

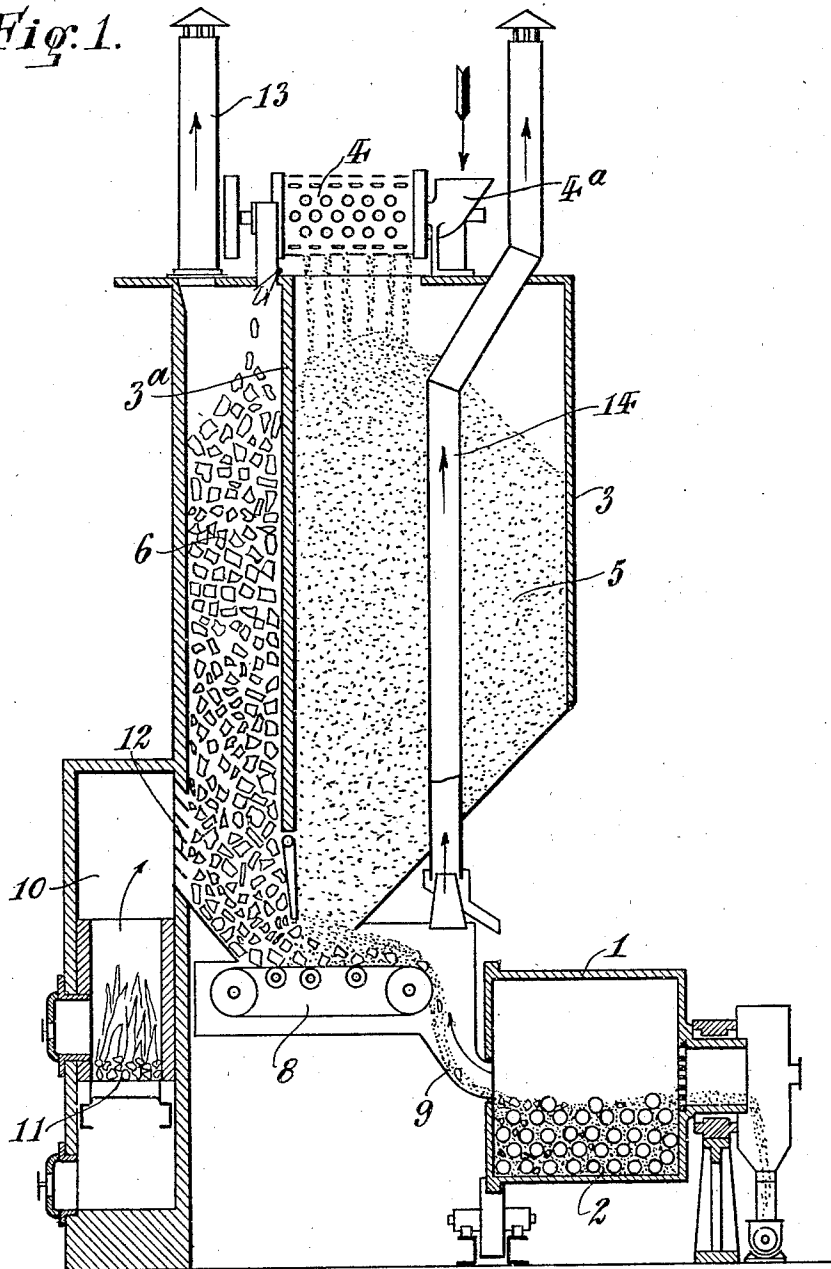
J. S. FASTING.
GRINDING IN BALL MILLS.
APPLICATION FILED MAR. 15, 1921.

1,394,294.

Patented Oct. 18, 1921.

2 SHEETS—SHEET 1.

Fig. 1.



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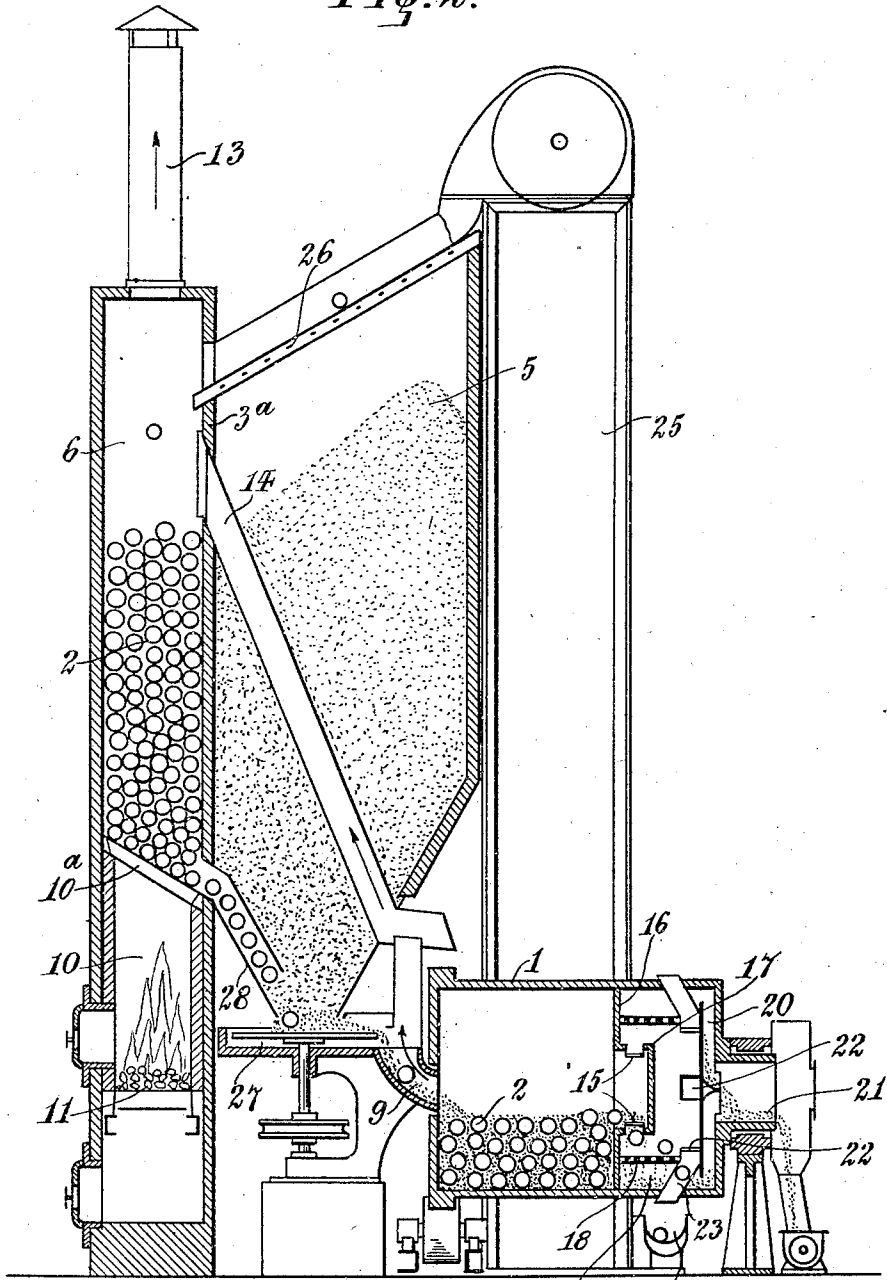
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Fig. 2.



19
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UNITED STATES PATENT OFFICE.

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GRINDING IN BALL-MILLS.

1,394,294.

Specification of Letters Patent.

Patented Oct. 18, 1921.

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To all whom it may concern:

Be it known that I, JOHAN S. FASTING, a subject of the King of Denmark, residing at Frederiksberg, near Copenhagen, Denmark, have invented certain new and useful Improvement in Grinding in Ball-Mills, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

In the grinding in ball mills of certain materials, such as peat and lignite, which carry an appreciable amount of moisture or dampness, the operation of grinding is oftentimes attended with considerable difficulty. Sometimes the particles of the material being ground stick together and the mass becomes more or less plastic, and therefore difficult to reduce to the desired degree of fineness, instead of being brittle and frangible. The grinding therefore requires much time and a large consumption of power. The preliminary driving off of the moisture by drying the material, as a separate operation, in a drier, also involves consumption of power and time. Furthermore, when the charge for the grinding mill consists of a mixture of relatively coarse bodies (whether grinding bodies or the larger pieces of the material to be ground) and relatively fine bodies or particles, the finer particles fill the voids between the larger bodies and so prevent the necessary intimate contact of the dry and heated air with all parts of the mass. In the development of the present invention it has been found that the difficulties can be largely overcome by separating the larger bodies (whether grinding bodies or the larger pieces of the material to be ground), from the charge for the grinding mill, heating the larger bodies before their introduction into the grinding chamber and then mixing the larger bodies with the finer particles in or on their way toward the grinding chamber. The larger bodies themselves, because the voids between them are not filled by the finer particles, permit the circulation of dry and heated air throughout the mass, thereby losing a large portion of the moisture, while the larger bodies are themselves heated and thereafter give off their heat when mixed with the finer particles in the grinding mill and thereby the drying of the finer particles, as they are brought in contact with the surfaces of the heated larger bodies, is facilitated. Ob-

viously it is immaterial, in the practice of the method, whether the larger bodies of the charge to be introduced into the grinding mill are of the same material as the finer particles and the separation is effected before any part of the whole mass enters the grinding chamber, or the larger bodies are the grinding bodies themselves and are separated from the finer particles as they leave the grinding chamber. In either case the larger bodies, after their separation from the finer particles, are themselves dried and heated by the circulation of dry, heated air through the mass, and are then mixed with the finer particles on the way to or in the grinding chamber, there giving off their absorbed heat and effecting the drying of the finer particles.

In the accompanying drawings, in which are illustrated two apparatus adapted for the practice of the invention, Figure 1, is a view in vertical section of an apparatus in which the bodies heated are the larger bodies of the material to be ground and Fig. 2 is a similar view of an apparatus in which the bodies to be heated are the grinding bodies themselves.

Referring first to the construction shown in Fig. 1 it will be seen that a grinding mill is somewhat conventionally represented at 1, the usual grinding bodies which, with the material being ground, make up the charge of the grinding chamber, being shown at 2. Preferably above the grinding mill is a vertical bin 3, which may be divided by a vertical partition 3^a to form in juxtaposition two vertical shafts or bins or chambers, one of which receives the finer particles, as at 5, while the other receives the larger bodies, as at 6. Above the two bins is represented, also somewhat conventionally, a rotary separator 4 into which, through a suitable hopper 4^a, is discharged the material to be ground, comprising a mixture of larger bodies and smaller bodies or particles. By means of such a separator the larger bodies are separated from the smaller bodies, the smaller bodies passing into the shaft or bin 5 where the larger bodies are discharged into the shaft or bin 6. From the two bins the larger bodies, after being dried and heated as hereinafter described, and the smaller bodies pass to the grinding chamber, being shown in the present instance as passing from the bins or shafts upon a belt conveyer

8, and thence, through a chute 9, into the grinding chamber 1, in which, with the grinding bodies 2, they form what is known as the charge of the grinding mill.

5 The larger bodies in the bin or shaft 6 are dried and heated and as the voids between them permit a free circulation of heated air through the mass, the drying and heating can be effected conveniently by the hot products of combustion from a furnace 10, 11 which may be admitted through a damper or grated opening 12, directly into the shaft 6, finally escaping therefrom through a suitable stack 13, at a lower temperature and with the moist vapors driven off from the bodies in the shaft or bin.

During the grinding in the mill the dry and heated larger bodies are broken up and reduced, along with the finer bodies, to the desired degree of fineness. While mixed with the finer bodies in the mill they separate and prevent amalgamation of the still moist finer bodies and at the same time give up their absorbed heat to such finer bodies and so facilitate the driving off of the moisture from the finer bodies, permitting the grinding of the entire mass to be accomplished in a comparatively short time and with a minimum consumption of power. The vapors driven off from the finer particles in the grinding drum carry considerable heat and in order that they may be drawn off quickly from the grinding chamber and that at the same time their heat may be utilized, they may be led off through a flue 14, which passes up through the shaft or bin 5, the contents thereof being thus somewhat warmed.

In the practice of the invention with the apparatus shown in Fig. 1, the larger bodies heated themselves form originally part of the mass to be ground and the separation of the larger bodies from the smaller bodies is conveniently accomplished above the bins 5 and 6, the separate constituents of the mass passing by gravity from the separator into the respective bins or shafts. In the practice of the invention with the apparatus shown in Fig. 2 it is assumed, however, that the material to be ground is of such a character that there are in it no relatively large bodies which retain their shape sufficiently to permit them to be heated as already described and that the grinding bodies 2, which form part of the charge in the mill, are themselves to be heated before they enter the mill. The separation of the grinding bodies from the already reduced material can be effected conveniently in the mill itself or during the discharge of the grinding bodies and ground material from the mill, the ground material passing to a suitable receptacle, while the grinding bodies are elevated and discharged into the bin or shaft to be heated. As shown in Fig. 2, the two

bins or shafts 5 and 6, separated by a partition 3^a, are adapted to receive, the one the material to be ground, and, the other, the grinding bodies 2. The latter may be heated, as before, by the products of combustion from a suitable furnace 10, 11, the same passing through a grate 10^a directly into the bin or shaft 6. The products of combustion, having given up most of their heat to the grinding bodies 2, pass off eventually through the stack 13.

From the bins 5 and 6 the material to be ground and the grinding bodies are discharged together, through a chute 28, upon a rotary mixing disk 27, from which they are discharged through a chute 9, into the grinding mill 1. The vapors given off in the mill may be conducted, as before, through a flue 14 in the bin or shaft 5, and eventually pass off through the stack 13.

In this case the grinding bodies, which have absorbed heat in the bin or shaft 6, serve the same purposes as already described with reference to Fig. 1, namely, to separate the finer bodies or particles to be ground and to give up to them their absorbed heat, whereby the finer particles are prevented from amalgamating and are made to lose their moisture.

The separation of the ground material from the grinding bodies may be accomplished by any suitable means, as commonly practised in the art. As shown in Fig. 2 the grinding bodies and the ground material pass from the grinding chamber through openings 15 in a cylinder secured to the partition wall 16 and closed at its end, as at 17. From the openings 15 the grinding bodies and material pass together upon a cylindrical sieve 18, through which the ground material passes into an annular chamber 19, being eventually discharged therefrom by devices commonly employed in the art and indicated at 20 and 21. The grinding bodies roll from the sieve 18 through radial tubes 23 into an external trough 24 and are raised by a suitable elevator, sufficiently indicated at 25, and discharged from the upper end thereof into the bin or shaft 6. As a matter of convenience the material to be ground may also be raised by the elevator, with the grinding bodies, and the mixture of grinding bodies and material discharged upon a sieve 26, through which the material to be ground falls into the bin or shaft 5 while the grinding bodies themselves pass into the bin or shaft 6.

It will be obvious that the advantages of the invention can be realized in various forms of apparatus, constructed to suit the particular conditions of operation, the larger bodies of the mill-charge (whether grinding bodies or the larger pieces of the material to be ground) being heated by any convenient means, separately from the mois-

ture-bearing finer bodies or particles and mingled therewith in the grinding mill, so that such finer bodies are prevented from amalgamating and are heated and dried through contact with the heated larger bodies, while the grinding of the material is carried on. The separation of the larger bodies from the finer bodies or particles, the mingling of the heated larger bodies and the finer bodies and the transfer of the larger bodies and finer bodies to the grinding chamber of the mill can also be accomplished by means well known in the art.

It will be obvious that the advantages of the invention can be realized in various forms of apparatus, constructed to suit the particular conditions of operation, the larger bodies of the mill-charge (whether grinding bodies or the larger pieces of the material to be ground) being heated by any convenient means, separately from the moisture-bearing finer bodies or particles and mingled therewith in the grinding mill, so that such finer bodies are prevented from amalgamating and are heated and dried through contact with the heated larger bodies, while the grinding of the material is carried on. The separation of the larger bodies from the finer bodies or particles, the mingling of the heated larger bodies and the finer bodies and the transfer of the larger bodies and finer bodies to the grinding chamber of the mill can also be accomplished by means well known in the art.

I claim as my invention:

1. The improvement in grinding moisture-bearing material containing larger bodies and finer bodies in ball mills which consists in heating separately the larger bodies of the mill-charge, mingling the heated larger bodies and the moisture-bearing finer bodies in the grinding chamber, heating and drying the finer bodies through contact with the larger bodies and carrying on the grinding.

2. The improvement in grinding moisture-bearing material containing larger bodies and finer bodies in ball mills which

consists in separating the larger bodies of the mill-charge from the moisture bearing finer bodies, heating separately the larger bodies of the mill-charge, mingling the heated larger bodies and the moisture-bearing finer bodies in the grinding chamber, heating and drying the finer bodies through contact with the larger bodies and carrying on the grinding.

3. The improvement in grinding moisture-bearing material in ball mills which consists in heating separately from the material to be ground the grinding bodies of the mill-charge, mingling the heated grinding bodies and the moisture-bearing finer bodies in the grinding chamber, heating and drying the finer bodies through contact with the heated grinding bodies, and carrying on the grinding.

4. An apparatus of the character described comprising a grinding chamber, means for separating the larger bodies of the mill-charge from the moisture-bearing finer bodies thereof, means for heating the larger bodies separately from the finer bodies, and means for delivering the heated larger bodies and the moisture-bearing finer bodies to the grinding chamber.

5. An apparatus of the character described comprising a grinding chamber, two bins to receive respectively the larger grinding bodies of the mill-charge and the finer bodies thereof, means to heat the larger bodies in the one bin, and means to deliver the heated larger bodies and the finer bodies from their respective bins to the grinding chamber.

6. An apparatus of the character described, comprising a grinding chamber, means to separate the larger bodies of the mill-charge from the finer bodies, two bins to receive respectively the larger bodies and the finer bodies, and means to deliver the larger bodies and the finer bodies from the respective bins to the grinding chamber.

This specification signed this 12th day of February, A. D. 1921.

JOHAN SIGISMUND FASTING.