

[54] **AUTOMATIC DUMP SYSTEM FOR CONTAMINANTS COLLECTED IN A SLURRY PROCESSING SUMP**

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[57] **ABSTRACT**

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 [51] Int. Cl. ....**B03b 3/34**  
 [58] Field of Search.....209/454-456, 495, 209/17, 158-161, 496; 210/20, 189; 137/546

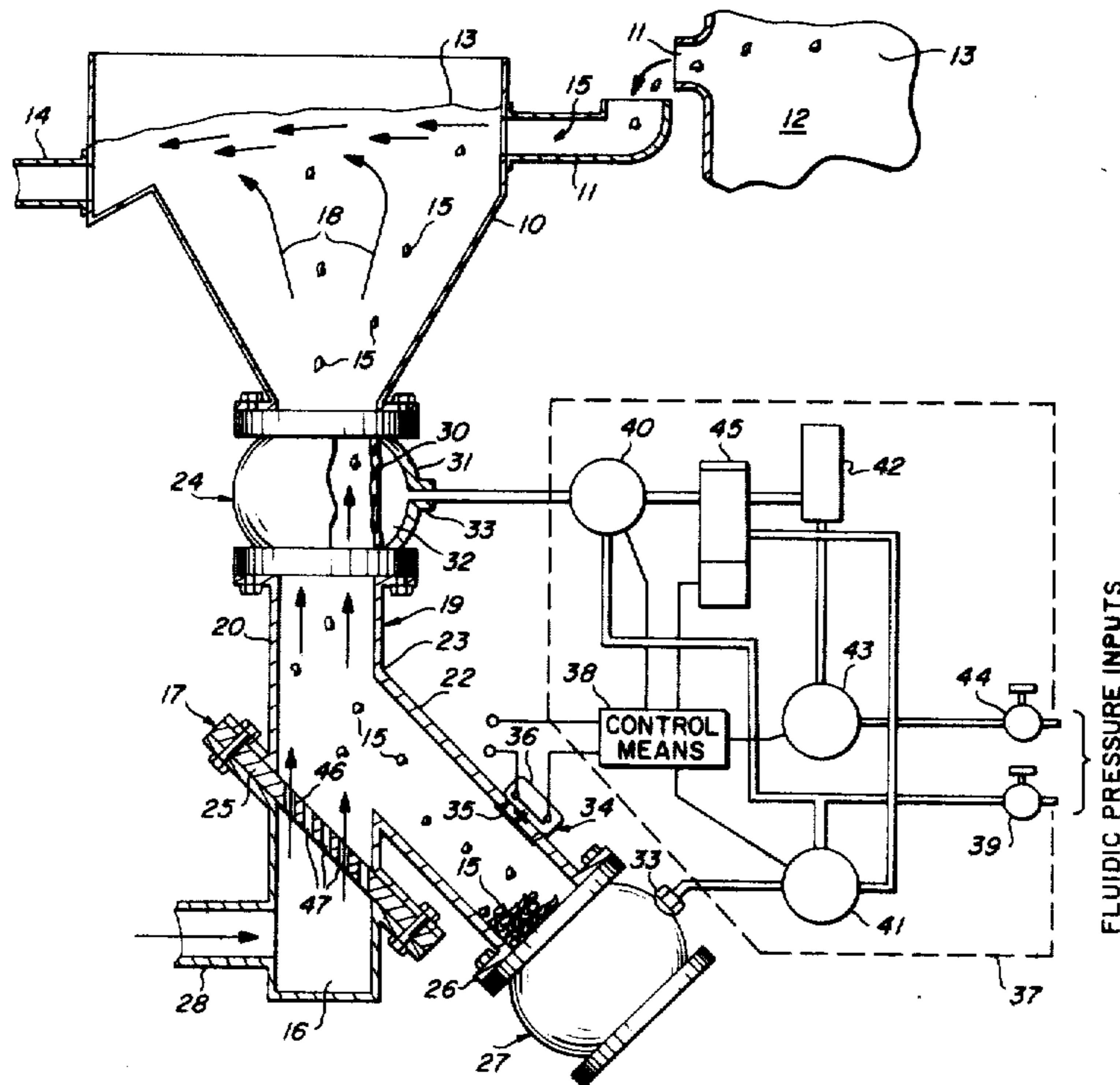
An automatic dump system for use with a slurry processing sump is disclosed. It has a flushing chamber and a collection chamber attached to the lower end of the sump. A flushing fluid is supplied to the flushing chamber to deflect relatively heavy contaminating materials into the collection chamber, and provide resistance to settlement of relatively light slurry materials. Both the flushing chamber and the collection chamber have valves which are controlled by an actuation means to periodically discharge collected contaminating materials without interrupting sump operation.

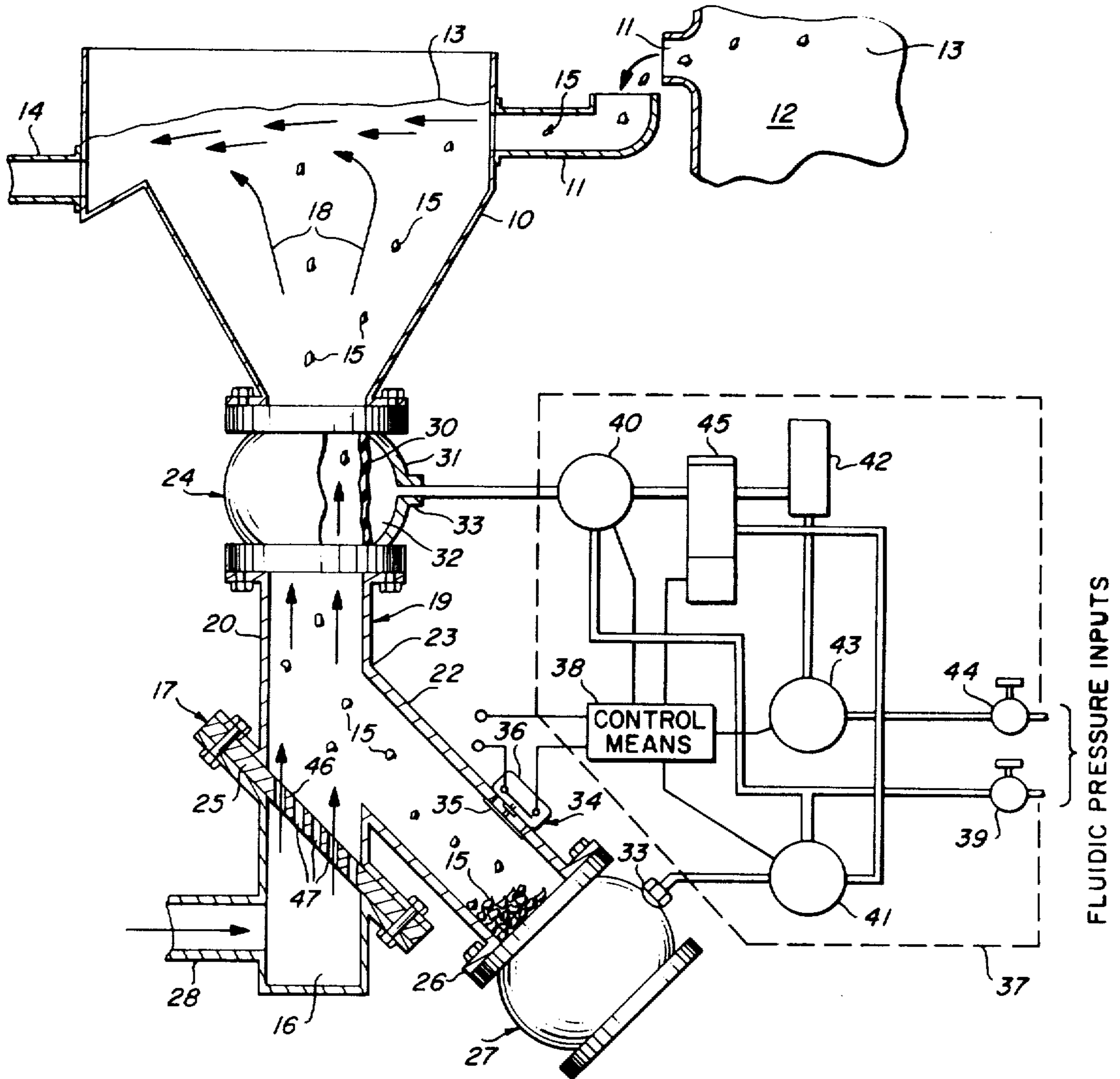
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**9 Claims, 2 Drawing Figures**





FLUIDIC PRESSURE INPUTS

FIG. 1

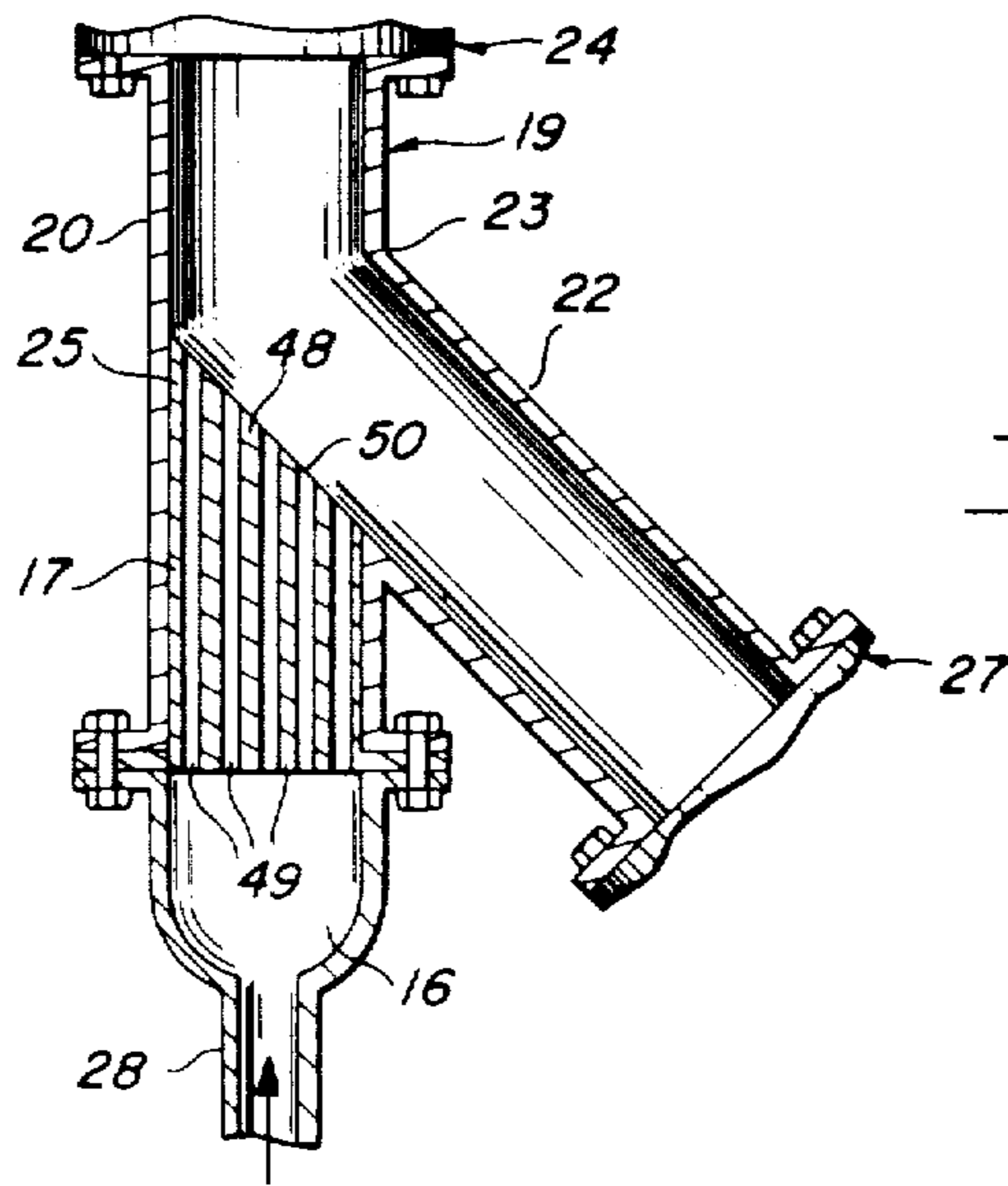


FIG. 2

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## AUTOMATIC DUMP SYSTEM FOR CONTAMINANTS COLLECTED IN A SLURRY PROCESSING SUMP

### BACKGROUND OF THE INVENTION

This invention relates to the art of ore refining.

More particularly, the invention concerns a slurry processing sump used in ore refining.

In a further aspect, the invention concerns a slurry processing sump having an automatic dump system attached thereto.

In still a further aspect, the invention concerns a mechanism which enhances slurry processing sump operation by providing resistance to undesired ore settling within the sump, and provides automatic discharge of collected contaminating materials without interfering with sump operation.

The normal ore refining methods in general use today provide a device to crush the mined ore, which is then fed into a grinding mill and mixed with water and pulverized by tumbling action. The grinding mill is generally a ball mill or rod mill; that is, hard steel rods or balls are tumbled to pulverize the ore. The mixture of water and pulverized ore, called slurry, is then fed through a sump which passes the slurry on to further refining processes, while permitting any relatively heavy contaminating materials carried in the slurry to settle out. The sump is a necessary part of the pulverizing system as the tumbling action within the grinding mill causes wear on the rods or balls, and the worn out rods or balls, called chips, are carried in the slurry. If the chips are allowed to remain in the slurry, they ruin the pumps used to carry the slurry to further refining processes.

The slurry processing sumps in prior art systems which have provisions for chip removal are provided with valves which must be operated intermittently to close down the chip removal process for emptying of chips; and, in some cases, collection chambers are provided which must be periodically emptied. In such cases, manual labor must be provided to assist in the cleaning process. Since the ore grinding process is continuous in nature, there is always the danger that, even where a prior art chip removal system has been installed, chips will be carried through to the pump during cleaning of the chip removal system.

It would be highly advantageous, therefore, to provide an automatic dump system for a slurry processing sump which resists the undesirable settling of ore and automatically empties the contaminating materials from the sump without interrupting the ore refining process.

### SUMMARY OF THE INVENTION

It is the primary object of the present invention, therefore, to provide an improved slurry processing sump.

Another object of the present invention is to provide a slurry processing sump which is adapted to resist undesired settling of ore.

A further object of the present invention is to provide a slurry processing sump having a system for emptying contaminating materials collected within the sump without interrupting the operation thereof.

Yet a further object of the present invention is to provide a slurry processing sump having a completely

automatic mechanism for emptying contaminants therefrom.

Briefly, to accomplish the desired objectives of this invention, there is provided a flushing chamber attached to the bottom of the usual sump. A collection chamber is provided which angularly intersects the flushing chamber. A normally closed valve is located at the discharge end of the collection chamber, and a normally open valve is provided in the flushing chamber. A flushing fluid is fed into the bottom of the flushing chamber and is directed through a dispersion grid where it deflects contaminating materials into the collection chamber. The flushing fluid is directed upwardly from the dispersion grid through the normally open valve and into the sump where it creates an upwardly directed current to resist ore settling. The upwardly directed flow of flushing fluid will converge upon the slurry flow thus creating an upward force tending to keep the ore from settling. A sensing means is provided in the collection chamber, so that when the chamber needs emptying, a timing means is triggered to start operation of an actuation means which cycles the valves to empty the collection chamber, and recycles the valves upon completion of this operation.

### BRIEF DESCRIPTION OF THE DRAWING

Further and more specific objects and advantages of the present invention will become readily apparent to those skilled in the art from the following detailed description thereof taken in conjunction with the drawing, in which:

FIG. 1 is a schematic illustration of a slurry processing sump showing the features of the automatic dump and ore settling resistance mechanism of the present invention;

FIG. 2 is a partial schematic view, showing a modification of the automatic dump and ore settling resistance mechanism of the present invention.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the drawings, in which the same reference numerals indicate corresponding elements throughout the various figures, FIG. 1 illustrates, in partially schematic form, a presently preferred embodiment of the invention chosen for purposes of illustration, and shows a sump 10 connected to a discharge port 11 of a grinding mill 12. It will be understood by those skilled in the art that the various outlines and hardware shapes illustrated are not intended to be representative of specific field hardware but only to show schematically the point within the system disclosed which concerns the present invention. The grinding mill 12 may be a ball mill, rod mill, wet autogeneous mill, or any similar device used to pulverize ore. The grinding mill 12 is normally a tumbler mechanism containing, for example, hard steel balls of between 1 and 3 inches in diameter. A liquid slurry 13 of crushed ore and water is passed from mill 12 through port 11 and into the upper portion of sump 10 at a velocity which carries most of the crushed ore across the sump 10 towards a discharge opening 14. The slurry 13 after entering discharge opening 14 is delivered by a pump (not shown) to other refining machinery as is normal in the ore refining industry.



The grinding process results in wear on the steel balls, and when they become small enough to pass out of the mill 12 with the slurry 13 they are called chips 15. The purpose of the sump 10 is to allow the chips 15 and any other foreign material, which is heavier than the crushed ore, to settle out of the slurry 13. To provide continuous operation and substantially reduce undesired ore settling within the sump, there is provided an automatic dump mechanism which eliminates periodic shutdowns to empty the sump. The automatic dump employs a flushing fluid 16 which is fed upwardly through a dispersion means 17 into sump 10 and results in a flow which converges with slurry flow as shown by arrows 18. The current flow and such fluid action creates upwardly directed forces which resist undesired ore settling. A contaminants receptacle 19 is provided which comprises a vertical flushing chamber 20, the top end of which is connected to the bottom of the sump 10, and an angularly downwardly disposed collection chamber 22 which intersects flushing chamber 20 at points 23, intermediate the ends of flushing chamber 20. The flushing chamber 20 is provided with a normally open valve means 24 positioned between the top end of flushing chamber 20 and intersection point 23. The dispersing means 17 comprises an angularly downwardly disposed dispersion grid 25 located below point 23. The collection chamber 22 is provided at its discharge end 26 with a normally closed valve means 27. The flushing fluid 16, of controlled quantity and pressure, is supplied through an inlet port 28 in the bottom end of flushing chamber 20, and passes upwardly through grid 25 and valve 24 into the sump 10. The fluid 16 is utilized within flushing chamber 20 to divert the chips 15, as they approach grid 25, into the collection chamber 22 where they settle on the normally closed valve 27.

The valves 24 and 27 may take the form of butterfly valves, pinch valves, or the like, and in the preferred embodiment will be illustrated and described as double-acting pinch valves. Pinch valves are fluid controlled devices which are generally constructed with an internal bellows-type sleeve 30 of deformable material. Bellows sleeve 30 is open at the top and bottom to permit flow of material therethrough, and is suitably attached to valve housing 31 so as to form an annular actuation chamber 32. Applying fluid pressure to actuation chamber 32 through a port 33 forces bellows sleeve 30 to close in a pinch motion, and relieving fluid pressure or positive evacuation of actuation chamber 32 will open the bellows sleeve 30.

A timing 15 (not shown) may be employed to periodically cycle the valves 24 and 27 to discharge the accumulation of chips 15, or a suitable sensing means 34 may be provided to determine when the accumulation of chips is has reached the point that they require removal. The sensing means 34 may take the form of a simple weight detector, pressure actuated switch, or the like. For the purposes of a complete disclosure, the sensing means is illustrated as a sealed diaphragm 35, suitably positioned in the side wall of collection chamber 22. Adjacent to diaphragm 35 is a switch 36 positioned so that when the accumulation of chips 15 deflects diaphragm 35, the switch 36 will apply suitable voltage to an actuation means 37 which controls the cycling of valves 24 and 27.

The actuation means 37 may take many forms. The system illustrated is particularly suited for control of pinch-type valves. When the sensing means 34 is actuated as hereinbefore disclosed, suitable voltage is applied to a control means 38 which properly sequences the actuation means 37. The actuation means comprises a fluidic system for sequentially applying pressure or vacuum to valves 24 and 27. Fluid pressure is supplied to the system from an external source (not shown) through regulator-gage 39 and is directed to solenoid valves 40 and 41. Solenoid valves 40 and 41 are two-position devices utilized in this embodiment to selectively apply either pressure or vacuum to their respective valves 24 and 27. Vacuum is provided within the system by an aspirator 42 supplied from an external source (not shown) through on-off solenoid valve 43 and regulator-gage 44. Switching of vacuum between valves 40 and 41 is accomplished by aspirator solenoid 45.

To discharge an accumulation of chips 15, solenoid valve 40 is switched from its vacuum position to its pressure position, thus closing valve 24. After valve 24 is fully closed, solenoid 43 is opened to operate aspirator 42. Solenoid 45 is switched to apply vacuum to solenoid 41, which is switched to its vacuum position to apply the vacuum to valve 27, causing it to open. After the chips 15 have been discharged, the solenoid 41 is switched to its pressure position to close valve 27. Simultaneously solenoid 43 is closed to stop aspirator 42. After full closure of valve 27, solenoid 40 is switched to its vacuum position, solenoid 43 is opened to start aspirator 42, and solenoid 45 is switched to apply vacuum through solenoid 40 to open valve 24. After full opening of valve 24, solenoids 43 and 45 are operated to trap a vacuum in valve 24 to positively hold it open.

The dispersion grid 25, as shown in FIG. 1, is an angularly disposed plate 46, having a matrix of apertures 47 formed therethrough to disperse flushing fluid 16 uniformly upwardly in flushing chamber 20. The lower end of the flushing chamber 20 may be constructed as illustrated in FIG. 2, which shows grid 25 as a plug member 48 co-axial with the chamber 20, and having an array of apertures 49 formed therein, with the top surface 50 angularly formed to coincide with the angle of collection chamber 22.

Various changes in the device herein chosen for purposes of illustration in the drawings will readily occur to persons skilled in the art having regard for the disclosure hereof. To the extent that such modifications and variations do not depart from the spirit of the invention, they are intended to be included within the scope thereof which is not limited to the device or method specifically illustrated but rather only by a fair interpretation of the following claims.

Having fully described the invention in such manner as to enable those skilled in the art to understand and practice the same, I claim:

1. A dump system for discharging contaminants collected by a slurry processing sump, said dump system comprising:

- a. a flushing chamber attached to the bottom of said sump, said flushing chamber having a fluid intake end;



- b. a collection chamber adjacent said flushing chamber, said collection chamber having a discharge end and having an inlet end connected to said flushing chamber;
  - c. a dispersion means disposed in said flushing chamber intermediate of said fluid intake end of said flushing chamber and said collection chamber inlet end;
  - d. means for introducing a flushing fluid to said fluid intake end of said flushing chamber and directing said flushing fluid through said dispersion means to deflect the contaminants into said collection chamber and for keeping the relatively lighter slurry materials from settling;
  - e. a normally closed valve means at said discharge end of said collection chamber for controlling flow of said flushing fluid and said contaminants there through; and
  - f. a normally open valve means in said flushing chamber above said collection chamber inlet end.
2. The dump system of claim 1 including actuation means connected to both of said valve means and constructed and arranged to operate both of said valve means in such manner that flow from said flushing chamber to the sump is stopped and flow out said discharge end of said collection chamber is started, said actuation means including control means constructed and arranged to open and close said normally closed valve means and to open and close said normally open valve means.
3. An automatic dump system for discharging contaminants collected by a slurry processing sump as claimed in claim 2 wherein each of said normally open and normally closed valve means comprises:
- a. a housing
  - b. a bellows sleeve within said housing, said sleeve being formed of deformable material and adapted to provide an annular actuation chamber between said sleeve and said housing; and
  - c. a port formed in said housing for either applying fluidic pressure to said actuation chamber to pinch said sleeve closed or applying a vacuum to said actuation chamber to open said sleeve.
4. An automatic dump system for discharging contaminants collected by a slurry processing sump as claimed in claim 1, said system further comprising sensing means mounted on said collection chamber for providing a signal to said actuation means when the contaminants collected within said collection chamber need to be discharged.
5. An automatic dump system for discharging contaminants collected by a slurry processing sump as

- claimed in claim 1, said system further comprising a timing device connected to said actuation means to periodically cycle said system to discharge the contaminants collected within said system.
6. An automatic dump system for discharging contaminants collected by a slurry processing sump as claimed in claim 1 wherein said dispersion means comprises an angularly disposed plate having an array of apertures formed therein.
7. An automatic dump system for discharging contaminants collected by a slurry processing sump as claimed in claim 1 wherein said dispersion means comprises a plug formed co-axially with said flushing chamber, said plug having a plurality of apertures formed therein.
8. An automatic dump system for discharging contaminants collected by a slurry processing sump as claimed in claim 1, wherein said actuation means comprises:
- a. a control means coupled to said actuation means for proper sequencing thereof;
  - b. a source of fluidic pressure coupled to said actuation means;
  - c. an aspirator controlled by said control means for providing a vacuum within said actuation means; and
  - d. a plurality of solenoid valves coupled to said source of pressure and said aspirator, said solenoid valves also being coupled to the automatic dump system to selectively apply either vacuum or pressure to the dump system, said solenoid valves being controlled by said control means.
9. An automatic dump system for discharging contaminants by a slurry processing sump as claimed in claim 1, wherein said actuation means comprises:
- a. a control means coupled to said actuation means for sequencing thereof;
  - b. a source of fluid pressure coupled to said actuation means;
  - c. a selectively operable aspirator for providing a vacuum within said actuation means;
  - d. a first solenoid valve coupled to said normally open valve means, said first solenoid valve adapted to selectively apply either pressure or vacuum to said normally open valve means under control of said control means; and
  - e. a second solenoid valve coupled to said normally closed valve means, said second solenoid valve adapted to selectively apply either pressure or vacuum to said normally closed valve means under control of said control means.

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