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Seki et al.

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[54] **SLURRY PUMP OF OIL-DIAPHRAGM TYPE**

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[52] **U.S. Cl.** **417/92,** 417/430, 417/900

[51] **Int. Cl.** ... **F04f 11/00,** F04b 21/00, F04b 15/02

[58] **Field of Search** 417/900, 92, 93, 417/94, 95, 96, 97, 98, 99, 103, 430

[56] **References Cited**

UNITED STATES PATENTS

3,241,496 3/1966 Imai et al. 417/98

FOREIGN PATENTS OR APPLICATIONS

1,193,368 5/1965 Germany 417/99

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[57] **ABSTRACT**

In a riser portion of the slurry connecting pipe between the valve box and the diaphragm chamber of an oil-diaphragm slurry pump having a plunger pump, there is installed a pipe part of large cross section having an interior of a volume greater than the suction displacement of the plunger pump and of a configuration such as to provide abruptly changing cross sectional area with respect to slurry flow therein, whereby turbulent flow, eddy flow or vortices are continually formed in the slurry during pump operation thereby to prevent settling of solid particles.

2 Claims, 2 Drawing Figures

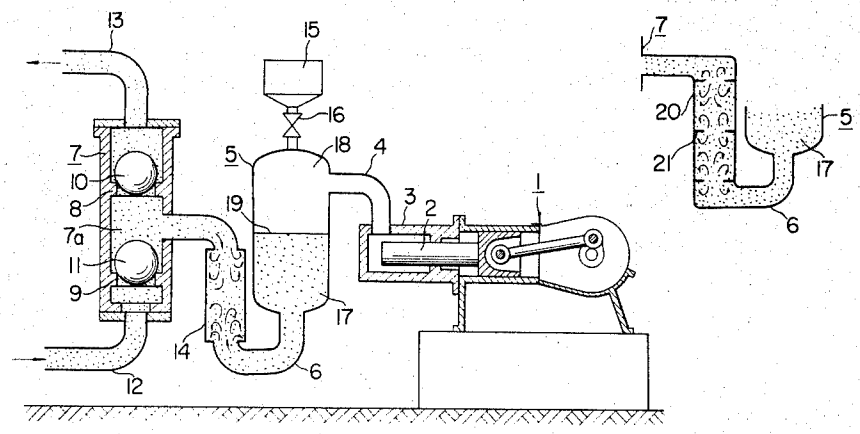


FIG. 2

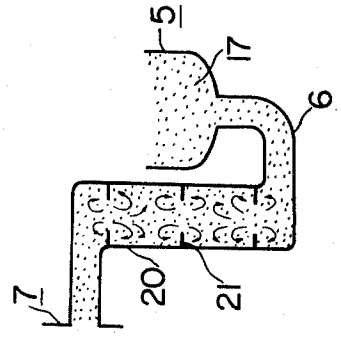
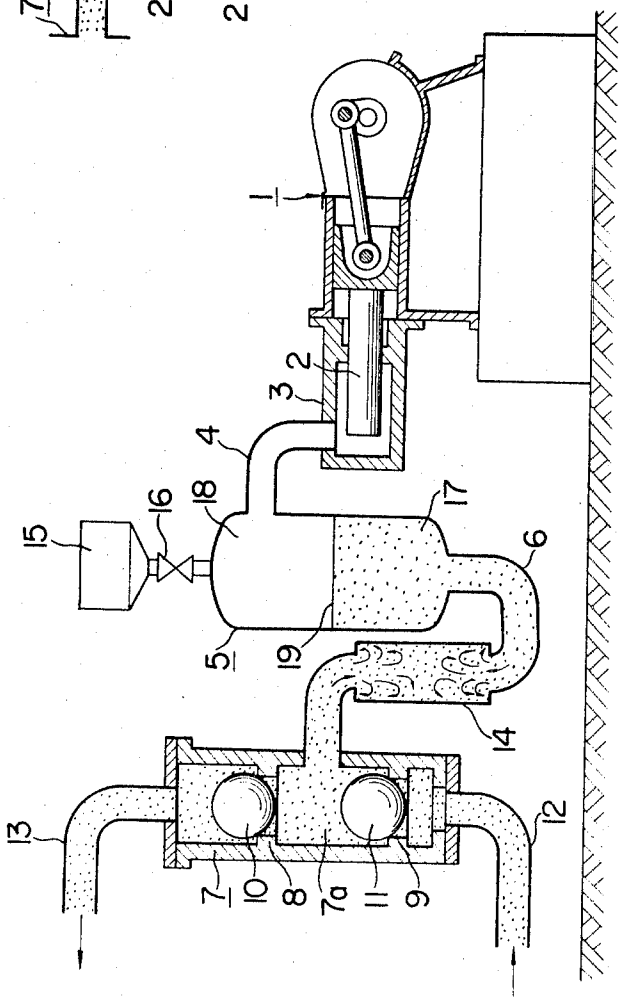


FIG. 1



SLURRY PUMP OF OIL-DIAPHRAGM TYPE

BACKGROUND OF THE INVENTION

This invention relates generally to slurry pumps of the oil-diaphragm type and more particularly to a slurry pump of this type with a new and advance communication path between the valve box and the oil-diaphragm chamber of the pump.

Slurry pumps with which this invention is concerned are of the class described in Japanese Patent Publication No. 12131/1960, U.S. Pat. No. 3,241,496, patented Mar. 22, 1966, British Pat. No. 1,187,912, patented Aug. 12, 1970, and South African Pat. No. 68/0753, patented May 30, 1969.

In general, liquids pumped by slurry pumps contain, in addition to solid particles, air bubbles in the form of minute particles, which give rise to various severely deleterious effects on the pump performance. Particularly in a slurry pump of the oil-diaphragm type, the oil-diaphragm chamber contains slurry with a large quantity of solid particles and a diaphragm oil, and the slurry connecting pipe between the valve box and the diaphragm chamber is also filled with the slurry.

Consequently, the liquid resistance is higher than that in other piston pumps and becomes a cause of liquid column separation which gives rise to loud noise and vibration in the mechanical structure of the pump. Furthermore, when air accumulates within the oil-diaphragm chamber, it causes a drop in the delivery capacity, of the pump and impairment of pumping performance in continuous operation over a long period.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an oil-diaphragm slurry pump in which the above described difficulties are overcome by simple and inexpensive means to improve substantially the pumping performance.

According to the present invention, briefly summarised, there is provided an oil-diaphragm slurry pump in which, in a riser portion of the slurry connecting pipe, there is provided a pipe part of large cross-sectional area having an internal volume greater than the suction displacement of the plunger pump of the slurry pump and having an internal configuration such that the cross-sectional area of the slurry flowpath therewithin is abruptly changed thereby to generate turbulent flow, eddy flow or vortices continually in the slurry flow during operation of the slurry pump.

The nature, principle, and utility of the invention will be more clearly apparent from the following detailed description with respect to preferred examples of embodiment of the invention when read in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. **1** is a diagrammatic side elevation, in vertical section, showing the essential parts of an example of an oil-diaphragm slurry pump constituting an embodiment of the invention; and

FIG. **2** is a fragmentary, diagrammatic side elevation, in vertical section, showing the essential parts of another embodiment of the invention.

DETAILED DESCRIPTION

Referring first to FIG. **1**, the principal components of the oil-diaphragm slurry pump illustrated therein are a plunger pump **1**, a valve box **7**, and an oil-diaphragm chamber **5** connected therebetween.

The plunger pump **1** has a cylinder **3** and a plunger **2** operating as a reciprocating piston in the cylinder **3** to draw in and expel diaphragm oil. The cylinder **3** is communicatively connected by an oil connecting pipe **4** to the upper part of the oil-diaphragm chamber **5**, the lower part of which is communicatively connected by a slurry connecting pipe **6** to a middle chamber **7a** in the valve box **7**.

The diaphragm chamber **5** contains in its upper part a diaphragm oil **18**, which is integrally communicative with oil in the oil connecting pipe **4** and the cylinder **3**, and in its lower part with slurry **17**, which is integral with slurry in the slurry connecting pipe **6** and the middle chamber **7***a*. An interface **19** is naturally formed between the oil **18** and slurry **17** in the oil-diaphragm chamber **5**. The chamber **5** is provided thereabove with an oil reservoir tank **15** connected by way of a shut-off valve **16** to the top of the chamber **5**.

The valve box **7** has at its bottom a slurry suction pipe **2** and at its top a slurry discharge or delivery pipe **13**. The aforementioned middle chamber **7***a* is formed between ball valves **10** and **11** operating cooperatively with respective valve seats **8** and **9** formed on the inner wall surface of the valve box **7**. The ball valves **10** and **11** and their valve seats operate as check valves to permit slurry to flow in only the delivery direction.

Further description of the slurry pump of the above described organization will be omitted since detailed description of the organization and operation thereof is given in the aforementioned references.

In accordance with this invention, the riser part of the slurry connecting pipe **6** is provided with a large-diameter conduit or pipe part **14** in which the flowpath cross-section area of the pipe **6** increase abuptly, and which has a volumetric capacity greater than the suction displacement volume of the plunger pump **1**.

During the operation of the slurry pump, the slurry in the connecting pipe undergoes reciprocating flow alternately toward and away from the valve box **7**. As the slurry flows in this manner through the abruptly expanded, large-diameter conduit **14**, vortices or eddys are formed in the slurry or turbulent flow of the slurry is created, whereby the particles contained in the slurry are continually maintained in a floating state without settling even when at low flow velocities. Accordingly, clogging of the pipe **6** due to settling and accumulation of the particles does not occur. Furthermore, since the volumetric capacity of this large-diameter conduit part **14** is greater than the suction displacement of the plunger pump **1**, there is no possibility of air or bubbles tending to be entrained in the slurry being drawn into the diaphragm chamber **5** through the connecting pipe **6** and thereby of a lowering in the pump delivery.

In another example of this invention as illustrated in FIG. **2**, the slurry connecting pipe **6** is provided in its riser portion with a large-diameter pipe part **20**, which has therewithin a plurality of baffle plates **21** of shapes similar to orifice plates. These baffle plates **21** function to produce abrupt changes in the flow cross-sectional area and, accordingly, to form vortices eddys or turbulence in the slurry flow with the same desirable effects as in the preceding example.

As described above with respect to two specific examples, the present invention provides a slurry pump in

which the aforedescribed difficulties are overcome. In addition to the aforementioned advantages derived in this invention, the labour of deaeration is unnecessary since the infiltration of air into and accumulation thereof in the oil-diaphragm chamber is prevented, and the pump delivery can be maintained steadily for long periods. Furthermore, since the flow resistance in the slurry connecting pipe is decreased, there is no liquid column separation, whereby generation of noise and vibration is prevented.

We claim:

1. In an oil-diaphragm slurry pump comprising a plunger pump of a certain suction displacement, a valve box for pumping slurry, and an oil-diaphragm chamber communicating by way of an oil path with the plunger pump and communicating with the valve box by way of a slurry connecting pipe having a riser portion, the improvement wherein said riser portion has a pipe part of enlarged cross-sectional area, said pipe part having an internal volume greater than the volume by which the plunger pump makes said suction displacement and also having such an internal configuration that the cross-sectional area of the slurry flowpath through the pipe part is abruptly and discontinuously changed at least at both ends of the pipe part, said pipe part having therewithin baffle plates for generating vortices in the slurry flow in the pipe part during operation of the slurry pump.

2. An oil-diaphragm slurry pump according to claim **1** in which said baffle plates are in the form of orifice plates.

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