United States Patent [19]

Green

[11] **3,751,186**

[45] **Aug. 7, 1973**

[54] **HYDRAULIC SOLIDS CONVEYANCE**

[75] Inventor: **Basil Wayland Green**, Johannesburg, Republic of South Africa

[73] Assignee: **Edward L. Bateman Limited**, Braamfontein, Transvaal, Republic of South Africa

[22] Filed: **June 24, 1971**

[21] Appl. No.: **156,429**

[30] **Foreign Application Priority Data**

June 25, 1970 Republic of South Africa...70/4372

[52] **U.S. Cl.**..... **417/118**, 417/137, 417/145, 417/394, 417/900

[51] **Int. Cl.**..... **F04b 15/02**, F04f 1/06, F04b 45/00

[58] **Field of Search**..... 417/389, 118, 137, 417/145, 900, 394

[56] **References Cited**

UNITED STATES PATENTS

3,667,865	6/1972	Faldi	417/900 X
1,503,279	7/1924	Nixon	417/394
2,606,500	8/1952	Schmidt	417/394 X
2,699,729	1/1955	Stevens	417/394 X

FOREIGN PATENTS OR APPLICATIONS

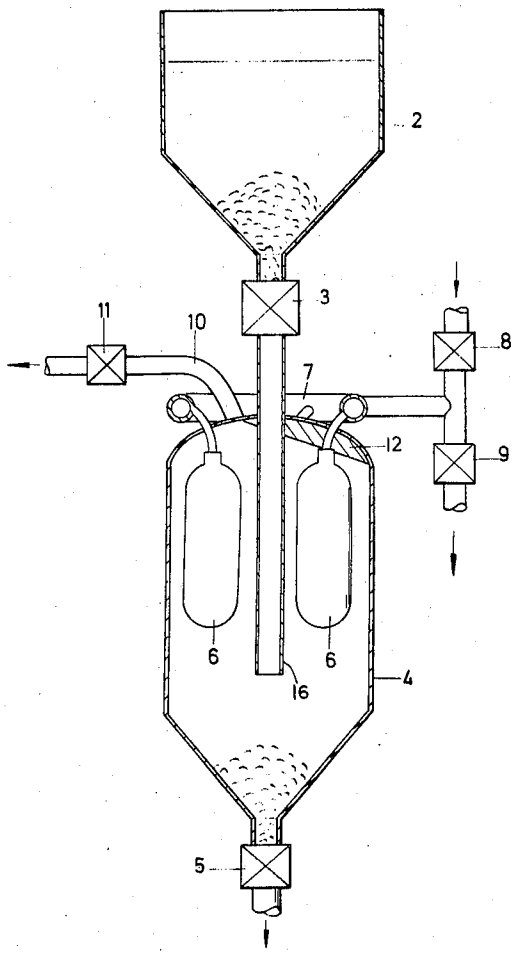
1,002,863	9/1965	Great Britain	417/900
471,348	1/1929	Germany	417/394
24,414	11/1901	Great Britain	417/118

Primary Examiner—Carlton R. Croyle
Assistant Examiner—Richard Sher
Attorney—Young & Thompson

[57] **ABSTRACT**

Mined ore is pumped by means of a pumping vessel fed from a settling tank. The latter discharges into the vessel through a central pipe going to the foot of the vessel. Around the pipe and above the lower end of the pipe there are a series of inflatable balloons. Pumping is effected by inflating the balloons. Oneway valves control the inlets and the outlets from the vessel. As the balloons are inflated the inlet valve closes and the outlet valve opens. When they are deflated the reverse happens.

2 Claims, 3 Drawing Figures



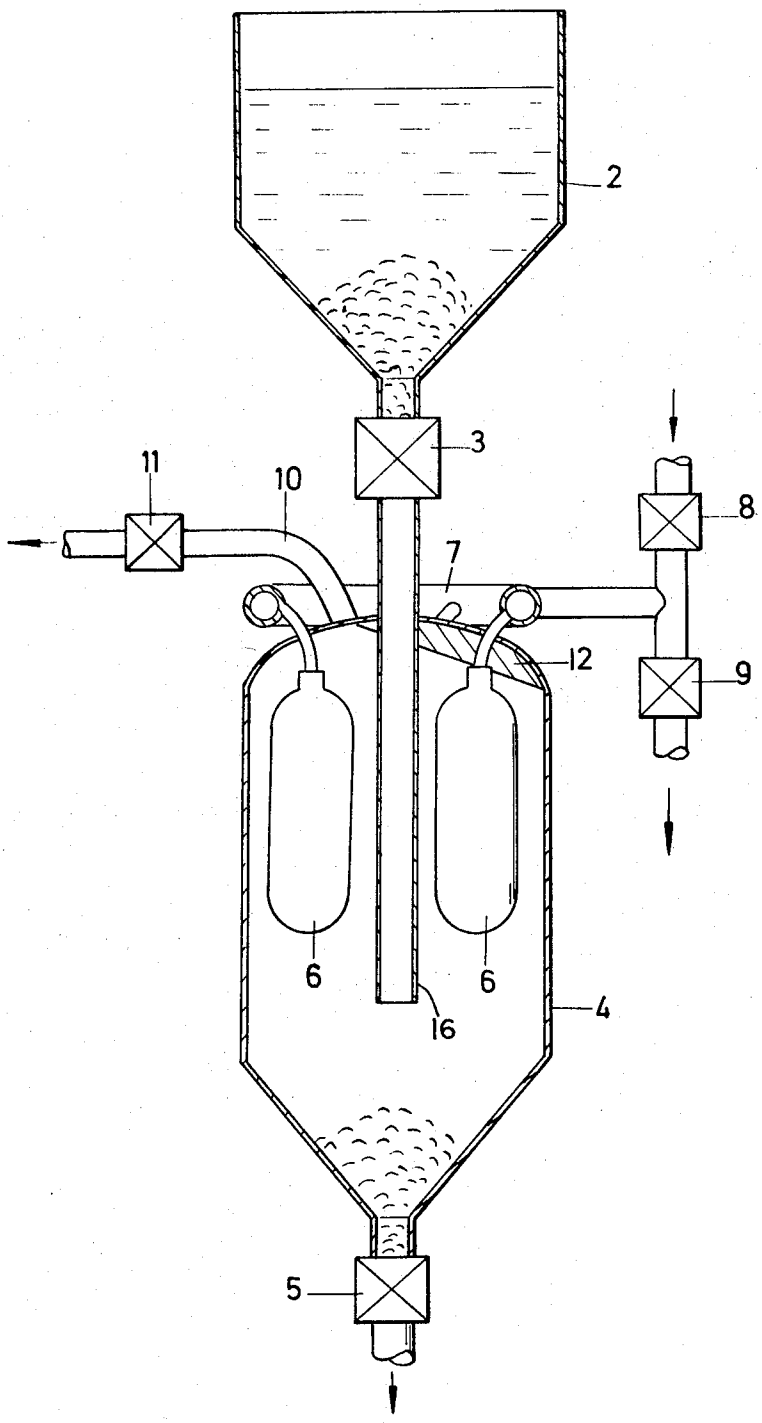


Fig. 1

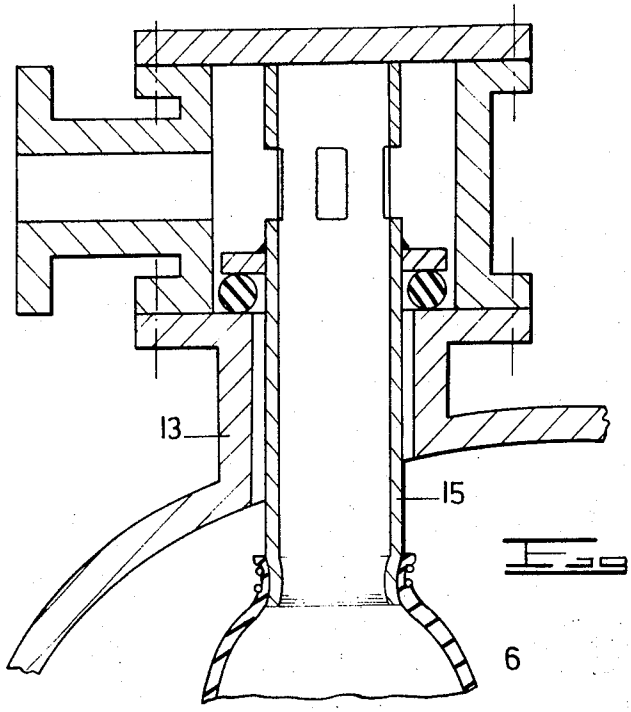


Fig. 2

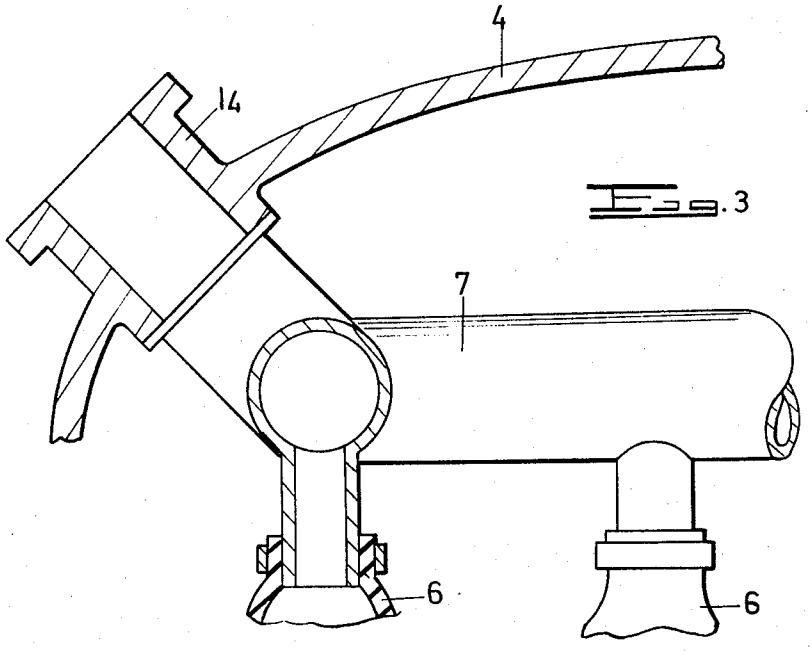


Fig. 3

HYDRAULIC SOLIDS CONVEYANCE

This invention relates to hydraulic solids conveyance such as rock hoisting.

It has already been proposed to hoist mined material from under-ground by pumping it along a rising main. Thus in one case a slurry of finely ground ore is pumped by what amounts to a piston pump system, even though the piston is an interface with an oil. In another case (see S.A. Pat. No. 62/4595) rock as mined, i.e., including large pieces, is pumped up by means of a diaphragm vessel.

In both the abovementioned prior proposals floating debris, mostly timber splints and chips, cause a problem. They tend to accummulate under the pistons or under the diaphragm and in the latter case they may cause piercing of the diaphragm while with the oil system, they enter the oil.

A diaphragm as previously proposed is not easy to construct and may cause difficulty in replacement.

It has also been proposed to provide a diaphragm in the form of a balloon in a pumping vessel. See for example French Patent Specification No. 1,300,197. But these balloon systems are not suitable for pumping mined solids which may be of a highly abrasive character since the solids make contact with the balloons.

An object of the invention is to provide a pumping system in which the mined solids do not come into contact with the balloons.

A pumping system according to the invention comprises a settling vessel, a pumping vessel, a first oneway valve between the settling vessel and the pumping vessel, an outlet at the base of the pumping vessel, a second oneway valve controlling the outlet, a feed conduit extending from the first oneway valve to a low level in the pumping vessel, and a series of inflatable balloons positioned in the pumping vessel between the top of the pumping vessel and the foot of the conduit, the balloons being adapted to be inflated by a pressure fluid to expel material charged into the pumping vessel and to be deflated for a further charge to be introduced into the vessel.

In the preferred form of the invention a series of balloons hang concentrically around the axis of the vessel to discharge material through the base of the vessel or a single balloon forms a toroid around the axis.

As with all diaphragm type pumping installations there is a danger of over-extension of the balloons. To minimize this danger the present invention provides that the pressure fluid be or include a radio-active material and that a detector or detector array be provided to monitor the total radio-activity in the vessel and either to give warning if a predetermined level is exceeded or to close off the supply of pressure fluid. Furthermore a suitably placed detector could by detecting a change in radioactivity of the energy fluid or the carrier fluid, signal a burst or punctured balloon.

The invention is further discussed with reference to the accompanying drawings which are sections through a typical installation according to the invention and parts of modified installations.

In FIG. 1 there is a settling vessel 2 to which water and ore are fed more or less in the manner described with reference to patent specification No. 62/4595. A suitable valve 3 controls flow along a feed conduit 16 from the settling vessel. The valve 3 is of a one-way

construction so that material can only flow downwardly through it.

The diaphragm vessel 4 is below the valve 3 and has a discharge valve 5 similar to the valve 3. The conduit 16 terminates at a low level in the vessel 4. Inside the vessel 4 there are suspended a series of balloons 6 concentrically about the vertical axis of the vessel 4. The balloons are fed off a feed manifold 7 which is fed from a source of water under high pressure through a valve 8 or connected to a sump through a valve 9.

At the top of a vessel 4 there is a floating debris outlet 10 controlled by a valve 11. In the zone marked 12 the vessel 4 is lined with an incompressible material to provide a straight slope for floating debris towards the outlet 10.

The heart of the present invention lies in the balloons 6. In practice they are made from a suitable material such as rubber. No very special material is called for since the balloons 6 are not subjected to complicated flexing — they simply expand up to their moulded size and collapse.

In each balloon or on the side of the vessel 4 there are a series of detectors (not shown) that detect radio-activity. The water used in the circuit of the 7 has a radio-active salt dissolved in it. The detectors feed a circuit arranged to control the valve 8. If during the pressure cycle the detected radio-activity exceeds a predetermined level, the valve 8 is closed immediately.

All the valves 3, 5, 8 and 9 are controlled by a control circuit in synchronism with the valves of other vessels 4 feeding the same rising main. As said above, the operation of the valves 3,5, 8 and 9 are standard in the sense that they operate on the principles set out in South African Patent No. 62/4595. In operation two conditions prevail in connection with the vessel 4:

a. charging of the vessel: In this case the valve 3 is open and the valve 5 closed, while the valve 9 is open and the valve 8 closed.
b. discharge of the vessel: In this case the valve 3 is closed and the valve 5 is open, while the valve 9 is closed and the valve 8 is open.

During charging the balloons 6 collapse and liquid contained in them is expelled. During discharge the balloons 6 are inflated to cause expulsion of material lying at the base of the vessel 4. The valve 11 is opened periodically when the vessel 4 is off circuit or while it is pumping and water or extra water is passed through the valve 3 to flush out any floating debris that may have collected in the vessel.

The operation of the vessel of the invention is standard. Thus ore from the vessel 2 passes with a quantity of water into the vessel 4. The valve 3 closes after a suitable settling time while the valve 5 is opened. At the same time the valve 8 opens (while the valve 9 is closed) to expel ore from the vessel 4 through the valve 5 to the rising main. When expulsion is complete the valves 8 and 5 close while the valves 3 and 9 open and so on. There is also a suitable settling time before the valve 5 closes. In the embodiment of FIG. 1 the vessel 4 has to be provided with a manhole for maintenance and replacement of the balloons 6. Where this is undesirable the construction shown in FIG. 2 may be used. In this case each balloon 6 is secured to a nipple 15 passing through a flanged branch 13 on the dome of the vessel 4. The balloon 6 is so shaped that in its collapsed condition it can pass through the branch 13.

Both of the embodiments of FIGS. 1 and 2 provide for several points of entrance through the shell of the vessel 4. At the pressures that may be involved this is not always desirable. In the embodiment of FIG. 3 there is one flanged entrance 14 to a manifold 7 which is housed in the vessel 4. Of course, in this case as in FIG. 1, a manhole for maintanance and replacement has to be provided through the shell of the vessel 4.

The pumping vessel provided by the invention is suitable for pumping solids up a rising main to achieve rock hoisting and is also suitable for pumping solids into any hydraulic conveyance system whether it runs vertically, at an incline or horizontally. Should differences in fluid densities cause the balloons to tilt sideways or should excessive turbulence cause balloon movement, the problem can be minimized in one of two ways. In the first way each balloon could be weighted by attaching a weight to its lower end or inserting it in its lower end. Alternatively a support ring supported off the side wall of the vessel 4 or support brackets cantilevered off that wall may be attached to the lower ends of the balloons which are moulded to a suitable shape to enable such attachment to take place.

I claim:

1. A pumping system suitable for pumping solids up a rising main comprising a settling vessel, a pumping vessel, a first oneway valve between the settling vessel and the pumping vessel, an outlet at the base of the pumping vessel, a second oneway valve controlling the outlet, a feed conduit extending from the first oneway valve to a low level in the pumping vessel, and a series of inflatable balloons positioned in the pumping vessel between the top of the pumping vessel and the foot of the conduit, whereby the balloons will not come into contact with the material being pumped during the pumping operation the balloons being adapted to be inflated by a pressure fluid to expel material charged into the pumping vessel and to be deflated for a further charge to be introduced into the vessel.

2. The system claimed in claim 1 in which the conduit extends along the axis of the pumping vessel and the balloons are positioned around the conduit.

* * * * *