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McCain

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[54] **SLURRY HOPPER SYSTEM**

[75] Inventor: **David L. McCain,** Ponca City, Okla.

[73] Assignee: **Continental Oil Company,** Ponca City, Okla.

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[21] Appl. No.: **389,272**

Related U.S. Application Data

[63] Continuation of Ser. No. 298,118, Oct. 16, 1972.

[52] **U.S. Cl.** **302/15,** 259/18, 299/18

[51] **Int. Cl.** **B65g 53/30**

[58] **Field of Search** 259/4, 18, 95, 36, 97, 259/98, 151, 147; 299/18, 88, 56, 64; 302/14, 15, 16

[56] **References Cited**

UNITED STATES PATENTS

1,939,225	12/1933	Quiller	259/95
2,139,430	12/1938	Witham	259/95
2,724,581	11/1955	Pahl	259/18
2,900,176	8/1959	Krogel	259/95
3,260,548	7/1966	Reichl	299/56
3,377,107	4/1968	Hodgson	302/15
3,690,730	9/1972	Nagata	302/15

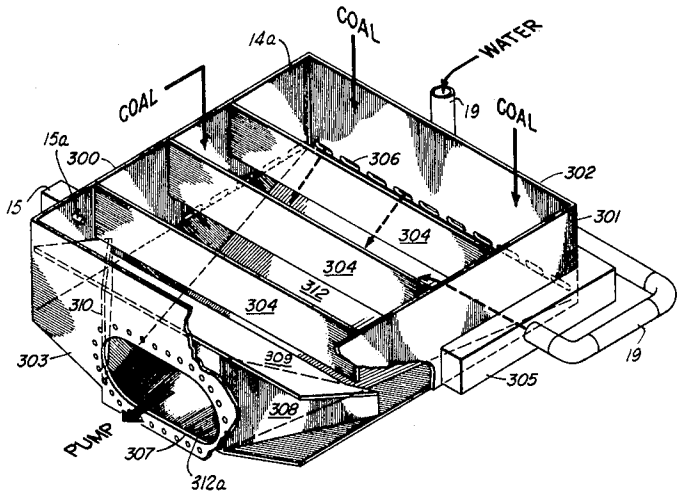
Primary Examiner—Robert W. Jenkins

Attorney, Agent, or Firm—William J. Miller; Joseph C. Kotarski, Jr.

[57] **ABSTRACT**

A low profile hopper for mixing a granular solid product, such as coal, with water to form a slurry. The hopper consists of an open-topped tank having low side walls and a bottom. One end has a slurry pump inlet, and the other end contains a water inlet system. The tank is designed to direct the slurry and gravity feed the slurry to the pump inlet. A water level maintenance system is provided which is mounted in the tank and communicates with the water inlet means for controlling the level of the water, regardless of the amount of product being dumped into the hopper. Baffles are also included to reduce surface turbulence in the vicinity of the water level maintenance system.

9 Claims, 3 Drawing Figures



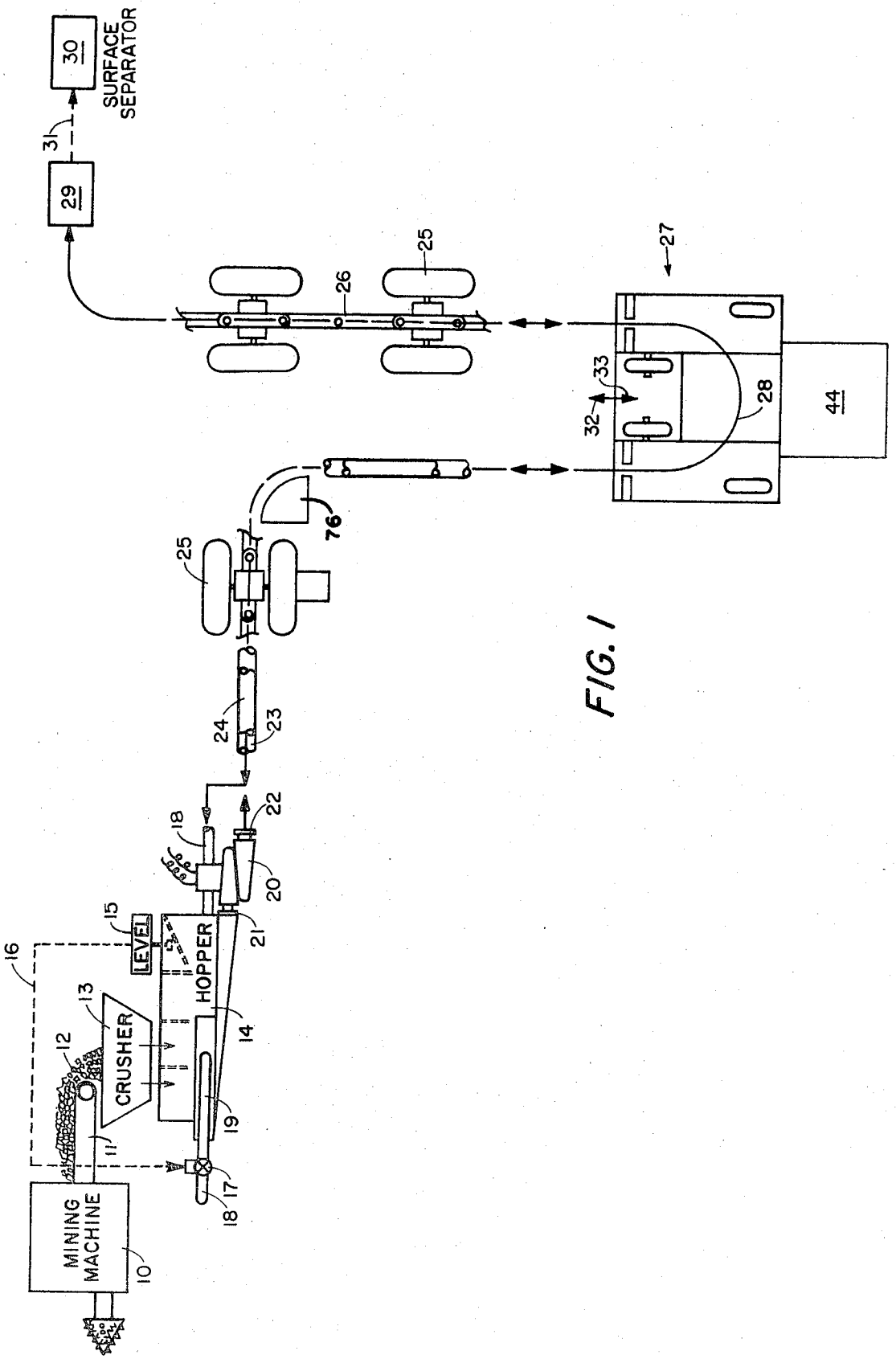

30
SURFACE SEPARATOR
31
29
25
26
27
33
32
28
44
76
25
24
23
22
18
20
21
15
LEVEL
16
HOPPER
13
CRUSHER
12
14
19
11
17
18
MINING MACHINE
10

FIG. 1

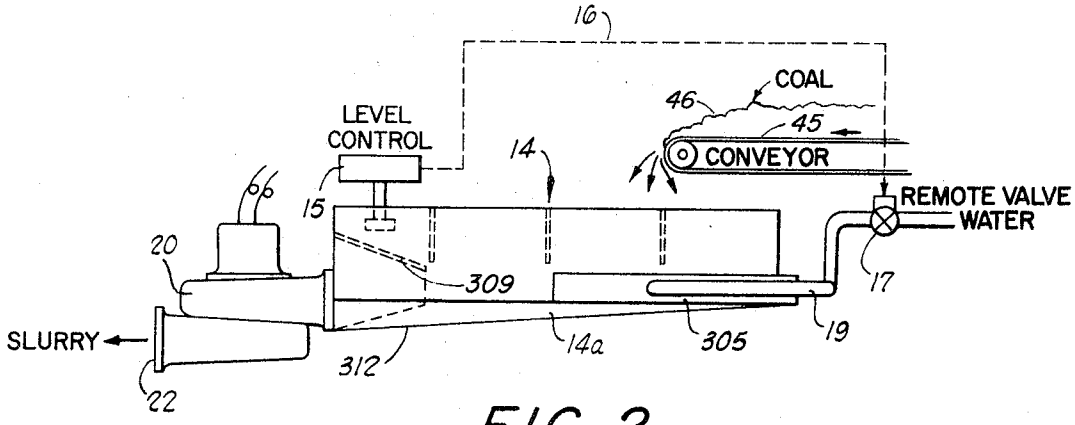

16
COAL
46
45
LEVEL
CONTROL
14
CONVEYOR
66
15
REMOTE VALVE
WATER
20
309
17
SLURRY
312
14a
305
19
22

FIG. 2

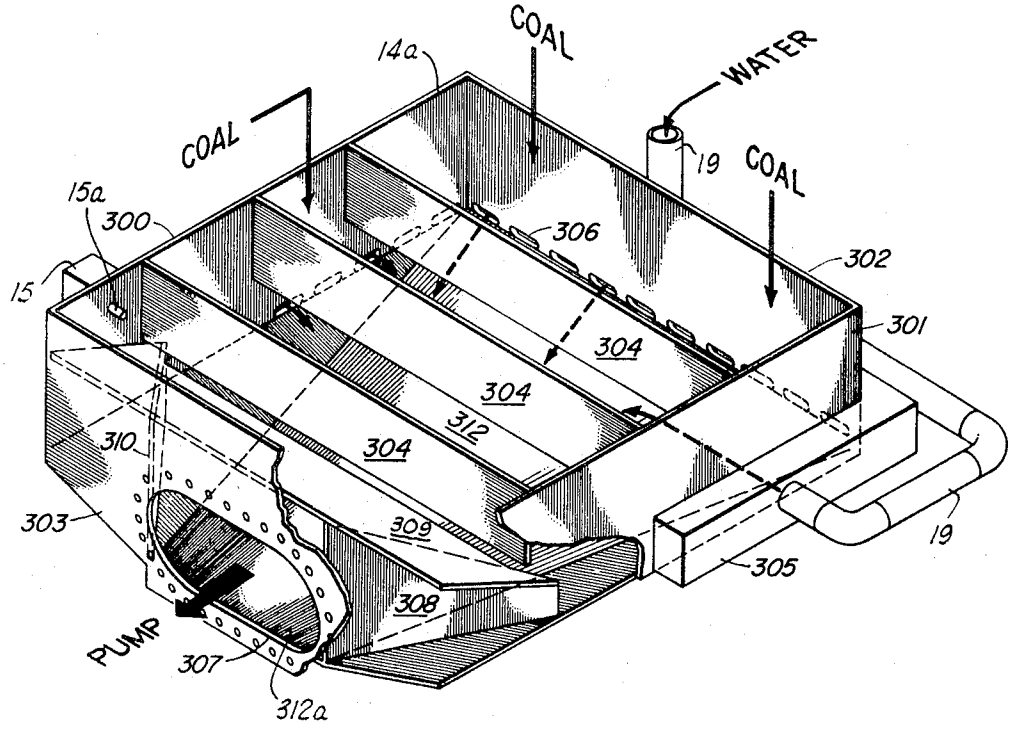

14a
COAL
WATER
COAL
COAL
19
15a
300
306
302
15
301
304
304
312
310
304
303
309
19
305
308
PUMP
307
312a

FIG. 3

SLURRY HOPPER SYSTEM

CROSS REFERENCES TO RELATED APPLICATIONS

This is a continuation of applicants' co-pending application of the same title, Ser. No. 298,118 filed Oct. 16, 1972. Related subject matter is disclosed in the co-pending application of Reichl et al, Ser. No. 294,720 filed Oct. 3, 1972 and entitled "A Mobile Slurry Handling System."

BACKGROUND OF THE INVENTION

This invention relates to improvements in apparatus for forming a slurry from a granular solid and water, and more particularly, but not by way of limitation, to such apparatus particularly useful in coal mining.

The best prior art relating to the above system is found in U.S. Pat. No. 3,260,548, entitled "Method and Apparatus for Continuous Mining and Transporting Coal" by E. H. Reichl. In addition to disclosing a basic slurry system this patent discloses a slurry hopper operating on the centrifuge principle. The hopper consists of a funnel-shaped retaining means having a pump inlet at the apex. Water inlet means are provided around the periphery at the top. The product is moved by conveyor and dumped into the top along with water to form a slurry. The hopper system in the Reichl patent does not disclose an effective way for maintaining the water level at a predetermined height so that the pump system can, for this reason, overfill or cavitate. Secondly, a centrifugal-type hopper as in the Reichl patent tends to cause the water to spiral, permitting air to pass directly into the pump and the slurry hose. Entrained air, among other things, tends to cause the pump to become inefficient and reduces the product pumped into the line, all of which tends to be detrimental to the proper operation of this system. Further, a centrifugal type hopper requires excessive head room which is at a premium in a coal mine.

BRIEF DESCRIPTION OF THE INVENTION

This invention discloses a hopper assembly including a tank which has shallow sides and a bottom which is tapered to the pump inlet. A plurality of baffles extends into the water slurry mixture, reducing surface turbulence, thereby allowing entrapped air to escape before entering the pump. The baffles also provide a reduction in water turbulence so that the water level can be properly determined and adjusted. The water inlet means injects water into the hopper along the bottom of the hopper. Water entering in this manner causes a directed stream of water which mixes with the product being dumped into the hopper, resulting in the flow and mixing of product with water as it moves toward the pump inlet. The overall design of this system permits large bariations in the quantity of the product being dumped into the hopper without causing overflow of the hopper or without causing air to enter the slurry hoses or pump. The hopper assembly has a low profile, making it particularly useful in restricted spaces, such as in coal mining.

BRIEF DESCRIPTION OF THE FIGURES

FIG. 1 is a schematic layout of a hose hauling system which may be used with this invention and its interconnection with the slurry hopper system of this invention;

FIG. 2 is a side view, partially schematic, of the slurry hopper system showing the location of the pump, the product conveyor, and water level control; and

FIG. 3 is a perspective view of the hopper.

GENERAL DESCRIPTION OF THE INVENTION

The same numbers will be used throughout the specification for the same or similar parts.

Referring to all of the drawings, but in particular to FIG. 1, reference character **10** designates a mine digging machine which mines the product, such as coal, and feeds the product onto a conveyor **11**. The product **12** is dropped into a crusher **13**, which may be any usual type crusher such as a roll crusher or jaw crusher, and may include means for separating the material that does not need to be crushed and crushing only the larger material. Crushers are well known and will not be further discussed. The material from the crusher is dropped or conveyed into the tank of a hopper system **14** which contains water. A water level control **15** applies a continuous signal through line **16** to a valve **17** which is connected to a water line **18**. Another water line **19** is connected to valve **17** and through a plurality of slots (not shown) communicates with the interior of the tank of the hopper system.

A slurry pump **20** has its inlet connected to the outlet **21** of the hopper system **14**. Slurry pump **20** has an outlet **22** connected to a slurry hose **23**. Another hose **24** is connected to water line **18**. Both hoses **23** and **24** are supported upon a slurry transportation system which essentially comprises a plurality of carts **25** connected by linkage **26**. A conveyor mechanism **27** controls the movement of the carts, linkage and pipe assembly around a 180° turn **28**. The termination of the slurry hose **23** and water hose **24** is at a remote terminal **29**. A surface separator **30** may be connected to remote terminal **29** through any well known system **31** such as a pipe line.

The operation of the overall system functions as follows:

As the mining machine **10** removes product **12**, it is carried by conveyer **11** and passed to crusher **13** where it is deposited in the tank of hopper system **14**. Pump **20** pulls the slurry mixture from the hopper and passes it into hose **23**, whereby it is eventually received at a remote terminal **29**, pumped to the surface through pipe line **31**, and separated by separator **30**. As mining machine **10** works in and out of the coal seam, the slurry hose must follow these movements. Carts **25**, through a servo mechanism, will follow the in and out movements of the mining machine. A portion of the slurry line between the conveyer **27** and the remote terminal **29** functions as a storage. Thus as additional length of hose is needed, conveyer **27** will move in the direction of arrow **32**, shortening the amount in storage and lengthening the amount of slurry hose which can penetrate the mine room with the mining machine. In order to accomplish the above, however, conveyer **27** must move the carts **25**, including the slurry hose supported by it, from the position in storage to a position where it can be utilized by the mining machine. Con-

veyer **27** accomplishes the transition from storage to active use by lifting the carts through 180° while the conveyer itself is moving either in the direction of arrow **33** where additional storage is needed or arrow **32** where less storage is needed. The conveyer further restricts the hose to a definite radius, thereby preventing excess flexing or bending.

The hopper system **14** is shown in more detail in FIGS. **2** and **3**. The system comprises an open topped tank **14***a* having overall dimensions such that the horizontal dimensions are greater than the vertical dimensions in order that the hopper may be most conveniently used in restricted spaces, such as in coal mines where the head room is extremely limited. The tank **14***a* has side walls **300** and **301** interconnected with end walls **302** and **303**. The bottom **312** of the tank slopes downwardly from the end wall **302** toward the end wall **303**, with the central portion **312***a*, the lowest portion of the bottom, being converged toward the central portion of the end wall **303** and the remaining portions of the bottom **312** being extended upwardly from the lower central portion to connect with the side walls **300** and **301**, as well as the end wall **303**. A plurality of vertical baffles **304** extend transversely across the tank between the side walls **300** and **301**, with the lower edges of the baffles **304** being spaced upwardly from the bottom **312** of the tank.

A manifold **305** extends around the end wall **302** and the adjacent portions of the side walls **300** and **301** to form a water supply manifold. The manifold **305** communicates with the interior of the tank **14***a* through slots **306** formed through the end wall **302** and the adjacent portions of the side walls **300** and **301**. The slots **306** are formed adjacent the bottom **312** of the tank below the baffles **304**, such that water is fed into the tank below the baffles **304**. The water pipe **19**, previously mentioned, communicates with the manifold **305**.

An outlet opening **307** is formed in the end wall **303** and is sized vertically to extend from the medial portion of the end wall **303** to the adjacent portion of the bottom **312** of the tank, in order that slurry formed in the tank will flow freely through the opening **307**. The width of the opening **307** is such that the side edges of the opening are spaced from the adjacent side walls **300** and **301**. Stated otherwise, the width of the opening **307** corresponds to the width of the respective end of the central portion **312***a* of the tank bottom, that being the lowest point at the bottom of the tank. A baffle **308** extends from one side edge of the opening **307** to the respective side wall **301** a distance from the end wall **303**, and a similar baffle **310** extends from the opposite side of the opening **307** to the side wall **300** at a point spaced from the end wall **303**. The baffles **308** and **310** form what may be considered a funnel to direct the slurry gravitating through the tank **14***a* out the outlet opening **307**. Another baffle **309** may be extended from slightly above the opening **307** into the interior of the tank to further funnel the slurry out the opening **307**. The outlet opening **307** is, of course, connected to the inlet of the slurry pump **20** as indicated in FIG. **2**.

The level control **15**, previously mentioned, has a level sensor **15***a* extending into the tank **14***a* at a point between the lower edges of the baffles **304** and the top of the walls of the tank and, as previously mentioned, the controller **15** controls the opening and closing of the water valve **17** to assure an adequate supply of water in the hopper system. The location of the sensor **15***a* assures an adequate supply of water in the hopper system to prevent cavitation at the outlet opening **307**.

As previously indicated, the granular solid product is fed to the hopper system by a suitable conveyer either directly or indirectly from a crusher. Such a conveyer is schematically illustrated in FIG. **2** at reference character **45** to illustrate the positioning of the conveyer with respect to the tank **14***a*. The conveyer **45** extends over the tank **14***a* and terminates a short distance beyond the end wall **302** in order that the solid product **46** will be deposited into the open top of the tank at a point remote from the outlet opening **307**.

In operation, as previously indicated, water is supplied to the tank of the hopper system through the slots **306** and the solid product is supplied into the open upper end of the tank, such that the solid and the water will be thoroughly mixed as the water and product flow downwardly through the tank along the bottom **312** to form a slurry discharging through the opening **307**. the baffles **304**, being spaced above the bottom **312**, do not interfere with the movement of the slurry along the bottom and through the outlet opening **307**, but minimize the turbulence of water being fed into the tank when the system is operating at maximum capacity. In a typical form of the invention, the individual slots **306** may be 6 inches long and the tank may be sized to handle up to 11 tons of coal per minute. It should also be noted that the water level sensor **15***a* is positioned at a point remote from the entry of the water into the tank between the baffle **304** nearest the end wall **303** to be in the least turbulent area of the water moving through the tank, such that the sensor and controller **15** may perform the function of accurately maintaining an adequate supply of water in the tank.

It should be apparent from the foregoing that the present hopper system is particularly adapted for use in restricted spaces, such as in coal mining operations. The water level in the tank of the hopper may be accurately controlled and the invention will not be subjected to cavitation of the slurry pump.

Changes may be made in the combination and arrangement of parts or elements as heretofore set forth in the specification and shown in the drawings without departing from the spirit and scope of the invention as defined in the following claims.

What is claimed is:

1. A hopper assembly for forming a slurry of a granular solid product and water in restricted spaces for transportation by a slurry pump, comprising:

an open-topped tank having horizontal dimensions greater than vertical dimensions and having interconnected end walls and side walls and a bottom tapered downwardly toward one end wall;

means for feeding water into the tank adjacent the higher end of the bottom;

means for feeding the granular solid into the tank adjacent the higher end of the bottom;

means adjacent the lower end of the tank bottom forming an outlet for the slurry to the pump;

means in the tank limiting the flow of water through the upper portion of the tank to minimize turbulence; and

means for maintaining the water at a predetermined level in the tank.

2. The assembly defined in claim 1 wherein the means for feeding water into the tank comprises a manifold extending around the end wall at the higher end of the bottom and the adjacent portions of the side walls, and slots in said end wall and adjacent portions of the side walls at the bottom of the tank communicating with the manifold.

3. An assembly as defined in claim 2 wherein the means for limiting the flow of water through the tank comprises at least one baffle extending between the side walls above said slots.

4. The assembly defined in claim 1 wherein the means forming an outlet for the slurry to the pump comprises an opening in the respective end wall extending from a medial portion of the end wall to the bottom of the tank and having a width less than the width of the tank, and a baffle extending from adjacent each side of the opening to the respective side wall in spaced relation from the respective end wall to funnel the slurry through the opening.

5. The assembly defined in claim 4 wherein said means forming an outlet for the slurry further comprises a baffle extending from the top of the opening into the container.

6. The assembly defined in claim 4 wherein the means for maintaining the water at a pre-determined level includes level control sensing means in the tank adjacent the end of the tank associated with the outlet for the slurry and positioned above said opening.

7. The assembly defined in claim 1 wherein the means for feeding granular solid into the tank comprises a conveyer extending over the top of the tank and terminating adjacent the end of the tank associated with the higher end of the bottom to feed the solid into the tank remote from the outlet for the slurry.

8. A hopper assembly for forming a slurry of a granular solid product and water is restricted spaces for transportation by a slurry pump comprising:

an open-topped tank having horizontal dimensions greater than vertical dimensions and having interconnected end walls and side walls and a bottom tapered downwardly toward one end wall;

a water manifold extending around the lower portion of the end wall at the higher end of the bottom and around adjacent portions of the side walls communicating with the interior of the tank through slots formed in the respective end wall and adjacent portions of the side walls;

a water supply line connected to the manifold;

a control valve in the water supply line;

means for feeding the granular solid into the tank adjacent the higher end of the bottom;

the end wall at the lower end of the bottom having an outlet opening formed therein for discharge of slurry formed in the tank;

a plurality of vertical baffles extending between the side walls having the lower edges thereof positioned above the slots through which the water enters the tank;

a level control sensor positioned in the tank above said outlet opening; and

a level controller connected to the sensor and the control valve for maintaining the water level in the tank above said outlet opening.

9. The assembly defined in claim 8 wherein the sensor is positioned between the vertical baffle located nearest to the end wall having the outlet opening therein and said end wall.

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