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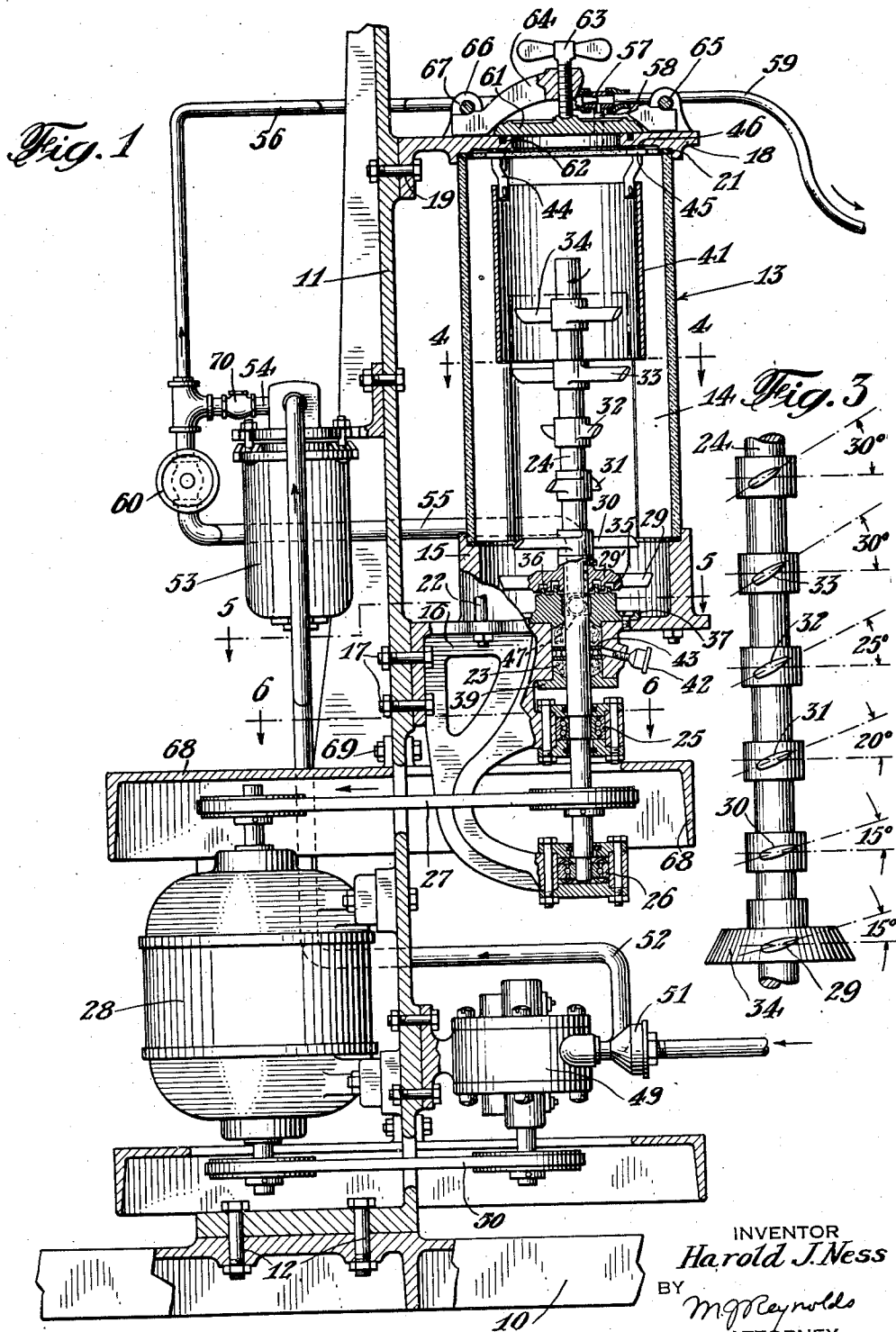
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2,297,791

ATOMIZING DEVICE FOR PULVERULENT MATERIAL

Filed May 25, 1938

2 Sheets-Sheet 1



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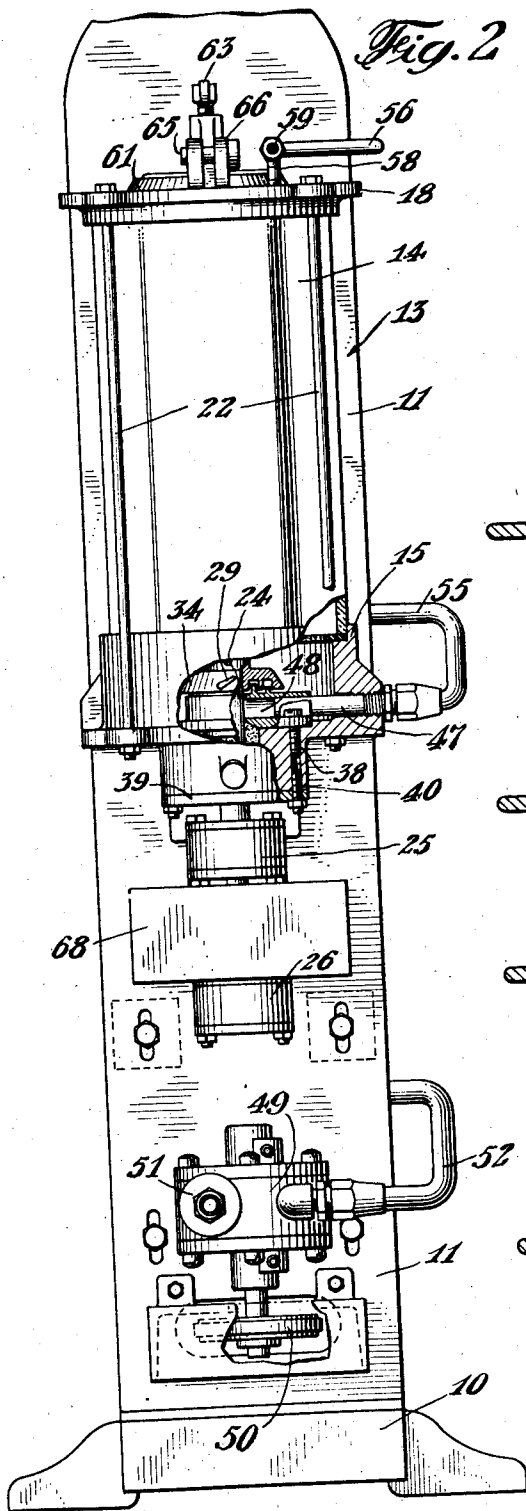
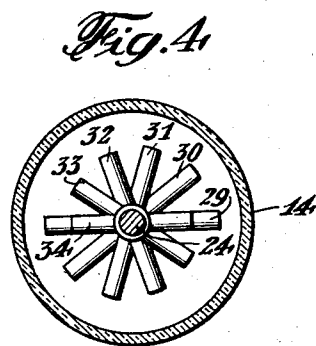
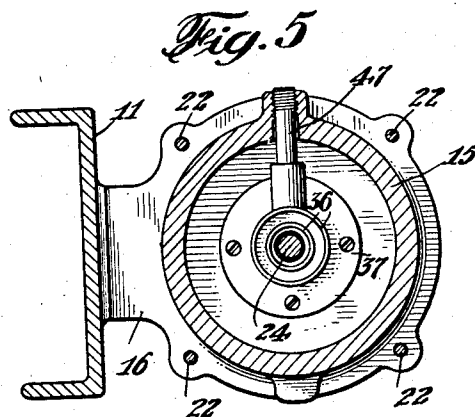
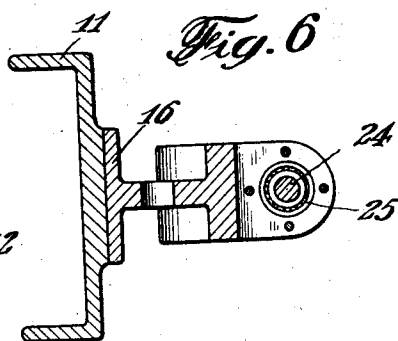
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2 Sheets-Sheet 2



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ATOMIZING DEVICE FOR PULVERULENT MATERIAL

Harold J. Ness, Bloomfield, N. J.

Application May 25, 1938, Serial No. 209,885

14 Claims. (Cl. 302—56)

This invention relates to injecting apparatus and more particularly to apparatus for mixing powdered material with air and/or other gas and introducing the same into a furnace or the like.

It is desirable in many instances to introduce various chemical treating agents into furnaces and similar treating chambers and as an example of such practice there is shown in my copending application Ser. No. 79,968, filed May 15, 1936, a process of producing a lithium atmosphere in a metallurgical furnace by the introduction of powdered lithium compounds, such as the carbonate, chloride or fluoride of lithium, into the furnace mixed with the air or fuel. The apparatus of the present invention is particularly suitable for the introduction of lithium compounds into a furnace for carrying out the invention of the aforesaid application, but it is equally useful for mixing powdered material with the gas for any purpose whatsoever.

In a copending application Ser. No. 143,410, filed May 19, 1937, I have shown one form of apparatus for the above purpose. Briefly such apparatus comprises a suitable container for the powdered material provided with means for agitating the powder therein and for permitting the passage of gas through the chamber during such agitation so that it will become laden with the powder and thereby convey the powder in suspension therein to the furnace or other treating chamber. The present invention is a continuation in part of my aforesaid copending application Ser. No. 143,410, one of the objects being to increase the efficiency of operation of the injecting mechanism.

Another object is to simplify the construction of the machine and to decrease and facilitate the maintenance thereof.

A further object is to permit better regulation of the quantity of powder obtainable from the inspirator whereby a more uniform minimum flow and a greater maximum flow of the powder is obtained.

Another object is to prevent access of the pulverulent material to the glands and bearings of the movable parts of such apparatus.

Another object is to prevent clogging or obstructing of the outlet conduit of the atomizer.

Other objects and advantages will hereinafter appear.

The invention will be better understood by reference to the accompanying drawings, in which:

Fig. 1 is a side view, partly in section, of an

injecting apparatus embodying the present invention;

Fig. 2 is a front view, as seen from the right of Fig. 1, of the apparatus;

Fig. 3 shows diagrammatically the pitch relation of the blades used in the apparatus for agitating the powder;

Fig. 4 is a sectional view on the line 4—4 of Fig. 1;

Fig. 5 is a sectional view on the line 5—5 of Fig. 1; and

Fig. 6 is a sectional view on the line 6—6 of Fig. 1.

The apparatus comprises a base plate 10 upon which is mounted an upright standard 11 by means of bolts 12. A container 13 for the powder to be inspirated is secured to the right side of the standard 11, as seen in Fig. 1. The powder container consists of a cylindrical tube 14, preferably composed of transparent material, such as glass having a low coefficient of expansion, as a boro-silicate glass, or it may be of a plastic composition such as a phenol resin. The tube 14 rests in a recess in the annular flange 15 of a base casting 16, which is secured to the upright standard 11 by bolts 17. An upper closure member 18, also secured to the vertical support 11, by bolts 19, is provided for the tubular member 14. Suitable gaskets 21 are clamped between the cylinder 14 and the upper and lower closure members by tie rods 22. Extending into the container 13 through a stuffing gland 23 in the lower casting 18 is a shaft 24, journaled in ball bearings 25 and 26 mounted in the yoke portions of the casting 18 and retained in place by suitable bearing caps, as shown in Fig. 1. The shaft 24 is revolved by a belt 27 driven from a motor 28 suitably mounted on the opposite side of the vertical upright 11. Secured to the shaft 24 are several sets of powder lifting and agitating blades designated as 29, 30, 31, 32, 33 and 34. The blades 29 to 34 decrease in length, as shown in Fig. 4, and increase in pitch progressively from the lowermost to the uppermost thereof. The pitch of the individual sets of blades is shown diagrammatically in Fig. 3 and varies from 15° at the lower and 30° at the upper, although it is obvious that the increase may be in different ratios from that specified. It is also to be understood that the blades are not all disposed in the same vertical plane, this arrangement being shown in Fig. 3 only for simplicity in illustrating the pitch of the blades. The lower blades 29 are integral with a collar 29' secured to the shaft 24 by a set screw. The lower face of the collar

29' is provided with a series of annular grooves 35 which form a labyrinth seal with a complementary set of annular ridges 36 on the upper surface of a gland closure plate 37 secured in the base of the cylindrical portion 15 of the casting 16 by means of screws 38 (Fig. 2). The lower gland closure plate 39 is held in place by screws 40. Grease is supplied to the gland 23 by a cup 42 communicating with a lantern ring 43. The purpose of the gland is to make a gastight seal for the shaft 24 and the function of the labyrinth seal is to maintain the gland free from the powder in the container 13.

A cylinder or stack 41 is supported below the top closure member 18 by means of rods 44 welded thereto and passing through the cover plate 18. Suitable nuts (not shown) are provided on the upper threaded ends of the rods 39 to compress a flange 45 on the rods against a gasket 46 to effect a gas tight seal at the point where the rods pass through the cover plate. The stack 41 extends from somewhat below the cover plate 18 to adjacent the blades 33 and is of a diameter substantially slightly greater than that of the upper blades 34.

When the container is provided with a supply of a powdered material such as lithium carbonate, and the shaft 24 rotated, the blades serve to agitate the powders and raise them upwardly through the stack 41. To assist in this elevation of the powders the blades 29 to 34 are spaced about the shaft 24 in different angular positions as shown in Figs. 1 and 4, in such manner that the blades pass a given vertical plane in succession from the lowermost to the uppermost as the shaft revolves. In consequence there is a continuous lifting force from the bottom of the container to above the upper blades whereby the mass of powder elevated by the lower blades 29 is then picked up by the blades 30 and passed along thereby to the next blades 31, and so forth, finally being driven upwardly through the stack 41 and over the upper edge thereof, dropping down between the stack and the cylinder 14. The directing of the powder into the stack 41 is effected by the progressive decrease in the length of the blades whereby the powder is caused to rise in a conical stream having the apex within the stack. This movement of the powder is assisted by an air or gas stream maintained through the container as described below. The increase in pitch of the blades propels the powder upward with gradually increasing velocity so that as it leaves the uppermost blade it is thrown to the top of the stack in a fine suspension in the air or gas in the chamber.

A suitable supply of air or other gas under pressure is directed into the chamber 13 through a conduit 47 extending through the base casting 16 and into an aperture 48 in the gland closure plate 37. The gas thus passes upward about the shaft 24 and out into the container between the labyrinth seal members. The gas is supplied by a compressor 49 driven by a belt 50 from the motor 28, a suitable strainer or air cleaner 51 being disposed on the intake side of the compressor. The gas, preferably under pressure of from two to four pounds, is directed by a conduit 52 into a suitable cleaner 53 where the oil and moisture acquired during compression are removed. The gas leaves the cleaner 53 through the conduit 54 and is passed by a conduit 55 and the aperture 47 into the base of the chamber 13. A portion of the gas is also directed by a conduit 56 through the nozzle 57 of an inspirator dis-

posed adjacent the top of the container. The inspirator serves to draw the gas laden with the powdered material from the container through the conduit 58, the stream of powder laden gas then being directed through a conduit 59 to the furnace or other treating chamber.

The combined action of the gas passing upwardly through the powder as it is broken up by the blades and the elevating force of the blades on the powder produces a cloudlike suspension of the powder in the upper portion of the stack 41 and the chamber 13, which suspension is drawn out by the action of the inspirator 57 in a very fine and uniform stream, the magnitude of which can be very accurately regulated by controlling the flow of gas into the chamber 13 as by means of the valve 60.

In order that the container 13 may be readily replenished with powder, a removable cover 61 is provided for the upper closure member 18, this cover being held against an annular gasket 62 whereby to effect a gas tight seal by means of a clamping screw 63 threaded into a yoke member 64 disposed beneath pins 64 and 65 carried by lugs 66 protruding from the upper surface of the closure member 18. The container may be operated until the powder therein is reduced to a point between the lower blades 29 and 30 after which it is desirable to refill it in order to maintain the uniform flow thereof from the chamber. It may be refilled to a point at about the level of the upper blade 33 in order to provide sufficient room in the upper portion of the chamber for the cloudlike suspension of the powders to accumulate. Between these levels the output of the device is substantially uniform for a given setting of the valve 60. If it is desired, two or more injector nozzles 57 may be provided each being supplied with air from the conduit 56 through a suitable manifold arrangement thereby increasing the output of the inspirator. Suitable guards 68 secured to the upright standard 11 by means of bolts 69 are provided for the inspirator motor and compressor pulleys and belts.

It should be noted that the inlet for the air into the chamber 13 is disposed adjacent the shaft below the lower labyrinth member so that the incoming air stream prevents migration of the powdered material toward the gland 23. The operation of the blade 29 also is such that it does not tend to force powder into the labyrinth seal between the lower blade and the upper gland closing member 37. This is important since the powder if permitted to migrate into the gland combines with the grease therein and hardens the gland so that it may score the shaft or cause heating sufficiently to freeze the shaft in the gland. Since the pressure in the chamber 13 may build up to an abnormal pressure, as for instance, due to stoppage of the outlet conduit 59, a check valve 70 is provided on the conduit 54 to prevent any backward flow of air or gas through the labyrinth seal, upon stopping of the compressor. Such backward flow if permitted would tend to carry the powdered material through the seal and into the gland 23. It should be noted that the ball bearings 25 and 26 are disposed entirely out of the container so that they will not be subject to clogging or abrasion by the powders in the chamber.

While lithium carbonate has been specifically referred to herein as one material which may be inspired by the above described apparatus, it is to be understood that any other form of pow-

dered material which may be retained in suspension in air or gas for a sufficient interval to enable its conveyance into the treating chamber to be effected, may be utilized, and therefore, it is not desired to be limited to any specific materials. It is to be understood, of course, that the pitch and speed of operation of the blades may be varied to suit the particular material being conveyed and the pressure of air or gas modified to obtain the most efficient operation with a particular material. Therefore, I do not desire to be limited to the specific details, construction and operation shown and described, but contemplate such modifications thereof as are within the skill of a mechanic, as coming within the scope of the appended claims.

I claim:

1. In a device for the atomization of pulverulent material, the combination of a closed receptacle for pulverulent material, a revolvable shaft extending into said receptacle, a plurality of blades carried thereby and positioned one above the other, said blades being progressively disposed about said shaft, from the lowermost to the uppermost, in angular spaced relation counter to the direction of rotation of the shaft and being pitched so as to cause an upward movement of said material when the shaft is revolved, means for admitting a gaseous medium into said receptacle adjacent the bottom thereof and means disposed adjacent the upper portion of said receptacle for permitting egress of said gaseous medium laden with said pulverulent material.

2. In a device of the character described, a receptacle for pulverulent material, a plurality of revolvable blades disposed one above the other for lifting said material, the pitch of said blades increasing towards the uppermost one thereof whereby to produce an increasing upward thrust on said material as it is elevated through the receptacle, means for admitting a gaseous medium into said receptacle and means disposed adjacent the upper portion of said receptacle for permitting egress of said gaseous medium.

3. In a device of the character described, a receptacle for pulverulent material, a plurality of revolvable blades disposed one above the other, the pitch of the uppermost blade being greater than that of the lowermost blade so as to increase the upward thrust on the material, means for admitting a gaseous medium into said receptacle and means disposed adjacent the upper portion of said receptacle for permitting egress of said gaseous medium.

4. In a device for the atomization of pulverulent material, the combination of a receptacle for said pulverulent material, a plurality of revolvable lifting blades disposed one above the other in said receptacle, said blades decreasing in length upwardly of the chamber, means for removing a portion of said material from the upper part of the receptacle and a partition in the upper part of said receptacle for directing a further part of said material from the upper part of the receptacle into a lower part thereof.

5. In a device of the character described, a receptacle for powdered material, a plurality of revolvable blades in said receptacle disposed one above the other and offset in different angular positions, said blades increasing in pitch and decreasing in length towards the upper blade, a cylinder disposed in said receptacle spaced from the top and side walls thereof and having its lower end surrounding the uppermost blades

whereby the stream is directed upwardly through said cylinder and means disposed adjacent the upper end of the cylinder for removing a part of the elevated material from the receptacle in an atomized stream.

6. In a device for the atomization of pulverulent material, the combination of a closed receptacle for said pulverulent material, a plurality of revolvable lifting devices vertically offset and spaced in progressive angular positions about the axis of the receptacle from the lower one to the upper one of said devices for causing an upward movement of said material, means for admitting a gaseous medium under pressure into said receptacle adjacent the bottom thereof and means disposed adjacent the upper portion of said receptacle for permitting egress from said receptacle of said gaseous medium laden with said pulverulent material.

7. In a device for the atomization of pulverulent material, the combination of a closed receptacle therefor, a revolvable shaft extending into said receptacle, a plurality of vertically spaced lifting blades carried thereby and angularly spaced relative to each other about said shaft, the spacing and pitch of said blades being so related as to cause a substantially continuous upward movement of said material when the shaft is revolved, means for admitting a gaseous medium into said receptacle adjacent the bottom thereof and means disposed adjacent the upper portion of said receptacle for permitting egress of said gaseous medium laden with said pulverulent material.

8. In a device for the atomization of pulverulent material, the combination of a closed receptacle therefor, rotary lifting means in said receptacle for causing upward movement of said material through said receptacle, means for confining said upward movement to the central part of said receptacle adjacent the top thereof, means independent of said lifting means for introducing gas into said receptacle at the base thereof and means for removing said gas and a portion of said material from the upper part of said receptacle.

9. In a device for the atomization of pulverulent material, the combination of a closed receptacle comprising a storage chamber for a mass of pulverulent material, a partition spaced from both the upper and lower walls of said receptacle, rotary means extending along one side of said partition for producing an upward movement of a portion of said material from said mass from the lower part to the upper part of said receptacle along one side of said partition and a downward movement thereof from the upper part to the lower part of the receptacle along the other side of said partition, means for introducing a gas under pressure into said receptacle below said partition and means for removing a portion of said gas laden with said pulverulent material from the receptacle at a point adjacent the upper end of said partition.

10. In a device for the atomization of pulverulent material, the combination of a closed receptacle for a mass of said material, a cylindrical partition spaced from the upper, lower, and side walls of said receptacle, rotary means extending into said cylindrical partition for producing an upward movement of material from said mass through said cylindrical partition and a downward movement thereof around the outer side of said partition, means for introducing a gas into said receptacle below said partition and means

for removing a portion of said gas laden with said pulverulent material from the receptacle adjacent the upper end of said partition.

11. In a device of the character described, a closed receptacle for pulverulent material, movable means disposed in said receptacle for agitating and lifting said material, means independent of said agitating means for supplying air or gas under pressure to said receptacle adjacent the bottom thereof and means connected adjacent the top of said receptacle for conducting a stream of said air or gas laden with said pulverulent material from said receptacle.

12. In a device of the character described, a closed receptacle for pulverulent material, revolvable blades disposed in said receptacle, said blades having a pitch such as to lift said material, means for supplying air or gas under pressure to said receptacle adjacent the bottom thereof and means connected adjacent the top of said receptacle for conducting a stream of said air or gas laden with said pulverulent material from said receptacle.

13. In a device of the character described, a closed receptacle for powdered material, means for introducing air or gas into said receptacle adjacent the bottom thereof, a shaft extending

through a wall of the receptacle, means on said shaft acting on the body of powdered material for elevating said material in the receptacle to produce a suspension thereof in the air above said material, means external of said receptacle for driving said shaft, means providing a gas tight connection between said shaft and the wall of said receptacle, and means adjacent the top of said receptacle for withdrawing powder laden air or gas from said receptacle.

14. In a device of the character described, a closed receptacle for powdered material comprising an upright cylinder, removable closure members for each end of said cylinder, means for maintaining gas tight connections between said cylinder and said closure members, an air or gas inlet extending through the lower one of said closure members and an air or gas outlet extending through the upper closure member, a shaft extending through one of said closure members, driving means for said shaft external of the receptacle and means on said shaft within said receptacle for producing an upward movement of said material to produce a suspension thereof in said air or gas.

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