

A BUCKET WHEEL SLUICE FOR GRANULATED LOOSE MATERIAL

The invention relates to a bucket wheel sluice for granulated loose material. In particular, the invention relates to such a sluice including a housing which contains the bucket wheel in a cylindrical bore, with an intake shaft or duct which ends in an intake cross-section of throat which is divided into two regions or "cross-sectional surfaces" of equal size by an elongate member of roof-shaped cross-section which extends at right angles to the bucket wheel shaft. In such a sluice the elongate member widens in the region of the intake throat which is passed over last of all by the bucket wheel spokes, so that its side edges (which are parallel over a first part of the length of the member) act there as scraper edges which end on mutually symmetrical scraper edge sections of the intake duct. In plan view, the scraper edge sections correspond to the V-shaped limbs of an arrow pointing in the direction of movement of the bucket wheel. The scraper edge sections continue in the inner wall of the cylindrical bore of the housing beneath the elongate member as a pair of grooves each approximately 1.5 times the width and depth of the largest grain diameter of the granulated material. The grooves meet in the main plane of symmetry of the housing at right angles to the bucket wheel shaft. (By "roof-shaped" is meant any shape having an apex or narrow portion at an upper end, and a widened portion at a lower end. An example of a member of roof-shaped cross-section is a member of triangular cross-section.)

DE-PS 34 45 710 discloses a bucket wheel sluice for granulated loose material, the housing of which bucket wheel sluice has an elongate member of roof-shaped cross-section which extends in the intake duct at right angles to the bucket wheel shaft, the elongate member dividing the intake throat into two regions of equal size, giving rise to a sloping cavity in the bucket wheel chambers beneath the roof-shaped elongate web portion. Viewed in the direction of movement of the bucket wheel, the roof-shaped elongate member ends in an inclined surface of the intake duct, which, in turn, ends in a pre-scraper edge about two grain diameters above the imaginary generated surface of the bucket wheel, and in the embodiment in Figure 8 of DE-PS 3445710 this prestripping edge consists of two mutually symmetrical sections which in the plan view correspond to the V-shaped head of an arrow pointing in the direction of movement of the bucket wheel. Following these prescraper edge sections, displaced in the forward direction of movement of the bucket wheel

are corresponding sections of a scraper edge which is disposed in the generated surface of the bucket wheel, this scraper edge thus in the plan view also having the shape of an arrow pointing in the direction of movement of the bucket wheel. With the generatrix of the generated surface of the bucket wheel, the prescraper edge sections and the scraper edge sections form an angle which is at least equal to the angle of friction between the loose material and the sluice material. This should mean that the grains of the granulated material, which, after passing the prescraper edge, are still in the pocket-like opening between this former and the scraper edge, and thus outside the generated surface of the bucket wheel, are scraped off in the sloping cavity, created by virtue of the roof-shaped member inside the generated surface. This prevents grains of loose material from being stripped off between the front edges of the end faces of the bucket wheel spokes and the first edge of the sluice housing passed over by the bucket wheel spokes in the region of nominal revolutionary movement of the bucket wheel, and provides sluice operation with a small amount of hacking, splitting, crushing, etc. of granular material. However, if the sloping cavity is taken into consideration at a given point of the bucket wheel chamber, this cavity decreases in size as it approaches the V-shaped tip of the scraper edge, firstly because the cavity is being increasingly filled with grains of granulated material which have already been stripped off, and secondly because the sloping ratios become more unfavourable since the V-shaped tips of the scraper edge, as viewed in the direction of rotation of the bucket wheel, are already disposed noticeably at greater depth than the highest surface line of the housing bore. Practice has therefore also shown that particularly with decreasing revolutionary speed of the bucket wheel, operation which is sufficiently low in hacking etc. is no longer ensured. Therefore, this known bucket wheel sluice is above all only suitable, under certain conditions, for dosing operations requiring a large range of different revolutionary speeds.

DE-PS 40 04 415 discloses another bucket wheel sluice for granulated loose material, wherein there is no roof-shaped elongate member in the intake duct or level with the intake throat, and wherein the prescraper edge does not extend with an arrow-like contour but is parallel to the bucket wheel spokes. The casing which is otherwise of the same design as that of the sluice disclosed in the aforementioned DE-PS 34 45 710 has a deflector body arranged therein in the pocket-like opening between the prescraper edge and the divided

scraper edge, this deflector body being of substantially V-shaped contour in the plan view and having a tip which points in the direction counter to the direction of rotation of the bucket wheel. The deflector body does not extend as far as the scraper edge sections but ends in front of these forming a gap which in width is a multiple of the average diameter of a grain of the granulated material. This sluice also ensures that in the region of nominal revolutionary movement of the bucket wheel there is a small amount of hacking, splitting, crushing, etc. of grains, but only on condition that the filling level of the chambers clearly remains at less than 100%, so that a sufficient volume remains to accommodate the scraped off grains of granulated material. The aforementioned requirement is satisfied in many instances of application, e.g. during operation at high revolutionary speeds, with pre-dosed loose material intake and/or at high counter-pressure, and a resulting large flow of leakage air which passes counter to the intake of loose material.

The bucket wheel sluice of the kind mentioned in the introduction has been used previously by the applicants, and has a housing, the intake region of which has features both of the sluice according to DE-PS 34 45 710 and also according to DE-PS 40 04 415. However, optimum possible hack-, split- or crush-free operation of this sluice is dependent on certain restrictive constraints. Depending on the respective kind of loose material which is characterised in particular by its hardness, its grain shape and pouring behaviour, and depending on the counter-pressure prevailing at the outlet side of the sluice, a specific revolutionary speed of the bucket wheel cannot be exceeded, or can only be exceeded with pre-dosed operation.

According to the invention, there is provided a bucket wheel sluice for granulated loose material, comprising a housing which contains a bucket wheel in a cylindrical bore, with an intake duct, shaft or chute which terminates in an intake throat which is divided into two regions of equal size by an elongate member of roof-shaped cross-section which extends at right angles to the bucket wheel shaft, wherein the elongate member widens in the region of the intake throat which is passed last by the bucket wheel spokes during a revolution thereof, so that its side edges which are parallel over a first part of the length of the member act there as scraper edges which end on mutually symmetrical scraper edge sections of the intake duct which in the plan view appear as the V-shaped head of an arrow pointing in the direction

of movement of the bucket wheel, wherein the scraper edge sections continue in the inner wall of the bore of the housing beneath the elongate member in grooves approximately 1.5 times the width and depth of the largest grain diameter of the granulated material; the grooves meet in the main plane of symmetry of the housing perpendicular to the bucket wheel shaft; the bucket wheel beneath the elongate member includes a plurality of chambers defined by two chamber partitioning walls which extend radially outwardly in the bucket wheel and which are spaced apart from each other by the width of the elongate member, the peripheral edges of which walls lie on the imaginary surface of revolution defined by the bucket wheel, and in the regions where the chamber partitioning walls abut the trailing bucket wheel spokes they each have an opening which interrupts the peripheral edge.

Thus there is provided a bucket wheel sluice of the kind mentioned in the introduction, which operates without any hacking for a wide range of applications of loose material and kinds of operating, above all with dosing operations where there is a large span between the minimum and maximum amounts of dosed material per unit of time.

Since the region of each bucket wheel chamber is kept free from intake of loose material beneath the roof-shaped elongate web portion, under all operating conditions a sufficient volume is available into which the grains of granulated material which penetrate in the direction of the main plane of symmetry of the housing by cooperation of the front edge of the rear bucket wheel spoke of each chamber and the corresponding groove flanks can fall through the openings into the chamber partitioning sheets. This space is thus independent of the properties of the loose material in question and of the operating conditions of the sluice. The sluice can therefore move in hack-free etc. manner from standstill.

The volume of the space - which may extend up to the shaft of the bucket wheel - between the chamber partitioning sheets must obviously be large enough to be able to accommodate the maximum possible number of grains of granulated material which are scraped off or which have penetrated in the direction of the main plane of symmetry of the housing. This maximum number of grains of granulated material is determined by the volume of the grooves in the inner wall of the cylindrical bore of the housing. The volume of the space between

the chamber partitioning sheets must be at least equal to this latter volume, but is preferably 1.5 times to twice this volume. If the width of the elongate web portion is measured appropriately, and the reciprocal spacing resulting from it between the chamber partitioning sheets, the desired volume is obtained.

By similar considerations, it is possible to optimise the position and geometric shape of the openings in the chamber partitioning sheets, as disclosed in greater detail in Claims 2 to 4.

Under certain operating conditions, e.g. with particularly fast revolutionary speeds of the sluice, it can be advantageous if the "rear" wall, usually formed by a corresponding section of the bucket wheel spoke in question, of the space between the chamber partitioning sheets is arranged in displaced relationship relative to their openings, counter to the direction of rotation, so that the arrow-like contour of the grooves in the inner wall of the cylindrical bore of the housing is better accounted for. Claim 5 is directed at this further development.

The drawings show a simplified illustration of an embodiment, selected by way of example, of a bucket wheel sluice according to the invention, wherein:

Figure 1 is a longitudinal section,

Figure 2 is a cross-section along the line A-A in Figure 1,

Figure 3 is a cross-section along the line B-B in Figure 1,

Figure 4 is a plan view of the sluice shown in Figure 1,

Figure 5 is a half-section along the line C-C in Figure 4, but without the bucket wheel,

Figure 6 is a part bottom view in the direction of the arrow X in Figure 1,

Figure 7 is a cross-sectional view corresponding to Figure 3 through a second embodiment,

Figure 8 is a plan view, corresponding to Figure 4, of the second embodiment, and

Figure 9 is a part bottom view, corresponding to Figure 6, of the second embodiment.

The bucket wheel sluice shown in Figure 1 has a housing 1, shown here simply by way of its mounted lid, with an intake shaft 2 and an outlet shaft 3. Disposed in the housing 1 is a bucket wheel, consisting of a shaft 4, bucket wheel spokes 5 and side pushers 4a on either side which are optional. The same bucket wheel sluice is shown in Figures 2 and 3 in cross-section along the lines A-A and B-B in Figure 1. It is seen that the housing 1 has a leakage gas delivery tube 1a which is also optional. The direction of movement and rotation of the bucket wheel is marked by an arrow. Disposed in the intake shaft 2, at right angles to the bucket wheel shaft 4 is an elongate web portion 6, which, as shown in Figure 1, is of roof-shaped cross-section. This roof-shaped elongate web portion 6 divides the intake throat into two cross-sectional zones 7a and 7b (cf. Figure 1) which are equal in size. The intake cross-section represents a cut-out in the generating surface 8 of the bucket wheel which simultaneously forms the inner wall of the housing bore in the region of the housing 1.

Each of the chambers delimited by the bucket wheel spokes 5 is sub-divided by two chamber partitioning sheets 9a and 9b, as shown in Figure 1, which, being disposed in the radial planes, are arranged exactly beneath the elongate web portion 6, and are spaced apart from each other by the width of the elongate web portion 6 (less the material thickness of the chamber partitioning sheets). The chamber partitioning sheets 9a and 9b thus delimit a space 10 which is initially empty of loose material (cf. also Figure 6), which is intended to receive the scraped off grains of granulated material which reach the space 10 through openings 11a and 11b in the peripheral edges of the chamber partitioning sheets 9a and 9b, as will be explained hereinafter.

As can be seen in Figure 4, the elongate web portion 6, which, as viewed in the direction of movement of the bucket wheel, has side edges which are parallel as far as about the centre of the intake cross-section, then widens so that the corresponding side edge sections act as scraper edges 6a, 6b. These scraper edges 6a, 6b each make a transition at the points A, B, into a smaller radius, into scraper edge sections 2a, 2b of the intake shaft which are symmetrical to each other and which in the plan view correspond to the V-shaped limbs of an arrow pointing in the direction of movement of the bucket wheel. They continue in the inner wall of the bore of the housing beneath the elongate web portions 6 in grooves 12a, 12b, which are approximately 1.5 times the width and depth of the largest grain diameter of the granulated material, and which meet at point C on the main plane of symmetry of the housing, at right angles to the bucket wheel shaft. The part section in Figure 5 shows the course of the grooves 12a, 12b in greater detail. This causes the following to happen: if the intake shaft is filled with granulated material by way of the cross-sectional surface areas 7a, 7b (Figure 1), the front edge of the rear bucket wheel spoke 5 entrains with it some of the grains of granulated material, relative to a specific bucket wheel chamber, whilst it skims over the intake cross-section. These grains of granulated material, depending on where they are in the cross-sectional surface in question, are either guided along the scraper edge (6a or 6b) of the elongate web portion 6 or along the scraper edge section (2a or 2b) in question of the intake shaft as far as the corresponding apex (A or B), and enter the respective groove (12a or 12b) there. When the bucket wheel then rotates further, as soon as the closest opening (11a or 11b) comes to be disposed beneath the groove in the associated chamber partitioning sheet (9a or 9b), the grains of granulated material are able to fall freely into the space 10 between the chamber partitioning sheets 9a, 9b. Usually, no grains of granulated material therefore reach the apex C where they could be stripped between the section 5a which delimits the space 10 to the rear (see Figure 6) of the associated bucket wheel spoke 5 and the inner wall of the bore of the housing.

This function also results in the optimum measurement of the openings 11a, 11b. The rear edge, as viewed in the direction of movement, of each opening should preferably be disposed in the plane of the front edge of the "rear" bucket wheel spoke in question. Furthermore, the width of the openings 11a, 11b, as viewed in the peripheral direction, should be at least equal to the

width of the grooves 12a, 12b projected into the main plane of symmetry, as shown clearly in Figure 4. The depth of the openings 11a, 11b, as measured in the radial extent of the bucket wheel must be at least equal to the largest diameter of the grain of the granulated material, but it should not be unnecessarily large, since then part of the space would be filled by intake of loose material from the lateral chambers.

Figures 7 to 9 show another embodiment of a variant of the present proposal concerning the bucket wheel alone. Therein, the central section 5b of the bucket wheel spokes 5, here acting as a rear wall or a boundary to the space 10 between the chamber partitioning sheets 9a, 9b, is arranged counter to the direction of rotation of the bucket wheel, counter to the direction of movement of the bucket wheel, in displaced relationship through about 20% of the width of the chamber measured in the peripheral extent, less the width of the limb portion. The position of the openings 11a 11b remains unchanged, however. Advantages can be gained, above all, at very high revolutionary speeds of the bucket wheel, at which the inertia of the grains of the granulated material begins to take effect, causing these grains to begin to fall basically on the principle of gravity, and visibly remain behind rotation of the spokes of the bucket wheel.

CLAIMS

1. A bucket wheel sluice for granulated loose material, comprising a housing which contains a bucket wheel in a cylindrical bore, with an intake duct, shaft or chute which terminates in an intake throat which is divided into two regions of equal size by an elongate member of roof-shaped cross-section which extends at right angles to the bucket wheel shaft, wherein the elongate member widens in the region of the intake throat which is passed last by the bucket wheel spokes during a revolution thereof, so that its side edges which are parallel over a first part of the length of the member act there as scraper edges which end on mutually symmetrical scraper edge sections of the intake duct which in the plan view appear as the V-shaped head of an arrow pointing in the direction of movement of the bucket wheel, wherein the scraper edge sections continue in the inner wall of the bore of the housing beneath the elongate member in grooves approximately 1.5 times the width and depth of the largest grain diameter of the granulated material; the grooves meet in the main plane of symmetry of the housing perpendicular to the bucket wheel shaft; the bucket wheel beneath the elongate member includes a plurality of chambers defined by two chamber partitioning walls which extend radially outwardly in the bucket wheel and which are spaced apart from each other by the width of the elongate member, the peripheral edges of which walls lie on the imaginary surface of revolution defined by the bucket wheel, and in the regions where the chamber partitioning walls abut the trailing bucket wheel spokes they each have an opening which interrupts the peripheral edge.
2. A bucket wheel sluice according to Claim 1, wherein the rear edge of each opening lies in the same plane as the front surface of the adjacent bucket wheel spoke of the associated chamber.
3. A bucket wheel sluice according to Claim 1 or Claim 2, wherein the width of the openings measured in the peripheral direction is at least equal to the width of the grooves projected into the main plane of symmetry.



4. A bucket wheel sluice according to any of Claims 1 to 3, wherein, measured in the radial extent, the depth of the openings is at least equal to the largest grain diameter of the granulated material.
5. A bucket wheel sluice according to any of Claims 1 to 4, wherein the central zone, between the chamber partitioning sheets of each bucket wheel spoke, is arranged relative to the two outer sections of the same bucket wheel spoke in displaced relationship through a maximum of the width of the chamber as measured in the peripheral extent less the width of the spoke, counter to the direction of rotation of the bucket wheel.
6. A bucket wheel sluice generally as herein described, with reference to or as illustrated in the accompanying drawings.

