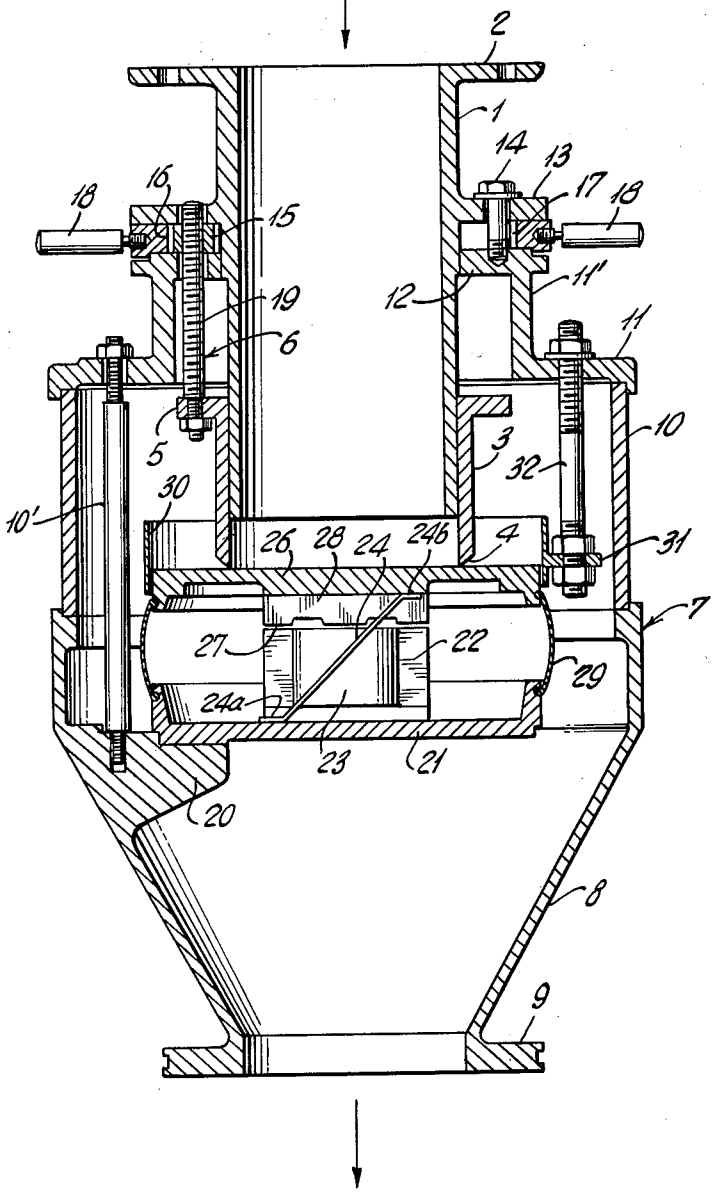
July 6, 1965 MASUO HOSOKAWA 3,193,153

DEVICE FOR CONTROLLING THE CONTINUOUS TRANSFER OF POWDERED MATERIALS

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Fig. 1.



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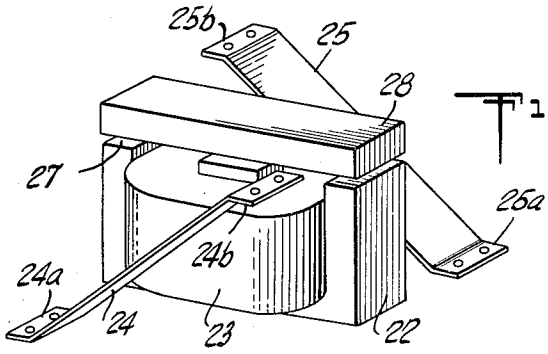


Fig. 2.

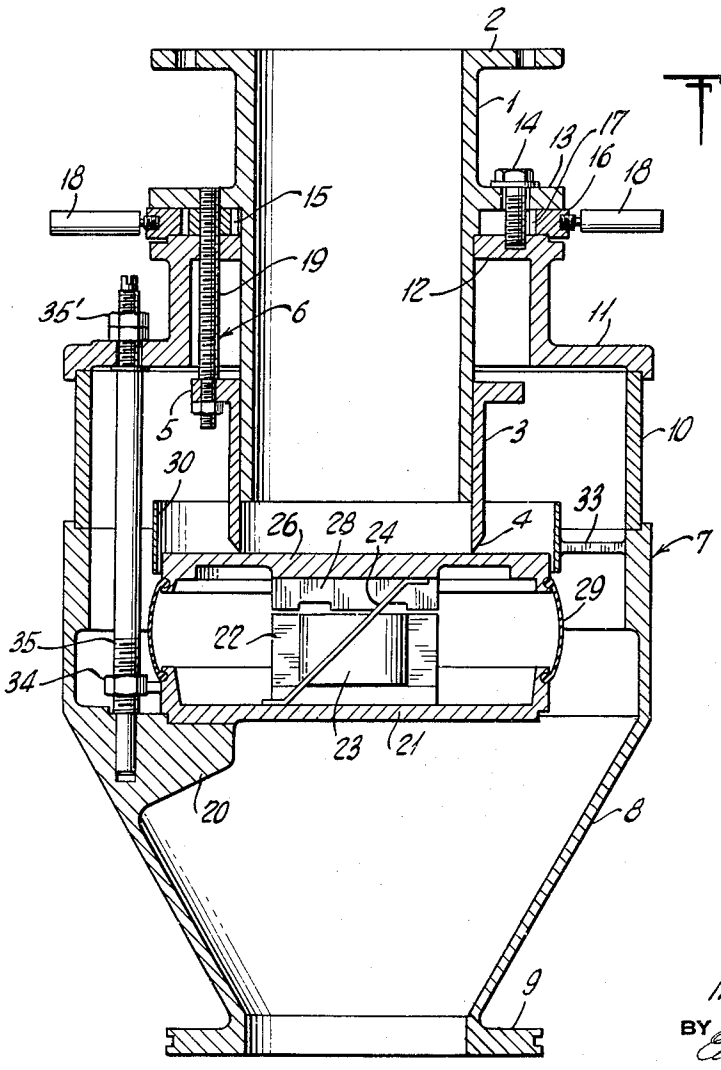


Fig. 3.

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DEVICE FOR CONTROLLING THE CONTINUOUS TRANSFER OF POWDERED MATERIALS

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This invention relates to control devices for the transfer and metering of powdered materials and more specifically to a novel and improved control which may be readily adjusted to modify the rate of delivery of powdered materials and to handle powdered materials of different physical characteristics and which affords means to control the density of those materials which may have quantities of air entrapped therein.

Known means for controlling the transfer of powdered materials from a suitable supply to a receiver have utilized such devices as hopper gates, mechanical vibrators and the like. These devices have not afforded the smoothness and degree of control desirable in many applications, and in many cases, known devices often produce lumps or intermix large amounts of air. When air is intermixed with the powdered material, the weight per unit volume is materially reduced and this adversely affects any process wherein powdered substances are to be mixed in predetermined volumetric ratios.

Other known devices have suggested structures to minimize both the formation of lumps and the intermixture of air with the material. While such devices have afforded a certain improvement in the handling of powdered materials, they have not been found satisfactory. For instance, known devices do not provide adequate means for the control of flow, nor do they provide means for modifying and controlling the weight per unit volume of the material delivered.

This invention overcomes the disadvantages of known devices and provides a novel and improved powdered material control which is characterized by its simplicity, means for continuously varying the rate of flow of the powdered material and means for controlling the density of such material.

A still further object of the invention resides in a novel and improved control for powdered materials utilizing a vibrating element in association with annular valving means engaging the element and a peripheral wall over which powdered material passing through the valve is discharged and wherein said element, valving means and peripheral wall are adjustable to control the rate of flow and the density of the material being discharged.

Another object of the invention resides in a novel and improved control valve for powdered materials that may be readily and easily adjusted to modify the rate of flow and wherein means are included to determine the density of the material being discharged through the outlet.

The above and other objects and advantages of the invention will become more apparent from the following description and accompanying drawings forming part of this application.

In the drawings:

FIGURE 1 is a cross-sectional view of a control device in accordance with the invention.

FIGURE 2 is a perspective view of supporting and vibrating means forming part of the valve shown in FIGURE 1.

FIGURE 3 is a cross-sectional view of another embodiment of a powdered material control valve in accordance with the invention.

Broadly, the valve in accordance with the invention includes a generally cylindrical body forming the powdered material inlet and having a telescoped skirt which

is adjustable lengthwise at the lower end of the body. Beneath the skirt is a plate or saucer-like element which cooperates with the skirt to form valving means. The skirt is vibrated vertically and oscillated annularly in a horizontal plane, and means are provided for vertically positioning the skirt relative to the plate. The invention further includes a peripheral wall surrounding the plate, with the height of the wall above the surface of the plate being adjustable to control the density of the material passing over the wall and discharged through the outlet.

More specifically and with reference to FIGURES 1 and 2, the valve in accordance with the invention includes a generally cylindrical body **1** having a flange **2** on the upper end thereof for attachment to a suitable source of supply such as a tube, funnel-type hopper, or the like. The lower end of the body **1** has a cylindrical skirt **3** slidably carried thereby having a sharpened portion **4** on the bottom edge and a peripheral outwardly extending flange adjoining the upper edge.

An outer casing generally denoted by the numeral **7** surrounds the skirt **3** and a portion of the body **1**. The bottom part of casing **7** forms a funnel-like outlet **8** terminating in a flange **9** for attachment to suitable receiving means. The upper portion of the casing **7** includes a generally cylindrical wall **10** which is fixedly secured to the funnel portion **8**. The upper end of the wall **10** carries an annular element comprising a pair of vertically spaced ring-like walls **11** and **12** and a vertical connecting wall **11'**. This annular element forms in effect a lid for the casing **7**, and the annular wall or ring **12** closely fits the outer wall of the body **1**. The body **1** further includes an annular flange **13** spaced below the flange **2**, and the flange **13** is secured to the annular wall **12** by a plurality of bolts **14** which secure the annular wall **12** in spaced relationship to the flange **13**. The funnel **8**, the cylindrical wall **10** and the lid portion comprising elements **11**, **11'** and **12** are all secured one to the other by a plurality of bolts **10'**.

A ring gear **16** having teeth on the inner wall thereof is rotatably carried in the gap between the annular wall or flange **12** and the flange **13**. The gear teeth **17** mesh with pinions **15** also carried within the space between the flanges **12** and **13**, and the pinions are threadably carried on elongated rods **6** having screw threads **19** meshing with cooperating screw threads within the pinions **15**. Each rod **6** is rotatably carried within cooperating openings in the flanges **12** and **13** and are secured at their lower ends to the flange **5** at the top end of the skirt **3**. The ring gear **16** is further provided with at least one outwardly extending handle **18** to facilitate rotation of the ring gear **16** and corresponding rotation of the pinions **15** to raise and lower the skirt **3**.

A plate or disc **26**, disposed beneath the skirt **3**, is supported by means of spring-like elements **24** and **25** secured to a bottom or base plate **21**, the latter being supported by arms **20** extending inwardly from the inner face of the funnel portion **8**. The base plate **21** in the instant embodiment of the invention has a shallow upwardly extending peripheral wall and carries an E-shaped yoke **22** of magnetic material with a coil **23** disposed about the center leg of the yoke. This is shown more clearly in FIGURE 2. The supports **24** and **25** are disposed on opposite sides of the yoke **22** and are inclined in mutually opposite directions. The lower ends **24***a* and **25***a* of the spring supports **24** and **25** are secured to the base plate **21**, while the upper ends **24***b* and **25***b* are attached to the disc **26**. A bar **28** of magnetic material is secured to the underside of the disc **26** and in normal spaced relationship to the upper edge of the yoke **22** to provide an air gap **27** therebetween.

With the foregoing arrangement and when the coil **23**

is energized, the disc **26** will be vibrated vertically and at the same time will be oscillated annularly in a horizontal plane.

In order to prevent the deposition of powdered materials in and about the air gap **27**, the peripheral area between the disc **26** and the plate **21** is closed by a thin flexible band **29** secured in any suitable manner to provide a substantially dust-proof seal.

In addition to the cooperation of the disc **26** with the skirt **3** which determines the rate of flow of the powdered material, the disc **26** is further provided with a peripheral wall **30** which slidably engages the periphery of the disc to permit vertical adjustment of the wall **30**, but yet prevent powdered material from passing therebetween. The cylindrical wall **30** has a plurality of ears **31** extending outwardly therefrom and engaging bolts **32**, the latter extending upwardly upwardly through the wall portion **11** of the outer casing **7**. By adjusting the nuts on the bolts **32**, the wall **30** can be raised or lowered as desired.

With the invention as described above, the powdered material is introduced into the cylindrical body **1** and, since the end portion **4** of the skirt **3** closely adjoins the disc **26**, flow of powdered material through the outlet is interrupted. When energy is supplied to the coil **23**, the disc **26** is vibrated vertically and angularly and imparts to the powdered substance a degree of fluidity which enables it to flow through the gap freely. By adjusting the height of the skirt **3** by operation of the handles **18**, the rate of flow of the material between the skirt and the disc can be controlled. In many adjusted positions of the skirt, a small gap exists between the skirt and the disc and even under such conditions powdered material will not flow through the gap unless the disc **26** is vibrated. The material flowing through the gap between the skirt **4** and the disc **26** passes outwardly by reason of centrifugal motion afforded by angular oscillation and then flows over the top of the wall **30** to be discharged through the funnel outlet **8**.

Powdered materials often contain lumps of compressed material and it is important in measuring precise quantities of material that the lumps be broken up so that all portions of the material will have substantially uniform density. With the arrangement of elements in accordance with the invention, the powdered material must pass through a very fine gap and, accordingly, the lumps must be broken up in order for the material to pass through the gap. It has been found that the combination of vertical and horizontal vibration of the disc **26** effects this end so that the material, after passing through the gap, is of uniform consistency.

Many powdered materials tend to entrap large amounts of air with the result that the specific gravity (weight per unit volume) tends to decrease. This is particularly evident in powdered materials such as talc, calcium carbonate, Portland cement and the like. In order to expel entrapped air and effect control of the density of the powdered material, the powdered material is caused to accumulate about the skirt **3** until it attains a height sufficient to overflow the wall **30**. This will expel the air and deliver a powdered material of substantially uniform density through the outlet.

By way of illustration, powdered talc and heavy calcium carbonate can be transferred smoothly and continuously from the outlet of a bag filter or other supply with a device in accordance with the invention having the following approximate dimensions:

	Mm.
(a) Diameter of cylinder body	130
(b) Diameter of disc **26**	200
(c) Height of cylinder **30** above disc **26**	150
(d) Gap between skirt **4** and disc **26**	10

The specific gravity of weight per unit volume of the powdered substance can be controlled by the height of the wall **30** above the disc **26**. With some substances, the height of the wall can be made relatively small, while in other cases, a greater height may be required. As the height of the wall **30** is increased, the density of the powdered substance will increase if large amounts of air are entrapped therein. When the wall is lowered, smaller amounts of air will be expelled from the powdered substance. As pointed out previously, adjustment of the height of the wall **30** is accomplished by means of the adjusting bolts **32**.

It is evident that other means may be employed for adjusting the height of the wall **30** above the disc **26** and an alternative structure is shown in FIGURE 3. In this embodiment of the invention, the base plate **21** may be provided with ears **34** threadably carried by elongated threaded rods **35** having their upper ends extending through the wall **11** and having nuts **35'** thereon. By rotating the nuts **35'** on the rods **35**, the base plate **21** and the disc **26** will be adjusted vertically relative to the wall **30**, the latter being fixedly secured to the housing by ribs **33**.

While only certain embodiments of the invention have been illustrated and described, it is apparent that alterations, modifications and changes may be made without departing from the true scope and spirit of the invention as defined by the appended claims.

What is claimed is:

1. A device for controlling continuous transfer of powdered materials comprising a tubular body having means on one end for introducing the material to be transferred, a disc adjoining the other end of said body, a peripheral wall surrounding said disc and extending in the direction of said body, means for adjusting the height of said wall relative to said disc, and means for vibrating said disc to cause the powdered material to flow between said other end of the body and said disc and over the edge of said peripheral wall.

2. A device for controlling continuous transfer of powdered materials comprising a tubular body having means on one end for introducing the material to be transferred, a disc adjoining the other end of said body, a peripheral wall surrounding said disc and extending in the direction of said body, means for adjusting the height of said wall relative to said disc, and means for vibrating said disc for movement toward and away from said body and for rotary oscillation in the plane of the disc to cause the powdered material to flow between said other end of the body and said disc and over the edge of said peripheral wall.

3. A device for controlling the continuous transfer of powdered materials comprising a tubular body having means on one end for introducing the material to be transferred, a disc in spaced relationship to the other end of said body, a skirt surrounding and slidably engaging the other end of said body and movable toward and away from said disc, means attached to said skirt for adjustably positioning it relative to said disc, a peripheral wall surrounding said disc, means for adjusting the height of said wall relative to said disc, and means for vibrating said disc to cause powdered material to flow between said skirt and said disc and over the edge of said peripheral wall.

4. A device according to claim **3** wherein said vibrating means vibrates said body in a path toward and away from said skirt and at the same time effects rotary oscillation in the plane of said disc.

References Cited by the Examiner

UNITED STATES PATENTS

2,729,362 1/56 Hughes ..... 222—199 X

FOREIGN PATENTS

907,131 10/62 Great Britain.

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