May 19, 1925.

1,538,791

W. FOWLER

GRINDING MILL

Filed July 28, 1923

2 Sheets-Sheet 1

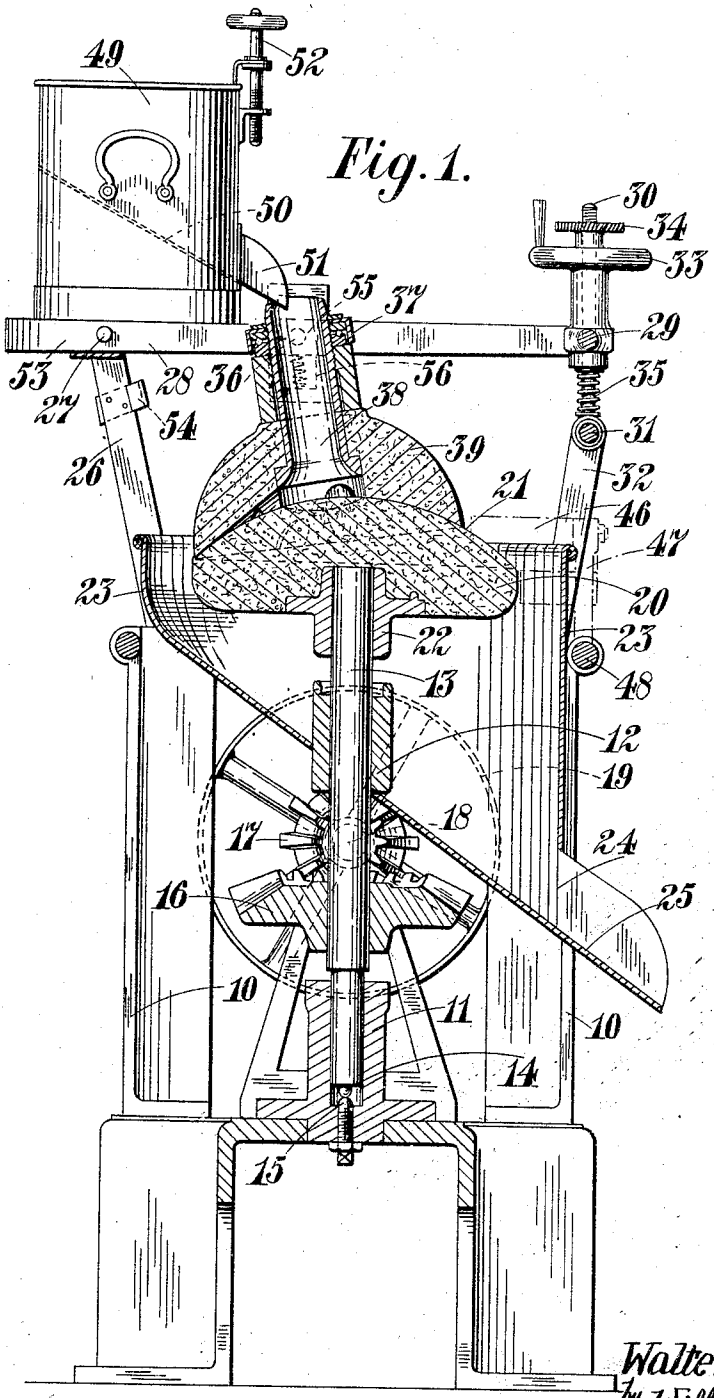


Fig. 1.

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2 Sheets-Sheet 2

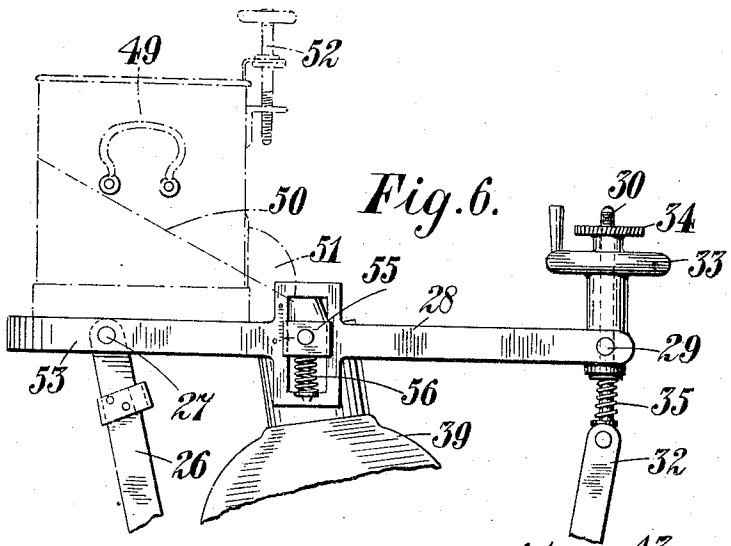


Fig.6.

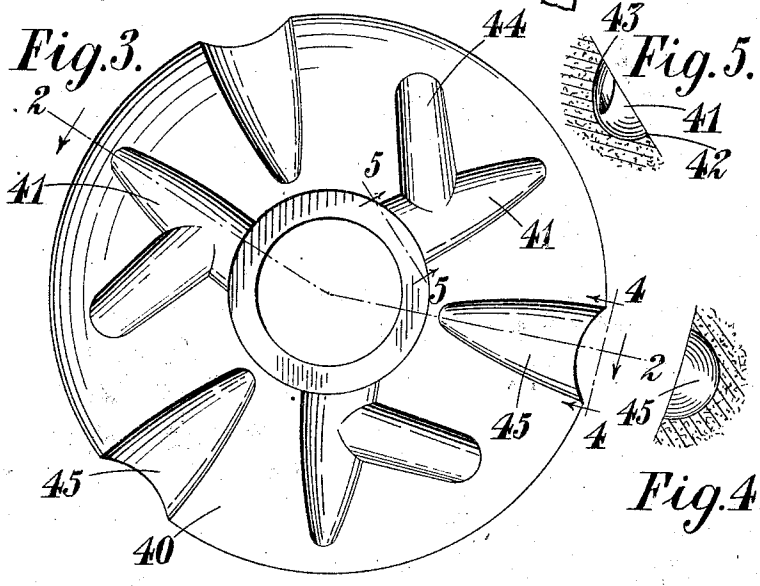


Fig.3.

Fig.5.

Fig.4.

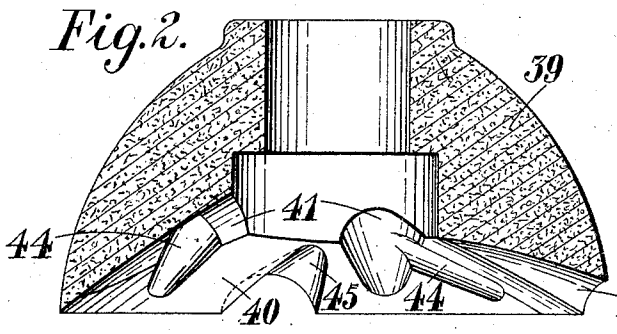


Fig.2.

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Patented May 19, 1925. 1,538,791

UNITED STATES PATENT OFFICE.

WALTER FOWLER, OF LONDON, ENGLAND.

GRINDING MILL.

Application filed July 28, 1923. Serial No. 654,460.

To all whom it may concern:

Be it known that I, WALTER FOWLER, a subject of the King of England, residing at London, England, have invented certain new and useful Improvements in Grinding Mills, of which the following is a specification.

This invention is for improvements in or relating to grinding mills suitable for grinding paint, colours or any other materials. The invention is applied to grinding mills of the type comprising two grinding elements whereof one is positively driven and the other, having surface contact therewith, is free to rotate about an axis that is not coaxial with the axis of rotation of the first member, and receives a drive only by its frictional engagement with the said first member.

This invention comprises a grinding mill of the type described wherein the grinding surfaces are of spherical curvature about the same centre, and are rotatable about fixed axes inclined to one another.

According to another feature of this invention, the operative surface of the positively driven grinding member subtends a solid angle of 90 degrees, and the second member which is driven frictionally from the first member, is smaller, for example, the greatest length of chord on it is about five-sixths of the length of the corresponding chord of the first member, and the axis of rotation of the second member is inclined to the axis of rotation of the first member by such an amount that their peripheral edges coincide at one point.

Provision may be made for adjusting the axes of rotation of the two grinding members relatively to one another if so desired, it being appreciated that once the adjustment has been made the axes remain in the same relative positions throughout the grinding operation, and that there is no continuous or automatic adjustment of the axes relatively to one another during the operation.

Other details of the invention will be hereinafter described with reference to a specific embodiment thereof, and the novel features pointed out in the claims appended to this specification.

In the accompanying drawings—

Figure 1 is a side elevation in central section of a grinding mill according to this invention;

Figure 2 is a sectional view of one of the grinding elements, being a section on the line 2—2 of Figure 3;

Figure 3 is a view looking on the underside of the grinding element shown in Figure 2;

Figures 4 and 5 are detail views on the lines 4—4 and 5—5 of Figure 3; and

Figure 6 shows a detail of the mounting of the upper grinding-member.

Like reference characters indicate like parts throughout the drawings.

Referring first to Figure 1, the machine comprises a suitable frame 10 provided with bearings 11, 12 for a vertical shaft 13. The shaft may be supported in any convenient manner, conveniently by a pin 14 in its lower end, formed with a rounded end engaging a similar pin 15 screwed into a convenient part of the machine. The height of the shaft 13 can be adjusted if desired by means of the pin 15.

This shaft has secured upon it a bevel-wheel 16 which meshes with and is driven by another bevel-pinion 17 mounted on a horizontal shaft 18, and this latter shaft also carries fast-and-loose-pulleys 19, for a belt drive, or is otherwise connected in any suitable manner to appropriate driving means.

At the upper end of the shaft 13 there is mounted a grinding member 20. This member which is rotatably secured to the shaft is formed with its upper surface 21 of a spherical curvature, the centre of curvature lying on the axis of rotation of the shaft 13. Preferably the proportions of the member 20 are such that its spherical surface 21 subtends a solid angle of about 90 degrees, and this member may be formed of any convenient or desired thickness to make provision for wear.

In the form illustrated, this member is made of stone, such as granite, and it is secured to the shaft by means of a socket-member 22 which is sunk into a central opening on the stone and is secured centrally therein in any convenient manner, as for example, by aligning it correctly and then pouring in cement. The socket may be formed with projections to engage the stone and provide a positive driving connection and is itself bored to fit on the upper end of the shaft. The shaft may be tapered if so desired, or provided with a key or keys.

A sheet-metal casing 23 is arranged to

encircle the grinding-member 20 completely, and preferably extends above the upper peripheral edge of this member so as to catch any material thrown off it during rotation. The lower end of the casing is open as at 24, and is provided with a convenient chute 25.

Upon the frame 10 there is mounted an upstanding bracket 26 which has pivoted on it at its upper end 27 a pair of members 28 which extend across the grinding member. At their free ends these members are connected by a tie-rod 29 which is bored to receive a screw-threaded spindle 30 pivotally mounted on a rod 31 carried on brackets 32 upstanding from the frame 10. A hand-wheel 33 provided with a locking-nut 34 engages the screw-threaded spindle so that the position of the members 28 can be adjusted relatively to the grinding member 20. A spring 35 is provided on the lower end of the spindle 30 to serve as an abutment against which the members 28 are swung downwards.

These members 28 are slotted transversely of their length to receive slide-blocks 55 which are supported on the levers 28 by springs 56 (see Figure 6). The blocks 55 engage trunnions 36 on a casing 37 which serves as a housing for a ball-thrust bearing wherein there is rotatably mounted a hollow member 38. This member constitutes the support for the upper grinding element 39, which is made of stone or any other desired material, and is in the form of a cap, being spherically curved on its under concave face, to the same radius as the grinding member 20.

It will be seen that if the members 28 (Figure 6) are swung upwards, the springs 56 will be compressed so as to take part of the weight of the element 39 and thereby reduce the pressure which it exerts on the lower element 20. A pointer and scale are provided on the member 28 and block 55, and the scale is calibrated in any convenient manner to indicate the pressure exerted by the element 39 on the element 20, or in other words, to indicate the grinding pressure. The member 39 is secured on the rotatable hollow shaft 38 in any convenient or desired manner, and the trunnions 36 are so disposed that when the two grinding elements are in engagement with one another their axes of rotation are not in the same straight line, but are slightly inclined to one another. The grinding surface of the member 39 is somewhat smaller than that of the member 20, being, for example, such that the ratio of the lengths of their chords is as 5 is to 6, and the trunnions 36 are so disposed that when the grinding members are in contact with one another their peripheral edges are substantially co-incident, as shown at the left-hand side of Figure 1. Since the grinding member 39 is free to rotate about its own axis, when a drive is imparted to the member 20, the frictional engagement between the two members transmits a drive to the member 39, but owing to its obliquity and eccentricity there is a relative rubbing or grinding movement between the two surfaces in contact with one another.

The grinding member 39 is further illustrated in Figures 2, 3, 4 and 5. Its concave spherical grinding face 40 is provided with two series of grooves or channels. One series extend from the inner edge of the grinding surface, as shown at 41, in a radial direction, and are tapered from the inner to the outer ends. The groove is of curved cross-section, as shown in Figure 5, but it is not symmetrical, the edge 42, which leads in the direction of rotation, being substantially a right-angled edge whilst the trailing edge 43 is oblique. Each of the grooves 41 has a branch 44 extending laterally from it on that side which is rearwards in the direction of rotation. These constitute the inlet passages for the material to be ground, as hereinafter described.

There are also provided outlet passages 45 which extend in a substantially radial direction from the outer periphery of the grinding surface, and these grooves are symmetrical in their cross-section as shown in Figure 4, tapering from their outer to their inner ends. The grinding element 39 is secured upon the rotatable hollow shaft 38 in such a manner that communication is provided from the interior of the shaft to the inlet grooves 41, 44, so that material fed in through the shaft can pass by way of these grooves in between the grinding surfaces. The tapering edge 43 aforesaid of the inlet grooves is on the trailing side, in order to facilitate the entry of the material between the grinding surfaces, and the trailing passages 44 also serve the same purpose. The grinding takes place between the two spherical contacting surfaces, and the material when ground is collected in the outlet grooves 45, and subsequently delivered to the periphery of the member 39. It spreads over the whole surface of the lower grinding member 20, and is collected therefrom by means of any convenient form of scraper 46 which delivers it to the chute 25. This scraper may be mounted in any convenient manner, being, for example, as indicated, carried by an upstanding arm 47 on the frame-member 48.

A platform or stand may be provided on the members 28, to receive a vessel 49 which contains the material to be ground. As illustrated, this vessel is provided with a sloping bottom 50, which leads down to a chute 51, and a valve is provided in the vessel to control the outlet therefrom, the valve being operated by the screw-threaded spindle 52.

The chute 51 is so disposed as to deliver the material into the upper open end of the hollow shaft 38 to introduce the material into the mill.

In the operation of this mill, the parts are arranged as illustrated in Figure 1, and the material to be ground is fed from the vessel 49 through the hollow shaft 38 and inlet passages 41, 44 between the grinding surfaces. It is collected from the surface 21 of the lower element by the scraper 46 and delivered through the chute 25. When it is desired to clean the mill, the vessel 49 is removed, the hand wheel 33 is also removed, and the members 28 can then be swung up, carrying with them the upper grinding member 39. The ends 53 of these members 28 engage a stop 54 on the frame-member 26 to retain the parts in a convenient position, and then both of the grinding surfaces are fully exposed and easily accessible. When the parts are replaced, the degree of fineness to which it is required to effect the grinding is determined by screwing down the hand-wheel 33 to a greater or less extent, to vary the pressure between the grinding surfaces.

If it is desired, provision may be made for altering the obliquity of the axis of rotation of the grinding member 39, for example, by arranging that the frame member 26 can be swung about a horizontal axis. It will be appreciated that in a grinding mill constructed in accordance with this invention, the wear is distributed uniformly over the whole of each of the grinding surfaces, so that they maintain their true spherical surfaces, and never require to be trued up, as is the case with other forms of mill. Moreover, owing to the fact that the drive is transmitted frictionally from one element to the other, a certain amount of slip takes place, and this assists in maintaining uniformity of wear.

The form of the grinding surfaces hereinbefore described, and illustrated, is suitable for grinding such materials as paints, but this invention also covers other forms of grinding surfaces, according to the materials which are to be treated. Thus, for example, instead of using smooth spherical surfaces, these surfaces might be corrugated, each concentrically with its own axis, if so desired, and all such modifications are held to lie within the scope of this invention.

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

1. In a grinding mill, the combination of a spherically-curved grinding element, means for rotating it about an axis passing through its centre of curvature, a second grinding element curved concentrically with the first element and bearing frictionally thereon, said second element being rotatable about an axis which is inclined to the axis of rotation of the first element and being driven frictionally thereby.

2. In a grinding mill, the combination of a convex spherically-curved grinding element whereof the spherical surface subtends a solid angle of 90 degrees, means for rotating said element about a fixed axis which passes through its centre of curvature, a concave concentrically-curved grinding element subtending a smaller solid angle than the first element, resting upon the first element and rotatable about an axis inclined to the axis of rotation of the first element.

3. In a grinding mill, the combination of a convexly-curved spherical grinding element that is symmetrical and rotatable about a vertical axis, a concave concentrically-curved grinding element resting thereon and rotatable about an axis inclined to the axis of the first element, means for rotating the first element, and means for indicating the pressure exerted by the second grinding element on the first grinding element.

4. In a grinding mill, the combination of a convexly-curved spherical grinding element that is symmetrical and rotatable about a vertical axis, a concave concentrically-curved grinding element resting thereon and rotatable about an axis inclined to the axis of the first element, means for rotating the first element, resilient means for raising the second grinding element from the first grinding element and means for indicating the pressure exerted by the said resilient means, substantially as set forth.

5. In a grinding mill, the combination of a vertical shaft, means for rotating it, a convex spherically-curved grinding element secured symmetrically upon the upper end of said shaft, a concave grinding element of equal curvature but smaller diameter resting on the convexly-curved surface with its peripheral edge at one point lying substantially on the peripheral edge of the lower grinding element, a shaft inclined to the said vertical shaft whereon said upper grinding element is rotatable, compression springs supporting said inclined shaft, a lever supporting said springs, means for adjusting said lever to vary the pressure exerted by the upper element on the lower element, and means for supplying material to be ground to a central cavity in the upper grinding element.

In testimony whereof I affix my signature.

WALTER FOWLER.