

Jan. 16, 1951

C. F. CARTER

2,538,441

METHOD AND APPARATUS FOR FILLING CONTAINERS

Filed Aug. 18, 1944

4 Sheets-Sheet 1

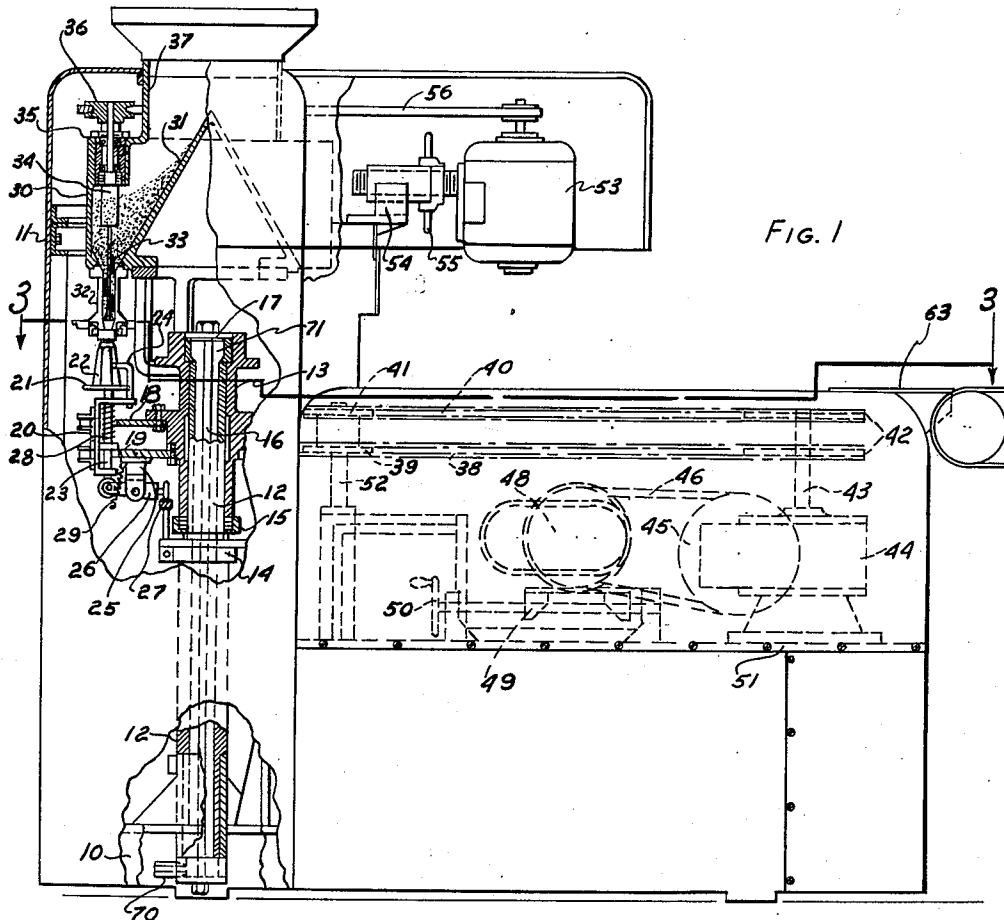


FIG. 1

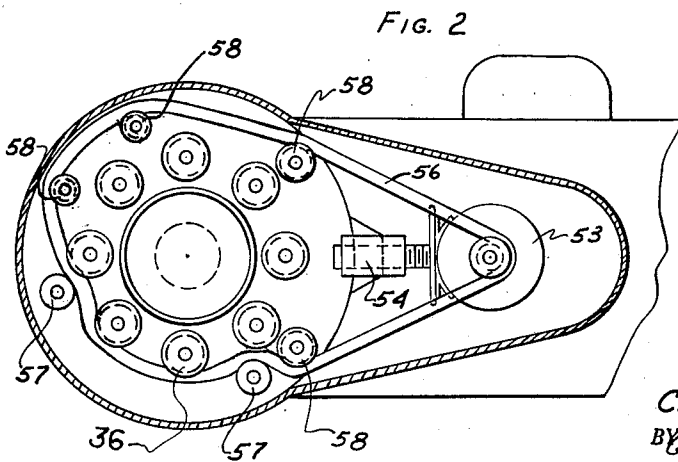


FIG. 2

INVENTOR.
CLARENCE F. CARTER
BY *Benedict & Swartwood*
ATTORNEYS

Jan. 16, 1951

C. F. CARTER

2,538,441

METHOD AND APPARATUS FOR FILLING CONTAINERS

Filed Aug. 18, 1944

4 Sheets-Sheet 2

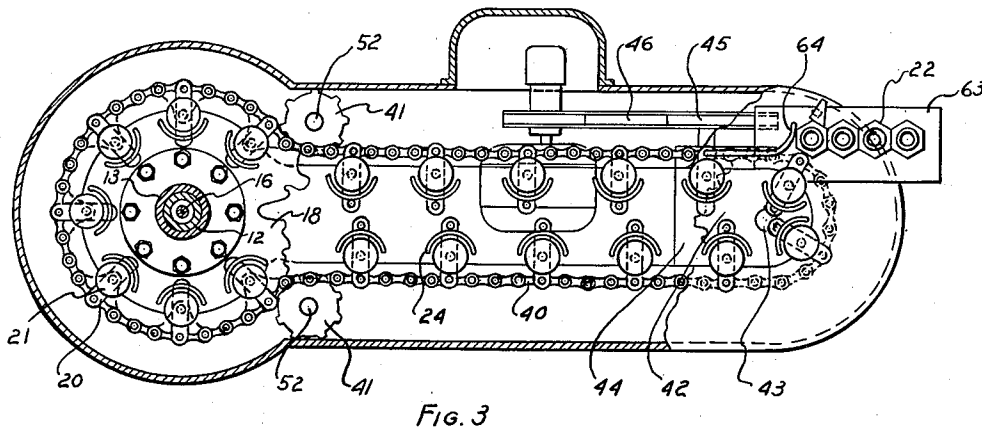


FIG. 3

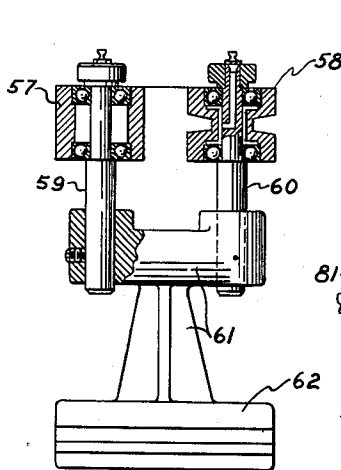


FIG. 4

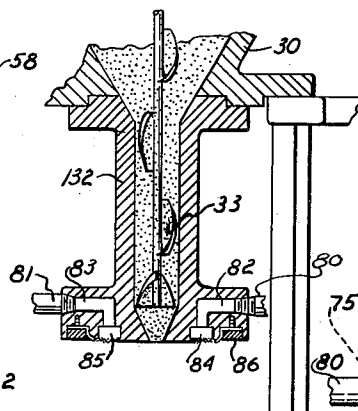


FIG. 5

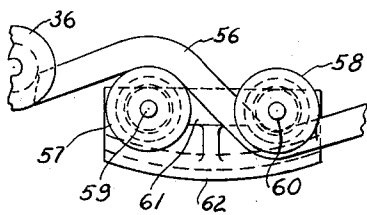
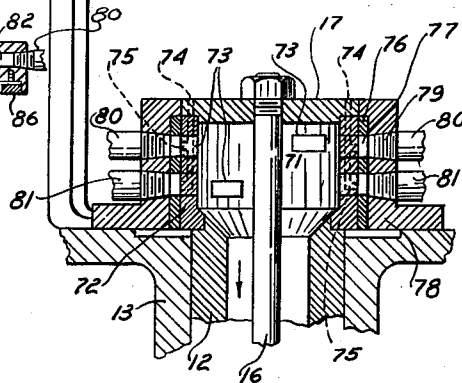


FIG. 7

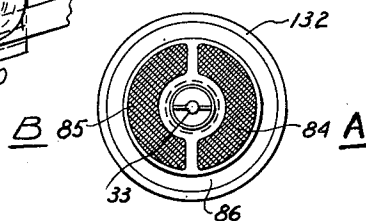


FIG. 8

INVENTOR.
CLARENCE F. CARTER
BY *Benedict & Swartwood*
ATTORNEYS

Jan. 16, 1951

C. F. CARTER

2,538,441

METHOD AND APPARATUS FOR FILLING CONTAINERS

Filed Aug. 18, 1944

4 Sheets-Sheet 3

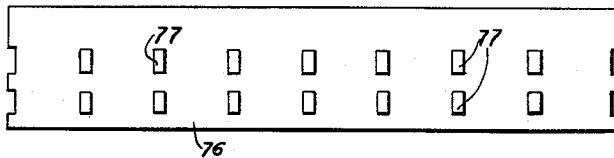


FIG. 7

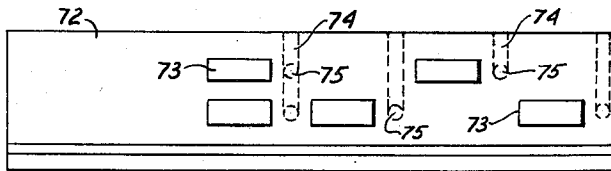


FIG. 8

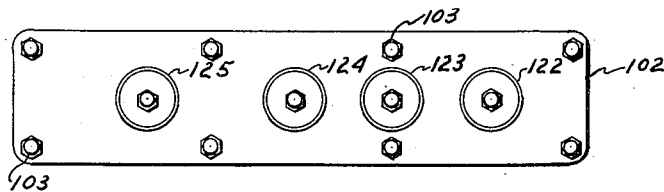


FIG. 11

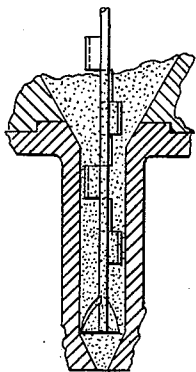


FIG. 12

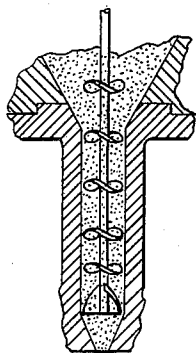


FIG. 13

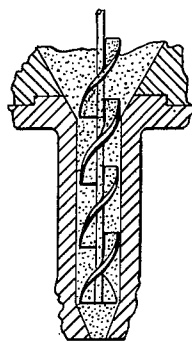


FIG. 14

INVENTOR.
CLARENCE F. CARTER
BY
Benedict & Swartwood
ATTORNEYS

Jan. 16, 1951

C. F. CARTER

2,538,441

METHOD AND APPARATUS FOR FILLING CONTAINERS

Filed Aug. 18, 1944

4 Sheets-Sheet 4

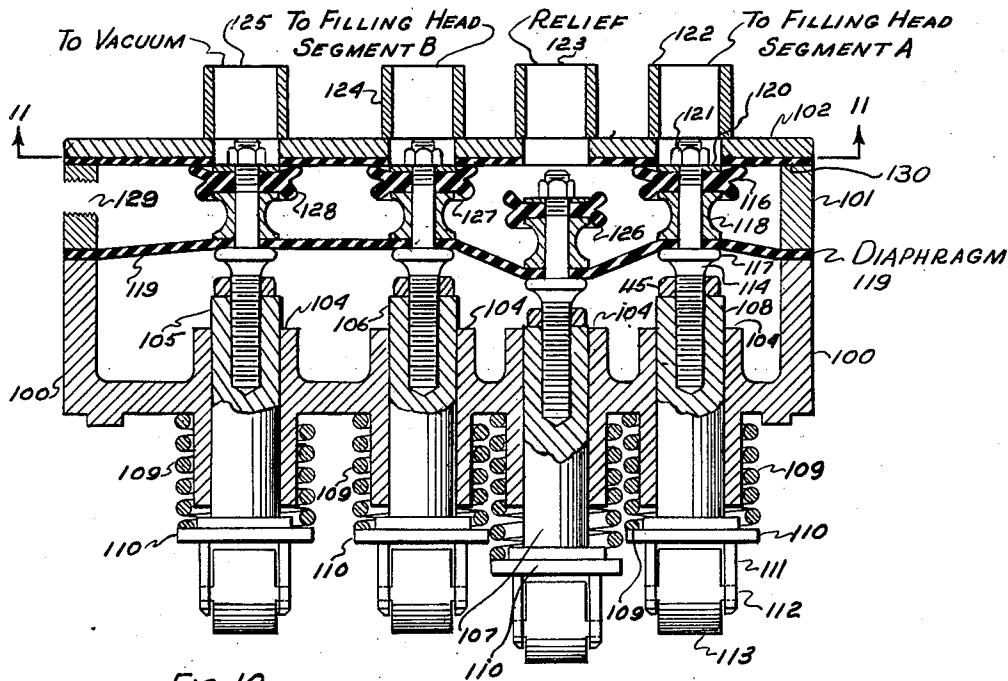


FIG. 10

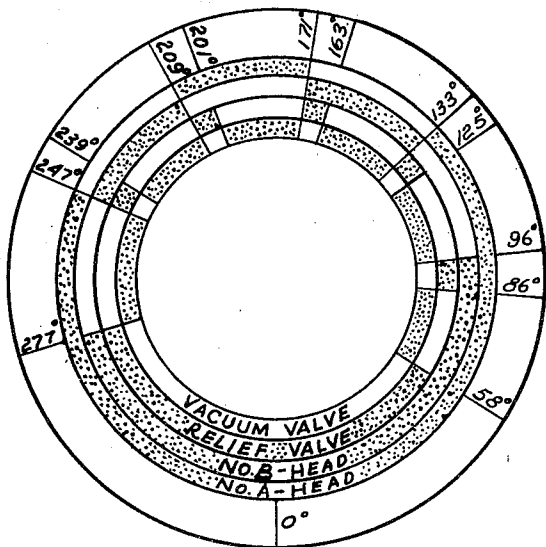


FIG. 15

INVENTOR.
CLARENCE F. CARTER
BY *Benedict & Swartwood*
ATTORNEYS

UNITED STATES PATENT OFFICE

2,538,441

METHOD AND APPARATUS FOR FILLING
CONTAINERS

Clarence F. Carter, Danville, Ill.

Application August 18, 1944, Serial No. 550,001

5 Claims. (Cl. 226—97)

1

This invention relates to improvements in methods and apparatus for filling cans, cartons, jars and similar containers or receptacles with powdered or granulated materials, and particularly to a multiple-head automatic filling machine.

It is the purpose of this invention to provide a method and apparatus for automatically and rapidly filling and packing a container with a comminuted material of either fine or coarse density to a prescribed and constant volume, weight and density. This is accomplished through a stepwise procedure wherein a major portion of the filling is accomplished by means of a pressure differential between the container being filled and the bulk supply of powder, the preliminary filling step being accomplished by alternately reducing and increasing the atmospheric pressure within the container while agitating the powder being drawn into the container and thereafter exerting a positive compressing action upon the powder within the container in order to effect uniform packing. By this method, the apparent bulk density of the powder within the package may be adjusted to a substantially constant predetermined value.

My invention also concerns an improvement in machines for filling containers with powder which comprises means for accomplishing the above described objectives and carrying out the above described method.

Whereas the conventional type of auger filler is slow and dusty in its operation, and whereas the vacuum type of filler will not successfully handle some of the granulated materials; this invention comprises improvements, moreover, embodying a means for packing powder uniformly in a container, together with certain more desirable principles of vacuum fillers. The resulting multiple automatic filler herein disclosed, operates rapidly in its continuous filling operations without dust.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims.

Figure 1 is a side elevation of the machine with parts broken away and shown in central vertical section. Figure 2 is a top plan view of the machine shown in Figure 1 with the hood removed. Figure 3 is a sectional view taken on the line 3—3 of Figure 1. Figure 4 is an elevation, with parts in section, of the adjustable filler control of which Figure 5 is a top view. Figure 6 is a sectional view of a filler head showing a modified form thereof and a modified form of associated

2

vacuum control. Figure 7 is a developed view of the vacuum control valve sleeve. Figure 8 is a developed view of the parted vacuum head. Figure 9 is a plan view of the underside of the filler head shown in Figure 6. Figure 10 is a side elevation partly in section of an improved device for alternately reducing and increasing the pressure within and around the container being filled. In Figure 11, is a top view of Figure 10 taken through lines 11—11. Figures 12, 13, and 14 illustrate a modified apparatus for agitating the powder in the filling throat and for compressing the powder within the container. Figure 15 is a diagrammatic representation of the filling cycle and represents the relationship of the valves during the various stages of the filling cycle.

In the drawings, there is illustrated a multiple-head filling machine having a base 10 with supporting frame 11 in which there is provided a vertically extending hollow supporting shaft 12, adapted to support at its upper end for rotation thereabout, a hopper supporting casting 13. For this purpose the shaft 12 has secured thereabout a fixed collar 14 to support the ball bearing race 15 upon which the hopper casting 13 revolves. A tie rod 16 extends centrally through the hollow shaft to secure over the top thereof a centering and closure washer 17.

Secured to suitable flanges about the casting 13, there are spaced sprocket wheels 18 and 19. Said sprocket wheels carry and are driven by driving and conveyor chains as will be hereinafter described. At spaced intervals along said driving and conveyor chains, there are mounted thereon a series of brackets 20, each supporting a lifter plate 21 for receiving and positioning a container indicated at 22. For this purpose, a plunger 23 is slidably mounted in the inwardly turned upper and lower flanges of each bracket 20, carrying said plate at its upper end. Each lifter plate 21 is provided with a finger 24 extending upwardly therefrom for receiving, centering and maintaining the container 22 in aligned position thereon, the stem of said finger being slidably guided in the upper flange of the bracket 20. Adjacent each bracket 20 and depending downwardly from the lower chain and its sprocket wheel 19, there is a yoke 25 having a lifter arm 26 fulcrumed thereto intermediate its ends. One end of the lifter arm is engageable with a cam track 27. The other end thereof is in roller contact with the lower end of the plunger 23. Said plunger is provided with a compression spring 28 having its upper end engaging the upper

flange of the bracket 20 and its lower end seated upon a collar fixed to the plunger. A lifting spring 29 is connected to the pivoted arm 26 at one end and to the base of the yoke 25 at its other end. This arrangement is such that the spring 29 normally tends to elevate the lifter plate 21 against the tension of the spring 28 when the lifter arm is released by the cam track 27. In this position the container is held against the filler head under tension of the spring 29 until the arm 26 rides onto the cam track 27, thereby permitting the plunger 23, lifter plate and container to be lowered by the spring 28.

The hopper casting 13 also supports hopper 30 which is provided with a central cone 31 extending upwardly therein. Extending downwardly from spaced openings in the bottom of the hopper, there is a series of filling heads 32, each being axially aligned with one of the lifter plates 21 and its plunger 23. Extending downwardly from the hopper through the throat of each of the heads 32, there is provided a shaft 34 fitted with a chuck engaging with a member 33 having a powder compressing means at the lower end and which may also be equipped along its length with agitating means for agitating the powder in the filling head, throat and the entrance thereto from the hopper as described more fully hereinafter.

In alignment with each of the throats and carried in the upper part of the hopper 30, are bearings and housing 35. Shaft 34 extends upwardly therethrough and has secured at its upper end a driving wheel or pulley 36, adapted to rotate one of the shafts when in alignment with one of the lifter plates 21 as hereafter described. The hopper 30 is provided with an upwardly-extending filler neck 37, centrally thereof, and within the annular series of pulleys 36.

The lower end of the filler head is flared to receive the mouth of the container 22 and center it with respect to the throat. Such flared portion of the filler head is provided with a resilient sealing gasket to seal the mouth of the container during the filling operation under pressure of the spring 29. The filler head is shown in greater detail in Figures 6 and 9.

For controlling the amount of material fed into the containers according to prescribed volume, weight and density, it is essential that the hopper be rotated at a predetermined speed, and that the containers 22 be automatically fed to and removed from their respective lifter plates. For this purpose, there is provided a pair of dual driving and conveyor chains, one chain 38 extending about an idler sprocket 39, and the driven sprocket wheel 19. The other chain 40 passes about the idler sprockets 41 and the sprocket wheel 18, as shown in Figures 1 and 3. Said chains, in addition to driving the sprocket wheels 18, 19, serve to convey the containers to the filling heads.

The driving and conveyor chains are driven by a pair of sprocket wheels 42 mounted on a shaft 43 extending upwardly from a speed reduction transmission, as indicated at 44, the speed reduction transmission being driven by a pulley 45, which in turn, is driven by a belt 46 from a pulley mounted on motor 48 mounted for adjustment on a base 49 by a hand wheel 50. The base, and driving pulley may be any suitable variable speed type and are for controlling the duration of the filling cycle of the containers. The driving mechanism is supported upon an extended frame 51 in which the shaft 43 of the driving sprockets and the spindle 52 of the idler

sprockets 39, 41, have their supporting bearings.

The pulleys 36 on the shafts act to rotate the powder compressing and agitating means attached thereto as hereafter described. They are driven by the motor 53, carried upon a supporting bracket 54 and adjustable relative thereto by a hand wheel 55. Said motor is adapted to drive a belt 56 as illustrated in Figures 1 and 2. The pulleys 36 are rotated only during a portion of the feeding operation, said belt 56 being so arranged as to engage and drive said pulleys during a predetermined partial cycle of the hopper. Inasmuch as it is desirable to impart rotation to the shafts for only a predetermined time and throughout a portion of their travel, the relative position of their driving engagement by the belt 56 is controlled through an adjustable filler control comprising idler pulleys 57, 58, which may be located in pairs at spaced points around the machine. Said idler pulleys, as shown in Figures 2, 4, and 5, are supported upon independent spaced vertical shafts 59 and 60, carried by an adjusting bracket 61 having a clamping base 62. The base 62 of each pair of idlers is clamped for adjustment about the frame 11 and so arranged that the belt 56 passes between the idlers, on the outer side of idler 58 and on the inner side of idler 57. Idler 57, therefore, acts to throw the belt into frictional engagement with the driving pulleys 36 when they reach a predetermined position and idler 58 directs the belt out of engagement therewith when the filling operation is completed.

By reason of this adjustment, the members 33 are caused to agitate the material in the throat of the filling head and to compress the powder within the container throughout a predetermined path of travel of the hopper during driving association of pulleys 36 with belt 56. The powder is drawn into the container by virtue of the reduced pressure therein and the member 31 compresses it, permitting additional powder to be drawn in. Although the period of engagement of belt 56 between pulleys 57 may include the entire time the container is in the filling position, it is preferred that the shaft operate only a portion of this time. It is illustrated as engaging at about 209° of the revolution of the hopper, and remains engaged to a point between about 250° and 275° where idler 58 causes it to disengage. The purpose of members 33 is not to feed the powder as is done by the conventional auger fed machine, but to compress the powder after it has been introduced, thereby permitting the container to be properly filled. The usual auger feeder is too slow for my purposes, and therefore I use a reduced pressure within the container as the means for impelling powder introduction, and use the member 33 to compress or pack the powder near the end of the filling cycle.

In operation of the machine, the empty containers 22 are conveyed to a loading platform 63 from which they are guided by an apron 64 onto the respective lifter plates 21 of the conveyor chains 38 and 40. Said chains convey each container on a lifter plate 21 into alignment with a filling head, at which position the driving belt 56 is out of driving engagement with the corresponding pulley 36, and the lifter plate 21 is in its lowermost position through the action of the spring 28. The container having been thus positioned by said lifter plate and centered thereon by the centering finger 24, further travel thereof brings the lifting arm 26 to position for release from the cam track 27, whereupon, the lifting spring 29 raises the lifter plate with the

5

mouth of the container pressed and sealed under spring tension in filling position against the filler head 32. As the hopper casting continues to rotate, the pressure within the container is reduced, as for example, by a vacuum pump, and powder is forced into the container by the greater pressure on the powder in the hopper; the pulley 36 moves into driving engagement with the belt 56, according to the adjustment of the idler pulley 57, and is rotated. The number of revolutions is governed by the speed of the motor 53, and the duration of the filling operation is controlled by the rotation of the hopper casting governed by the speed controller 44. The amount of material introduced is governed by the volume of the container and the extent of packing or compression exerted on the powder after a substantial amount has been introduced, thereby permitting more to be drawn into the container. The amount of compression is governed by the fraction of the cycle pulley 36, is engaged with driving belt 56, and this, in turn, influences the amount of powder added since the reduced pressure automatically and instantly fills up the space provided when the powder compresses. Preferably, the belt 56 disengages just before the pressure is allowed to come to normal in order that dust may be withdrawn from the container and that a bridge may form over the mouth of the feeding head as hereinafter described, to prevent spillage.

The cam is engaged to lift the arm 26, permitting spring 28 to lower the lifter plate 21. This frees the mouth of the container from the filler head, whereupon the container is carried therefrom by the link conveyor chains to a position for removal.

In order to accomplish the purpose of my invention, the pressure within the container is alternately reduced to a point below that of the hopper and increased preferably to the same pressure as is carried in the hopper. Normally, the pressure in the hopper is atmospheric, but in some cases, a higher or lower pressure can be maintained. I prefer to employ a sub-atmospheric pressure within the container and to return the pressure to atmospheric at the end of the cycle, this being the preferred pressure on the hopper.

The operation is accomplished by causing the powder to flow at a rapid rate into the container when the pressure is reduced therein. It should be understood that in carrying out my process, sufficient pressure reduction is employed in the container so that the major portion of the filling is accomplished by virtue of this reduction in pressure and without a positive mechanical feeding action such as the conventional auger-type filling machine employs. The compressing member 33 has of itself no feeding action because flow of powder past it is too rapid. If anything, the member tends to impede the flow of powder except insofar as it exerts an agitating effect. With certain powders which do not flow readily the agitation is important; with free-flowing powders, the agitation need not be used. The member 33, called for convenience a packer, should be designed so as to impede the flow of powder as little as possible in order to obtain the maximum filling speed. Because of this a space may be left between the walls of the throat and the blades of the packer. This does not prevent the packing action since, as the level of powder rises to the top of the container, the powder tightly fills the space around and under the

6

packer and is thrust downward by its action. The packer may, however, fit closely within the filling throat. The packer may comprise, as compressing means, a section of a screw or the like. In some cases, a plunger may be used, although this is not an exact equivalent and would require suitable modification of the mechanism. In any event, the function of the packer is not to feed or measure the powder introduced into the container, but to speed up the compressing of the powder, thus permitting additional powder to be drawn into the vessel because of the reduced pressure. I am able to approximately triple the rate of filling of containers over what can be done with a conventional auger-feed machine, and can increase the amount of powder introduced into a unit-size container by as much as about 7% over what can be introduced in a like period of time by a conventional vacuum feed filler.

To apply the vacuum, a suitable vacuum pump is connected to a nipple 70 leading to the interior of the hollow shaft 12 and vacuum head 71 in the hopper casting 13, as illustrated in Figure 6. The vacuum head is embraced by an apertured stationary ring 72 securely clamped to the upper end of the hollow shaft 12 by the washer 17. Said ring is viewed from the interior in developed form in Figure 8, being provided with a staggered series of elongated apertures 73 and spaced intermediate downwardly-extending air vents 74 registering with suitable ports 75 in the washer 17. Surrounding and conforming to said stationary ring there is a rotating ring 76, a development of which is shown in Figure 7. Said ring is provided with a double series of spaced apertures 77 adapted to register periodically with the apertures 73 and air ports 75 in the stationary ring during their relative rotation. The rotating ring is locked to the rotating head 78 having apertured sockets 79.

Connected with each of the sockets 79, there is a flexible air hose, the upper of which is indicated as 80 and the lower of which is indicated as 81. Each pair of hose 80 and 81 is connected to opposite sides of the modified filler head 132, being in communication with the air ducts 82 and 83, respectively. Said air ducts lead to the semi-circular screened openings 84 and 85, also designated as segments A and B, respectively. Surrounding said semi-circular screened openings, there is provided an annular gasket 86 against which the upper edge of a large mouthed container engages.

In operation, as the hopper casting 13 is rotated, the rotating ring 76 rotates relative to the stationary ring 72. This brings the aperture 77 of the rotating ring in periodic registry with the elongated apertures 73 and the ports 75 of ducts 74. Each pair of apertures 77 is connected through the flexible hose with one of the filler heads 132 which comprise a modification of and is otherwise similar in its operation to the heads 32. The upper series of apertures 77 being connected with their respective hose 80, lead to the screened opening 84. The lower series of the apertures 77 communicate with their respective hose 81, leading to the screened opening 85.

With a partial vacuum being maintained in the vacuum head 71 air will be drawn from the container through first one and then the other of screened openings 84 and 85. This has the effect of evacuating the air in the container to permit introduction and some packing of the material therein and at the same time, remove and carry away any dust developed in the filling of the con-

tainer. It has the further effect of partially degasifying the powder, permitting it to be packed more firmly and uniformly. To prevent clogging of the screens in said openings by the material when the air is evacuated from the container, a pulsating effect is developed by causing air to pass first through one side and then the other side of the screen, as hereinafter described.

It may be noted from the development of the stationary ring in Figure 8 that it is blanked off and there are no apertures in that portion thereof extending from the unloading stations of the hopper. Immediately upon the filling operation commencing, the apertures 77 of the rotating ring will engage both an upper and lower aperture 73 in the stationary ring. This has the effect of initially withdrawing air from the container through both screened openings simultaneously for about 30° of the hopper rotation.

Upon apertures 73, 77 initially passing out of registry, apertures 77 of the rotating ring register with air ports 75, allowing the air hose to fill up with air at atmospheric pressure. Thereupon apertures 77 move out of registry with the ports 75, the lower aperture 77 then registering with the lower aperture 73. This evacuates the air trapped in the lower hose 81, and draws air from the container upwardly through the screened opening 85 in the head while at the same time, drawing the trapped air from the hose 80 in the reverse direction through the opposite screened opening 84 to thereby unclog the latter. Continued rotation of the hopper moves the lower apertures 77 out of registry with lower aperture 73 and brings it into registry with the next following air vent 74, filling hose 81 with air at atmospheric pressure. Thereupon the upper aperture 77 registers with the upper aperture 73 to withdraw air from the container upwardly through the screened opening 84 and draw the entrapped air from the hose 81 downwardly through the screen 85 to unclog it. This cycle of pulsations, first drawing air upwardly from the container through the screen on one side of the head and drawing entrapped air from the hose down through the opposite screen to unclog it, is repeated, first on one side of the head and then the other during each filling operation.

By means of the combined packing mechanism and intermittent pulsating vacuum control, advantages are realized which can be obtained in no other way particularly as regards the amount and speed of filling. This is particularly applicable to powder or finely comminuted material, where a dense packing is desired. This results in a packaging operation which is accurate as to quantity, weight and density, as well as being dustless.

As claimed herein, the driving belt and wheels or pulleys for the packers and hopper may be in the form of link belts or chains and sprocket wheels; or the belts may be of a character for driving flat-faced pulleys or sheaves. Also the comminuted material may be of varying degrees of fineness, i. e., either fine and powdery or coarse and granulated. With the former, it is more desirable to utilize a greater vacuum, that is, a lower internal pressure, than is needed for coarser materials.

Figure 10 is an improved device for effecting the alternate reduction and increase in pressure within the container and may be used in place of the device above described. One of these may be used for each filling head, although in some cases, one may be used for each pair of heads.

The device consists of a lower block 100, and upper block 101, upon which head 102 is placed. The upper block, the lower block and the head may be assembled by the conventional means such as stud bolts 103 to produce a tight seal.

Lower block 100, which may comprise a single casting, contains a plurality of guides, 104, through which pistons 105, 106, 107 and 108 pass. The guides 104, serve also as supports for springs 109 which bear at one end upon the base of block 100, and at the other end upon a collar 110 attached to the pistons. Also attached to this collar, is a yoke 111 having a journal therein for the bearing 112 of wheel or roller 113. A threaded hole is drilled in the upper end of the pistons and is designed to receive valve stem 114 which is adjustable and may be held in any desired position by locknut, 115. Intermediate in the valve stem length is a washer, 117 which may be attached to or integral with the valve stem. The valve stem passes through an elastic diaphragm, 119. A spool, 118 rides upon the diaphragm and supports the valve, 116 which may be held in place by a means such as washer, 120 and nut, 121. The other valve assemblies are similar to the one described.

The valves illustrated in Figure 10 have novel features which are particularly useful in connection with operations associated with dust or powder which may tend to accumulate on valve seats and heads preventing their proper functioning. The valve head comprises a resilient disk of suitable material such as rubber or synthetic elastomers such as neoprene, chloroprene, etc. The disk has a winged member extending circumferentially around it. This may comprise a ridge or roll of rubber. The preferred method of forming the head is by molding it from the proper material, or the head may be made by incising a disk circumferentially and then compressing the portion nearest the center. A hole is provided for insertion on the valve stem. Although any suitable means of attachment may be used, as illustrated in Figure 10, the valve head 116 is placed on the valve stem over spool 118 which is of smaller cross-section than the resilient head. A washer 120 also of smaller diameter than the head, is placed over the head and drawn up tightly by means of nut 121. This compresses the mid-portion of the rubber head and tends to throw the winged member upward toward the valve seat. The travel of the valve stem is set so that the wings strike the valve seat before the valve is completely closed. The upward travel of the valve causes the wings to spread outward in all directions across the face of the valve seat imparting a wiping effect, thus forming a tight seal and at the same time, cleaning the valve seat of any powder or foreign matter clinging thereto.

The upper block 101 is designed to rest upon a rubber diaphragm 119, and as previously mentioned, may be fastened to the lower block by conventional means. The rubber diaphragm may serve as a gasket between the upper block 101 and lower block 100. Between the head 102 and block 101 is a rubber lining 120 extending, except for openings as described, over the entire surface of head 102. If desired, it may be cemented to head 102. As illustrated, it serves as a gasket between block 101 at head 102. It is within the scope of the invention that only the portion of the head adjacent to and comprising the valve seats be rubber lined.

Block 101 may contain an aperture 129 which

may be threaded to receive a nipple. This may be connected with a hood or shroud surrounding the container, these being used when the container is collapsible to permit the pressure to be kept equalized inside and outside the container. When a rigid container is used, the opening 129 may be plugged. Cylinder head 102 contains ports 122, 123, 124 and 125. These ports are equipped to be attached to suitable conduits. The valves, by virtue of their design and the material used, tend to wipe the face of the rubber lines 130, removing powder which may cling thereto and preventing faulty action due to plugging of the ports.

The operation of the device shown in Figure 10 is as follows and may be further clarified by reference to Figure 15 which is a diagrammatic illustration of the process cycle.

The wheels 113 ride upon cams (not shown) which may be supported in a conventional manner and which are cut so as to produce cyclic operations such as are illustrated in Figure 15. The 0° point in the Figure 15 is the point about 58° before the container first is engaged with the filling head. At this point, the relief valve 125 is open to the atmosphere. When hygroscopic powders are employed, the relief valve may be attached to an air dryer or air conditioner. The ports 122 and 124 lead through ducts or conduits attached to the respective sides A and B of the filling head (see Figure 9) and both valves 116 and 127 controlling ports 122 and 124 are open until the hopper has passed through about 58° of revolution. At this point the relief valve 125 is closed and the vacuum valve 128 is opened, reducing the pressure within the container. Both sides of the filling head are open at this point. At about 86° of revolution, the vacuum valve 128 is closed and the relief valve 126 is opened in order to allow the pressure to return to atmospheric and to clear the screens. Although the pulleys 36 may be engaged at this point, in the preferred operation, this is not yet done, although as stated before, this depends on the character of the powder. At this point, the vessel has been partially filled with powder by the vacuum action.

Valves 126 and 127 are closed at 96° revolution, valve 116 remains open, vacuum valve 128 opens and remains open to 125° revolution, at which time, it closes, the relief valve 126 opens. This permits air to pass back through section A of the filling head screen and clear it of powder. At 133° revolution, valve 126 to the relief port, and valve 116 to one filling head port A closes and valve 127 to segment B and 128 to the vacuum line opens and remains open to 163°. The vacuum is then shut off and the relief valve 125 opened to permit air to pass back through the screen on the side B of the filling head controlled by valve 127 and swept clean. At 171°, the vacuum valve 128 and the valve 116 to filling head A open and the relief valve 126 closes permitting a reduction of pressure in the container through the side of the filling head controlled by valve 116. At 201°, the vacuum line valve 128 closes and the relief valve 126 opens to clear the screen on the A side of the filling head.

At about this point, the container has as much powder as can readily be introduced by vacuum means alone and according to my preferred operation, the packer begins operation by virtue of the engagement of the driving belt 56 with pulley 36. In those cases, where the packer is equipped with agitating member, it usually begins to func-

tion as a packer at about this point and the powder within the container is compressed. The exact point will depend in part on the duration of the cycle, the degree of vacuum and the flowing characteristics of the powder. The point at which the packer is disengaged may vary, but in one preferred embodiment, this is done while the container is evacuated in order that there be no dusting when the container is finally disengaged from the filling head. In any event, it is preferred not to operate the packer after the pressure in the container is restored to normal. In order to completely fill the container, vacuum valve 128 is opened as is filling head valve 127 and the relief valve 126 is closed. At 239° of revolution, the vacuum valve 128 is closed and the relief valve 126 is momentarily opened to clear segment B. At 247°, both valves 127 and 126 are closed. Vacuum valve 128 is again opened and filling valve 116 to the filling head is opened. The packer may continue to compress the powder within the container from approximately 209° to 277° of revolution during which time, additional powder is being supplied by virtue of the vacuum to fill the space made by compressing the powder already in the vessel. At 277°, the packer has preferably stopped and the vacuum valve 128 closed; relief valve 126 is opened and so is valve 127. This permits a back blast of air to both heads, clearing them for the next cycle. The period from 277° to the starting position is occupied in removing the container from filling device. In some cases, the operation of the packer may be stopped between about 250° and 275° largely to permit removal of dust from the container. An additional function is to permit a slight bridge to form over the mouth of the filling head which is tapered for this purpose. This prevents spillage of the powder between the time the filled container is removed and the next empty is put in place.

In large capacity machines with large filling heads, several tapered openings may be provided in the head. The taper begins below the packer and becomes smaller toward the lower outlet of the head.

My apparatus and method of filling containers with comminuted material has advantages over those machines heretofore used for this purpose in that it provides rapid filling and at the same time, more uniform packing of the material. Combination of vacuum and auger filling have been used but these methods depended upon the auger to supply the filling. The vacuum was intended to eliminate dust due to air displacement in the container. The vacuum did not aid otherwise in the filling operation, indeed could not if the purpose of the auger for measuring powder were to be accomplished. As a consequence, the rate of filling is no greater than that of a regular auger filler, since these machines use the auger to measure the amount of material introduced into the container. They depend upon the auger operating a certain fixed time to do the filling and hence must design the auger and limit the vacuum used so that the auger does all the filling work. If this were not so, there would be no control over the amount of material introduced insofar as the auger is concerned.

My device on the other hand, does not depend on an auger feed. It uses a vacuum feed for the actual introduction of the powder, but it supplies a further feature in that the material already introduced can be packed more compactly and uniformly. This permits the use of a smaller

container for the same weight of material than can be used with vacuum filling alone, and at the same time, increases the speed of filling enormously.

The apparatus is useful for other purposes as well as for filling containers, for example in supplying powdered resins, plastics, wood fiber, clays, etc., to mold forms in connection with the technique of molding from powders developed in the last few years. One machine may supply several molding machines and may be synchronized with it.

I claim as my invention:

1. An apparatus for filling containers with comminuted solids which comprises a rotating hopper, a plurality of filling heads depending therefrom, means for aligning and engaging containers with said filling heads, means for alternately reducing and increasing the pressure within the containers while in filling relationship with said heads, mechanical means associated with each filling head for compressing the powder thus introduced, means for reducing the pressure within the said container correlated with the operation of said compressing means and means for removing the filled container.

2. A filling machine for loading comminuted solids into a container, said machine comprising a hopper and a filling head and having a conduit containing a throat communicating between said hopper and said filling head, means for alternately reducing and increasing the pressure within said container so as to draw comminuted solids through said throat from said hopper, a compressing and agitating means extending into said throat and terminating adjacent the mouth thereof, said throat being tapered at its terminal end, the taper beginning at a point below the termination of the agitating and compressing means, said means for reducing the pressure in said container being synchronized with the operation of said compressing means, and means for removing the filled container.

3. An apparatus for filling containers with comminuted solids which comprises a hopper, a plurality of filling heads depending therefrom, means for aligning and engaging containers with said filling heads, means for alternately reducing and increasing the pressure within the containers while in filling relationship with said heads, mechanical means associated with each filling head for compressing the powder thus in-

troduced, said mechanical means comprising a section of a screw, said means for reducing the pressure within said container synchronized with the operation of said compressing means, and means for removing the filled container.

4. An apparatus for filling containers with comminuted solids which comprises a hopper, a plurality of filling heads depending therefrom, means for aligning and engaging containers with said filling heads, means for alternately reducing and increasing the pressure within the containers while in filling relationship with said head, mechanical means associated with each filling head for compressing the powder thus introduced, said mechanical means comprising agitating members and a packing member, said means for reducing the pressure within said container synchronized with the operation of said compressing means and means for removing the filled container.

5. A method for filling containers with comminuted solids which comprises reducing the pressure within a container while in filling relationship with a filling head thereby filling said container substantially to capacity with loose powder but without substantial positive mechanical feeding action, then mechanically compressing the powder thus drawn into said container while maintaining a reduced pressure therein during the compressing step thereby supplying additional powder to the container, stopping the mechanical compressing action and restoring the pressure within the container to atmospheric pressure and removing the filled container from engagement with the filling head.

CLARENCE F. CARTER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
346,265	Charlton et al.	July 27, 1886
648,702	Murray	May 1, 1900
1,452,585	Adams	Apr. 24, 1923
1,520,669	Zugner	Dec. 23, 1924
1,880,840	Currier	Oct. 4, 1932
1,981,485	Westin	Nov. 20, 1934
2,170,469	Carter	Aug. 22, 1939
2,443,182	Carter	June 15, 1948