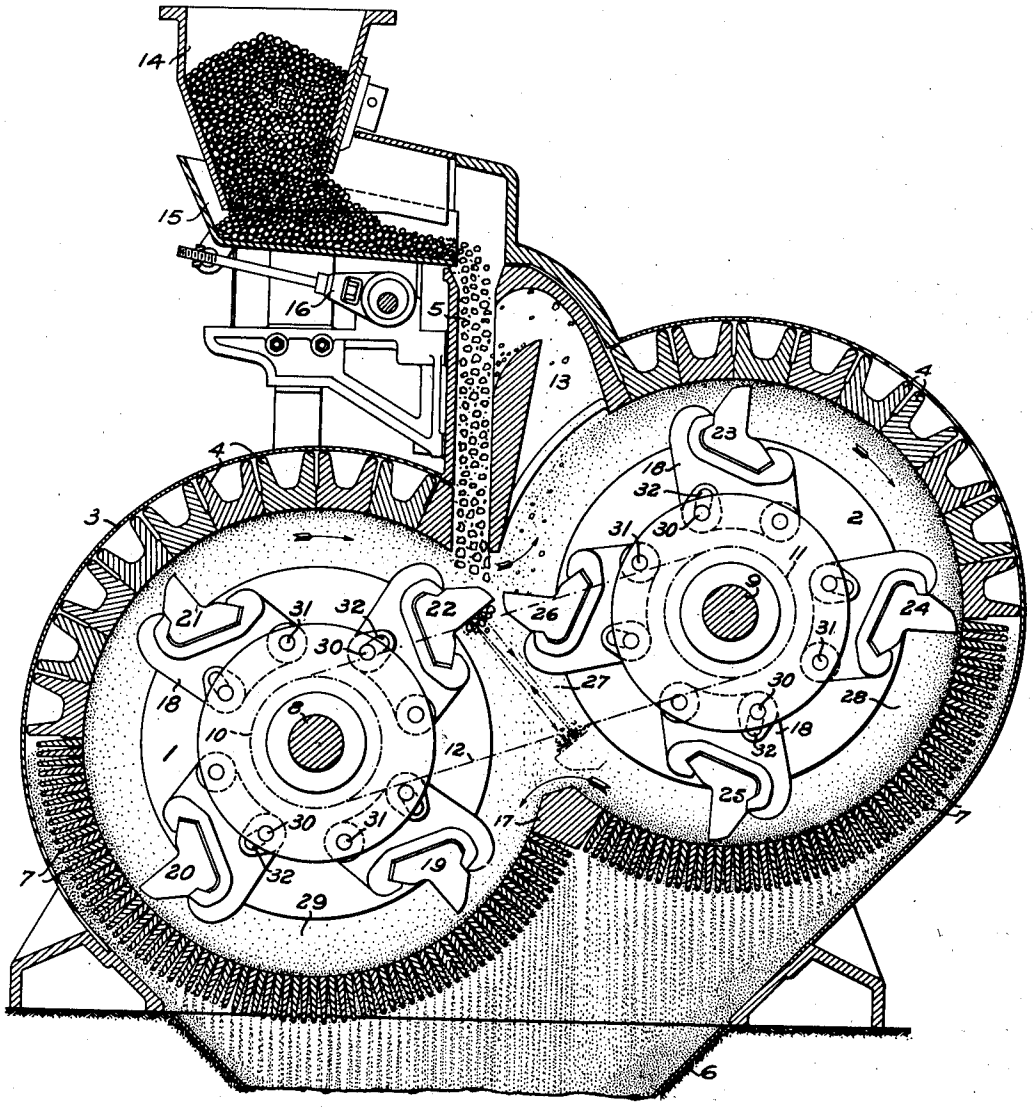
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ROTARY IMPACT PULVERIZER.

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ROTARY IMPACT-PULVERIZER.

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To all whom it may concern:

Be it known that I, CLIFFORD J. TOMLINSON, a citizen of the United States, residing at West Allis, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Rotary Impact-Pulverizers, of which the following is a specification.

This invention relates to improvements in the construction of rotary impact pulverizers of the type in which the material is reduced by impact with a plurality of revolving hammers.

An object of the invention is to provide a rotary impact pulverizer which is simple in construction and efficient in operation. One of the more specific objects is to provide an efficient rotary impact pulverizer of large capacity which is operable at relatively low speed. Another object is to provide a pulverizer in which wear on the elements is reduced to a minimum. A further object is to provide a pulverizer in which possibility of injury of the machine due to abnormal conditions of operation is reduced to a minimum.

These and other objects are accomplished by providing a pair of spaced rotors having opposed impact surfaces, with means for positively causing predetermined impact surfaces to coöperate for crushing. The rotors are caused to rotate in the same direction and have a pulverizing chamber or zone formed between them, which is maintained substantially free from air currents in order to eliminate interference with the pulverizing action. The pulverizing rotors are furthermore mounted in a novel manner in order to permit ready feeding of the material to the pulverizing zone. The pulverizer is also provided with means for returning the uncrushed material directly to the pulverizing zone, in order to confine the disintegration to the pulverizing chamber, and also to obtain a more uniform product at the discharge.

A clear conception of an embodiment of the invention may be had by referring to the drawing accompanying and forming a part of this specification in which like reference characters designate similar parts.

The single figure of the drawing discloses a central vertical section through a rotary impact pulverizer built in accordance with this invention.

The pulverizer comprises essentially a housing or casing 3 having the rotors 1, 2, mounted therein. The rotor 1 is secured to the horizontal shaft 8, while the rotor 2 is secured to the horizontal shaft 9, the shaft 9 being mounted somewhat above the horizontal plane of the axis of the shaft 8. The shafts 8, 9, are positively geared to rotate in the same direction by means of a suitable train of gearing comprising sprockets 10, 11, mounted upon the respective shafts 8, 9, and connected by means of a chain 12. Driving power may be applied to either one or both of the shafts 8, 9, by any suitable power means, not shown.

The rotor 1 comprises essentially a supporting element and a circular series of hammer supports 18 which carry hammers 19, 20, 21, 22. The hammer supports 18 are pivoted at their leading ends to the supporting element by means of pivots 31, and have their trailing ends provided with elongated slots 32 which embrace the pins 30, carried by the supporting element. The rotor 2 comprises a supporting element and a circular series of hammer supports 18 which carry hammers 23, 24, 25, 26. The hammer supports 18 are pivoted at their leading ends to the supporting element by means of pivots 31, and have their trailing ends provided with elongated slots 32 which embrace the pins 30, carried by the supporting element. The hammers 19, 21, of the rotor 1 are smaller than the hammers 20, 22, the smaller hammers 19, 21, having their extreme outer ends nearer the center of the shaft 8 than are the extreme outer ends of the larger hammers 20, 22. As disclosed, the rotors 1, 2, are so geared that the hammer 22 will always directly approach the hammer 25, while the hammer 25 will always approach the hammer 21, which in turn will always approach the hammer 24. The hammer 24 will always approach the hammer 20, which will approach the hammer 23, which in turn will approach the hammer 19. The hammer 19 will always approach the hammer 26, while the hammer 26 will always approach the hammer 22. It is not, however, essential to have the driving relation such that these specific hammers approach each other, it being necessary only to have the rotation of the rotors so timed that a hammer of one of the rotors will be passing through the pulverizing zone 27 at all times.

The casing 3 is provided along its upper portions with liners 4, and along its lower portions with discharge grates 7. The casing 3 forms annular chambers 29, 28, around the rotors 1, 2, respectively. The pulverizing zone or chamber 27 is formed between the rotors 1, 2, and due to the arrangement of the rotors with their axes in different horizontal planes, is slightly inclined relative to the vertical. An impact plate or anvil 17 is mounted in the casing 3 at the lower end of the pulverizing chamber 27. A feed inlet passage 5 has its lower extremity directed toward and into the upper end of the pulverizing chamber 27, and its upper extremity communicating with the discharge end of a reciprocable feed plate 15. The feed plate 15 is reciprocable by means of a suitable eccentric 16, and is adapted to convey the raw material from the feed hopper 14 to the feed inlet passage 5. A return passage 13 leading tangentially from the annular chamber 28 to an upper portion of the feed inlet passage 5 is adapted to automatically direct uncrushed material delivered from the pulverizing chamber 27 back into the inlet passage 5. The material discharged through the grates 7 is delivered by gravity from the casing 3 through a suitable discharge hopper 6.

During the normal operation of the device, the rotors 1, 2, are rotated in a clockwise direction as viewed in the figure, and produce a continuous current of air in the annular chambers 28, 29, flowing in the direction indicated by the arrows. The current of air flowing in the annular chambers 28, 29, causes a slight reduction in pressure in the pulverizing chamber 27 between the rotors 1, 2, and maintains the pulverizing zone relatively free from air currents. The raw material is fed from the hopper 14 to the feed inlet passage 5 by means of the reciprocating feed plate 15, and is delivered through the passage 5 by gravity. As the raw material drops from the lower extremity of the passage 5 into the path of the hammers, the large or feeding hammers 20, 22, successively approach and remove the material composing the projecting portion of the stream of inflowing material and hurl the same through the pulverizing chamber 27. As the material thus projected through the pulverizing chamber 27 reaches the lower end of this chamber, the opposed hammer on the rotor 2 advances and strikes the material causing a partial reduction thereof, and returning the partially reduced material upwardly through the pulverizing chamber 27. The partially reduced material upon reaching the upper extremity of the chamber 27 is struck by the next advancing hammer of the rotor 1 and is further reduced and again returned to the lower end of the pulverizing chamber 27. This course of events continues until the material is either reduced to a fineness permitting its withdrawal by the air current passing through chambers 28, 29, or until it is carried beyond the crushing chamber by one of the hammers of the rotor 2. If uncrushed material is carried beyond the pulverizing chamber 27 by a hammer of the rotor 2, centrifugal force will immediately act thereon and cause the same to pass upwardly through the passage 13 and back into the inlet passage 5. The fine material withdrawn from the chamber 27 is carried around the chambers 28, 29, and is eventually delivered from these chambers through the grates 7.

Due to the difference in size of the hammers 19, 21, and the hammers 20, 22, it will be noted that diversion of the stream of raw material to the pulverizing chamber 27 takes place only when the large hammers 20, 22, reach the stream of inflowing raw material. By making the hammers 19, 21, smaller in size, more raw material is permitted to advance into the path of the feeding hammers 20, 22, and a larger charge is admitted to the pulverizing chamber 27 at each feeding stroke. The smaller hammers 19, 21, are preferably made of such size, and the speed of rotation of the rotor 1 is preferably such that these hammers will entirely clear the lower extremity of the inflowing stream of raw material. It will be noted that with the arrangement disclosed, diverting of material to the pulverizing chamber 27 takes place twice for each complete revolution of the rotor 1. It should be understood however, that this feature is not essential and the hammers might be properly formed to permit feeding of more or less charges for each revolution of the rotor 1.

If for any reason the normally fixed phase relation of movement of the hammers should be destroyed so that the hammers of one rotor due to their overlap with those of the other rotor should strike, or if unbreakable substance should be dropped into the pulverizer through the inlet passage 5, the hammers upon being obstructed, or upon striking the unbreakable substance, would swing inwardly about their pivots 31, thus avoiding destruction of the rotary elements. It will be noted that by causing direct impingement of the material on the moving hammers and avoiding impact of the material directly with surfaces of the casing, excessive wear on the parts is eliminated and practically the entire wear is confined to the renewable hammers of the rotors. The only portion of the casing which may be subjected to direct impingement of the material thereon is the anvil 17. If any of the material projected through the pulverizing chamber 27 misses the advancing hammer of the rotor 2, it will strike against the anvil 17 and will rebound sufficiently to permit

the next advancing hammer or the rotor 2 to carry it into the pulverizing chamber for further reduction. The location of the rotor 2 at a higher elevation than the rotor 1, permits efficient feeding of the raw material with a minimum travel of the feeding hammers 20, 22, through the inflowing stream. It is desirable to have the feeding hammers cut the inflowing stream at right angles to the direction of flow of the stream; it is also desirable to have the material fed into the path of the feeding hammer at its point of entry into the chamber 27. The location of the feed inlet passage 5 as disclosed, causes the feeding hammers to cut the stream of raw material substantially at right angles, and also permits the feeding hammers to properly inject the raw material into the pulverizing chamber 27.

By employing two oppositely rotating rotors having opposed impact surfaces cooperating for crushing, the speed of rotation of the rotors may be reduced to a minimum. As a result of the reduction in speed, the abrasive action on the hammers resulting from cutting the stream of inflowing raw material and from urging material along the liners and grates of the casing 1, is also greatly reduced. The reduction of the large particles is accomplished entirely by impact with surfaces of the hammers rather than with sharp edges thereof, thus further reducing the wear. By confining the reduction of the large particles to the pulverizing chamber 27 and providing means for automatically returning escaping pieces of uncrushed material to the feed passage 5, abrasion due to impact of the larger pieces against the casing liners and against the hammer ends, is eliminated. The continuous current of air flowing in the chambers 28, 29, at substantially the velocity of the hammers, and the entrainment by this current of the fine particles of crushed material, also avoids abrasion of this material against the hammer ends. It will thus be noted that all of the elements of the machine coöperate to produce a completed structure in which the elements are subjected to minimum wear.

The material is projected through the pulverizing chamber 27 by the combined action of centrifugal force and the impact of the hammers thereagainst. It has been found by actual demonstration that with a machine of predetermined design, it is necessary to vary the speed when operating upon materials of different characteristics, in order that most efficient pulverization may be effected. In a properly designed machine the major portion of the disintegration is shown by actual test to take place within the crushing chamber, and but a very small amount of the raw material is reduced by abrasion on the liners 4 and grates 7. It has also been found that the grates 7 may be entirely eliminated, but their use will tend to prevent the discharge of the few pieces of uncrushed material which may otherwise pass through the machine.

It should be understood that it is not desired to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

It is claimed and desired to secure by Letters Patent,—

1. In combination, a pair of spaced rotors having opposed impact surfaces, means for positively causing predetermined impact surfaces of said rotors to coöperate for crushing, and means for feeding material directly to one only of said rotors and then to the space between coöperating surfaces.

2. In combination, a pair of spaced rotors having opposed impact surfaces, means for positively maintaining a fixed phase relation between the impact surfaces of said rotors, and means for feeding material directly to one only of said rotors and then to the space between opposed surfaces of said rotors.

3. In combination, a pair of spaced rotors having opposed impact surfaces, means for rotating said rotors in the same direction and for positively causing predetermined impact surfaces thereof to coöperate for crushing, and means for feeding material to one of said rotors above and to one side of the space between said coöperating surfaces.

4. In combination, a pair of rotors having overlapping elements provided with opposed impact surfaces and having a crushing chamber between them, means for positively rotating said rotors and for causing said overlapping elements to pass through said chamber at different times, and means for feeding material directly to one of said rotors above and to one side of said crushing chamber.

5. In combination, a pair of spaced rotors having opposed overlapping crushing surfaces movable in the same plane, means for rotating said rotors in the same direction whereby said surfaces are moved directly toward each other to crush material, and means for feeding material to one of said rotors above and to one side of the space between the approaching surfaces.

6. In combination, a casing, a pair of horizontally spaced rotors within said casing having a crushing chamber directly between them, the axis of one of said rotors being at a higher elevation than that of the other, means for rotating said rotors in the same direction, and means for feeding material to said crushing chamber.

7. In combination, a pair of co-acting

rotors having impact elements provided with opposed crushing surfaces, at least one of said elements extending farther away from the axis of its rotor than another of said elements, and means for feeding material into the path of said elements.

8. In combination, a pair of co-acting rotors having impact elements, some of said elements on one of said rotors being larger and extending farther away from the axis of said rotor than other of said elements, and means for feeding material into the path of said larger elements.

9. In combination, a pair of co-acting rotors having a crushing chamber between them, inlet means communicating with said chamber, and means forming a conduit extending tangentially of one of said rotors for returning uncrushed material to said chamber through said inlet means.

10. In combination, a pair of spaced rotors having overlapping impact elements provided with opposed crushing surfaces, means for rotating said rotors in the same direction about their axes, said impact elements being movable transversely of the axes of rotation to permit interfering elements to clear each other, and means for feeding material to the space between said rotors.

In testimony whereof, the signature of the inventor is affixed hereto.

CLIFFORD J. TOMLINSON.