Jan. 2, 1968 R. D. HEYL 3,361,413

APPARATUS FOR BLENDING PARTICULATE SOLIDS

Filed Nov. 10, 1966 2 Sheets-Sheet 1

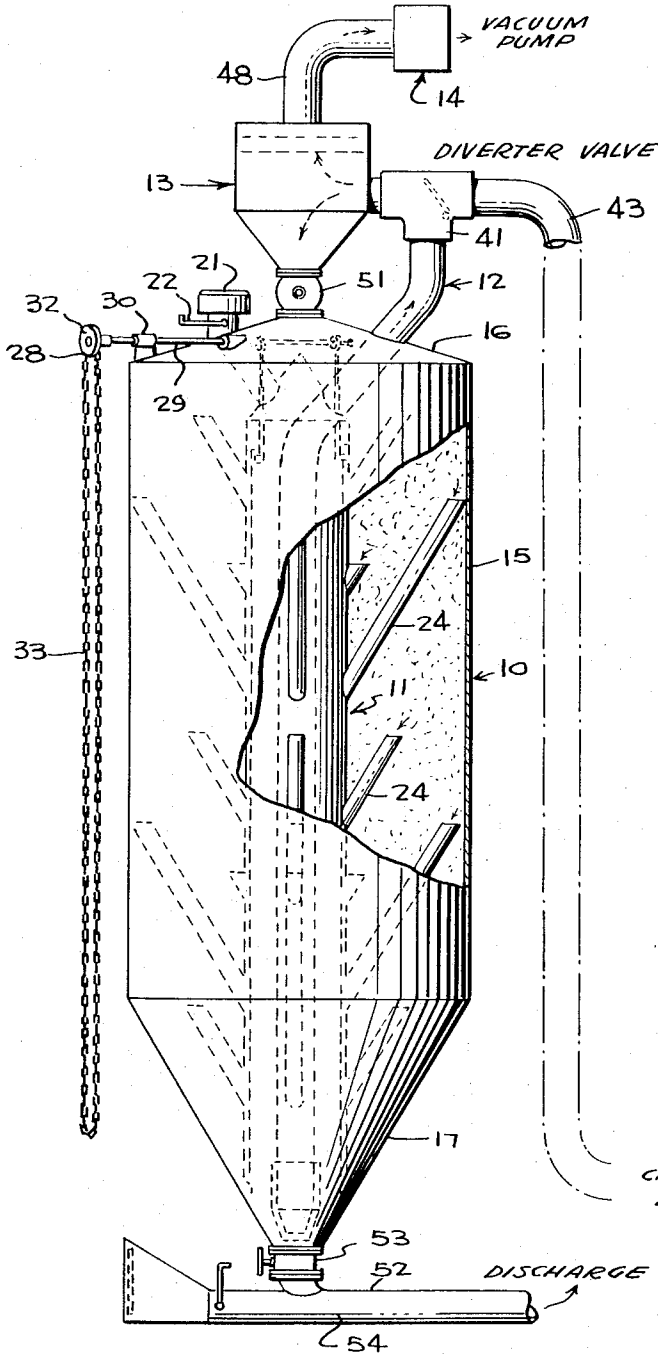


Fig-1

INVENTOR

ROBERT D. HEYL

BY Mason, Fenwick & Lawrence

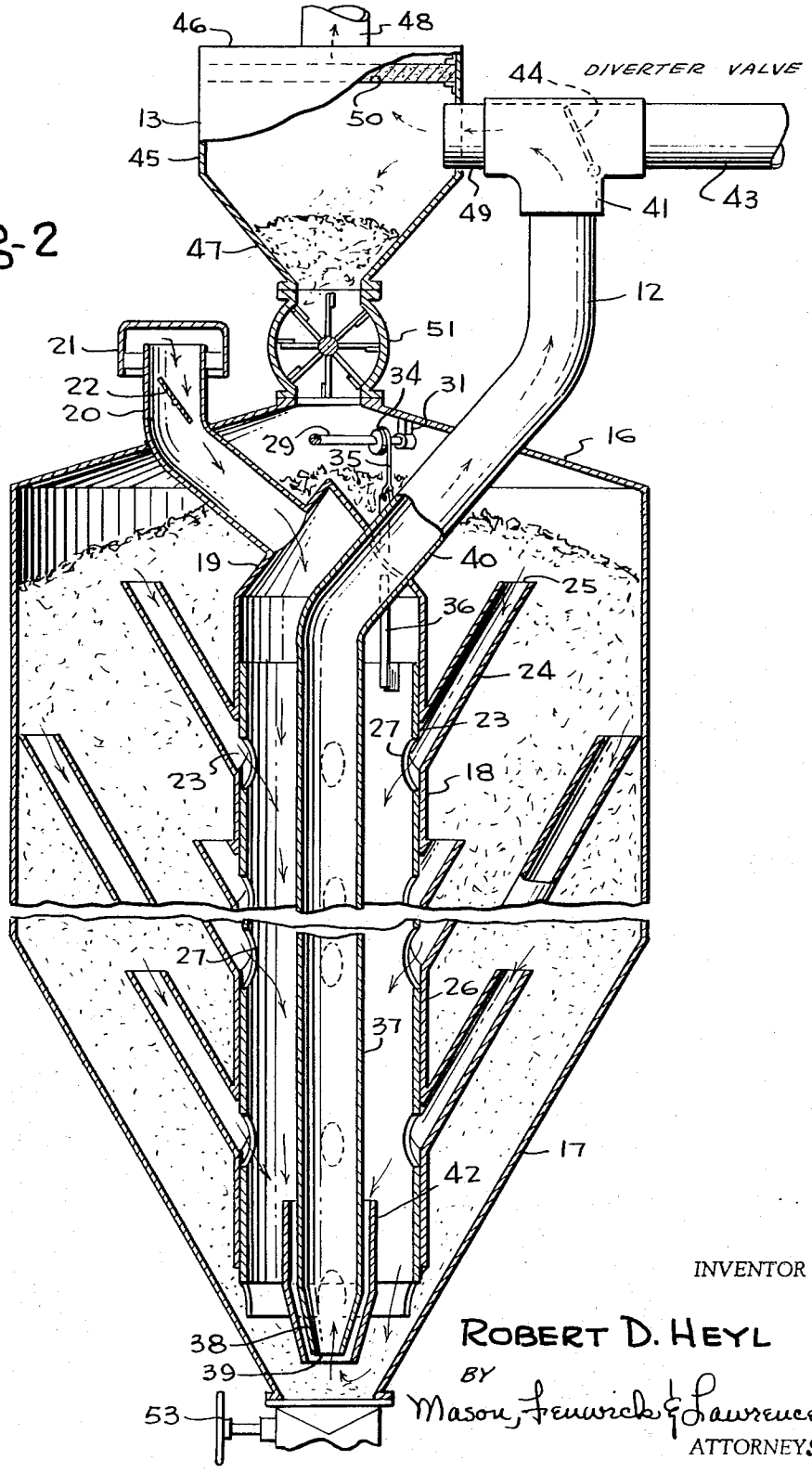
ATTORNEYS

Jan. 2, 1968 R. D. HEYL 3,361,413

APPARATUS FOR BLENDING PARTICULATE SOLIDS

Filed Nov. 10, 1966 2 Sheets-Sheet 2

FIG-2



INVENTOR

ROBERT D. HEYL

BY

Mason, Fenwick & Lawrence

ATTORNEYS

United States Patent Office

3,361,413
Patented Jan. 2, 1968

3,361,413

APPARATUS FOR BLENDING PARTICULATE SOLIDS

Robert D. Heyl, Montoursville, Pa., assignor to The Young Machinery Company, Inc., Muncy, Pa., a corporation of Pennsylvania

Filed Nov. 10, 1966, Ser. No. 593,452
24 Claims. (Cl. 259—4)

ABSTRACT OF THE DISCLOSURE

An apparatus for blending particulate solids generally including a container means for a mass of particulate solids, collector means disposed within the container means, a plurality of passage means for conveying particulate solids within 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, means for controlling the flow of particulate solids into the collector means, means for charging material into the collector means and means for withdrawing material from the collector 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 the 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 batch or continuous processing. However, it has been found that since the withdrawal of the particulate solids from the various locations within the large container depends solely on the gravity flow of the material, positive flow of the particulate solids of all sizes and under all conditions is not completely assured. In addition, most of such apparatus in the prior art has been of complicated design and has not provided any entirely satisfactory means for controlling the aforementioned blending process. It thus has been found desirable to provide a blender of the type described, which obviates the aforementioned deficiencies.

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 blending apparatus of the type utilizing a large storage container for holding bulk quantities of particulate solids to be blended, which solids are withdrawn from

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 blending apparatus of the type utilizing a large storage container for holding bulk quantities of particulate solids to be blended, which solids are withdrawn from various locations within such container, in which the blending process can be controlled.

A still further object of this invention is to provide an apparatus for blending particulate solids of the type described, having a compact and efficient construction.

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; and

FIGURE 2 is an enlarged vertical cross-sectional view of the embodiment illustrated in FIGURE 1, having a portion thereof broken away.

Briefly described, the present invention relates to an apparatus for blending particulate solids generally comprising container means for a mass of particulate solids, collector means disposed within the container means, a plurality of passage means for conveying particulate solids within 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, means for charging material into the container means and means for withdrawing material from the collector 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, the passage means consist of tubular members disposed within the container means, communicating with the collector means and projecting outwardly therefrom, 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 a more specific embodiment of the invention, there is provided an apparatus for blending particulate solids comprising container means for a mass of particulate solids, collector means disposed within the container

means, the container means having a carrier fluid inlet, a plurality of passage means for conveying particulate solids within the container means to the collector means, the passage means having inlets disposed at selected loci in the container means, means for conveying particulate solids from the collector means to the upper end of the container means for recycling therethrough, means for applying a negative pressure to the passage means, the collector means and the recycling conveying means, whereby carrier fluid introduced through the fluid inlet and the collector means draws particulate solids through the inlets of the passage means and carries the same to the upper end of the container means by means of the recycling conveying means, means for controlling the flow of particulate solids into the collector means, means disposed above the container means for filtering out the particulate solids carried in the carrier fluid stream, permitting filter particulate solids to gravity fall into the container means, means for charging material to be blended into the container means and means for withdrawing blended material from the container means. Furthermore, in this embodiment, it is preferred that the passage means consist of tubular members disposed within the container means, communicating with the collector means and projecting outwardly therefrom, and the inlets of the passage means are disposed at loci of different elevations and distances from the vertical centerline of the container means.

Referring to the drawings, 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 recycling conduit **12**, a separator unit **13**, and a vacuum pump **14**. The bulk container **10** comprises a vertically disposed cylindrical section **15**, an upper, frustoconically shaped wall section **16**, and a lower, inverted frustoconically shaped wall section **17**. The collector unit **11** is axially disposed within the container **10**. As best illustrated in FIGURE 2, the collector unit includes an elongated cylindrical stationary sleeve member **18**, closed at the upper end by a frustoconically shaped wall **19** which is spaced below the upper wall section **16** of the container, and which terminates at its lower end adjacent the lower end of the lower wall section **17** of the container. Communicating with the upper end of the sleeve member **18** is an air inlet conduit **20** which is secured to the upper wall section **19** of the collector unit, and extends through an opening in the upper wall section **16** of the container. The air inlet conduit **20** is provided with a protective cap **21**, preventing the entry of any foreign matter into the conduit **20**, and a valve **22** for controlling the amount of air intake into the collector unit.

Formed along the length and about the circumference of the sleeve member **18** is a plurality of inlet ports **23**. A plurality of upwardly and outwardly projecting tubular members **24** are mounted on the stationary sleeve member **18**, which are provided with inlets **25**, and which communicate with the interior of the stationary sleeve member through the inlet ports **23**, The inlets **25** of the tubular members **24** are located at different elevations and at different distances from the vertical centerline of the container and are adapted to receive particulate solids within the container **10** and conduct such material through the tubular members to the interior of the stationary sleeve member **18**.

Slidably mounted within the stationary sleeve member **18** is a movable cylindrical valve sleeve member **26**. The valve sleeve **26** is provided with a plurality of inlet ports **27** which are registrable with the inlet ports **23** in the stationary sleeve member **18**. The valve sleeve **26** is adapted to be moved axially, relative to stationary sleeve member **18**, moving the inlet ports **27** into and out of registry with the inlet ports **23** of the stationary sleeve member **18** by means of an operating unit **28**, as best seen in FIGURE 1. The unit **28** consists of a horizontally disposed shaft member **29** which extends through a suitable opening in the upper wall **16** of the container, and is journaled at opposite ends in an upstanding bracket member **30** mounted on the wall section **16** and a depending bracket member **31** also secured to the wall section **16**, as best illustrated in FIGURE 2, a chain driven gear **32** mounted on the outer end of the shaft member having a depending endless chain **33** operatively connected thereon, and winch elements **34** mounted on the inner end of the shaft member **29** above the collector unit having lifting cables **35** wound thereon, which are connected at their lower ends to linking members **36** rigidly secured to the upper end of the valve sleeve **26**. The wall member **19** of the stationary sleeve member **18** is provided with a suitable openings through which the linking members **36** and the lifting cables **35** pass. It will be appreciated that by operating the chain **33** to rotate the shaft **29**, the valve sleeve **26** can be moved axially relative to the stationary sleeve member **18**, to move the inlet ports **27** of the valve sleeve member into and out of registry with the inlet ports **23** of the stationary valve member, or to partially obstruct the inlet ports **23**, thereby controlling the flow of particulate solids through the tubular members **24** into the interior of the collector unit.

The recycling conduit **12** includes an elongated main body section **37** disposed coaxially within the collector unit substantially the entire length thereof, a nozzle section **38** at the lower end thereof extending below the lowermost position of the valve sleeve **26**, and having an inlet opening **39**, and a continuous offset section **40** extending through openings in the wall sections **19** and **16**, connecting to a coupling member **41**. Mounted on and in spaced relation to the lower end of the recycling conduit is an anticlogging device **42**, which consists of a nozzle member permitting air flow between the device **42** and the lower end of the recycling conduit, which functions to prevent material from clogging the inlet **39**. The coupling member **41** communicates the offset section **40** of the recycling conduit and a charging conduit **43** with the interior of the separator unit **13**. The offset section **40** and the charging conduit **43** are communicated with the separator unit **13** selectively by means of a diverter valve **44**, provided in the coupling member **41**. It will be appreciated that by operation of the diverter valve either material to be blended can be supplied to the separator unit through the charging conduit **43**, or blended material can be supplied to the separator unit through the decycling conduit.

As best illustrated in FIGURE 2, the separator unit **13** comprises a cylindrical wall section **45**, a closed top wall **46** and a lower inverted frustoconically shaped wall **47**. The upper end of the collector unit is connected to the vacuum pump **14** by means of a suction conduit **48**. Mounted within the separator unit between the outlet of conduit **49** interconnecting the coupling member **41** and the separator unit, and the inlet of suction conduit **48** is a filter element **50**.

Interposed between the lower end of the separator unit **13** and the upper end of the container unit **10** is an air lock **51**. It will be seen that when suction is applied to the suction conduit **48**, the air stream containing particulate solids emanating from the conduit **49**, will be drawn upwardly toward the filter element **50**. When the stream contacts the element **50**, the air will pass through the filter, and the particulate solids will be caused to be filtered out of the air stream and will fall to the bottom of the separator unit wherefrom they gravity fall through the air lock **51** into the container unit **10**. It further will be noted that while permitting particulate solids to pass therethrough, the air lock **51** functions as a pressure seal between the separator unit and the container unit. The air lock **51**, as illustrated in FIGURE 2, 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.

The lower end of the container unit is provided with a

connecting conduit 52, including a gate valve 53. The conduit 52 communicates with a discharge conduit 54. Operation of the gate valve 53 permits material to be withdrawn from the container unit.

In the operation of the embodiment of the invention illustrated in the drawings, the gate valve 53 is closed, the diverter valve 44 is adjusted to block the recycling conduit 12, and communicate the charging conduit 43 with the separator unit, the valve sleeve 26 is adjusted relative to the stationary sleeve member 18, so that the inlet ports 23 and 27 are at least partially registered and the air flow valve 22 is opened. with the charging conduit 43 being connected to a supply of material to be blended, the vacuum pump 14 is started so as to apply a negative pressure to the separator unit 13 and the charging conduit 43. Under such conditions, the material to be blended will be conveyed through the charging conduit into the separator unit 13. The filter element will cause the particulate solids to be filtered out of the flow stream and dropped to the bottom of the separator unit, wherefrom they will pass through the air lock 51 into the container unit 10. After a sufficient amount of material has been deposited in the container unit and the level of the material rises above the uppermost inlet 25 of the tubular members 24, the diverter valve 44 is adjusted to block the charging conduit 43 and to communicate the recycling conduit 12 with the separator unit.

As the vacuum pump 14 continues to operate, a negative pressure is applied to the separator unit 13, the recycling conduit 12 and the collector unit 10, thereby causing air to be introduced through the air inlet conduit 20 into the collector unit. Simultaneously, as a result of the tubular members 24 being in communication with the interior of collector unit, particulate solids are drawn through the inlets 25 and pass through the tubular members 24 and inlet ports 23 and 27. Particulate solids introduced into the collector unit through the inlet ports 27 become entrained in the air flow stream, and are carried to the lower end of the collector unit, wherefrom they are drawn through the lower inlet 39 of nozzle section 38, through the recycling conduit 12, coupling member 41 and linking conduit 49 into separator unit 13. The flow stream emanating from the connecting conduit 49 will be drawn into the unit 45, wherein the stream contacts element 50, causing the particulate solids of the flow stream to be filtered out and dropped to the bottom of the separator unit, wherefrom they are discharged through the air lock 51 into the upper end of the container unit. It will be appreciated that by drawing off particulate solids from different locations within the container unit, combining the same in the collector unit and recycling the same, the particulate solids within the container will be blended. Depending on the size and other conditions of the material being blended, the aforementioned processing is continued to provide the desired degree of blending.

The aforementioned blending operation can be controlled either by adjusting the amount of air flow introduced into the collector unit by means of the valve 22, or adjusting the axial position of the valve sleeve 26 relative to the stationary sleeve member 18 to vary the effective openings between the inlet ports 23 and 27, by means of operation of the chain member 33. Either or both of these control means can be utilized to vary the characteristics of the flow stream comprising the stream of said containing entrained particulate solids.

Clogging of the opening 39 is prevented by the continuous stream of air flowing between the anticlogging device 42 and the nozzle section 38 of the recycling conduit, which is directed toward the inlet 39.

When it is desired to withdraw material from the container unit, the negative pressure applied to the apparatus is removed and the gate valve 53 is opened to permit the material within the container to flow into the discharge conduit 54. It would be possible to apply a negative pressure to the discharge conduit 54 to withdraw the material from within the container.

From the foregoing detailed description it will be evident that there are a number of changes, adaptations and modifications of the present invention which come within the province of those skilled in the art. However, it is intended that all such variations not departing from the spirit of the invention be considered as within the scope thereof as limited solely by the appended claims.

What I claim is:

1. An apparatus for blending particulate solids comprising container means for a mass of particulate solids, collector means disposed within said container means, fluid discharge means having an inlet disposed within said collector means, a plurality of passage means for conveying particulate solids within said container means to said collector means, said passage means having inlets disposed at selected loci in said container means, means for causing material flow in said passage means from said selected loci in said container means to said collector means and said fluid discharge means, means for preventing clogging of the inlet of said fluid discharge means, means for charging material into said container means and means for withdrawing material from said collector means.

2. An apparatus for blending particulate solids according to claim 1, wherein said 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 according to claim 2, wherein said passage means consist of tubular members disposed within said container means, communicating with said collector means and projecting outwardly therefrom.

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

6. An apparatus for blending particulate solids comprising container means for a mass of particulate solids, collector means disposed within said container means, a plurality of passage means for conveying particulate solids within said container means to said collector means, said passage means having inlets disposed at selected loci in said container means, means for conveying particulate solids from said collector means to said container means for recycling, means for applying a pressure differential to said passage means, said collector means and said recycling conveying means whereby particulate solids are drawn therethrough, means for controlling the flow of particulate solids in said collector means, means for charging material into said container means and means for withdrawing material from said container means.

7. An apparatus for blending particulate solids according to claim 6, including means for removing the carrier medium for the particulate solids in said recycling conveying means, permitting residual particulate solids to be returned to said container means.

8. An apparatus for blending particulate solids according to claim 7, wherein the inlets of said passage means are disposed at loci of different elevations and distances from the vertical centerline of said container means.

9. An apparatus for blending particulate solids according to claim 7, wherein said passage means consist of tubular members disposed within said container means, communicating with said collector means and projecting outwardly therefrom.

10. An apparatus for blending particulate solids according to claim 7, wherein said passage means consist of tubular member disposed within said container means, communicating with said collector means and projecting therefrom, and the inlets of said passage means are disposed at loci of different elevation and distances from the vertical centerline of said container means.

11. An apparatus for blending particulate solids comprising container means for a mass of particulate solids, collector means disposed within said container means, said container means having a carrier fluid inlet, a plurality of passage means for conveying particulate solids within said container means to said collector means, said passage means having inlets disposed at selected loci in said container means, means for conveying particulate solids from said collector means to the upper end of said container means for recycling therethrough, means for applying a negative pressure ot said passage means, said collector means and said recycling conveying means whereby carrier fluid introduced through said fluid inlet and said collector means draws particulate solids through the inlets of said passage means and carries the same to the upper end of said container means by means of said recycling conveying means, means for controlling the flow of particulate solids into said collector means, means disposed above said container means for filtering out the particulate solids carried in said carrier fluid stream, permitting filtered particulate solids to gravity fall into said container means, means for charging material to be blended into said container means and means for withdrawing blended material from said container means.

12. An apparatus for blending particulate solids according to claim 11, wherein the inlets of said passage means are disposed at loci of different elevations and distances from the vertical centerline of said container means.

13. An apparatus for blending particulate solids according to claim 11, wherein said passage means consist of tubular members disposed within said container means, communicating with said collector means and projecting outwardly therefrom.

14. An apparatus for blending particulate solids according to claim 11, wherein said passage means consist of tubular members disposed within said container means, communicating with said collector means and projecting therefrom, and the inlets of said passage means are disposed at loci of different elevations and distances from the vertical centerline of said container means.

15. An apparatus for blending particulate solids comprising container means for a mass of particulate solids, collector means disposed within said container means, said container means having an air inlet, a plurality of passage means for conveying particulate solids within said container means to said collector means, said passage means having inlets disposed at selected loci in said container means, separator means mounted above said container means and being communicable therewith, means for conveying particulate solids from said collector means to said saparator means, means for applying a negative pressure to said separator means, said conveying means, said collector means and said passage means whereby air introduced into said collector means draws particulate solids through the inlets of said passage means and carries the same in a stream to said separator means through said conveyor means, means for controlling the flow of particulate solids into said collector means, means disposed in said separator means for filtering out particulate solids carried in said air stream, permitting filtered particulate solids to gravity fall into said container means, an air lock interposed between said separator means and said container means, means for charging material to be blended into said container means and means for withdrawing material from said container means.

16. An apparatus for blending particulate solids according to claim 15, wherein said collector means comprises an enlogated stationary sleeve closed at the air inlet end thereof, said stationary sleeve is provided with a plurality of ports communicating with said passage means, and wherein said means for controlling the flow of material into said collector means comprises a movable sleeve disposed within said stationary sleeve having ports therein registrable with said ports in said stationary sleeve, and means for actuating said movable sleeve for moving said ports in said sleeves into and out of registry.

17. An apparatus for blending particulate solids according to claim 15, wherein the inlets of said passage means are disposed a loci of different elevations and distances from the vertical centerline of said container means.

18. An apparatus for blending particulate solids according to claim 15, wherein said passage means consist of tubular members disposed within said container means, communicating with said collector means and projecting outwardly therefrom.

19. An apparatus for blending particulate solids according to claim 15, wherein said passage means consist of tubular members disposed within said container means, communicating with said collector means and projecting therefrom, and the inlets of said passage means are disposed at loci of different elevations and distances from the vertical centerline of said container means.

20. An apparatus for blending particulate solids comprising container means for a mass of particulate solids, an elongated, vertical stationary sleeve mounted in said container means, said stationary sleeve having a closed upper end spaced from the upper end of said container means, means for introducing air into the upper end of said stationary sleeve, said stationary sleeve having a plurality of inlet ports communicable with upwardly and outwardly projecting tubular members, said tubular members having inlets at different elevations and distances from the vertical centerline of said container means, a valve sleeve slidably mounted within said stationary sleeve, said valve sleeve having a plurality of inlet ports registrable with the inlet ports of said stationary sleeve, means for moving said valve sleeve relative to said stationary sleeve causing the inlet ports of said sleeves to move into and out of registry to control the flow of particulate solids through said tubular members into the interior of said stationary sleeve, a separator unit mounted above said container means, an air lock interposed between said separator unit and said container means, permitting particulate solids to gravity fall from said separator unit into said container means while providing a pressure seal thereacross, a recycling conduit mounted within said sleeves, said recycling conduit having an inlet disposed at the lower ends of said sleeves and communicating at its opposite end with said separator unit, means for applying a negative pressure to said separator unit, said recycling conduit, said stationary sleeve and said tubular members whereby when a negative pressure is applied, air introduced through said air inlet into said stationary sleeve will form a flow stream with particulate solids drawn through said tubular members, which will be conveyed through said stationary member, the lower inlet of said recycling conduit and said recycling conduit and be deposited within said separator unit, filter means disposed in said separator unit for filtering out air from said stream, permitting filtered particulate solids to gravity fall through said air lock into said container means, means for charging particulate solids to be blended into said container means and means for withdrawing particulate solids from said container means.

21. An apparatus for blending particulate solids according to claim 20, wherein means are provided for controlling the air intake in said air inlet.

22. An apparatus for blending particulate solids according to claim 20, including means for preventing clogging of the inlet of said recycling conduit.

23. An apparatus for blending particulate solids according to claim **20**, wherein said means for charging particulate solids to be blended into said container means comprises a charging conduit communicable with said separator unit whereby particulate solids may be charged into the apparatus by applying a negative pressure to said separator unit.

24. An apparatus for blending particulate solids according to claim **23**, including means for selectively communicating said charging conduit and said recycling conduit with said separator unit.

References Cited

UNITED STATES PATENTS

2,805,802	9/1957	Strong	259—180 X
3,138,369	6/1964	Bennett et al.	259—95
3,158,362	11/1964	Seifarth	259—95 X
3,216,629	11/1965	Goins	259—180 X
3,258,252	6/1966	Lanier	259—95
3,268,215	8/1966	Burton	259—180

ROBERT W. JENKINS, *Primary Examiner.*