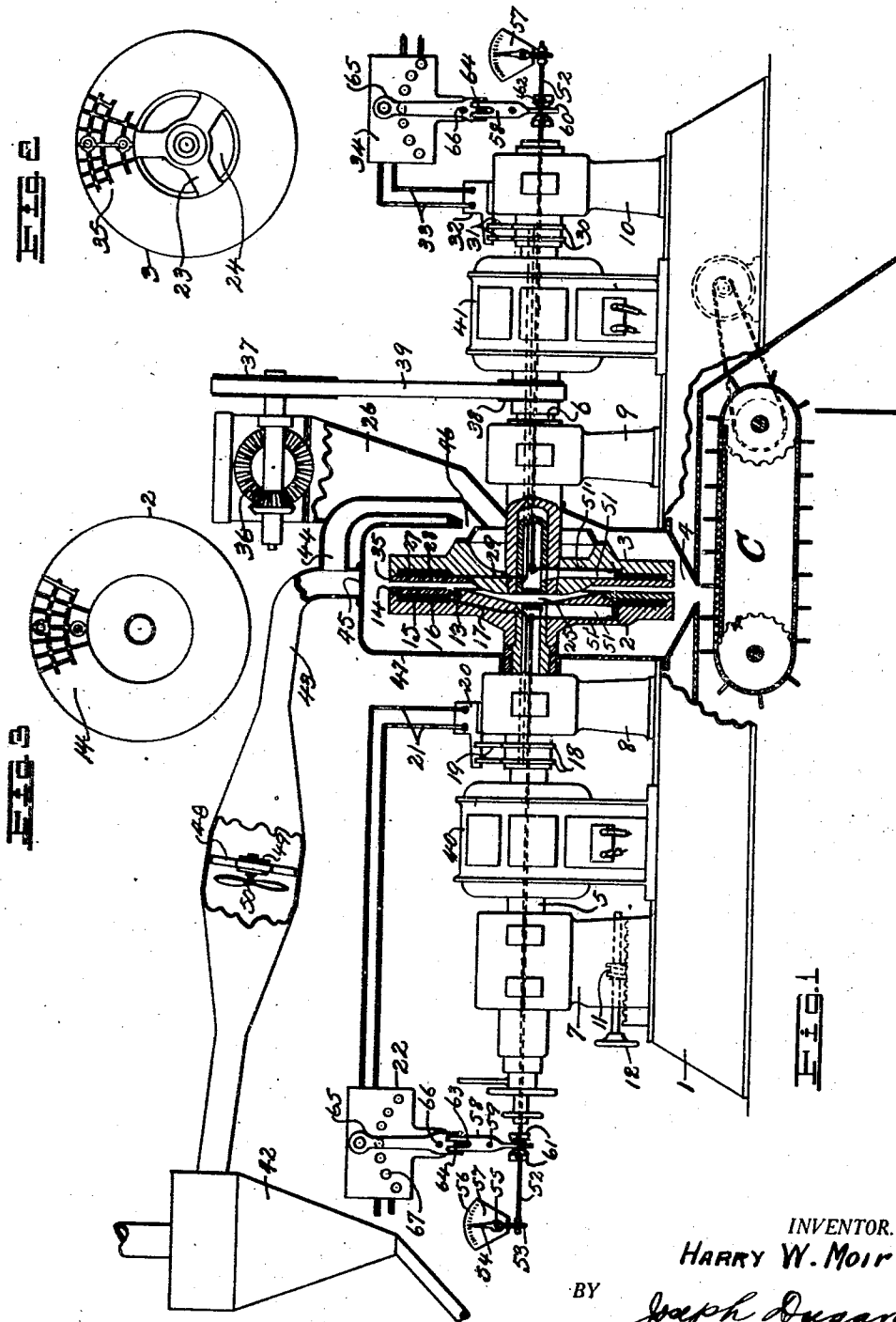


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PROCESS AND APPARATUS FOR GRINDING MATERIAL AND EXTRACTING
VOLATILE MATTER THEREFROM
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PROCESS AND APPARATUS FOR GRINDING MATERIAL AND EXTRACTING VOLATILE MATTER THEREFROM

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This invention relates generally to grinding and calcining apparatus and to processes for grinding, calcining, dehydrating, and collecting volatile matter from hydrous and other solids. It is particularly designed for simultaneously grinding and calcining mineral ores such as gypsum to form plaster of paris; for simultaneously grinding and dehydrating coal and similar fuels to form powdered fuel adapted to be sprayed and ignited in the power plants of buildings, mines, locomotives, steamships, etc.; for grinding and heating bituminous shales to separate their volatile contents from their asphaltic nuclei; etc.

The grinding apparatus disclosed herein is not new. My invention resides in the application to any suitable standard grinding machine of: means for heating the material being ground, during the grinding thereof; and means for controlling the temperature of the heating means as applied to the material being ground; and means for removing and collecting water and other volatile matter released from the material being ground, during the simultaneous grinding and heating thereof. Particularly, my invention resides in the installation of electric heating elements in the grinding plates of attrition grinding machines, and in automatically controlling the temperatures of these heating elements and plates. With my invention, it is possible to automatically maintain the grinding plates at a constant temperature and to raise the temperatures thereof much higher than is possible with any other available heating agencies.

The addition of electrical heating elements to attrition grinders of the type disclosed herein produces the most remarkable results: For example; in grinding coal to reduce it to "powder" form, it is found that, when the temperature of the grinding plates is maintained at about five hundred degrees F., coal fed in "walnut" size to the machine emerges as a powder nearly four times as fine as the setting of the machine would call for, and it emerges bone dry and moisture proof. This remarkable increase in fineness of grinding over the fineness resulting from

the cold-setting of the machine holds for every substance I have run through the electrically heated machine. The reasons for this result can only be guessed at, since it is not possible to determine just what chemical or physical changes take place between the plates during the operation of the machine. It is thought, however, that the intense heat, vaporizes or decomposes the water contents and water of crystallization into its gaseous components and explodes the solid nuclei into a multiplicity of still smaller particles.

Raw gypsum ground by this machine, at around five hundred degrees F., emerges much finer than any "plaster of Paris" heretofore made, and can be used immediately, without ageing or the addition of retardants, to form an exceedingly hard, white, and alabaster like plaster capable of being polished. It has also been found that used "plaster of Paris" can be revitalized and used over repeatedly by running it through this machine at high temperatures, and that the revitalized product is superior in every respect to the "plaster of Paris" resulting from the previously known methods of reducing raw gypsum to the plaster of Paris form.

These are only a few instances of the remarkable results obtained by the use of this invention and discovery. It has been successfully used to "crack" gasoline from crude oil, to extract oil from shale, to powder a mixture of shale and gypsum to form an extremely hard hydraulic cement, to roast coffee berries and produce a pulverized coffee ready for instant use by merely dropping it into boiling water, to form very hard and white cements from different mixtures of gypsum and various salts, and many other products.

The operation of grinding is, of itself, a heating operation, and much of the ordinary calcination of gypsum and similar ores is effected solely by repeated and prolonged grindings, with tests after each grinding to determine the water content of the ground product. The old grinding method of calcination is a time-consuming operation, which, in the case of gypsum, often requires grinding through a period of four or five

hours, in order to reduce the gypsum to "plaster of Paris." With my invention and discovery, the calcination of gypsum involves but one grinding operation extending over a few seconds, since the desired proportion of water contents of the gypsum can be removed at once by merely regulating the temperature of the grinding plates of my apparatus and by aspirating the water vapor and other volatile products from the electrically heated material during the grinding and exploding thereof.

It must be understood that my invention is not to be considered as limited in any way to the grinding or calcination of any particular material, or to processes for extracting any particular by-products from the material being ground. The application of electrically generated heat and the subjection of the material being processed to such heat during the grinding thereof, renders the machine and the processes involving its use practically unlimited in its uses.

In the drawing:—

Figure 1 is an elevation of my apparatus, parts thereof being shown in section;

Figure 2 is an elevation of one of the grinding plates of the apparatus; and

Figure 3 is an elevation of the other grinding plate.

As shown in the drawing, my invention comprises a base member 1 on which is mounted the grinding apparatus having the grinding disks 2 and 3 located immediately over the discharge hopper 4, formed in the base member 1. These grinding disks 2 and 3 are fixed, to rotate in opposite directions about aligned axes, on the shafts 5 and 6, respectively, rotatably mounted in suitable bearings 7, 8, 9 and 10. The bearing standard 7 is adapted to be slid lengthwise on the member 1 by means of the well-known worm and gear construction 11, operated in the usual way by the hand wheel 12, and to carry with it the shaft 5 and disk 2, in order to provide access to the grinding mechanism whenever it becomes necessary to renew, remove, or repair the parts thereof, or to adjust the grinding disks relatively to one another to vary the fineness of grinding. As so far described, this apparatus is old and well-known in the art.

The grinding disk 2 is provided with an annular recess 13 shaped to receive snugly the annular grinding plate 14, the disk and plate being detachably secured together by the usual bolt and nut connections. An electric heating coil 15 is located in an annular recess 16 in disk 2 between the plate and disk, and is connected for energization by means of the wiring 17 to the collector rings 18, suitably fixed on the shaft 5 and insulated therefrom. Brushes 19 are supported in contact with the rings 18 on an insulated bracket 20 extending laterally from the bear-

ing standard 8, and wiring 21 connects these brushes 19, through the rheostat 22 to any suitable source of electrical energy.

The disk 3 is formed centrally as a convex spider hub 23 provided with apertures 24, and the disk 2 is correspondingly concaved to receive the hub 23 and to form therewith a chamber 25 adapted to communicate with the feed hopper 26 through the said apertures 24.

The disk 3 is also provided with an annular recess 27, in which is arranged the heating coil 28, connected by wiring 29 to the collector rings 30 fixed to and insulated from the shaft 6. Brushes 31 in contact with rings 30 are supported from the insulated bracket 32 extending laterally from the bearing standard 10, and wires 33 connect these brushes 31 through a rheostat 34 to any suitable source of electrical energy.

The grinding plate 35 is adapted to be detachably fixed to the disk 3 in any suitable manner, and to be heated by the coil 28 to any desired temperature.

The usual feed gearing 36 of the hopper 26 is adapted to be operated by the pulleys 37 and 38 and the belt 39 from the shaft 6, and motors 40 and 41 are suitably connected to the shafts 5 and 6, respectively, to rotate them and their grinding disks in opposite directions.

In order to collect the gaseous vapors and other volatile by-products resulting from the grinding and heating of material in this apparatus, there is provided a collector hopper 42, connected by any suitable system of conduits to a condenser or any other instrument or apparatus designed to collect or utilize said by-products. This hopper 42 is connected by conduits 43 and 44 to the apertures 45 and 46, respectively, formed in the housing 47, the several parts of which are designed to provide ready access to the grinding mechanism.

The conduit 43 is provided with a support 48 carrying a motor 49 adapted to operate a blower 50, which may be regulated either to draw only gaseous or the lighter volatile products from the material being ground, or to draw over particles of any desired weight and to feed this material to the collector hopper 42, or wherever desired. When this blower apparatus is adjusted to withdraw only ground particles of a given weight, the endless conveyor C is arranged below the hopper 4 to carry off all the heavier particles from the grinding members. When the apparatus is adjusted to carry off only gaseous or the lighter volatile by-products, the conveyor C may be omitted and the ground product discharged directly from the hopper 4.

In order to control the temperatures of the grinding disks and to maintain them at any desired constant temperature, each grinding

disk is provided with a recess 51 in which is arranged a thermostatic control element 51' of any well known type and having one end thereof fixed to the heating element, with the free end of said element fixed to one end of a wire 52 extending from said free end through an axial bore of the shaft 5 or 6, as the case may be. The other end of wire 52 is connected rotatably to the lever arm 53 of an indicator 54 mounted to swing around a pivot 55 over the scale 57.

A lever 58, mounted to pivot about the pivot 59, has its lower arm 60 perforated to permit the wire 52 to pass freely there-through and to be engaged by clamping members 61, slidably mounted on the wire 52 and adapted to be secured in adjusted positions thereon by means of the set screws 62. The ends of the clamping members next to the arm 61 are made spherical in order to permit the lever arm 60 to swing about its pivot 59 as the wire 52 may be moved by the thermostatic element 51'.

The lever 58 has its upper end provided with a slot 63 adapted to receive slidably a pin 64 fixed to the lower lever arm of the rheostat control lever 65, which is mounted on the rheostat 22 to pivot about the pivot 66 and to swing over the contacts 67. As the thermostatic control is identical for each grinding plate, the several parts of each control have been designated by the same reference characters without describing the specific connection of said parts to each plate.

It is to be understood that either grinding plate may be held stationary and that the grinding operations may be effected by rotating one plate only relative to the fixed plate. In the small capacity commercial machines only one plate is rotatable. In any case, each plate of my apparatus should be equipped with electrical heating elements and the thermostatic control therefor. Each thermostatic element 51' is designed to bend or curl inwardly toward the plate opposite to the one carrying it, and this bending draws the wire 52 inwardly to make the indicator 54 traverse the scale 56 and indicate the temperatures of the heating elements or plates.

In order to effect the automatic control of the temperatures: in starting up the machine, the set screws 62 are loosened on the members 61 and the rheostat arm 65 is swung over to a contact 67 corresponding to the temperature desired. When the desired temperature has been reached, as indicated on scale 56, the clamping members 61 are slid up on wire 52 to contact with each side of the arm 60 and are fixed to the wire 52 by the set screws 62. It will be obvious that increase or decrease of temperature of the heating elements will move the wire 52 in one direction or the other, and, through the arm 58, will move the rheostat lever 65 to

decrease or increase the supply of electrical heating energy to the heating elements and thereby maintain the temperatures of said elements at the constant temperature shown on the indicator dial 57.

I claim:—

1. Grinding and dehydrating apparatus comprising a pair of plates having opposed grinding surfaces, means for relatively moving said plates, means for feeding material between said plates during the movements thereof, and non-fluid means carried by each of said plates for heating them.

2. Grinding and dehydrating apparatus comprising a pair of plates having opposed grinding surfaces, means for moving said plates relative to each other, means for feeding material between said plates during the movement thereof, non-fluid means carried by each of said plates for heating them, and means for controlling the temperature of said heating means.

3. Grinding and dehydrating apparatus comprising plates having opposed grinding faces, means for moving one of said plates relatively to the other, means for feeding material between said plates during the relative movements thereof, and non-fluid means carried by one of said plates for heating it.

4. Grinding and dehydrating apparatus comprising plates having opposed grinding faces, means for moving said plates relative to each other, means for feeding material between said plates during the relative movements thereof, and non-fluid means carried by each of said plates for heating it.

5. Grinding and dehydrating apparatus comprising relatively movable grinding plates having opposed grinding faces, and non-fluid means connected to one of said plates to heat it.

6. Grinding and dehydrating apparatus relatively movable comprising plates having opposed grinding faces, and non-fluid means connected to each of said plates to heat them.

7. Grinding and dehydrating apparatus comprising a plurality of plates having opposed grinding faces and mounted to rotate about a common axis of rotation, means for rotating said plates in opposite directions, means for feeding material between the grinding faces of said plates, and non-fluid means for heating said plates.

8. Grinding and dehydrating apparatus comprising a pair of plates having opposed grinding faces, means for rotating said plates relatively to each other, means for feeding material between said grinding faces, non-fluid heating means carried by said plates to heat them, and means for controlling the temperature of said heating means.

9. Grinding and dehydrating apparatus comprising plates having opposed grinding

faces, means for rotating said plates relatively to each other, means for feeding material between said grinding faces, and an electric heating element in one of said plates.

5 10. Grinding and dehydrating apparatus comprising plates having opposed grinding faces, means for relatively rotating said plates, means for feeding material between the grinding faces thereof, and an electric heating element in each of said plates.

10 11. In combination with the apparatus set forth in claim 9, means for controlling the temperature of said heating element.

15 12. The combination with the apparatus set forth in claim 10, of means for controlling the temperatures of each heating element.

20 13. In a grinding machine, a grinding member, non-fluid means carried by said member to heat it, means controlling the temperature of said heating means, and means connected to said heating means to indicate the temperature thereof.

25 14. The instrument set forth in claim 13 in combination with means connecting the indicating and controlling means to maintain the temperature of the heating means at any desired constant temperature.

30 15. In a grinding machine, a grinding member, an electric heating element carried by said member to heat it, a rheostat controlling the temperature of said element, and means connected to said element to indicate the temperature thereof.

35 16. The combination with the instrument set forth in claim 15 of means connecting the rheostat and the temperature indicating means to maintain the heating element at any desired constant temperature.

40 17. In a grinding machine, a grinding member, non-fluid means carried by said member to heat it, and means adjustably connected to said heating means to control the temperature thereof and to maintain the heat thereof at any desired constant temperature.

45 18. In grinding apparatus, a plurality of grinding members having opposed grinding faces and mounted to rotate in opposite directions about a common axis of rotation, a heating element carried by each of said plates, means independent of each other to control the temperature of each element, and means connected to each element to indicate the temperatures thereof.

50 19. The combination with the apparatus set forth in claim 18 of means adjustably connecting the temperature controlling and indicating means to maintain the temperature of either or both elements at any desired constant temperature.

55 20. That process of comminuting material which consists in grinding the material, spatially confining the material during the grinding thereof, and applying heat at a

predetermined temperature to said material during the spatial confinement thereof to explode the ground particles thereof.

21. Grinding apparatus comprising a support, a pair of axially alined shafts journaled in said support, said shafts being axially bored, grinding members fixed to said shafts with grinding faces opposed to each other, a heating element in each member, a thermostat connected to each element, a temperature indicator outside each shaft, and means passing through the bore in each shaft to connect each thermostat operatively to one of said temperature indicators.

22. Grinding apparatus comprising a support, a pair of axially bored and alined shafts, grinding members fixed to each shaft with grinding faces opposed to each other, a heating element in each member, means outside of each shaft and passing through the bore thereof to control the temperature of each element, a temperature indicator outside each shaft, and thermostatic mechanism passing through the bore of each shaft to connect a temperature indicator operatively to each heating element.

23. The combination with the apparatus set forth in claim 22 of means adjustably connecting each temperature indicator to a temperature controlling means to maintain the temperature of either or both elements at any desired constant temperatures.

24. Grinding apparatus comprising opposed grinding members, electrical means for heating each of said members, and settable means connected to said heating means to predetermine the temperatures of said heating means and to maintain said heating means at any of such predetermined temperatures as desired.

In testimony whereof I have signed my name to this specification.

HARRY WILSON MOIR.