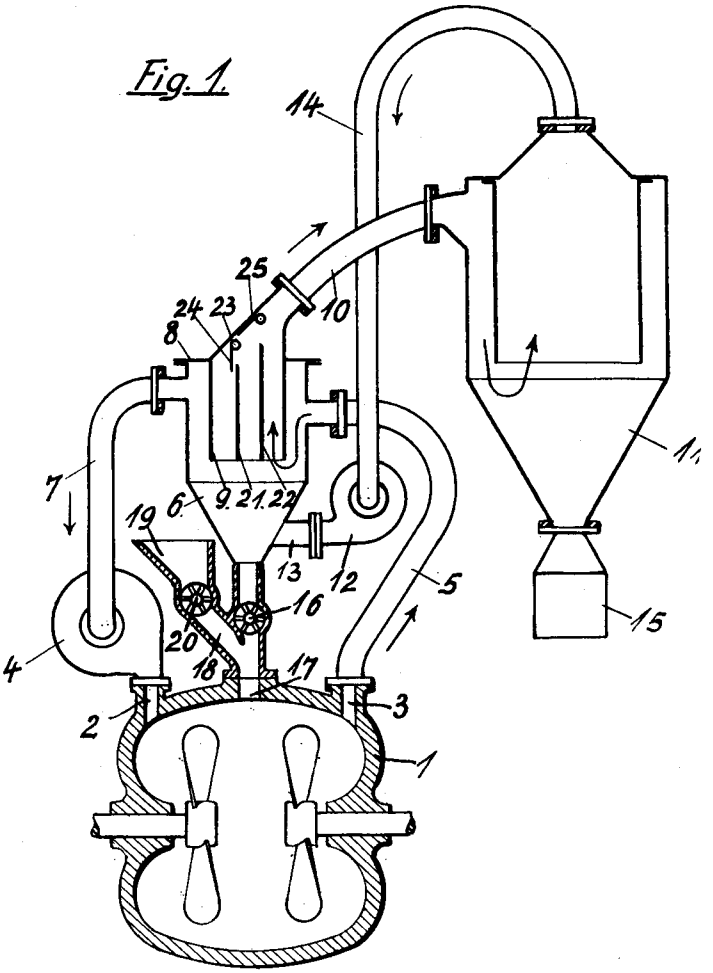
Feb. 23, 1932. E. KRAMER 1,846,209

SEPARATOR

Filed June 2, 1928 2 Sheets-Sheet 1

Fig. 1.



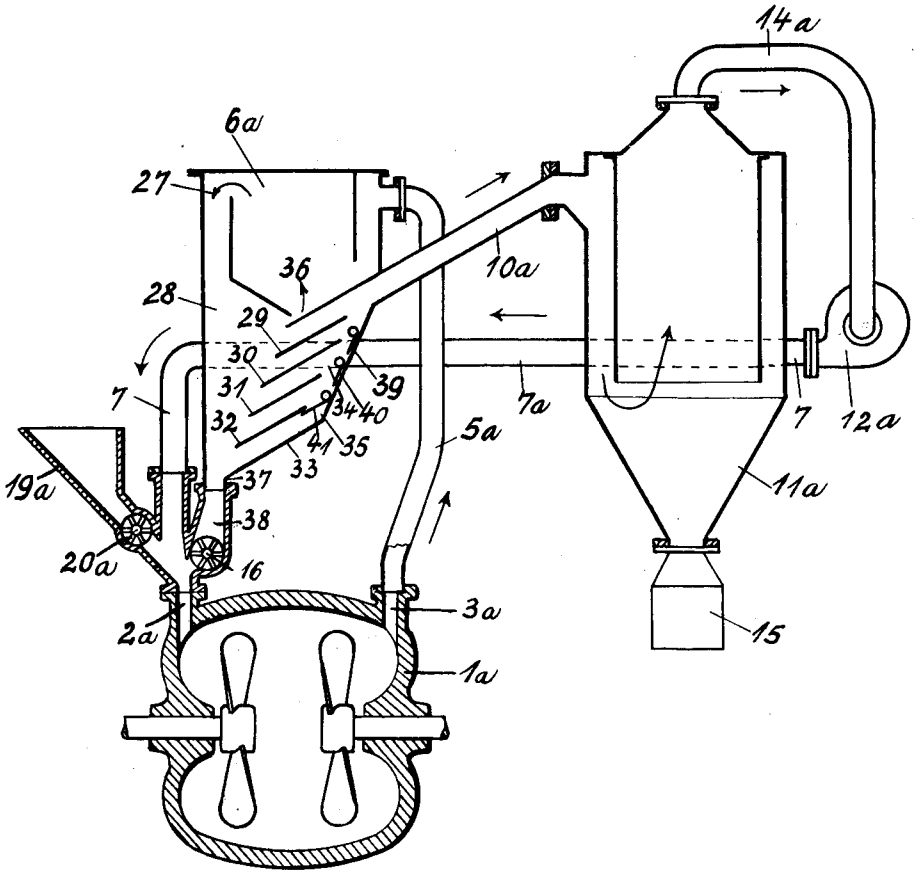
Inventor:
Erwin Kramer
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Filed June 2, 1928 2 Sheets-Sheet 2

Fig. 2.



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Patented Feb. 23, 1932

1,846,209

UNITED STATES PATENT OFFICE

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SEPARATOR

Application filed June 2, 1928, Serial No. 282,332, and in Germany June 2, 1927.

My invention relates to a method of, and an apparatus for, operating mills in which the material ground in the mill proper is conveyed out of the same by a blast and is then sifted in a preliminary separator or fore-sifter from which the not yet sufficiently ground material is conveyed back into said mill.

With the old apparatus of this type the fineness of the sifting in the fore separator or sifter is influenced greatly by the intensity of the blast used for conveying the ground material out of the mill. When the blast is throttled, the material conveyed out of said sifter is finer, and reversely.

My invention starts, in contradistinction to what has just been stated, from the idea to make the sifting of the material in the fore separator practically independent of the intensity of the blast coming from the mill, and to regulate it also independently, whereby the quality of the product is improved and the entire procedure is rendered more economic.

Every mill grinds most economically when the already sufficiently comminuted material is conveyed completely out of the mill immediately after the desired degree of fineness has been attained so that it does not remain in the mill and constitutes therein an undesired ballast which, besides, has a detrimental effect upon the comminution of the other particles of the material. On the other side however, it is also known that when the mill is blown out a considerable portion of the material which has not yet been reduced to the desired fineness is also conveyed out of the mill. The more intense the blast is, the larger is the amount of material conveyed unintentionally out of the mill, and the more difficult is it to separate it from the other particles in the fore separator. Furthermore, however, in the old apparatus referred to, the degree of fineness of the powder leaving the fore-separator is diminished when the blast is intensified, and the necessity has, therefore, arisen to adjust the blast in such a manner that the fore separator separates the material just at that point of time when its fineness is that desired. The drawback of this procedure is, however, that the complete removal of the sufficiently comminuted material is rendered questionable. Finally, the attempts to separate the fine particles and the coarse ones to a sufficient degree in the fore separator have not been successful, because, sufficiently comminuted material was conveyed back from the fore separator into the mill.

Now, the present invention enables sufficiently comminuted material to be conveyed out of the mill practically completely without any detrimental detainment thereof in the mill, and to improve materially at the same time the separation of the coarse particles from the fine ones within the fore separator. These effects are attained by regulating the blast used for the sifting in the fore separator independently of the intensity of the blast used for conveying the material out of the mill. This blast can, in this way, be kept at such a degree of intensity that the sufficiently comminuted material is conveyed out of the mill within practical limits instantly after the comminution has been effected, whereas from out of the fore separator only those particles are conveyed which have attained the desired degree of fineness.

Another useful effect is this that the separation of the fine particles from the coarse ones can be carried out far more perfectly in the fore separator. The too long detainment of the sufficiently comminuted material in the mill whereby with many kinds of material the form of the grain is affected in an undesired way, or the properties of the grains are changed by heat, is considerably shortened. Finally, a comminution beyond the desired degree or fineness is prevented.

The invention is particularly important in connection with mills in which the feed opening and the discharge opening cannot have any desired size. In such mills the sifting in the mill by means of the conveying blast can be dispensed with without impairing the fineness of the material drawn from the fore separator.

My improved method can be carried out by means of such apparatus as are shown diagrammatically by way of example on the accompanying drawings, on which Figure 1 is a side-view, partly in section, of one embodi-

ment, and Figure 2 a side-view, also partly in section of another embodiment.

In Fig. 1, 1 denotes the casing of the mill proper, and 2 and 3 are passages in the top of the same. The passage 2 communicates with a blower 4 which in turn communicates with a pipe 7 whereby the blower is connected with a cyclone 6. Also the passage 3 is connected with said cyclone by a pipe 5. The cyclone is the above mentioned fore separator. In other words, the fore separator is designed as a cyclone. The blast passes through the above-mentioned parts of the apparatus in this direction: 4, 2, 1, 3, 5, 6, 7, 4. From the cover plate 8 of the fore separator is suspended a casing 9 which is open at its bottom, and of rectangular transverse section, and connected at its top with a pipe 10. This pipe terminates in another cyclone 11, from the top of which extends a pipe 14 to another blower 12 connected by a branch 13 with the lower part of the cyclone or fore separator 6. The direction of the blast produced by this blower is as follows: 12, 13, 6, 9, 10, 11, 14, 12.

The comminuted material contained in the mill is conveyed out of this latter by the blast of the blower 4 through the passage 3 and the pipe 5 into the fore separator 6 in which it falls into the hopper-shaped lower part of the same where the particles are encountered by the blast produced by the blower 12. The already sufficiently comminuted material, i. e. the sufficiently fine particles, are carried away by the second blast up into the casing 9 and through it and the pipe 10 into the cyclone 11 in which latter the fine particles of the material are separated from the blast and collected in a vessel 15, whereas the blast passes back to the blower 12.

That part of the material which has not yet been sufficiently comminuted and, therefore has not been carried upward by the blast of the blower 12 into the casing 9 falls through a rotary conveying or feeding member 16 back into the mill casing 1 through a passage 17. The casing enclosing said member 16 is made integral with a branch 18 and a feed hopper 19, and another rotary feed member 20 is arranged between the parts 19 and 18, as shown. The hopper 19 may always contain a certain store of the material to be comminuted in the mill.

The casing 9 (in the top of the fore separator 6) is subdivided into three passages or channels by two vertical partition walls 21 and 22, and above these channels are flaps 24 and 25 hinged to the oblique top plate 23 of the casing 6. In Fig. 1 the flap 24 is in its closed position, whereas the flap 25 is open. It is obvious that the blast can pass now only through two of the three channels, and if also the flap 25 were closed, the blast could flow only through one channel, viz. that on the righthand side of the casing 6. Instead of closing the other channels, or one of them, viz. that on the left, at the upper end, the closure may be effected also at the lower end by appropriately otherwise arranged flaps or the like. I prefer, however, the embodiment shown in the drawings in that no particles can collect on the thus arranged flaps.

The intensity of the blast produced by the blower 4 can be regulated or varied either by varying suitably the number of revolutions of the blower, or by means of throttling flaps (not shown) or by both means. This having been effected, the intensity of the air currents passing through the channels of the casing 6 is determined by the flaps 24 and 25 which can be closed or opened or partly opened just as suited in the given case. The sifting of the material or particles carried away out of the mill is determined by the velocity of the air current or currents flowing through the casing 9, i. e. through the channel or channels of the same, as the case may be; more precisely, the speed of the air when entering into said channel or channels is the decisive feature for the degree or fineness of the sifting. If the speed of the air at that place or at those places is high, also coarser particles are carried upward and through the casing 9, whereas otherwise only finer particles are conveyed through it to the cyclone 11.

It appears from the above explanation of the arrangement and combination of parts that it is possible to adjust or determine the fineness of the particles conveyed into the tube 10 independently of the velocity of the conveying blast passing through the tube 5, and the particles conveyed to and into the cyclone 11 are the finer, the more the flaps 24 and 25 are open, and reversely. By opening or closing the flaps, or the corresponding channels respectively, the sectional area of the casing 9 is correspondingly altered, and it is altered just where the sifting chiefly takes place, viz. in the sifting zone proper, without acting thereby upon the amount of the material conveyed away from the mill. The finer the particles are which are carried away, the larger is, therefore, the sectional area of the sifting zone, and the sifting can be carried out the more carefully and in a better manner.

In the simplified construction shown in Fig. 2 only one blower 12^a connected at one side by a pipe 7^a with the feed hopper 19^a and on the other side by a pipe 14^a with the cyclone 11^a which is of the same design as in Fig. 1. The mill 1^a is provided with two passages 2^a and 3^a, of which 2^a establishes a communication with the feed hopper 19^a and the pipe 7^a, and 3^a establishes a connection with the pipe 5^a, the upper end of which communicates with the fore-separator 6^a. A chamber 28 provided in the casing enclosing the fore-separator is connected with the cyclone 11^a by the pipe 10^a. The way of the

blast is, thus, as follows: 12^a, 7^a, 2^a, 1^a, 3^a, 5^a, 6^a, 28, 10^a, 11^a, 14^a, 12^a.

The dimensions of the fore separator 6^a are such that the entire amount of the comminuted material conveyed into it is separated from the blast and falls down upon the oblique bottom 36 of the separator, whereas the air passes through a channel 27 into the chamber 28 in which are provided a plurality of oblique, step-wise arranged plates 29, 30, 31, 32 lying between the bottom 36 of the fore-separator and the oblique bottom 33 of the chamber 28. At its lower end 37 this chamber communicates with a casing 38 made integral with the hopper casing and communicating also with the channel 2^a of the mill casing 1^a. 16^a and 20^a are rotary feed members corresponding to the rotary feed members of Fig. 1.

The space between the bottoms 36 and 33 is subdivided into passages or channels by the plates 29—32, and the lower three of the five passages or channels can be closed at will or as may be necessary by flaps 39, 40, 41 whereby it is rendered possible to vary the sectional area between the bottoms 36 and 33. The particles dribbling down from the bottom 36 to the lower portion of the plate 29 and further to the lower portions of the plate 30, 31 and 32 are subjected during this time to the action of the blast passing from the chamber 28 into the pipe 10, and those particles which the blast cannot carry away with it through the passages between the oblique plates fall down into the casing 38 from which they are conveyed back into the mill by means of the rotary feed member 16, whereas the other particles are conveyed into the cyclone 11 in which another separation takes place, as has already been described with respect to Fig. 1. The finished product is collected in the vessel 15.

In view of the size of the sectional areas as existing in the apparatus as actually built for practical use the velocity of the blast passing through the mill and the pipe 5 in order to convey the material into the fore-separator 6 is only immaterially varied by the opening or closing of one or more of the flaps 39, 40, 41. At any rate, opening a flap or the flaps means a diminution of the resistance which the passage presents the blast, that is to say, it means an increase of the speed of the air in the pipe 5 in spite of the increase of the fineness of the sifting carried out at the same time.

There is in this embodiment presented a separate zone for the sifting operation in a still better way than in Fig. 1, this zone being located at those places where the material slides down from the bottom 36 to the plate 29, from this to the plate 30, and so on, and it is obvious that the advantages claimed with respect to Fig. 1 are attained with the modification illustrated in Fig. 2 in a still higher degree.

The separation of the particles from the blast in the chamber or fore separator 6^a of Fig. 2 need by carried practically only so far that the blast passing from the fore separator into the chamber 28 does no longer contain coarser particles than are to be conveyed away through the pipe 10.

It is, of course, possible to choose another number of oblique plates, such as 29—32, and another number of flaps, such as 39—41. This depends upon the degree of fineness aimed at.

I wish it to be understood that I do not limit myself to all details shown in the drawings. There may be departures in the details without a departure from the essence of the invention.

I claim:

1. A separator for comminuted material comprising a casing having an outlet opening in an upper portion thereon, a pair of pipes connected at spaced points with said casing and adapted for connection at spaced points, respectively, with a container for comminuted material, a blower for producing a circulation of air through said container and said pipes and said casing whereby comminuted material is adapted to be conveyed from the container to the casing by the air, means within said casing dividing the portion of the same adjacent to said outlet opening into a plurality of individual passages leading to said outlet opening, and means for varying the effective cross sectional area of certain of said passages.

2. A separator for comminuted material comprising a casing having an outlet opening in an upper portion thereon, a pair of pipes connected at spaced points with said casing and adapted for connection at spaced points, respectively, with a container for comminuted material, a blower for producing a circulation of air through said container and said pipes and said casing whereby comminuted material is adapted to be conveyed from the container to the casing by the air, means within said casing dividing the portion of the same adjacent to said outlet opening into a plurality of individual passages leading to said outlet opening, and means for varying the effective cross sectional area of certain of said passages, the lower portion of said casing having an outlet opening adapted for connection with the container.

In testimony whereof I affix my signature.

ERWIN KRAMER.