pivotally mounted on the base.

17. A press according to claim 4 wherein the press additionally includes a mechanism for adjusting the location of at least one of the vessel, the barrier structure, and the compliant pad.

18. A press for removing supernatant from a flexible vessel, the press including cooperating press members having an open position to insert the vessel between them, and a closed position to compress the vessel between them, at least one of the press members having a compliant pad on its press surface, the compliant pad compensating for variable thickness of the vessel when it is compressed, the press being constructed to compress a first portion of the vessel less than a second portion of the vessel, and the press including a barrier structure that creates a barrier between the first and second portions of the vessel when the vessel is compressed.

19. A press for removing supernatant from a flexible vessel, the press including:

cooperating press members having an open position to insert the vessel between them, and a closed position to compress the vessel between them, at least one of the press members having a compliant pad on its press surface, the compliant pad compensating for variable thickness of the vessel when it is compressed, and the press being constructed to compress a first portion of the vessel less than a second portion of the vessel; and

a vessel holder having a structure for adjusting the height of the vessel within the press.

20. A press according to claim 19 wherein the vessel holder comprises a vertically adjustable hanger.

21. A method of removing a portion of biological material from a flexible process vessel comprising the steps of:

(1) providing a flexible process vessel containing fluid biological material at least partially separated by density;

(2) placing the vessel into a press for removing the material of a selected density gradient from the vessel, the press including cooperating press members having an open position to insert the vessel between them, and a closed position to compress the vessel between them, the press being constructed to compress a first portion of the vessel less than a second portion of the vessel; and

(3) pressing the vessel to remove the material of a selected density gradient from the vessel while retaining the remaining biological material in the vessel.

22. The method of claim 21

wherein at least one of the cooperating press members further includes a compliant pad on its press surface constructed to compress the first portion of the vessel less than the second portion, and at least one of the cooperating press members further includes a barrier structure constructed to define a barrier between the first and second portions of the vessel; and

wherein the method further includes the steps of adjusting the position of at least one of the vessel, the compliant pad and the barrier structure prior to the step of pressing to define the first and second portions.

23. The method of claim 21 wherein at least one of the cooperating press members further includes at least one compliant pad on its press surface constructed to compress a first portion of the vessel less than second and third portions of the vessel, and wherein at least two barrier structures are disposed on the cooperating press members to define the first portion of the vessel between the second and third portions of the vessel;

wherein the method further includes the step of pressing the vessel to remove the material of a selected density gradient from the second and third portions of the vessel while retaining the remaining biological material in the first portion of the vessel.

24. A press according to claim 21 wherein at least a portion of one or more of the press plates is transparent, and the step of pressing includes the step of monitoring the vessel through a transparent portion of a press plate during the pressing operation.

* * * * *