United States Patent

Higgins

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

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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

[56] **References Cited**

UNITED STATES PATENTS

1,647,310	11/1927	Richardson	209/454
3,280,975	10/1966	Evans	209/454 X
1,047,106	12/1912	Neall	209/158
1,686,435	10/1928	Chance	209/496
1,895,504	1/1933	Wuensch	209/161 X
2,074,977	3/1937	Bird et al.	209/495
2,442,522	6/1948	Wiegand	209/159
3,255,883	6/1966	Nelson et al.	209/273 X

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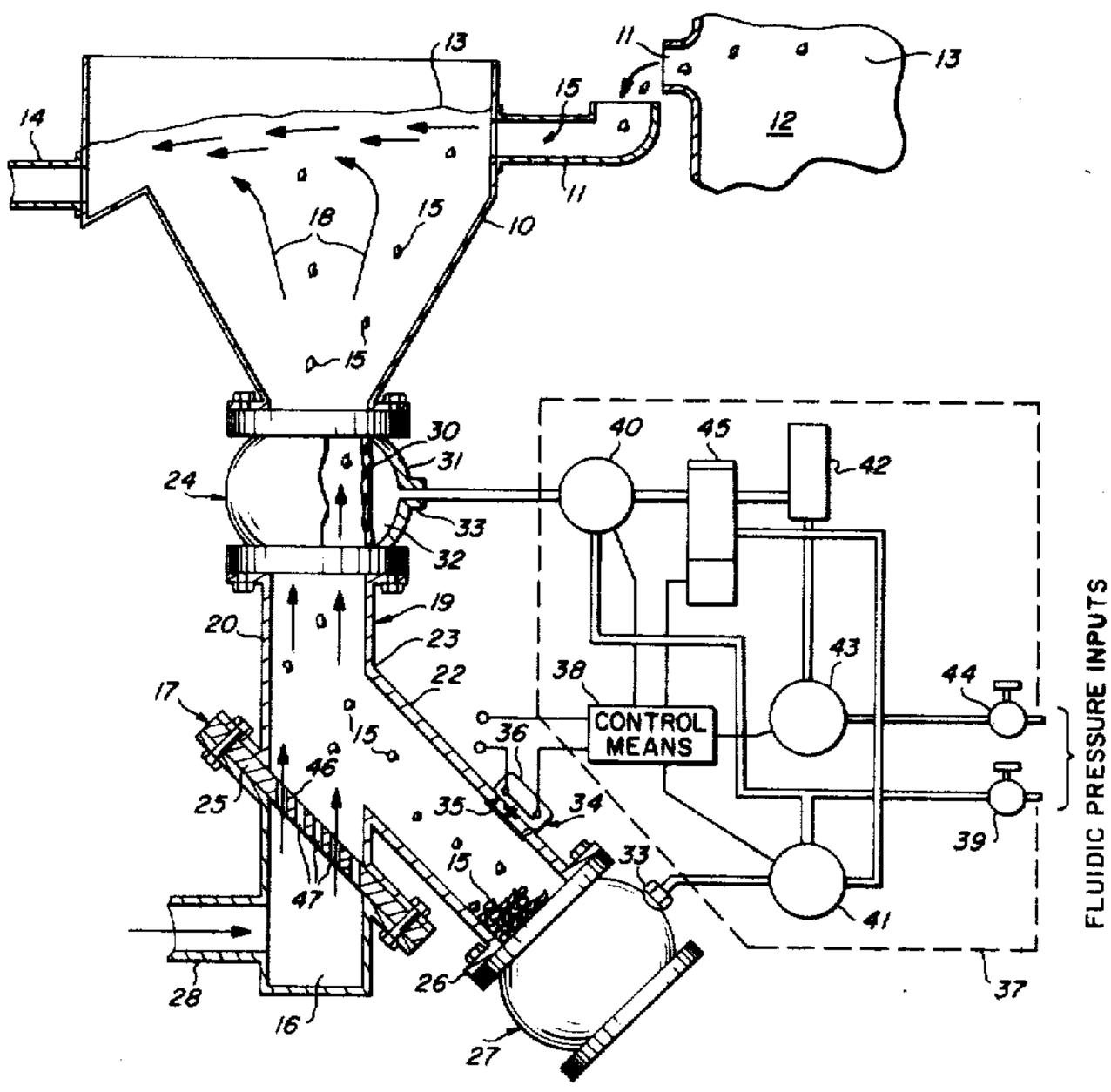
[57] **ABSTRACT**

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.

9 Claims, 2 Drawing Figures



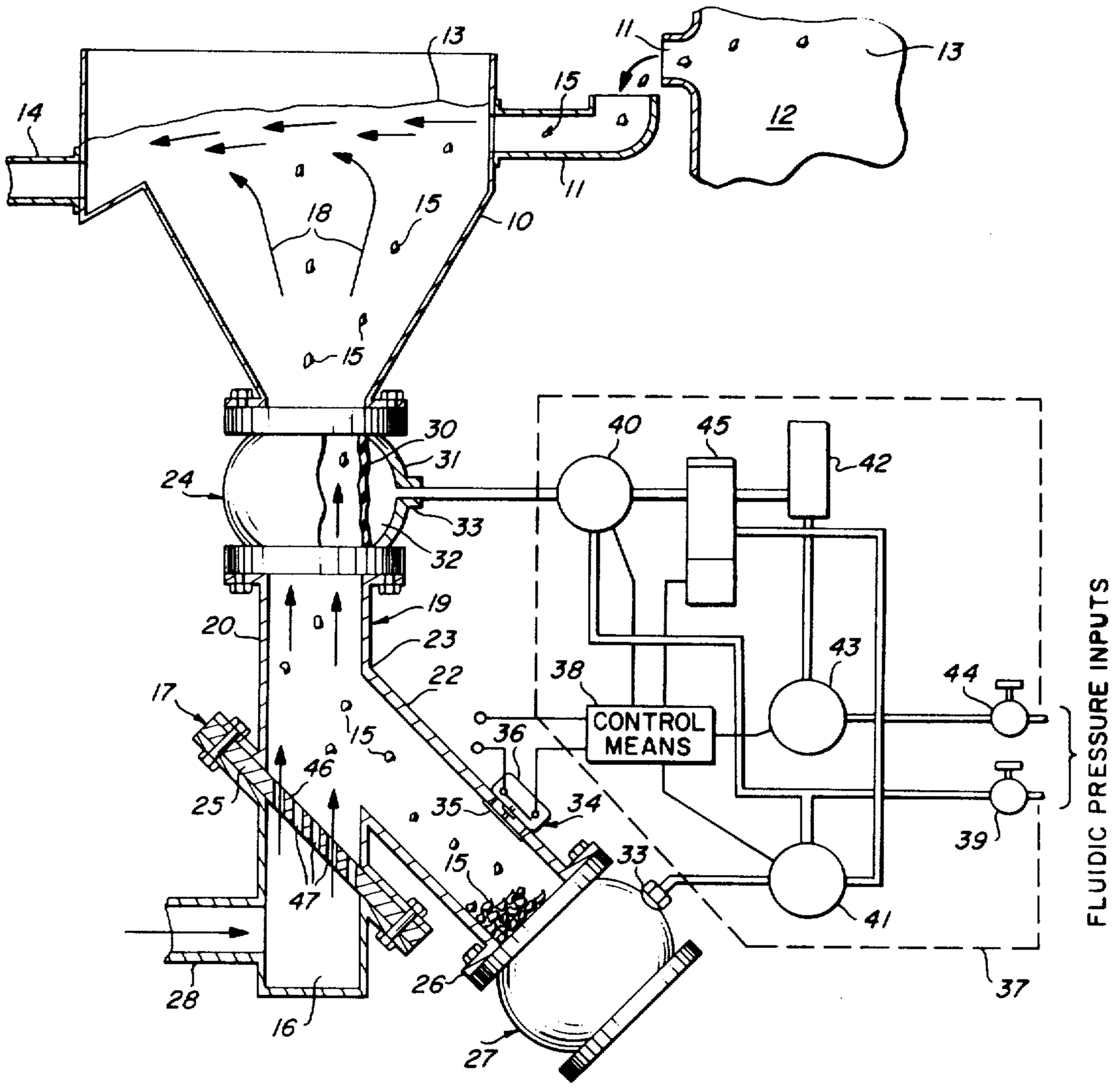


FIG. 1

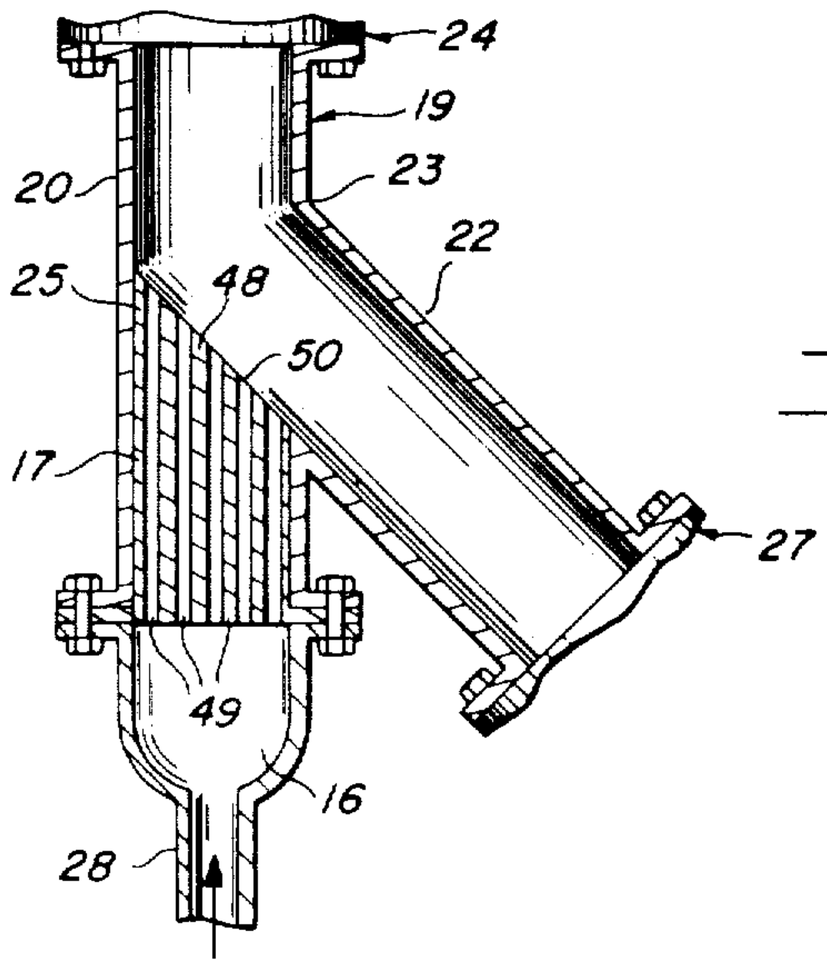


FIG. 2

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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 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 cbips **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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