

ORIGINAL

ABSTRACT

The present invention relates to a metering device and a dense phase conveying system for the dosed supply of a light bulk material from a supply device (B, SG) via conveying tubes (FR1, FR2, FR3) to a consumer. For this purpose, an airlock (S) has a delivery device (AE/S) having a dust flow regulation device (FI4), which opens into a metering container (DB), whose delivery device (AE/DB) comprises multiple dust flow regulation devices (FI1, FI2, FI3), which each open into one conveying tube (FR1, FR2, FR3). A pressure regulation device of the metering device is coupled for differential pressure regulations (PDC1-2, PDC3-R) to pressure measuring devices (PIS1, PI2) of the airlock (S) and the metering container (DB) and to pressure measuring devices (PIR, PI3) of the metering container delivery device (AE/DB) and the consumer, in order to control the metering container pressure (PI2) as a function of the second differential pressure regulation (PDC3-R). For a differential pressure control (PISA4-1) between supply device (B, SG) and airlock (S), the pressure regulation device is coupled to a pressure measuring device (PISA4) of the supply device (SG, B). The pressure regulation device controls the airlock pressure (PIS1) as a function of an airlock fill level (LIS/S) and the differential pressure control (PISA4-1) by actuating at least one suction device (V) connectable to the airlock (S). Furthermore, the present invention discloses a method using the dense phase conveying system having the metering device.

Figure 1

CLAIMS

1. Metering device, which comprises a metering container (DB) and at least one airlock (S) arranged downstream, for the steady, continuous, dosed supply of a bulk material in powder form made of light, polydisperse particles from a supply device (B, SG) into a plurality of conveying tubes (FR1, FR2, FR3) to a consumer arranged downstream, the metering container (DB) and the airlock (S) each comprising a delivery device (AE/DB, AE/S), and wherein a mass flow measuring probe (FIC1, FIC2, FIC3) being arranged on each conveying tube (FR1, FR2, FR3) and the metering device having a pressure regulation device for regulating a differential pressure between the metering container (DB) and the consumer,
characterized in that
 - the delivery device (AE/DB) of the metering container (DB), for each of the conveying tubes (FR1, FR2, FR3), comprises a dust flow regulation device (FI1, FI2, FI3), which is assigned thereto and opens therein, wherein the mass flow measuring probe (FIC1, FIC2, FIC3) being coupled to the dust flow regulation device (FI1, FI2, FI3), which opens into the corresponding conveying tube (FR1, FR2, FR3), and
 - the delivery device (AE/S) of the airlock (S) opening via a dust flow regulation device (FI4) into the metering container (DB),
the pressure regulation device,
 - for a first differential pressure regulation (PDC1-2) between an airlock pressure (PIS1) and a metering container pressure (PI2), at least being coupled to a pressure measuring device (PIS1) assigned to the airlock (S) and a pressure measuring device (PI2) arranged on the metering container (DB),
 - for a second differential pressure regulation (PDC3-R) between a metering container delivery pressure and a consumer pressure, being coupled to a pressure measuring device (PI3) assigned to the delivery device (AE/DB) of the metering container (DB) and a pressure measuring device (PIR) of the consumer, which comprises the regulation of the differential pressure between the metering container (DB) and the consumer, the pressure regulation device controlling the metering container pressure (PI3) as a function of at least the second differential pressure regulation (PDC3-R),and wherein the pressure regulation device,

- for a first differential pressure control (PISA4-PIS1) between a supply device pressure (PISA4) and the airlock pressure (PIS1), being coupled to a pressure measuring device (PISA4) assigned to the supply device (SG, B) and the pressure measuring device (PIS1) of the airlock (S), and
 - controlling the airlock pressure (PIS1) as a function of at least one airlock fill level (LIS/S) and the first differential pressure control (PISA4-PIS1) by an actuation of at least one suction device (V), which can be coupled to the airlock (S).
2. Metering device according to Claim 1,
characterized in that
the airlock (S) and the metering container (DB) are connected via a filling line, which has a closing device (KH14), which can be actuated at least as a function of the airlock pressure (PIS1), a metering container pressure (PI2), the metering container fill level (LIS/DB), and/or the airlock fill level (LIS/S).
 3. Metering device according to Claim 2,
characterized in that
the closing device (KH14) and the dust flow regulation device (FI4) of the airlock (S) are operatively coupled to one another via a control device, a filling mass flow into the metering container (DB) being provided as a function of the metering container fill level (LIS/DB), the airlock fill level (LIS/S), and/or the pressure differential (PDC1-2).
 4. Metering device according to at least one of Claims 1 to 3,
characterized in that
the pressure regulation device
 - actuates a plurality of regulating and shutoff valves in a pressurization gas line (KG), a depressurization gas line (EG), and a swirl gas line (BAG3) to the metering container (DB),
 - actuates a plurality of regulating and shutoff valves in a pressurization gas line (BG), a depressurization gas line (EG), and a swirl gas line (BAG2) to the airlock and the suction device (V), which is connected to the airlock (S) via the depressurization gas line (EG),

and is operatively coupled

- to the mass flow measuring probes (FIC1, FIC2, FIC3) and/or
- a measuring device for the total mass flow (W).

5. Metering device according to at least one of Claims 1 to 4,
characterized in that

the delivery device (AE/DB) of the metering container (DB)

- comprises a swirl base (WB) and a stirring device (RW) arranged above the swirl base (WB), the swirl gas line (BAG3) opening into the delivery device (AE/DB) below the swirl base (WB), and
- comprises a plurality of closure devices (KH9, KH10, KH11) assigned to the dust flow regulation devices (FI1, FI2, FI3), the dust flow regulation devices (FI1, FI2, FI3) being coupled to the pressure measuring device (PI3) of the delivery device (AE/DB) and to a measuring device for a total mass flow (W).

6. Metering device according to Claim 4 or 5,
characterized in that

the delivery device (AE/S) of the airlock (S) comprises a ventilation device (BE/SiR), into which the swirl gas line (BAG2) opens, and which comprises the closure device (KH14) arranged upstream or downstream from the dust flow regulation device (FI4), at least the ventilation device (BE/SiR) being coupled to the pressure regulation device.

7. Metering device according to at least one of Claims 1 to 6,
characterized in that

the dust flow regulation device (FI1, FI2, FI3, FI4) has a smooth and wear-resistant flow channel having an adjustable flap having a fine actuator, the flow channel continuously decreasing in size downstream.

8. Metering device according to at least one of Claims 5 to 7,
characterized in that

the compensation gas line (KG) opens horizontally into the metering container (DB) above a dust bulk fill present over the swirl base (WB) and the pressurization gas line (BG) opens horizontally into the airlock (S) above a dust bulk fill

present over the delivery device (AE/S) in such a manner that a compensation gas and a pressurization gas can be introduced diffusely distributed.

9. Metering device according to at least one of Claims 1 to 8,
characterized in that
the light, polydisperse particles have a void volume in a range up to 94% and a gross density of 200 to 800 kg/m³.
10. Dense phase conveying system for the steady, continuous, dosed supply of a bulk material in powder form made of light, polydisperse particles, comprising a bunker (B), a metering device, and conveying tubes (FR1, FR2, FR3), the bunker (B) being connected to the metering device, from which the conveying tubes (FR1, FR2, FR3) extend to a consumer,
characterized in that
 - the metering device is a metering device according to at least one of Claims 1 to 9,
 - the bunker (B) comprises a ventilation element (BE) and at least one bunker delivery device (AE/B), which is connected via a filling line having at least one closure device (KH12, KH13) to the airlock (S), at least the bunker delivery device being coupled to the pressure regulation device, and
 - the dense phase conveying system comprising the suction device (V), which is connected to the airlock (S) via the depressurization gas line (EG), the suction device (V) being able to be actuated as a function of the airlock fill level (LIS/S) by the pressure regulation device and providing an airlock pressure (PIS1), which is lower than a pressure in the bunker (B).
11. Method for the steady, continuous, dosed supply of a bulk material in powder form made of light, polydisperse particles using a dense phase conveying system according to Claim 10 having a supply device (B, SG), a metering device according to at least one of Claims 1 to 9, and having conveying tubes (FR1, FR2, FR3) to a consumer arranged downstream, through coupled, adapted operation of the airlock (S) and the metering container (DB) of the metering device,
wherein

bulk material is alternately and successively applied to the at least one airlock (S) and the metering container (DB) in a controlled manner as a function of the airlock fill level (LIS/S) and the metering container fill level (LIS/DB), in that the airlock (S),

- upon reaching a fill level minimum (LIS-/S) of the airlock (S), has bulk material applied thereto for filling using a partial vacuum in relation to the supply device (B, SG) by actuating the suction device (V), and,

- upon a fill level maximum (LIS+/S) of the airlock (S), has pressurization gas from the pressurization gas line (BG) and/or swirl gas from the swirl gas line (BAG 2) applied thereto at an overpressure in relation to the operating pressure (PI2) of the metering container (DB),

and in that the filling mass flow into the metering container (DB),

- is provided upon reaching a fill level minimum (LIS-/DB) of the metering container (DB) from the airlock (S), to which overpressure is applied, by opening the closing device (KH14) of the filling line between the airlock (S) and the metering container (DB) and by operatively coupled actuation via the control device of the dust flow regulation device (FI4) of the airlock (S).

12. Method according to Claim 11,

wherein

the closing device (KH14) closes the filling line upon reaching a fill level maximum (LIS+/DB) of the metering container (DB).

13. Method according to Claim 11 or 12,

wherein

the differential pressure (PDC 3-R) between the delivery pressure (PI3) in the delivery device (AE/DB) of the metering container (DB) and the consumer pressure (PIR) is kept constant during the filling, and the individual mass flows (FIC1, FIC2, FIC3) in the conveying tubes (FR1, FR2, FR3) are regulated by the dust flow regulation devices (FI1, FI2, FI3) of the metering container (DB), the steady, continuous, dosed supply to the consumer being provided.

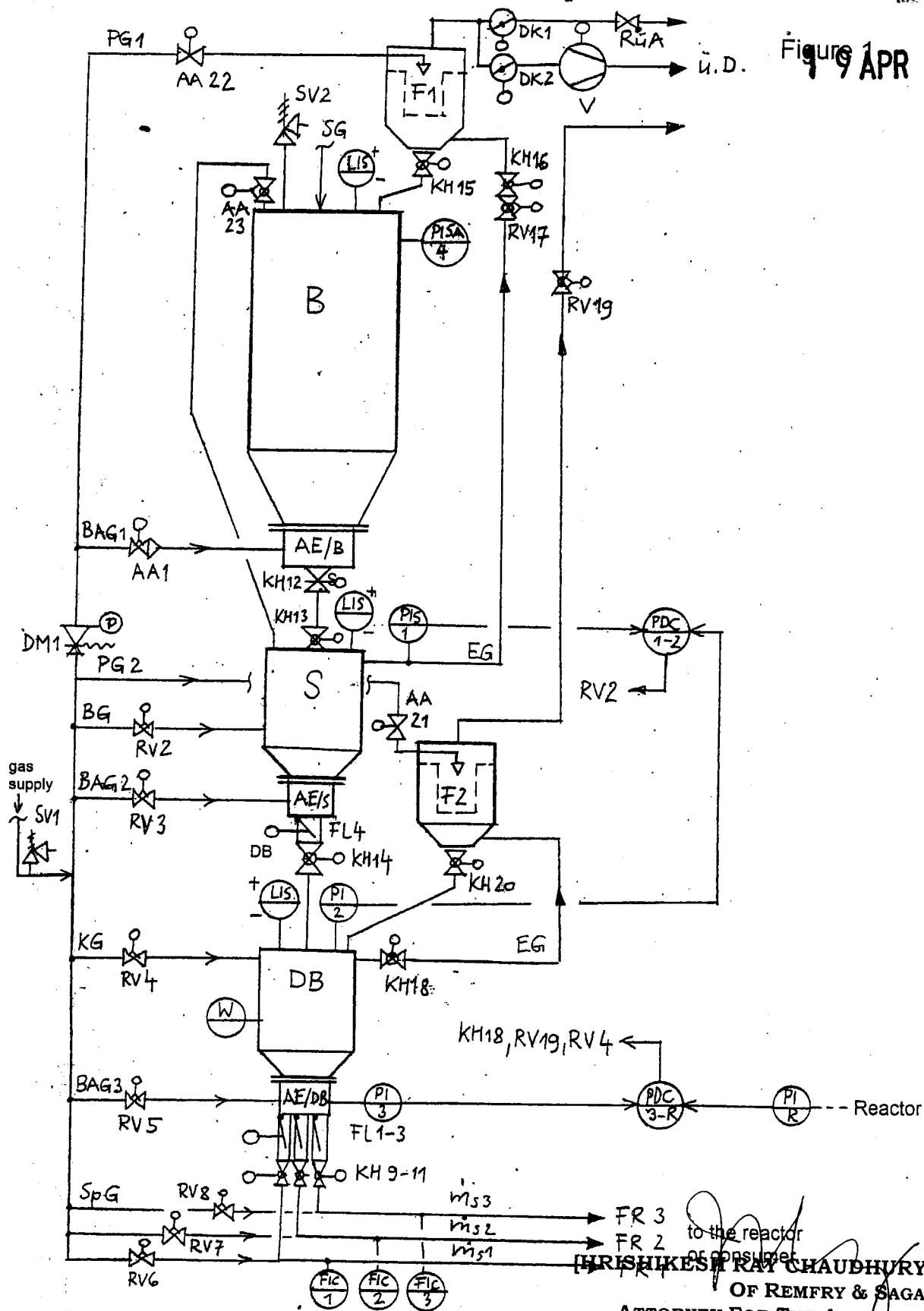
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Figure 1 APR 2012



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Figure 2 ORIGINAL

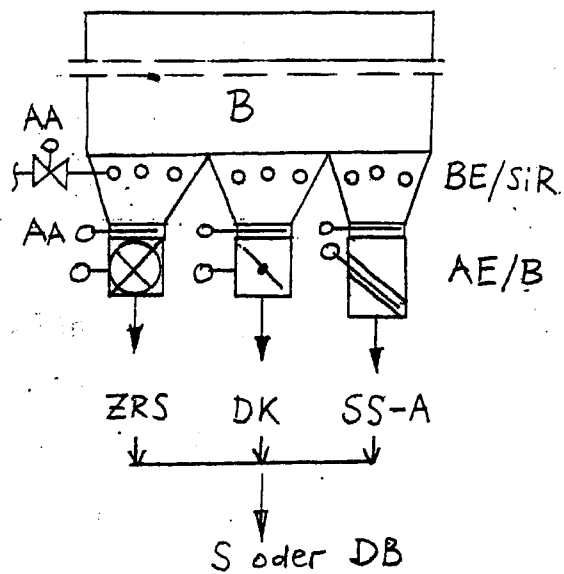


Figure 3

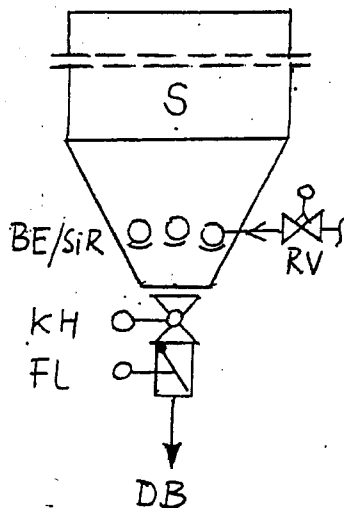
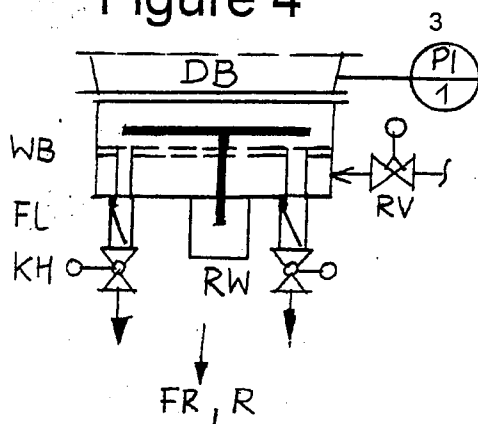


Figure 4



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