Aug. 14, 1928.

1,680,894

H. G. LYKKEN

PULVERIZER

Filed Aug. 16, 1924

2 Sheets-Sheet 1

Fig. 1.

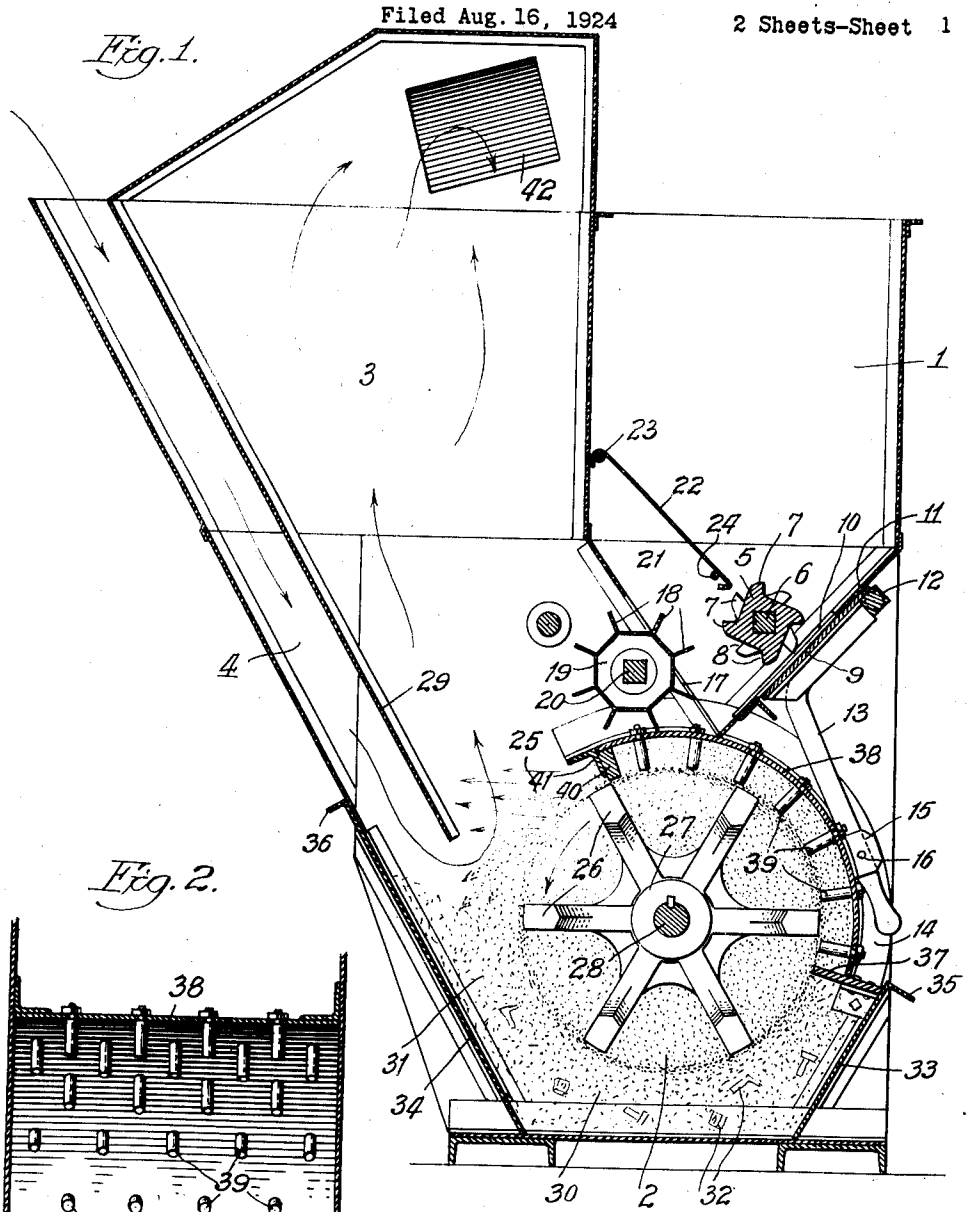
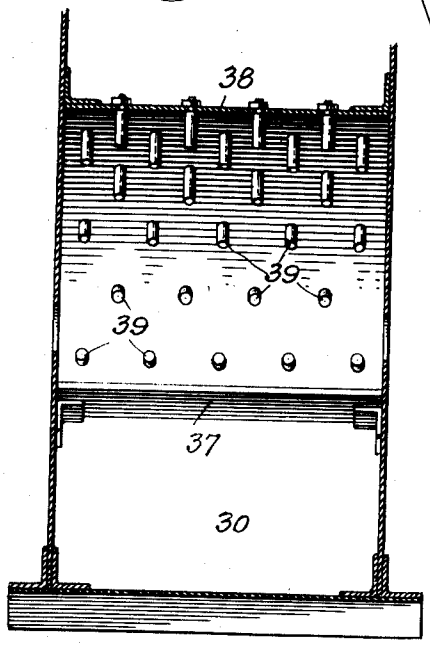


Fig. 2.



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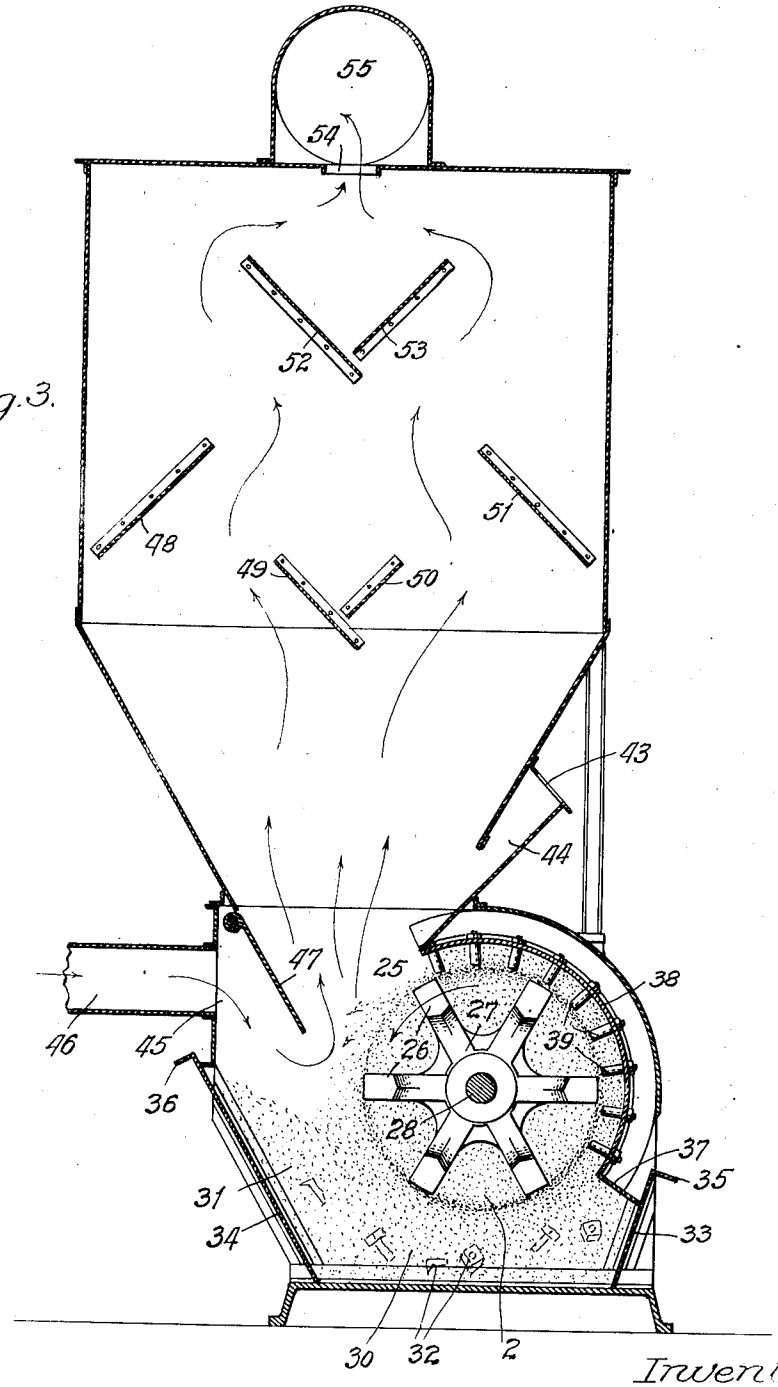
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Fig. 3.



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Patented Aug. 14, 1928. 1,680,894

UNITED STATES PATENT OFFICE.

HENRY G. LYKKEN, OF MINNEAPOLIS, MINNESOTA.

PULVERIZER.

Application filed August 16, 1924. Serial No. 732,436.

The present invention relates to devices or apparatus for the reducing of material to a fine state and for the separation of the finer particles from the coarser particles to obtain the desired fluidal character of the final material.

Among the objects of the invention are to provide novel unitary means including, preferably, a feeding device, a grinding and pulverizing part and a separating part all grouped together in a single unitary apparatus or mechanism; to provide for a novel crushing means, capable of acting upon large lumps of material and efficiently and effectively acting upon the lumps to crush or reduce the size thereof to a desired maximum size capable of being acted upon by the grinding mechanism; to provide a novel crushing member capable of acting with efficacy upon the lumps of material, preferably forming the member with tangential projecting parts or fingers having radial working surfaces so that when the member is rotated the pojections will efficiently and effectively engage with the lumps for crushing and reducing the size thereof to a given maximum size; to provide novel means for the release of non-crushable material, as the providing of one of the members between which the material is crushed with means for releasing such member or yielding to the movement of such member when non-crushable material is engaged between such member and the breaker operating upon the material, such member being preferably in the form of a plate or gate in an opening and the means for holding the material while being ground, and so relating it with the breaker that when the non-crushable material enters between the breaker and the plate, the latter will move and permit the non-crushable material to be ejected through the opening and to the exterior of the means for holding the material; to provide such plate or gate with an arm with means for normally holding it in place, as a spring, weight or shear pin secured to a fixed part of the apparatus and the arm; to provide a novel grinding means with means for receiving and collecting any non-grindable objects or materials that may reach the grinder, preferably by the providing of a collecting pocket or chamber in the lower part of the grinding device where the non-grindable material may be projected by the rotor of the grinder upon first coming into contact with such object and causing the non-grindable material to become imbedded or to sink in whatever grindable material may have accumulated in the pocket; to provide such pocket with means for giving ready access into the pocket for the removal of the non-grindable objects that may have accumulated therein; to provide the grinder with relatively movable series of projections, preferably in the form of a rotor having projecting arms and a number of spaced projections or pins extending inwardly from a part of the grinding chamber so that the ends of the projections will operate close to each other when the projections of the rotor move past the projections of the chamber; to provide for spacing these projections so that the spaces therebetween may be filled with the grindable material so that materials in the rotor may be carried as a mass and operate against the mass of material held by the stationary pins so as to provide a pulverizing or mulling region between the surface portions of the two masses of the material whereby the mulling or pulverizing action will occur in such region to finally grind or pulverize the material to the desired extent and in this way reducing the amount of power generally required to pulverize like material of the same fineness; to provide for the accumulation in the pocket of grindable material such that the upper surface thereof will be acted upon by the peripheral surface of the material carried by the rotor so as to provide a mulling or pulverizing region between the surfaces of the relatively movable masses of material so as to effect a pulverizing in such region of the material similarly as in the region between the ends of the relatively movable projections to provide for preventing movement of the mass of material in the pocket into the spaces between the stationary pins, preferably by a projecting wall provided in the chamber between the pocket chamber and the space of the grinding chamber including the stationary pins, in order that the non-grindable objects will not move in among the pins and be engaged thereby to effect damage thereto to provide for projections or pins in the grinding device of a length to hold a given depth of grindable material therein such that the centrifugal action of the material in the rotor will press against and act upon the material held by the stationary pins in the grinding device so as to

effect a mulling and pulverizing action in the region between the movable and stationary pins; to provide a grinder with an opening through which the material to be ground may be fed to the rotor and also through which the pulverized material may be projected in the form of a fan or the like whereby the pulverized material may be thrown about to permit an efficient separation of the finer particles therefrom; to provide such device with means for directing a fluid, such as a gas or air, preferably in a heated condition, so that the stream of the same may pass upwardly through the projected pulverized material and carry the finer particles thereof into a separating chamber or to a point of consumption where the finer particles are utilized; to provide for the directing of hot fluids as hot air into the device so as to heat the projected pulverized material for the removal or elimination therefrom of part of the moisture carried thereby and also to heat the feeding means so as to remove a part of the moisture of the material being crushed and the material after crushing before it enters the grinding device, and also to heat the grinder mechanism so as to remove part of the moisture of the material in the grinding chamber; to provide a novel form of separating chamber in which the stream of air and pulverized material may be made to move for the separation of the finer particles, this chamber preferably having means for causing a tortuous path of the particles in the air, preferably in the form of baffles arranged in the path of the stream of air so as to aid in the separation of the finer particles before the same is caused to pass through the outlet of the separator; and to provide for such other objects, advantages and capabilities as will later appear and are inherently possessed by the invention.

In the drawings illustrating a few embodiments of the invention, Fig. 1 is a vertical sectional view through a device constructed in accordance with the invention; Fig. 2 is a vertical sectional view taken through the grinding part of the device; and Fig. 3 is a vertical sectional view taken through another embodiment of the invention.

Referring more particularly to the drawings, the embodiment shown in Figs. 1 and 2 includes a hopper 1 in which the material may be located for the crushing operation, a grinding chamber 2 in which the grinding and pulverizing takes place of the material, a separating chamber 3 in which the separation of the finer particles takes place, and a passage 4 through which the air or other gas, whether heated or not, may enter to aid in the separation of the finer particles.

Within the hopper is located a rotary breaker member 5 upon a squared shaft 6, and provided with substantially tangential projections or fingers 7 having substantially radial faces 8 such that the ends of these projections may readily engage with and act upon the material to be crushed, particularly lumps thereof whereby the same may be effectively and efficaciously broken up or crushed when the projections press the same against a plate or gate 9 located opposite an opening 10 provided in an inclined wall 11 in the lower part of the hopper. The gate is mounted to the hopper by means of a hinge 12 and carries an arm 13 extending downwardly between the side wall portions 14 of the grinding part of the mechanism. The arm 13 may carry a suitable weight 15 which may act to normally hold the gate or plate 9 in closed position at the opening 10 and in proper relation with the breaker roll so as to crush the material between the roll and the plate at a definite maximum size. Should any non-crushable material, such as pieces of iron or other metal, be caught between the breaker roll and the plate, the pressure imposed upon the plate will be such as to cause the same to move against the gravitational force of the weight 15 and to permit the non-crushable material to be ejected through the opening 10 to the exterior of the device. It will be understood that a spring may be used in place of a weight and suitably arranged and located to normally but yieldingly hold the arm 13 in place for maintaining the plate normally in crushable position with respect to the breaker roll.

If desired, a shear pin 16 may be placed through a suitable aperture in the arm 13 and connected to a fixed part of the mechanism, such as to the side walls 14 of the grinding part, the shear pin being of such material that when there is an excess pressure imposed upon the plate 9 by reason of non-crushable material tending to be acted upon between the breaker and the plate, the stress may forcibly cause the arm 13 to shear the pin 16. After the non-crushable material is ejected, a new shear pin may be located in place.

The crushed material is fed downwardly into the lower part of the hopper toward an opening 17 in which operate the vanes or blades 18 of a rotary feeding device 19 fastened to a squared shaft 20 rotatably mounted in the mechanism between the side walls thereof. Should the material be fed at a greater rate from the breaker roll than the feeding device can take it, the material will accumulate in the space 21 between the feeding mechanism and the breaker roll and press upwardly against a pivotally mounted plate or door 22 supported upon a pivot 23 and normally resting upon a pin 24. The upward pressure of the material will move this plate 22 upwardly and permit the mate-

rial to return into the upper part of the hopper above the breaker roll and mix with the material descending to the breaker roll and the plate 9.

The feeding means 19 will feed the crushed material at a given rate toward an opening 25 formed in an upper part of the grinding chamber 2 so that the material may proceed into the chamber 2 and be engaged by radially extending arms 26 of a grinding rotor 27 secured to a shaft 28 extending between and mounted in suitable bearings in the side walls 14 of the grinding device.

At one side of the opening 25 is provided an inclined wall or plate 29 against which the pulverized material thrown or cast by the rotating arms 26 of the rotor, through the opening 25 against the plate 29 will cause the pulverized material to be thrown about in the form of a cloud for efficient acting thereon by the stream of air passing upwardly through the opening 25 as the same issues from the passage 4. The air, whether heated or not, will pass down in the passage 4 in the direction of the arrows and upwardly through the opening 25 and will pneumatically separate the fine particles from the projected material, as well as from the clouds set up by the impact of the material against the plate 29, and then pass upwardly through the separating chamber 3, the coarser particles finding their way downwardly again by gravity into the opening 25 and into the grinding chamber 2.

In the lower part of the grinding mechanism is provided a collecting chamber or pocket 30 in which grindable material 31 may accumulate together with non-grindable material or objects 32. Non-grindable objects too small to be acted upon and ejected through the opening 10 may pass through the feeding mechanism into the grinding device and in order to prevent entry to the latter, these objects are engaged by the rotating arms 26 and will be projected forcibly downwardly into the collecting pocket 30 and will become imbedded or sink in the material 31 and accumulate in the pocket 30. After a time, when many of these have accumulated, the same may be removed from the pocket through suitable doors at the sides thereof having closing members 33 and 34, these being preferably slidable doors having handles 35 and 36 by which they may be manually operated to open the ports through which the material may be removed as desired. It will be noted that the material will substantially fill the chamber 2 such that a certain amount of it will be carried about by the projections 26 of the rotor and a certain amount of it will remain in stationary position in the pocket 30. By reason of the centrifugal action of the rotor on the material carried thereby, the same will press outwardly against the material 31 and there will be a region between the two masses of material in which there will be a mulling or pulverizing action. At the same time there will be a tendency of the rotor to cause the movement of the material in the pocket 30 in the direction of rotation of the rotor. In order to prevent the movement of the material 31 there is preferably provided an inwardly projecting plate or wall 37 acting as a dam for such material. Above the wall 37 extends a peripheral portion 38 of the chamber 2 provided with spaced inwardly projecting pins 39 so arranged, preferably in rows and in staggered relation, and with sufficient space therebetween to permit the packing of grindable material therein or among the pins. The pins are of such length to hold a given thickness or depth of the material, the free ends of the pins being proximate to the free ends of the projections 26 on the rotor and the surface of the material held by the pins 39 will be proximate to the peripheral surface of the material carried by the rotor such that there will be at such surface portions a region of mulling or pulverizing of the relatively movable masses of material. The pins 39 will also serve as anchor members for preventing the movement of the mass of material held thereby by the action of the rotor. The mass of the material held by the rotor will act centrifugally against the mass of material held by the pins 39 during the mulling or pulverizing action. At the upper part of the chamber 2 and near the end of the region of operation of the material may be provided a cross-member 40 supported by a flange 41 attached to the end of the wall 38, the member 40 acting very much in the same manner as the member 37.

The pulverized material will be thrown more or less tangentially from the arms 26 in the direction of arrows shown in the opening 25 and against the plate 29 as above described.

The chamber 3 preferably is provided with an opening or discharge outlet 42 through which the separated particles with the air will pass to a suitable conduit to carry the particles to a point of utility or to a suitable separating and segregating device forming the subject-matter of another application.

When using heated fluids, such as hot air, the same will heat the interior of the device, such as the grinding mechanism so as to reduce some of the moisture in the material, and will also, as it passes upwardly in the chamber 2, come in contact with the feeding device and the hopper 1 and heat the material therein and reduce some of the moisture thereof. At the same time, while it is separating the particles from the pro-

jected material from the rotor, it will also dry or remove the moisture from the same so that the separated particles will be in substantially dried condition when discharged through the port 42.

In the form shown in Fig. 3 of the drawings, the hopper is omitted and the material is fed through an opening 43 into a chute 44, in any suitable manner, to the opening 25 of the grinding mechanism. The grinding mechanism is otherwise the same as that shown in Fig. 1 of the drawings. Opposite the opening 25 may be provided a pivoted plate 47 serving the same purpose as the plate 29 in the other construction, and also for regulating the passage of air through the discharge port 45 of an air inlet passage 46. Above the opening 25 is a separating chamber similar to that of Fig. 1 but it includes a set of baffle plates 48, 49, 50, 51, 52 and 53 so arranged that the upwardly flowing stream of air with the pulverized particles will be deflected by the plates 49 and 50 towards the plates 48 and 51 and thence to the plates 52 and 53 and around the same to a discharge outlet 54 leading into a conduit 55. The arrangement of these baffles is such that the stream must take a tortuous path, and be delayed so that the progress of the material to the chamber 47 will take ample time for the separation of the finer particles and the retreating movement of the heavier particles toward the opening 25 and into the grinding chamber 2.

While I have herein described and upon the drawings shown a few embodiments of the invention, it is to be understood that the same is not limited to the particular construction, details and arrangements of parts described and shown, but that the same comprehends other constructions, arrangements of parts and details without departing from the spirit thereof.

Having thus described my invention, I claim:

1. In a device of the character disclosed, a crushing device adapted to crush lump material and comprising means for holding the material to be crushed, said means including a rotary breaker having tangentially extending projections provided with radial faces whereby the projections may engage and act upon the lumps of material to break and crush the same, a plate located in spaced relation to the breaker member whereby the material may be pressed against said plate by the projections of the breaker member for crushing the material.

2. In an apparatus of the character disclosed, a grinder comprising a grinding chamber, grinding parts including a rotor, a collecting chamber in the lower part of the chamber in front of and beneath the rotor for the collection of grindable and non-grindable material, the material in the collecting chamber coacting with the material being moved by the rotor to effect grinding or pulverizing of the grindable material, the non-grindable material remaining in the collecting chamber below the grinding region.

3. In an apparatus of the character disclosed, a grinder comprising a grinding chamber, grinding parts including a rotor, a collecting chamber in the lower part of the chamber in front of and beneath the rotor for the collection of grindable and non-grindable material, the material in the collecting chamber coacting with the material being moved by the rotor to effect grinding or pulverizing of the grindable material, the non-grindable material remaining in the collecting chamber below the grinding region, and a door for the collecting chamber for affording removal of the non-grindable material therefrom.

4. In an apparatus of the character disclosed, a grinder comprising a grinding chamber, grinding parts including a rotor, a collecting chamber in the lower part of the chamber in front of and beneath the rotor for the collection of grindable and non-grindable material, the material in the collecting chamber coacting with the material being moved by the rotor to effect grinding or pulverizing of the grindable material, the non-grindable material remaining in the collecting chamber below the grinding region, an upper portion of the grinding chamber having projections for holding a thickness of grindable material at the periphery of the rotor, the surface of said material and the material moved by the rotor forming a grinding or pulverizing region in which the grindable material is ground or pulverized.

5. In an apparatus of the character disclosed, a grinder comprising a grinding chamber, grinding parts including a rotor, a collecting chamber in the lower part of the chamber in front of and beneath the rotor for the collection of grindable and non-grindable material, the material in the collecting chamber coacting with the material being moved by the rotor to effect grinding or pulverizing of the grindable material, the non-grindable material remaining in the collecting chamber below the grinding region, spaced projections located about the periphery of the rotor and operative to hold a depth of grindable material, the surface portions of said material and the material moved by the rotor forming a grinding region for reducing the grindable material to a fine or pulverized state.

6. In an apparatus of the character disclosed, a grinder comprising a grinding chamber, grinding parts including a rotor, a collecting chamber in the lower part of the

chamber in front of and beneath the rotor for the collection of grindable and non-grindable material, the material in the collecting chamber coacting with the material being moved by the rotor to effect grinding or pulverizing of the grindable material, the non-grindable material remaining in the collecting chamber below the grinding region, relatively movable series of projections having the ends of one series thereof moving proximately by the ends of the other series thereof and providing spaces between the projections for the holding of the material to form a mulling region for the material between the relatively movable projections and the material held thereby.

7. In apparatus of the character disclosed, a grinder comprising a chamber having an opening in the upper part thereof for the reception of the material to be ground and the ejectment through said opening of pulverized material, a rotor having projections rotably mounted in the chamber and cooperating projections distributed over a part of the chamber wall, said projections being arranged to hold the material among them and to provide a mulling region between the ends, the rotating and the non-rotary projections.

8. In apparatus of the character disclosed, a grinder comprising a chamber having an opening in the upper part thereof for the reception of the material to be ground and the ejectment through said opening of pulverized material, a rotor having projections rotatably mounted in the chamber and cooperating projections distributed over a part of the chamber wall, said projections being arranged to hold the material among them and to provide a mulling region between the rotating and non-rotary projections, the lower part of the chamber forming a collecting pocket for the gathering of non-grindable material that may come into contact with the rotor.

9. In apparatus of the character disclosed, a grinder comprising a chamber having an opening in the upper part thereof for the reception of the material to be ground and the ejectment through said opening of pulverized material, a rotor having projections rotatably mounted in the chamber and cooperating projections distributed over a part of the chamber wall, said projections being arranged to hold the material among them and to provide a mulling region between the rotating and non-rotary projections, the lower part of the chamber forming a collecting pocket for the gathering of non-grindable material that may come into contact with the rotor, and means to prevent the entry of the non-grindable material in the mulling region between the projections.

10. In an apparatus of the character disclosed, a grinder comprising a grinding chamber having an opening, grinding parts including a rotor, a collecting chamber in the lower part of the chamber in front of and beneath the rotor for the collection of grindable and non-grindable material, the material in the collecting chamber coacting with the material being moved by the rotor to effect grinding or pulverizing of the grindable material, the non-grindable material remaining in the collecting chamber below the grinding region, and an air inlet passage leading to said opening for directing a stream of air upwardly through the pulverized material being cast from the rotor in said opening.

11. In an apparatus of the character disclosed, a grinder comprising a grinding chamber having an opening, grinding parts including a rotor, a collecting chamber in the lower part of the chamber in front of and beneath the rotor for the collection of grindable and non-grindable material, the material in the collecting chamber coacting with the material being moved by the rotor to effect grinding or pulverizing of the grindable material, the non-grindable material remaining in the collecting chamber below the grinding region, a separating chamber above said opening in which the finer particles of pulverized material are separated by the stream of air passing through said chamber and the heavier particles returned through said opening into the grinding chamber.

12. In an apparatus of the character disclosed, a grinder comprising a grinding chamber having an opening, grinding parts including a rotor, a collecting chamber in the lower part of the chamber in front of and beneath the rotor for the collection of grindable and non-grindable material, the material in the collecting chamber coacting with the material being moved by the rotor to effect grinding or pulverizing of the grindable material, the non-grindable material remaining in the collecting chamber below the grinding region, a separating chamber above said opening in which the finer particles of pulverized material are separated by the stream of air passing through said chamber and the heavier particles returned through said opening into the grinding chamber, and baffles located in said separating chamber for aiding in the separation of the finer particles over an extended space.

13. In a device of the character disclosed, a grinding chamber, a rotor and means therein cooperating to pulverize the material to be ground, said chamber having an opening for the entry of the material to be ground and for the projecting therethrough of the pulverized material cast from the rotor, a dash plate against which the pulverized material is cast for the spreading

thereof, means for feeding the material to be ground to said grinding chamber through said opening, a passage for the directing of heated air through said opening for the drying and separating of moisture from the particles of the pulverized and cast material and for the heating of the feeding means to reduce the moisture content of the material being fed thereby to the grinding chamber.

14. In a pulverizer of the character described, a hopper having an opening in one wall thereof, a shaft rotatably mounted in said hopper adjacent to said opening, a crusher member carried by said shaft, a pivotally mounted gate positioned to close said opening so that it will cooperate with said crusher to break up material passing between them, and rigid means for maintaining said gate in a normally closed position, said means being yieldable to abnormal pressure of said material so that said gate will temporarily open to eject non-crushable materials through said opening.

15. In a pulverizer of the character described, a hopper having an opening in one wall thereof, a shaft rotatably mounted in said hopper adjacent to said opening, a crusher member carried by said shaft, a pivotally mounted gate positioned to close said opening so that it will cooperate with said crusher to break up material passing between them, an arm connected to said gate, and rigid means cooperating with said arm for holding said gate normally closed, said means being shearable under abnormal pressure of said material, so that said gate will open to eject non-crushable materials through said opening.

In witness whereof, I hereunto subscribe my name to this specification.

HENRY G. LYKKEN.