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[54] **APPARATUS FOR FILLING A RECEPTACLE WITH COMPACTED PULVERULENT MATERIAL**

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[51] **Int. Cl.**..... **B65b 1/16**

[58] **Field of Search**..... 141/93, 83, 286, 71–82, 141/56, 57, 59, 67, 68; 251/212; 177/122; 222/436, 442, 445, 450, 373

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[57] **ABSTRACT**

An apparatus for filing a receptacle with compacted pulverulent material comprising a compaction compartment equipped with a closable inlet and outlet. A negative pressure source, atmospheric pressure and/or an overpressure source can be connected via a filter mechanism with the compaction compartment. According to important aspects of the invention a supply compartment is connected following the compaction compartment, the outlet of the supply compartment being equipped with a dosing mechanism.

20 Claims, 3 Drawing Figures

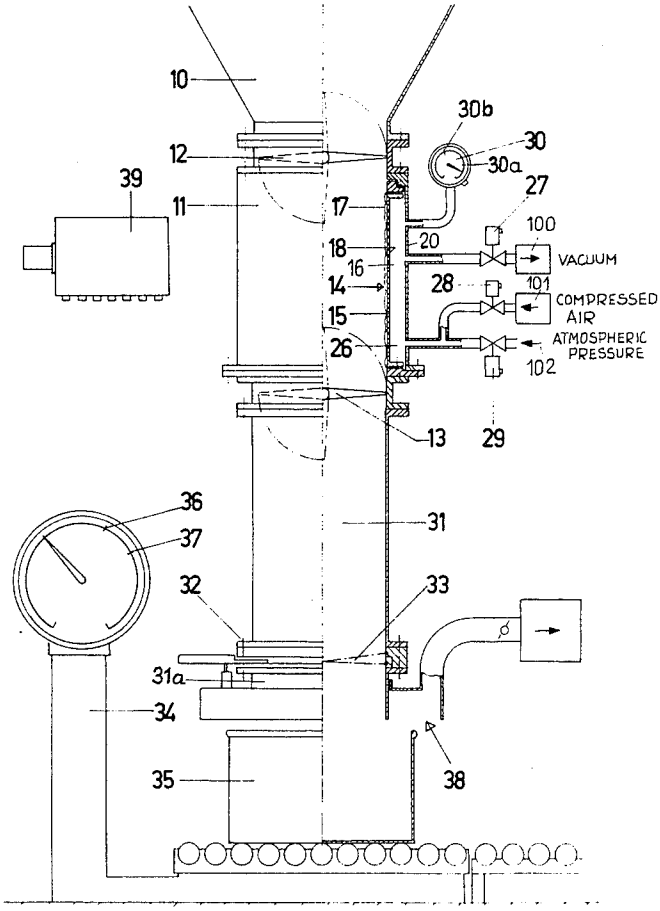

Fig. 1

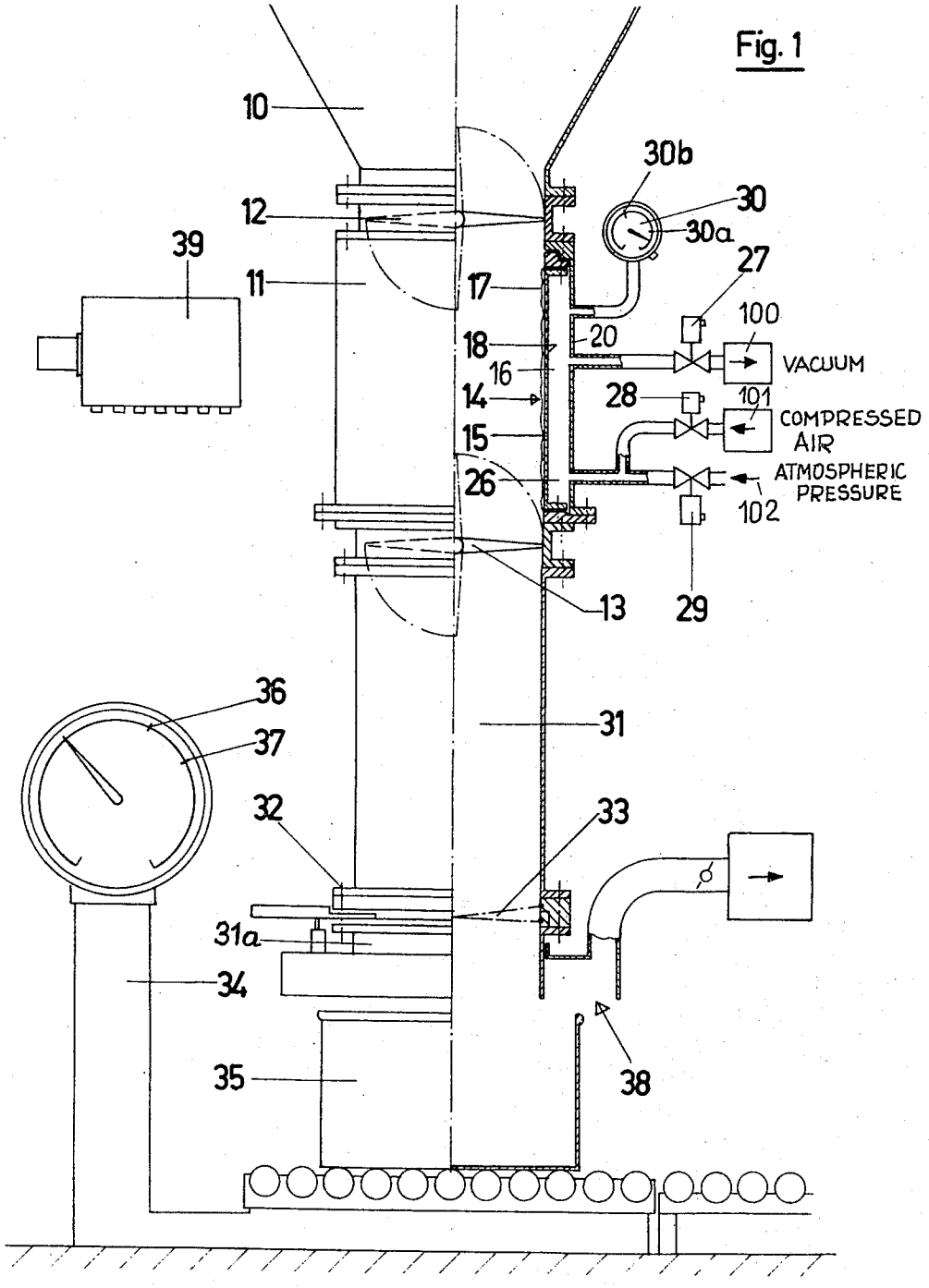
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Fig. 2

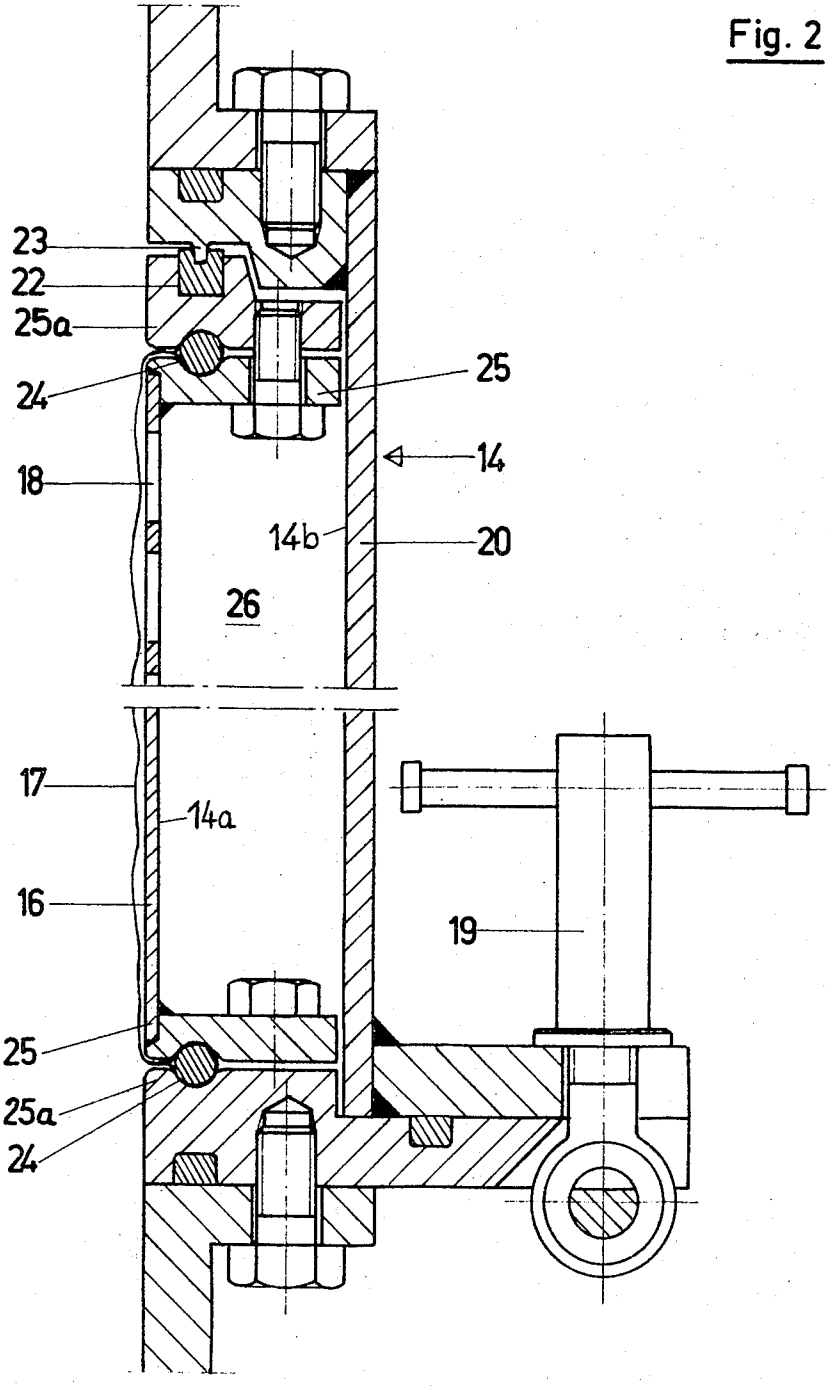
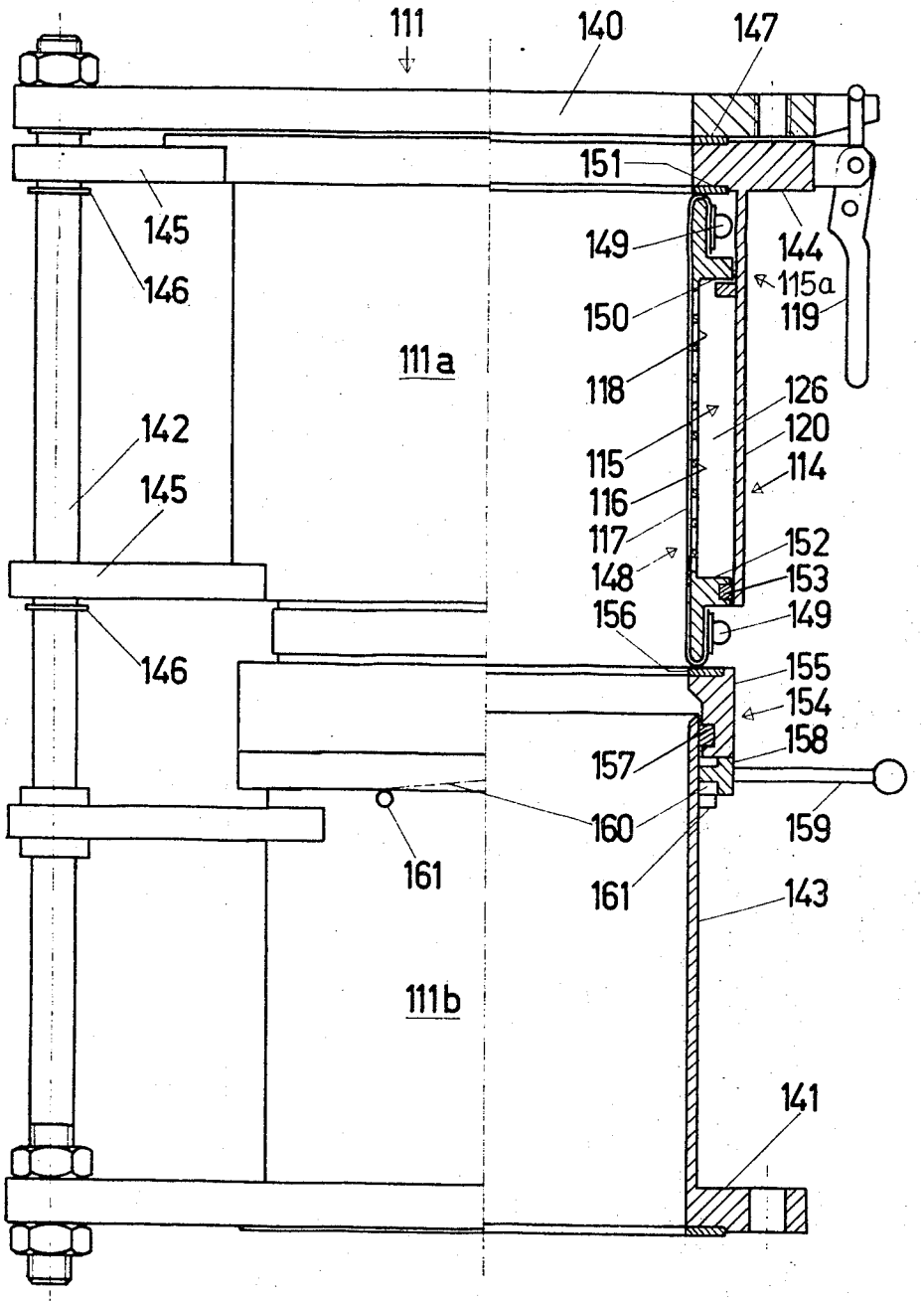


Fig.3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APPARATUS FOR FILLING A RECEPTACLE WITH COMPACTED PULVERULENT MATERIAL

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved construction of apparatus for filling a receptacle or any other suitable material receiving device, simply generally referred to herein as a receptacle or container, with compacted pulverulent material, and which apparatus is of the type comprising a compaction compartment equipped with a closable inlet and outlet, and wherein a negative pressure source, atmospheric pressure and/or an overpressure source can be connected via a filter mechanism with such compaction compartment.

Apparatuses for the filling of a receptacle with compacted pulverulent material of the previously mentioned general character are well known to the art. In this connection it is mentioned the pulverulent material is introduced into the compaction compartment for compaction, the gas pressure is reduced and thereafter quickly increased, and the pulverulent material which is subjected to increased pressure is introduced into the receptacle in order to fill the latter. A drawback of this technique resides in the fact that the filling operation only can be carried out intermittently, that is, after a filling operation there follows a compaction operation and again a filling operation, and so forth. During the filling operation the compaction compartment is blocked as concerns the compaction operation. This results in the capacity of the equipment being limited. It is also contemplated to continuously carry out the compaction and filling operations, the pulverulent material initially flowing through a region of reduced pressure and thereafter a region of increased pressure. Owing to these procedures there is present the drawback that only a rather bulky or massive compaction takes place since a continuous gas exchange occurs between the regions of higher and lower pressure, leading to a loosening of the throughflowing pulverulent material.

Continuing, it is also here to be mentioned that an apparatus for filling a receptacle with compacted pulverulent material is known to the state-of-the-art wherein there is likewise provided a compaction compartment equipped with a closable inlet and outlet. This compaction compartment can be connected through the agency of a filter device with a negative pressure source, atmospheric pressure and/or an overpressure source. At the lower end of the compaction compartment there is connected in pressure tight fashion the receptacle to be filled. By opening the upper inlet, and with the lower outlet also open, pulverulent material initially loosely flows into the receptacle and into a portion of the compaction compartment. For the purpose of removing the entrapped gas the outlet of the filter compartment is blocked and negative pressure applied via an outlet connection or stud to the receptacle. After reaching a certain negative pressure the outlet of the compaction compartment is suddenly opened and the material located within the compaction compartment flows at high pressure into the receptacle. At that location this material simultaneously serves for the further compaction of the material which is already located within the receptacle. In order to improve the first filling operation of the receptacle, a negative pressure can be applied to the compaction compartment, accelerating sucking-up of pulverulent material out of the supply container. The filter device can also be impinged with an overpressure by carrying out a suitable switching-operation, this overpressure, during a second phase of the filling operation, supporting the further filling of the evacuated receptacle. A drawback of this known equipment resides in the fact that it is necessary to provide a mouthpiece which is exactly accommodated to the receptacle to be filled. Furthermore, it is only possible to fill receptacles possessing a rather rigid or sturdy wall capable of withstanding the negative pressures used for evacuation of the receptacle. Additionally, this prior art equipment is extremely limited as concerns its capacity since the two-phase filling operation requires a relatively large amount of time.

SUMMARY OF THE INVENTION

Hence, from what has been stated above it will be recognized that the art is still in need of an apparatus for filling a receptacle with compacted pulverulent material which is not associated with the aforementioned drawbacks and limitations of the prior art. Therefore, it is a primary objective of the present invention to provide a new and improved construction of apparatus for filling a receptacle with compacted pulverulent material in a manner effectively and reliably fulfilling the existing need in the art and overcoming the aforementioned drawbacks and shortcomings of the prior art constructions. Still another and more specific object of the present invention relates to an improved apparatus for filling a receptacle with compacted pulverulent material which, while preventing the previously explained drawbacks of the prior art constructions and with the most simple design of the equipment, ensures for the greatest possible utilization of its capacity.

Now, in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, the inventive apparatus for the filling of a receptacle with compacted pulverulent material is manifested by the features that a supply compartment is arranged after the compaction compartment, the supply compartment having an outlet equipped with a dosing mechanism.

By virtue of the provision of a supply compartment following the compaction compartment a supply of compacted material can be continuously maintained in such supply compartment and which allows filling of the receptacle independently of the compaction of the pulverulent material in the compaction compartment. Hence, both during exchange of a receptacle as well as also during the filling of a receptacle it is possible to independently carry out the compaction operation in the compaction compartment. In this way the capacity of the apparatus can be considerably increased in contrast to the known constructions of prior art equipment. Since the receptacle itself is not utilized for the compaction of the pulverulent material, rather the already compacted material is filled into the receptacle, it is possible to resort to the use of receptacles of random construction and design, especially also those which do not possess any rigid walls capable of withstanding negative or sub-atmospheric pressures. Since the receptacle need not be connected in pressure tight fashion with the supply compartment there is also obviated the need of providing special mouth pieces and it is possible to fill receptacles possessing different construction and cross-section of their opening.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. 1 is a schematic elevational view, the right-half of which is in section, of a preferred constructional form of apparatus for filling a receptacle or the like with compacted pulverulent material;

FIG. 2 is an enlarged sectional view through the double-wall of the compaction compartment with the filter mechanism dismantled; and

FIG. 3 is an elevational view, again with the right-half thereof shown in section, of a further embodiment of compaction compartment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawings, and referring initially to the exemplary embodiment of inventive apparatus for filling a receptacle with compacted pulverulent material as depicted in FIG. **1**, such will be seen to comprise a compaction compartment or chamber **11** connected in airtight fashion to a silo or hopper **10**. Compaction compartment **11** is provided at its upper end or region with a closable inlet **12** and at its lower end or region with a closable outlet **13**. Conventional valves can be used for this purpose which, for preserving clarity in illustration, have not been particularly shown. The compaction compartment **11** possesses a substantially cylindrical construction and is equipped with a double-wall jacket **14** embodying the inner wall **16** and outer wall **20**, the inner wall **16** of which is constructed to provide a filter mechanism **15**. The internal cross-section of the outlet **13** is preferably at least as large as the internal cross-section of the compaction compartment **11**.

The filter mechanism **15**, which has been illustrated in detail in FIG. **2**, embodies an at least partially perforated support wall defined by the inner wall **16**, at the inner surface of which there is mounted a filter element **17** formed of flexible material. It is preferred if this support wall **16** only possesses perforations or apertures **18** at its upper region. The lower region of such support wall **16** is preferably continuous i.e. not perforated. The filter mechanism **15** is advantageously constructed as a filter insert for the purpose of facilitating cleaning, and which can be clamped by quick operating-closure mechanism **19** with the outer jacket **20** of the compaction compartment **11**. At the upper end of the filter insert there is provided a pressure ring **25***a* carrying a sealing ring **22** bearing against a sealing lip **23** of the compaction compartment **11**. The flexible filter **17** is equipped at its upper and lower marginal edges with a respective flexible marginal bead or bulge portion **24**, by means of which it can be clamped at the clamping rings **25** of the filter mechanism **15**, the upper clamping ring **25** simultanously functioning as pressure ring **25***a*.

The double-wall jacket **16, 20** of the compaction compartment **11** will be seen to contain a substantially ring-shaped intermediate compartment **26**, at which there are selectively connectable, via the closure or valve elements **27, 28** and **29**, a negative pressure source, generally indicated by reference character **100**, an overpressure source indicated at **101**, and/or atmospheric pressure indicated by **102**. Furthermore, a conventional pressure meter or manometer **30** with adjustable contacts is connected with the intermediate compartment or space **26**.

A supply compartment **31** merges with the compaction compartment **11**, this supply compartment **31** being closed towards its outlet or bottom by means of a dosing mechanism **32**. In the embodiment under consideration this dosing mechanism **32** preferably incorporates an iris diaphragm **33**. Moreover, dosing mechanism **32** is coupled with a weighing device or balance **34** upon which rests the receptacle or container **35** to be filled. This balance or weighing device **34** is equipped with an adjustable pre-contact **36** and a main contact **37**, at which the course and actual filling weight of the receptacle can be set. The pre-contact **36** serves for partially closing the iris diaphragm **33** while the main contact **37** serves for completely closing such iris diaphragm. Continuing, it will be recognized that a suitable suction mechanism **38** is also provided and such surrounds the outlet **31a** of the supply compartment **31** and serves to promote the dustfree functioning of the equipment. The inner cross-section of the supply compartment **31** is preferably at least as large as the inner cross-section of the compaction compartment **11** and its closeable outlet **13**. Also the outlet **31a** of the supply compartment **31** advantageously possesses a cross-section for its outlet opening which corresponds at least to that of the supply compartment **31**. For the purpose of controlling the equipment there is provided a control mechanism **39** which coordinates the individual functions of the components.

The mode of operation of the described equipment is as follows:

Now for the purpose of initiating the compaction- and filling operations initially the inlet **12** from the silo **10** and the output **13** to the supply compartment **31** are closed and the closure or valve element **27** leading to the negative pressure source **100** is opened so that a negative pressure is applied to the intermediate compartment **27**. By means of an adjustable contact **30***a* at the pressure metering device **30** there is set a minimum negative pressure, and when reaching such minimum negative pressure the inlet **12** is opened. The pulverulent material flows in the presence of negative pressure out of the silo **10** into the compaction compartment **11**. After a certain time, which for instance can be determined by any conventional timing element or by a filling level indicator, the inlet **12** is automatically closed. Application of suction to the compaction compartment **11** by means of the negative pressure source **100** is continued until the pressure metering device **30** reaches a further adjustable contact **30***b*, so that by means of the negative pressure source so much air entrapped in the material within the compaction compartment **11** has been sucked-off that sufficient compaction of the material has been realized. When this happens and triggered by the action of the contact **30***b*, the valve or closure element **27** leading to the negative pressure source closes and the closure element **29** leading to atmosphere opens, in order to now communicate the compaction compartment **11** with the atmosphere **102**. A further timing element of the control mechanism **39** ensures for the closing of the valve or closure element **29** and opening of the valve or closure element **28** leading to the compressed air source **101**. The throughflowing

gas thus cleans the filter mechanism **15** by a flushing action and arrives at the compaction compartment **11** where it protectively arranges the loose particles of pulverulent material without additionally mechanically loading same and compresses such material into a smaller volume. As soon as the pressure in the compaction compartment **11** equalizes with the atmospheric pressure or the overpressure, then, the outlet **13** is opened, either by controlling same via the pressure metering device **30** or through a further timing element, and the compacted pulverulent material is removed or ejected into the supply compartment **31.** After emptying the compaction compartment **11** the outlet **13** is closed and filling of the compaction compartment again with material can begin anew. Inlet and outlet are preferably coupled with one another in such a fashion that upon opening one the other is locked so as to prevent any erroneous operations. In order to prevent overfilling of the supply compartment **31** such is advantageously provided with any suitable and therefore not particularly illustrated filling level indicator, which upon reaching a maximum filling condition interrupts the compaction operation and again initiates same when a minimum filling condition is present.

The receptacle or container **35** is placed upon the weighing device **34** beneath the outlet **31***a* of the supply compartment **31.** A suitable tare switch at the weighing device **34** triggers an automatic filling operation. In this regard the iris diaphragm **33** of the dosing mechanism **32** is opened and the compacted pulverulent material flows out of the supply compartment **31** into the receptacle **35.** As soon as the weighing device **34** reaches the pre-contact **36** the iris diaphragm **33** is partially closed and the flow of material is throttled, in order then to be completely shut-off at the primary or main contact **37.** During the filling operation the suction or ventilation mechanism **38** ensures for the withdrawal of any possible dust or other contaminants which may be present.

It is recommended to carry out a number of trial runs and measurements for determining the most optimum conditions for setting the contacts **30***a* and **30***b* at the pressure metering device **30** and those at the weighing device **34.** Further, the apparatus can be automatically controlled without any great expenditure in hardware. Thus, the operator can devote his attention completely to the packaging operation.

The apparatus is also suitable for use with dust explosion-dangerous substances, since during the entire operation always one of the inlets or outlets is closed, and therefore there is prevented spreading of any possible explosion.

Referring now to the embodiment of FIG. **3** there is illustrated therein an extremely advantageous construction of compaction compartment **111,** rendering possible a simple opening or dismantling of the filter mechanism **115** and cleaning or exchange of the filter **117.** The compaction compartment **111** will be seen to comprise an upper flange **140** and a lower flange **141,** by means of which such can be connected with the inlet of the supply compartment **31** of FIG. **1** and outlet of the silo **10,** here omitted for purposes of simplifying the drawing illustration. Both flanges **140** and **141** are connected with one another through the agency of a bolt or tie rod **142** arranged in spaced relationship with regard to the compaction compartment chamber. The compaction compartment **111** embodies an upper region or portion **111***a* which is equipped with a double-wall jacket **114** and contains the filter mechanism **115,** as well as being equipped with a lower portion **111***b* equipped with a simple wall **143.**

At the upper region **111***a* of the compaction compartment **111** the outer jacket wall **120** in conjunction with an upper flange **144** forms a filter housing **115***a* which is pivotably mounted via arm means **145** with the bolt **142.** Stop means **146** provided at the bolt **142** limits the downward path of movement of the filter housing **115***a* at the bolt **142.** The flange **144** of the filter housing **115***a* is applied through the agency of a sealing member **147** against the upper flange **140** and is pressed thereagainst by means of any suitable quick closure fastening mechanism **119.**

A filter insert **148** is arranged within the filter housing, this filter insert **148** containing a support wall **116,** here likewise forming the inner wall of the double-wall jacket **114.** This support wall **116** is provided with perforations or apertures **118.** Filter element **117** formed of flexible material is spanned over the support wall **116,** such filter element **117** being flexed back towards the outside at both ends of the support wall **116,** as shown, and at that location being retained by a respective clamping collar **149** or equivalent device. The filter insert **148** will be seen to possess at its upper end a bayonet closure **150,** by means of which it can be connected with the outer wall **120** of the filter housing **115***a* and pressed against a flat sealing member **151** located at the inside of the flange **144,** in order to be able to seal the intermediate compartment or space **126** with regard to the interior of the compaction compartment **111.** A support flange **152** is provided at the lower end of the filter insert **148,** this support flange **152** carrying at its periphery a sealing ring **153,** by means of which it bears in sealing fashion against the inside of the outer wall **120.**

The lower portion **111**b of the compaction compartment contains a contact- and sealing mechanism **154** serving for additionally pressing the filter insert **148** against the upper flat seal member **151.** If desired, the bayonet closure **150** can only serve to hold the filter insert **148** within the filter housing **115***a* and there can be employed for the purpose of pressing same against the upper flat seal **151** only the contact- and sealing mechanism **154.** The latter will be seen to be equipped with a ring member **155** which is inserted about the wall **143,** this ring member **155** carrying at its upper end face a flat sealing member or seal **156** cooperating in sealing fashion with the filter **117** bent about the lower end of the support wall **116.** This ring member **155** also carries a sealing ring **157** at its inside surface, such sealing ring **157** cooperating with the outside surface of the wall **143** and sealing the filter compartment **111** towards the outside. A clamping ring **158** engages with the lower end face of the ring member **155,** this clamping ring **158** being provided with a manually operable member **159.** The clamping ring **158** which engages with the wall **143** is provided with inclined or bevelled surfaces **160** which cooperate with shoulder or stop surfaces **161** provided at the wall **143.**

For the purpose of cleaning the filter **117** or exchanging the filter insert **148** the clamping ring **158** is rotated by means of the manually operable member **159** to such an extent that due to sliding of the shoulder or stops **161** into the inclined surfaces **160** the clamping ring **158** is lowered. This results in the simultaneous

lowering of the ring member **155**. Thereafter the quick closure fastening mechanism **119** is released, resulting in lowering of the upper portion **111a** of the compaction compartment. The stops **146** at the bolts **142** limit the degree of lowering of the upper portion **111a** of the compaction device. Such can now be pivoted out and by loosening the bayonet closure **150** the filter insert **148** can be removed from the filter housing **115***a*. The filter **117** can then be either cleaned or by loosening the clamping collar **149** removed and exchanged. The assembly of the compaction compartment **111** occurs in the reverse manner from the release or dismantling operation described.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims. Accordingly,

What is claimed is:

1. An apparatus for filling a receptacle with compacted pulverulent material, said apparatus comprising a compaction compartment equipped with a closable inlet and closable outlet, means for providing a negative pressure source, an overpressure source, and for communicating said compaction compartment with atmospheric pressure, a filter mechanism provided for said compaction compartment by means of which said compaction compartment can be selectively connected with at least any one of said negative pressure source, atmospheric pressure and said overpressure source, a supply compartment arranged following said compaction compartment, said supply compartment being provided with an inlet and an outlet, said closable outlet of said compaction compartment also constituting said inlet to said supply compartment, and a dosing mechanism provided for said outlet of said supply compartment, said compaction compartment being chargeable with a fresh charge of pulverulent material to be compacted during such time as a compacted charge of pulverulent material is filled from said supply compartment into the receptacle.

2. The apparatus as defined in claim **1**, wherein said dosing mechanism incorporates an iris diaphragm.

3. The apparatus as defined in claim **2**, further including a weighing device supporting the receptacle provided for said dosing mechanism, said weighing device being provided with at least one adjustable contact for controlling said outlet of said supply compartment.

4. The apparatus as defined in claim **1**, wherein said outlet of said supply compartment possesses a cross-section of its opening which at least corresponds to the throughflow opening cross-section of said supply compartment.

5. The apparatus as defined in claim **1**, further including a suction mechanism arranged about said outlet of said supply compartment.

6. The apparatus as defined in claim **1**, wherein said compaction compartment possesses a double-wall jacket defining an inner wall portion and an outer wall portion, said inner wall portion forming said filter mechanism, and wherein said double-wall jacket forms an intermediate compartment, and closure means for selectively connecting said intermediate compartment with any one of said negative pressure source, the atmospheric pressure and said overpressure source.

7. The apparatus as defined in claim **6**, wherein said inner wall portion defines an at least partially perforated support wall, said filter mechanism including a filter element consisting of flexible material bearing against said support wall.

8. The apparatus as defined in claim **7**, wherein said support wall has an upper perforated wall portion and a lower continuous wall portion.

9. The apparatus as defined in claim **6**, wherein said filter mechanism comprises a flexible filter element having an upper edge and a lower edge, a respective clamping mechanism provided for each said upper and said lower edges of said filter element, said clamping mechanisms serving to releaseably secure said flexible filter element to said inner wall portion of said double-wall jacket.

10. The apparatus as defined in claim **9**, wherein said flexible filter element is provided with a respective marginal bead portion at each of its upper and lower edges, and said clamping mechanisms including clamping ring means provided for said upper and lower filter edges, said upper and lower marginal bead portions serving to secure said filter element to said clamping ring means.

11. The apparatus as defined in claim **10**, wherein said filter mechanism incorporates an exchangeable filter insert, quick closure fastening means and sealing means for supporting said filter insert at said compaction compartment, said filter insert embodying said inner wall portion defining a support wall, said support wall possessing a ring flange forming at its ends forming a portion of said clamping ring means, said clamping ring means defining an upper and lower clamping ring member, said upper clamping ring member serving to clamp a ring member functioning as a pressure ring, said pressure ring functioning-clamping ring member carrying a sealing ring supported at an upper wall of said intermediate compartment, a clamping ring member serving as an attachment flange for clamping said lower clamping ring member, and a quick closure fastening mechanism for clamping said lower clamping ring member defining said attachment flange with said outer wall portion of said double-wall jacket and for retaining said filter insert.

12. The apparatus as defined in claim **1**, wherein said filter mechanism comprises an exchangeable filter insert, and quick closure fastening means and sealing means for supporting said filter insert at said compaction compartment.

13. The apparatus as defined in claim **1**, further including respective closure means for selectively connecting said compaction compartment with any one of said negative pressure source, the atmospheric pressure and said overpressure source, force-actuatable elements provided for said closure means and for said inlets and outlets of said compaction compartment and supply compartment, and automatic control means for operatively coupling said force-actuation elements with one another.

14. The apparatus as defined in claim **13**, wherein said control means is designed such that with closed inlet and outlet of said compaction compartment initially the closure means of the negative pressure source is opened and upon reaching a certain negative pressure in the compaction compartment the inlet of the compaction compartment is opened.

15. The apparatus as defined in claim 13, wherein said control means is constructed such that with closed inlet and outlet of said compaction compartment and with filled compaction compartment after reaching a certain negative pressure one closure means closes the negative pressure source and another closure means opens to atmosphere, after pressure equalization with the atmosphere said another closure means again closes, and the closure means leading to the overpressure source opens and then the outlet of said compaction compartment is open.

16. The apparatus as defined in claim 1, wherein said inlet and said outlet of said compaction compartment are coupled with one another such that upon opening one the other is locked in its closing position.

17. The apparatus as defined in claim 1, wherein said compaction compartment embodies a lower portion and an upper portion, said upper portion having a double-wall jacket equipped with said filter mechanism and constructed to be pivotable.

18. The apparatus as defined in claim 17, wherein said filter mechanism comprises a removable filter insert containing an inner perforated wall of said double-wall jacket and serving as a support wall, a bayonet closure for connecting said perforated wall with an outer wall of said double-wall jacket, means for sealing the inner perforated wall at its lower end towards said outer wall, a flexible filter carried by the inside surface of said inner perforated wall, said flexible filter being flexed at both ends about the ends of said inner perforated wall and fixedly clamped thereat, and a lower contact and sealing device for pressing said filter insert against an upper seal provided at an end wall bounding an intermediate compartment of said double-wall jacket.

19. The apparatus as defined in claim 18, wherein said lower portion of said compaction compartment carries said contact and sealing device, said contact and sealing device incorporating a ring member which is seated about a wall of said contact and sealing device, said ring member containing at its upper end a seal bearing against said filter insert, and an upwardly pressable clamping ring for supporting a bottom portion of said ring member.

20. The apparatus as defined in claim 18, wherein said upper portion of said compaction compartment is provided with a flange at its upper end, said flange bearing through the agency of a seal at a connection flange located at the top of said compaction compartment, and at least one quick-operating fastening closure for clamping said flange with said connection flange.

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