

12 **EUROPEAN PATENT APPLICATION**

21 Application number: 82306119.7

51 Int. Cl.³: **B 65 B 1/32**
G 01 G 15/00, G 01 G 13/24

22 Date of filing: 17.11.82

30 Priority: 30.11.81 DK 5297/81

43 Date of publication of application:
08.06.83 Bulletin 83/23

64 Designated Contracting States:
DE FR GB IT SE

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64 **Method and machine for filling sacks with pulverulent material.**

57 A sack (11) is filled with pulverulent material, e.g. cement from a container (7) as the sack is carried around a path suspended from a filling spout (8). The weight of the filling in the sack is measured by a load cell (10) which transmits a weight signal via a damper (14) and computer unit (20) to a comparator (13) which closes a filling valve (9) when the weight of filling reaches a preset weight determined by a setting unit (12). After the sack has been filled it is immediately checked whilst still on the spout (8) and a feed-back unit (15) resets the setting unit (12) to compensate for any difference between the actual and desired weight of filling.

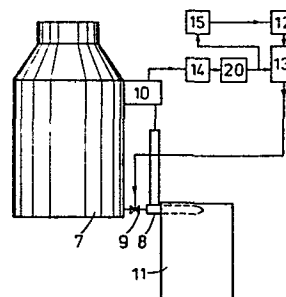


Fig. 2

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Ref: 50/5061/02

METHOD AND MACHINE FOR FILLING SACKS
WITH PULVERULENT MATERIAL

The invention relates to a method of filling sacks, such as valve sacks, with pulverulent material, e.g. cement, by means of a sack-filling machine comprising a number of filling spouts suspended from
5 respective weighing systems which are each preset to cut off the material from the respective filling spout when a sack on the filling spout has attained a certain weight. Such a method is hereinafter referred to as of the kind described.

10 The sack-filling machine may be a rotatable, automatic machine with its filling spouts distributed evenly around a circle and rotatable about the vertical axis of the machine. In principle, such a machine operates in the following way. After placement, manual
15 or automatic, of a sack on a filling spout, the weighing system of the filling spout is tared for the weight of sack, dust deposits etc., after which the filling of the pulverulent material into the sack starts. When the weighing system ascertains that the desired weight in
20 the sack has been attained, the supply to the filling spout is cut off, and the sack is discharged. All this happens while the filling spout moves along its circular path about the axis of the filling machine.

25 If the filling of a sack could be represented as an even and rectilinear graph, a weighing system, be it

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mechanical, electronic or combined electro-mechanical, would be capable of cutting off the filling process exactly when the desired weight in the sack had been attained.

5 The continuous measuring does not, however, follow an even curve because of the dynamic mass force deriving from the filling process, i.e. from the forceful outflow of pulverulent material through the filling spout and into the sack. Consequently, the cutting off of the
10 filling process rarely takes place when the desired weight in the sack has been attained, but more often when the total load of the weight in the sack and the dynamic mass forces equal the desired weight.

 It is known to damp the fluctuations from the
15 dynamic forces in a way which makes it possible to represent the material weight of the sack filling as a comparatively even curve. Such damping, however, entails a delay in the actual weight measuring, and consequently it is also known to compensate the
20 weighing system for such a delay as well as for other systematical deviations in the weighing system, by check weighing the filled sacks.

 Check weighings of filled sacks must be made in respect of each filling spout at regular intervals;
25 partly because two filling spouts with appertaining weighing systems do not react exactly alike although they have the same construction, and partly because the material filled into the sacks acts differently during the filling process from filling spout to filling
30 spout and from hour to hour.

 A manual check weighing of the filled sacks to correct the weighing systems of the filling machine, is considerably work consuming. An automatic check
35 weighing made after the filling machine calls for extra equipment to control from which filling spout the

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individual check weighed sack is discharged.

Thus, it is the object of the invention to devise a method eliminating the above disadvantages of the known sack-filling machines.

5 According to the invention a method of the kind described is characterised in that the filled sack is check weighed while hanging on its filling spout and that the result of the check weighing, immediately and before discharge of the sack from the filling spout, is
10 used for resetting the weighing system for that spout.

 By this check weighing of the filled sack on the filling spout after a terminated filling process, and after the weighing system has settled down, it is possible to measure statically, and thus more exactly,
15 the weight of the material in the sack, and to make the necessary adjustments of the weighing system without the risk of making wrong adjustments for the weighing systems of other filling spouts. Furthermore, it is made impossible to fill more sacks with wrong material
20 weight, through a filling spout, before the weighing system has been adjusted.

 Particularly advantageous for carrying out the method according to the invention are sack-filling machines with electro-mechanical weighing systems, and
25 consequently the invention also includes such a sack-filling machine characterized in that each weighing system comprises a load cell, a control unit, a comparator and a feed-back unit for instantaneous, automatic adjustment of the preset weight setting of the
30 weighing system according to the actual weight of the just filled sack.

 As compared with sack-filling machines in which the check weighing takes place outside the machine, thus demanding extra separate weighing equipment, it is an
35 additional advantage of a machine according to the

invention that the check weighing and the appertaining equipment form an integral part of the weighing process and the weighing system, respectively.

5 The invention will now be described in more detail by means of an example of a sack-filling machine according to the invention, and illustrated in the accompanying drawings, in which:-

10 Figure 1 is a diagram of the circular path of a filling spout, with indications of certain process stages;

Figure 2 is a diagrammatic side view of part of a rotating sack-filling machine with a filling spout and an appertaining weighing system; and,

15 Figures 3 and 4 are weight/time diagrams describing the mode of operation of the weighing system.

Figure 1 illustrates the travel of a filling spout along a circular path during the rotation of the sack-filling machine. Various process stages are indicated along the path, of which only stages important for an understanding of the invention are provided with reference numerals.

At stage 1 a sack is placed, in the example automatically, on a filling spout, and between stages 2 and 3 the weight of the sack per se is tared in the weighing system of the filling spout in such manner that the sack weight does not influence the measurement of the weight proper of the material with which the sack is to be filled. At stage 3 starts the filling of the material into the sack, and this filling is cut off when the weighing system ascertains that the preset weight has been attained. At the latest at stage 4, the filling of the sack has been completed, and at stage 6 the filled sack is discharged after which the filling spout in question is ready for receiving a new empty sack.

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In a sack-filling machine according to the invention a check weighing stage 5 is inserted between stages 4 and 6, at which stage the filled sack is check weighed while still hanging on its filling spout, having settled down and no longer being exposed to dynamic impacts from the filling process. If the result of this check weighing deviates from the preset weight an instantaneous adjustment automatically takes place for the setting of the weighing system.

Figure 2 shows a rotating material container 7 of a sack-filling machine, the material being e.g. cement to be filled into sacks, and one filling spout 8 out of a number of filling spouts mounted around a circle, evenly distributed about the container 7. The filling spout 8 is, as indicated, connected to the container 7 via a pipe or a hose with a valve 9, and is furthermore in a manner known per se suspended from a weighing system illustrated by a load cell 10 on the container 7.

On the filling spout is shown a sack 11 which is to be filled with a certain weight of material from the container 7.

When the sack 11 has been placed on the filling spout 8 at stage 1 in Figure 1, and the weighing system has been tared for the weight of the sack, dust deposits etc. between stage 2 and 3, the valve 9 opens at stage 3 in Figure 1, and the filling starts.

Figure 2 also shows an electro-mechanical setting unit 12, which has been set according to the required weight in the sack. A comparator 13 receives a signal from the load cell 10 during the filling process and compares this signal with a signal from the setting unit 12. The signal from the load cell 10 passes a damper unit 14 which damps fluctuations in this signal deriving from dynamic mass forces which arise during discharge of the material into the sack 11.

When the comparator 13 ascertains concord between the actual weight of the sack 11 and the weight set on the setting unit 12, a cut off signal is sent to the valve 9.

5 At the latest at stage 4 in Figure 1, the filling is completed, and between stages 4 and 5 the weighing system settles down whereupon at stage 5 a check weighing is made which is not influenced by dynamic forces in the system. In a comparator and feed-back unit 15 the result of the check weighing is compared with the preset sack weight. If the actual weight in the sack 11 deviates from the one desired, adjustment of the setting unit 12 is made automatically in accordance therewith through the feed-back unit 15, and the weighing system is ready for a more precise weighing of the next sack to travel on the same spout along the circular path in Figure 1.

20 The check weighing system can in a simple way form an integral part of the weighing system measuring the material weight in the sack 11 during the filling process.

25 Figures 3 and 4 are weight/time-diagrams in which the ordinate indicates the actual weight of material in the sack whereas the abscissa indicates the time by markings corresponding to the previously mentioned process stages. The dotted, horizontal line 16 indicates the preset weight of material in the filled sack.

30 Figure 3 shows a rectilinear ideal curve 17 of the weight of material filled into the sack at any time between stages 3 and 4. If the signal from the load cell 10 followed this curve exactly, the attainment of the desired weight would be very simple, as the filling could be cut off precisely when the curve 17 reached or intersected the horizontal line 16.

35 As the filling process entails the occurrence of

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dynamic mass forces in the system, the signal from the load cell 10 will not be rectilinear and even, but a strongly fluctuating curve as indicated by 18 in Figure 3. The intersection point between the horizontal line 16 and the curve 18 consequently does not every time coincide with the intersection point between the horizontal line 16 and the ideal curve 17 and thus the signal for closing the valve 9 may occur before or after the material weight in the sack has reached the preset weight. This may entail that sacks from the same filling spout do not contain the same preset weight.

Consequently, as mentioned above and shown in Figure 2, a damper unit 14 is inserted between the load cell 10 and the comparator 13 so that the signal from the load cell 10 to the comparator 13 follows a curve 19 as shown in Figure 3. This curve is, however, as a consequence of the damping delayed by a time lag t as compared with the ideal curve 17, and consequentially the valve 9 closes too late, i.e. the time lag t , after the sack has attained its desired weight.

If the time required for filling a sack always was the same for the individual filling spout and the corresponding weighing system it would be possible to compensate for the delayed closing of the valve 9, and consequently to avoid excess weight in the sack 11 by a suitable setting of the setting unit 12.

The filling time is, however, not constant, and therefore a computer unit 20 is additionally inserted between the load cell 10 and the comparator 13 after the damper unit 14, the computer unit being programmed to compensate during the filling process for the time lag t in Figure 3 so that the signal received by the comparator 13 does not follow the curve 19 (Figure 4), but a curve 21 which during the filling process approximates to the ideal curve 17 prior to the latter

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intersecting the horizontal line 16. In this way is achieved a cutting off of the filling exactly when the preset weight has been attained.

5 In practice, however, the counter pressure to the outflow of material in the sack increases with the degree of filling of the latter; as a result the filling instead of following the ideal curve 17 the last section before intersecting the horizontal line 16, follows a curved curve segment, as indicated by a dotted line 22
10 in Figure 4. This entails the risk of incorrect material weight in the sack in spite of the above measures.

This problem is, as mentioned, solved according to the invention by check weighing each filled sack on
15 its filling spout, and comparing this weighing signal in the comparator and feed-back unit 15 (Figure 2) with a signal corresponding to the preset weight after which the result of this comparison is immediately used for an adjustment of the control unit 12.

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CLAIMS

1. A method of filling sacks with a pulverulent material by means of a sack-filling machine comprising a number of filling spouts (8) suspended from respective weighing systems (10) which are each preset to cut off
5 the material from the respective filling spout when a sack (11) on the filling spout has attained a certain weight, characterized in that the filled sack is check weighed while hanging on its filling spout and that the result of the check weighing, immediately and
10 before discharge of the sack from the filling spout, is used for resetting the weighing system for that spout.
2. A sack-filling machine for carrying out the method according to claim 1, the machine comprising electro-mechanical weighing systems, characterized in
15 that each weighing system comprises a load cell (10), a control unit (12), a comparator (13) and a feed-back unit (15) for instantaneous, automatic adjustment of the preset weight setting of the weighing system according to the actual weight of the just filled sack.
- 20 3. A sack-filling machine according to claim 2, characterized in that each weighing system also comprises a damper unit (14) for damping fluctuations in the signal from the load cell (10) and a computer unit (20) to compensate for a signal delay caused by the
25 damper unit (14).

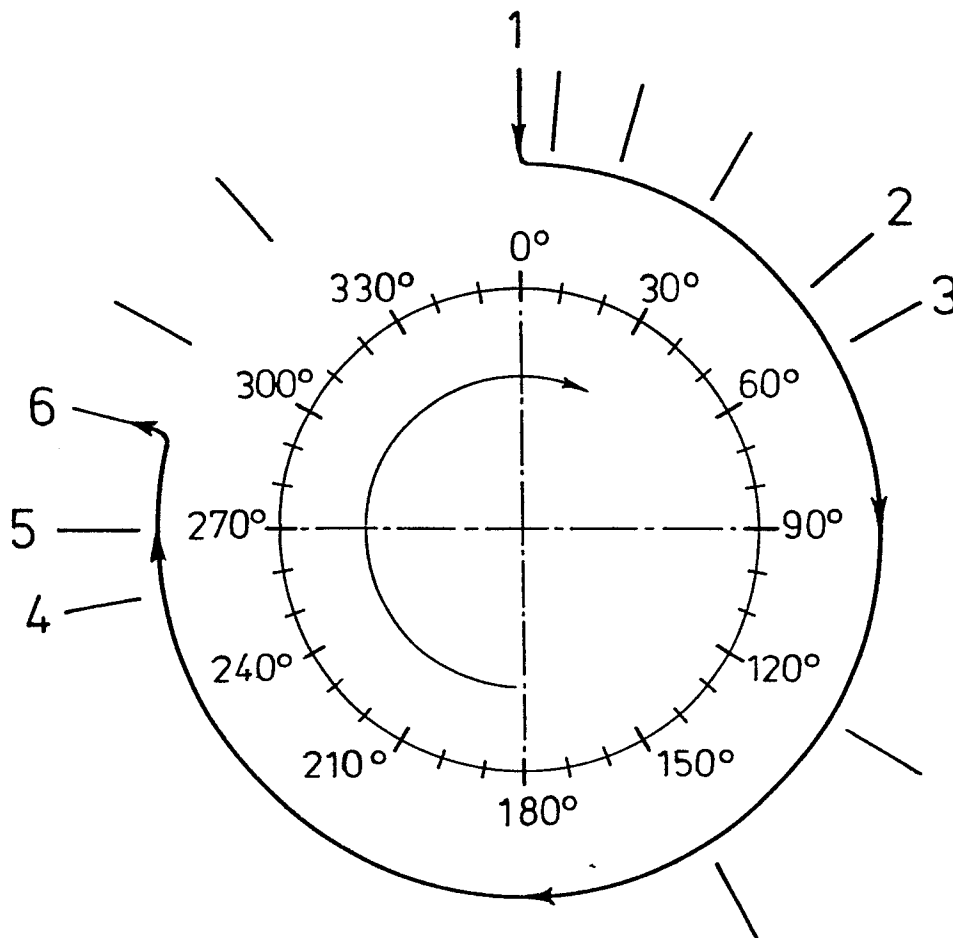


Fig.1

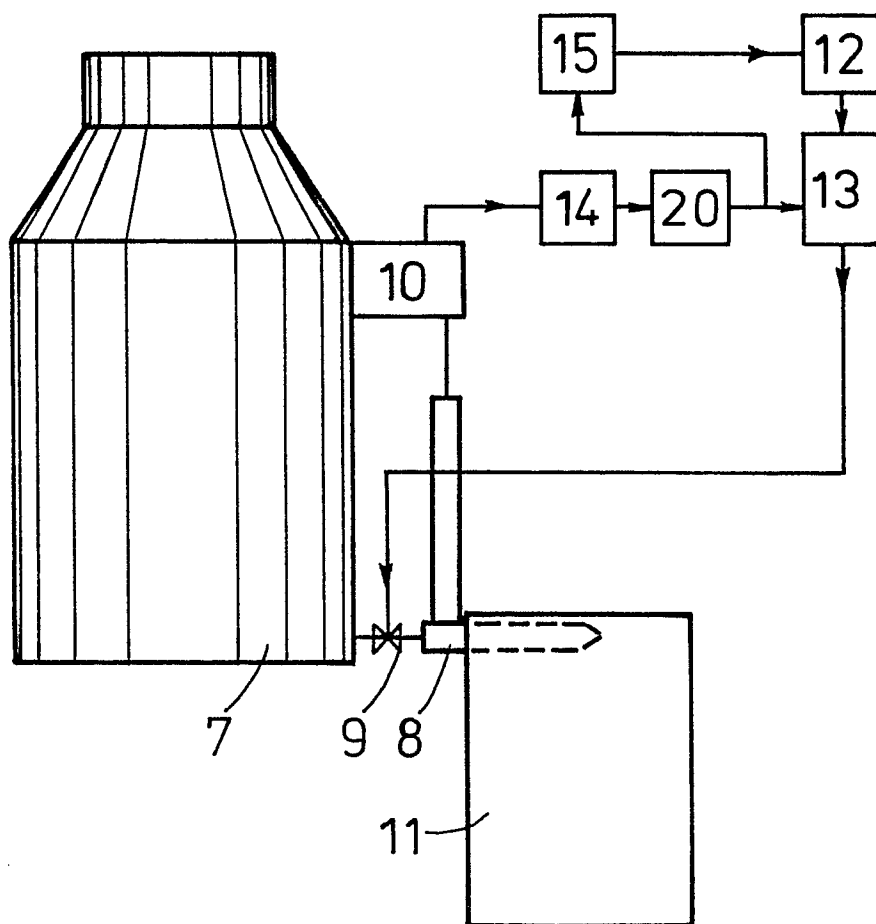


Fig.2

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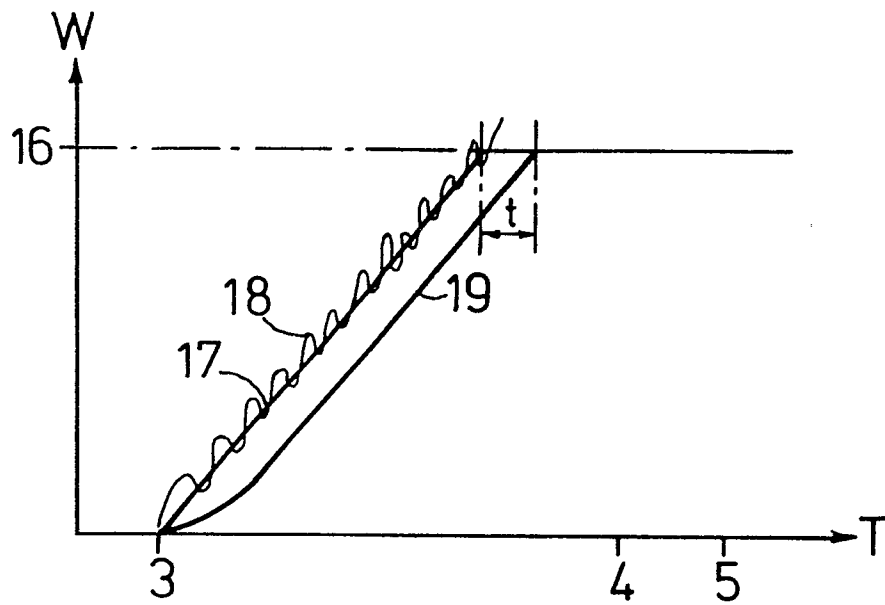


Fig. 3

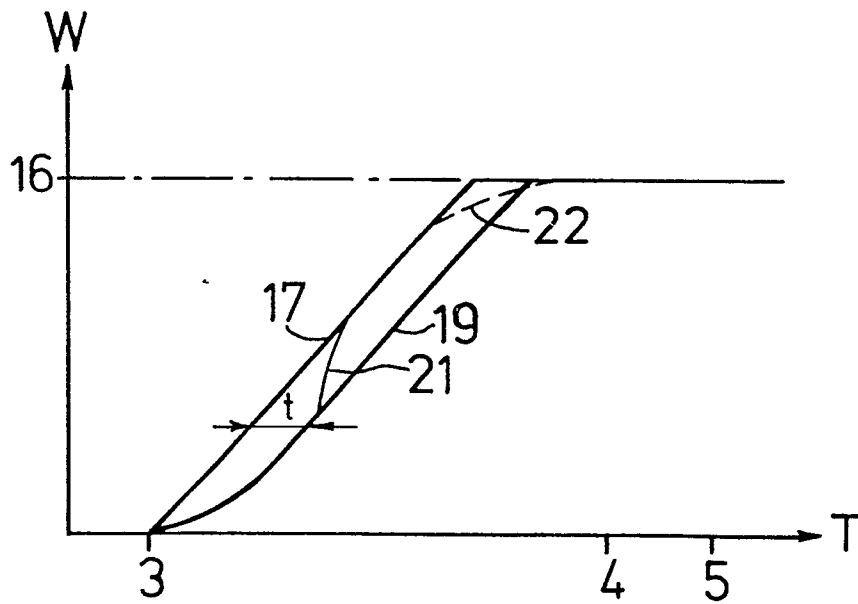


Fig. 4