Nov. 4, 1952 A. H. SANBORN ET AL 2,616,766

MATERIAL DISTRIBUTING APPARATUS

Filed Aug. 24, 1948 2 SHEETS—SHEET 1

Fig. 1.

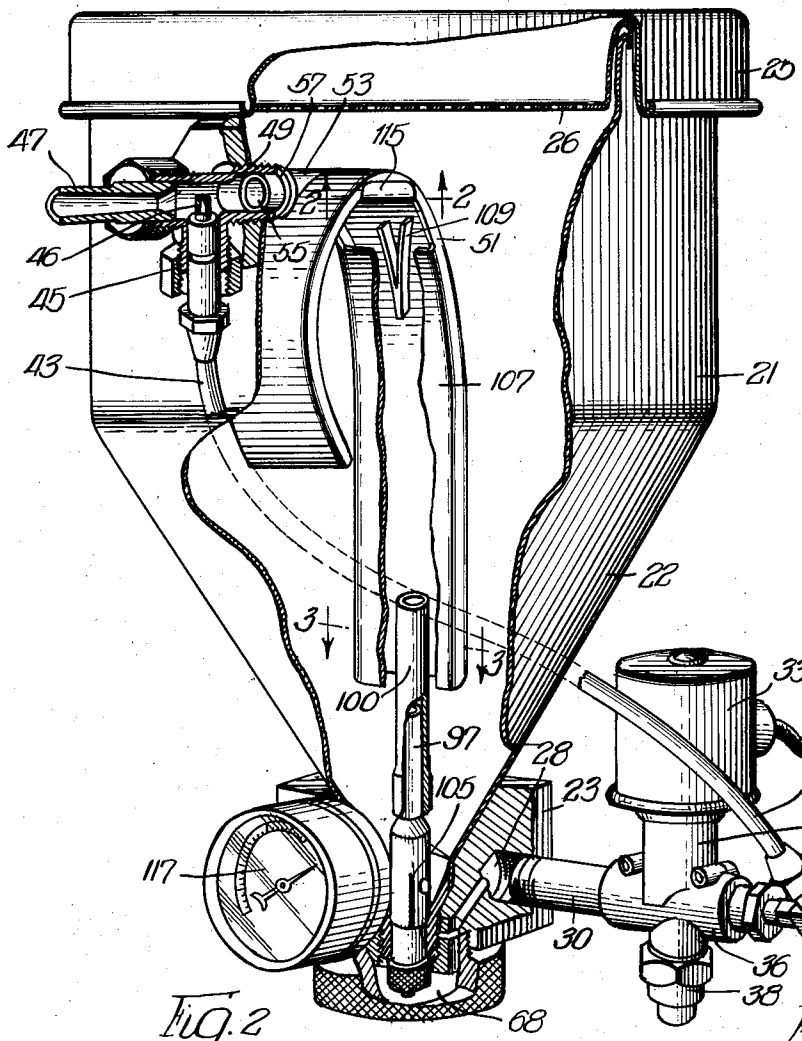


Fig. 2.

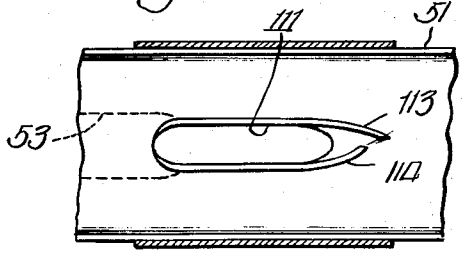
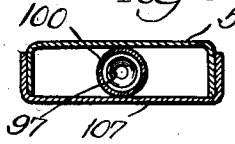


Fig. 3.



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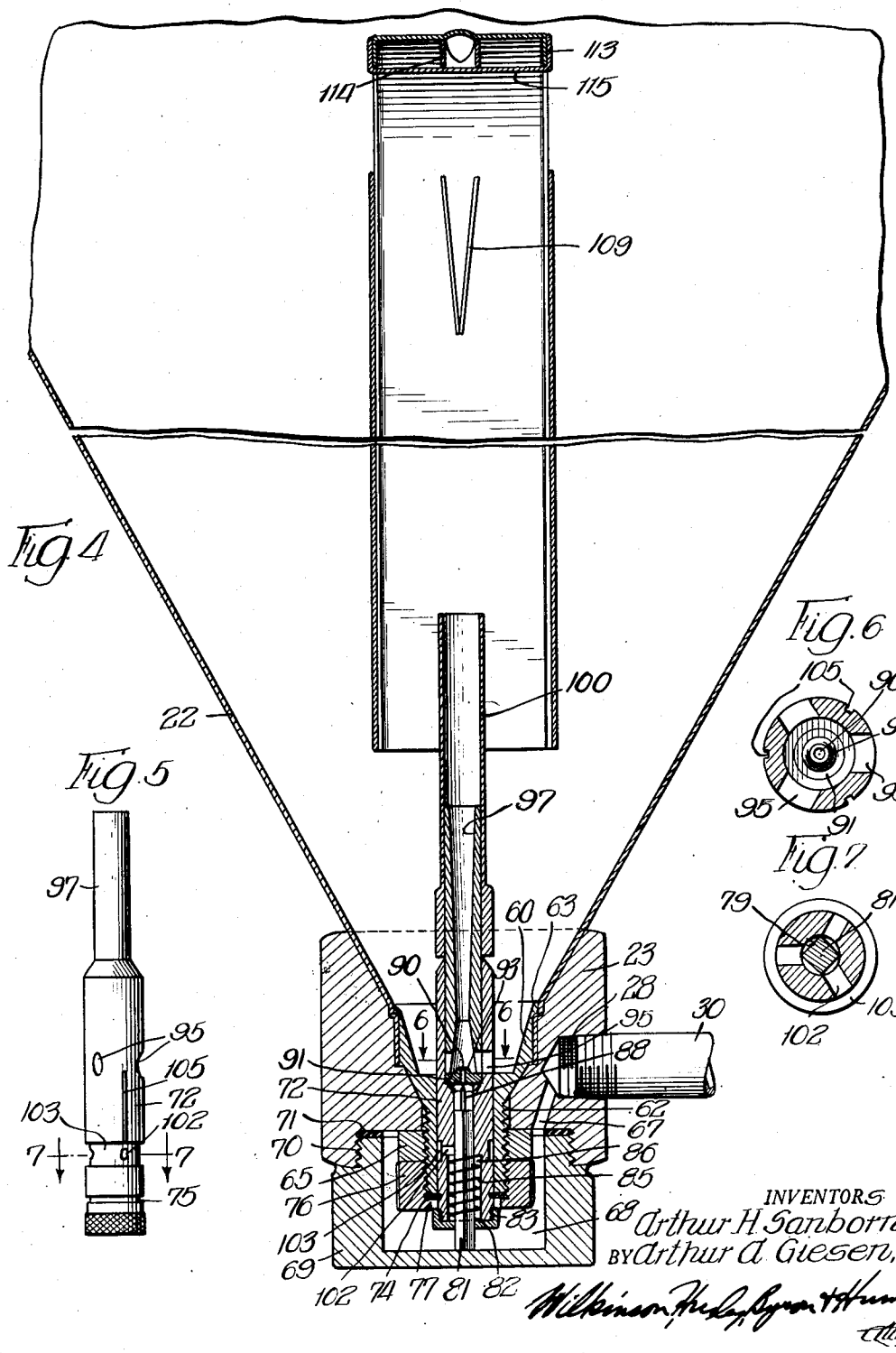


Fig. 4

Fig. 5

Fig. 6

Fig. 7

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MATERIAL DISTRIBUTING APPARATUS

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7 Claims. (Cl. 302—53)

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This invention relates to a new and improved apparatus for distributing material and more particularly to apparatus for handling and moving granular or powdered material at accurately controllable rates of flow.

There are numerous commercial processes which require a continuous and relatively uniform movement of granular or powdered material. Where the flow is relatively large in quantity many forms of apparatus are available to handle the problem. The present invention is especially directed to the problem of handling small amounts of material with a continuous and substantially uniform flow. By way of illustration, and not by way of limitation, the present construction will handle a flow of one-half pound of granular material distributed substantially uniformly over the period of an hour.

A flow of this character represents such a small amount of material handled per minute or per second that it is difficult to uniformly supply it. Mechanical means for measuring and moving such small amounts of material are difficult to design and control. There are various collateral difficulties such as preventing packing of the material and the clogging of small passages or chambers.

While the present invention is of broad application where the continuous supply of small quantities of granular material are desired, it is especially adapted for use in connection with the supply of certain materials to fire boxes or combustion chambers of boilers or the like. Materials have been developed which, when fed in slowly, disintegrate insulating deposits of firescale soot and slag in such fire boxes and prevent the further accumulation of such deposits or coatings.

It is an object of the present invention to provide a new and improved method and apparatus for the handling of granular and powdered material.

It is a further object to provide a method and apparatus of this character which is designed to handle such materials continuously with the distribution of small quantities.

It is also an object to provide such apparatus which moves larger quantities of material and selects and distributes small portions of the material moved.

It is an additional object to provide apparatus which comprises a hopper for holding material and, in addition to continuously distributing small quantities from the hopper, moves the material in the hopper in such manner as to prevent packing or caking of the material or clogging of any of the orifices.

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It is a further object to provide a method and apparatus which provides air flow through the material in such manner as to dry the material and remove moisture therefrom.

It is also an object to provide a method and apparatus in which the circulation or movement of the material is controlled by the amount and pressure of the air used and which may serve to further pulverize the material.

It is an additional object to provide a method and apparatus which aids in mixing different ingredients in the material being handled and in maintaining the mixture.

It is another object of the invention to provide apparatus which, in its normal operation, has a self-cleaning action, maintaining all surfaces and orifices clean and free from unwanted deposits of material.

It is also an object to provide a construction which moves the material, selects a desired portion for transfer and delivery and provides additional means for accomplishing the delivery.

It is an additional object to provide apparatus of this character which operates by fluid pressure and is devoid of mechanically moving operating parts.

Other and further objects will appear as the description proceeds.

We have shown certain preferred embodiments of our invention in the accompanying drawings, in which—

Figure 1 is a perspective view, partly broken away, showing the apparatus;

Fig. 2 is a section taken on line 2—2 of Figure 1;

Figure 3 is a section taken on line 3—3 of Figure 1;

Figure 4 is a vertical section through the hopper and control apparatus, parts being broken away to show the construction;

Figure 5 is an elevation of the central tubular member including the ports and control orifices;

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

Figure 7 is a section taken on line 7—7 of Figure 5.

In the drawings, the hopper 21 is provided with a conical bottom portion 22 fitting into the body member 23 of the apparatus. This hopper 21 is provided with a movable cover 25 and with an internally fitted sieve member 26. The body member 23 has an air bore 28 formed therein and the air inlet pipe 30 is threaded into the wall of the member 23 to discharge in said bore. The valve 32 is controlled by a solenoid 33, this solenoid being actuated by means of current sup-

plied through wires 34. This may be any usual type of solenoid valve and is normally in the closed position. A second air passage is formed in the fitting 36, this passage being controlled by a manually adjustable valve 38 in the fitting. The specific forms of these valves form no part of the present invention and they will not be described in further detail.

Air under pressure is led to the fitting 36 through tube 40 and intermediate T-fitting 42. The tube 43 connects the fitting 42 with the lower end of the fitting 45. This fitting 45 includes a jet 46 directed into the throat of the discharge venturi 47. This venturi may be connected by any suitable pipes or passages to the place where the material is to be transported or used. The fitting 45 is secured in the upper cylindrical wall of the hopper 21 and has a tubular portion 49 projecting through that wall. The deflecting guide member 51 carries the tubular member 53 at its upper portion, this member 53 having an extension 55 which fits into the tubular portion 49 of the fitting 45. A shoulder 57 is formed on the tubular member 53 to insure proper relative location of the parts.

The interior construction of the apparatus is best shown at the lower portion of Figure 4. The lower portion of the conical hopper 22 is held in the body member 23 by means of the fitting 60 which extends downwardly through the central opening in the member 23. The upper portion of the fitting 60 has a circumferential ridge 63 which fits in a corresponding circumferential groove in the lower end of the hopper to retain it against displacement from the body 23. The fitting 60 is held in place by means of the nut 65 which is threaded on a lower portion of the fitting and which bears against the under face of the body member 23.

The chamber 28 in the body member 23 communicates through passage 67 with a chamber 68 in the cup-shaped lower cap member 69. This member 69 is threaded into the lower side of the body member 23 at 70, a gasket 71 being provided in order to secure an air-tight joint.

The tubular member 72 is fitted in the axial opening in the member 60 and serves to control and direct the fluid flow. This member 72 carries a split ring 74 fitting in a groove 75, as shown in Figures 4 and 5. This split ring 74 bears against the lower face of the fitting 60 and is held against that face by the securing nut 76 which is threaded on the fitting 60 and has a flange 77 underlying the split ring. The tubular member 72 has a central opening 79, as shown in cross section in Figure 7. This opening carries the square plunger 81 which fits in the circular opening in such manner as to provide a substantial unoccupied area for passage of air or gas under pressure from chamber 68 up through the interior of the member 72. This plunger 81 carries a cross pin 82 which fits against the inner face of the cap 83 threaded on the bottom of the member 72. The spring 85 is fitted around the plunger 81, bearing at its upper end against the upper face of the recess 86 formed in member 72 and bearing at its lower end against the cross pin 82 to normally maintain the member 81 in its lower position. The upper end of member 81 carries a pointed plunger 88 adapted to fit into the orifice 90 formed in the disk 91 seated in member 72. It will be noted that the disk 91 carries a conical shoulder 93 surrounding the orifice 90. This conical shoulder 93 extends up beyond the lower portion of the lateral ports 95 formed in the wall of the member 72. The Venturi tube 97 is fitted into the upper portion of the fitting 72 and its lower end bears against the disk 91 and retains it in place. The lower portion of the Venturi tube 97 is formed with orifices aligned with the ports 95 in the member 72. A guide tube 100 is fitted upon the Venturi tube 97, its lower portion resting on the upper edge of the fitting 72.

The lower chamber 66 in fitting 72 communicates through ports 102 with the circumferential channel 103. Leading upward from the channel 103 are a plurality of spaced grooves 105 which are narrow and shallow. These grooves 105 extend above the lower edges of the ports 95 in member 72, as best shown in Figure 5.

The deflector 51 fits over the upper portion of the tube 100 and is provided with a cover member 107 which extends up the major portion of the upwardly extending leg of the deflector 51, as shown in Figure 1. This cover 107 fitting on the deflector 51 makes, in effect, a flat tube extending upwardly with the tube 100 located approximately in its center, as shown in cross section in Figure 3. A V-shaped divider 109 is secured to the deflector 51 at a point adjacent the upper end of the cover member 107.

As shown in Figure 2, the deflector 51 is provided with an elongated orifice 111 which communicates with the tube 53. Deflecting members 113 and 114 are secured adjacent the lateral edges of the orifice 111, the member 113 being longer than member 114 and extending beyond the inwardly curved end of the latter member. A short cover member 115 is secured to the under face of deflector member 51 below the orifice 111 and deflectors 113 and 114. In Figure 1, pressure gauge 117 has been shown connected to the chamber 68 in the member 69 so that the actual air pressure present may be determined by the operator and, also, the functioning of the solenoid 32.

In the use of the apparatus, tubing 40 will be connected to a source of supply of air under suitable pressure such, for example, as the amount of twenty to twenty-five pounds per square inch. It will be understood that if the air under pressure is available only under higher pressure, any suitable pressure reducing valve may be used to bring the desired pressure to pipe 40. The material to be distributed is poured into the hopper 21 through the sieve 26. This material is placed in in such quantities so as not to completely fill the hopper but to be located in the conical lower section 22. The cover 25 may be used as a measuring device for selecting the quantity desired for a single change of the hopper. The air under pressure flows continuously through the bypass which is controlled by the manually adjustable valve 38 into the bore 28 in the body 23. This air under pressure passes downwardly through passage 67 into chamber 68 in the cap 69. A portion of the air passes up around member 81 to the orifice 90 in the disk 91. This air will be in such amount as to be inadequate to draw in the material and discharge it to any substantial distance or in any substantial quantity from the top of tube 100. A further portion of the air will pass through lateral ports 102 to the channel 103 and up through grooves 105 intermediate ports 95 where it will be discharged into the mass of material in the lower portion of the hopper and in the fitting 60. This small continuous air supply does not operate to cause the discharge of any material from the hopper. It does, however,

prevent the material in the hopper from settling and clogging the various orifices since it keeps it stirred up and in motion in the lower part of the hopper. It also aids in drying the material or in maintaining it dry.

When it is desired to discharge material from the hopper, the solenoid valve 33 is operated to permit direct flow of air in substantial quantities into bore 28. This air takes the same paths as have been described in connection with the continuous air supply, but is adequate in amount to provide a flow through orifice 90 which draws up through the Venturi tube 97 a supply of the finely divided material in the hopper. This material has been drawn into the Venturi tube by suction through ports 95. This finely divided material is floated and carried by the air blast through the tube 100 up through the rectangular lower portion of the deflector 51 and the flow is divided by the V-shaped deflector 109. A portion of the material drops down back into the hopper, while a portion is carried up against the deflectors 113 and 114. A small portion of this material passes between these two deflectors and through orifice 111 and tube 53 into fitting 45.

The jet 46 serves to cause a suction in tube 53 and helps to draw the material into that tube, from which it is drawn into and ejected from the venturi 47. This material may then be carried for any desired distance and for any desired purpose. It will be understood that if the carry is to be long, additional fittings, such as 45, and jets, such as 46, may be supplied at intervals along the line of movement. The deflecting and directing means are such that only a very minute portion of the material ejected from the tube 100 actually reaches the discharge tube 53. Thus, it is possible to very slowly discharge material from the hopper. The material which is moved and which returns to the lower part of the hopper is again acted upon when it, in turn, reaches the bottom of the hopper adjacent the ports 95. This recirculation of the material aids in drying it and, also, in keeping it loosened up and thoroughly admixed.

When the valve 32 controlled by solenoid 33 is not in operation, the air coming up through grooves 105 keeps the material stirred up and ready for instant, uniform operation of the apparatus when valve 32 is again opened.

It will be apparent that the various baffles and surfaces against which the granular material is directed have a crushing or breaking effect on the material, dependent upon the strength of the material and the size of the venturi and the amount of flow therethrough. Additional deflecting baffles may be added if it is desired to increase any crushing action.

It will also be apparent that the continued recirculation of the material, the major portion of which remains in the hopper, serves to maintain a uniform mixture if the material consists of a plurality of ingredients. The continuous flow of air through the material and its drying action are particularly important in preventing caking when the materials being handled are such that take up moisture from the atmosphere or where the apparatus is located and operated in places of high humidity.

It will be apparent that, by variation of the size of the various orifices and formation of the venturi, the amount of material discharged from the lower tube 100 may be controlled within wide limits. It will also be apparent that by the formation of the deflectors and dividing means such as 109, 113 and 114, the portion of the material moved which is actually carried out of the hopper may also be varied within very wide limits.

Should the apparatus become clogged for any reason, such for example as when standing idle with material in the hopper and no air supplied to tube 40, the orifice 90 may be readily cleared. This is accomplished by removing the lower cap 69 and pressing upwardly against member 81. This causes the pointed plunger 88 to pass upwardly through the orifice 90 and clear that orifice. If other openings or passages are clogged, the entire Venturi assembly may be removed downwardly from fitting 60 by removal of nut 76. In such case, the cover 25 may be inverted below the apparatus to catch any loose material which may drop from the hopper when the assembly is removed. It will be apparent, therefore, that the apparatus may be readily cleaned and adjusted.

While we have shown certain preferred embodiments of our invention, these are to be understood to be illustrative only as it is capable of variation to meet differing requirements and conditions, and we contemplate such modifications as come within the spirit and scope of the appended claims.

We claim:

1. Apparatus for distributing finely divided material which comprises a container for the material, said container having a sloping bottom, a tubular member projecting upwardly a lower portion of the bottom, a lateral opening in the tubular member adjacent the bottom adapted to permit material to pass into said member, means for supplying air under pressure to the lower end of the tubular member, said air under pressure ejecting material from the upper end of the tubular member, discharged means adapted to select a portion of the material ejected from the upper end of the tubular member and carry it from the container, and means for guiding the flow of the material not selected, said guiding means returning such material to the lower portion of the container exteriorly of said tubular member.

2. Apparatus for distributing finely divided material which comprises a container for the material, said container having a sloping bottom, a tubular member projecting upwardly through a lower portion of the bottom, a lateral opening in the tubular member adjacent the bottom, means for supplying air under pressure to the lower end of the tubular member, a curved guide for directing the flow of material ejected from the upper end of the tubular member, and means associated with the guide for intercepting a portion of the material from the guide and discharging it from the container.

3. Apparatus for distributing finely divided material which comprises a container for the material, said container having a sloping bottom, a tubular member projecting upwardly through a lower portion of the bottom, a lateral opening in the tubular member adjacent the bottom, means for supplying air under pressure to the lower end of the tubular member, a curved guide for directing the flow of material ejected from the upper end of the tubular member, said guide being curved and extending upwardly, outwardly and downwardly to return the material to the lower portion of the chamber, and means associated with the guide for intercepting a portion of the material from the guide and discharging it from the container.

4. Apparatus for handling finely divided material which comprises a container for the material, an upwardly extending ejector nozzle in the lower portion of the container, said ejector nozzle comprising a tube with lateral material receiving openings, an axial air jet extending above the lower edges of the lateral openings, and a Venturi section in said tube above the openings, and means for guiding material leaving the ejector nozzle.

5. Apparatus for handling finely divided material which comprises a container for the material, an upwardly extending ejector nozzle in the lower portion of the container, said ejector nozzle comprising a tube with lateral material receiving openings, an axial air jet extending above the lower edges of the lateral openings, manually operable means for cleaning said air jet, and a Venturi section in said tube above the openings, and means for guiding material leaving the ejector nozzle.

6. Apparatus for handling finely divided material which comprises a container for the material, an upwardly extending ejector nozzle in the lower portion of the container, said ejector nozzle comprising a tube with lateral material receiving openings, an axial air jet extending above the lower edges of the lateral openings, manually operable means for cleaning said air jet, said means comprising a plunger carrying a member adapted to pass through the jet orifice and

spring means normally maintaining the member clear of the orifice, and a Venturi section in said tube above the openings, and means for guiding material leaving the ejector nozzle.

7. Apparatus for handling finely divided material which comprises a container for the material, an upwardly extending ejector nozzle in the lower portion of the container for moving a portion of the material upwardly, supplementary jets adjacent the ejector to supply air for loosening and moving the material, a valve for supplying air under pressure to the jet and supplementary jets and a bypass around the valve for supplying air under lower pressure to the jet and supplementary jets.

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