

[54] **PRESSURE HOPPER**

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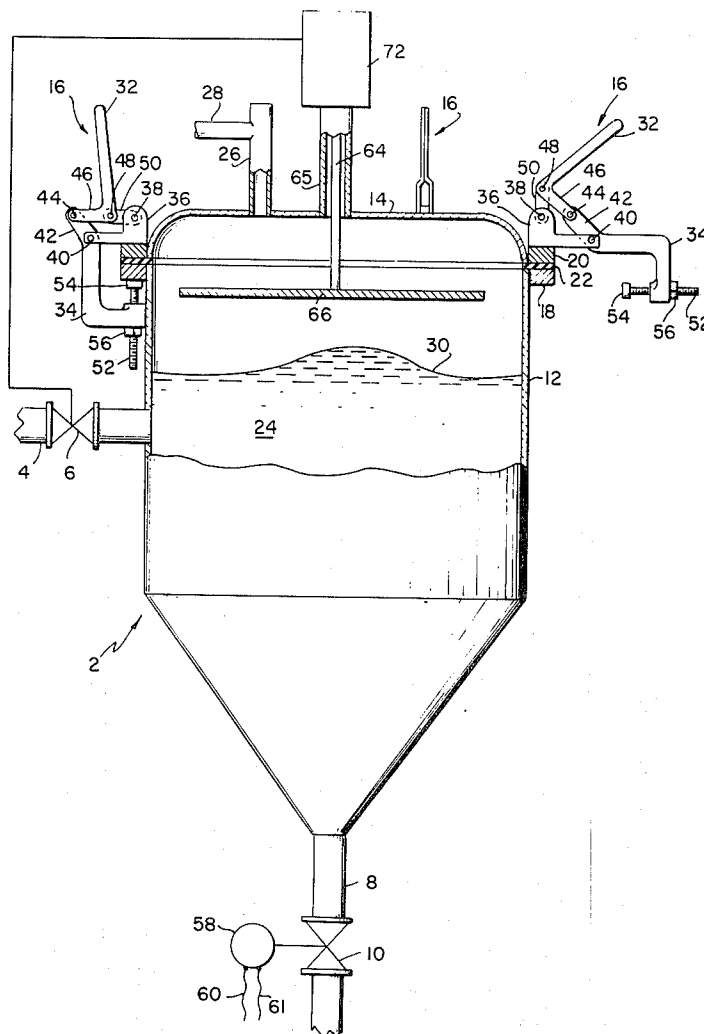
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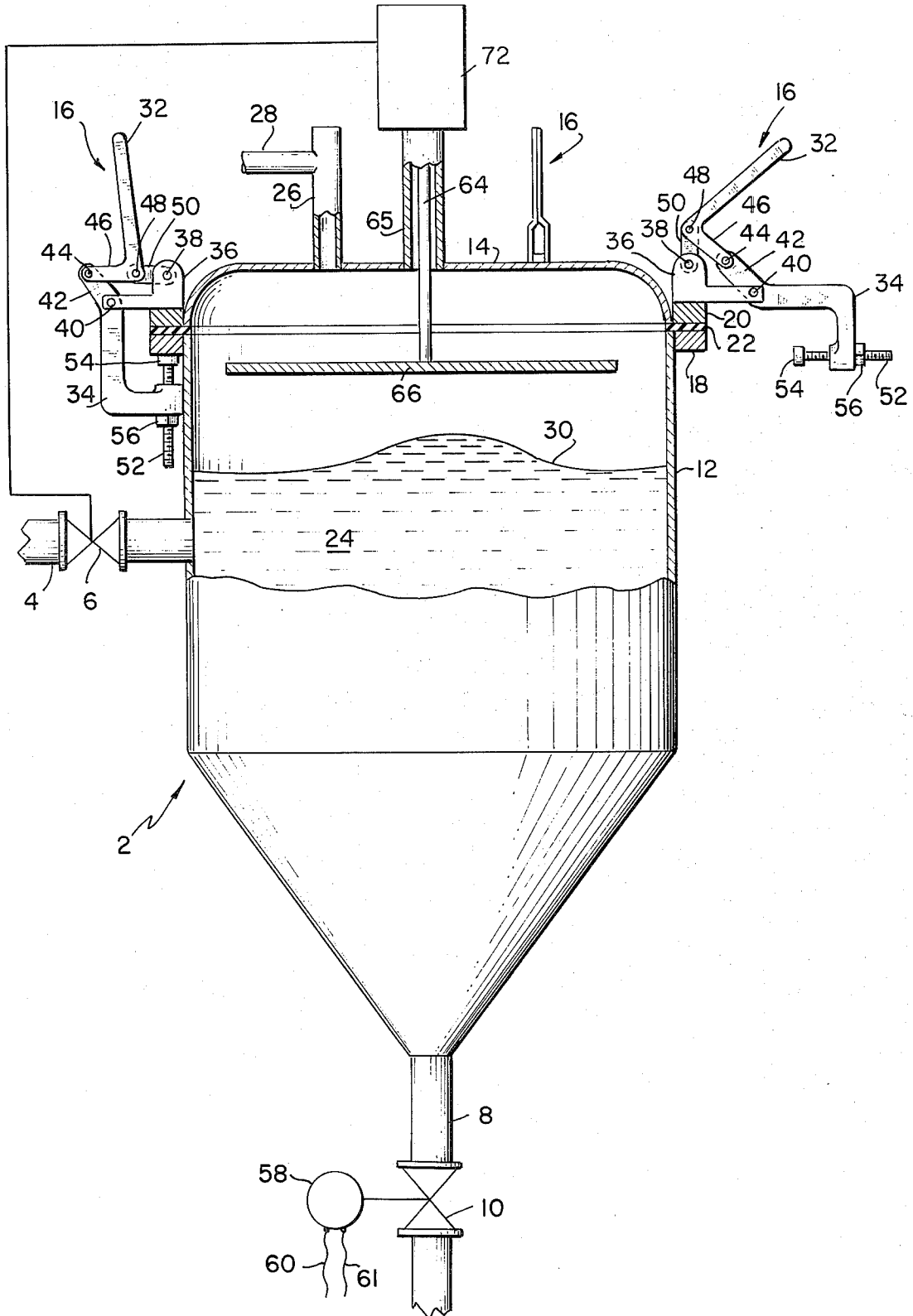
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ABSTRACT

A hopper for the handling of extremely viscous liquids or gels under pressure has a removable top cover fastened to a hollow cylindrical body with a multiplicity of quick action clamps of a locking toggle bolt type; and the movable operating handles of the clamps extend above the cover to which the clamps are welded. An optional but preferred feature for balancing the input and output of fluid material for the hopper is a capacitive sensing device in the form of a single condenser plate suspended above the surface of the fluid to maintain a predetermined fluid level by means of signals controlling an automatic valve that adjusts the input of fluid material to the hopper.

5 Claims, 1 Drawing Figure





PRESSURE HOPPER

BACKGROUND OF THE INVENTION

The present invention is an improved pressure hopper for the handling of fluids under pressure. It is particularly suited for use with fluids of high viscosity that are maintained under superatmospheric pressure.

PRIOR ART

A variety of covered tanks and enclosed vessels have been proposed or utilized for handling viscous liquids or syrups for many different purposes. Among the various types of devices for fastening their lids or closures, the two most common are probably individual pivoting dogs bearing on cam blocks on the cover, and lids that are rotated to engage interrupted flanges with corresponding slots in the body of the vessel, as exemplified by household pressure cookers.

Such apparatus leaves much to be desired from standpoints of safety and convenience, particularly when it is necessary to remove or to replace the closure. For example, the aforementioned fastening devices operate on the basis of frictional engagement and can be affected seriously by deposits of a spilled resinous fluid that is hardened or cured by exposure to air or heat with the result that the vessel is apparently properly sealed but not in actuality. Also, thermal expansion and contraction can change the frictional engagement considerably so that the dogs, etc., are loosened dangerously or tightened so much that they cannot be operated by hand. Another disadvantage is the fact that the necessity for rotating the entire cover in order to engage its flange in a slot limits the size or the width of the cover to what the particular operator is strong enough to handle. Hammering and other applications of force to such a closure are so that it can no longer provide a tight seal.

It is highly desirable to employ closures of a type that a quick visual inspection will enable the operator to determine with certainty whether the cover is securely fastened or merely lying on top of the opening in the vessel. That feature is lacking in the aforementioned fastening devices, because one must test each pivoting dog separately or try to rotate the entire lid in the case of slotted engagement.

As a result of wear of frictional engagement surfaces, the position of a rotating lid changes and the same is true of pivoting dogs. Moreover, dogs often must be tightened in several stages with an attendant loss of operating time; also heating and cooling of the apparatus aggravates the problem of obtaining a good seal and usually requires repeating the checking the tightness of the dogs, etc.

The difficulties and problems mentioned hereinbefore are eliminated, or at least greatly alleviated, by using the apparatus of the present invention. This novel pressure hopper is able to handle fluids of very high viscosity including not only liquids but any gels and other semisolid materials which can be pumped or forced through conduits under suitable pressure. The new pressure hopper is particularly suitable for handling the polysiloxane compositions of the type described the U.S. Pat. No. 3,077,465, especially when these silicone compositions are in a room temperature vulcanizable (RTV) state with the catalyst and all other ingredients incorporated therein. Such material may have a viscos-

ity ranging from as little as 12,000 to as much as 1,000,000 centipoises at 30°C.

Many liquid level control systems were known in the prior art, but they usually displayed a relatively low degree of effectiveness and reliability and often they were rather complicated or limited in application and not suitable for use with this highly viscous material.

The apparatus described herein is a pressure vessel provided with a number of novel and improved features including an arrangement of clamping devices of a certain type for rapidly locking and releasing a relatively large cover and also a simple and improved effective device for sensing the fluid level.

SUMMARY OF THE INVENTION

This invention relates to a pressure hopper for handling a highly viscous fluid with comprises a hollow body for holding said fluid, a removable top cover with a configuration adapted for a close fit with the rim of an aperture in the upper portion of said body, and a plurality of rapidly releasable, toggle joint clamps disposed around the periphery of said cover and said rim for quickly and strongly locking said cover to said rim by throwing the toggle joint of each said clamp beyond the neutral point and into the locking position thereof.

Other aspects of the invention relate to one or more of such preferred features as affixing the clamps to a flange, preferably the cover flange, the location of the clamp operating handles, and especially the incorporation of a simple and effective capacitive sensing means for controlling the level of fluid within the hopper, and the preferred embodiment thereof which employs a single flat plate suspended horizontally a short distance above the surface of the fluid in the hopper.

The objects, advantages and benefits of this invention will be apparent to those skilled in the art upon consideration of the detailed disclosure hereinafter.

DESCRIPTION OF THE DRAWING

The FIGURE is an elevation view, partly shown in section on a central vertical plane, of one embodiment of the apparatus of the invention; and certain elements of the apparatus are shown schematically.

DESCRIPTION OF SPECIFIC EMBODIMENTS

The principal objects and advantages of this invention are set forth hereinafter with or following the description of the structure of the illustrated embodiment; however, still other benefits of the invention will be apparent to those skilled in the art upon consideration of the detailed disclosure herein.

Turning now to the accompanying drawing, it illustrates one version of equipment which is particularly suitable for use with an organo-polysiloxane sealer composition of high viscosity of the type described in the aforesaid U.S. Pat. No. 3,077,465. The closed hopper 2 serves as a surge tank and input control device in receiving premixed RTV sealer material from the supply line 4 which is controlled by the automatic valve 6 and in delivering this composition through the discharge line 8 under the control of the automatic valve 10 to a loading machine (not shown) where the sealing material is loaded into small containers. Since the hopper preferably is located on top of a loading apparatus and supported thereby, it is important to keep the weight of the hopper 2 and its accessories as low as possible.

There are two main components of the hopper 2, a hollow body 12 for holding most or all of the fluid material that is being processed and a tightly fitting lid or top cover 14 which not only protects the contents against contamination by dust, atmospheric gases, etc. but also enables the hopper to be operated under any feasible pressure conditions. In general, moderately elevated superatmospheric pressures of, for example, about 10 to 50 pounds per square inch gage pressure (psig) are preferred for handling a viscous material and providing enough force to discharge the thick fluid through the line 8; however, the hopper is hermetically sealed and may be operated at any pressure from the lowest feasible subatmospheric pressure to as high a superatmospheric pressure as the equipment will safely stand.

The top closure 14 is sealed and securely fastened to the body shell 12 by clamping their peripheral surfaces with a plurality of the associated toggle bolt clamps which are described in detail hereinafter. The body 12 is provided with a strong and outwardly projecting circular flange 18 which is affixed to the top of the body shell by any suitable method including welding, casting, riveting, etc. The dished cover 14 has a similar strong projecting flange 20 around its lower edge. Usually, a circular gasket 22 of sponge rubber or another elastomeric material is employed between the adjacent surfaces of flanges 18 and 20 to insure that the vessel 2 is both gas-tight and liquid-tight when the clamps 16 are locked in the closed position. While the entire hopper may be constructed of any impermeable material of suitable strength and fabricating characteristics, metals are usually employed. To minimize corrosion of the body shell 12 by the fluid 24 therein as well as contamination of the contents by corrosion products, it is often desirable to construct the shell and its lid of stainless steel or other suitable corrosion-resistant materials. In addition, it is contemplated that the interior of the body 12 may have a thin tubular plastic film (not shown) disposed around the interior surface of shell 12 and supported by being clamped in place along with the gasket 22. Such a film might well be composed of a thin inert synthetic resin, such as polyethylene or another polyolefin or polytetrafluorethylene. Even though this film would tend to afford substantial protection against the corrosion of the interior of shell 12, its primary purpose would probably be to expedite the task of cleaning out the hopper by providing an easily removable liner that could be taken out of shell 12 along with the residue of viscous liquid clinging mainly on the inner wall of the liner. Such cleaning of the hopper may be a relatively frequent matter, if the composition or color of the fluid contents are changed often or it may be necessitated by routine maintenance or for the proper preservation of the equipment during idle periods of substantial length.

It is apparent that the configuration of the removable closure 14 must be adapted for a close fit with the rim or flange 18 at the open end or aperture at the top of the body shell 12 in order to provide a sealed joint suitable for operations under elevated pressures. As a matching or mating pair, the aperture and lid may be large or small and of various regular or irregular shapes. However, it is generally advantageous to employ a sufficiently large aperture to facilitate maintenance and cleaning operations as well as simple shapes such as apertures of rectangular and especially circular configurations for easy fabrication to facilitate main-

taining a tight joint and exerting a relative uniform clamping pressure around the entire periphery.

A pipe connection 26 projects from the top of cover 14 and leads to a branch line 28 connected to a suitable accumulator (not shown) or other source of a gas under pressure in order to fill the upper part of hopper 2 above the surface 30 of its fluid contents. While compressed air or other gaseous materials may be used in many cases, a dried inert gas, such as, nitrogen or carbon dioxide, is usually necessary in the case of a one-package RTV silicone sealant to insure that the moisture vapor present in air and certain other gases does not initiate premature curing of this resinous composition. Also, the lid 14 may be provided with a rupture disc (not shown) as a precaution against explosions resulting from excessive pressures.

It is also generally desirable to have a body aperture and covering lid that either extend across the full horizontal cross section of the apparatus as in the accompanying drawing or to have that aperture located in a smaller body section projecting above the main body section or that other means be employed to provide for peripheral flanges projecting outward for use with the clamps.

The toggle joint clamps 16 are of a conventional type, and hence not novel per se. However, the particular type illustrated in the accompanying drawing is uniquely suited for use in securing the lid of a pressure hopper for highly viscous materials having viscosities in the range of about 12,000 to 1,000,000 centipoises, such as gels, sols, syrups as exemplified by resinous materials that are difficult to handle and/or must be kept out of contact with air or certain other gaseous substances.

Although toggle joint clamps are a very safe type, they are desirably employed in multiple in order to provide a relatively uniform clamping force around the periphery of the flanges. This also provides a safety factor even though toggle joint clamps are generally not subject to failure or to disengagement from the locked position unless the operating handle is moved deliberately, for a substantial number of clamps of suitable size can provide an adequate safety factor in the event of the failure or breakage of one or several of these clamps.

The toggle bolt clamp at the left side of the accompanying drawing is shown in the engaged or locked position with its operating handle 32 moved in as far as possible towards the flange 20, thereby throwing the toggle joint past its neutral point and locking clamp. A disengaged or open clamp 16 is shown on the right side of the figure with its handle 32 swung outward about 50° to unlock and this pivots the movable clamp jaw 34 through an arc of 90°.

Each of the clamps 16 has a fixed jaw 36 in the form of a hollow bracket (i.e., V-shaped in cross section) which is welded or otherwise affixed to the upper clamping flange 20. Thus, the bracket 36 is fixed in position relative to the lid or cover 14, and the bracket supports two fixed pivot pins 38 and 40 across the space between the two ears (front and rear) of the bracket; consequently, pivots 38 and 40 are also fixed in position relative to lid 14. The lower clamping jaw 34 is a double lever shaped generally like an L with its integral upper arm 42 bent outwardly at the point of its pivotal mounting between the ears of bracket 36 on the fixed pivot pin 40. Jaw 34 is also pivotally connected at the end of its bent upper section 42 by means of the

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movable pivot pin 44 to the short horizontal leg 46 which is an integral part of the operating handle 32. It will be noted that the operating lever 32 has an angular configuration that is slightly more acute than a right angle (e.g., about 75°, and it has a second movable pivot connection near its vertex by means of another movable pivot pin 48 coupling the handle to a straight link 50. Link 50 is also pivotally connected between the ears of bracket 36 to the fixed pivot pin 38 to complete the toggle joint structure.

The lower clamp jaw is provided with an adjustment which enables the operator to adjust the spacing between the actual clamping members and the pressure exerted by the clamp. The inner end of jaw 34 has a tapped hole for threadably engaging a bolt 52 of suitable strength and diameter which is equipped with a head 54. The upper surface of the head of that bolt is the actual clamping surface engaging the lower flange 18 which is affixed to body shell 12. In addition, an ordinary nut 56 is provided as a lock nut for engagement with the lower surface of the clamp arm 34 in order to fasten the bolt 52 against the rotation of its thread after it has been adjusted for the proper spacing and the clamping pressure.

For operating the clamp, it is only necessary to move the operating handle 12 of a locked clamp outward through an angle of about 50° to swing the movable jaw 34 outward about 90° in opening the clamp to the position shown by the clamp at the right side of the drawing. To close and lock the clamp in the engaged position shown at the left side of the illustration, it is only necessary to reverse the operation by pushing the operating handle 32 in as far as it will go toward the lid 14. Thus, each of the clamps may be opened or closed very quickly. Moreover, the large multiplication of force exerted by pushing a toggle joint past its neutral point is a matter of common knowledge, and a very strong clamping force is obtained with very little effort required from the operator, even when a relatively short operating handle 32 is employed. Such easy operation is an important advantage because strong clamping forces are necessary for fastening large covers on pressure hoppers operating only at moderately elevated pressures, for the total force exerted on the lid by internal gas pressure may range from about 5,000 to 30,000 lbs. or more.

Toggle joint clamps are also uniquely adapted for the present device by reason of their locking action which is an additional safety factor. The spacing of the clamps is best determined by the total clamping force involved and the ultimate strength of the clamps employed. For example, the clamps may be spaced at about 2 inches intervals in some installation or over 2 feet in others. Another important safety factor of the present device is the fact that the operator can immediately see by casual visual observation whether or not a toggle joint clamp is properly fastened in contrast with the sometimes deceptive appearance of pivoting dog types of clamps. Moreover, this visual inspection can be accomplished at a single glance from above when the operating handles are above the cover as in the accompanying drawing. Thus, although the clamps may be reversed and the fixed jaw or bracket 36 welded instead to the lower clamping flange 18 for greater convenience in reaching the operating handle 32 on a tall hopper as the handle which would then extend below the clamping flanges, a somewhat more careful visual inspection may be necessary.

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An optional but highly desirable feature of the apparatus is a simple and effective capacitive sensor for maintaining the level of fluid contents inside the hopper within a predetermined and usually relatively small range. Such control is important in the case of the RTV silicone sealing materials in order to balance the fluid input to the hopper through the supply line 4 with the transfer of materials through discharge line 8 to a loading machine. This outflow of material for loading is regulated by the automatic valve 10 which is actuated by a conventional control device 58 in response to signals received from the loading device through the electrical leads 60 and 61. Accurate control of the level of the surface 30 of the fluid is important in an embodiment involving RTV silicone sealants because large changes in the volume of the vapor space above surface 30 in hopper 2 may be conducive to the introduction of objectionable air into the product if too low or contaminate the sensing plate if allowed to contact it. Also, such changes in volume may result in considerable variations in pressure from the desired level of 20 psig and affect the uniform feeding of the fluid through the discharge line 8. Because of fluid thickness, the surface 30 is somewhat domed, as shown.

Improved control of the fluid level, for example, holding it within about two inches or less of the desired height is obtainable with single plate capacitor sensor 66 constructed of metal and suspended from the top cover 14 by the insulated support electrode 64. The plate 66 has a diameter of about 80 percent of that of the diameter of shell 12. Maintaining the fluid level within such a narrow range is accomplished through signals carried by the insulated support electrode 64 through a gas-tight stuffing box (not shown) at the top of the pipe 65 and thence to the control device 72 which is provided with a capacitive proximity sensor circuit and which operates motor driven valve 6. This regulation of the automatic valve 6 tends to restore the level 30 of the fluid to the desired height or distance below plate 66 by increasing or decreasing the flow of fluid through automatic valve 6 to correspond with the flow rate out through discharge line 8.

While the foregoing description is concerned mainly with a single embodiment of apparatus according to the present invention, it will be apparent to those skilled in the art that many other embodiments and modifications thereof are within the purview of this invention. Accordingly, this invention should not be construed as restricted in any particulars except as may be recited in the appended claims of required by the prior art.

I claim:

1. A pressure hopper for handling a highly viscous fluid which comprises a hollow body for holding said fluid, a removable top cover with a configuration adapted for a close fit with the rim of an aperture in the upper portion of said body wherein the peripheral edges of said cover and said rim are provided with strong flanges, a sealing gasket located between said cover and said rim, a plurality of rapidly releasable toggle joint clamps disposed around the peripheries of said cover and said rim for quickly and strongly locking said cover to said rim by throwing the toggle joint of each said clamp beyond the neutral point and into the locking position thereof by movement of an operating handle of each said clamp into a substantially erect position extending substantially above said rim and said cover, said clamps being affixed to one of said flanges with a movable operating handle of each said clamp in

the locking position extending above said flanges, and a capacitive sensing means for controlling the flow of said fluid into said hopper to maintain the level of said fluid inside said hopper within a predetermined range, said sensing means comprising the pool of said fluid in said body and a substantially flat plate of electrically conductive material suspended substantially horizontally inside said hopper from said cover and located adjacent to and above the surface of said fluid and electric means for sensing a capacitive charge between said plate and said pool.

2. A hopper according to claim 1 in which each said clamp is provided with individual adjustment means for adjusting the clamping force exerted by the clamp in the locking position.

3. A hopper according to claim 2 in which each said clamp is provided with means for fastening said adjustment means to maintain a predetermined clamping force.

4. A hopper according to claim 3 in which said adjustment means and said fastening means are equipped with screw threads.

5. A pressure hopper for handling a highly viscous fluid which comprises a hollow body for holding said fluid, a removable top cover with a configuration adapted for a close fit with the rim of an aperture in the upper portion of said body, a sealing gasket located be-

tween said cover and said rim, a plurality of rapidly releasable toggle joint clamps disposed around the peripheries of said cover and said rim for quickly and strongly locking said cover to said rim by throwing the toggle joint of each said clamp beyond the neutral point and into the locking position thereof by the movement of an operating handle of each said clamp into a substantially erect position extending substantially above said rim and said cover, threaded adjustment means on each said clamp for individually adjusting the clamping force exerted in the locking position, threaded fastening means for fastening said adjustment means to maintain a predetermined clamping force; capacitive sensing means for controlling a valve for regulating the flow of said fluid into said body to maintain a relatively constant level of said fluid therein within a predetermined range, said sensing means comprising the pool of said fluid in said body and a substantially flat plate of electrically conductive material suspended substantially horizontally inside the hopper from said cover and located adjacent to and above the surface of said fluid and electric means for sensing a capacitive charge between said plate and said pool, and an inlet connection in said body for introducing a supply of said fluid into the interior of said body at a level below said plate.

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