

June 10, 1969

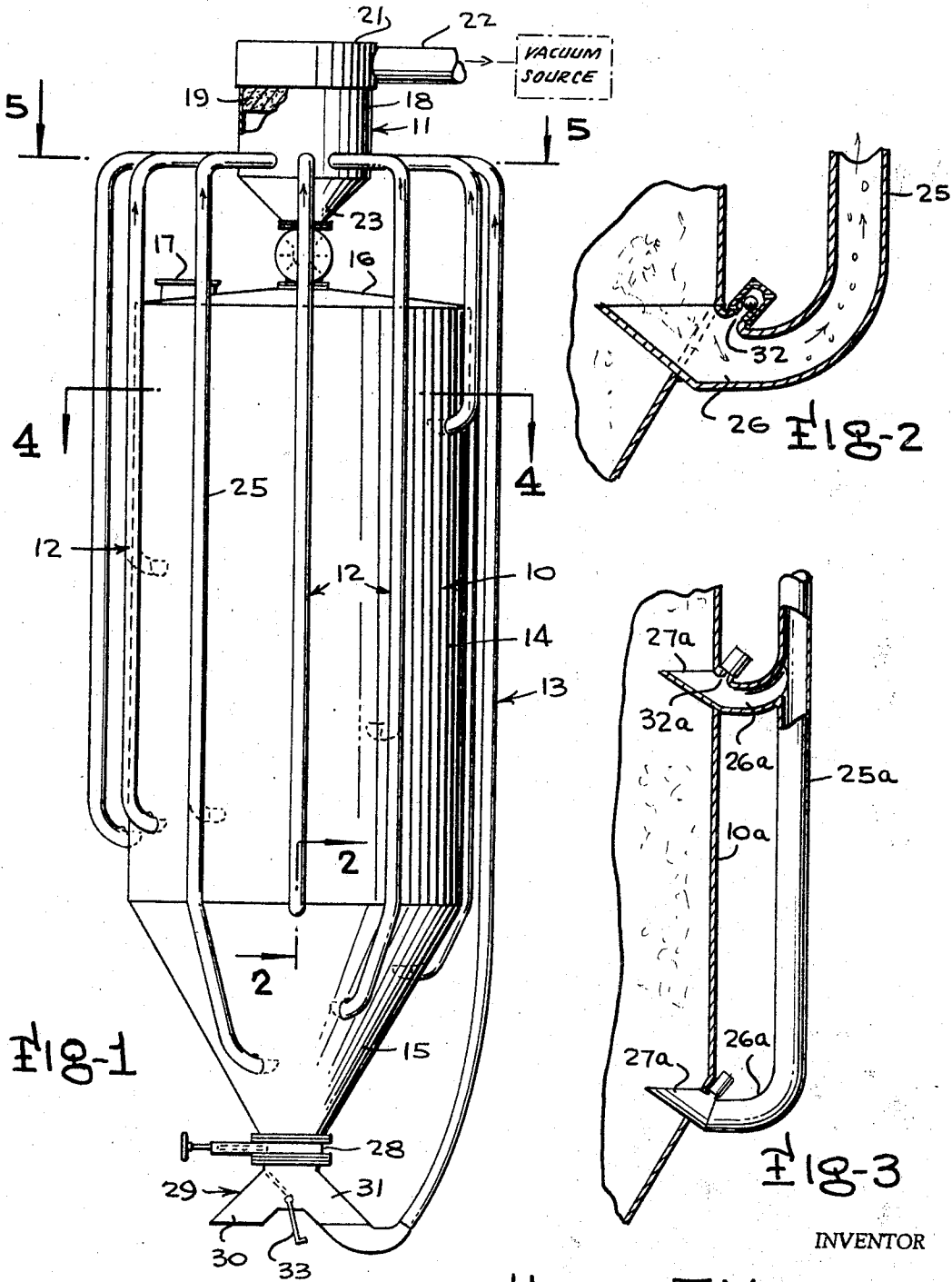
H. T. YOUNG

3,448,965

APPARATUS FOR BLENDING PARTICULATE SOLIDS

Filed March 10, 1967

Sheet 1 of 4



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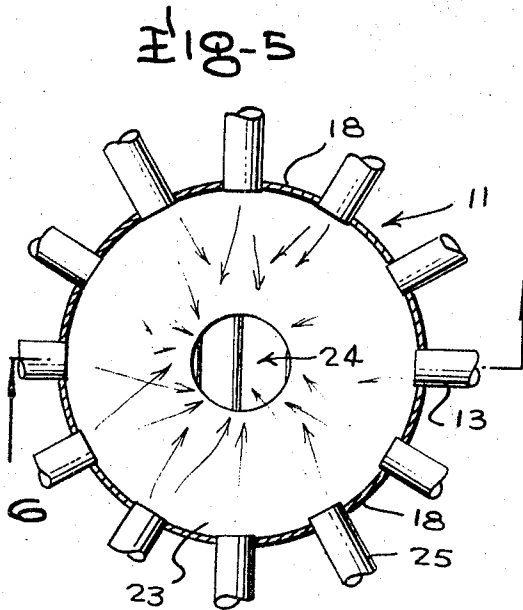
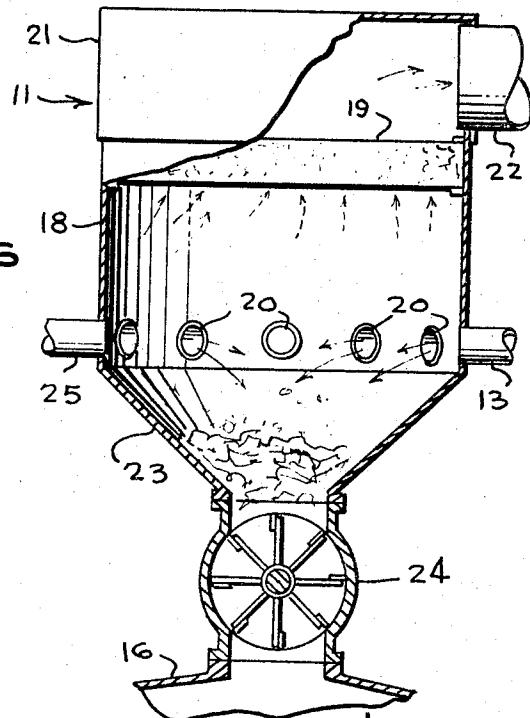
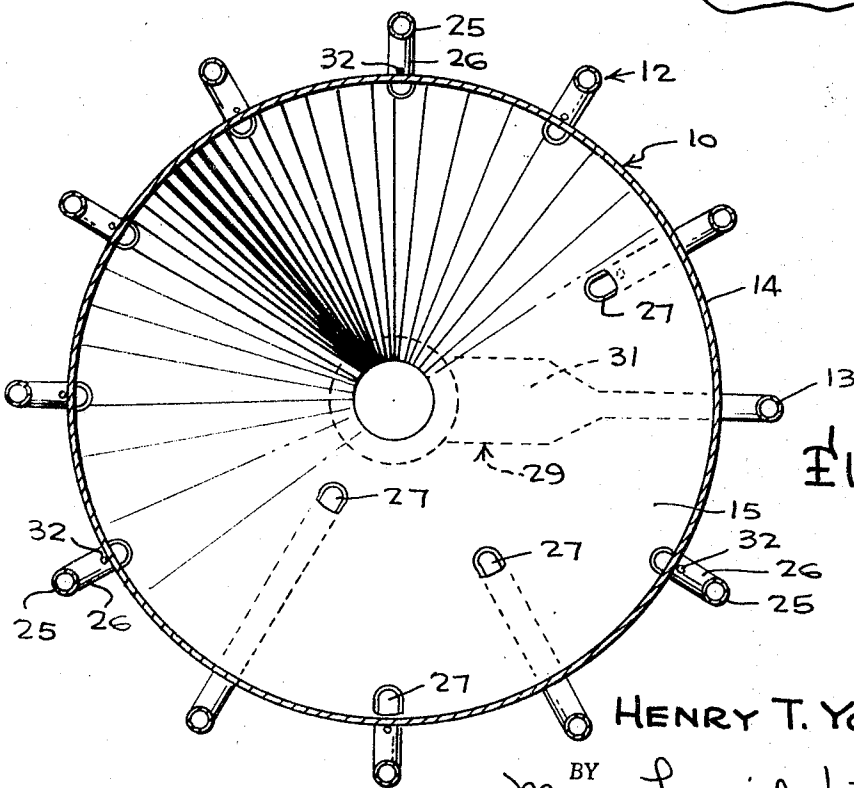
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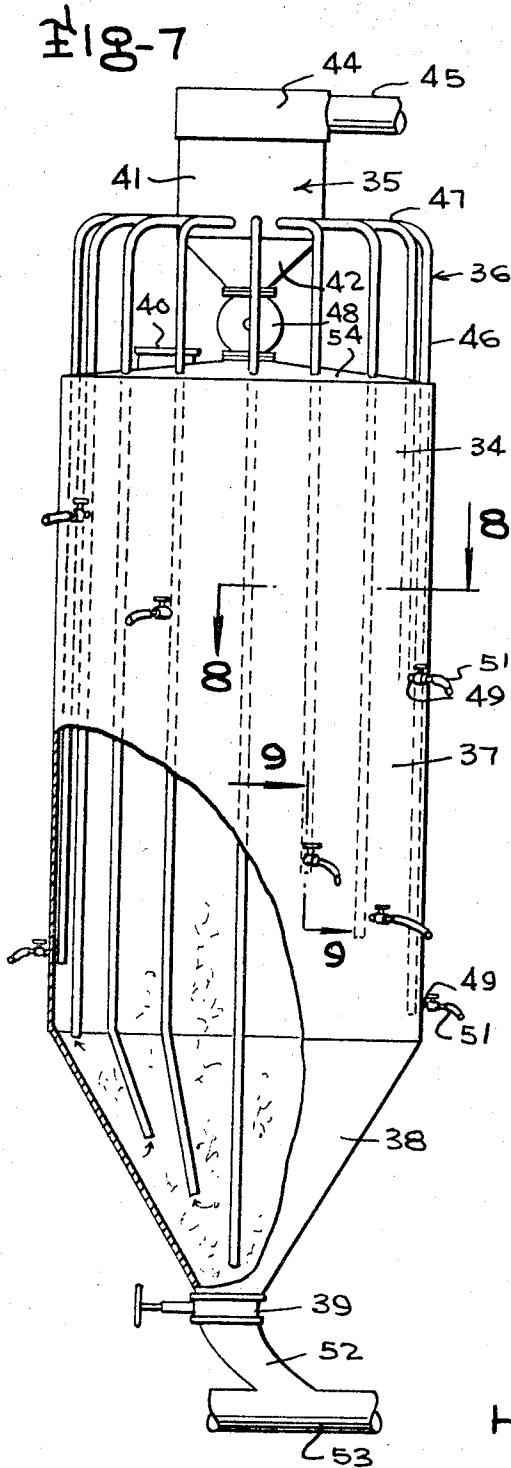
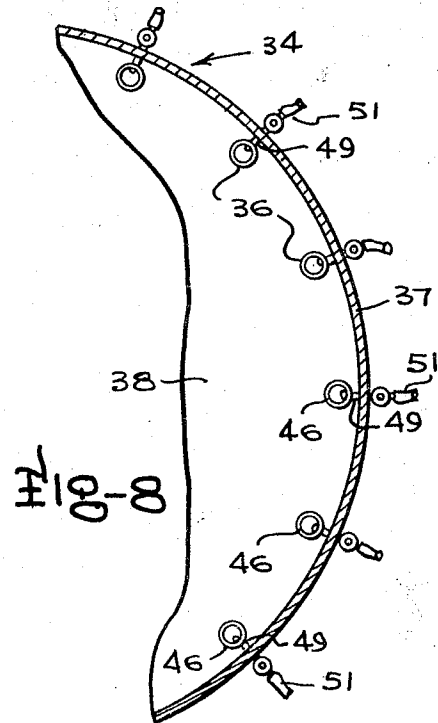
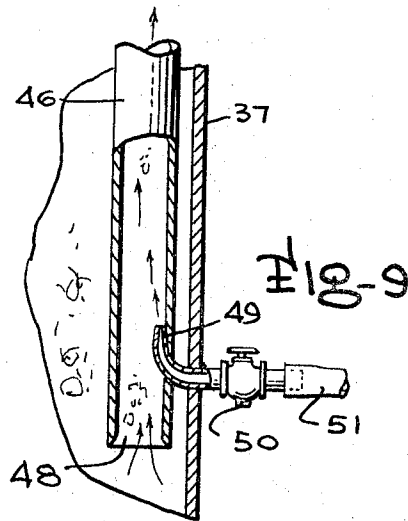
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Sheet 3 of 4



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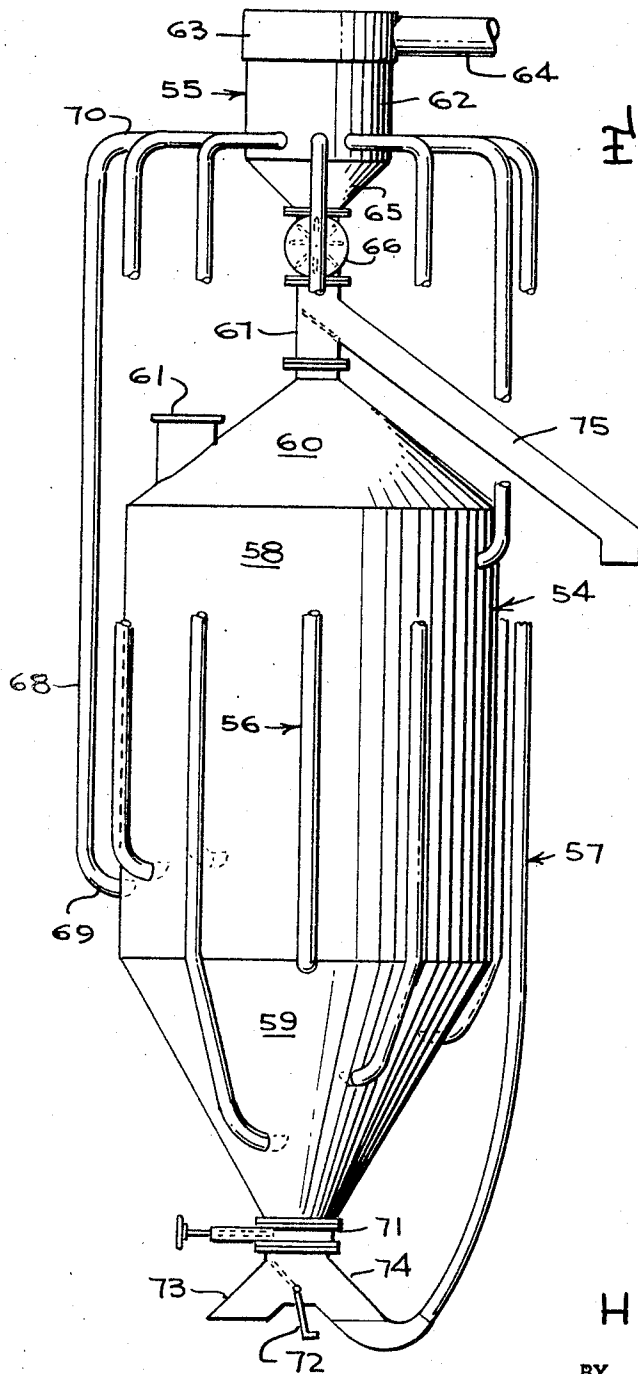


Fig-10

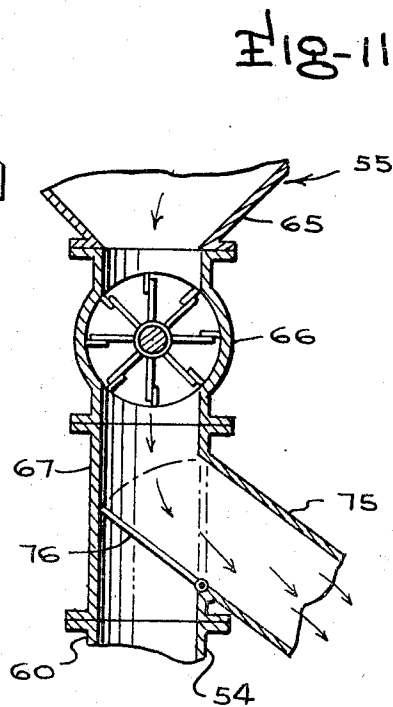


Fig-11

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3,448,965

## APPARATUS FOR BLENDING PARTICULATE SOLIDS

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Int. Cl. B01f 5/12, 15/00, 5/10

U.S. Cl. 259-95

31 Claims

### ABSTRACT OF THE DISCLOSURE

A blending apparatus including container means for a mass of particulate solids, elevated collector means, a plurality of passage means for conveying solids from the container means to the collector means, the passage means having inlets disposed at selected loci in the container means, positive means for causing material flow in the passage means from the selected loci in the container means to the collector means and means permitting gravity flow of the solids from the collector means to the container means.

This invention relates to a blending apparatus, and more particularly to an apparatus for blending particulate solids.

In the prior art there are many types of apparatus for blending dry, particulate solids which generally comprise a large container for holding a bulk quantity of particulate solids, a plurality of tubes having inlets located within the container at different elevations, and at different distances from the centerline of the container, through which particulate solids are drawn and flow under the force of gravity to a common collector vessel. The withdrawal of particulate solids from different locations within the large container results in a uniform blending of the solids discharged into the collector vessel. The particulate solids thus blended either can be withdrawn from the collector vessel or can be recycled through the large container, the tubes and the collector vessel for more intimate blending.

The aforementioned type of blending apparatus has been found to be satisfactory for uniformly blending particulate solids either in bulk or continuous processing. It further has been found, however, that since the withdrawal of the material from the various locations within the large container depends solely on the gravity flow of the material, positive flow of particulate solids of all sizes and under all conditions is not completely assured. It thus has been found desirable to provide a blender of the general type described which is operative to assure the continuous and unobstructed withdrawal of particulate solids from such container.

Accordingly, it is the principal object of this invention to provide an improved blending apparatus.

Another object of this invention is to provide an improved apparatus for blending particulate solids.

A further object of this invention is to provide an improved blender of the type utilizing a large storage container for holding bulk quantities of particulate solids to be blended, which solids are withdrawn at various locations within such container, in which positive withdrawal of the solids from all locations within the container is assured.

A still further object of this invention is to provide an apparatus for blending particulate solids of the type described, wherein the solids are caused to flow continuously, regardless of the size and condition of the solids.

Another object of this invention is to provide an improved apparatus for blending particulate solids which will provide uniform blending of such solids.

A further object of this invention is to provide an apparatus for blending particulate solids having no internal obstructions, or mechanical agitators or mixers.

A still further object of this invention is to provide an improved apparatus for blending particulate solids, which is adapted for either batch or continuous processing of such solids.

Another object of the present invention is to provide an improved apparatus for blending particulate solids, which is comparatively simple in construction, easy to assemble, and economical to operate.

Other objects and advantages of the present invention will become more apparent to those persons skilled in the art, from the following description taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is an elevational view of an embodiment of the invention;

FIGURE 2 is an enlarged cross-sectional view taken along line 2-2 in FIGURE 1;

FIGURE 3 is an enlarged fragmentary view of a modification of the embodiment illustrated in FIGURE 1, having portions thereof shown in vertical cross-section;

FIGURE 4 is an enlarged cross-sectional view taken along line 4-4 in FIGURE 1;

FIGURE 5 is an enlarged cross-sectional view taken along line 5-5 in FIGURE 1;

FIGURE 6 is a cross-sectional view taken along line 6-6 in FIGURE 5;

FIGURE 7 is an elevational view of a second embodiment of the invention;

FIGURE 8 is an enlarged cross-sectional view taken along line 8-8 in FIGURE 7;

FIGURE 9 is a cross-sectional view taken along line 9-9 in FIGURE 7;

FIGURE 10 is an elevational view of a third embodiment of the present invention; and,

FIGURE 11 is an enlarged vertical cross-sectional view of the diverter valve illustrated in FIGURE 11.

Briefly described the present invention relates to an apparatus for blending particulate solids generally comprising a container means for a mass of particulate solids, elevated collector means, a plurality of passage means for conveying particulate solids from the container means to the collector means, the passage means having inlets disposed at selected loci in the container means, means for causing material flow in the passage means from the selected loci in the container means to the collector means, and means permitting gravity flow of the particulate solids from the collector means to the container means. Preferably, the means for causing the flow of particulate solids in the passage means consists of means for producing a pressure differential in the passage means, such as means for providing either a negative or positive pressure in the passage means, and the inlets of the passage means are disposed at loci of different elevations and distances from the vertical centerline of the container means. In addition, in the preferred embodiment of the invention, the passage means consist of tubular members disposed either within or without the container means, which project upwardly and communicate with the elevated collector means.

Referring to FIGURES 1 through 6, there is illustrated an embodiment of the invention. FIGURE 1 illustrates an elevational view of the embodiment which generally includes a bulk container 10, a collector unit 11, a plurality of conduits 12, and a recycling conduit 13. The bulk container 10 is provided with a vertically disposed cylindrical section 14, a lower, inverted frusto-conically shaped section 15, and an upper circular wall section 16 having an inlet 17. Mounted above the bulk container 13 is the collector unit 11, which is disposed coaxially rela-

tive to the bulk container. The collector unit comprises a cylindrical section 18 having a filter element 19 disposed at the upper end therein, and a plurality of inlet ports circumferentially spaced about the lower end thereof, a circular cap section 21 closing the upper end of the cylindrical section 18, having a conduit 22 adapted to be connected to a vacuum pump, and a lower, inverted frusto-conically shaped section 23. Interposed between the collector unit 11 and the container 10, and providing passage therethrough is an air lock 24, which is best illustrated in FIGURE 6.

The conduits 12 are radially spaced from the cylindrical section 14 of the bulk container and are circumferentially spaced relative to each other. Each of the conduits comprises a vertical section 25, a lower section 26 extending inwardly into the interior of the container 10, having an upwardly facing inlet 27, and upper section 28 extending radially inwardly and communicating with an inlet port 20 in the lower end of the cylindrical section 18 of the collector unit. As best illustrated in FIGURES 1 and 4, the inlets 27 of the conduits 12 are located at selected loci within the container 10 at different elevations, and distances from the vertical centerline of the container 10. As shown in the modification illustrated in FIGURE 3, a conduit 12 may be formed with a single vertical section 25a and plural inwardly extending sections 26a having inlets 27a disposed at different elevations within the container 10a. The inwardly extending sections 26a also can project different distances into the container 10 so that the inlets 27a will be located both at different elevations and different distances relative to the vertical centerline of the container 10.

A valve 28 is provided on the lower open end of the container 10, which may be opened to permit material to flow into selector valve 29 having a discharge conduit 30 and a conduit 31 communicating with the lower end of the recycling conduit 13. The upper end of the recycling unit 13 communicates with the collector unit 11 so that when the valve 28 is open and the selector valve 29 is in the position as illustrated in FIGURE 1, material from the container 10 will flow through the conduit 31 and the recycling conduit 13 to the collector unit 11.

In the operation of the embodiment of the invention illustrated in FIGURES 1 through 6, the particulate solids to be blended are introduced into the container 10 through the inlet 17 either in batch quantities or continuously during the operation of the apparatus. Assuming a batch quantity of particulate solids is introduced into the container 10, so that the level of material lies above and covers the inlet of the uppermost conduit 12, the inlet 17 is sealed and the valve 28 is closed. The conduit 22 is connected to a vacuum pump so that a vacuum can be applied to the collector unit 11 and the conduits 12. When this occurs, particulate solids at different locations within the container 10 are drawn through the inlets 27 of the conduits 12 and flow through such conduits into the collector unit 11. As best shown in FIGURES 2 and 4, each of the lower sections 26 of the conduits 12 is provided with an air intake port 32 having a suitable check valve through which air is drawn from the atmosphere to assist in the flow of the particulate solids up through the conduits 12 to the collector unit.

When a vacuum is applied to the collector unit and the conduits 12, the particulate solids are prevented from being drawn up through the bottom of the collector unit by means of the air lock 24. As best shown in FIGURE 6, the mixture of air and particulate solids entering the collector unit are drawn upwardly where the filter element 19 removes the particulate solids from the air passing through the filter element. The filtrate particulate solids fall to the bottom of the collector unit and pass through the air lock 24 into the container 10 for discharging from the container, or recycling, as desired. The air lock 24, as illustrated in FIGURE 6, can be of

the rotary vane drop-thru air lock feeder type manufactured by The Young Machinery Company, Inc. of Muncy, Pa., or any other suitable type.

It will be appreciated from the foregoing description of the operation of the embodiment of the invention illustrated in FIGURES 1 through 6 that by withdrawing particulate solids from different locations within the container 10 and discharging the same into a common collector unit, the particulate solids will become uniformly blended. The operation can be conducted for a set period of time and then the blended solids are either discharged from the apparatus or recycled again. To discharge the material from the apparatus, the handle 33 of the selector valve 29 is moved to the left relative to FIGURE 1, and the valve 28 is opened so that the material will be discharged by gravity flow through the conduit 30. When it is desired to recycle the solids, the handle 33 is moved to the position as illustrated in FIGURE 1, and the valve 28 is opened. Suction then is applied to the conduit 22 so that the solids in the lower end of the container 10 are drawn through conduit 31 and recycling conduit 13, and flow to the collector unit 11, wherefrom they fall through the air lock into the container 10. During this phase of the recycling operation, the conduits 12 may be closed or left open as desired.

Referring to FIGURES 7 through 9, there is illustrated a second embodiment of the invention. This embodiment is similar to the first embodiment described, and includes a large bulk container 34, a collector unit 35 and a plurality of conduits 36. The container 34 comprises a vertically disposed cylindrical section 37, a lower, inverted frusto-conically shaped section 38 having a valve 39 closing the lower end thereof, and a circular wall section 54 closing the upper end thereof having an inlet opening 40. The collector unit 35 is similar to the collector unit 11 described in connection with the first embodiment, and is provided with a vertically disposed cylindrical section 41, a lower, inverted frusto-conically shaped section 42 having a lower opening communicating with an air lock 43 interposed between the collector unit 35 and container 34 to permit gravity flow therethrough of material from the collector unit into the container 34, and an upper cap section 44, having a discharge conduit 45. The air lock 43 is similar to the air lock 24 described in connection with the first embodiment. The collector unit 34 is mounted coaxially above the container 34. The conduits 36 are spaced circumferentially relative to each other, and radially equally relative to the centerline of the apparatus.

As illustrated in FIGURE 7, each of the conduits 36 include a vertical section 46 and a radially disposed upper section 47. Each of the vertical sections is provided with an inlet 48 at the lower end thereof, within the interior of the container 34, and extend upwardly through the upper wall section 54 of the container 34. As shown in FIGURE 7, the inlets 48 of the conduits 36 are disposed at different loci within the container 34. Such loci are at different elevations and radial distances relative to the centerline of the apparatus within the container 34. The upper sections 47 of the conduits 36 project radially inwardly and communicate with the interior of the collector unit 35.

The embodiment illustrated in FIGURES 7 through 9 relies on induced flow within the conduits 36 for conveying the particulate solids from the various locations within the container 34 to the common collector unit 35. This induced flow is provided by means of jet nozzles 49 mounted within the lower end of conduits 12 adjacent the inlets 48 and directed upwardly. As best shown in FIGURE 9, each jet nozzle 49 is provided with a cut-off valve 50 and is connected by means of a line 51 to a source of air under pressure. The discharge end of the jet nozzle 49 is placed adjacent the inlet 48 of a conduit 36 and directed upwardly so that when air under pressure is injected in the conduit, particulate solids within the con-

tainer will be drawn up through the inlet 48 and become entrained in the air stream emanating from the jet nozzle.

In the operation of the embodiment illustrated in FIGURES 7 through 8, a batch of particulate solids to be blended is introduced into the container 34 through the inlet opening 40. With the inlet opening 40 sealed and the valve 39 closed, air under pressure is introduced through the jet nozzles 49 into the conduits 36, causing particulate solids from different locations within the container 34 to be drawn up through the conduits 36 and discharged into the common collector unit 35. As described in connection with the first embodiment, the particulate solids in the air stream entering the collector unit 35 will be filtered by the filtering element in the container unit, and caused to fall downwardly through the air lock 43 into the container 34. It thus will be appreciated that by withdrawing particulate solids from different locations within the container 34, and discharging the same into a common collector unit, the solids will be caused to become blended uniformly. Filtered air ejected through the discharge conduit 45 either can be discharged to the atmosphere or returned to the air pump or other means for producing air under pressure in a closed system arrangement.

When it is desired to discharge the blended particulate solids from the container 34, the supply of air under pressure to the jet nozzles 49 is discontinued and the valve 39 is opened to permit the blended particulate solids within the container 34 to pass by gravity flow through an outlet conduit 52 into a discharge line 53.

FIGURES 10 and 11 illustrate a third embodiment of the invention which is similar in construction and operation to the embodiment illustrated in FIGURES 1 through 6. FIGURE 10 illustrates an elevational view of the third embodiment which generally includes a bulk container 54, a collector unit 55, a plurality of conduits 56 and a recycling conduit 57. The bulk container 54 is provided with a vertically disposed cylindrical section 58, a lower, inverted frustoconically shaped section 59, and an upper frustoconically shaped section 60 having an inlet 61. Mounted above the bulk container 54 is the collector unit 55, which is disposed coaxially relative to the bulk container. The collector unit comprises a cylindrical section 62 having a filter element at the upper end therein similar to the filter element 19 illustrated in FIGURE 1, and a plurality of inlet ports circumferentially spaced about the lower end thereof, a circular cap section 63 closing the upper end of the cylindrical section 62, having a conduit 64 adapted to be connected to a vacuum pump, and a lower, inverted frustoconically shaped section 65.

Interposed between the collector unit 55 and the bulk container 54, and providing passage therethrough is an air lock 66 which is similar to air lock 24 described in connection with the embodiment illustrated in FIGURES 1 through 6, and a coupling conduit 67 interconnecting the lower end of the air lock 66 and the upper end of the frustoconically shaped section 60 of the bulk container.

The conduits 56 are radially spaced from the cylindrical section 58 of the bulk container and are circumferentially spaced relative to each other. Each of the conduits comprises a vertical section 68, a lower section 69 extending inwardly into the interior of the bulk container, having an upwardly facing inlet similar to the upwardly facing inlet 27 described in connection with the first embodiment, and an upper section 70 extending radially inwardly and communicating with an inlet port in the lower end of the cylindrical section 62 of the collector unit 55. Similarly, as provided in the first mentioned embodiment, the inlets of the lower inwardly extending portions 69 of the conduits 56 are located at selected loci within the bulk container at different elevations and distances from the vertical centerline of the bulk container.

Each conduit 56 may be formed with a single vertical

section and plural inwardly extending sections having inlets disposed at different elevations within the bulk container similar to the modification as illustrated in FIGURE 3. The inwardly extending sections also can project different distances into the bulk container so that the inlets thereof will be located both at different elevations and different distances relative to the vertical centerline of the bulk container.

A valve 71 is provided on the lower open end of the bulk container 54, which may be opened to permit material to flow into a selector valve 72 having a discharge conduit 73 and a conduit 74 communicating with the lower end of the recycling conduit 57. The upper end of the recycling conduit 57 communicates with the collector unit 55 so that when the valve 71 is opened and the selector valve 72 is in the position as illustrated in FIGURE 10, material from the bulk container 54 will flow through the conduit 74 and the recycling conduit 57 to the collector unit 55. It further will be appreciated that when the valve 71 is open and the selector valve 72 is switched over to obstruct passage through the conduit 74, material will be discharged through conduit 73.

The coupling conduit 67 intercommunicating the air lock 66 and the bulk container 54, is provided with a discharge conduit 75 for withdrawing material discharged from the air lock 66. As best illustrated in FIGURE 11, the coupling conduit 67 is provided with a diverter valve 76. The valve 76 can be operated so that material discharged from the air lock 66 can be directed to the bulk container 54 for recycling, or diverted as illustrated in FIGURE 11, through the discharge 75 to be withdrawn from the apparatus. The principal advantage of the diverter valve 76 is that the material discharged from the air lock 66 either can be recycled through the bulk container or withdrawn from the apparatus after a single pass through the conduits 56, the collector unit 55 and the air lock 66.

In the operation of the embodiment of the invention illustrated in FIGURES 10 and 11, when it is desired to recycle the material being blended through the bulk container, the particulate solids to be blended are introduced into the bulk container 54 through the inlet 61 either in batch quantities or continuously during the operation of the apparatus. Assuming a batch quantity of particulate solids is introduced into the bulk container, so that the level of material lies above and covers the inlet of the uppermost conduit 56, the inlet 61 is sealed and the valve 28 is closed. The conduit 64 is connected to a vacuum pump so that a vacuum can be applied to the collector unit 55 and the conduits 56. When this occurs, particulate solids at different locations within the bulk container are drawn through the inlets of the conduits 56 and flow through such conduits into the collector unit 55.

When the particulate solids are to be recycled, the diverter valve 76 is in the position as illustrated by the broken lines in FIGURE 11 to obstruct passage of the solids through the discharge conduit 75. When vacuum is applied to the collector unit and the conduits 56, the particulate solids are prevented from being drawn up through the bottom of the collector unit by means of the air lock 66.

Each of the conduit portions 69 are provided with air intakes similar to the air intakes described in connection with the first embodiment so that the mixture of air and particulate solids entering the collector unit are drawn upwardly where the filter element therein removes the particulate solids from the air passing through the filter element. The filtrate particulate solids fall to the bottom of the collector unit and pass through the air lock 66 into the bulk container, for discharging from the container at the bottom thereof, or recycling, as desired. The air lock 66 as illustrated in FIGURE 11, can be of the rotary vane drop-thru air lock feeder type manufactured by The Young Machinery Company of Muncy, Pa., or any other suitable type.

Whenever it is desired to provide only a single pass

of the particulate solids through the conduits 56, the collector unit 55 and the air lock 66, and to withdraw the material from the apparatus, the same procedure is followed except that the diverter valve 76 in the coupling conduit 67 is moved to the position as illustrated in solid lines in FIGURE 11. With the valve in such position, particulate solids blended in the collector unit 55 and discharged through the air lock 66 will be diverted through the discharge conduit 75.

What I claim is:

1. An apparatus for blending particulate solids comprising container means for a mass of particulate solids, elevated collector means, a plurality of passage means for conveying particulate solids from said container means to said collector means, said passage means having inlets disposed at selected loci in said container means, positive means for causing material flow in said passage means from said selected loci in said container means to said collector means and means permitting gravity flow of said particulate solids from said collector means to said container means.

2. An apparatus for blending particulate solids according to claim 1, wherein said positive means for causing the flow of particulate solids in said passage means consists of means for producing a pressure differential in said passage means.

3. An apparatus for blending particulate solids according to claim 2, wherein the inlets of said passage means are disposed at loci of different elevations and distances from the vertical centerline of said container means.

4. An apparatus for blending particulate solids according to claim 2, wherein said passage means consist of tubular members disposed within said container means and project upwardly to said elevated collector means.

5. An apparatus for blending particulate solids according to claim 2, wherein said passage means consist of tubular members disposed within said container means and project upwardly to said elevated collector means, and the inlets of said tubular members are disposed at loci of different elevations and distances from the vertical centerline of said container means.

6. An apparatus for blending particulate solids according to claim 2, wherein said passage means consist of tubular members extending outwardly, and upwardly about the periphery of said container means to said collector means.

7. An apparatus for blending particulate solids according to claim 2, wherein said passage means consist of tubular members extending outwardly, and upwardly about the periphery of said container means to said collector means, and the inlets of said tubular members are disposed at loci of different elevations and distances from the vertical centerline of said container means.

8. An apparatus for blending particulate solids according to claim 1, including means for withdrawing particulate solids selectively from said collector means.

9. An apparatus for blending particulate solids comprising a vessel for a mass of particulate solids, elevated collector means, a plurality of passage means for conveying particulate solids from said vessel to said collector means, said passage means having inlets disposed at selected loci in said vessel, means for applying a negative pressure to said passage means whereby particulate solids are drawn therein and conveyed to said collector means, and means permitting gravity flow of said particulate solids from said collector means to said vessel.

10. An apparatus according to claim 9, including means disposed between said means for applying negative pressure and said passage means for filtering said particulate solids and permitting the same to deposit in said collector means.

11. An apparatus according to claim 9, wherein said means permitting gravity flow of said particulate solids from said collector means to said vessel includes an air lock.

12. An apparatus according to claim 9, including means disposed between said means for applying negative pressure and said passage means for filtering said particulate solids and permitting the same to deposit in said collector means, and wherein said means permitting gravity flow of said particulate solids from said collector means to said vessel includes an air lock.

13. An apparatus for blending particulate solids according to claim 12, wherein the inlets of said passage means are disposed at loci of different elevations and distances from the vertical centerline of said vessel.

14. An apparatus for blending particulate solids according to claim 12, wherein said passage means consist of tubular members extending outwardly, and upwardly about the periphery of said container means to said collector means.

15. An apparatus for blending particulate solids according to claim 12, wherein said passage means consist of tubular members extending outwardly, and upwardly about the periphery of said container means to said collector means, and the inlets of said tubular members are disposed at loci of different elevations and distances from the vertical centerline of said vessel.

16. An apparatus for blending particulate solids according to claim 12, including means disposed between said air lock and said vessel for withdrawing particulate solids therefrom selectively.

17. An apparatus for blending particulate solids according to claim 9, including means for withdrawing particulate solids selectively from said collector means.

18. An apparatus for blending particulate solids comprising a vessel for a mass of particulate solids, elevated collector means, a plurality of passage means for conveying particulate solids from said vessel to said collector means, said passage means having inlets disposed at selected loci in said vessel, means for applying a positive pressure to said passage means whereby particulate solids are drawn therein and conveyed to said collector means, and means permitting gravity flow of said particulate solids from said collector means to said vessel.

19. An apparatus according to claim 18, including means disposed between said means for applying positive pressure and said passage means, for filtering said particulate solids and permitting the same to deposit in said collector means.

20. An apparatus according to claim 18, wherein said means permitting gravity flow of said particulate solids from said collector means to said vessel includes an air lock.

21. An apparatus for blending particulate solids according to claim 20, including means disposed between said air lock and said vessel for withdrawing particulate solids therefrom selectively.

22. An apparatus according to claim 18, including means disposed between said means for applying positive pressure and said passage means, for filtering said particulate solids and permitting the same to deposit in said collector means, and wherein said means permitting gravity flow of said particulate solids from said collector means to said vessel includes an air lock.

23. An apparatus for blending particulate solids according to claim 22, wherein the inlets of said passage means are disposed at loci of different elevations and distances from the vertical centerline of said vessel.

24. An apparatus for blending particulate solids according to claim 22, wherein said passage means consist of tubular members disposed within said vessel and project upwardly to said elevated collector means.

25. An apparatus for blending particulate solids according to claim 22, wherein said passage means consist of tubular members disposed within said vessel and project upwardly to said elevated collector means, and the inlets of said tubular members are disposed at loci of different elevations and distances from the vertical centerline of said vessel.

26. An apparatus for blending particulate solids according to claim 22, including means disposed between said air lock and said vessel for withdrawing particulate solids therefrom selectively.

27. An apparatus for blending particulate solids according to claim 18, including means for withdrawing particulate solids from said collector means selectively.

28. An apparatus for blending particulate solids comprising a vessel for holding a mass of particulate solids, a plurality of passage means for conveying particulate solids from selected loci in said vessel to the upper end thereof wherefrom the same are discharged into said vessel, means for producing a pressure differential in said passage means, causing flow of particulate solids from said selected loci in said vessel to the upper end thereof and an air lock disposed between said means for producing a pressure differential and said vessel.

29. An apparatus for blending particulate solids comprising a vessel for holding a mass of particulate solids, a plurality of passage means for conveying particulate solids from selected loci in said vessel to the upper end thereof wherefrom the same are discharged into said vessel, means for producing a pressure differential in said passage means, causing flow of particulate solids from said selected loci in said vessel to the upper end thereof, means disposed between said means for producing a pressure differential and said passage means, for filtering said particulate solids and permitting the same to deposit in

said vessel, and an air lock disposed between said means for producing a pressure differential and said vessel.

30. An apparatus for blending particulate solids comprising a vessel for holding a mass of particulate solids, a plurality of passage means for conveying particulate solids from selected loci in said vessel to the upper end thereof wherefrom the same are discharged into said vessel, means for producing a pressure differential in said passage means, causing flow of particulate solids from said selected loci in said vessel to the upper end thereof and means for withdrawing particulate solids from the upper end of said vessel selectively.

31. An apparatus for blending particulate solids according to claim 29, including means disposed between said air lock and said vessel for withdrawing particulate solids therefrom selectively.

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ROBERT W. JENKINS, *Primary Examiner*.

U.S. Cl. X.R.

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