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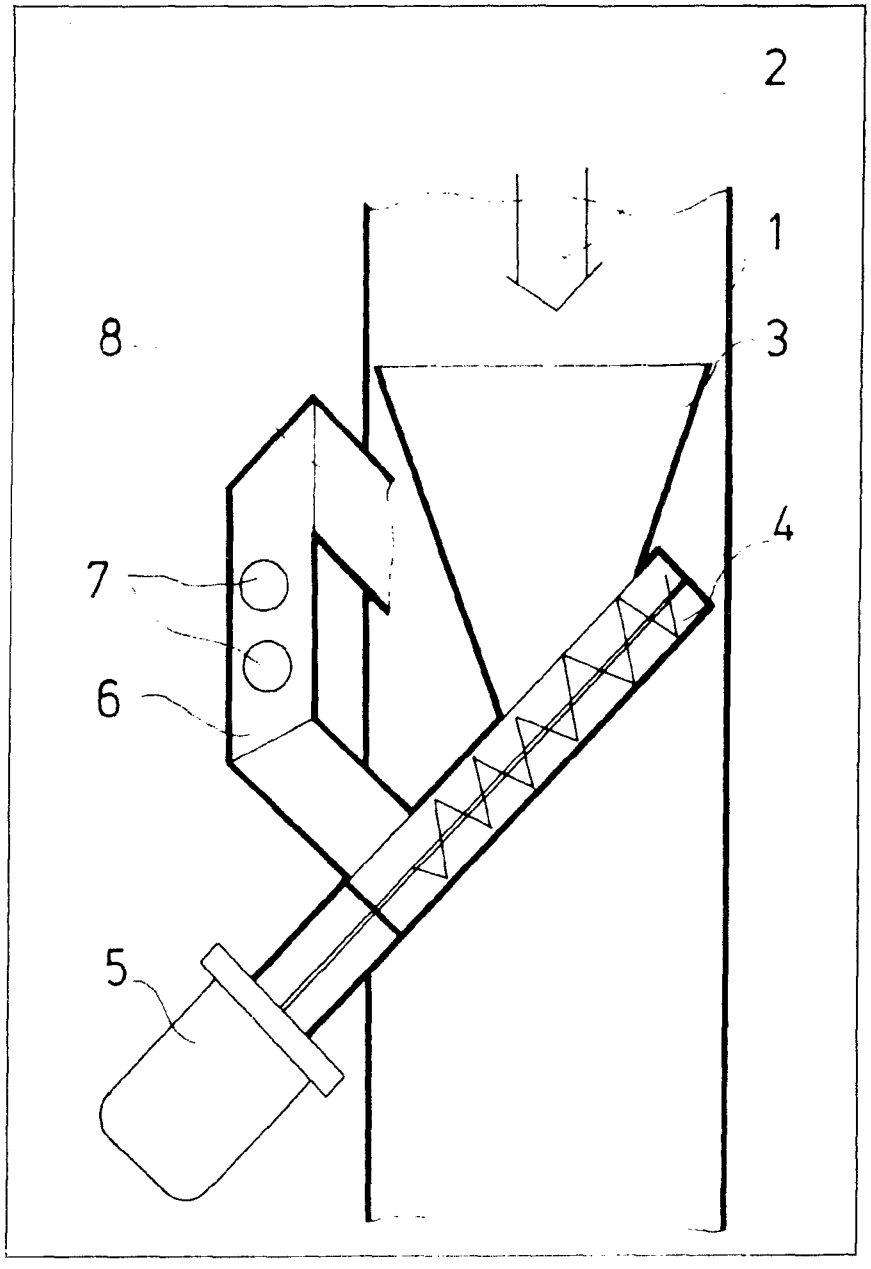
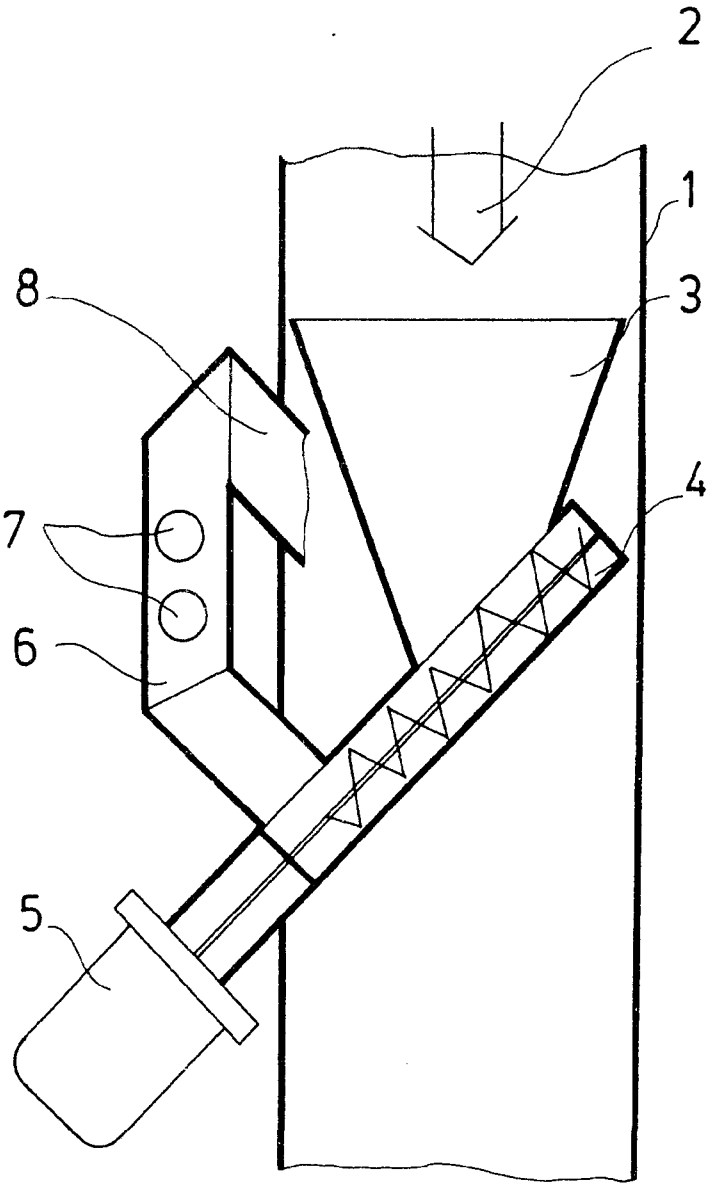
(54) **Method and apparatus for continuous sampling**

(57) An apparatus and method for continuously sampling a pulverous material flow includes means (3) for extracting a representative subflow from a pulverous material flow (2). A screw conveyor (4) is provided to cause the extracted subflow to be pushed upwardly through a duct (6) to an overflow (8). Means (not shown) for transmitting a radiation beam transversely to the subflow in the duct (6), and means (not shown) for sensing the transmitted beam through opposite pairs of windows (7) in the duct (6) are provided to measure the concentration of one or more constituents in the subflow.



GB 2 087 841 A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SPECIFICATION

Method and apparatus for continuous sampling

The invention relates to a method and apparatus for continuously sampling a pulverous material flow, for example to measure the concentration of one of more constituents by gamma- or X-ray radiation.

From British Patent Specification No. 1,455,869 it is known to measure the concentration of one or more elements in a sample by gamma- or X-ray radiation in a way which, within a considerable range, makes the measurement substantially independent of the specific gravity of the sample undergoing measurement viz. by measuring both the radiation scattered in the sample undergoing measurement and that transmitted through the sample.

When taking out discrete samples to be placed in the measuring apparatus described in U.K. 1,455,869, it is a simple matter to compress the individual sample to keep the specific gravity variation within the limits permitted. However, matters stand quite differently if it is desired to measure samples taken out continuously. In that case measurement is made through measuring windows in a measuring duct through which a representative part of the material flow is passed, e.g. by free fall through the measuring duct. The material flow is, however, mixed with highly varying amounts of air. This can be compensated for by restricting the outlet end of the measuring duct, the material thus leaving the measuring duct more slowly than it is supplied; as a result, the test material is continuously accumulated in the measuring duct, the superfluous material leaving the measuring system through an overflow. Substantial variations in the specific gravity of the material accumulated in the measuring duct may also occur with this apparatus as temporary arching above the measuring windows will cause the measuring duct facing the measuring windows to be completely or partly emptied. Subsequently, when the archings fall together, the material blockage above suddenly passes the measuring windows, after which the density of the material present in the duct grows as the duct is filled, the material column exerting an increasing hydraulic pressure on the material below. This pressure reaches its maximum when the duct is full, and additional material supplied bypasses the measuring duct by means of an overflow.

In accordance with one aspect of the present invention, a method of continuously sampling a pulverous material flow comprises extracting a representative subflow from the pulverous material flow; causing the extracted subflow to be pushed upwardly through a duct to an overflow; and subjecting the subflow in the duct to a transverse radiation beam.

In accordance with another aspect of the present invention, apparatus for continuously sampling a pulverous material flow comprises means for extracting a representative subflow from a pulverous material flow, and for causing the extracted subflow to be pushed upwardly through a duct to an overflow; means for transmitting a radiation beam transversely to the subflow in the duct; and means for sensing the transmitted beam.

The material density in the area where the beam is transmitted is thus determined by the hydrostatic pressure exerted by the material column above that area. This pressure is fairly stable as supply of additional material merely results in overflow, whereas stoppage in the supply of material has the effect that the material column remains in the duct.

The passage of the subflow upwards through the duct may be brought about by hydrostatic pressure exerted by the extracted material in the extraction part of the apparatus, or preferably by a screw conveyor pressing the extracted material up through the measuring duct, with the optional addition in either case of fluidizing air to cause a fluidized bed effect.

Preferably, if the subflow is returned to the pulverious material flow, this is carried out such that the returned subflow is not recycled as a part of a subsequently extracted subflow. This may be achieved by returning the subflow at a position downstream of the extraction position.

The extraction means may comprise a flat, funnel-shaped device, the top forming an upstream facing slot for extracting material along a diameter of a tube down which the material flow passes.

One or more measuring windows may be provided in the duct through which the radiation beam can be transmitted and sensed. Preferably, the measuring windows are provided in pairs facing each other, so that when the extracted material passes between them they constantly delimit a material sample of well-defined thickness.

An example of a method and apparatus in accordance with the present invention is illustrated in the accompanying, diagrammatic drawing, which shows a sampling apparatus.

A flat, funnel-shaped sampling or extracting device 3 having a slot shaped opening is located in a vertical tube 1, down which a pulverous material flow, indicated by the arrow 2, falls, in such a way that a material subflow through a diameter of the tube 1 passes into the device 3 through the slot shaped opening.

From the bottom of the sampling device 3 the subflow is carried to a measuring duct 6 by a screw 4 driven by a motor 5, whereupon the subflow is pressed vertically upwards through the measuring duct 6 by means of the screw 4. The duct 6 is provided with measuring windows 7 and, immediately above the window 7, has an overflow 8 through which the extracted subflow is returned to the main material stream in the tube 1 at a place below the top slot of the sampling device 3.

The measuring windows 7 are located in pairs facing each other in opposite walls of the measuring duct 6 so that they delimit a material layer of well-defined thickness, this being appropriate for measuring the radiation transmission through a material. The drawing only shows the measuring windows 7 at one side of the measuring duct 6.

The apparatus is particularly suitable for use in connection with the method described in British Patent Specification No. 1,455,869, according to

which the presence of one or more elements in a medium is sensed by simultaneous measurement of transmitted and scattered radiation. A primary radiation source and a detector (not shown) are located at one measuring window 7 while an ancillary radiation source is located at the corresponding measuring window 7 in the opposite wall of the measuring duct 6.

Further sets of measuring windows can be used for parallel measurements, possibly selectively directed to measuring the amount of substances causing errors in the desired measurements in such a way that it is possible to compensate for such errors. The signals measured can be processed in a micro-computer thus making possible direct readings of the content of the substance the concentration of which it is desired to measure e.g. the CaO-content in cement raw meal and/or fly ash.

CLAIMS

1. A method of continuously sampling a pulverous material flow, the method comprising the steps of extracting a representative subflow from the pulverous material flow; causing the extracted subflow to be pushed upwardly through a duct to an overflow; and subjecting the subflow in the duct to a transverse radiation beam.

2. A method according to claim 1, wherein the subflow is returned to the pulverous material flow in such a way that the returned subflow is not recycled as a part of the subsequently extracted subflow.

3. A method according to claim 2, wherein the subflow is returned to the pulverous material flow at a position downstream of the extraction position.

4. A method according to any of claims 1 to 3, wherein fluidised air is added to the subflow to cause a fluidised bed effect.

5. A method according to claim 1, substantially as described with reference to the accompanying drawing.

6. Apparatus for continuously sampling a pulverious material flow, the apparatus comprising means for extracting a representative subflow from a pulverous material flow, and for causing the extracted subflow to be pushed upwardly through a duct to an overflow; means for transmitting a radiation beam transversely to the subflow in the duct; and means for sensing the transmitted beam.

7. Apparatus according to claim 6, wherein a screw conveyor presses the extracted material up through the measuring duct.

8. Apparatus according to claim 6 or claim 7, wherein the means for extracting a representative subflow comprises a flat, funnel-shaped device, the top forming an upstream facing slot for extracting material along a diameter of a tube down which the material flow passes.

9. Apparatus according to any of claim 6 to 8, wherein one or more measuring windows are provided in the duct through which the radiation beam can be transmitted and sensed.

10. Apparatus according to claim 9, wherein the measuring windows are provided in pairs facing each other so that when the extracted material passes between them in use, they constantly delimit a material sample of well-defined thickness.

11. Apparatus according to claim 6, substantially as described with reference to the accompanying drawing.

New claims or amendments to claims filed on 24 February 1982
Superseded claims 1, 6
New or amended claims:- 12

1. A method of continuously sampling a pulverous material flow, the method comprising the steps of extracing a respresentative subflow from the pulverous material flow; enabling the extracted subflow to flow downwardly to cause the extracted subflow subsequently to be pushed upwardly through a duct to an overflow; and subjecting the subflow in the duct to a transverse radiation beam.

6. Apparatus for continuously sampling a pulverous material flow, the apparatus comprising means for extracting a representative subflow from a pulverous material flow, and a duct, the arrangement being such that the extracted subflow flows downwardly, in use, to cause the extracted subflow subsequently to be pushed upwardly through the duct to an overflow; means for transmitting a radiation beam transversely to the subflow in the duct; and means for sensing the transmitted beam.

12. Apparatus according to any of claims 6 to 10, wherein the overflow is positioned below the position at which the subflow is extracted.

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