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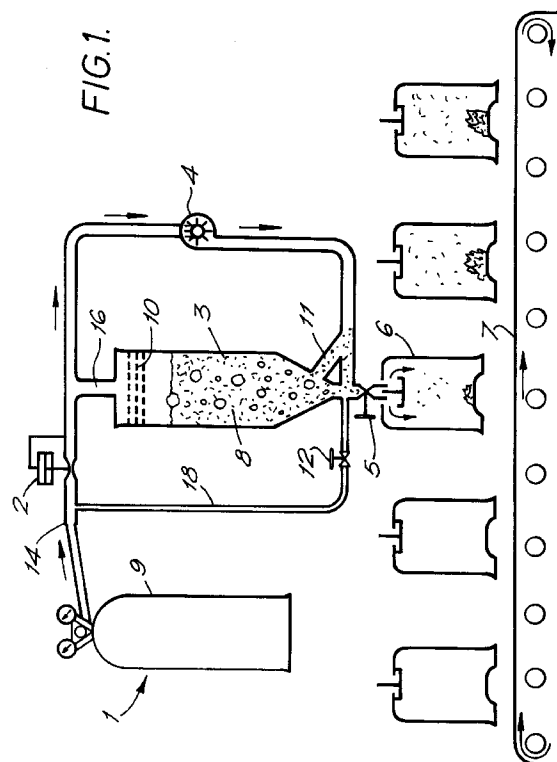
(71) Applicant : **The BOC Group plc**
Chertsey Road
Windlesham Surrey GU20 6HJ (GB)

(72) Inventor : **Sajik, Wasyl Michael**
28 Buckingham Way, Frimley
Camberley, Surrey GU16 5XF (GB)
Inventor : **Shervington, Evelyn Arthur**
2 Horses Knapp, South Harting
Petersfield, Hants GU31 5LD (GB)
Inventor : **Downie, Neil Alexander**
1 Eustace Road
Guildford, Surrey GU4 7EB (GB)

(74) Representative : **Gough, Peter et al**
c/o THE BOC GROUP PLC Patent Department
Chertsey Road
Windlesham Surrey GU20 6HJ (GB)

(54) **Filling containers.**

(57) A method of filling a container 6 with particulate material 8 and gas under pressure includes the steps of fluidising the particulate material contained in a vessel 3 and permitting its flow towards a filling valve 5 ; passing the gas from a cylinder 9 towards the filling valve 5 via line 14 ; and opening the filling valve 5 to permit the fluidised particulate material 8 and the gas to pass simultaneously therethrough to enter a container 6.



The present invention relates to methods of and apparatus for the filling of containers with a mixture of particulate material and gas under pressure.

Pressure pack dispensers, that is, aerosol containers are used to dispense many different substances. In European Patent Publication No. 0385773 there is described a system for storing and dispensing gases in a container in which a polymeric material having microvoids is utilised, the microvoids functioning as interstitial stores for the gas.

Currently the filling of such containers is performed sequentially, that is, by first filling the container with particulate material; next filling the container with a high pressure gas and subsequently sealing off of the container whilst still under pressure. However, in addition to being two separate operations, this known method has the disadvantage that it is difficult to fill particulate material in the form of fine powders through a narrow orifice into a container at high speed. Powders under such circumstances will clog, accumulating into large lumps which block the orifice. Powders under these circumstances also tend to charge up to high voltages and stick to the walls of the conveying pipes.

It is the aim of the present invention to provide an apparatus and method for the simultaneous and high speed filling of particulate material and high pressure gas into a container.

For the avoidance of doubt, when used throughout this specification the expression "particulate material" is intended to cover powders and the term "gas" is intended to cover a single gas and gas mixtures.

According to one aspect of the present invention there is provided a method of filling a container with particulate material and gas comprising the steps of:

- a) fluidising the particulate material and permitting the flow thereof towards a filling valve;
- b) passing the gas under pressure from a source towards the filling valve; and
- c) opening the filling valve to permit the fluidised particulate material and the gas to pass simultaneously therethrough to enter a container aligned therewith.

According to a further aspect of the present invention there is provided an apparatus for filling a container with particulate material and a gas comprising a vessel containing the particulate material in fluid communication with a filling valve, means for fluidising the particulate material within the vessel, a pump for delivering gas under pressure to the filling valve, and means for opening the filling valve to permit the passage therethrough simultaneously of the fluidised particulate material and the gas to fill a container when aligned with the filling valve.

An embodiment of the invention will now be described, by way of example, reference being made to the Figure of the accompanying diagrammatic draw-

ing which is a schematic cross-section of an apparatus for filling a container with particulate material and a gas.

As shown, the apparatus 1 comprises a cylinder 9 of a gas, for example, carbon dioxide under pressure. The outlet of the cylinder 9 is connected to a pipework circuit including a pipeline 14 along which is located a pressure regulator 2. From the pressure regulator 2 the line 14 has a branch 16 which communicates with the upper (as shown) end of a vessel 3 containing particulate material 8, for example, a powdered polymer. Located in the line 14 downstream of the branch 16 is a circulating pump 4. From the pump 4 the line 14 continues towards a filling valve 5. At a location upstream of the filling valve 5 a second branch 11 from the line 14 communicates with the interior of the vessel 3. It will be apparent that the bottom (as shown) end of the vessel 3 also communicates with the filling valve 5.

A pipeline 18 extends from the line 14 at a location upstream of the pressure regulator 2 and communicates with the filling valve 5. An auxiliary valve 12 is located in the line 18.

A filter or cyclone particle separator 10 or a combination of filter and cyclone particle separator is located in the vessel 3 adjacent the upper (as shown) end.

Containers 6 to be filled with the gas and particulate material are moved intermittently in a manner known *per se* by means of a conveyor 7 so that successive containers 6 are aligned with the filler valve 5.

In use, the auxiliary valve 12 is first closed and the cylinder 9 opened such that gas flows along line 14 and through the pressure regulator 2. Some of the gas then enters the vessel 3 where it fluidises the particulate material 8 contained therein. The remainder of the gas is pumped by means of pump 4 towards the filling valve 5. Thus at the filling valve 5 there is fluidised particulate material 8 from the vessel 3 and gas.

If the filling valve 5 is closed, then the gas passes up the second branch 11 and into the vessel 3, where the flow is calculated to provide a fluidising effect, together with some flow down the branch 11. If, however, the filling valve 5 is open, then gas and particulate material will flow out, and fill the container 6 on the conveyor 7 aligned therewith with a mixture of particulate material and gas. The filter or cyclone particle separator 10 or combination of filter and cyclone is deployed to ensure that particles do not enter and clog the pump 4 or the line to and from the pump.

The flow of gas through the vessel 3 is selected by means of pressure regulator 2 so that the particulate material 8 is maintained in the liquid-like 'fluidised' state at least at the bottom of the vessel 3, but possibly in the whole of the vessel. The flow may be calculated by the Rowe formula, which assumes drag

factor for small particles in a bed of a constant times the isolated particle drag (see P N Rowe, Part II Trans. Inst. Chem. Engrs., London Volume 39, 175, 1961). The circulating gas flow must be carefully regulated, so that severe bubbling of the fluidised bed does not occur. According to the two-phase theory, all excess flow through a fluidised bed goes into bubbling.

The preferred gas is carbon dioxide, at a high pressure (greater than 10 bar). This is because there is evidence that CO₂ forms a better fluidised bed than other gases such as nitrogen (see L S Leung, Ph.D., University of Cambridge, England, 1961). Also, a mixture of carbon dioxide, a powdered polymer, and acetone is the basis of the pressurised container (aerosol) propellant system described in European Patent Publication No. 0385773.

In the case where the system is used to fill powdered polymer and carbon dioxide for the propellant described in European Patent Publication No. 0385772 the containers 6 are prefilled or subsequently filled with metered amounts of acetone, and the powdered polymer and gas are added at a pressure chosen so that after adsorption of the acetone by the polymer and gas by the acetone, the container pressure settles to a required lower pressure. The pressure at the bottom of the vessel 3 will be greater than that at the top by an amount given by multiplying the powder density by the acceleration due to gravity and the height difference between filling nozzle and the powder level in the vessel 3 and multiplying by (0.524), approximately.

The auxiliary valve 12 is provided which opens momentarily at the end of filling a container 6. This gives a pulse of extra pressure gas at the filling valve 5, which clears powder out of the valve and terminates powder fill by initiating a large bubble of gas in the powder/gas fluid. There will also be an extra flow of gas into the container 6, which will raise its pressure somewhat above that of the valve static pressure and needs to be allowed for.

In an example, when filling a container having a volume of 100 mls with powder of a particle size from 5 to 50 microns, the filling time was approximately 0.1 seconds resulting in a container pressure of approximately 10 bar.

It will be apparent that control of the opening and closing of the valves 5 and 12 as well as the movement of the conveyor 7 is effected by means known per se.

Although in the above described embodiment the vessel 3 and the filling valve 5 are arranged above the container 6 to be filled, it is possible that they be arranged below the container 6 and filling is effected by the gas flow, that is by a "gas lift" effect.

The above described embodiment allows for the filling of container 6 at relatively higher speeds, in the order of 100's of containers per minute.

Claims

1. A method of filling a container (6) with particulate material (8) and gas is characterised by the steps of:
 - a) fluidising the particulate material (8) and permitting the flow thereof towards a filling valve (5);
 - b) passing the gas under pressure from a source (9) towards the filling valve (5); and
 - c) opening the filling valve (5) to permit the fluidised particulate material (8) and the gas to pass simultaneously therethrough to enter a container (6) aligned therewith.
2. A method as claimed in Claim 1, characterised in that a portion of the gas from the source (9) is used to fluidise the particulate material (8).
3. A method as claimed in claim 1 or 2, characterised in that a plurality of spaced containers (6) are fed intermittently by means of a conveyor (7) such that successive containers (6) are each aligned with the filling valve (5) for filling simultaneously with the particulate material (8) and the gas.
4. A method as claimed in any one of claims 1 to 3, characterised in that the gas is carbon dioxide.
5. A method as claimed in any one of claims 1 to 4, characterised in that the or each container (6) is filled with the particulate material (8) and the gas at a pressure greater than one atmosphere.
6. A method as claimed in any one of claims 1 to 5, characterised in that a pulse of relatively high pressure gas is applied at predetermined intervals to the filling valve (5) for clearing the filling valve (5) of particulate material.
7. An apparatus (1) for filling a container (6) with particulate material (8) and a gas, characterised by a vessel (3) containing the particulate material (8) in fluid communication with a filling valve (5), means for fluidising the particulate material within the vessel (3), a pump (4) for delivering gas under pressure to the filling valve (5), and means for opening the filling valve (5) to permit the passage therethrough simultaneously of the fluidised particulate material (8) and the gas to fill a container (6) when aligned with the filling valve (5).
8. An apparatus as claimed in claim 7, characterised in that the fluidising means includes a source (9) of gas under pressure in fluid communication by means of a first pipeline (14, 16) with the interior of the vessel (3), a pressure regulator (2) being located in the first pipeline upstream of the vessel

(3).

9. An apparatus as claimed in claim 8, characterised in that the first pipeline (14) also communicates with the filling valve (5), the pump (4) being located in the pipeline (14) upstream of the filling valve (5). 5
10. An apparatus as claimed in claim 8 or 9, characterised in that a further pipeline (18) communicates at one end with the first pipeline (14) at a location upstream of the pressure regulator (2) and at its opposite end with the filling valve (5), an auxiliary valve (12) being located in the further pipeline (18) which when opened allows relative high pressure gas to pass to the filler valve (5) and clear any particulate material blocking the filling valve (5). 10 15
11. An apparatus as claimed in any one of claims 7 to 10, characterised in that the vessel (3) is located above the container to be filled. 20
12. An apparatus as claimed in any one of claims 7 to 10, characterised in that the vessel (3) is located below the container (6) to be filled. 25

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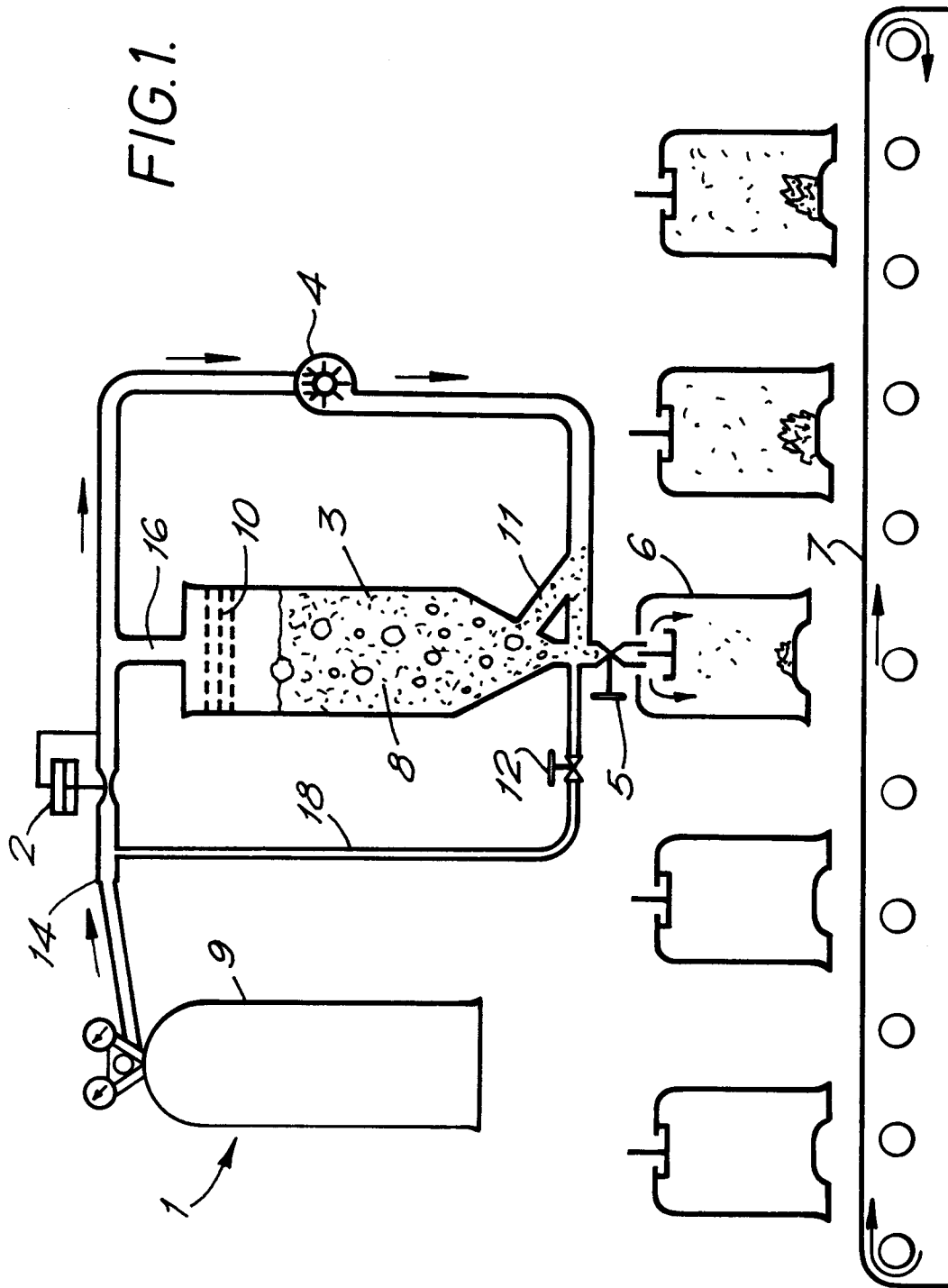
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European Patent
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EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 93304802.7
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	DD - A - 246 747 (VEB CHEMIEKOMBINAT BITTERFELD) * Totality * --	1, 2, 4, 5	B 65 B 31/10 B 65 D 83/42
A	DE - A - 3 625 034 (COZZOLI MACHINE CO.) * Totality * --	1, 3, 7-12	
A	US - A - 4 863 316 (GIANELLA) * Totality * --	7-12	
A	DE - A - 3 805 531 (INTEC MASCHINENBAU GMBH) * Totality * --	1, 7	
A	EP - A - 0 065 624 (DEGUSSA AG) * Totality * ----	1, 7	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B 65 B 1/00 B 65 B 31/00 B 65 D 83/00 B 65 G 53/00 B 65 G 67/00 F 17 C 5/00
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 15-10-1993	Examiner MELZER
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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