

Translation :

Technical field

The invention relates to a stand of rollers for the grinding of grain in order to produce products ground from grain such as flour, semolinas, middlings etc. by repeated roller grinding and the sifting-out of specific product fractions, using the high-grinding system, according to the pre-characterising part of claim 1; (see DE-A-2730166).

In the production of bread flour, two basically different grinding methods are known. Wholegrain or wholemeal/dark flour has for ages past been obtained by grinding the whole grains once, twice or three times correspondingly through one, two or three grinding passages and, where appropriate, from a proportion of the husks or the outermost layer of the individual grains.

This system has recognised advantages. Almost all the constituents of the individual grain are retained integrally and, through bread and other cereal products, provide high-quality nourishment for people. But it has also been undeniable that this old method, often referred to as low grinding, also has disadvantages. The products obtained by means of wholegrain grinding keep for only limited lengths of times. The corresponding health food products are intended mostly for immediate consumption. Dirt, bacteria, fungus spores etc. adhere normally mainly on the outside of the individual grain, the husk. It is precisely these impurities which impair the quality of the products and also reduce their shelf life, or increase the risk of the ground products spoiling, and prejudicing the quality of the end products

Often insufficient attention is given to the fact that the cereal grain is made up of greatly differing parts. These various parts give the end products of a mill i.e. the flour, semolinas and/or middlings the desired properties e.g. specific

baking properties. A pre-requisite if these quality criteria are to be controlled is the possibility of obtaining the various parts of the ground grain separately. Such products, required for a specific need, cannot be separated out economically with the simple low grinding system with only a few grinding passages. A plurality of basic products is required now precisely because of higher expectations in eating habits.

The modern method is the so-called high grinding system, which is characterised by grinding repeated many times, with sifting after each grinding. Up to two or three decades ago this operation has often been repeated 15 to 20 times. With more recent developments it has been possible to show that as little as an average twelve to twenty times grinding, with good operation control, leads to the same results. Since the beginning of the 70's the short high-grinding method has become accepted almost world-wide as the state of the art rather than the previously used high grinding method.

A good miller is capable of achieving the quality standard expected by the further-processing trades e.g. bakers, pasta factories etc., even from greatly varying raw materials, by mixing the various grain qualities and careful mill control.

To stay competitive of course the mill must produce from a specific quantity of raw material a specific quantity of end products of high quality and thus with a relatively high price. That is to say, a flour mill is always trying to achieve a high yield of refined flour, semolinas, etc. A mill is working well only if it has a high yield and at the same time meets the quality criteria. A not unimportant factor as regards the overall economic aspect is the amount of operating equipment needed, and in a mill this depends for example directly on the number of grinding and screening apparatus and the space required. All endeavours in most recent times have shown that in traditional milling the grinding cannot be further shortened without also directly reducing the yield or the ground product quality at the same time. To this

extent, for some years a stagnation has been detectable in the development of grinding processes used by millers.

Description of the invention

The invention now has as its object to develop a stand of rollers for the grinding of grain for the production of flour, semolinas, middlings etc. the use of which allows the economic efficiency of a mill to be improved, preferably whilst retaining the full flexibility or adaptability of the mill to the specific grinding task, grinding quality, and/or the controllability of the grinding process.

The solution provided by the invention is characterised in that the roller stand comprises two double units each with two roller pairs arranged with spacing above one another, wherein between the roller pairs arranged one above the other within each double unit there is provided in each case a product discharge hopper transferring the material processed by the respective upper roller pair directly into the grinding gap of the associated lower roller pair, and the double units form a joint assembly, an 8-roller roller stand. In this way the material being ground is conducted repeatedly through double grinding passages without intermediate sifting i.e. preferably sifted after each double grinding passage, each grinding being individually controllable and monitorable.

Tests with the roller stand constructed according to the invention have shown, to the surprise of all experts participating, that the set object could be achieved fully. It was interesting to observe that triple grinding without intermediate sifting, as was practised in part in early days of modern milling, gives distinctly worse results. To some extent this may be put down to excessive heating of the material, but probably is due mainly to the fact that, with triple grinding without intermediate sifting a considerable proportion of the ground material is comminuted disadvantageously, or too many fines are produced at much too early a stage.

Here we have probably one of the most important secrets of grinding as used by millers, namely that each working step by itself can be monitored and controlled. The head miller with his experience knows at each point what he is doing. In actual practice, therefore, at each grinding stage special conditions are produced e.g. by adjusting the grinding gap, special fluting, differentials at the grinding rollers, throughput through a grinding passage, etc.

But a very surprising fact was that double passage grinding can be used advantageously not only at the first two break passages i.e. B1/B2, but also at the first reduction passages C1/C2 for example. Over and above this, in the case of at least a majority of raw materials it was possible to use double passage grinding successfully also for B3/B4 or e.g. C3/C4. It is also possible to make use of only one, two or three of the four possibilities mentioned, all other passages using only single grinding with subsequent sifting. If the raw grain is of very uniform quality, all the grinding passages can be arranged as double grinding passages.

Thus the method proposed by the invention opens up the possibility, for the grinding process, of multifarious development in that e.g. the mill can have a combination of double grinding and single grinding passages, the material being ground being subjected to intermediate sifting after each double grinding passage and each single grinding passage.

Quite a number of advantageous possible variations follow from this. As is known, most machines in mills have a long working life. Many existing mills, if they used the new solution, could increase the mill output without space problems, namely by constructing one, two, three, four or

more double grinding passages. Since as regards the sifters also a corresponding number of sifting passages are omitted, more output can be provided within an existing mill building. A further possibility is that of making more optimum use of a new mill building by a careful choice of appropriate single and double grinding passages, reducing the number of installed machines relatively to the state of the art, which in the end has its effect on the procurement price. Nevertheless the same quality values can be guaranteed; because the possibilities of intervening in the conduct of the grinding work are unaltered.

It is very preferable to conduct the material at least twice through double grinding passages e.g. through the combination B1/B2 and C1/C2 and/or B1/B2 and B3/B4 and/or C1/C2 and C3/C4, the material being sifted after each double grinding passage.

The invention also relates to a roller stand for the grinding of grain for the production of flour, semolinas, middlings etc., especially for use with the method according to the invention and is characterised in that it comprises a double unit with in each case two roller pairs arranged with spacing one above the other. This is referred to hereinafter as an eight-roller stand.

In the form of the eight-roller roller stand there is now a new monitoring possibility for the miller, since two grinding stages can be supervised at the same time and at the same place, directly. This means that a decision can be made at once on changing e.g. the first roller pair in response to the grinding result of the possibly unaltered second roller pair. This facility

has never been possible hitherto in the field of high grinding as far as the applicant company knows. Because there is sifting between each grinding, in the state of the art it has been necessary to wait not only for the appropriate time until the material passed through sifting and the second grinding stage, but each intermediate sifting also varied the composition of the material being ground, in that individual fractions were conducted to other passages. It has been found that the slight disadvantage that a small proportion is unnecessarily comminuted in the second grinding is more than compensated for by the advantage of direct control possibilities and direct intervention on both pairs of grinding rollers.

It is especially preferred to arrange below each pair of rollers a product discharge hopper, these each having a monitoring door for monitoring the material after each grinding.

Thus the running of the flour mill is almost unaltered as regards grinding, as far as the miller is concerned, although the new solution affords quite unexpected advantages. The new idea does not call for blindly grinding twice in succession in each case, and instead it is possible by direct control of the first and second stage of each double grinding stage to keep the grinding result of both comminutions directly under supervision. This has been found to be very important since grinding in mills is not simply comminuting but rather a multi-stage careful opening of the grain, releasing of the endosperm parts, careful grinding of the semolina parts, for example for semolina intended for pasta production, etc. Criteria on which to judge include not simply the grain size distribution, but also the visual appearance of the first break, the feel of the ground products, colour, fine flour proportion, etc. But

other factors are significant in this connection as well such as the state of the rollers, sharpness of fluting, the operation of knife strippers and roller brushes, etc. Therefore, it can be said without exaggeration that the sum of these parameters, which are often considered to be marginal factors by persons not fully conversant with the miller's art, is just as important in actual practice as the grinding gap, which per se can easily be monitored by automatic means. Without a perception of these circumstances an assumed technological step forward in progress can turn out to be, as in very recent times, an actually retrogressive step in very many technological fields, one which in the final reckoning needs far more outlay than the economies claimed at by the intended progress.

Preferably, also, each roller pair is provided with individual adjusting means and a preventive device against foreign matter.

But the new invention also opens up very different methods of working which have not been appropriate hitherto in grinding work in mills. Thus there can be superordinated regulation of the two grinding roller pairs arranged one above the other, or only of one grinding roller pair, to the actual motor power consumption, in relation to the throughput. In this case it is possible to control only one of the two roller pairs, preferably the upper, through automatic means to a specific roller spacing. It is thereby possible to achieve a long-cherished wish - namely specific predetermined automatic control of all the grinding gaps and the regulating of the intensity of the grinding work through the motor power consumption of several double roller pairs.

It has also been found to be especially advantageous for the operating, especially the supervision of the machine

and of the grinding work if the rollers of a pair of rollers are arranged in a single horizontal plane. This also allows for example easy roller changing, and that each roller pair is constructed as an interchangeable assembly.

If the aspiration on the feed chamber is connected to the product discharge through the product discharge hopper, the escape of dust can be prevented, and more particularly for the control of the grinding work no disturbance will occur when the monitoring door for the upper grinding roller pair or for the lower, or both, is opened.

Grinding in mills also presumes that in the great majority of passages the grinding rollers of each pair of grinding rollers are at different rotational speeds, preferably all the rollers of an eight-roller roller stand having the same diameter as a rule.

The two roller pairs situated immediately above one another have common control means for the engaging and disengaging of the movable rollers. (When material for grinding is present and not present respectively).

A further, especially advantageous development idea is that the grinding gap adjusting device is associated in each case with a remote control, and has computer means for storing and retrieving the grinding gap settings specific to each grinding task, and also all other setting values of the processing and conveying means.

The invention will now be described in more detail with reference to some examples of embodiment.

Brief description of the invention

Fig. 1 is a cross-section showing a new eight-roller roller stand,

Fig. 2 shows a side view of Fig. 1 with bearing means, grinding roller adjustment, drive, etc.,

Fig. 3 is a diagram showing grinding and sifting in an example of embodiment.

Ways of carrying out the invention

Reference will now be made to Fig. 1. The eight-roller roller stand 1 comprises two halves, the left-hand half being represented as a breaks passage 2 and a right-hand half as a reductions passage 3. The breaks passage 2 has usually fluted rollers 4 and 5 respectively, the faster-running roller 5 being indicated with two arrows in the Figure. Below the rollers 4 and 5 there is situated in each case a stripping brush 6. In the reductions passages, predominantly smooth rollers 7 and 8 respectively are used, and stripping knives 9 for keeping the roller surfaces clean. Depending on the specific grinding work, the respectively lower roller pair 4', 5' and 7', 8' will be of the same roller type respectively coarse fluted, fine fluted, or smooth, as the corresponding upper pair.

The material is conducted through a feed cylinder 10 at the left or right into the roller stand 1. Only in the case of very large mill outputs is it expedient to construct the left and right roller stand halves identically, such that the two halves each have to process half of the quantity of material. In the feed cylinder 10 a sensor 10 is constructed as a so-called "Christmas tree" shaped sensor as shown, and this

controls a product feed 12, so that each arriving quantity of material which enters above at the feed cylinder 10 is discharged in an equal amount through the product feed. The material is conducted directly into the grinding gap via a feed duct 13. A strong air flow is produced in the feed duct 13, which can be ensured advantageously by two air ducts 14 which extend about the rollers 4, 5 and 7, 8 respectively. The material produced as breaks by the upper roller pair 4, 5 is conducted directly via a product discharge hopper 20 into the grinding gap of the lower roller pair 4', 5'. At the lower roller pair 4', 5' also the air is aspirated through air ducts 14. The material being ground is transferred by a product discharge hopper 21 and a transfer element 22 to the intermediate upward transfer devices. All four pairs of rollers 4, 5 - 4', 5' - 7, 8 - 7', 8' can be adjusted as regards the grinding gap by means of an adjusting device 15. All other devices such as a device for guarding against foreign bodies, engaging and disengaging devices, etc., are used as in normal four-roller mill stands. The DE-A- 27 30 166 in its entirety should be referred to in this connection. It has been found that the assembly for the pair of rollers in the said publication by the applicant company can also be used with great advantage in eight-roller stands, so that in cases where there is a combination of eight-roller and four-roller stands it is possible in each case to proceed from the same basic construction for the roller group, which is a further advantage for the manufacturer as for the user.

In individual cases it may be advantageous to provide a feed roller or product distribution roller above the lower roller pair. But preferably roller engagement and disengagement is effected for both pairs of rollers by means of the common sensor 11.

An air guide 18 is additionally shown in the product discharge hopper 21 in the right-hand half of the illustration. This may afford advantages especially with middlings-type and flour-type materials, since separate conducting of air and product allows more compact guiding of the falling flow of product.

Each grinding roller pair (4, 5 - 7, 8) has its own grinding gap adjusting device comprising a hand wheel 15 and the corresponding adjusting elements. A motor-operated adjusting device 16 can be provided additionally, and both can monitor the instantaneous spacing of the two grinding rollers by means of an indicator device 17. Motor adjustment can also be effected automatically by computer (R) and memory means.

Each grinding roller pair also has associated with it a monitoring door 19 which is shown in the closed position above and in the open position below in the right-hand half of the illustration. The monitoring door can be opened whether or not the roller stand is in operation. Because of additional air ducts 14, 18 described hereinbefore, constant air pressure conditions and therefore constant grinding conditions are maintained.

Reference will now be made to Fig. 2 in which adjusting elements are shown as a sub-assembly 100, and also a controllable adjusting drive 100'. The two grinding rollers 104 and 105 are mounted on a common support 101. The free roller 105 is secured pivotably on a stationary eccentric pin 102, engagement and disengagement being controlled by an appropriate lever 103, also a disengagement cylinder 106. Through the pivoting movement of the lever 103 the eccentric pin 102 is rotated and causes horizontal displacement of the lower portion of a pivotable bearing housing 107,

so that the spacing of the two grinding rollers can thus be pre-set. This device would be less well suited to the precise adjusting of the grinding rollers. It is only used in fact to bring the grinding rollers into an engaged or disengaged position, or into two fixed positions. The actual fine adjusting of the grinding rollers 104 and 105 is effected by means of an adjusting spindle 108 which by rotation directly moves an adjusting arm 109 about a stationary pivot bearing 110. The upper shorter end of the adjusting arm 109 is connected by means of a connecting rod 111 in force-locking manner to the pivotable bearing housing 107. Force transmission is via knife edges, at one side part of an overload spring safety device 112. At the opposite side there are arranged at the connecting rod 111 an adjustable counter-holder head 113, also a pressure measuring device 114 with a pressure indicator 115. In order that the grinding rollers can be adjusted in parallel manner in service operations, correction can be effected at the side where it happens to be needed by means of adjusting screws 143, 144. The adjusting spindle 108 is held stationary by bearings 110' and can be operated by means of a hand wheel 116 or alternatively by motor means, transmission chain 118, and a geared motor or drive motor 119. The drive motor 119 is secured on the roller standard 126 and is connected directly to the adjusting spindle 108 by a friction clutch and a chain wheel.

Also connected directly to the adjusting spindle 108 is a position pickup 120, so that every movement of the chain wheel 123 or the hand wheel 116 is recorded in the position pickup 120 and transmitted to the desired places. Moreover in Fig. 2 a drive belt 128 for driving

the grinding rollers 104, 105 and 104', 105' respectively is indicated only sketchily. It is possible also to provide in the drive system a device 129 for measuring and indicating the electrical power demand. Thus for example the electrical power consumption can be limited to upper and lower values and, if the preselected range is exceeded, e.g. one or both grinding roller pairs are disengaged from one another. But it is also possible thus for example to regulate the electrical power consumption as a function of the lower grinding gap, the upper grinding gap being fixedly set by the automatic control in this example.

All the signals of a roller stand are preferably coordinated and controlled by means of an in-machine computer R, this computer R being able to call the required desired values from a central computer with memory Sp. The position indicator is provided preferably with a position limit switch which is adjustable to preselectable limit values, and in this way can prevent an automatic misadjustment. A position limit value switch has the advantage that a manual misadjustment can also be obviated therewith, since both hand wheel and automatic adjustment result in a corresponding displacement travel of the chain 118. The position pickup just like the adjustment motor 119 can be connected to an input/output unit which receives and emits appropriate signals from the machine computer R, correspondingly with digital display and manual input keys. In the same sense the pressure measuring and indicator device 114, 115 can be connected to the machine computer. One or more safety devices can be provided at the same roller mill depending on the extent to which the roller mill is developed. For example if fluted rollers are fitted, grinding pressure supervision makes less sense, whereas there is advantage in supervising the spacing of the grinding rollers, whether through the position indicator or a distance measuring device.

The reverse is true in the case of smooth rollers, where pressure monitoring brings more advantages. With a computer and the indicated ^{signal} transmission lines it is intended to indicate that the computer or store controls quite a number of, possibly all of, the roller stands in a mill, and also co-ordinates regulating functions if necessary.

It has also been found particularly advantageous for the digital display to indicate a value corresponding to a time measurement (05.50 clock) and returns preferably an identical value correspondingly to a position-indicating device or the indicator dial of the hand wheel.

The great advantage is that the empirical values of non-automated or non-remote-controllable roller stands can be compared and made use of for constructing or improving appropriate control programmes.

Reference will now be made to Fig. 3 hereinafter. This Fig. 3 shows the combination of double grinding passages and single grinding passages. The double grinding passages B_1/B_2 and C_1/C_2 are brought together in a single eight-roller roller stand 70. A conveying conduit 140 brings the material ground in the first double grinding B_1/B_2 to the first large screen section 73. The third breaks B_3 , also the fourth breaks B_4 , are ground on a single grinding passage in each case in a 4-roller stand 142. Upward transfer devices 143 and 144 respectively bring the third and fourth breaks into the corresponding screen sections 145 and 146 respectively. The first two reduction passages C_1 and C_2 are again arranged as double grinding passages. The material produced from C_2 is conducted via a pneumatic conveying conduit 141 into the second large screen section 74. The reduction passages C_3 and C_4 are again formed as single grinding passages (four-roller roller mill 151), and the

corresponding products are conveyed with upward transfer devices 147 and 148 respectively into the corresponding third and fourth screen section 149 and 150 respectively. The following reduction passages, likewise the rear break passages which are not shown, can be constructed in accordance with particular requirements of the mill in question, either as double grinding passages or as single grinding passages. The large surface screens 73, 74 etc. can be combined to form a special large plansifter 152, likewise correspondingly the screen sections 145, 146, 149, 150 can be combined in a plansifter 153 according to the state of the art.



Claims

1. Roller stand for the grinding of grain for the production of flour, semolinas, middlings etc., using the high grinding method, equipped with two pairs of rollers (4; 5 and 7; 8) which are situated parallel side by side in the grinding direction and are connected via a feed cylinder (10) each to a system supplying material for grinding, with sensor and product feed (12), wherein each pair of rollers (4;5 and 7; 8), operating independently of one another, is provided with an individual adjusting device (15) for the grinding gap and with a protective device (112) against foreign matter in each case, and a product discharge hopper (21) having a monitoring door (19) is associated with each roller pair (4; 5 and 7; 8), characterised in that the roller stand comprises two halves or two double units (2; 3) each with two roller pairs (4,5; 4',5' and 7,8; 7'; 8') arranged spaced one above the other, and between the roller pairs (4; 5 and 7; 8) and (4',5' and 7';8') arranged one above the other within each double unit (2; 3) there is provided in each case a product discharge hopper (20) transferring the material processed by the respective upper roller pair (4; 5 and 7; 8) directly into the grinding gap of the associated lower roller pair (4';5' and 7';8'), and the double units (2; 3) form a joint assembly, an 8-roller stand of rollers.

2. Roller stand according to claim 1, characterised in that each grinding roller pair (4, 5; 4', 5' and 7, 8; 7', 8') has associated with it its own adjusting means (15; 16) and monitoring means (monitoring door) (19).

3. Roller stand according to claim 1 or 2, characterised



in that all the rollers (4; 4'; 5; 5'; 7; 7'; 8; 8') of the 8-roller roller stand have the same diameter, and the rollers (4; 5 and 4'; 5' and 7; 8 and 7'; 8') of each roller pair are arranged in one horizontal plane.

4. Roller stand according to one of claims 1 to 3, characterised in that each two roller pairs situated directly above one another (4; 5 and 4'; 5', likewise 7; 8 and 7'; 8') have common control means for engaging and disengaging the respective movable roller (when material for grinding is and is not present respectively).

5. Roller stand according to one of claims 1 to 4, characterised in that each roller pair (4,5; 4',5'; 7,8; 7',8') is constructed as an interchangeable sub-assembly.

6. Roller stand according to one of claims 1 to 5, characterised in that the aspiration of the feed chamber is connected to the product discharge through the product discharge hopper (21) by means of an air guide duct (18).

7. Roller stand according to one of claims 1 to 6, characterised in that each roller pair (4, 5; 4',5'; 7, 8; 7', 8') has a grinding gap adjusting device, independently of a roller engaging and disengaging arrangement regulated through the agency of the product flow.