April 4, 1950 R. A. NORBOM 2,502,740

NOZZLE CONSTRUCTION FOR USE IN THE PNEUMATIC HANDLING OF FLOUR AND THE LIKE

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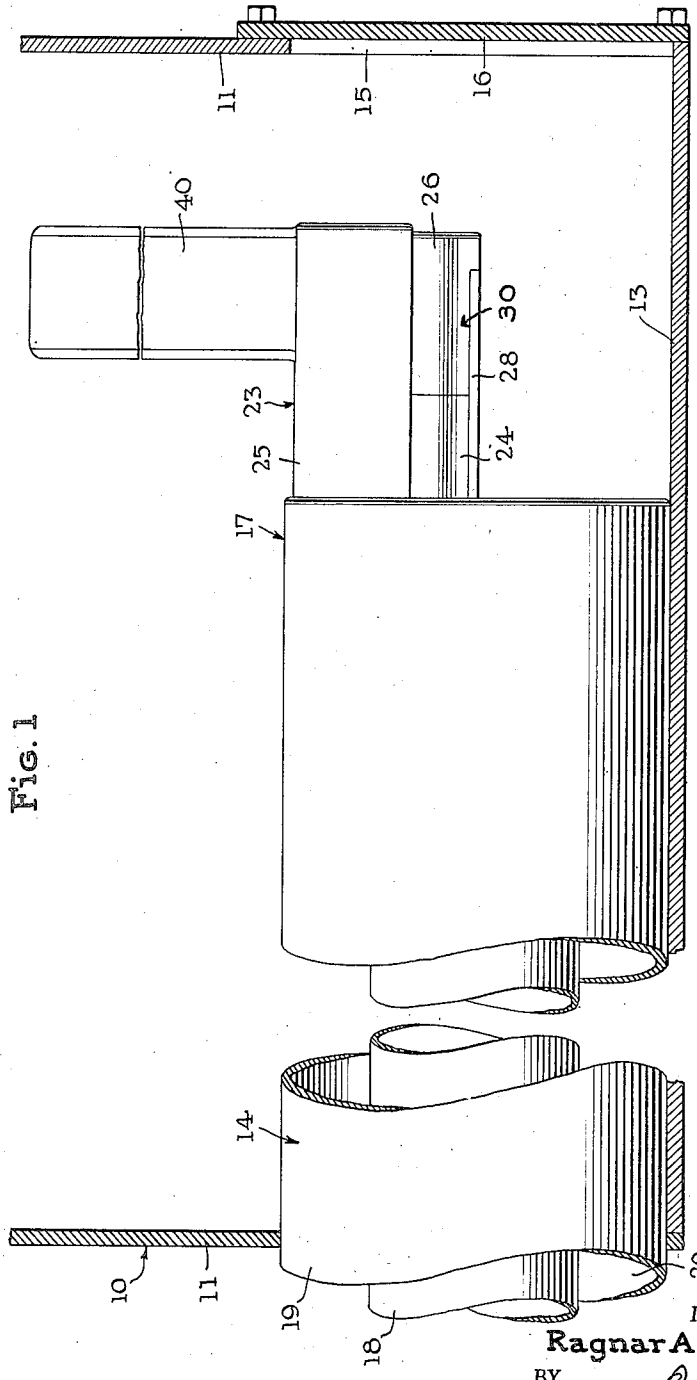


Fig. 1

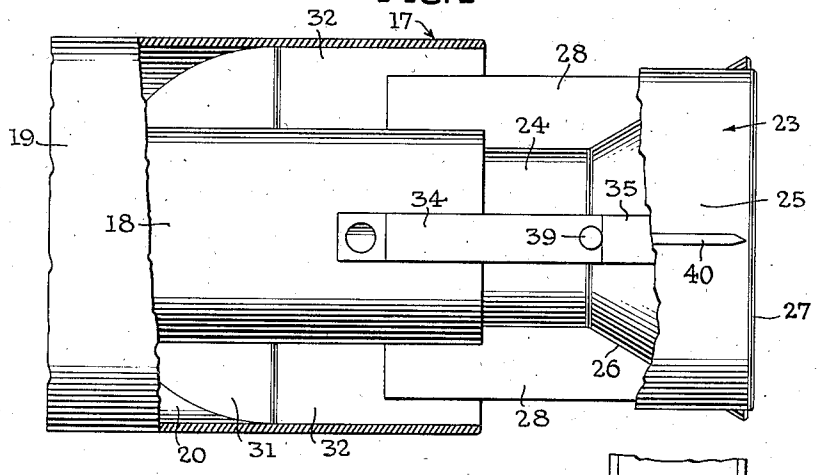
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Fig. 2



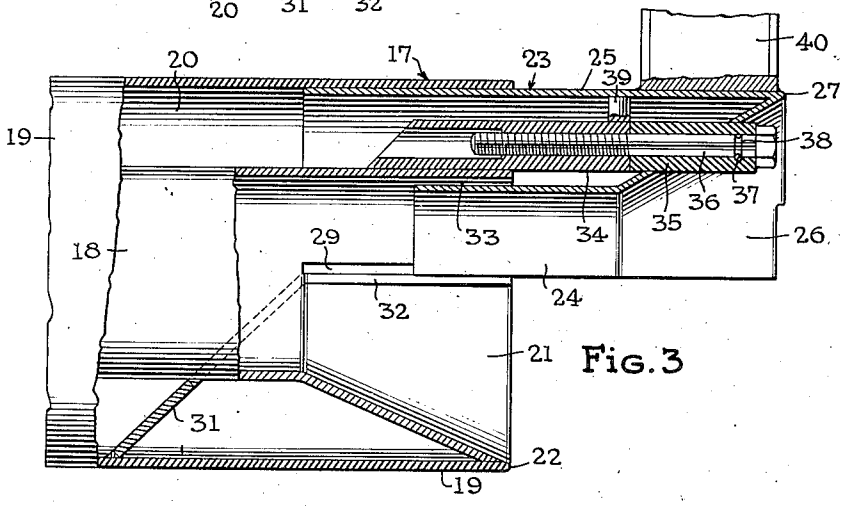


Fig. 3

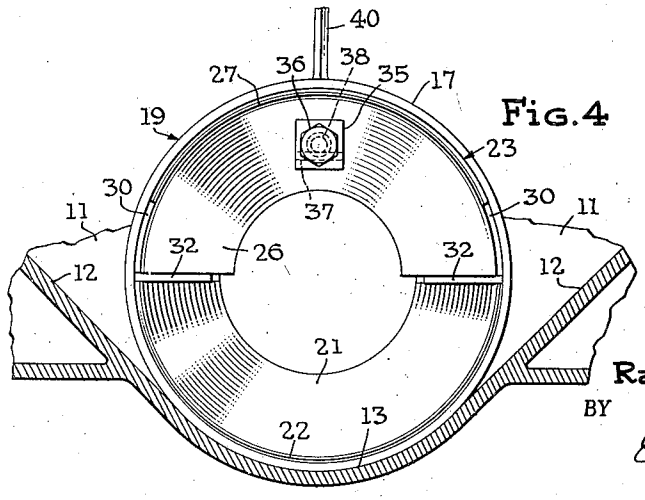


Fig. 4

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Fig.5

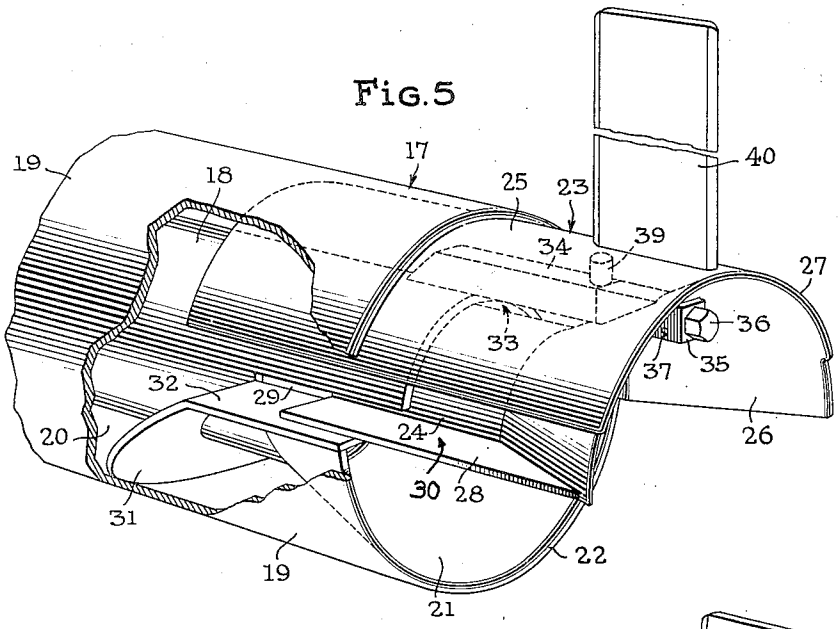


Fig.6

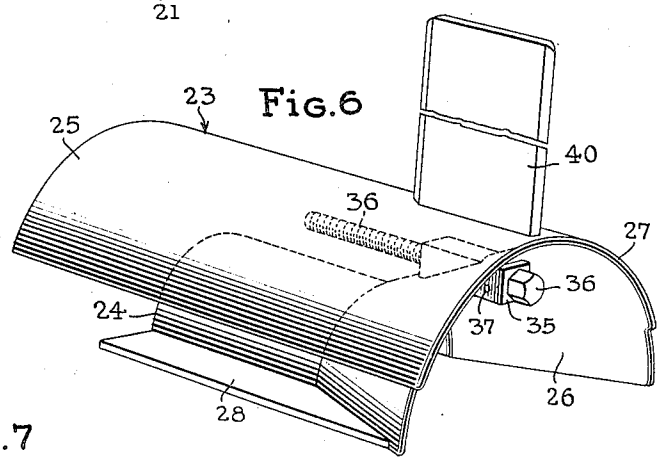
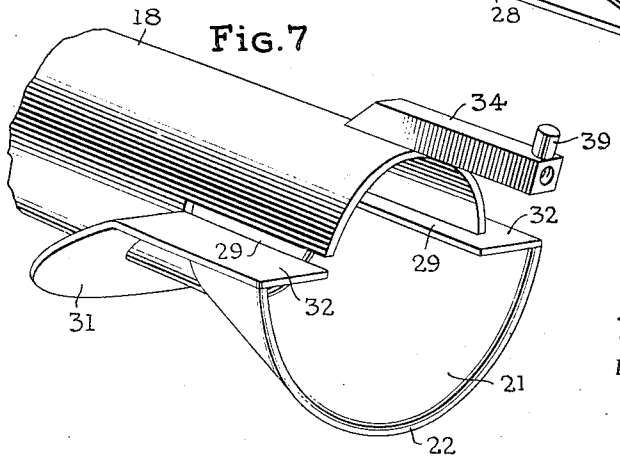


Fig.7



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NOZZLE CONSTRUCTION FOR USE IN THE PNEUMATIC HANDLING OF FLOUR AND THE LIKE

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Application April 11, 1949, Serial No. 86,632

9 Claims. (Cl. 302—58)

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This invention relates to the handling of finely divided bulk material and more particularly to an improved suction nozzle for facilitating the discharge of a container by a pneumatic conveyor system. The invention will be described with particular reference to flour, as the material handled, but it will be understood that the invention may be used to facilitate the handling of any pulverized, granular, or powdered material, such as cereal, grain, chemicals and minerals, which is susceptible of being conveyed in an air stream.

In U. S. Patent No. 2,440,379 there is shown an extensible, horizontally-disposed suction nozzle which projects through an end wall and is adapted to be reciprocated along the bottom wall of an elongated, generally trough-shaped storage compartment to withdraw finely divided bulk material contained therein. The extensible portion of the nozzle shown in the aforementioned patent comprises two open-ended concentric tubular conduits which are spaced apart to provide an annular passageway therebetween. The inner of these two conduits is telescopically associated with a fixed conduit, the rearward end of which is connected to the suction hose of a pneumatic conveyor system. The rearward end of the annular passageway communicates with the atmosphere exteriorly of the compartment. Thus, the passageway serves to conduct the requisite supply of material-entraining air to the nozzle head for discharge annularly about the open intake end of the inner conduit.

In actual practice, it has been found that evacuation of flour from a storage compartment with a nozzle of the above described type, which is forced horizontally directly into and under the flour to be evacuated, presents practical problems. First of all, flour is difficult to handle pneumatically because of its lack of free-flowing characteristics when compacted in a container, and requires a rather delicate directing of the air supply for a suction intake opening in order to be broken down and aerated properly for suction pick-up and evacuation. Such air supply, if improperly directed, will tend to blow material away from the suction intake opening, thus lessening the rate of evacuation. An improperly directed or excessive air supply also causes excessive turbulence and consequent undesirable dusting of the material. Additionally, an open-ended suction nozzle which is forced directly into the material to be evacuated is susceptible of becoming plugged. Furthermore, penetration of such a nozzle into densely packed material is not

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easily effected. Lastly, particularly in the case of flour and other finely divided materials having similar physical characteristics, bridging of the material sometimes occurs in bins having generally V-shaped bottoms. Such bridging, wherein the material becomes arched over the nozzle and forms a horizontal tunnel through which the nozzle moves, causes substantially a cessation of all evacuation.

Accordingly, it is an object of this invention to provide a more efficient nozzle head, having a high rate of evacuation, for a suction discharge nozzle of the type that is adapted to project through an end wall and be moved horizontally along the bottom of a container for finely divided bulk material.

Another object of this invention is to provide a suction nozzle head of the type described that does not readily become plugged, that may more easily penetrate the material to be evacuated, that prevents bridging, and that effects proper aeration without dusting.

It is a further object of this invention to provide a nozzle head of the type described with adjustable means for regulating the velocity of the air supply to the suction intake opening.

Other objects and advantages of the invention will be evident from the following description and accompanying drawings in which:

Figure 1 is a fragmentary longitudinal sectional view of a container, showing a nozzle embodying this invention positioned therein.

Figure 2 is a plan view of the nozzle head shown in Figure 1 with portions broken away to show details.

Figure 3 is an elevational view, partly in section, of the nozzle head.

Figure 4 is an end view of the nozzle head.

Figure 5 is a perspective view of the nozzle head with portions broken away to show details.

Figures 6 and 7 are perspective views of separate assemblages shown in Figure 5.

Referring now to the drawings, there is shown in Figures 1 and 4 the lower portion of an elongated enclosed container or bin 10 having vertical end walls 11 and side wall slope sheets 12 which converge downwardly to a generally rounded trough 13 disposed centrally along the bottom of the container. Projecting snugly through an opening in the lower portion of one end wall of the container and resting in the trough 13 is the extensible portion 14 of an elongated tubular suction nozzle. Preferably the portion 14 and the trough have the same radius of curvature. Suitable mechanism (not shown), such as

that described in the aforementioned patent, is connected to the portion 14, exteriorly of the container 10, for effecting reciprocating movement thereof from one end of the trough 13 to the other. The container end wall which faces the intake end of the nozzle preferably has an opening 15 therein provided with a detachable closure 16 in order to provide access to the intake end of the nozzle or nozzle head 17.

The extensible portion comprises a pair of concentrically-arranged spaced tubular conduits 18 and 19. The rearward end, i. e., the end projecting exteriorly of the container, of the inner or suction conduit 18 is adapted to be telescopically associated with a fixed conduit (not shown), the rearward end of which is connected to the suction hose (not shown) of a pneumatic conveyor system. The forward end of the suction conduit is open to provide a suction intake opening. The annular space between the two conduits forms an air duct 20 having its rearward end in communication with the atmosphere, exteriorly of the container, in order to supply material-conveying air to the intake end of the nozzle, as later described. Preferably an air filter (not shown) is provided to clean the air entering the duct 20 in order to avoid contamination of the flour.

At the intake end of the nozzle, or the nozzle-head 17, the lower half of the suction conduit 18 is provided with an outwardly flared portion 21 that is secured, at its forward edge, to the forward edge of the outer conduit 19. Hence, the lower portion of the mouth or intake opening of the suction conduit is funnel-shaped while the upper portion is cylindrical. This construction also provides the lower portion of the nozzle head with an arcuate cutter edge 22 which facilitates penetration of the nozzle head into densely packed material. It also is pointed out that the flared portion 21 closes the lower portion of the forward end of the air duct 20 so that the lower portion of the nozzle head is devoid of discharge outlets for material-entraining air.

The upper half of the air duct 20 is provided with a telescopic extension 23 (shown best in Figure 6) which overhangs and thus shields the intake opening of the suction conduit from material directly thereabove. The extension 23 comprises segmental extension elements 24 and 25 for the upper portion of the inner and outer conduits, respectively. Each of these elements is telescopically mounted within its corresponding conduit. The forward end of the inner element 24 is provided with an outwardly flared portion 26 which is secured, at its forward edge, to the forward edge of the outer element 25. This construction provides the upper portion of the nozzle head with an arcuate cutter edge 27 which facilitates penetration of the nozzle head into densely packed material. It also is pointed out that the underside of the extension 23 is funnel-shaped to facilitate the movement of material into the suction conduit. The inner element 24 is provided with longitudinal side flanges 28 which extend radially through diametrically-opposed longitudinal slots 29 in the forward end of the inner conduit 18. The outer edges of the flanges 28 preferably are spaced somewhat inwardly of the peripheral outline of the outer conduit 19 (as shown best in Figure 2). The opposite side edges of the outer element 25 are spaced above the flanges 28 to provide, on each side of the extension 23, an elongated air discharge port or opening 30. The air currents issuing laterally from each side of the nozzle head through the ports 30 move in a generally forward and downward direction before turning back into the intake opening of the suction conduit. A forwardly and upwardly inclined, generally arcuate, baffle member 31 having horizontally-disposed rectangular extensions 32 is disposed in the lower portion of the duct 20 somewhat to the rear of the flared portion 21 of the inner conduit. The baffle member 31 directs the air flowing forwardly in the lower portion of the duct upwardly toward the lateral ports 30, and also provides additional support for the forward end of the suction conduit. The rectangular extensions 32 of the baffle member rest upon the upper edges of the flared portion 21 of the suction conduit to prevent the entrance of material into the space between the baffle member 31 and the flared portion 21, and also provide support for the rearward ends of the flanges 28.

The radius of curvature of the inner element 24 is somewhat less than that of the suction conduit 18, so that an arcuate passageway 33 (shown best in Figure 3) is provided therebetween. The passageway serves to by-pass a portion of the air from the duct 20 for discharge directly within the mouth of the suction conduit. The rearwardly directed jet of air issuing from the passageway 33 removes any material that tends to plug the suction intake opening as a result of the nozzle being forced forwardly into the material to be evacuated. It also will be noted that the slots 29 extend somewhat rearwardly of the flanges 28 to form additional air by-passes that also assist in preventing plugging of the intake opening of the suction conduit.

The entire assembly comprising the duct extension 23 is mounted for telescopic adjustment axially of the nozzle head in order to vary the size of the air discharge ports 30 and, hence, the velocity of the air issuing therefrom. Thus, the extension may be adjusted to obtain maximum evacuation efficiency with various types of finely divided or granular material, certain of which require a greater turbulence than others in order to be broken down and correctly aerated for entrainment in an air stream. The extension is adjustably mounted by means of two elongated aligned members 34 and 35 (shown best in Figure 3), one of which is secured to the upper side of the inner conduit 18 adjacent its forward end and projects forwardly thereof, and the other of which is secured in an opening formed in the flared portion 26 of the inner element 24. A bolt 36, which passes through a smooth bore in the member 35 and is threaded into the member 34, connects the two members. The bolt 36 is freely rotatable in the member 35, but is maintained against axial displacement relative thereto by a pin 37 and annular groove 38. Hence, rotation of the bolt moves the extension 23 axially of the nozzle head. Preferably a block 39 is secured on the forward end of the member 34 and bears against the underside of the outer element 25 in order to provide added support for the element 25 against the weight of bulk material resting thereon.

In order to prevent bridging of flour over the nozzle with consequent cessation of evacuation, a double-edged knife-like blade 40 is mounted vertically on the forward end of the nozzle head. The height, or length, of the blade preferably is about equal to the diameter of the nozzle and the blade is disposed in a plane parallel to the axis of the nozzle, so that the blade will not impede movement of the nozzle through the flour.

Both front and rear edges of the blade serve to cut through and break down any bridges that form above the nozzle head, thereby permitting the flour to flow down to the suction intake opening. Since such bridging usually occurs, however, only when both side wall slope sheets **12** are disposed closely adjacent the sides of the nozzle, the cutter blade **40** usually is not necessary when the nozzle head is used in a container having slope sheets which are relatively widely spaced apart at their bottom edges.

In order to discharge the contents of the container **10** by means of the nozzle, the suction is established and the extensible portion **14** moved slowly back and forth from one end of the container to the other. Air is drawn through the duct **20** from the exterior of the container and is discharged laterally from each side of the nozzle head **17** in a somewhat forward and downward direction directly ahead of the suction intake opening. Hence, flour sliding down the slope sheets **12** is drawn in by suction under the duct extension **23**, and simultaneously mixed with sufficient air for proper conveying in the pneumatic conveyor system. No excessive turbulence is created, thus eliminating undesirable dusting of the flour. It also is to be noted that all the forwardly directed edges of the nozzle head are shaped as cutters to facilitate penetration of the nozzle into densely packed material.

Various structural changes in the specific embodiment of the invention shown and described will be evident to one skilled in the art. Therefore, the invention embraces all modifications that come within the spirit and scope of the following claims.

I claim:

1. A suction nozzle for use with a pneumatic conveyor system to effect the discharge of finely divided bulk material from a container having a substantially horizontally disposed bottom wall, said nozzle being adapted for axial movement in a horizontal position within and along the bottom wall of the container, said nozzle comprising: a suction conduit having a material intake opening at one end thereof, the other end of said conduit being adapted to be connected to the suction intake of a pneumatic conveyor system; means secured to the intake end of said conduit and projecting forwardly from the upper portion thereof to form an overhanging shield for said intake opening; and means for conducting material-entraining air from outside the container to said intake end of the conduit and for discharging said air laterally and outwardly of said opening adjacent and along the lower opposite side edges of said shield.

2. The structure defined by claim 1, including blade-like cutter means projecting upwardly from the forward end of the shield a distance substantially equal to at least the height of the nozzle for breaking down bridging material.

3. A suction nozzle for use with a pneumatic conveyor system to effect the discharge of finely divided bulk material from a container having a horizontally disposed bottom wall, said nozzle being adapted for rectilinear movement in a horizontal position within and along the bottom wall of the container, the said nozzle comprising: a suction conduit having an intake opening at one end thereof, the other end of said conduit being adapted to be connected to the suction intake of a pneumatic conveyor system; means overhanging said intake opening and defining a hollow segmental extension of the upper portion of said conduit shielding said opening, said extension having openings in the lower opposite sides thereof; and means for conducting material-conveying air from outside the container into said extension for discharge through said side openings laterally and outwardly of said intake opening.

4. The structure defined by claim 3 including means defining a passageway having one end thereof in communication with the interior of the hollow extension, the other end of said passageway being disposed within and directed rearwardly of the intake opening, whereby a portion of the material-conveying air is directed rearwardly into said intake opening.

5. A suction nozzle for use with a pneumatic conveyor system to effect the discharge of finely divided bulk material from a container having a horizontally disposed bottom wall, said nozzle being adapted for rectilinear movement in a horizontal position within and along the bottom wall of the container, the said nozzle comprising: inner and outer spaced concentric conduits, one end of said inner conduit being adapted to be connected to the suction intake of a pneumatic conveyor system, the other end thereof being open to provide a material intake opening, and the space between said conduits forming a duct for conveying material-entraining air from outside the container for discharge adjacent said intake opening; closure means for the lower portion of the forward end of said duct, and means overhanging said intake opening and defining an extension of the upper portion of said duct, said extension being closed at the forward end thereof and having air discharge openings in the opposite lower sides thereof.

6. The structure defined by claim 5 in which the lower portion of the intake opening and the underside of the forward end of the duct extension are defined by outwardly flaring portions of the inner conduit and the overhanging means, respectively, said portions extending outwardly to the peripheral outline of the outer conduit to provide the forward end of the nozzle with cutter-like edges to facilitate penetration of the material to be discharged.

7. A suction nozzle for use with a pneumatic conveyor system to effect the discharge of finely divided bulk material from a container having a horizontally disposed bottom wall, said nozzle being adapted for rectilinear movement in a horizontal position within and along the bottom wall of the container, the said nozzle comprising: inner and outer spaced concentric tubular conduits, one end of said inner conduit being adapted to be connected to the suction intake of a pneumatic conveyor system, the other end thereof providing a material intake opening, and the space between said conduits forming a duct for conveying material-entraining air from outside the container for discharge adjacent said intake opening; the lower portion of the forward end of said inner conduit being flared outwardly and joined to the outer conduit, thereby closing the lower portion of the forward end of said duct; inner and outer arcuate elements secured concentrically within the upper portion of said intake opening and the upper portion of the forward end of said outer conduit, respectively, and forming an extension of said duct, said inner element having longitudinal flanges on opposite sides thereof which extend radially outwardly through corresponding slots in the forward end of said inner conduit, the forward ends of said

elements being joined by an outwardly flaring portion of said inner element; the radius of curvature of said outer element being substantially equal to that of said outer conduit and the radius of curvature of said inner element being somewhat less than that of said inner conduit to provide a longitudinal passageway therebetween, the side edges of said outer element being spaced above said flanges to provide lateral discharge openings for material-entraining air.

8. The structure defined by claim 7 in which the duct extension is telescopically adjustable axially of the conduits to vary the size of the air discharge openings.

9. A suction nozzle for use with a pneumatic conveyor system to effect the discharge of finely divided bulk material from a container having a horizontally disposed bottom wall, said nozzle being adapted for rectilinear movement in a horizontal position within and along the bottom wall of the container, the said nozzle comprising: a suction conduit having a material intake opening

at one end thereof, the other end of said conduit being adapted to be connected to the suction intake of a pneumatic conveyor system; means for conducting material-entraining air from outside the container to said intake end of the conduit; and means defining discharge openings for said air adjacent opposite lateral sides of said intake opening for discharging said air laterally and outwardly thereof without discharge adjacent the upper and lower portions of said intake opening.

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