May 21, 1929. O. CRAIG 1,714,080

PULVERIZING APPARATUS

Filed Dec. 15, 1927 3 Sheets-Sheet 1

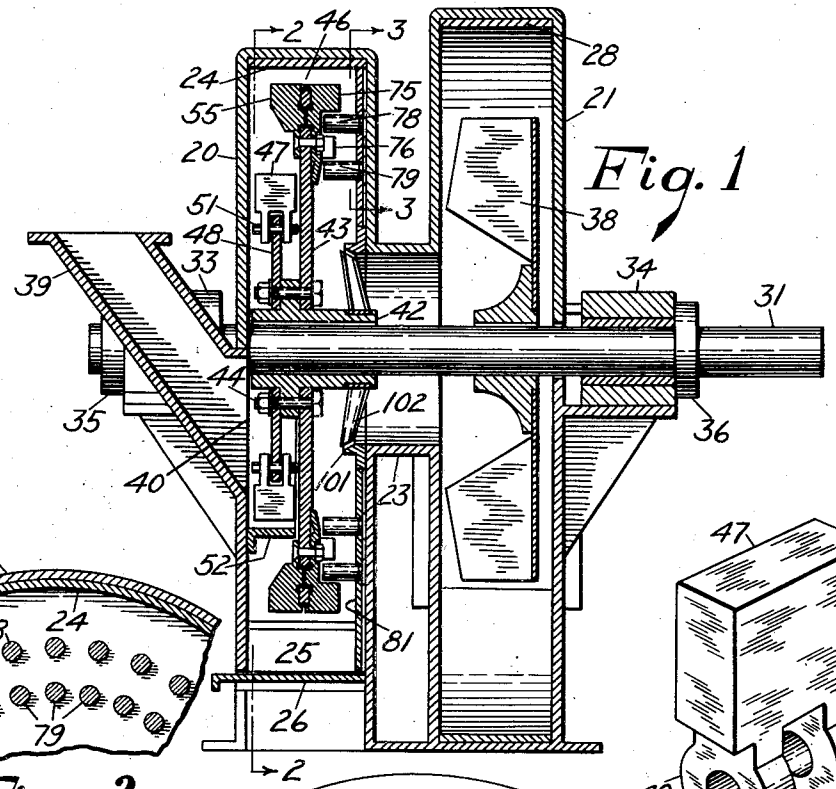


Fig. 1

Fig. 3

Fig. 4

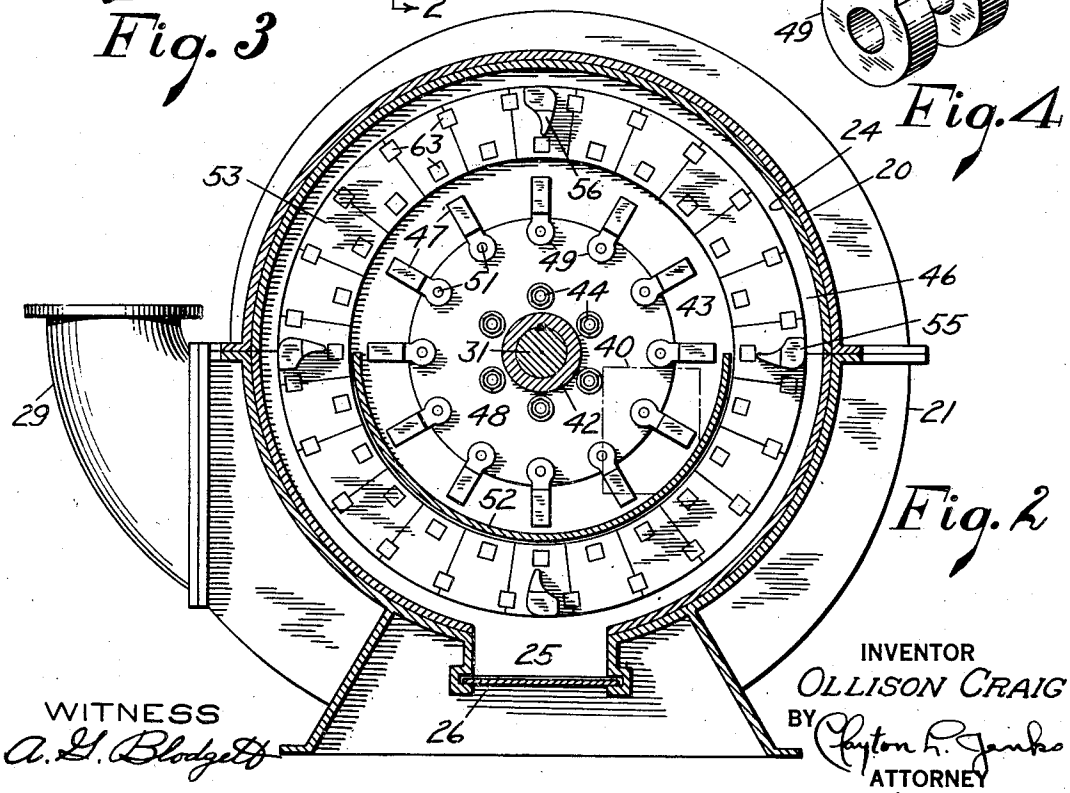


Fig. 2

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May 21, 1929. O. CRAIG 1,714,080

PULVERIZING APPARATUS

Filed Dec. 15, 1927 3 Sheets-Sheet 2

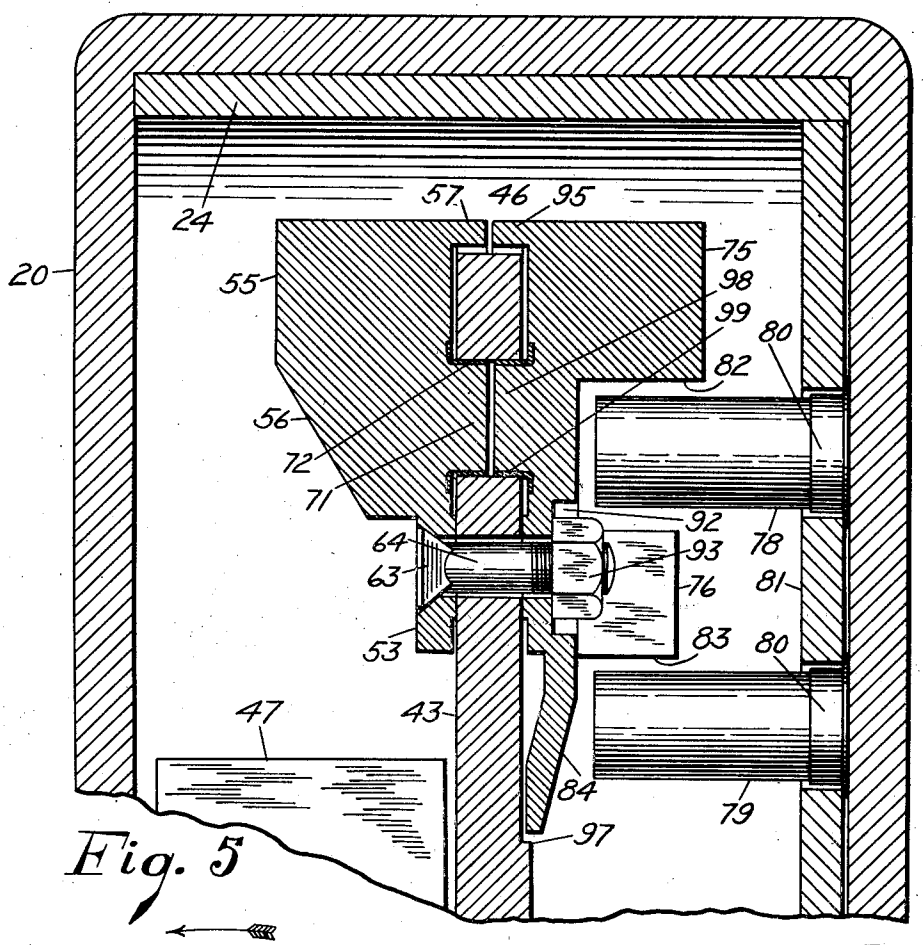


Fig. 5

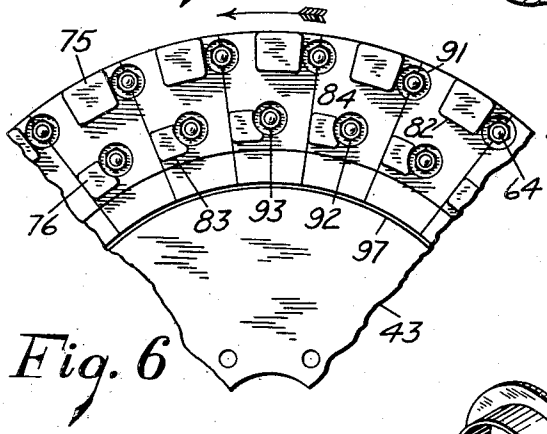


Fig. 6

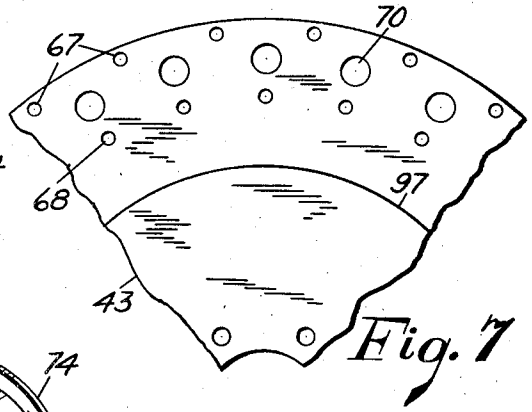


Fig. 7

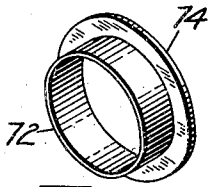


Fig. 8

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May 21, 1929. O. CRAIG 1,714,080

PULVERIZING APPARATUS

Filed Dec. 15, 1927 3 Sheets-Sheet 3

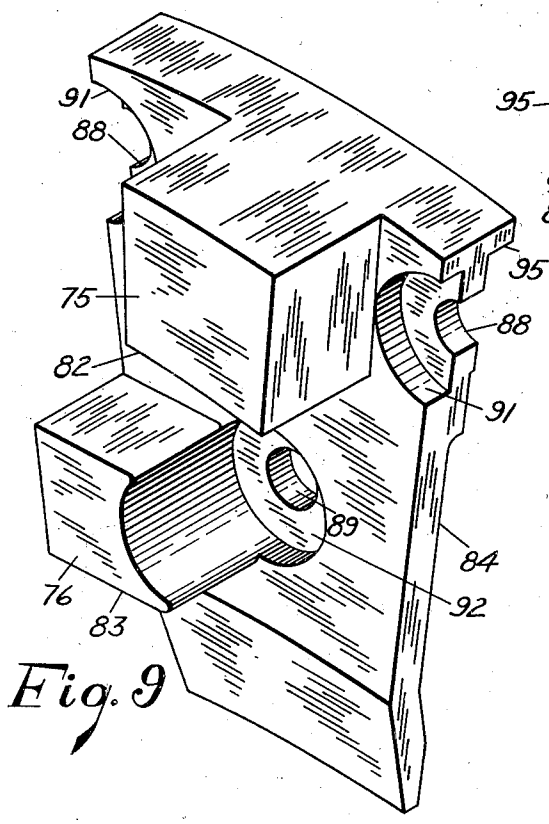


Fig. 9

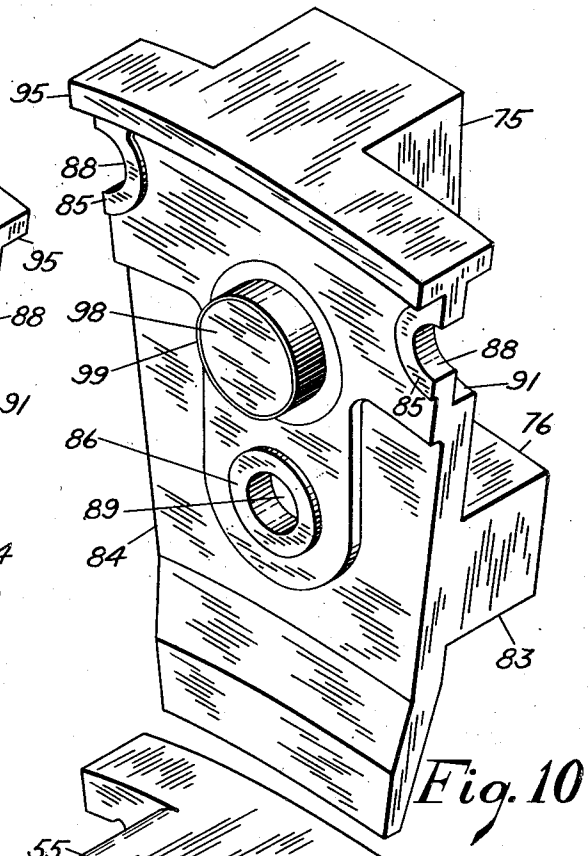


Fig. 10

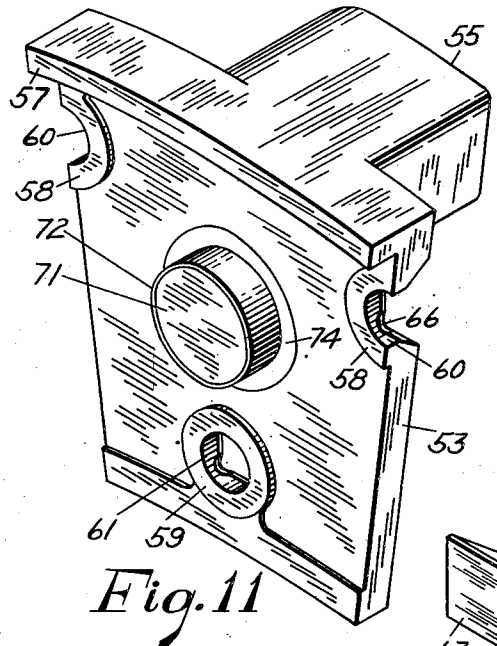


Fig. 11

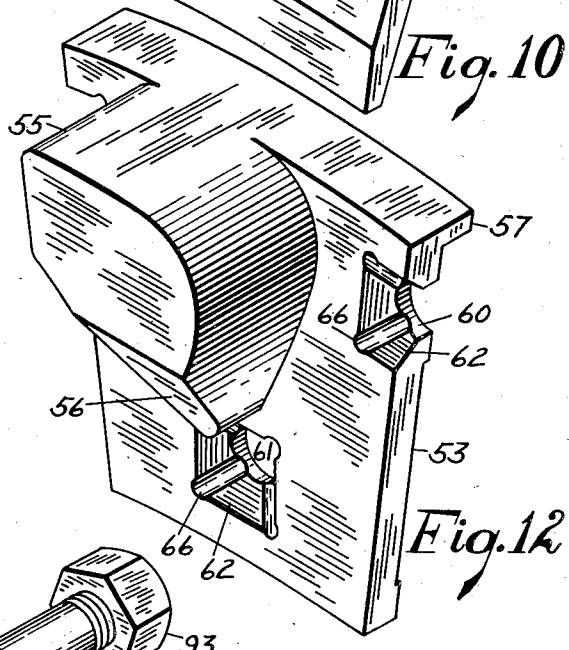


Fig. 12

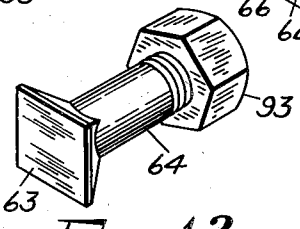


Fig. 13

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Patented May 21, 1929. 1,714,080

UNITED STATES PATENT OFFICE.

OLLISON CRAIG, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO RILEY STOKER CORPORATION, OF WORCESTER, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

PULVERIZING APPARATUS.

Application filed December 15, 1927. Serial No. 240,177.

This invention relates to pulverizing apparatus and more particularly to machines of the type having a rapidly rotatable disk on which beater elements are mounted, and comprises an improvement in the machine described in the reissue patent to Blyth No. 16,229 and in the prior application of Riley and Craig, Serial No. 67,639, filed November 7, 1925.

The apparatus disclosed by Riley and Craig comprises a rotatable disk which is so mounted within a stationary casing as to provide two pulverizing zones connected by an annular passage around the outside of the disk. Coarse material is introduced through an inlet passage into the first pulverizing zone, where it is struck by sets of revolving swing hammers. Around the outside of the swing hammers there is mounted a perforated annular grid structure which is adapted to cooperate with the swing hammers in bringing about the preliminary crushing of the coarse material. In the second pulverizing zone the material is drawn inwardly towards a centrally located outlet near the axis of the machine by means of the air current caused by a fan, and it is finely pulverized in this zone by the action of interfitting stationary and revoluble impact pegs mounted on the casing wall and the rotor disk respectively. It has been found in practice that the revolving pegs and the rotor disk are subjected to rapid wear, particularly when the machine is operating upon certain materials, such as coal having a high ash content. As a result, it has been necessary to interrupt the operation frequently in order to renew the pegs, and the rotor disk itself has occasionally required replacement, causing the maintenance cost with this prior machine to be excessive.

It is accordingly one object of this invention to overcome such difficulties and to provide a beater element for machines of this general type which will have a comparatively long life of usefulness, and to provide means for protecting the expensive rotor disk from the abrasive action of the material undergoing pulverization.

In the pulverizing machines of this type as heretofore constructed, the pegs have been made by casting them into resilient steel ferrules provided with flanges, as described in the U. S. patent to Riley No. 1,576,472, and they are mounted by inserting them through holes in the rotor and clamping the flanges of the ferrules between the rotor disk and a plate attached thereto. Because of the difficulty of machining holes of other shapes in the rotor, these pegs have always been made either circular or elliptical in cross section. It has been found however, when pegs of such shapes are utilized on the rotor, that the fineness of pulverization varies as the pegs wear away.

It is therefore a further object of my invention to provide a construction for the revoluble impact members by which they may be made of any shape which is found desirable for producing efficient pulverization, and in particular to make them of such a shape that the original efficiency and fineness of pulverization will be maintained throughout their life.

Since machines of this type rotate at a high rate of speed, the centrifugal force exerted by a member mounted adjacent to the periphery of the rotor is enormous and the problems involved in securely attaching it to the rotor are very difficult of satisfactory solution. Moreover, because of the high speed it is imperative that each member be located with great accuracy, especially as regards its distance from the axis of rotation, as otherwise a serious amount of vibration will inevitably arise. Since it is impossible in practice to manufacture castings which will all have exactly the same weight, it is important to provide some means of compensating for such variations. In addition, if bolts are utilized in attaching such a member to the rotor disk it is necessary that they be protected from wear in order to prevent any danger of their becoming so weakened as to permit the revoluble member to loosen on the disk.

It is accordingly a further object of this invention to provide an improved method of attaching the revoluble impact members to the rotor disk, by which they are accurately located in position and securely held throughout their life against the centrifugal forces set up by the rapid rotation of the disk, and to overcome the tendency towards

vibration caused by slight variations in the weights of the members.

It is found that certain difficulties arise in the operation of the prior machines, particularly when they are being used to pulverize materials having a high moisture content. Under these conditions there is a serious tendency for the wet material thrown off by the revolving swing hammers to accumulate in the lower half of the first pulverizing zone and pack in at this point so solidly as to eventually seriously obstruct the operation of the machine. The rotor disk rubs against this accumulation and as a result the power consumption of the machine is increased and the disk is subjected to rapid wear. These considerations have seriously limited the capacity at which the apparatus could be successfully operated.

It is accordingly an object of this invention to overcome this difficulty and to increase the capacity and efficiency of the prior apparatus by preventing the accumulation in the bottom of the casing of material undergoing pulverization.

The pulverizing elements in the second zone of the machine are intended and adapted only for producing fine pulverization of material which is already substantially reduced by the action of the swing hammers in the first zone. It is found however, in the prior apparatus, that a considerable proportion of the coarse material which is introduced into the machine is carried by the air current into the second zone before it has been sufficiently reduced by the swing hammers. This results in unnecessary wear upon the pulverizing elements in the second zone and also in an increased power consumption as the second zone is not adapted for acting upon such coarse material efficiently.

It is accordingly a further object of the invention to provide a pulverizing apparatus of this general type in which it will be impossible for coarse material to enter the machine without being acted upon by the preliminary breaker hammers.

It is a further object of the invention to provide a pulverizing apparatus which will have a large capacity and which will reduce coarse material to the desired degree of fineness efficiently and with a minimum amount of expense for replacement of the pulverizing elements.

With these and other objects in view, as will be apparent to one skilled in the art, my invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

Referring to the drawings illustrating one embodiment of my invention and in which like reference numerals indicate like parts,

Fig. 1 is a vertical section somewhat diagrammatically shown of a pulverizer embodying the invention;

Fig. 2 is a section on the line 2—2 of Fig. 1;

Fig. 3 is a section on the line 3—3 of Fig. 1, with parts broken away;

Fig. 4 is a perspective view of one of the preliminary breaker hammers;

Fig. 5 is a greatly enlarged view of a portion of Fig. 1, showing the upper part of the pulverizing chamber;

Fig. 6 is a view showing the rotor disk with parts broken away, having the revoluble impact members in the second zone mounted thereon;

Fig. 7 is a view similar to Fig. 6 but with the impact members removed from the disk;

Fig. 8 is a perspective view of one of the flanged ferrules;

Fig. 9 is a perspective view showing one of the unit cast wearing plates and pulverizing elements, as used in the second pulverizing zone;

Fig. 10 is a perspective view of the member shown in Fig. 9 looking from the opposite side thereof;

Fig. 11 is a perspective view of a unitary wearing plate and agitator peg as used in the first pulverizing zone;

Fig. 12 is a perspective view of the member shown in Fig. 11 looking from the opposite side thereof; and,

Fig. 13 is a perspective view of a plow bolt utilized for holding the pulverizing elements in position on the rotor disk.

The embodiment of the invention illustrated in the drawings comprises a casing so shaped as to form a substantially cylindrical pulverizing chamber 20 and a fan chamber 21 which are connected by a central passage 23 forming an outlet for the pulverizing chamber. The casing is divided along a horizontal plane for convenience in manufacture and to permit ready access to the interior. A peripheral liner plate 24 of suitable material is arranged within the chamber 20 to protect the casing from wear. This liner plate is omitted for a short distance at the bottom of the casing and a small pocket or receptacle 25 is arranged at this point in order to collect any hard foreign bodies such as tramp metal which may enter the machine. In order to permit access to this tramp metal pocket from outside of the casing I provide a sliding plate 26 which may be removed when it is desired to empty the pocket. The fan chamber 21 may also be provided with a peripheral liner plate 28 to protect the casing from wear. This fan chamber is preferably made scroll shaped as shown particularly in Fig. 2. It is provided with a tangential outlet 29 which may be flanged as shown to permit easy connection to a suitable pipe line.

A horizontal shaft 31 extends through the chambers 20 and 21 and is rotatably mounted in bearings 33 and 34 attached to the lower half of the casing. Endwise movement of the shaft is prevented by suitable collars 35

and 36 which are mounted on the shaft outside of the bearings. A suitably constructed fan 38 is keyed to the shaft within the fan chamber 21 and arranged to rotate so as to draw a current of air through the machine. This air may enter the machine with the coarse material through a chute 39 leading to an opening 40 in the casing wall. If desired, separate openings for the air may be provided, and dampers utilized for controlling its flow. The coarse material to be pulverized may be introduced to the chute 39 by any suitable feeding mechanism.

A flanged hub 42 is keyed to the shaft 31 within the chamber 20 and a disk 43 is attached to this hub by means of bolts 44. The disk 43 is so arranged as to divide the chamber 20 into two pulverizing zones adjacent the inlet 40 and the outlet 23 respectively. These two pulverizing zones are connected by an annular passage 46 around the outside of the disk 43.

In the first pulverizing zone are a plurality of beaters or hammers 47 equally spaced around the periphery of a suitable support, such as a disk 48, for the purpose of bringing about the preliminary pulverization of coarse material as it enters the casing. This disk 48 is somewhat smaller in diameter than the main rotor disk 43, and may also be attached to hub 42 by the bolts 44. Each hammer 47 has a pair of parallel lugs 49 integral therewith which are so arranged that they straddle the disk 48 and are attached thereto by a pin 51. If desired, the hammers 47 may be rigidly attached to the disk 48 but the construction described is the one which I prefer, as it makes it unnecessary to fit these parts accurately together. It will be understood that during the operation of the machine the hammers 48 are held substantially rigidly in a radial position by the action of centrifugal force and that under no conditions can they swing backward more than a small amount, because of the small clearance provided between the disk and hammers.

As shown in Fig. 1, the coarse material enters through the opening 40 in the casing adjacent to the revolving hammers 47. In order to prevent the coarse material from falling directly to the bottom of the pulverizing chamber and failing to come into contact with the hammers, I provide a curved plate 52 which is bolted to the casing wall beneath the hammers and closely adjacent to their peripheral path. As shown the plate is imperforate and extends from the casing wall almost into contact with the rotor and serves as a shelf on to which the incoming coarse material falls. It extends preferably through a considerable arc of the hammer path so as to give the hammers ample opportunity to strike the material before it escapes from the shelf, but the upper half of this path is left free from obstruction so that the material may be thrown upwardly and into the space outside of the hammer path. This construction insures that every particle of coarse material will be struck by the hammers and that any foreign bodies which enter the machine with the coarse material will be thrown into the upper part of the casing from which they will fall by the action of gravity and eventually rest in the pocket 25 provided for this purpose in the lower portion of the pulverizing chamber.

It has been found in practice that there is a serious tendency, particularly with materials containing a high percentage of moisture, for the material thrown off by the hammers to accumulate in the lower portion of the pulverizing chamber beneath the member 52. This accumulation is very undesirable since it tends to pack in tightly and rub against the rotor disk causing serious wear thereto and acting as a brake to limit the capacity of the machine and increase the power consumption. The rotor disk is a very expensive member and difficult to replace and I have provided a construction which will prevent such wear from occurring. For this purpose a plurality of plates 53, made in segments and each shaped as a circular ring sector, are mounted closely adjacent to each other, as shown in Fig. 2, on the peripheral portion of the rotor and on the side towards the inlet. Certain of the plates 53 are provided with impact members 55 termed agitator pegs, which are integral therewith. As illustrated there are four of these members 55 which sweep through the lower portion of the casing and thereby prevent any accumulation of coarse material at this point. It is desirable that there shall be only a small number of these agitators 55, so as to avoid any possibility of interference by them with the depositing of tramp metal in the proper receptacle 25. Each member 55 is provided with an inwardly projecting web 56 which increases the area of the member and thus provides an additional fan action to assist in carrying the material through the machine. As shown clearly in Fig. 11, each plate 53 is provided with a flange 57 along its outer edge extending in a direction opposite to the projection 55. The purpose of this flange is to overlie the periphery of the rotor disk and prevent any contact thereby with the material undergoing pulverization.

Since the plates 53 are necessarily of considerable weight and are usually made of some hard cast material, such as white iron which cannot be machined, the problems involved in securely mounting them upon the rotor disk and providing for holding them safely in place against the enormous centrifugal forces involved are very serious ones indeed. Moreover, it has been found that these plates must be located with great accuracy on the disk, as a displacement of 1/64" in relation to the axis of the machine is suf-

ficient to cause a serious vibration during operation. Accordingly, one feature of the invention involves the provision of a firm and accurate fit without any danger of rocking, for which purpose I provide each plate 53 with a three-point contact against the disk. This is done by forming two slightly raised bosses 58 near the outer edge of each plate and a third boss 59 near its inner edge. The boss 59 is circular in shape whereas the bosses 58 are semi-circular, their centers being upon the side edges of the plates. The bosses 58 and 59 are provided respectively with semi-circular openings 60 and circular openings 61 which extend entirely through the plate 53. As shown in Fig. 12, the openings 60 and 61 are countersunk at the ends opposite the bosses, and these countersunk portions 62 are shaped like a square pyramid so as to receive the head 63 of the plow bolt 64 shown in Fig. 13. The corners 66 of the countersunk opening 62 are preferably grooved as shown in Fig. 12 in order to insure the head 63 fitting firmly against the walls of the opening and not resting upon the sharp corners of the bolt head. As shown in Fig. 7 the rotor disk 43 is provided with circular holes 67 and 68 which register with the openings 60 and 61 respectively in the plates 53. When the plates 53 are assembled upon the rotor disk, as will be seen from inspection of Fig. 2, each plow bolt 64 in the outer row helps to hold two adjacent plates in place, whereas each bolt in the inner row contacts with only one of the plates 53. It will be apparent that there is a further advantage in providing the bosses 58 and 59 in that by utilizing them the direct stresses brought about by tightening the bolts 64 are transmitted directly to the bosses without setting up any artificial bending stresses in the plate itself. In other words, the bolt stresses are applied directly over the point of support rather than between them.

While the bolts 64 hold the plates 53 firmly against the rotor disk nevertheless they cannot be depended upon to locate them on the disk with sufficient accuracy nor can they be depended upon to counteract the enormous centrifugal forces set up when the machine is in operation. For this purpose we provide openings 70 which extend entirely through the rotor disk 43. These openings are preferably circular, as shown, as this is the easiest and cheapest form to construct. Each plate 53 is provided on the side which comes next to the disk with a cylindrical projection 71 which is so shaped as to fit closely in the opening 70 in the disk. While the member 71 may be cast with sufficient accuracy to fit the holes 70, yet we prefer to form this projection 71 accurately by casting it inside of a ring or ferrule 72. This ferrule is preferably provided with a flange 74 as shown clearly in Fig. 8 as this has the advantage of adding to the strength of the ferrule and preventing it from being accidentally distorted, particularly before the metal has been cast therein.

There is a particular advantage in making each plate 53 of a comparatively small size in that such a construction permits the centrifugal force from one plate to be safely carried by a single projection 71. If the plates are made larger the centrifugal force of course is greatly increased and it will eventually become necessary to use a plurality of projections to counter-balance the centrifugal force. In such a case difficulties arise in maintaining the distance between these projections on a single casting with sufficient accuracy so that they will fit in the openings in the rotor disk. This trouble is avoided by the construction disclosed. There is a further advantage in the use of comparatively small plates, since this permits an accurate balancing of the rotor. It is apparent that a given weight on the rotor must be balanced by an equal weight diametrically opposite thereto if vibration is to be avoided. It has been found practically impossible to produce castings of exactly the same weight, and I have overcome this difficulty by weighing them and placing pairs of equal weight opposite each other on the rotor. If the castings are so constructed as to cover an extensive arc on the rotor, one end of a casting is likely to be heavier than the other, and it is obvious that under these conditions an accurate balancing is impossible.

The second zone of our apparatus is so constructed and arranged as to finely pulverize the material which is drawn through the annular passage 46 around the periphery of the disk by the air current produced by the fan 38. In the embodiment illustrated this fine pulverization is brought about by the action of two rows of rapidly revoluble impact members or pegs 75 and 76 which interfit with two rows of stationary pegs 78 and 79. The number of rows of these revoluble and stationary members may be increased or decreased as may be found desirable with various materials. The arrangement disclosed is one which we have found particularly efficient in pulverizing bituminous coal.

The stationary pulverizing members 78 and 79 are subjected to much less wear than the revolving members, and while they may be made the same as the attrition members 75 and 76 they are shown as constructed and mounted in the manner described in the U. S. patent to Riley No. 1,576,472. As shown in the patent, the pegs may be cast into flanged metal ferrules 80 and the flanges on these ferrules may be clamped between a plate 81 and the casing wall. The circular openings in the plate 81 through which the pegs extend are preferably made large enough to provide a certain amount of clear-

ance so that the pegs are held only by the flanges on the ferrules, whereby a certain amount of resilience is obtained in the mounting.

The members 75 and 76 are preferably made somewhat shorter than the stationary members in order to provide a space between their ends and the plate 81, through which material which is sufficiently fine may be drawn inwardly against centrifugal force by the action of the air current. It will be understood that the general course of the fine material adjacent the plate 81 is inwardly toward the center of the machine, whereas the coarse material which is in the path of the revolving pegs is being carried by centrifugal force away from the center. Because of this peculiar recirculation in the second zone, substantially all of the wear on the revolving pegs occurs on their inner faces, towards the axis of the machine, and it is believed that the greater part of the pulverization is brought about by a rubbing action or attrition of the material over these surfaces. In order to assist this attrition, I provide the revolving pegs 75 and 76 with extensive inner faces 82 and 83 which are substantially flat and which extend in their direction of travel. As the pegs wear away, each of these inner faces remains parallel to its original plane, and its area remains substantially unchanged. As a result, the fineness of pulverization is uniform throughout the life of the revolving pegs.

In the embodiment illustrated each pair of revolving pegs 75 and 76 is made integral with a plate 84 which is in many respects similar to the plates 53 on the opposite side of the rotor disk. A three-point support is provided for each plate 84 by forming integral therewith two outer bosses 85 and an inner boss 86 which correspond to bosses 58 and 59 on each plate 53. The plates 84 have openings 88 and 89 therethrough at the points where the bosses are located, these openings being so located as to register with openings 67 and 68 in the rotor disk. Circular recesses 91 and 92 are provided in the plates on the side away from the rotor disk in order to receive the nuts 93 on the bolts 64 and thereby protect them to a certain extent from the abrasive action of the material undergoing pulverization. These nuts 93 are further protected from wear by their position in relation to pegs 75 and 76. As shown clearly in Fig. 6, as the rotor disk revolves in the direction of the arrow the nuts are directly behind the pegs so that the material is thereby kept from contact with them. Each plate 84 is provided with a flange 95 on its outer edge which is arranged to overlie the periphery of the rotor disk and protect it from wear. On its inner end each plate 84 is sloped inwardly toward the rotor, which is provided with a shoulder 97 at this point to prevent the coarse material, which is moving outwardly along the surface of the rotor, from getting beneath the plates and causing wear on the rotor disk. The plates 84 may be located on the rotor disk and held against centrifugal force in a similar manner to that employed with the plates 53 by providing on each a cylindrical projection 98 which is preferably cast in a ferrule 99 similar to the ferrule 72.

In order to prevent the escape through the outlet 23 of any particles of material which have not been sufficiently pulverized, this outlet opening is surrounded by a beveled ring 101, and a plurality of substantially radial U-shaped rejector blades 102 are mounted on the hub 42. These rejector blades scoop out of the issuing cloud of fine material any coarse particles which may reach them and hurl them back by centrifugal force into the path of the revolving impact members.

The operation of the invention will now be apparent in view of the above disclosure. The shaft 31 is rotated at a high rate of speed by means of any suitable source of power. Coarse material to be pulverized is introduced by a suitable feed regulating device into the chute 39 and passes through the opening 40 into the first pulverizing zone. This coarse material is struck by the revolving hammers 47, and the imperforate plate 52 prevents any of this material from falling into the bottom of the pulverizing chamber without coming into contact with the hammers. The hammers 47 throw the coarse material, together with any foreign bodies which may be present therein, into the upper portion of the casing and against the outer walls. The pieces of tramp metal or other hard foreign bodies fall by gravity into the receptacle 25 provided therefor, and the material to be pulverized is drawn through the annular passage 46 into the second pulverizing zone by the action of the air current brought about by the fan 38. In the second zone the material is reduced to the desired degree of fineness by the action of the rapidly revolving impact members 75 and 76 in cooperation with the stationary pegs 78 and 79. The material which has been reduced sufficiently is carried inwardly by the air current toward the centrally located outlet 23 and passes therethrough into the fan chamber 21, from which it is discharged through the outlet 29 which may be connected to any desired point of deposit. Any coarse particles which reach the rejector blades 102 are returned by them for further pulverization. The plates 53 and 84 protect the comparatively soft and expensive rotor disk 43 from wear and these plates are firmly and safely held in place against the enormous centrifugal forces which are inherent in such a high speed machine. Although the plates are firmly attached to the rotor disk nevertheless they may be easily removed when

it is desired to do so for replacement purposes. The plates and the revoluble impact members which are integral with them are made entirely of cast material which may be as hard as is desired since there is no necessity for performing any machining operation on them. The revolving impact members themselves may be made of any shape or contour which is desired and which may be found most suitable for bringing about efficient pulverization of the material in question. The agitator pegs 55 assist the fan in producing an air current through the machine and prevent any accumulation of material in the space beneath the curved plate 52, thereby increasing the capacity of the machine and reducing the power consumption.

What I claim as new and desire to secure by Letters Patent is:—

1. A pulverizing apparatus comprising a casing having an inlet and an outlet on opposite sides thereof, a rotor disk mounted between the inlet and the outlet, pulverizing pegs mounted adjacent to the periphery of the disk, a series of small wear plates arranged on the side of the rotor adjacent to the pulverizing pegs, and means for removably fastening said plates to the rotor.

2. A pulverizing apparatus comprising a casing having an inlet and an outlet on opposite sides thereof, a rotor disk mounted to rotate therebetween, pulverizing pegs on the rotor adjacent to the periphery thereof, small segmental wear plates adjacent to said pegs means for locating the wear plates correctly in position and holding them against centrifugal force and means for removably fastening the plates on the rotor.

3. A pulverizing apparatus comprising a casing having an inlet and an outlet, a rotor mounted therebetween, pulverizing pegs mounted near the periphery of the rotor, small segmental wear plates integral with said pulverizing pegs and means for removably fastening said pulverizing pegs and wear plates rigidly on the rotor.

4. A pulverizing apparatus comprising a casing having an inlet and an outlet, a rotor disk mounted therebetween, and a series of small segments removably fastened adjacent to the periphery of the rotor, each segment comprising a substantially flat wear plate and a projecting pulverizing member integral therewith, the segments when assembled forming an annular row of pulverizing members in which but one member is located on each segment.

5. A pulverizing apparatus comprising a casing having an inlet and an outlet, a rotor disk mounted therebetween and a series of unitary segmental castings removably fastened on one side of said disk, the castings having extensive, plate-like, wear portions and projecting pulverizing members, said members being arranged in a plurality of concentric rows and there being but one pulverizing member in each row on each casting.

6. A pulverizing apparatus comprising a casing having an inlet and an outlet, a rotor mounted therebetween which has a series of locating holes, a series of unitary, segmental, wear castings, means for removably fastening them on the side of the rotor, pulverizing members integral with and projecting laterally from the castings and a locating member having a projecting surface extending inwardly from each casting and interfitting with a hole in the rotor so that the casting is held securely against the forces set up during rotation.

7. A pulverizing apparatus comprising a casing having an inlet and an outlet, a rotor mounted therebetween, pulverizing members thereon, and a series of small, segmental, wear plates fastened on the side of the rotor, balanced pairs of which are initially selected and mounted directly opposite each other on diametrical lines across the rotor.

8. A pulverizing apparatus comprising a casing having an inlet and an outlet, a rotor disk mounted therebetween, a series of unitary segmental castings removably fastened on one side of said disk, the castings having extensive, substantially plane, wearing surfaces and projecting pulverizing members, said members being arranged in a plurality of concentric rows and there being but one pulverizing member in each row on each casting, and a lug projecting rearwardly from the casting shaped to interfit with a corresponding part on the rotor and locate the casting correctly and hold it against the action of centrifugal force.

9. A pulverizing apparatus comprising a casing having an inlet and an outlet, a rotor mounted therein, stationary pegs projecting towards the rotor from the casing wall and revoluble pulverizing members mounted on the rotor in close proximity to the stationary members, said pulverizing members being spaced by a considerable distance apart and having impact faces which are substantially radial and inner attrition faces which lie substantially in their own path of travel, the attrition faces being extensive in size and so arranged that the material passing outwardly under the influence of centrifugal force will rub thereagainst and be further pulverized.

10. A pulverizing apparatus comprising a casing having an inlet and an outlet, a rotor disk mounted to rotate therebetween, two sets of segment plates mounted near the periphery of the rotor on opposite sides thereof to prevent wear of the rotor, means for positively and accurately locating the segments on the rotor disk, and means for removably fastening the segments thereto, certain of the segments having laterally projecting pulverizing members formed integral therewith.

11. A pulverizing apparatus comprising a casing having an inlet and an outlet, a rotor mounted therebetween, a series of plates mounted on the rotor and having pulverizing members projecting therefrom and openings close to and in the rear of said members, and bolts in said openings arranged to fasten the plates in position, the projecting portions of the fastening bolts being protected by the pulverizing members as they revolve.

12. A pulverizing apparatus comprising a casing having a central inlet and an outlet, a rotor mounted therebetween, revoluble pulverizing members near the inlet which are spaced from the periphery of the casing to form an annular passage for tramp iron, and a few widely spaced members projecting laterally from the side of the rotor which are located in said passage near the casing periphery and are arranged to prevent the material from accumulating in said passage.

13. A pulverizing apparatus comprising a casing having a centrally disposed inlet and an outlet, a vertical rotor disk mounted between the inlet and the outlet and spaced therefrom to form two pulverizing zones connected around its periphery, revoluble hammers between the disk and the inlet which are spaced from the periphery of the casing to form an annular passage for tramp iron, a set of revolving members in the outlet zone for finely pulverizing the material, and a set of widely spaced pegs in said passage projecting from the side of the rotor near its periphery which aid in circulating the material and preventing its accumulation in the bottom of the casing.

14. A pulverizing apparatus comprising an inlet and an outlet, a set of impact members revolubly mounted near the inlet but spaced from the peripheral wall of the casing to form an annular chamber, and a plate adjacent to the lower portion of the path of said impact members arranged to hold the material temporarily in contact therewith and prevent its escape into the bottom of the casing except as it is thrown upwardly and outwardly into said annular passage.

15. A pulverizing apparatus comprising a casing having an inlet and an outlet on opposite sides thereof, a set of pulverizing hammers mounted to revolve about a horizontal axis near said inlet which are spaced from the peripheral wall of the casing to form an annular passage, and an imperforate plate arranged closely adjacent to the lower portion of the path of said hammers to hold the material momentarily in the path of the hammers, but permit it to escape upwardly and into said passage.

16. A segment for a pulverizing machine rotor comprising a narrow plate shaped substantially as a circular ring sector for mounting with like members to form a wear receiving surface on the rotor, and a locating member having an accurately shaped portion projecting rearwardly from the plate which is adapted to interfit with a corresponding depression in the supporting rotor.

17. A wear plate for a pulverizing machine rotor comprising a body shaped to be mounted with others to form an annular wear receiving surface on the rotor and having a flange arranged to project over and protect the edge of the rotor, and three spaced bosses arranged to form a three point contact with the side of the rotor, said plate having further provisions which permit fastening it in place.

18. A segment for a pulverizing machine rotor disk comprising a plate having a flange thereon, which is shaped to fit with other segments to cover an annular portion of the rotor disk and overlap the peripheral edge thereof, and openings therethrough which permit fastening it to the rotor.

19. A pulverizing and wear segment for pulverizing machines comprising a casting having a substantially plate shaped body and pulverizing members projecting laterally therefrom which are massive and have extensive attrition and impact surfaces, the parts being so shaped that when assembled on a rotor the pulverizing members will form an annular row in which there is but one pulverizing member on each segment.

20. A segment for a pulverizing machine rotor, comprising a substantially plate shaped casting having two pulverizing members projecting laterally therefrom and spaced apart, the segment being narrow and of such shape that when mounted with other segments on the rotor the two pulverizing members on the segments will form two spaced concentric rows in which the pulverizing members in a row are spaced by a considerable distance from one another.

21. A pulverizing and wear segment for a pulverizing machine rotor comprising a unitary casting having a substantially plate shaped body and pulverizing members projecting laterally therefrom, the parts being so shaped that when assembled on the rotor the pulverizing members will be spaced widely apart, and rearwardly projecting lugs integral with the segments which are adapted to locate the segments on the rotor and prevent movement thereof.

22. A segment for a pulverizing machine rotor, comprising a narrow, plate shaped body constructed to be mounted with others to form a wear surface, pulverizing members projecting laterally from one face thereof, a locating member projecting laterally from the opposite face and bosses forming a three point contact with the rotor surface.

23. A segment for a pulverizing machine rotor comprising a substantially plate shaped body having integral therewith projecting members providing extensive impact and

attrition faces, a substantially cylindrical locating member projecting rearwardly from the plate and spaced bosses forming a three point contact with the supporting rotor, said segment having perforations therethrough for bolting it to the rotor.

24. A segment for a pulverizing machine rotor comprising a unitary plate having a projecting member surrounded by a thin metal ferrule of the required size attached thereto by the casting operation.

Signed at Worcester, Massachusetts, this 12th day of December, 1927.

OLLISON CRAIG.