Dec. 28, 1937. B. GRAEMIGER ET AL 2,103,454

IMPACT CRUSHER FOR COMMINUTING HARD MATERIALS

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Fig.1

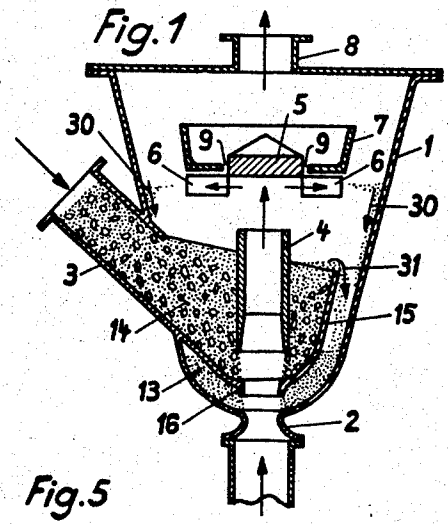


Fig.3

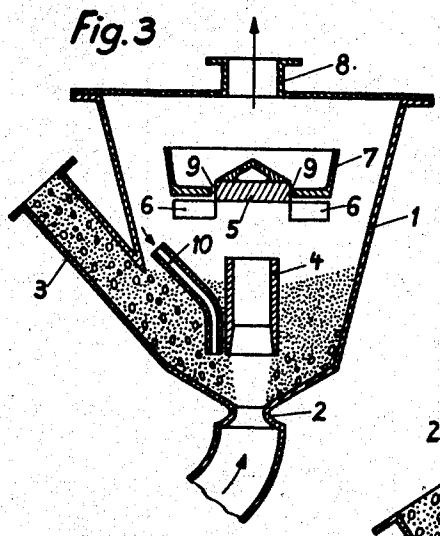


Fig.5

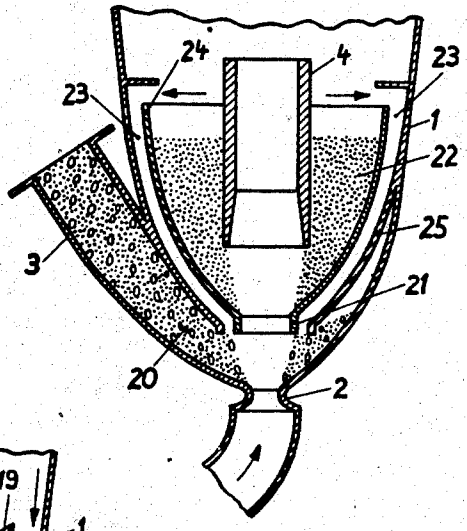


Fig.4

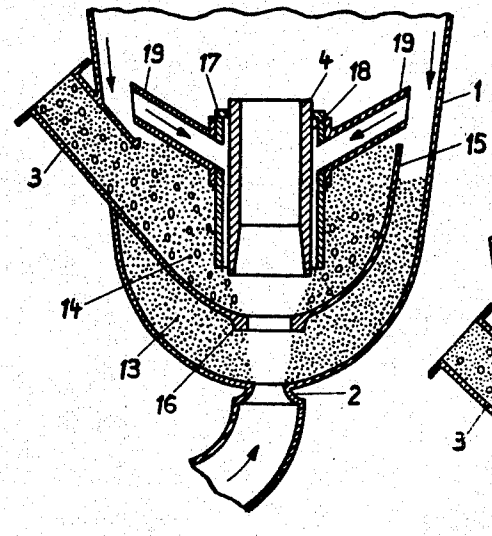
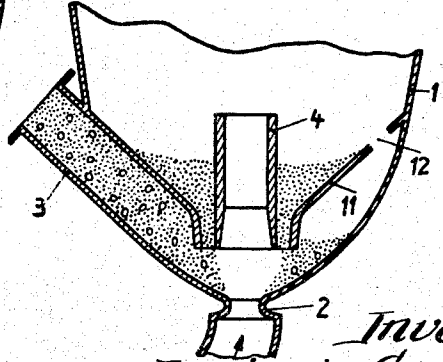


Fig.2



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IMPACT-CRUSHER FOR COMMINUTING HARD MATERIALS

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9 Claims. (Cl. 83—46)

The present invention relates to an impact-crusher for comminuting hard material, for instance coal to coal dust adapted to be used for coal-dust-firing of boilers and so on.

Impact-crushers are known in which the material to be pulverized is fed to the operative parts by a jet of compressed air, steam or gas. An automatic feed control is obtained by the effect of the circulating material which, after partial pulverization does not pass the separators or the like, but falls back and is deposited on the coarse raw material thereby retarding the feed of said coarse material which percolates the layer of raw material to be caught again by the jet of air or gas to be projected anew on to the crushing body.

Experience shows that the automatic feed control is not reliable if the raw material to be comminuted is already comparatively fine. The circulating material cannot percolate the raw material and cannot pass on to the jet, the latter feeding therefore only raw material. The deposit of circulating material increases; the working of the separator etc., is finally affected thereby and dust too coarse is produced. Some success in automatically controlling the input has been attained by adjusting the mixing tube-orifices or by regulating the feed in the entrance socket say by means of studs obstructing the flow of the raw material, but such emergency devices proved unsatisfactory as the rate of flow of the raw material alters continuously with its moisture contents. Such changes in the moisture and therefore in the rate of feed occur even in different layers of one and the same bunker of raw material. It is quite impossible to provide devices which control automatically and effectively the feed under varying conditions, to prevent an overflow or to obviate the idle running of the crusher.

The main object of the invention is to provide improved means to control the feed of raw material to the impact-crusher automatically and effectively even under the very worst conditions.

Another object of the invention is to prevent the idle running of the impact-crusher and to obviate at the same time the flooding of the same if the conditions improve.

To attain these and other objects, we provide an impact crusher having ducts or the like by which at least a part of the circulating material falling back from the separator is separately led back to the jet which projects the raw material to be comminuted by impact.

According to our invention at least a part of the circulating material is brought back to the acting jet quite independently of the amount and of the condition of the raw material to be projected by the jet, and also independently of the moisture content and the coarseness of the raw material.

In a preferred construction of the new impact-crusher we pass at least part of the circulating material rejected by the separator separately to the gas jet when it leaves the expansion-nozzle. By this arrangement the gas jet is loaded by the circulating material as soon as it leaves the expansion nozzle, thereby regulating its capacity to accept other raw material according to the amount of circulating material. The raw material to be fed to the jet may be stored in a central space surrounded by an outer space which is used to pass on all or part of the circulating material to the gas jet. A division wall between the inner space for storing the raw material and the outer chamber for the circulating material may be shaped to serve as part of the mixing tube. For instance, it may be shaped to form a nozzle.

The mixing tube may be subdivided in such a manner that one of the subdivisions receives raw material and the other circulating material. The circulating material passes unimpeded through the raw material to the second part of the acting gas jet. The circulating material influences the inflow of raw material owing to its effect on the gas jet.

It has been ascertained that the raw material is being introduced into the mixing tube by being drawn round the inflow-edge of the mixing tube. A great influence is to be attributed to the air in the interstices of the loosely heaped raw material. If there is a large amount of air the inflow of raw material is facilitated by the suction action of the gas jet. An interconnection by a duct or the like between the space in which the circulating material is deposited and the zone in which the inflow of the raw material into the mixing tube is effected may have a controlling influence in a double sense: as long as the layer of deposited circulating material does not reach the entrance orifice of such a duct only air will pass therethrough, which facilitates the inflow of raw material into the mixing tube. If on the contrary the layer of deposited circulating material reaches the entrance of said duct, the amount of air passing therethrough is reduced and the inflow of circulating material increased. More circulating material is being fed into the mixing tube and less raw material. The circulating material falling back prevents the inflow of raw mate-

rial and the back flow of additional circulating material which automatically sets in has a controlling effect.

The duct may be used as an additional controlling device which may be brought to action when the mixing tube is subdivided.

In the drawing we have shown several embodiments of our invention.

Fig. 1 shows in sectional elevation in a diagrammatical manner an impact-crusher in which the raw material is arranged in a central space surrounded by a space to receive the circulating material.

Fig. 2 shows in sectional elevation part of another impact crusher in which the heavier circulating material is returned to a duct having the shape of a funnel surrounding the mixing tube.

Fig. 3 shows in sectional elevation in a diagrammatical manner an impact-crusher in which the circulating material passes at least partly through the raw material by returning to the acting jet, separate controlling means being shown to interconnect the collecting space of the circulating material with the inflow of the mixing tube.

Figs. 4 and 5 show in a diagrammatical manner and in sectional elevation part of an impact-crusher with different forms of return ducts for the circulating material.

All the impact-crushers shown in the drawing comprise a casing 1, an expansion nozzle attached to the supply pipes for compressed fluid, such as air, gas and so on. All crushers shown comprise further an inflow 3 for the raw material and a mixing tube 4 through which the compressed fluid and the material to be comminuted pass, an impact body 5 against which the raw material to be pulverized is thrown, a separator 7, and an outflow socket 8 for the discharge of the compressed fluid loaded by the pulverized material. The filter or separator 7 is provided with a number of slots 9 which interconnect the space above the separator 7 and the space below the same. Within the casing 1, in the form shown in Fig. 1, a substantially conical division wall 15 is arranged which is adapted to receive the raw material being fed by the inflow 3. The space 14 within the wall 15 is filled with raw material. The annular space 13 between the wall 15 and the casing 1 is adapted to receive the circulating material, that is such material which cannot pass the separator 7 and which is guided back by the vanes 6. Within the wall 15 at the lowest point thereof, a tubular part 16 is arranged which runs concentrically to the nozzle 2. The said part 16 may be shaped to form a nozzle. Moreover it forms part of the mixing tube 4 which is arranged within the space 14 concentrically to the nozzle 2. Between the parts 4 and 16 there is an annular opening through which raw material may pass from the space 14 to the jet of air expanding in the nozzle 2. Moreover an annular open space is provided between the parts 2 and 16 through which annular opening circulating material may enter the jet of gas passing through the mixing tube 4 on to the impact body. The device works as follows:

The compressed air or gas or steam expands in the nozzle 2 and projects the raw material and the circulating material through the mixing tube 4. The raw material is crushed by impact on the body 5, but some pulverizing of the raw material already takes place within the mixing tube 4, owing to the friction and the impact of the particles of the raw material and the circulating material on each other. Some very coarse particles are thrown back by the body 5. Smaller particles are brought by the air stream along the vanes 6 to the separator 7. The vanes are set oblique, so as to give the stream of air a certain rotational movement. Such particles too coarse to pass the separator are led back into the space 13 as shown by arrow 30. Within the separator a second filtering action takes place and particles not having passed the finer meshes return by the slots 9. Most of the circulating material passes to the space 13 and from said space 13 through the annular slot into the jet, passing through the nozzle 2. The jet of expanded air takes moreover additional raw material from the space 14. The raw material is fed through the inflow socket 3, according to the amount of pulverized material passing through the outflow 8. The angle at which the socket 3 stands agrees with the kind and the coarseness of the raw material to be treated.

Part of the circulating material which is deposited on the raw material in the space 14 percolates the said material and passes mixed with the raw material proper on to the open slot between the parts 4 and 16, where it is taken off by the jet. If circulating material is deposited in the space 14 in excess to its capacity it flows over into the space 13 as shown by arrow 31. Practical results have shown that the greater part of the circulating material passes along the inner wall of the casing 1 into the space 13. The mixing tube 4 may be mounted adjustably in axial direction. By altering the position of the mixing tube the slot by which the raw material enters the jet of expanded air is widened or narrowed and more or less raw material may be caught by the air jet while the inflow of circulating material is not altered at all. The feeding of the material in equal amounts along the whole circumference of the jet will give a very high efficiency to the air jet.

The impact pulverizer as shown in Fig. 2 comprises a central division wall 11 which is provided with at least one opening 12. The wall 11 is provided with a circular flange running concentrically to the lower face of the mixing tube 4, an annular slot being left between the parts 4 and 11 by which circulating material may pass into the opening between the nozzle 2 and the mixing tube 4. The raw material is fed through the chute 3. It spreads around the said flange portion of the division wall 11 in such a manner that raw material is fed into the jet equally from all sides. Circulating material may pass through the opening 12 into the raw material space and is deposited on the raw material therein. The mixing tube may be mounted adjustably in its axial direction in order to vary the width of the annular entrance slots for the raw material to be projected.

The construction of the device shown in Fig. 3 differs from that shown in Fig. 1 in that the division wall 15 is done away with and circulating material, that is all the particles which have been rejected by the separator 7, 9 are deposited on the top of the raw material flowing in by the socket 3. At least one pipe 10 is provided, the lower end of which is adjacent the lower face of the mixing tube 4. The upper end of the pipe 10 projects a certain amount above the level of the raw material within the casing 1. The jet of expanded air ejected by the nozzle 2 sucks air through pipe 10. The air sucked in by the

pipe 10 facilitates the introduction of raw material into the jet, the air stream loosens the raw material. As soon as sufficient circulating material has been deposited on the raw material, such circulating material will enter the upper entrance of the pipe 10. The air circulation through pipe 10 will be reduced. The flow of air through pipe 10 and in the same measure the inflow of raw material into the jet will be less. Moreover circulating material is taken up by the jet in an increasing manner. An automatic control of the material projected against the impact body 5 is attained thereby. If the amount of circulating material is increased the inflow of raw material is decreased and so on. The pipe 10 might be shaped in any suitable manner. It may have the shape of a funnel and act similarly to the part 11 described with reference to Fig. 2.

The construction of the device shown in Fig. 4 is similar to that shown in Fig. 1. On the mixing tube an outer concentric mantle 17 is arranged. With the space 18 of annular cross-section communicate two pipes 19. The upper free ends of the pipes 19 are at a certain distance from the wall 1 and outside the upper edge of the division wall 15. The lower end of the outer wall 17 ends just above the lower face of the mixing tube 4. A jet issuing from the nozzle 2 sucks air through the pipes 19. The deposit of circulating material may grow so far that such circulating material is sucked in by the pipes 19. The controlling action of the said circulating raw material is the same as described with reference to the pipe 10 of Fig. 3.

The device shown in Fig. 5 comprises within the casing 1 a second cup-shaped container 24 in which the circulating material is collected. Between the parts 1 and 24 a space 23 is left forming a duct through which circulating material 22 flows downwardly as soon as material in the container 24 overflows. The container 24 is provided at its lower end with an opening arranged concentric to the nozzle 2 and the mixing tube 4 projecting into the said container 24. The partition wall 25 is provided with an opening which forms together with the wall of the container 24 and the casing 1 a duct 23. The duct 23 forms an annular orifice concentric to the circular flange 21 of the container 24. The jet issued by the nozzle 2 has a sucking effect and draws air from the space above the mixing tube 4. The air drawn in loosens the particles of the raw material 20 and facilitates their flow into the jet. As soon as the container 24 is full the excess of the circulating material 22 flows in the direction of the arrow to the duct 23 downwardly and enters the jet. Also raw material 20 will now enter the jet. The controlling action of the circulating material comes now again in force as described with reference to Figs. 3 and 4. An annular ring may be arranged above the upper orifice of duct 23 to lead the circulating material into the container 24.

Extensive trials have proved the efficiency of such an automatic controlling device. Comminuting devices of the type described show the most uniform working. The supply of the mixture of air and the pulverized material may be graded by adjusting the separator within very wide limits. If the separator is set once the mixture is uniform under any condition.

It will be understood that in practice various changes in the form, proportion and the minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention. For instance, other separating devices may be combined with the comminuting device, the ducts may be arranged outside the casing 1 and the means to introduce the circulating material into the jet may be placed in the centre of the nozzle 2 near the narrowest cross-section thereof. The circulating material may be introduced coaxially to the expansion nozzle 2. The inflow of raw material may be effected from 2 or 3 different bunkers, and so on.

Having described our invention, what we claim is:—

1. A comminuting device comprising a casing adapted to receive a bed of raw material to be comminuted, a feed inlet for said raw material, a nozzle for forcing a stream of gas at high velocity into said casing and in contact with said raw material to entrain the particles of said material, means in said casing for separating the finer from the coarser and heavier entrained particles, an outlet for conducting the finer material entrained in said gas from said casing, and a passage extending from a section slightly above the bed of raw material to a section adjacent to the outlet of said nozzle for conducting at least a portion of said separated coarser particles separate from said raw material and to a point adjacent to the outlet of said nozzle.

2. A comminuting device, including a casing having an inlet for raw material to be pulverized, an expansion nozzle having an inlet for a gaseous fluid under pressure, a mixing tube having its inlet spaced from the outlet of said nozzle and below the normal level of the raw material in said casing, whereby said raw material may enter said jet and be delivered thereby through said mixing tube, an impact body, a separator, and means for conducting coarse particles rejected by the separator to a point between the outlet of said nozzle and the inlet of said mixing tube independently of the down flow of the raw material, for reintroduction into the jet.

3. A comminuting device, including a casing having an inlet for raw material to be pulverized, an expansion nozzle having an inlet for a gaseous fluid under pressure, a mixing tube having its inlet spaced from the outlet of said nozzle and below the normal level of the raw material in said casing whereby said raw material may enter said jet and be delivered thereby through said mixing tube, an impact body, a separator, a compartment within said casing for receiving coarse particles rejected by the separator, and an opening leading from said compartment for delivering said coarse particles between the outlet of said nozzle and the inlet of said mixing tube separate from and out of contact with the raw material.

4. A comminuting device as defined in claim 3 in which the compartment encircles the raw material in the casing, and said compartment has a delivery opening concentric with the nozzle orifice.

5. A comminuting device, including a casing having an inlet for raw material to be pulverized, an expansion nozzle having an inlet for a gaseous fluid under pressure, a mixing tube having its inlet spaced from the outlet of said nozzle and below the normal level of the raw material in said casing, whereby said raw material may enter said jet and be delivered thereby through said mixing tube, an impact body, and a separator, said casing having separate compartments

for the raw material and the coarse particles rejected by said separator, said compartments having separate outlet openings directly leading into the space between the outlet of the nozzle and the inlet of the mixing tube.

6. A comminuting device, including a casing having an inlet for raw material to be pulverized, an expansion nozzle having an inlet for a gaseous fluid under pressure, a mixing tube having its inlet spaced from the outlet of said nozzle and below the normal level of the raw material in said casing, whereby said raw material may enter said jet and be delivered thereby through said mixing tube, an impact body, and a separator, said casing having a partition wall provided with an opening concentric with and disposed between the outlet of the nozzle and the inlet of the mixing tube, whereby said raw material and said coarse particles may separately enter the jet at spaced points along the length of the latter.

7. A comminuting device as defined in claim 6, in which the opening in said partition wall is in the form of a tubular conduit section.

8. A comminuting device as defined in claim 2, in which the conducting means includes a conduit leading from above the raw material through the latter to a point adjacent to the inlet of the mixing tube.

9. A comminuting device including a casing adapted to receive raw material to be comminuted, a nozzle for directing a stream of fluid under pressure at high velocity into said casing, a mixing tube having an inlet spaced from the outlet of said nozzle and disposed below the normal level of the raw material in the casing whereby said raw material may be entrained in the jet delivered from the nozzle to the mixing tube, an impact body in said casing, and means in said casing for receiving coarser and heavier particles delivered with the fluid from said impact body and returning them to the jet at a point between the outlet of the nozzle and the inlet of the mixing tube and independently of the downflow of the raw material, whereby said coarser particles are entrained by the jet, and the capacity of said jet for entraining raw material will vary with the amount of said separated coarser particles returned to it.

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