

Aug. 28, 1956

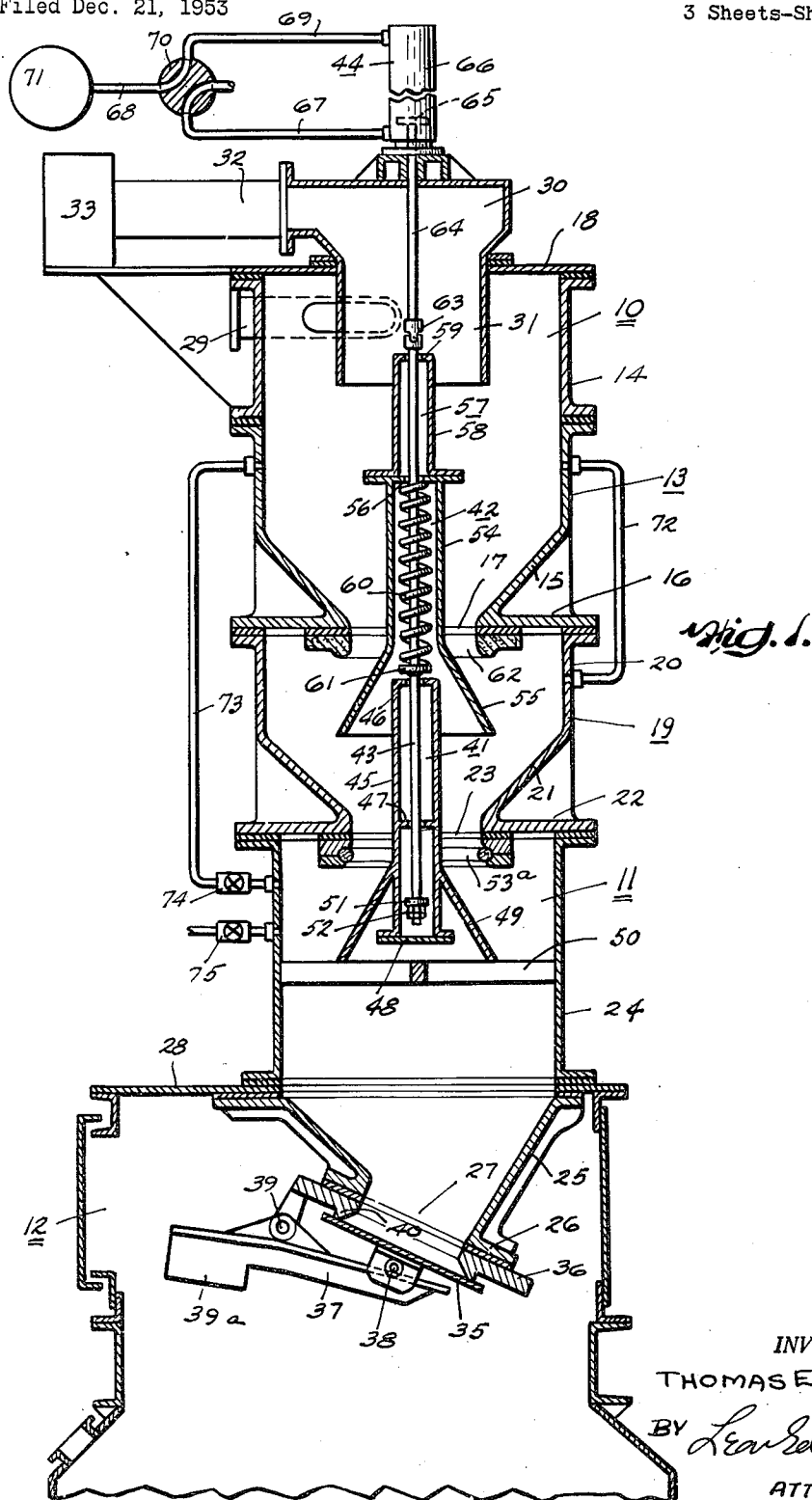
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2,760,595

CONTINUOUS OPERATION CYCLONE RECEIVER

Filed Dec. 21, 1953

3 Sheets-Sheet 1



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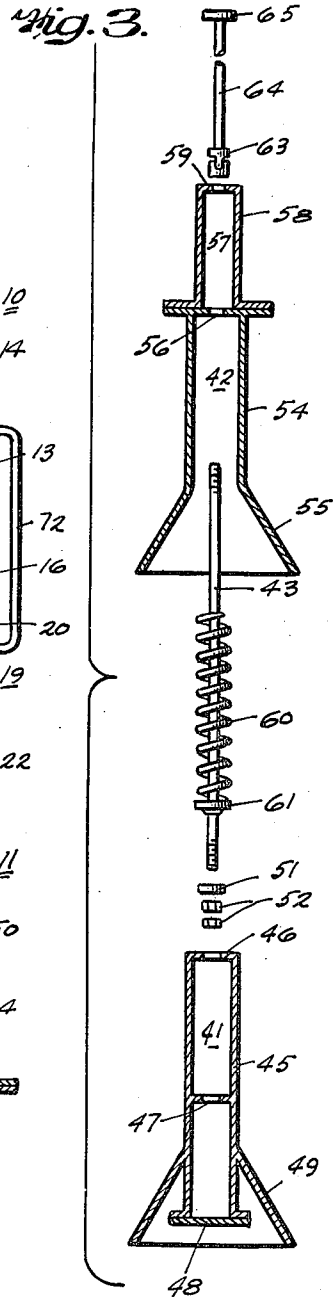
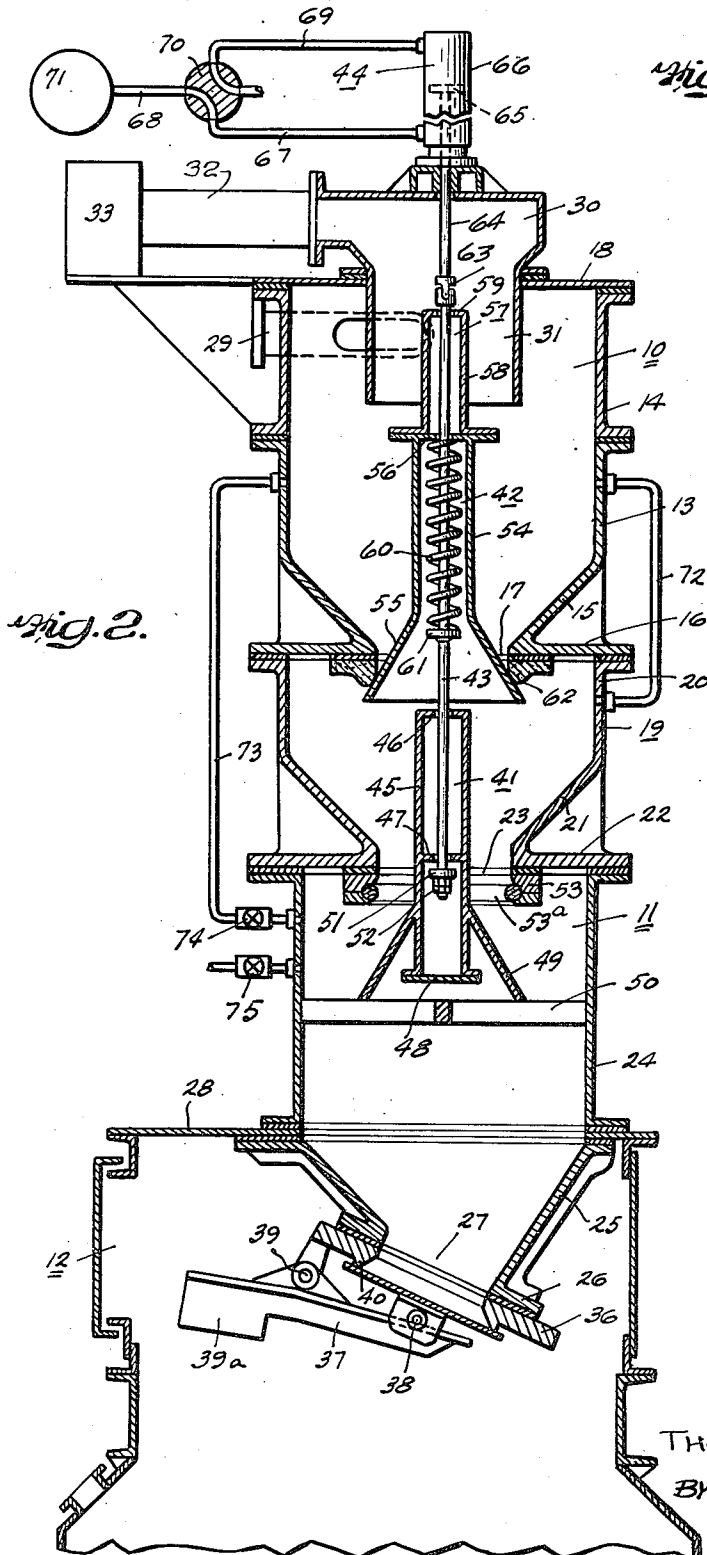
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CONTINUOUS OPERATION CYCLONE RECEIVER

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3 Sheets-Sheet 2



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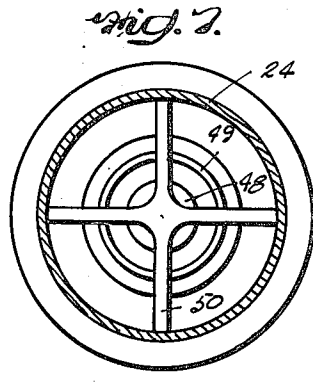
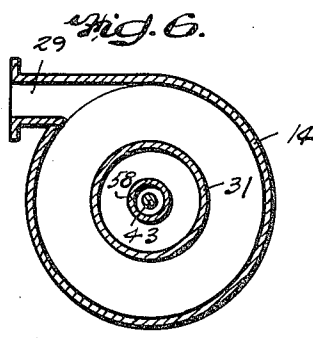
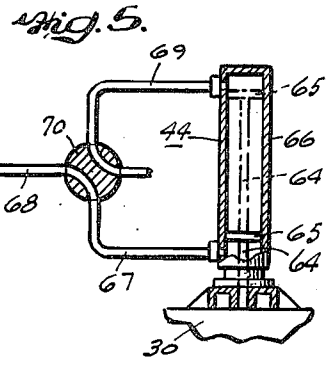
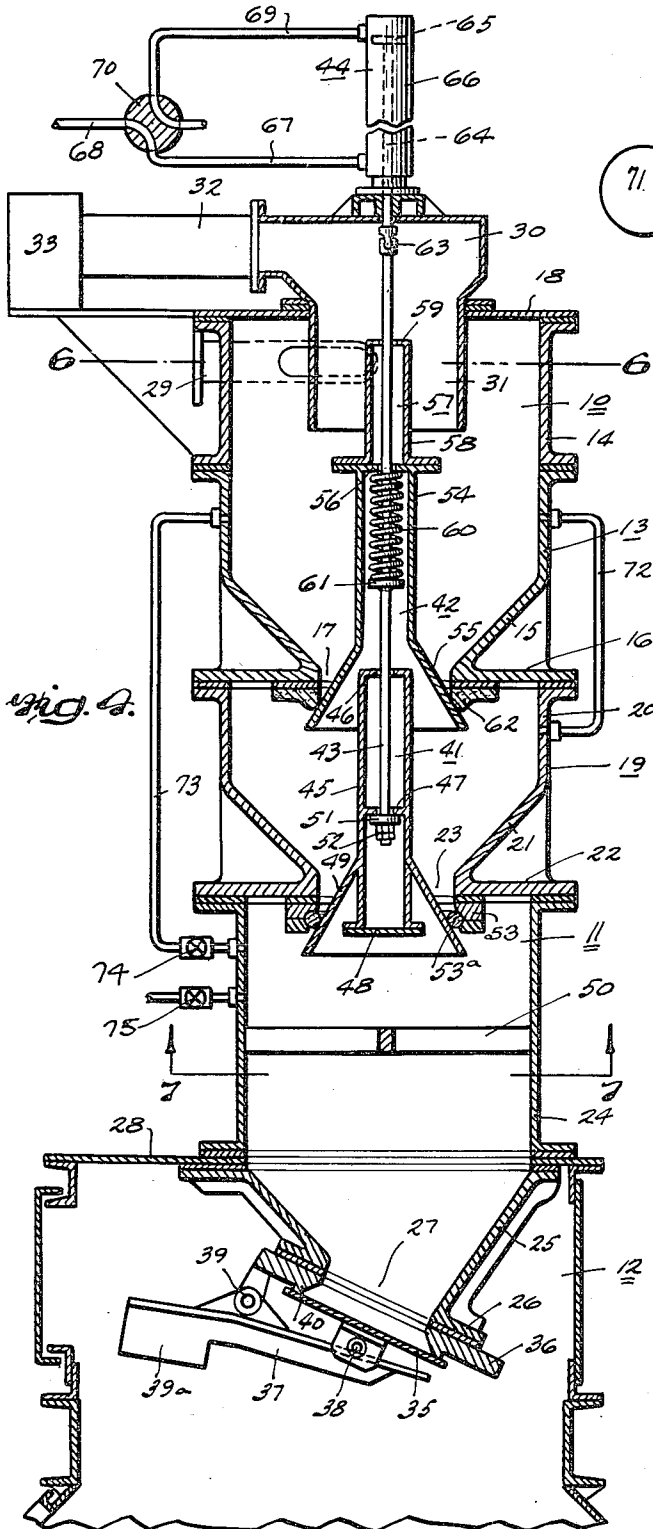
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CONTINUOUS OPERATION CYCLONE RECEIVER

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3 Sheets-Sheet 3



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CONTINUOUS OPERATION CYCLONE RECEIVER

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8 Claims. (Cl. 183—37)

This invention relates generally to apparatus for centrifugally separating solid material from a conveyor fluid and collecting the same and more particularly is concerned with an improved construction of the pneumatic type of such apparatus.

A principal object of the present invention is to provide such apparatus with valve and discharge gate means operable for continuous operation of the apparatus and intermittent discharge of material separated and collected thereby.

Another object of the present invention is to provide such apparatus with a valved passage between the principal sections thereof, the valve being operable for cutting off the flow of material at the entrance end of said passage and for hermetically sealing by delayed action the discharge end of said passage.

Still another object of the present invention is to provide such apparatus with means for equalizing the pressures in the principal sections and the valve controlled passage of the apparatus to facilitate movement of the passage controlling valve or placing in communication with atmosphere the one of the aforementioned principal sections from which the material is discharged from the apparatus to facilitate movement of the discharge gate.

Other objects and advantages of the present invention will appear more fully hereinafter, it being understood that the invention consists substantially in the combination, construction, location and general arrangement of parts, all as described in detail in the following specification, as shown in the accompanying drawings and as fully pointed out in the appended claims.

In the accompanying drawings:

Figure 1 is a vertical section through an apparatus embodying the present invention, the passage between the principal sections of the apparatus being shown fully open;

Figure 2 is the same as Figure 1 but shows the passage between the principal sections of the apparatus closed at the entrance end thereof;

Figure 3 is an exploded view of the valve of the present invention, the closure members being shown in section;

Figure 4 is the same as Figures 1 and 2 but shows the passage between the principal sections of the apparatus closed at both ends;

Figure 5 is an enlarged vertical section through the valve actuating fluid pressure motor;

Figure 6 is a horizontal section on line 6—6 of Figure 4; and

Figure 7 is a horizontal section on line 7—7 of Figure 4.

Referring to the drawings, the apparatus of the present invention comprises a collector 10 disposed directly over a receiver 11 which is mounted over a storage bin 12.

The collector 10 is provided with a separator section 13 having a cylindrically shaped upper wall portion 14 and a conically shaped lower wall portion 15, the latter terminating in an external annular flange 16 having a central opening 17. The separator section 13 is provided

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with a cover plate 18 and is seated upon an axially shorter material transfer section 19 the shape of which is generally similar to that of the separator section 13, being provided with a cylindrically shaped upper wall portion 20 and a conically shaped lower wall portion 21, the latter terminating in an external annular flange 22 having a central opening 23.

The receiver 11 is provided with a cylindrically shaped upper wall portion 24 and a downwardly converging lower wall portion 25 which terminates in an external flange 26 disposed along an inclined plane and having a central opening 27. The portion 24 of the receiver 11 has seated thereon the section 19 of the collector 10, and the portion 25 of the receiver 11 projects into the storage bin 12 through a cover plate 28 over the storage bin 12. It will be understood that the component parts of the apparatus so far described are suitably flanged and otherwise conventionally secured together.

For passing through the collector 10 the fluid medium which conveys the solid material, the collector 10 is conventionally provided with a tangentially disposed inlet nozzle 29 and an outlet duct 30, the latter being provided with a section 31 which extends vertically through the collector cover plate 18 and with a laterally extending section 32 which communicates with an exhaustor 33.

The solid material separated from the fluid medium is collected by the apparatus for discharge through the opening 27 in the inclined flange 26 at the bottom of the receiver 11. For controlling the opening 27, the receiver 11 is provided with discharge gate means including a gate in the form of a plate 35 which is carried by a frame 36 through the medium of an arm 37. The gate plate 35 is pivotally secured at 38 to the arm 37, and the latter is pivotally secured at 39 to the frame 36. For biasing the gate plate 35 toward the closed position thereof, the arm 37 is suitably weighted at 39a; and for hermetically sealing the opening 27, the frame 36 is provided with a collar in the form of a suitably raised bead 40 which extends about the opening 27 for contact with the gate plate 35.

The section 19 of the collector 10 affords a passage between the principal sections 11 and 13 of the apparatus. For controlling this passage, the apparatus is provided with valve means comprising a pair of closure members 41 and 42 which are mounted on a rod 43, the latter being suspended from a valve actuating fluid pressure motor designated generally by the reference character 44.

The closure member 41 includes a cylindrical part 45, the upper end and intermediate portions of which are provided respectively with transversely extending webs 46 and 47. The lower end portion of the closure member 41 is closed by a suitable plate 48. Referring particularly to Figure 1, the closure member 41 is provided with a bell-valve part 49 which extends around, and outwardly from, the lower end portion of the cylindrical part 45 and further extends downwardly to a level below the plate 48, being supported on a spider 50 mounted in the portion 24 of the receiver 11 so as to position the bell-valve 49 below the section 19 of the collector 10 with the upper end portion of the cylindrical wall 45 projecting into the section 19 of the collector 10. The transversely extending webs 46 and 47 of the closure member 41 are apertured, and the rod 43 is freely projected through the apertures, the lower terminal portion of the rod 43 being provided with a washer 51 carried by nuts 52—52 and disposed intermediate the plate 48 and the transverse web 47. The flange 22 of the collector section 19 has suitably secured thereto a downwardly presenting annular member 53 which extends about the central opening 23 in the flange and suitably supports a gasket 53a of rubber or other compressible material against which the valve

49 may be seated to hermetically seal the bottom of the section 19.

The closure member 42 also includes a cylindrical part 54 the lower end portion of which is flared outwardly and downwardly to form a bell-valve part 55. The upper terminal portion of the cylindrical part 54 is provided with a transversely extending web 56 upon which is suitably seated a cap 57 having a cylindrical wall 58 the upper end portion terminates in a transversely extending web 59. The transversely extending webs 56 and 59 of the closure member 42 are apertured, and the rod 43 is freely projected through these apertures. The web 56 is seated on the upper end portion of a coiled compression spring 60 which embraces the rod 43 and which in turn is seated upon an element 61 axially fixed on the rod 43; the position of the element 61 and the length of the spring 60 being such as to position the upper end portion of the cap 57 above the lower terminal of the discharge duct section 31, the bell valve 55 within the collector section 19 and the lower terminal of the valve 55 at a level below the upper terminal of the closure member 41, all as shown in Figure 1. The flange 16 of the separator section 13 has suitably secured thereto an annular member 62 which extends about the central opening 17 in the flange and against which the valve 55 may be seated.

The upper end portion of the rod 43 is secured through a universal joint 63 to the lower terminal portion of a double acting piston 64 of the valve actuated fluid pressure motor 44. The piston 64 extends through the top wall of the duct 30 and terminates in a head 65 which is disposed in a cylinder 66, the latter being suitably supplied with a fluent pressure medium from a suitable source of supply by means of conduits 67, 68 and 69, a four-way valve 70 and a pump 71.

The means for equalizing the pressures in the separator section 13, the section 19 and the receiver 11 so as to provide for movement freely of the closure members 41 and 42 of the valve means, or for placing the receiver 11 in communication with atmosphere so as to provide for movement freely of its discharge gate include a continuously open conduit 72 which places the separator section 13 constantly in communication with the section 19, an additional conduit 73 through which the separator section 13 may communicate with the receiver 11, the conduit 73 being fitted with a valve 74, and a valve 75 in an atmospheric vent which is suitably carried by the receiver 11.

Still referring particularly to Figure 1, in the operation of the apparatus, the exhaustor 33 operates continuously as a consequence of which the conveyor fluid (for example, air) is continuously drawn into the separator section 13 through the nozzle 29 and discharged through the duct 30. The solid material (for example, ash) which is initially entrained in the air is centrifugally separated from its conveying stream of air by cyclonic action of the latter in the separator section 13, dropping by the force of gravity through the opening 17 into the section 19, where it spills over the bell-valve 55 of the closure member 42, through the opening 23 into the receiver 11, where it then spills over the bell-valve 49 of the closure member 41, and then to the bottom of the receiver 11, where it collects over the closed discharge gate 35.

When a predetermined load of ash, dust or the like has collected over the discharge gate 35, the fluid pressure motor 44 acts to raise the rod 43. Initial movement of the latter raises the closure member 42 with the rod 43 from the position thereof shown in Figure 1 to that shown in Figure 2, in which condition of the apparatus the spring 60 remains uncompressed, the valve 55 is raised into engagement with its annular seat 62, and the closure member 41 remains supported on the spider 50. Continued axial shifting movement of the rod 43 upwardly causes the closure member 41 to raise from the position thereof shown in Figures 1 and 2 to that shown

in Figure 4, in which latter position the closure member 41 is raised from the spider 50 to present the valve 49 thereof firmly seated against the annular gasket 53a to thereby hermetically seal the collector 10 from the receiver 11. The spring 60 will then be compressed, as a consequence of which the closure member 42 is firmly seated against its annular seat 62.

It will be observed that there is lost motion between the rod 43 and the closure member 41 during the aforementioned initial movement of the rod 43, and between the rod 43 and the closure member 42 during the aforementioned continued movement of the rod 43, as a consequence of which delayed action closing of the member 41 is effected. The purpose of the delayed action is to provide a period of time after the flow of ash has been cut off by the closure member 42 during which any ash in the section 19 may clear the same and drop into the receiver 11 so that none will lodge between the bell-valve 49 of the closure member 41 and the annular member 53 to prevent hermetic sealing of the opening 23 by the closure member 41.

In the conditions of the apparatus shown in Figures 1, 2 and 4, the valves 74 and 75 are closed. The pressures prevailing within the collector 10 and the receiver 11 are uniform and subatmospheric, as a consequence of which the difference in the pressures prevailing within and without the receiver 11 and acting on the underside of the discharge gate 35 assist the counterweight 39a in keeping the discharge gate 35 closed.

While the apparatus is in the condition shown in Figure 4, the valve 75 is opened in order to place the receiver 11 in communication with atmosphere. Thus the pressures prevailing within and without the receiver 11 are equalized, whereupon the weight of the load of ashes accumulated in the receiver 11 over the discharge gate 35 to a predetermined level below the spider 50 swings the discharge gate open against the influence of the counterweight 39a for discharging the load through the opening 27 into the storage bin 12. When the load has been thus discharged, the gate 35 automatically closes. The valve 75 is then closed, thereby cutting off communication of the receiver 11 with atmosphere. Then valve 74 is opened and permitted to stay open until the subatmospheric pressures prevailing within the collector 10 and the receiver 11 are again equal, whereupon the valve 74 is again closed.

The fluid pressure motor 44 now acts to lower the rod 43. Initial downward movement of the latter lowers the closure member 41 to the spider 50, without however disengaging the valve 55 from its seat 62 due to the lost motion existing between the rod 43 and the closure member 42. Upon continued downward axial shifting movement of the rod 43 relative to the member 41, the closure member 42 is lowered into its position shown in Figure 1, in which latter position the spring 60 is fully expanded. Upon such lowering of the closure member 42, the ash accumulated in the separator section 13 over the closure member 42 during the discharge operation hereinabove described drops through the section 19 into the receiver 11 to start the collection of another load of ash over the discharge gate 35. If the valve 74 has been left open, the same is closed prior to opening of the valve 75 which is a necessary prelude to discharge of the ash from the receiver 11.

It will be observed that the rod 43 is freely suspended from the piston 64 of the fluid pressure motor 44 through the medium of the universal joint 63, the purpose being to suitably center the closure members 41 and 42 and to mount the same in a manner which facilitates the proper seating of the valves 49 and 55 respectively against their annular seats 53 and 62. It will be additionally observed that in the conditions of the apparatus shown in Figures 1 and 4, the upper end portion of the closure member 41 projects upwardly into the valve 55 of the closure member 42, and that in all conditions of the apparatus the cap 57 of the closure member 42 projects

upwardly into the section 31 of the duct 30, the purpose being to prevent any accumulation of ashes in closure members 41 and 42 which could interfere with the axial shifting movement thereof on the rod 43.

It will be understood, of course, that the apparatus hereinabove shown and described is susceptible of various changes and modifications which may be made from time to time without any departure from the general principles or real spirit of the invention. For example, the valves 74 and 75 and the fluid pressure motor 44 may be arranged for fully automatic operation. Accordingly, it is intended to claim the present invention broadly, as well as specifically, as indicated in the appended claims.

What is claimed as new and useful is:

1. In an apparatus of the character described, a collector for solid material, an exhaustor for drawing through said collector a fluid in which the solid material is initially entrained and from which the same is centrifugally separated in the collector, said collector being adapted for discharging the material under the influence of gravity through an elongated discharge passage formed therein, a receiver for the material discharged from said collector through said passage, a discharge gate hermetically sealing a discharge opening formed in said receiver, said gate being operable for discharging the material under the influence of gravity from said receiver, a valve adapted to cut off the flow of said material from said collector into said receiver at the entrance end of said passage and to hermetically seal said collector from said receiver at the discharge end of said passage, said discharge gate and valve being operable to hermetically seal said collector constantly from atmosphere so as to permit continuous operation of said collector and intermittent discharge of the material from said receiver, and means independent of said discharge gate and valve operable for equalizing the pressures in said receiver and collector or placing said receiver in communication with atmosphere.

2. In an apparatus of the character described, a collector for solid material having a principal section and an elongated discharge passage, an exhaustor for drawing through said collector a fluid in which the solid material is initially entrained and from which the same is centrifugally separated in the collector, said collector being adapted for discharging the material under the influence of gravity through said elongated discharge passage, a receiver for the material discharged from said collector through said passage, a discharge gate hermetically sealing a discharge opening formed in said receiver, said gate being operable for discharging the material under the influence of gravity from said receiver, a valve adapted to cut off the flow of said material from said collector into said receiver at the entrance end of said passage and to hermetically seal said collector from said receiver at the discharge end of said passage, said discharge gate and valve being operable to hermetically seal said collector constantly from atmosphere so as to permit continuous operation of said collector and intermittent discharge of the material from said receiver, means permanently establishing communication between the principal section and the discharge passage of said collector so as to equalize the pressures therein, and means independent of said discharge gate and valve operable for establishing communication between said collector and receiver to equalize the pressures therein and optionally for establishing communication between said receiver and atmosphere.

3. In an apparatus of the character described, a collector for solid material initially entrained in a fluid and then centrifugally separated in the collector from the fluid, said collector being adapted for discharging the material under the influence of gravity through an elongated discharge passage formed therein, a receiver for the material discharged from said collector through said passage, a discharge gate hermetically sealing a discharge opening

formed in said receiver, said gate being operable for discharging the material under the influence of gravity from said receiver, and a valve comprising a pair of closure members associated respectively with the entrance and discharge ends of said passage, said members being shiftable for closure of the entrance end of said passage by the associated closure member for cutting off the flow of said material from said collector into said receiver and for delayed action closure of the discharge end of said passage by the other closure member for hermetically sealing said collector from said receiver, said discharge gate and valve being operable to hermetically seal said collector constantly from atmosphere so as to permit continuous operation of said collector and intermittent discharge of the material from said receiver.

4. In an apparatus of the character described, a collector for solid material initially entrained in a fluid and then centrifugally separated in the collector from the fluid, said collector being adapted for discharging the material under the influence of gravity through an elongated discharge passage formed therein, a receiver for the material discharged from said collector through said passage, a discharge gate hermetically sealing a discharge opening formed in said receiver, said gate being operable for discharging the material under the influence of gravity from said receiver, and a valve comprising axially shiftable suspended means extending through said passage, and a pair of closure members each mounted for lost motion on said suspended means and associated respectively with the entrance and discharge ends of said passage, said closure members being shiftable by said suspended means for closure of the entrance end of said passage by the associated closure member for cutting off the flow of said material from said collector into said receiver and for delayed action closure of the discharge end of said passage by the other closure member for hermetically sealing said collector from said receiver, said discharge gate and valve being operable to hermetically seal said collector constantly from atmosphere so as to permit continuous operation of said collector and intermittent discharge of the material from said receiver.

5. In an apparatus of the character described, a collector for solid material initially entrained in a fluid and then centrifugally separated in the collector from the fluid, said collector being adapted for discharging the material under the influence of gravity through an elongated discharge passage formed therein, a receiver for the material discharged from said collector through said passage, a discharge gate hermetically sealing a discharge opening formed in said receiver said gate being operable for discharging the material under the influence of gravity from said receiver, a valve comprising an axially shiftable suspended rod extending through said passage, a pair of closure members shiftable mounted on said rod and associated respectively with the entrance and discharge ends of said passage, axially spaced seating elements on said rod associated respectively with said closure members, and yieldable means disposed between the closure member at the entrance end of said passage and the associated seating element on said rod, and means for supporting the closure member at the discharge end of said passage in unseated relation to the other seating element on said rod, said closure members being shiftable by said suspended rod for closure of the entrance end of said passage by the associated closure member for cutting off the flow of said material from said collector into said receiver and for delayed action closure of the discharge end of said passage by the other closure member for hermetically sealing said collector from said receiver, said discharge gate and valve being operable to hermetically seal said collector constantly from atmosphere so as to permit continuous operation of said collector and intermittent discharge of the material from said receiver.

6. In an apparatus of the character described, a collector for solid material initially entrained in a fluid and then

centrifugally separated in the collector being adapted for discharging the material under the influence of gravity through an elongated discharge passage formed therein, a receiver for the material discharged from said collector through said passage, a discharge gate hermetically sealing a discharge opening formed in said receiver, said gate being operable for discharging the material under the influence of gravity from said receiver, a valve comprising an axially shiftable rod freely suspended through the medium of a universal coupling and extending through said passage, a pair of closure members shiftable mounted on said rod and associated respectively with the entrance and discharge ends of said passage, axially spaced seating elements on said rod associated respectively with said closure members, and a coil compression spring wrapped around said rod and disposed between the closure member at the entrance end of said passage and the associated seating element on said rod, and a spider in said receiver for supporting the closure member at the discharge end of said passage in unseated relation to the other seating element on said rod, said closure members being shiftable by said suspended rod for closure of the entrance end of said passage by the associated closure member for cutting off the flow of said material from said collector into said receiver and for delayed action closure of the discharge end of said passage by the other closure member for hermetically sealing said collector from said receiver, said discharge gate and valve being operable to hermetically seal said collector constantly from atmosphere so as to permit continuous operation of said collector and intermittent discharge of the material from said receiver.

7. In apparatus of the character described, a solid materials collector having elongated discharge passage means, an exhaustor for drawing through said collector a fluid in which the solid material is initially entrained and from which it is centrifugally separated in the collector for gravity discharge thereof through the passage means aforesaid, receiver means for the material discharged from said collector through said passage means, discharge gate means hermetically sealing said receiver means, said gate means being operable for discharging the material under the influence of gravity from said receiving means, valve means adapted to cut off the flow of material from said collector into said receiver means at the entrance end of said passage means and to hermetically seal said collector from said receiver means at the discharge end of said passage means, said discharge gate and valve means being operable to hermetically seal said collector constantly from atmosphere so as to permit continuous operation of said collector and intermittent discharge of the material from said receiver means, and means operable for equalizing the pressures in said receiver means and collector

or placing said receiver means in communication with atmosphere.

8. In apparatus of the character described, a collector for solid material having discharge means including at least one elongated passage through which material is gravity discharged from said collector, an exhaustor for drawing through said collector a fluid in which the solid material is initially entrained and from which the same is centrifugally separated in the collector and discharged therefrom in the manner aforesaid, receiver means including a receiver for each of said discharge passages, each receiver being adapted for receiving the material discharged through the associated passage, discharge gate means including a discharge gate for each of said receivers, each discharge gate being adapted to hermetically seal a discharge opening formed in the associated receiver and being operable for discharging the material under the influence of gravity from the receiver, valve means adapted to control the flow of material from said collector into said receiver means at the entrance end of said passage means and to hermetically seal said collector from said receiver means at the discharge end of said passage means, the discharge gate and valve means being operable to hermetically seal said collector constantly from atmosphere so as to permit continuous operation of said collector and intermittent discharge of the material from said receiver means, and means independent of said discharge gate and valve means operable for establishing communication between said collector and receiver means to equalize the pressures therein and optionally for establishing communication between said receiver means and atmosphere.

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