United States Patent

Wilder

[15] **3,675,374**

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[54] DIRECT PRESSURE TREATING DEVICE

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[73] Assignee: **The Carborundum Company**, Niagara Falls, N.Y.

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[52] **U.S. Cl.** **51/12**

[51] **Int. Cl.** **B24c 3/00**

[58] **Field of Search** 51/12

[56] **References Cited**

UNITED STATES PATENTS

1,171,286	2/1916	Wadsworth	51/12
1,443,762	1/1923	Smith	51/12
2,597,434	5/1952	Bishop et al.	51/12
3,521,407	7/1970	Nalley et al.	51/12

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[57] **ABSTRACT**

A direct pressure treating device includes a nozzle and a lower chamber communicating with the nozzle. A middle chamber is disposed between the lower chamber and an upper chamber, while the upper chamber communicates with a feed hopper. A first valve is arranged between the lower and middle chamber, a second valve is between the middle and upper chambers, and a third valve is between the upper chamber and feed hopper. At least one of these valve is diaphragm operated with the diaphragm being arranged in a closed housing and disposed in such a manner as to overcome the force of sealing means for thereby opening the valve.

9 Claims, 14 Drawing Figures

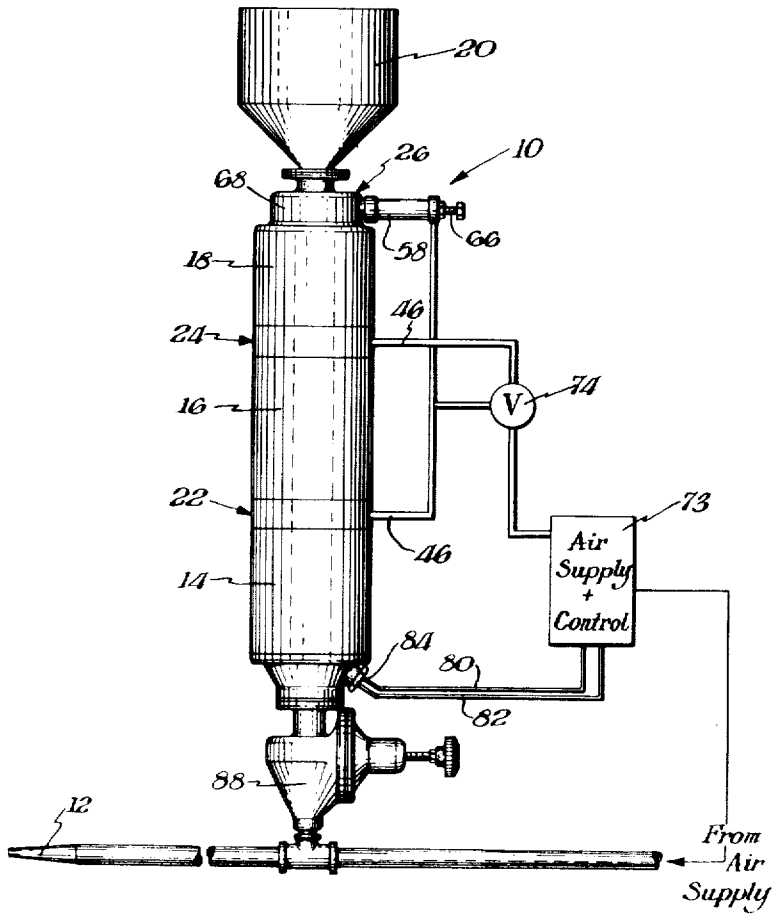


Fig. 1.

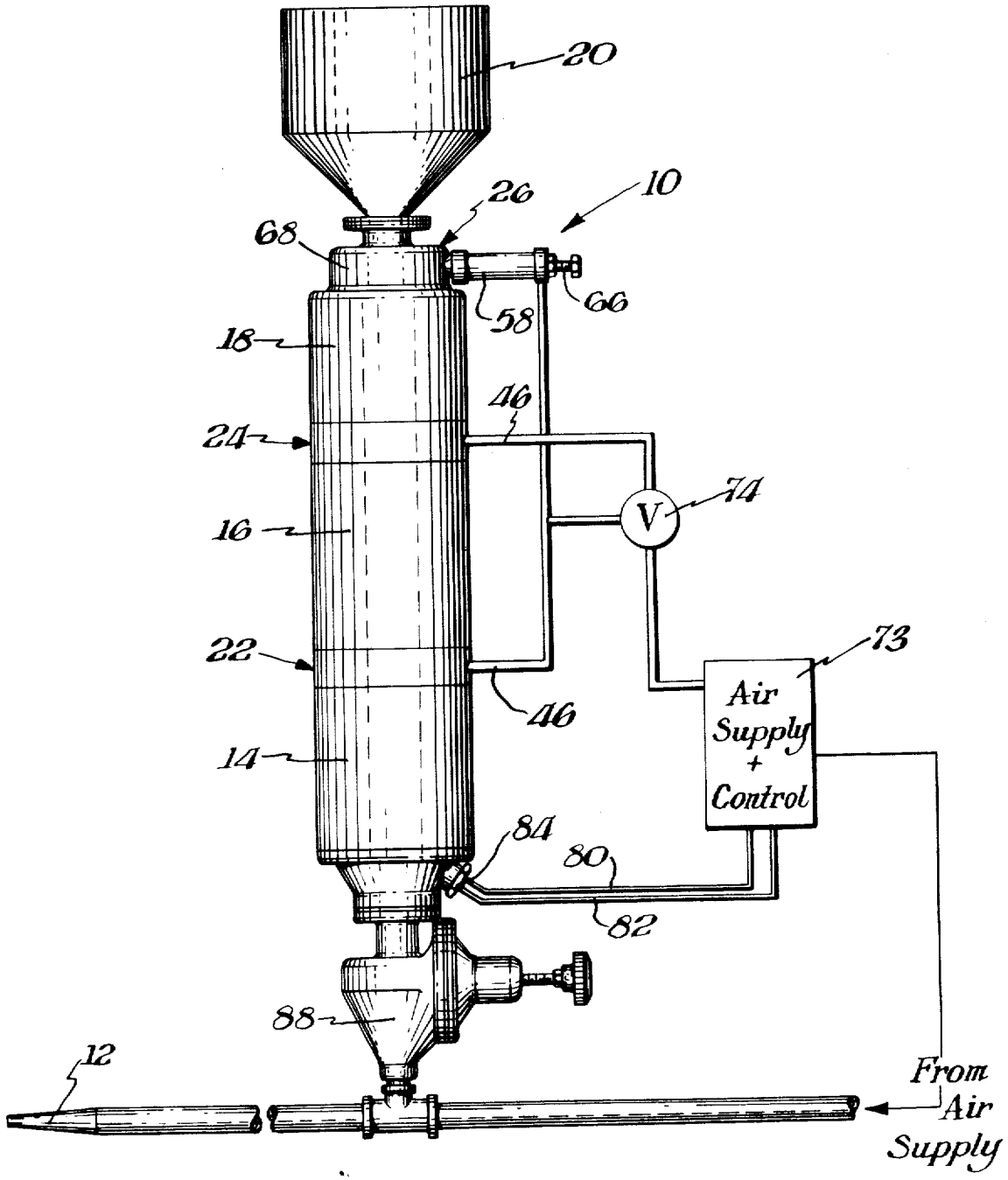

20
26
10
68
66
58
18
46
24
74
V
16
22
73
Air Supply + Control
46
14
84
80
82
88
12
From Air Supply

Fig. 2.

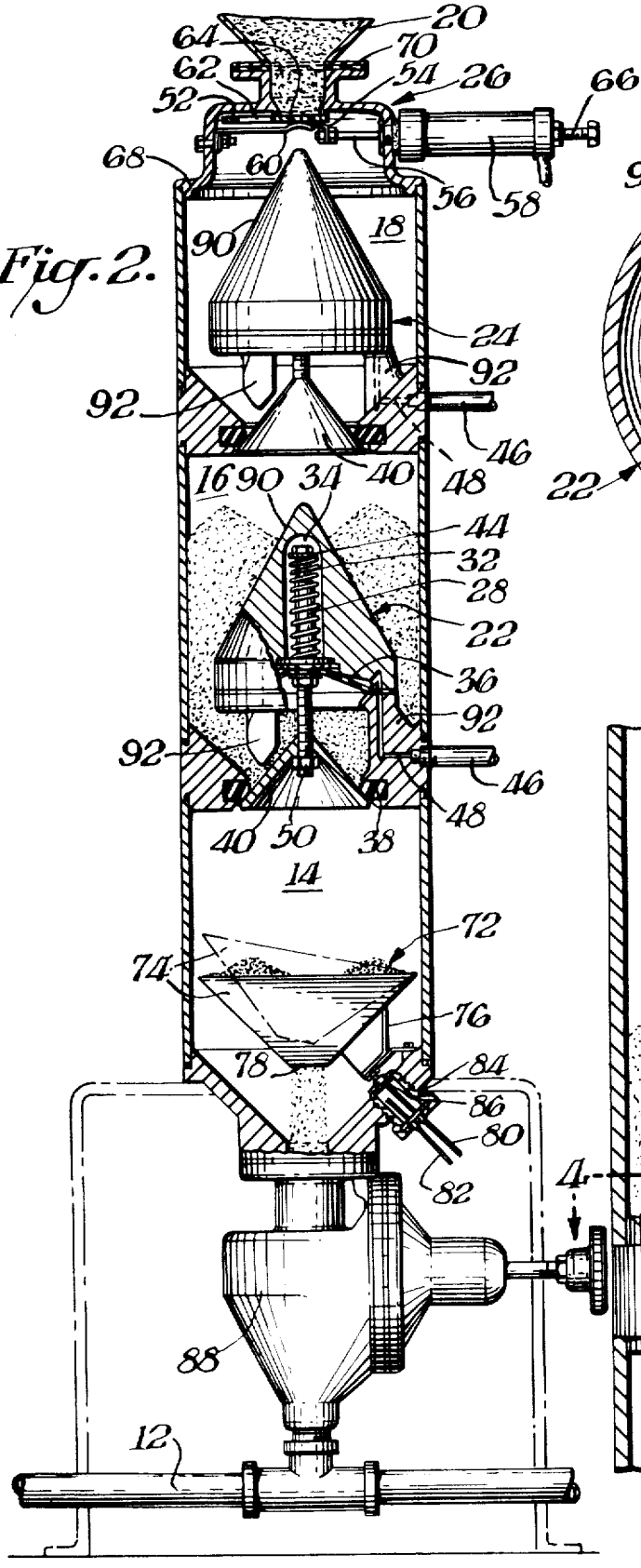


Fig. 4.

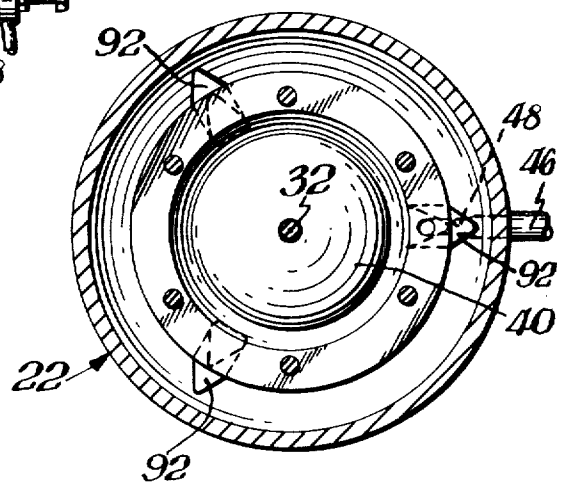
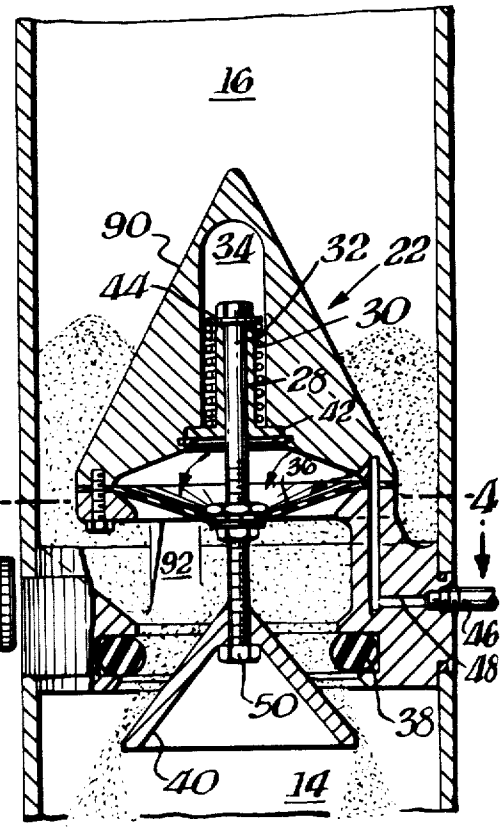


Fig. 3.



DIRECT PRESSURE TREATING DEVICE

BACKGROUND OF INVENTION

A recently developed metal cleaning device which utilizes a direct pressure treating nozzle for peening metal surfaces is described in U. S. Pat. No. 3,521,407. The device of that patent includes a plurality of chambers; the lowermost chamber is maintained under pressure and the middle chamber is intermittently under pressure, while an upper chamber is provided with a feed hopper. The successful operation of the device depends to a large extent upon the reliability of the valves.

SUMMARY OF INVENTION

An object of this invention is to provide an improved device of the above type.

A further object of this invention is to provide such a device which includes reliably operating valves.

In accordance with this invention a direct pressure treating device includes a nozzle and a lower chamber communicating with the nozzle. A middle chamber is disposed between the lower chamber and an upper chamber, while the upper chamber communicates with a feed hopper. A first valve is arranged between the lower and middle chamber, a second valve is between the middle and upper chambers and a third valve is between the upper chamber and a feed hopper. At least one of these valves is diaphragm operated with the diaphragm being arranged in a closed housing and disposed in such a manner as to overcome the force of sealing means for opening the valve under pressure.

The valve between the upper chamber and feed hopper may be a slidable gate valve which includes an operating member flexibly connected to a slidable plate and with a piston and cylinder assembly connected to the operating member.

The diaphragm operated valve may include a stem connected to the diaphragm and movable therewith and with a conical skirt or closure member mounted on the stem. A spring may be mounted on the stem for urging the skirt upward for contact with the sealing ring.

Each of the valves between the lower and middle chambers and between the middle and upper chambers may be of the above diaphragm operated type with single pressure means being connected thereto for controlling the actuation of the valves and the intermittent pressurizing of the middle chamber. Sequential control means are provided for assuring the proper sequence of operations. This sequential control means may include a level detection unit in the lower chamber to initiate the sequential cycle in accordance with the level of material in the chamber.

THE DRAWINGS

FIG. 1 is a front elevation view of a device in accordance with this invention;

FIG. 2 is a cross-sectional elevation view of the device shown in FIG. 1;

FIG. 3 is a cross-sectional elevation view on an enlarged scale of a portion of the device shown in FIG. 2; and

FIG. 4 is a cross-sectional view taken through FIG. 3 along the line 4—4 with the diaphragm omitted.

DETAILED DESCRIPTION

As shown in FIG. 1 the device 10 is of the same general type as that disclosed in U. S. Pat. No. 3,521,407 the details of which are incorporated herein by reference thereto. Device 10 includes a peening nozzle 12, a lower chamber 14, middle chamber 16, upper chamber 18 and feed hopper 20 for the peening particles. The details of these chambers and its valving are most clearly shown in FIG. 2. As indicated therein a first valve 22 is disposed between lower chamber 14 and middle chamber 16 while a second similar valve 24 is provided between middle chamber 16 and upper chamber 18. Additionally, a third valve 26 is arranged between feed hopper 20 and upper chamber 18.

FIGS. 2 and 3 show the details of valve 22 (and of course valve 24 would be similarly constructed). As indicated therein valve 22 is diaphragm operated rather than utilizing a piston cylinder assembly as in U. S. Pat. No. 3,521,407. By use of the valve 22 all lubricated parts such as spacer 28, spring 30 and stem 32 are sealed in a closed housing or chamber against dust and fine abrasive particles which cause moving surfaces to gall and seize. As shown in FIG. 3 the chamber 34 which houses these moving parts is closed by diaphragm 36 also mounted on stem 32. Valve 22 includes an O-ring type valve seat 38 through which the abrasive particles fall when the valve is open. At the end of stem 32 a closure member or conical skirt 40 is mounted for movement into and out of engagement with valve seat 38. Conveniently stem 32 is threaded to permit proper vertical adjustment of the various elements mounted on the stem. Resilient means or spring 30 reacts between flange 42 on spacer 28 and stop member or washer 44 to urge stem 32 upward thereby biasing or urging skirt 40 against seat 38.

Valve 22 is opened by the supply of air through air line 46 and through suitable passages 48 into housing 34. The pressure build-up in the housing reacts against diaphragm 36 to overcome the action of spring 30 thereby causing skirt 40 to move away from seat 38 and thus permitting the abrasive particles to flow from middle chamber 16 into lower chamber 14. Valve 22 is particularly advantageous in that it is spring loaded. In this respect only one air line is required to open the valve hence a three way valve can be used instead of a more expensive four way valve. Moreover, since spring 30 is arranged to urge the valve in its closing position, if there should be any failure in air supply such as a leak in the air line or the air supply being turned off, valve 22 automatically closes. Thus valve 22 is fail-safe. Moreover, the conically shaped skirt 40 is drawn against O-ring seat 38 by being supported by the diaphragm 36 in a floating self-centering manner. In this respect the conical skirt 40 is threaded onto stem 32 in the proper position and locked thereto by nut 50. Accordingly, variations in the manufacture of the components can be taken into account during their assembly.

The inclusion of spacer 28 is advantageous not only to provide a convenient member against which spring 30 may react but also to limit the travel of the diaphragm in both directions thus preventing damage to diaphragm 36 and thereby assuring longer life.

Although valves 22 and 24 are of the same construction, valve 26 differs in construction. In this respect valve 26 utilizes a slidable gate or plate 52 made of suitable wear resistant material such as polyurethane which has proven to be outstandingly effective in its long life expectance. Plate 52 is flexibly connected to operating member 54 which in turn is mounted on piston rod 56 which in turn reciprocates into and out of cylinder 58. A leaf spring 60 reacts against the under surface of plate 52 to assure its proper horizontal positioning during the movement caused by reciprocation of piston rod 56. Plate 52 contains an opening 62 which is alignable with the discharge opening 64 at the end of feed hopper 20 whereby abrasive particles may flow from the feed hopper into upper chamber 18. As previously indicated this sliding plate 52 is held against the flat sealing surface at the discharge end of hopper 20 by spring 60. As is apparent an increase in friction can only reach the amount caused by the upward force of spring 60 and hence the gate valve 26 is jam proof.

The use of a flexible coupling of operating member 54 to slide plate 52 is particularly advantageous since any lack of alignment of the slide plate would not be transmitted to the rigid piston rod 56. As shown in FIG. 2 actuating cylinder 58 includes an adjustable stop screw 66 at the cap end thereof to limit the travel of the slide plate 52. In this manner the degree of alignment of openings 62 and 64 can be adjusted which in turn adjusts the flow capacity of gate valve 26. Since this part of device 10 operates in atmospheric pressure, the sliding gate need only provide shut off service.

In practice gate valve 26 would be arranged within a closure member 68 at the top of upper chamber 18. Closure member

68 would in turn be secured to hopper or bin 20 with a suitable gasket 70 arranged therebetween to assure a dust free connection thereof.

Device 10 also utilizes a fluidic system to control the sequential opening and closing of the various valves. In operation a signal detection unit 72 in lower chamber 14 causes the sequential cycle to begin. The fluidic pulse unit produces a series of pulses to the appropriate fluidic switch and control means 73 and finally to valve means 74 (FIG. 1) which cause the function of device 10 to operate in a predetermined consecutive sequential manner. In this respect first lower valve 22 opens and remains open for a sufficient time for the abrasive charge to pass through seat 38 and into the lower chamber 14. Valve 22 then closes. Next middle chamber 16 which had been under pressure is exhausted to atmospheric pressure to balance its pressure to that of upper chamber 18. Since valve 22 is closed lower chamber 14 remains pressurized. Middle valve 24 is then opened and a charge of abrasive passes from upper chamber 18 into middle chamber 16. Valve 24 then closes and middle chamber 16 is again pressurized to the same pressure as chamber 14. This equilization of pressure is necessary so that when valve 22 is later opened there will be no change in the steady blasting pressure through nozzle 12. Gate valve 26 is in parallel connection with lower valve 22 and opens to permit a charge of abrasive to flow into upper chamber 18 at the same time that abrasive particles are flowing into lower chamber 14 when valve 22 is opened.

FIG. 2 shows the details of level detection unit 72. As indicated therein a frusto-conical open ended tilting bin 74 is provided in lower chamber 14 directly under valve seat 38. When there is a low level of abrasive particles in chamber 14 bin 74 is urged by spring 76 into the inclined position indicated in phantom in FIG. 2. Bin 74 includes an open end or discharge opening 78 to permit the falling abrasive which is received therein to flow through the bin and ultimately into the nozzle 12. A pair of air circulating lines 80, 82 are provided in a plug or housing 84 in the lower portion of chamber 14. When bin 74 is in the tilted position indicated in phantom there is communication between lines 80 and 82. Spring member 76, however, includes a movable closure member 86 which closes off line 80 to break the circulation caused by downward movement of bin 74 and therefore also downward movement of spring 76. The breaking or the opening of circulation may be utilized for initiating the sequential operation previously discussed. In operation as abrasive is received in bin 74 the bin moves from the tilted position to the horizontal position indicated in solid and simultaneously therewith member 86 moves toward line 80. When a predetermined level of abrasive is reached, the level is detected by the breaking of circulation between the lines 80 and 82.

The falling abrasive particles pass from lower chamber 14 into a suitable metering chamber 88 and ultimately into nozzle 12. Metering chamber 88 may be of the type described in detail in copending application Ser. No. 837,271; filed June 27, 1969 the details of which are incorporated herein by reference thereto. Accordingly, it is not necessary for the purposes of this invention to repeat a description of these details.

As can be seen particularly from FIG. 2 device 10 is highly efficient by the inclusion of the various diaphragm operated valves which are sheltered from the abrasive particles. The flow of abrasive particles is also enhanced by the conical surfaces of housing 90 which houses various components of the diaphragm operated valves. Flow of abrasives is facilitated by the use of spaced legs 92 connecting housing 90 to the wall of the device. Moreover the operation of the valves are fail-safe so that nozzle 12 will receive only the required amount of abrasive particles necessary for the treating operation.

What is claimed is:

1. A direct pressure treating device comprising a treating nozzle, a lower chamber communicating with said nozzle, a middle chamber communicating with said lower chamber, an upper chamber communicating with said middle chamber, a feed hopper communicating with said upper chamber through an outlet opening, a first valve between said lower chamber and said middle chamber, a second valve between said middle chamber and said upper chamber, a third valve between said upper chamber and said feed hopper, said third valve being a slidable gate valve having an opening movable into and out of registry with the outlet opening of said feed hopper, said first and second of said valves being a diaphragm operated valve and including a valve seat, a closure member for selectively seating against said seat for closing communication therethrough, a diaphragm, transmitting means connecting said diaphragm to said closure member, a housing, said diaphragm being in said housing, sealing means for urging said closure member against said seat, and pressure means connected to said housing for overcoming the force of said sealing means to open said valve.

2. A device as set forth in claim 1 wherein said transmitting means includes a stem connected to said diaphragm and movable therewith, and said closure member being a conical skirt mounted on said stem.

3. A device as set forth in claim 2 wherein the housing for said first valve is mounted in said middle chamber and the housing for said second valve is mounted in said upper chamber, said sealing means for each of said first and second valves being a spring mounted on its stem and urging said skirt upward.

4. A device as set forth in claim 3 wherein said pressure means includes a single pressure line for opening said skirt, said skirt being mounted on said stem in a floating self-centering manner, and a spacer being mounted on said stem to limit the amount of movement of said diaphragm.

5. A device as set forth in claim 1 wherein said gate valve includes a slidable plate, an operating member flexibly connected to said plate for controlling the sliding movement thereof, and a piston and cylinder assembly connected to said operating member.

6. A device as set forth in claim 5 wherein said plate is made of wear resistant polyurethane, a leaf spring reacting against said plate for maintaining said plate in a horizontal plane, and said piston and cylinder assembly including stroke limiting means.

7. A device as set forth in claim 1 wherein said pressure means also actuates said gate valve, said lower chamber being under constant pressure and said middle chamber being under intermittent pressure, and sequential control means connected to said pressure means for simultaneously opening said first valve and said gate valve, then for closing said first valve and said gate valve, then for exhausting said middle chamber to the atmosphere, then for opening said second valve while said first valve and said gate valve remain closed, and then for pressurizing said middle chamber to complete the sequential cycle.

8. A device as set forth in claim 7 wherein said sequential control means includes a level detection unit in said lower chamber for initiating the sequential cycle in accordance with the level of treating material in said lower chamber.

9. A device as set forth in claim 8 wherein said level detection unit includes a tilting bin in said lower chamber disposed under the valve seat of said first valve, a discharge opening in said bin, air circulating lines, a moving member disposed for breaking the circulation of said air lines, and resilient means connecting said moving member to said bin for breaking the circulation when said bin is in a predetermined position in said lower chamber.

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