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F. D. PFENING
HOPPER CONSTRUCTION

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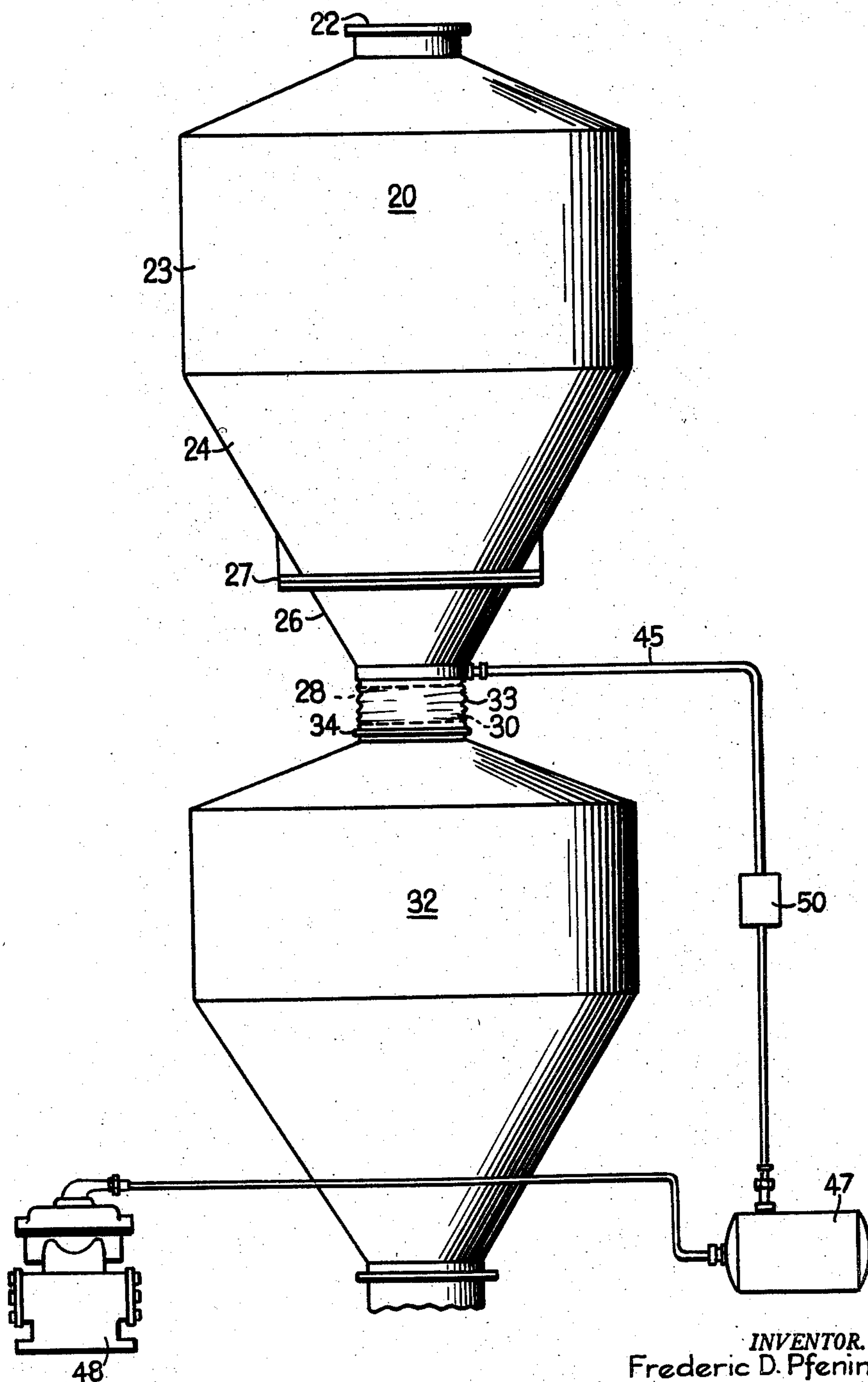


Fig. 1

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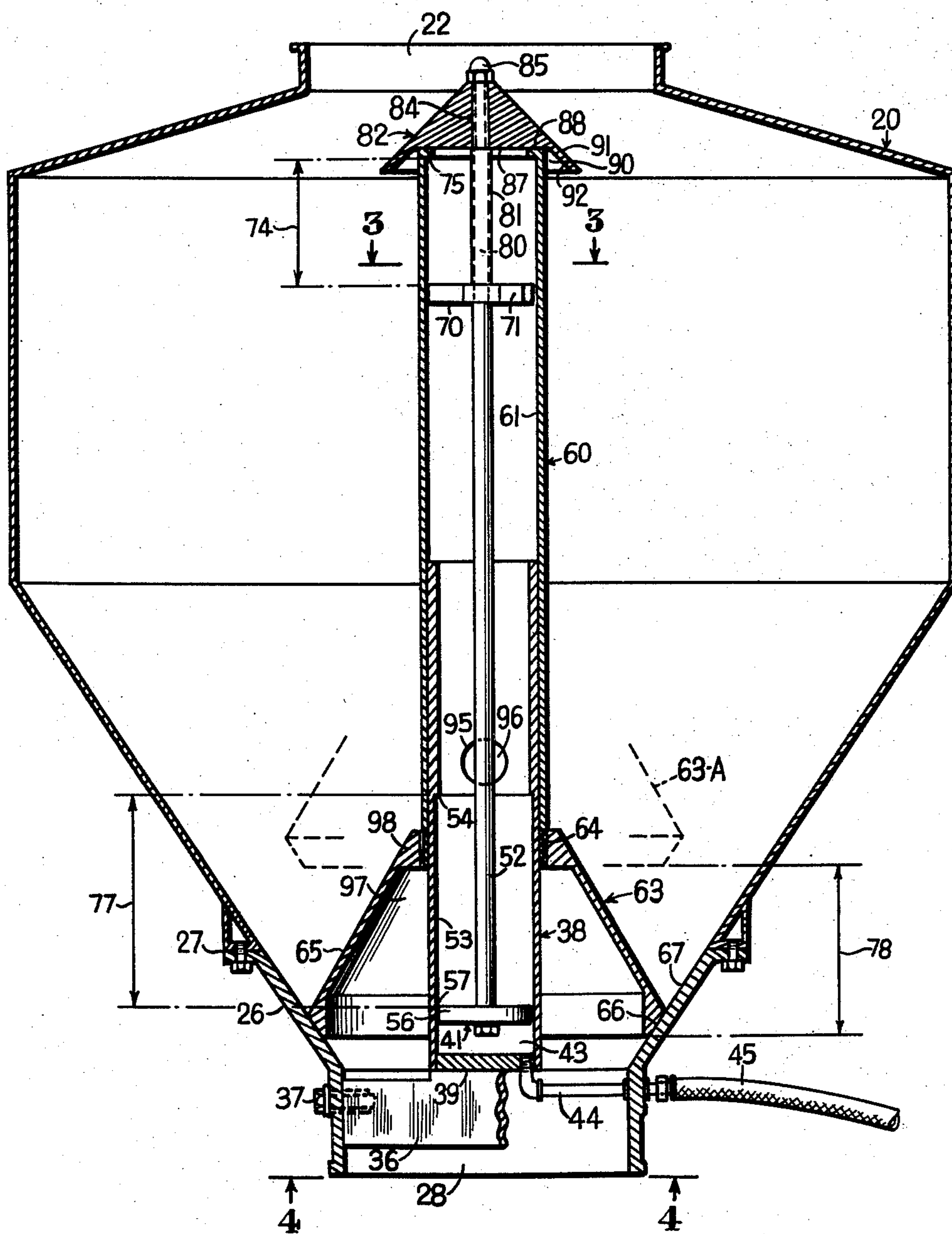
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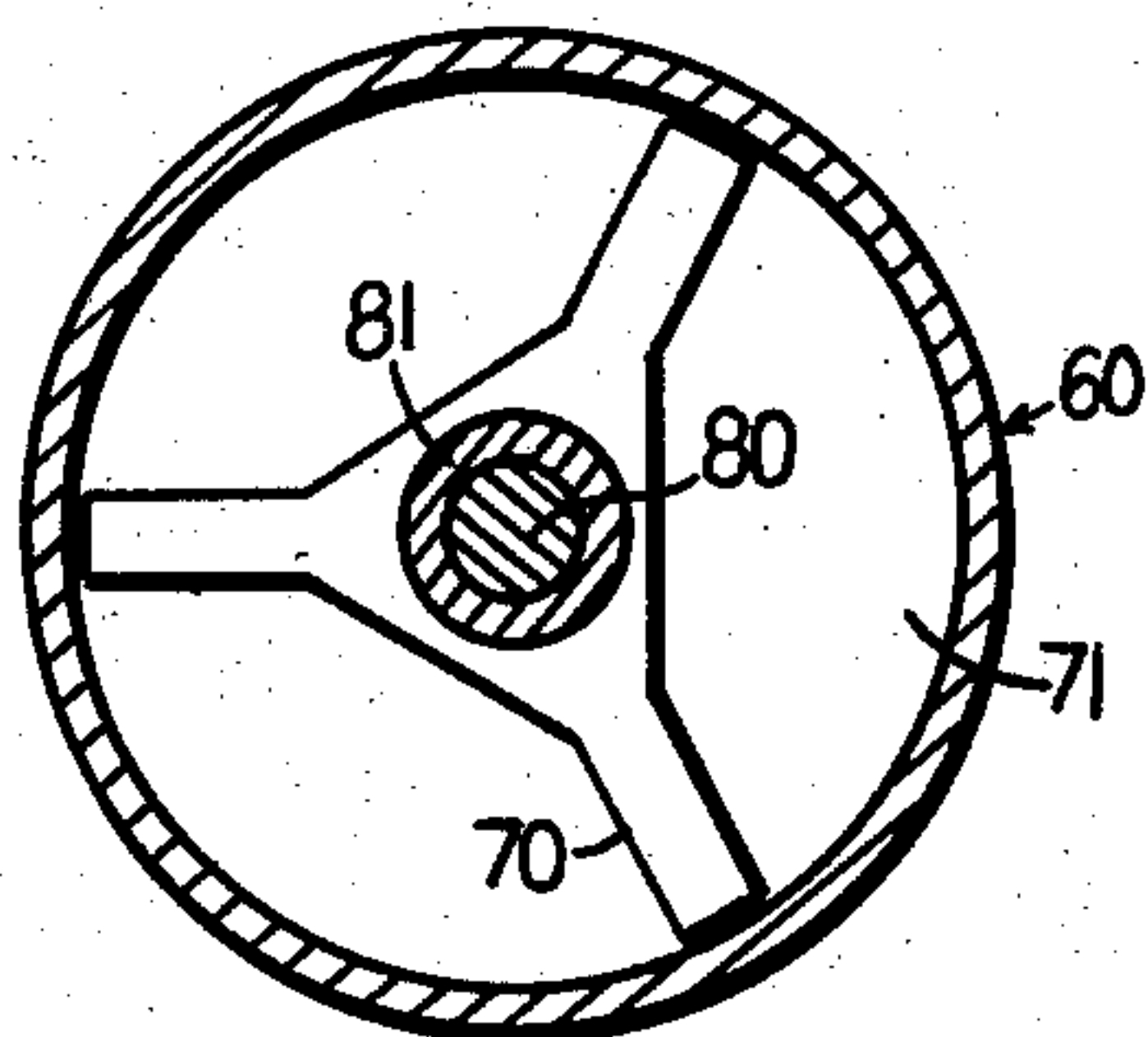


Fig. 3

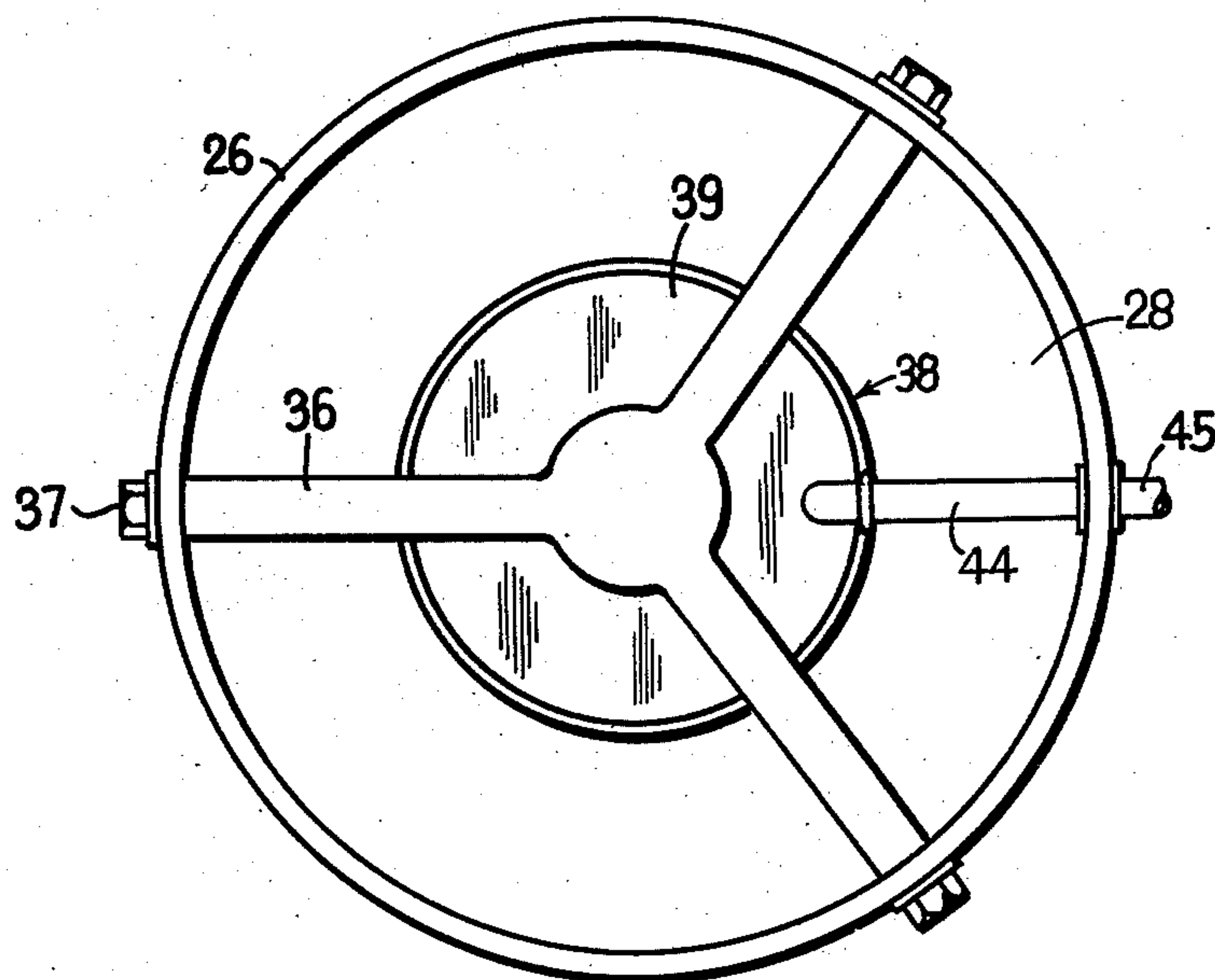


Fig. 4

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2,858,966

HOPPER CONSTRUCTION

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Application February 10, 1956, Serial No. 564,831

18 Claims. (Cl. 222—504)

This invention relates to hoppers for containing and discharging solid material in particle form, such as flour or other ingredients of foods, and more particularly to a novel discharge mechanism for such a hopper.

In the course of handling materials in particle form the novel discharge mechanism is particularly useful when incorporated in a hopper used for temporary storage of material just prior to introduction of the material into a machine or conveying means. As an example, in larger scale baking operations, flour and other baking ingredients are delivered to a scale hopper provided with weighing means and temporarily retained therein prior to being discharged from the hopper to a mixer. In other instances the mechanism of the present invention may be advantageously incorporated in the flour handling system disclosed in my co-pending application Serial Number 582,378 filed May 3, 1956 in which system a scale hopper is arranged to receive, temporarily retain, and then discharge a weighed charge of flour to a second adjoining hopper from which the charge, and subsequent charges, may be automatically distributed to each of a plurality of mixers.

In order to conduct such operations on a faster and more efficient basis the present invention provides a novel hopper construction which includes a power operated valve mechanism which mechanism provides positive control over the discharge operation.

In general, the apparatus of the present invention comprises a container having inclined inner wall surfaces extending upwardly and outwardly from a discharge opening. The closure member for the discharge opening is vertically slideably mounted on a guide member which extends upwardly through the contents of the hopper to a location adjacent the intake opening. A fluid actuated cylinder for opening the closure member is located within the guide member and such guide member is further utilized as a conduit for venting air being displaced from an adjoining container to which material is being discharged.

It is therefore an object of the present invention to provide a hopper construction of the type described which includes a novel valve mechanism for maintaining positive control over the discharge operation.

It is another object of the present invention to provide a novel hopper construction of the type described from which material can be automatically discharged from a remote location.

It is another object of the present invention to provide a novel air venting system for a hopper whereby such hopper can be efficiently utilized to discharge material to an adjoining sealed compartment from which air must be displaced by the material being delivered thereto.

It is still another object of the present invention to provide a novel valve mechanism for transferring material from one compartment to another which mechanism is both power operated and of sanitary construction such that ingredients of foods can be handled without contamination.

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Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of embodiment of the invention is clearly shown.

In the drawing:

Figure 1 is a side elevational view of a hopper and associated mechanism constructed according to the present invention;

Figure 2 is a side sectional view of the hopper and associated mechanism of Figure 1 with the section being taken along a vertical plane through the center of said hopper and mechanism.

Figure 3 is a top sectional view of a portion of the apparatus of Figure 2 with the section being taken along the line 3—3 of Figure 2; and

Figure 4 is a bottom elevational view of a portion of the apparatus of Figure 2 with the view being taken along the line 4—4 of Figure 2.

Referring next to the drawing, Figure 1 illustrates a hopper constructed according to the present invention and indicated generally at 20. Hopper 20 includes an intake opening 22 through which material can be introduced by suitable charging means, not illustrated. The shell of the hopper comprises a vertical side wall portion 23 and an inclined side wall portion 24, the latter being supported by a tapered outlet portion, or valve seat, 26 which may be joined to the hopper shell by the bolted flange construction 27. The bottom of outlet portion 26 is provided with a discharge opening 28 which communicates with an intake opening 30 of a container 32. In place of the container, illustrated, the hopper 20 may be connected to other types of chambers such as the mixing chamber of a mixer. The lower end of hopper 20 is joined to the upper end of container 32 at a sealed junction provided by a flexible connector 33 and the metal wires or straps 34.

Reference is next made to Figure 2 which is a side sectional view of the hopper 20, Figure 1, which illustrates the internal construction of the hopper discharge mechanism.

The valve seat member 26 is provided with a spider assembly 36 which is illustrated in the plan view of Figure 4. Spider 36 is secured in the discharge opening of the valve seat 26 by a plurality of cap screws 37. Spider assembly 36 supports a vertically extending tubular member 38 provided with a lower end closure 39 and a piston 41, slidably carried in a cylinder 43 formed by the inner surface of tubular member 38. A pipe 44 connects the interior of cylinder 43 with a flexible line 45 which in turn leads to a suitable source of pressurized air such as that provided by the tank 47 and compressor 48 illustrated in Figure 1. As seen in Figure 1, flexible line 45 includes a suitable valve 50 for controlling the flow of pressurized air from the source 47 to the interior of cylinder 43.

With reference to Figure 2, when air is introduced into cylinder 43, by actuation of the valve 50, shown in Figure 1, the piston 41 and rod 52 connected thereto are moved upwardly in the tubular member 38. The inner wall 53 of tubular member 38 is provided with a shoulder 54 which forms a stop for limiting the upward travel of piston 41.

In order to effect return of piston 41 and rod 52 to the lower limit of travel, it has been found satisfactory to provide an appropriate amount of clearance between the outer surface 56 of piston 41 and the inner wall surface 53 of tubular member 38. Hence when valve 50 is turned on, piston 41 and rod 52 move upwardly and are retained in a raised position so long as air is being delivered to cylinder 43. When valve 50 is closed, however, the air entrapped in cylinder 43 can bleed past the clearance space 57 provided between the piston 41 and the

inner wall 53 of the cylinder. Hence piston 41 and rod 52 are returned to lower position of travel by gravity.

With continued reference to Figure 2, the mechanism includes a second tubular member indicated generally at 60, which member includes an inner surface 61 fitted in telescoping relationship to the outer surface of the lower tubular member 38. The lower end of outer tubular member 60 carries a closure member, indicated generally at 63, which member may be secured to the outer tubular member 60 by means of the threaded junction 64. Closure member 63 has an inclined upper surface 65 terminating at a beveled edge surface 66 which edge is angled to conform with the inner surface 67 of seat member 26 to provide a sealed junction between closure member 63 and the seat member when the closure member is in its lowermost position of travel as illustrated in Figure 2.

The upper portion of rod 52 carries a lifter 70 which may be formed as shown in Figure 3 to provide openings 71 for the passage of air upwardly through the outer tubular member 60. After piston 41 and lifter 70 have been moved through a certain vertical distance, as indicated by the arrow 74, the lifter 70 will engage the shoulder 75 provided at the top of outer tubular member 60, and, upon further movement of piston 41 and lifter 70, in excess of the certain distance represented by arrow 74, the outer tubular member 60 is raised by such further upward movement of piston 41. When this occurs the closure member 63 is lifted away from sealed seated engagement with seat member 26, and the contents of hopper 20 gravitate downwardly past the spider 36 and outwardly through discharge opening 28. If the total length of stroke of piston 41 is say $8\frac{1}{2}$ inches as represented by the arrow 77, and since the outer tubular member 60 is not moved until the lifter 70 has moved say $2\frac{1}{2}$ inches, as represented by arrow 74, then the total amount of lift available for the closure member 63 is the difference between the distances 77 and 74, or 6 inches, as represented by the arrow 78. The upper limit of travel of closure member 63 is illustrated by the dotted delineation of such closure member indicated at 63-A.

Referring next to the upper end of rod 52, such rod is provided with a neck portion 80 which carries a spacer 81 and a cap member indicated generally at 82. Neck portion 80 extends through a hole 84 in the cap member, and a nut 85 serves to retain the cap member 82, spacer 81, and lifter 70 in assembled relationship, on the upper end of rod 52. The under surface 87 of the cap member normally rests on the upper end 88 of tubular member 60, but when piston 41 is raised the cap member moves upwardly away from the upper end 88 of member 60 to provide an annular opening therebetween for the venting of air at 90. Such air must be vented from the lower container 32, Figure 1, since it must be displaced by the material being delivered to container 32. The hopper 20 is of course filled when the cap member 82 is in the lowermost position illustrated and the upper surface 91 of the cap member is therefore preferably angled downwardly to permit the free entry of material through intake opening 22. The under surface 92 of cap 85 may also be angled downwardly to form a baffle, to deflect the escaping air downwardly to help return any particles of material, which may be carried in the air being vented, to the interior of hopper 20. Hence such particles are prevented from being carried to the environment by the passage of air outwardly from under the cap 82.

Referring again to the inner tubular member 38 illustrated in Figure 2, the walls thereof are provided with a plurality of air holes 95 which holes are normally closed by a wall portion 96 of outer tubular member 60. When the piston 41 is moved upwardly, beyond the distance indicated by arrow 74, the outer tubular member 60 is lifted upwardly whereby the wall portion 96 thereof uncovers the air holes 95. When the air holes 95 are uncovered, the space 97 under closure member 63 is placed in communication with the interior of outer tubular

member 60 since the portion 98 of closure member 63 will then lie above the level of air holes 95. When this condition exists the air being displaced from the adjacent container 32, of Figure 1, can escape upwardly through discharge opening 28 to make room for the material being delivered downwardly through discharge opening 28 to lower container 32. The air being vented from container 32 passes upwardly into the space 97 formed by the under surface of closure member 63, then through the air holes 95 and passages 71 through the lifter, and thence outwardly under cap member 82 at the annular opening present at 90 when the cap member is raised. The air then passes through intake opening 22, or through a suitable air vent, to the environment.

It will be noted that the interior of cylinder 43 is never placed in communication with the air holes 95 since the shoulders 54 arrest the upward travel of piston 41 and confine the movement of the piston to a location below the air holes 95.

In operation, material is introduced into the hopper 20 at the intake opening 22 by means of a suitable conveying or charging means not illustrated. If hopper 20 is a weighing hopper it is filled to an appropriate level as indicated by suitable weighing equipment not illustrated. When it is desired to empty hopper 20, and discharge the contents thereof to an appropriate receptacle or processing apparatus such as is represented at 32 in Figure 1, the valve 50 is actuated to place the interior of cylinder 43 in communication with the source of pressurized air provided by tank 47 and compressor 48. Piston 41 is thereby moved upwardly causing lifter 70 to engage shoulder 75 of outer tubular member 60. As initial movement of piston 41 occurs, cap 82 is raised above the upper end 88 of outer tube 60. When the lifter 70 engages shoulder 75 of outer tubular member 60 such outer tubular member, and the closure member 63 carried thereon, are moved upwardly by an amount controlled by the delivery of air through line 45 to the interior of cylinder 43. When closure member 63 is moved upwardly to a point whereat portion 98 of such closure member lies above the air holes 95, the air which must be displaced from lower container 32 passes upwardly through discharge opening 28 and the conduit formed by outer tubular member 60. Since the upper intake opening 22 of the hopper 20 is either maintained open, or provided with a suitable air vent for the escape of air from its interior, it will be understood that the air which must be displaced from lower container 32 can readily escape upwardly and outwardly of container 20 notwithstanding the fact that material is present in the interior of hopper 20. After the desired amount of material has been discharged from hopper 20, valve 50 can be closed to shut off the flow of air to the interior of cylinder 43. The mechanism will then automatically return to the configuration illustrated, with the closure member 63 in sealed engagement with seat member 26, since any air entrapped in cylinder 43 will escape upwardly through the clearance space provided between the outer surface 56 of piston 41 and the inner surface 53 of cylinder 43. If it is desired to agitate the material in hopper 20, as may be necessary to institute flow of the material if clogging has occurred, air valve 50 can be turned on and off to effect rapid upward and downward reciprocation of closure member 63 which action will agitate the contents and cause same to commence to flow downwardly and outwardly through discharge opening 28.

It will be understood from consideration of Figure 2 that when material is being introduced into hopper 20 through opening 22, and with valve 50 in the closed position illustrated, the under surface 87 of cap 82 forms a seal with the upper surface of cylinder 60 which seal prevents the entry of material into cylinder 60.

The valve mechanism of the present invention is adapted for easy removal from container means 20 in

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that the seat member 26 has an upper peripheral portion removably secured to the lower portion of the container wall at the bolted flange construction 27 of Figure 2. Since seat member 26 is removable, the inner seating surface 67 can be remachined, when necessary, and access is provided to the interior of the hopper for cleaning, and to the valve actuating mechanism for cleaning or repairing same.

It will be understood that although the illustrated mechanism shows a fluid actuated cylinder 43 adapted to actuate the movable structural elements of the invention, other suitable power means, such as a solenoid, switch, and source of electrical energy can be connected to the movable structure, to actuate same, without departing from the spirit of the present invention.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow:

I claim:

1. A hopper for receiving and discharging finely divided particles comprising, in combination, container means including an intake opening in the upper portion thereof, a discharge opening in the lower portion thereof, and an inner wall surface communicating with said discharge opening; closure means for said discharge opening; a vertically extending guide for moveably mounting said closure means relative to said container means, said guide including a cylindrical inner surface, said closure means providing a cover for said discharge opening at a lower limit of movement of said closure means on said guide; a piston slideably carried by said cylindrical inner surface; means connecting said piston with said closure means; a second container means for receiving the contents of said first container means; and means for venting air from said second container means when said contents are discharged from said first container means.

2. A hopper for receiving and discharging finely divided particles comprising, in combination, container means including an intake opening in the upper portion thereof, a discharge opening in the lower portion thereof, and an inner wall surface communicating with said discharge opening; closure means for said discharge opening; a vertically extending guide for moveably mounting said closure means relative to said container means, said closure means providing a cover for said discharge opening at a limit of movement of said closure means on said guide; means for moving said closure means relative to said guide means; means forming a conduit for the venting of air from an adjoining container means when the contents of said first container means are being discharged to said adjoining container means; and valve means for said conduit, said valve means being operatively associated with said means for moving said closure means whereby opening of said closure means opens said valve.

3. A hopper for receiving and discharging finely divided particles comprising, in combination, container means including an intake opening in the upper portion thereof, a discharge opening in the lower portion thereof, and an inner wall surface communicating with said discharge opening; closure means for said discharge opening; a vertically extending guide for moveably mounting said closure means relative to said container means, said closure means providing a cover for said discharge opening at a limit of movement of said closure means on said guide; means for moving said closure means relative to said guide means; said vertically extending guide forming a conduit for the venting of air from an adjoining container means when the contents of said first container means are being discharged to said adjoining container means; and valve means for said conduit, said valve means being operatively associated with said means for moving said closure means whereby opening of said closure means opens said valve.

4. A hopper for receiving and discharging finely di-

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vided particles comprising, in combination, container means including an intake opening in the upper portion thereof, a discharge opening in the lower portion thereof, and an inner wall surface communicating with said discharge opening; closure means for said discharge opening; a vertically extending guide for moveably mounting said closure means relative to said container means, said closure means providing a cover for said discharge opening at a limit of movement of said closure means on said guide; means for moving said closure means relative to said guide means; means forming a conduit for the venting of air from an adjoining container means when the contents of said first container means are being discharged to said adjoining container means; an air conduit closure means; and means operatively associated with said means for moving said first mentioned closure means for opening said air conduit closure means when said first mentioned closure means is moved relative to said guide.

5. A hopper for receiving and discharging finely divided particles comprising, in combination, container means including an intake opening in the upper portion thereof, a discharge opening in the lower portion thereof, and an inner wall surface communicating with said discharge opening; closure means for said discharge opening; a vertically extending guide for moveably mounting said closure means relative to said container means, said closure means providing a cover for said discharge opening at a limit of movement of said closure means on said guide; means for moving said closure means relative to said guide means; means forming a conduit for the venting of air from an adjoining container means when the contents of said first container means are being discharged to said adjoining container means, and a baffle member for the discharge end of said venting conduit, said baffle member serving to remove particles from the flow of air passing through said venting conduit.

6. A hopper for receiving and discharging finely divided particles comprising, in combination, container means including an intake opening in the upper portion thereof, a discharge opening in the lower portion thereof, and an inner wall surface communicating with said discharge opening; closure means for said discharge opening; a vertically extending guide for moveably mounting said closure means relative to said container means, said closure means providing a cover for said discharge opening at a limit of movement of said closure means on said guide; means for moving said closure means relative to said guide means; said inner wall surface including an inclined portion extending upwardly and outwardly, by said closure means including an upper surface inclined upwardly and inwardly and by said discharge opening being opened by moving said closure member upwardly on said guide.

7. A hopper for receiving and discharging finely divided particles comprising, in combination, container means including an intake opening in the upper portion thereof, a discharge opening in the lower portion thereof, a seat in the lower portion thereof, and an inner wall surface communicating with said discharge opening; closure means for said discharge opening, said closure means being engageable with said seat; a vertically extending tubular guide for movably mounting said closure means for upward movement relative to said seat, said closure means providing a cover for said discharge opening at the lower limit of movement of said closure means on said guide, said guide including an inner surface; a fluid actuated cylinder formed by said inner surface of said guide for moving said closure means relative to said guide; means forming a source of pressurized fluid communicating with said cylinder; valve means for controlling the flow of fluid from said source to said cylinder; means forming a conduit for the venting of air from an adjoining container means when the contents of said first container means are being discharged to said ad-

joining container means; and an air conduit closure means operated by said fluid actuated cylinder.

8. A valve mechanism for discharging material from a container having confining walls and a discharge opening in the lower portion thereof, said mechanism comprising, in combination a tubular member including an outer surface and an inner surface forming a vertically extending cylinder; means for mounting said first tubular member within said container and above said discharge opening; a closure member for said discharge opening, said outer surface of said tubular member forming a guide for vertical movement of said closure member; a piston slideably carried in said cylinder; means connecting said closure member with said piston; means forming a source of pressurized fluid communicating with said cylinder; and valve means for controlling the flow of fluid from said source to said cylinder.

9. Apparatus defined in claim 8 characterized by means forming a conduit for the venting of air from an adjoining container when material is being discharged from said first mentioned container to an adjoining container, and valve means for said conduit, said valve means being operatively associated with said piston.

10. A valve mechanism for discharging material from a container having confining walls and a discharge opening in the lower portion thereof, said mechanism comprising, in combination a tubular member forming a vertically extending cylinder; means for mounting said first tubular member within said container and above said discharge opening; a second tubular member in surrounding telescoping relationship with said first tubular member; a closure member for said discharge opening, said closure member being mounted on said second tubular member; and means for moving said second tubular member relative to said first tubular member, said means including a piston mounted for reciprocating movement in said first tubular member.

11. A valve mechanism for discharging material from a container having confining walls and a discharge opening in the lower portion thereof, said mechanism comprising, in combination a tubular member forming a vertically extending cylinder; means for mounting said first tubular member within said container and above said discharge opening; a second tubular member in surrounding sliding relationship with said first tubular member, said first tubular member having a hole through the wall thereof, said hole being normally covered by said second tubular member; a closure member for said discharge opening, said first tubular member forming a guide for vertical movement of said closure member; means for moving said closure member relative to said guide; and means for moving said second tubular member relative to said first tubular member whereby the wall of said second tubular member uncovers said normally covered hole, said means for moving said second tubular member being operatively associated with said means for moving said closure member.

12. Apparatus defined in claim 11 characterized by a piston slideably carried in said cylinder and adapted to raise said second tubular member relative to said first tubular member; means forming a source of pressurized fluid communicating with said cylinder; and valve means for controlling the flow of fluid from said source to said cylinder.

13. A valve mechanism for discharging material from a container having confining walls and a discharge opening in the lower portion thereof, said mechanism comprising, in combination a tubular member forming a vertically extending cylinder; means for mounting said first tubular member within said container and above said discharge opening; a second tubular member in telescoping relationship with said first tubular member and extending upwardly to an intake opening for said container, said second tubular member including an air vent opening

whereby the interior of said second tubular member communicates with a second container to which material is being discharged; a cap member for the upper end of said second tubular member; means for raising said cap member relative to the upper end of said second tubular member; a closure member for said discharge opening; means for moving said closure member relative to said discharge opening; means operatively connecting said means for raising said cap member with said means for moving said closure member.

14. A valve mechanism for discharging material from a container having confining walls and a discharge opening in the lower portion thereof; said mechanism comprising, in combination vertically extending tubular means having a lower end adjacent said discharge opening and an upper end adjacent an intake opening for said container; a closure means for said discharge opening, said tubular means forming a guide for vertical movement of said closure means, said tubular means having an air vent opening whereby the interior of said tubular means communicates with a second container to which material is being discharged; a cap member for the upper end of said tubular means; means for raising said cap member relative to the upper end of said tubular means; means for moving said closure member relative to said guide; and means operatively connecting said means for raising said cap member with said means for moving said closure member.

15. Apparatus defined in claim 14 characterized by a piston being slideably carried in a cylinder formed by said tubular means; a rod connecting said cap member with said piston; a source of pressurized fluid communicating with said cylinder; and valve means for controlling the flow of fluid from said source to said cylinder.

16. A valve mechanism for discharging material from a container having confining walls and a discharge opening in the lower portion thereof, said mechanism comprising, in combination a tubular member forming a vertically extending cylinder; means for mounting said first tubular member within said container and above said discharge opening; a second tubular member in telescoping relationship with said first tubular member and extending upwardly to an intake opening for said container, said second tubular member including an air vent opening whereby the interior of said second tubular member communicates with a second container to which material is being discharged; a closure member for said discharge opening, said closure member being mounted on said second tubular member; a piston slidably carried in said cylinder; a rod means connected to said piston and extended into said second tubular member; means in said second tubular member engageable by said rod means for raising said second tubular member after a certain distance of vertical movement of said piston; and a cap member for the upper end of said second tubular member, said cap member being mounted on the upper end of said rod.

17. A hopper for receiving and discharging finely divided particles comprising, in combination, container means including an intake opening in the upper portion thereof and a discharge opening in the lower portion thereof, a valve seat member above said discharge opening, said seat member being removably attached to an adjoining portion of said container; a valve member adapted to seat with said seat member to form a closure for said discharge opening; a vertically extending guide for movably mounting one of said members relative to the other of said members, said guide including a first inner surface portion forming a cylinder and a second inner surface portion forming the confines of an air venting conduit; a piston in said cylinder for moving said one member; and a second container means forming a receptacle for material discharged from said first container means, said air venting conduit serving to release air

from said second container means when said material is discharged.

18. Mechanism defined in claim 17 characterized by said seat member being formed by an upwardly and outwardly extending cylindrical member having an upper peripheral portion removably attached to a lower peripheral portion of the wall of said container means. 5

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