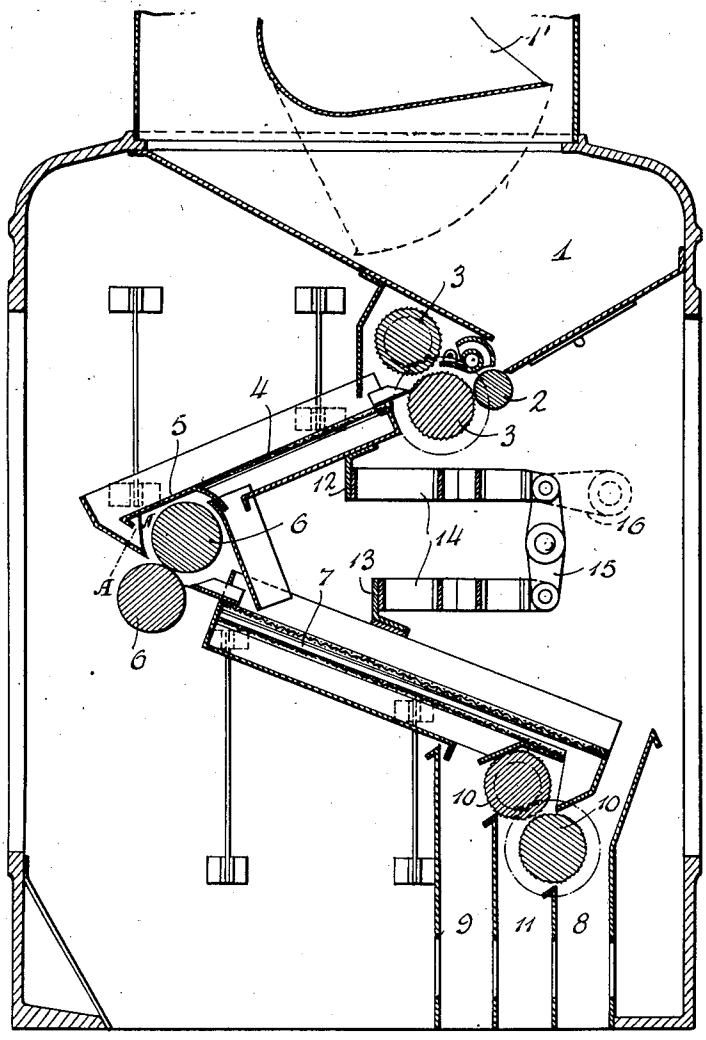
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APPARATUS FOR GRINDING GRAIN INTO CRUSHED MALT AND THE LIKE

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Fig.1.



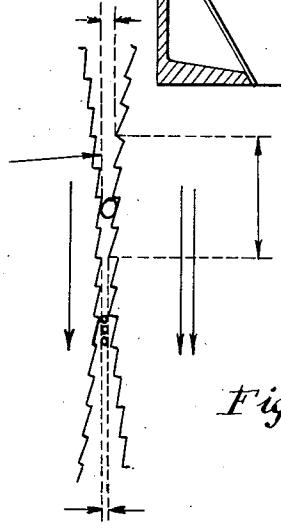


Fig.6.

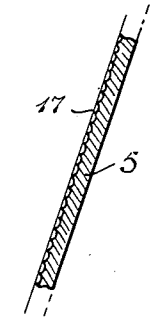


Fig.2.

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Fig. 3

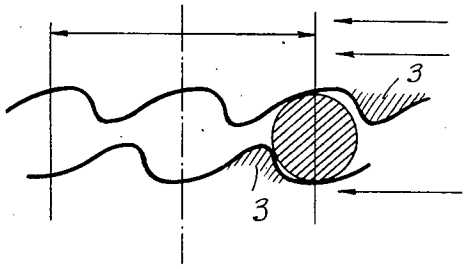


Fig. 4

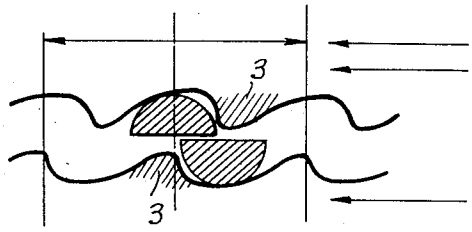


Fig. 5

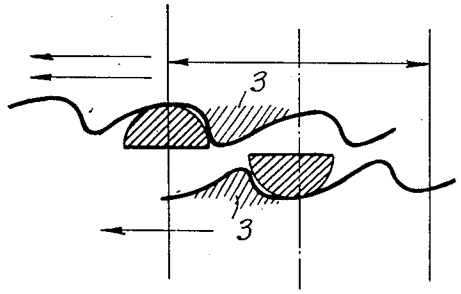


Fig. 7

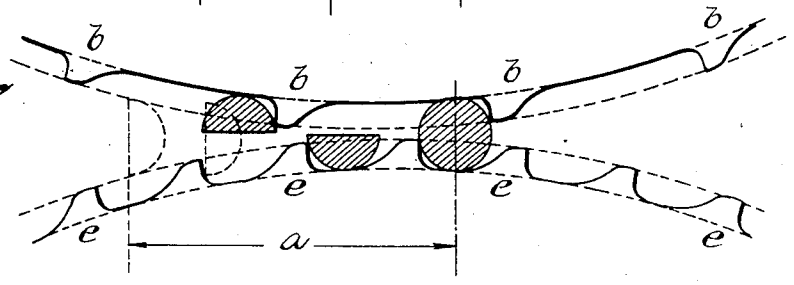
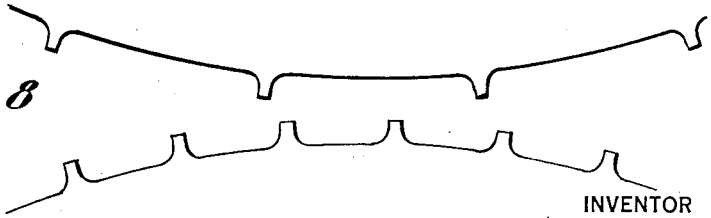


Fig. 8



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UNITED STATES PATENT OFFICE

JOSEF SCHAEFER, OF FRANKFORT-ON-THE-MAIN-BOCKENHEIM, GERMANY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO MIAG MUHLENBAU UND INDUSTRIE AKTIENGESELLSCHAFT, OF FRANKFORT-ON-THE-MAIN, GERMANY, A CORPORATION OF GERMANY

APPARATUS FOR GRINDING GRAIN INTO CRUSHED MALT AND THE LIKE

Application filed May 19, 1925, Serial No. 31,276, and in Czechoslovakia May 24, 1924.

As in other known apparatus for grinding grain so as to obtain crushed malt, the hulls are as far as possible separated in large pieces and in a form suitable for facilitating the separation or filtering processes in the brewery, so that the resulting product contains the largest possible portion of fine grist and the smallest portion of fine meal. Known methods are utilized in order to effect, by rolls placed at three different positions, first a coarse subdivision and then to separate the intermediate products, and convey them to two further pairs of rolls. Finally, the particles of the hulls are again generally mixed with the rest of the products of reduction. In particular, in the first reduction to smaller pieces the grains are cut into two parts about their longitudinal axis.

According to the invention, a single longitudinal division of the grain is first effected between fluted rolls and any further engagement of the cutting surfaces with the halved grains is avoided. For this purpose the grains must be accurately arranged as far as possible in the spaces between the cutting surfaces but this is not claimed herein. In order to avoid any further separation in the longitudinal direction and to enable the halved grains to pass out of the rolls without further division, a special formation and suitable determination of the diameters of the rolls are necessary, in order, with a given differential speed of the rollers, to avoid a second engagement of the cutting edges during the path of the grains through the rolls.

The invention also relates to the further working of the products of the first pair of rolls by the after pair of rolls and the relation of these to the first pair. The rolls of the second pair are spaced apart at a distance which is only a little less than the thickness of the half grains, and further prepares these grains by completely separating the kernels from the hulls, any further division of these hulls being avoided as far as possible, at least in their transverse direction. This is obtained by causing the halved grains to be arranged in the longitudinal direction as they are led to this pair of rolls and imparting between the rolls a more percussive action, which separates the hulls from the kernels without reducing them further than, at the most, to the dimensions of coarse grist, that is, a grist which passes through a sieve of square meshes with a width of opening of 1.27 mm. The distance apart of the smooth rolls can for this purpose be about 1 mm.

This coarse grist is then conveyed to a pair of finely fluted rolls of which the distance apart may, for example, be 0.2 mm. and the depth of the blades 0.4 mm. The coarse grist is led to the lower of these rolls and is usually distributed on it so that a grain lies in the recess between the cutting surfaces. With this assumption the peripheral speeds of both rolls and their dimensions are selected so that during the passage between the rolls three blade edges act on the coarse grist grain.

The general idea of the invention is, consequently, a mathematically calculated division of the processes of reduction over the three pairs of rolls in such a manner that the first pair of rolls effects only a longitudinal division of the whole grain in the transverse position, while, by the second pair of smooth rolls there is as far as possible only a separation of the hull from the interior of the grain and a breaking up of the interior of the grain into coarse grist by a percussive action on the longitudinally directed halved grains, so that in both processes the formation of fine meal and the reduction of the hulls, especially in the longitudinal direction, are as far as possible avoided, and the resulting coarse grist is then reduced by the finely fluted rolls as completely as possible to fine grist, while avoiding the formation of fine meal. The new process requires a novel installation of known apparatus with three pairs of rolls.

The invention also consists in the details described below:

In the accompanying drawings, Fig. 1 is a section through a roller frame.

Fig. 2 is a section on the line A—A of Fig. 1 through the chute to the pair of smooth rolls.

Figs. 3, 4 and 5 illustrate the action of the first pair of fluted rolls.

Fig. 6 illustrates the action of the last fluted rolls.

Figs. 7 and 8 show modified constructions of the flutings.

The grains are fed from a tiltable container 1' to a hopper 1 and over a feed roller 2, to fluted rolls 3, 3 and are here cut longitudinally. The products pass over a sieve 4 for separating the finest parts, and over a chute 5 to smooth rolls 6, 6. The products of this pass over a double sieve 7 which also receives the products from sieve 4. The upper sieve allows all coarse grist to pass, the lower only the fine meal, and conveys the largest parts, that is the hulls, to a container 8 and the fine meal to a container 9, while the coarse grist passes to the fluted rolls 10, 10 and as fine grist to a container 11. The sieves 4 and 7 are provided, respectively, with shoes 12 and 13 having supporting arms 14. Adjacent ends of these arms are pivotally joined by a link 15 oscillated by a crank 16 to reciprocate said sieves, said crank being operated from any suitable source of power, not shown.

The following considerations apply to the construction and speed of rotation of the dividing rolls: If referring to Figs. 3, 4 and 5 it is assumed that the mean thickness of the grain is 4 mm., the depth of the grooves 1.5 mm., and the distance apart of the rolls at the cutting edges of the blades 1 mm., and, with regard to the necessary strength of material of the cutting surfaces, the spacing apart of these surfaces at 5.4 mm., if further a differential speed of the rolls is assumed to be in the ratio of 1:2, as indicated in Fig. 1, a complete division of the grain will be effected with certainty if the quicker moving blade edge passes over a spacing of the other roll. This will be the case if the periphery of the upper roll is advanced by two spacings and that of the lower by one spacing. In order to prevent a repeated engagement of the cutting edge after the division of the grains, the space between the rolls must be sufficiently large to allow the halved grains to fall out.

It has been found that with the assumed relations a roll diameter of 100 mm. complies with this requirement. If a different relation of the peripheral speed of the rolls is selected, or if grains of a different size are to be crushed, the relations must be correspondingly modified.

Figs. 3–5 show the stages of the cutting and separation of the halved grain. Obviously, it assumes an average condition, since all grains are not of the same size and do not all lie with mathematical accuracy correctly in the spaces between the cutting edges of the rolls.

If the path over which a complete cutting process is effected on a grain is called the working path, this would, therefore, amount to two spacings or 10.8 mm.

The halved grains now arrive at the sieve 4 and fall on the chute 5 which is provided with longitudinal ribs 17 which correspond to half the thickness of the grain and in which the halved grains are arranged in their longitudinal direction and are conveyed to the smooth rolls 6, 6.

With the above-mentioned relations of the size of the grains, we can assume the average thickness of a half grain to be about 3 mm. The smooth rolls usually run at the same peripheral speed and their distance apart for the above-mentioned thickness of the grains is about 1 mm. It has been found that with these conditions any superfluous destruction of the halved grains by pressure and too complete reduction in size are avoided, if the diameter of the rolls is assumed to be 100 mm. Essentially only a coarse grist is then produced by the smooth rolls.

The coarse grist on its way to the fine fluted rolls 10 is passed through a sieve of square openings of 1.27 mm. width. If we assume 1.2 mm. to be the practical size of the particles, we arrive at a blade spacing of about 1.25 mm. and with a distance apart of the rolls of 0.2 mm. to a blade depth of 0.4 mm., if a grain of 1.2 mm. mean diameter is to lie in the space between the bladings. Between these rolls a three-fold engagement of the blade edges with the grist grains is preferable. If the speed relation between the two rolls is assumed to be 1:2, as indicated in Fig. 1, the working path will be about 7.5 mm. and in order to obtain this the diameter of the rolls must be also 100 mm. As regards the sieve, it has been found that sieves with short, very rapid shaking movement are most suitable.

It is found that for ideal relations, that is for a mathematically exact correspondence between the dimensions of the grains and the formation of the blading, and the mathematically exact disposition of the grains in the spaces between the blades of the first rolls, every other blade of the upper roll has no work to do and, consequently, can be omitted. This economy in the manufacture of the upper roll has also the important advantage that the intermediate blade edges operate disadvantageously, since they may cause a further-pressing or cutting action on the halved grains which had been already divided, and this drawback is obviated by halving the number of blades. Also, for the same reason by this omission the distance apart of the two rolls can be somewhat reduced and the cutting action can more closely approach the mathematical ideal. This doubling of the distance apart of the two blades on the roll is only one example of a general principle. If the diameter of the rolls or the peripheral speeds are modified, as should preferably be the case in the treatment of different kinds of grain, the distance apart of the upper recesses should be correspondingly modified in dependence on

the peripheral speed, since, according to the invention, it is only necessary to comply with the condition that while the grain is moving between two rolls, there should be no second action on the grain or grain halves, and this result is dependent simply on the relation of the peripheral speeds of the two rolls, which should be such that, during the whole time in which the grain and its halves are held between the two rolls, two edges of the blades should pass one another once but not twice, and act on the grain or its half. To comply with this condition it is advisable to indicate more definitely the so-called working path. This path is the direction at right angles to the line connecting the two centres of the rolls, and from the first seizure of the whole grain passes between two blades to the point at which the cutting edges of the blades of the two rolls are removed to a distance from one another corresponding to the largest transverse diameter of the divided grains, that is, to the point in which the halved grains are no longer held between two blades, but are allowed a free path between them and, consequently, pass out freely from the working path owing to the tangential speed of the rolls and their own weight. Obviously, this exact relation cannot be mathematically determined. If that were done, one end of the working path must begin at the place in which the bottoms of the recesses between the blades are separated from one another by the diameter of the grain, and the other end of the path must be at the place at which the cutting edges of the blades are separated by this distance, since the greatest diameter of the half grains is that of the diameter of the uncut grain, namely that at the cutting surface. Practically, however, this distance apart of the blades and therewith also the working path can be smaller, since the grain as it flies freely through the air can rotate so as to adapt itself to this distance and usually the half grain lies on the bottom of the recess and not on the cutting edge of the blades.

In Fig. 7 a relation between the two peripheral speeds of 1:2 is assumed and practically useful length of the working path indicated, and it is seen that this length depends also on the diameters of both rolls. The line *a* gives the length of the working path. The teeth or blades *b* of the upper roll are spaced twice as far apart as the teeth *e* of the lower roll. The recesses between the different teeth may also in this case be freely shaped and adapted to different conditions. The teeth *b* and *e* seize the grain at the commencement of the working path and cut it at the centre of the path and the halves of the grain leave at the end of the working path. The full lines show the ideal position of the grains, while the dotted lines show the most unfavourable position of the halved grains.

If the depth and spacing of the blades are arranged according to the above principles, there is the further advantage of the invention that more scope is given in the formation of the blading and its improvement in other directions made possible.

Fig. 8 shows a form of blading which has the following advantages: It is more easily manufactured on account of its simpler and symmetrical form, the thickness of every blade is itself smaller and more blades can, consequently, be applied to a roll of given diameter. The blades have two sharp edges, so that after one edge has become blunt, by turning the roll over the other edge can be used before they need be resharpened.

Having thus described the nature of my said invention and the best means I know of carrying the same into practical effect, I claim:—

1. In an apparatus for grinding grain, the combination of a pair of bladed cutting rolls, the blades of which operate to cut the single grains longitudinally into halves, a sieve to which the products are fed from said cutting rolls, a pair of smooth rolls at one end of said sieve and distanced a space a little less than the thickness of a halved grain, another sieve receiving the products from said smooth rolls, a second pair of bladed rolls to which particles are fed from the smooth rolls and having their blades rotated at different speeds so that said blades act more than once on every particle of the grain produced by said pair of smooth rolls, and means for diverting portions of the products from the first named sieve past said smooth rolls and on to the second named sieve.

2. Apparatus for grinding grain comprising a pair of rolls for cutting each grain into halves, a second pair of smooth rolls for separating the hull and reducing the kernel to coarse grist, and a third pair of fluted rolls for converting the coarse grist into fine grist, combined with means for sieving portions of the products before and after passing the second pair of rolls and sieving other portions of the products so as to pass the same through only the third pair of rolls after leaving the first pair.

3. Apparatus for grinding grain comprising a pair of rolls for cutting each grain into halves, cutting blades on said rolls, the peripheral speed of the rolls being such that the halved grains are ejected freely from the recesses between the blades of the rolls, a second pair of rolls for separating the hull and reducing the kernel to coarse grist, and a third pair of rolls for converting the coarse grist, into fine grist, combined with means for sieving portions of the products before and after passing the second pair of rolls and sieving other portions of the products so as

to pass the same through only the third pair of rolls after leaving the first pair.

4. Apparatus for grinding grain comprising a pair of rolls for cutting each grain into halves, a second pair of smooth rolls for separating the hull and reducing the kernel to coarse grist, a third pair of fluted rolls for converting the coarse grist into fine grist, and a sieve located between the second and third pairs of rolls by which the coarse grist is separated from the hulls and from the fine meal, and means for feeding certain particles from the first rolls on to said sieve without said particles passing through said second rolls.

In testimony whereof, I have signed my name to this specification at Frankfort-on-the-Main, Germany, this 30th day of April, 1925.

JOSEF SCHAEFER.