March 15, 1927. 1,621,409

H. HORN

MANUFACTURE OF COCOA, CHOCOLATE, AND THE LIKE

Filed Nov. 19, 1925

Fig. 1.

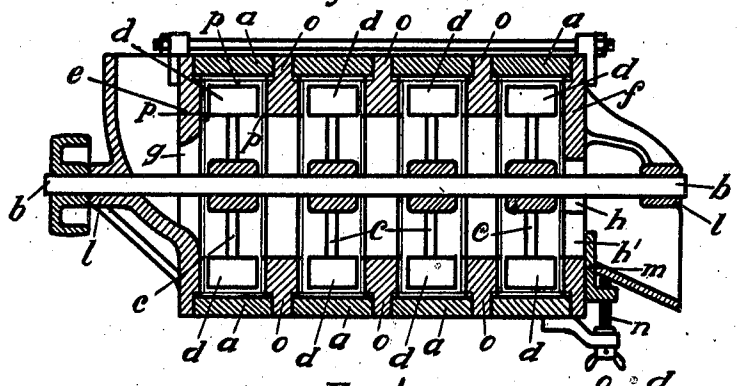


Fig. 2.



Fig. 3.



Fig. 4.

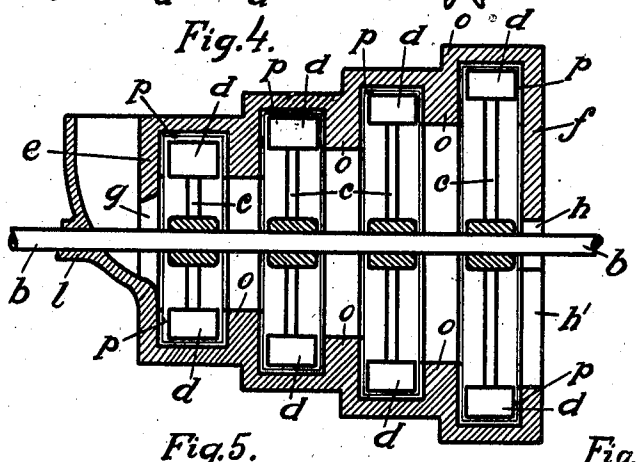


Fig. 5.

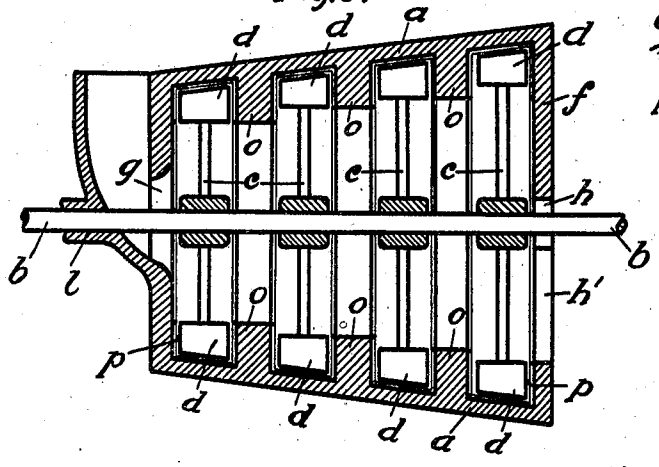
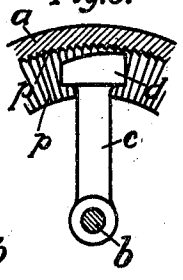


Fig. 6.



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UNITED STATES PATENT OFFICE.

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MANUFACTURE OF COCOA, CHOCOLATE, AND THE LIKE.

Application filed November 19, 1925, Serial No. 70,166, and in Germany October 22, 1924.

This invention relates to a beater mill with beaters revolving in chambers enclosing them, which are only open inwardly, for the disintegration and extra fine comminution of pasty and liquid materials.

The object of the present invention is to render those beater mills in which the beaters revolve in chambers surrounding them and open only inwardly and which hitherto have only been designed and only usable for the disintegration of hard material, capable of being used for the continuous disintegration and extra fine comminution of pasty and liquid materials, such as chocolate and cocoa. For hard material the walls of the chambers enclosing the beater heads must be provided with deep corrugations or ribs, against which the material is thrown. If it were desired to utilize this apparatus for pasty and liquid material, the latter would be thrust by centrifugal force for the most part into the large gaps between the ribs or the deep troughs of the corrugations and would be withdrawn from the action of the beaters. Hence only a low output could be obtained.

Now according to the invention a maximum output is to be obtained even when working up pasty and liquid materials, by surrounding the beater mill so closely by the continuous or unperforated chamber walls constructed as retarding and rubbing surfaces, that the material practically cannot escape from the beaters, so that the layers of material on the one hand driven round by the beaters and on the other hand held fast by the chamber walls, grind one another away in a manner known in itself, with continual renewal. This grinding action, and with it the output, are further increased according to the invention by the fact that the beater heads, besides a head surface ascending in the direction opposite to the direction of rotation, also have lateral surfaces converging in the direction of rotation, so that the layers of material driven round by them are continually thrust against those that are being held back by the walls of the chamber, and the grinding pressure is thereby increased.

The material is continually delivered in the usual way at the inlet, and can only pass out of the grinding chamber in an inward direction against the action of centrifugal force in a very finely disintegrated condition. The operation is therefore continuous. Coarser particles cannot leave the grinding chamber, because they are driven by centrifugal force towards the outer periphery and thereby retained in the chamber until finely ground.

Preferably however the beater mill is constructed not with one grinding chamber only but in a plurality of stages in a known manner, in which case the material travels through successive beater stages from the inlet to the outlet. Under these circumstances it is important that at the outlet only very fine and extra fine material should be able to pass out as a final product. On this account according to the invention the multi-stage beater mill is constructed with a horizontal beater shaft, and the outlet aperture for the material is arranged in the wall of the casing at the level of the beater shaft, and extends downwards therefrom, being adjustable by means of a slide. If only extra fine material is to pass out, the slide is almost closed, because the finest material of all is located near the shaft, where the centrifugal force is least. By opening the slide to a greater or less degree the material can be caused to leave the apparatus at the desired degree of fineness.

In the accompanying drawings various constructional forms of the invention are illustrated, with a horizontal beater shaft, wherein according to the invention the discharge aperture for the material in the wall of the casing is arranged at the level of the beater shaft, and is extended adjustably downwards by means of a slide. If only extra fine material is to be discharged the slide is almost closed, because the extra fine material takes up a position close to the shaft, where the centrifugal force is least. By opening the slide to a greater or less extent the material can be caused to leave the apparatus with any degree of fineness required in a particular case.

Figure 1 is a longitudinal section through a multi-stage apparatus, Figure 2 a side elevation and Figure 3 a plan view of a beater head, and Figures 4 and 5 are longitudinal sections of modified forms of the multi-stage apparatus, and Figure 6 shows a beater in side elevation with a portion of the casing partly in section.

In the constructional form shown in Fig. 1 in longitudinal section in a cylindrical cas-

ing *a* on a rapidly rotating shaft *b* a number of beating arms or crosses *c* are mounted next to one another. The casing *a* is provided with end walls *e* and *f* having axial inlet and outlet openings *g* and *h* for the material. On the end wall *e* is a hopper *i*, in the end wall *f* a chute *k* and the end walls also support the bearings *l* for the shaft *b*. The axial outlet opening *h* in the end wall *f* has a radial downward extension *h'* and is regulable by an adjustable slide *m*, for instance by means of a screw spindle *n*. The screw spindle *n* is rotatably but not slidably supported in the usual manner in the arm *g* on the casing, so that by rotating it in one direction or the other the slide *m* traversed by it in a screw-threaded hole is pushed up or down, for the purpose of diminishing or increasing the area of the discharge aperture *h'*. Axial displacement in the arm *g* is prevented by a collar *s* on the screw spindle *n* and the claw-shaped head of the spindle. Within the casing are disc-shaped, tight fitting partitions *o*, which are provided on both sides with rubbing surfaces *p*. Similarly the cylinder walls between the partitions and those between the latter and the end walls *e* and *f* and the insides of the end walls, over which the heads *d* of the beaters sweep, are formed as rubbing surfaces *p*. The said surfaces of the hammer heads converge in the direction of rotation and their end surfaces are made so as to incline upwards in the opposite direction to the direction of rotation, as is shown in Figures 2 and 3 in side elevation and plan view, so that when the beaters rotate, the material is forced against the rubbing surfaces *p* surrounding and embracing the beater heads to both sides and towards the outside against the wall of the casing by the rubbing action of the beater heads. The material entering at *q* is caught by the beaters lying nearest to it and is driven round along the rubbing surfaces *p* with great velocity, the material forced into the rubbing surfaces and held back by the same against the action of centrifugal force forming stationary grinding surfaces against which, as already described above, the revolving layers of material grind superficially.

As fresh material is fed in, the material travels in the axial direction from beater to beater towards the outlet being gradually disintegrated down to the finest state where it emerges through the outlet opening *h*, *h'*. As at the outlet end the coarser particles, owing to their greater centrifugal force, are driven away from the shaft, experience has shown, that only the most finely disintegrated material is in the neighbourhood of the shaft. Hence, if only the opening *h* around the shaft is left unobstructed, only the finest ground material will pass out. The coarser material cannot reach the outlet opening, but will remain so as to be subjected to further treatment. Hence, when the correct amount of fresh material is fed in and the apparatus is of the correct capacity continuous working will produce a continuous outflow of the very finely disintegrated, finished material, the separating out of the coarser constituent parts by the action of centrifugal force being far better and more thorough than by sifting devices. If the material which has been worked through in one apparatus is to pass through further similar apparatus for the sake of being further disintegrated, it may leave the apparatus in a less fine state. In this case the slide *m* is opened more or less according to requirement, whereby the opening *h'* is left more or less unobstructed. But even in this case the operation is an uninterrupted one.

If for certain reasons, in accordance with certain requirements with respect to the material, it is desired to pass the material more rapidly through the apparatus, the beaters and their heads may at the same time be given the form of axially conveying means or be provided with such.

A good and uniform axial conveyance of the material may also be obtained by the cylindrical casing being widened in steps or conically from the inlet to the outlet, as shown in Figures 4 and 5. In this case the diameters of the beaters increase correspondingly. During the onward conveyance of the material from step to step or gradually in the case of a conical casing the velocity of movement and consequently the centrifugal force which drives the material in the direction of the increasing diameter of the apparatus increases. In this case the forward drive is automatic and positive and depends on the differences in diameter.

The arrangement may also be such that cylindrical and conical or stepped casing parts succeed each other and for certain masses where it is important for the material to be made particularly fine, stages of the largest diameter may be followed by stages of a smaller diameter, so that the finest particles of the mass in the neighbourhood of the shaft are at the end again subjected to a vigorous treatment. In this case the beaters and their heads over the smaller diameters should be constructed as conveying means or be provided with conveying means.

Instead of being made with a horizontal axis, as shown in the drawings, the apparatus can be made with a vertical axis. When the form is cylindrical or when it increases the diameter towards the bottom, the fresh material is fed in from the top.

When the diameter increases from the bottom to the top, the material will have to be fed in from the bottom, as in this case the weight of the material itself cannot, as in the former case, cause the gradual forward feed

to the outlet, but this will be better effected by the increasing centrifugal force in opposition to the weight of the material.

In any case the apparatus which is in itself simple and takes up little space may be adapted easily and accurately in a simple manner to all conditions and the building up of the casing from separate rings and interposed partitions, indicated in Figure 1, allows of the parts to be made by mass production and therefore cheaply and being put together in true alignment, so that by using the bearing parts any required apparatus can be put together and delivered in the shortest time. When cocoa beans are to be treated in the apparatus, there should be placed in front of the first beater stage a roughing-mill of the known kind, the revolving grinding disc of which is also fixed on the beater shaft. The first beater stage will then receive the roughly broken beans for being further dealt with.

What I claim is:

1. A beater mill for the disintegration and extra fine comminution of pasty and liquid materials, comprising rotatable beaters, and chamber walls enclosing said beaters and only open inwardly, the internal surfaces of said chamber walls being formed as retarding and frictional surfaces, said walls uninterruptedly surrounding the beaters so closely that the material under treatment is prevented from escaping from the action of said beaters, and the head surfaces of the beaters rising in the direction opposite to the direction of rotation and the lateral surfaces of said beaters converging in the direction of rotation, for the purpose of driving the layers of material that are being carried round by the beaters against the layers of material that are being retarded by the chamber walls and thereby increasing the grinding pressure.

2. A beater mill for the disintegration and extra fine comminution of pasty and liquid materials, comprising a horizontal rotatable shaft, rotatable beaters mounted on said shaft, and chamber walls enclosing said beaters and only open inwardly, said chamber walls being arranged to form a plurality of successive beater stages, and the internal surfaces of said chamber walls being formed as retarding and frictional surfaces, said walls uninterruptedly surrounding the beaters so closely that the material under treatment is prevented from escaping from the action of said beaters, and the head surfaces of the beaters rising in the direction opposite to the direction of rotation and the lateral surfaces of said beaters converging in the direction of rotation, for the purpose of driving the layers of material that are being carried round by the beaters against the layers of material that are being retarded by the chamber walls and thereby increasing the grinding pressure, an inlet for the admission of material to the first beater chamber, an outlet for the discharge of material from the last beater chamber, said outlet being arranged in the end wall of said chamber at the level of the shaft and extending downwards therefrom, and an adjustable slide for partially closing said outlet.

In testimony whereof I have signed my name to this specification.

HEINRICH HORN.