

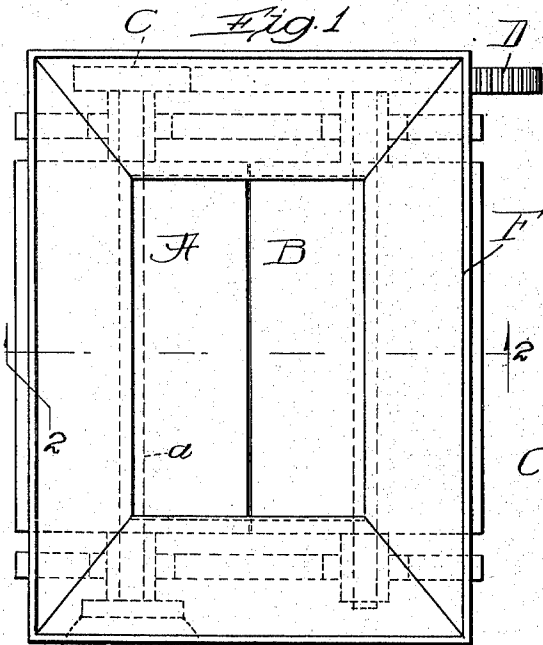
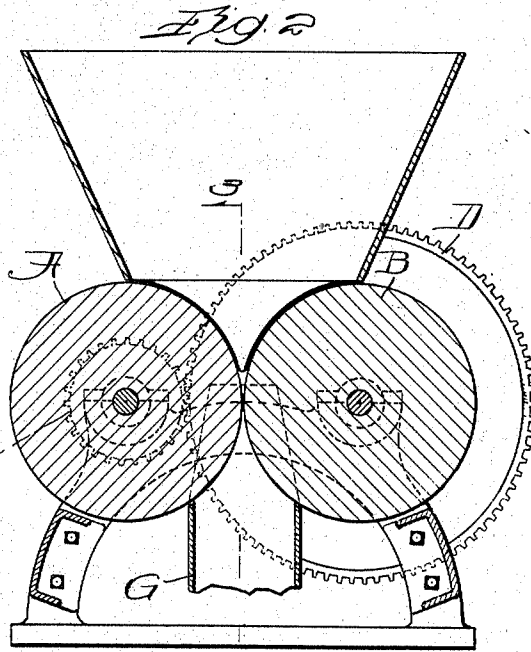
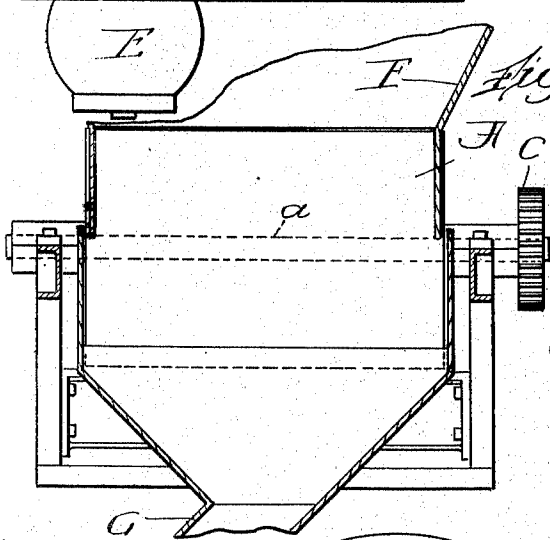
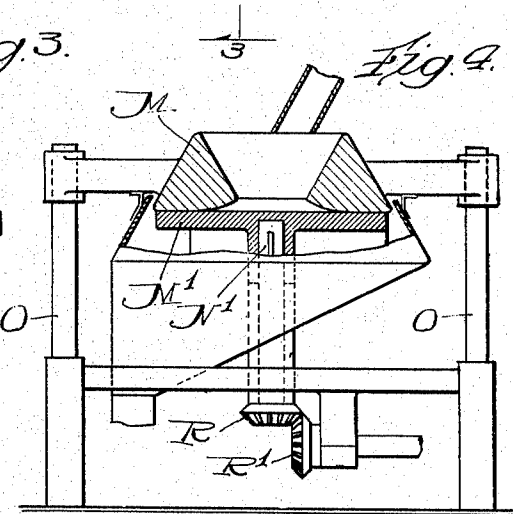
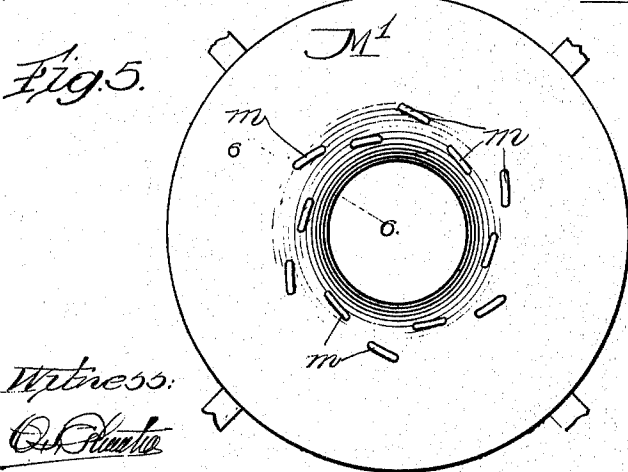
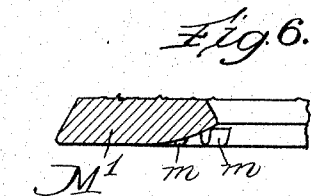
R. FORSYTH.

GRINDING INSTRUMENTALITY AND PROCESS OF PRODUCING SAME.

APPLICATION FILED SEPT. 29, 1917. RENEWED SEPT. 23, 1918.

1,308,007.

Patented June 24, 1919.



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UNITED STATES PATENT OFFICE.

ROBERT FORSYTH, OF HANCOCK, MICHIGAN.

GRINDING INSTRUMENTALITY AND PROCESS OF PRODUCING SAME.

1,308,007.

Specification of Letters Patent.

Patented June 24, 1919.

Application filed September 29, 1917, Serial No. 193,914. Renewed September 23, 1918. Serial No. 255,382.

To all whom it may concern:

Be it known that I, ROBERT FORSYTH, a citizen of the United States, residing at Hancock, in the county of Houghton and State of Michigan, have invented new and useful Improvements in Grinding Instrumentalities and Processes of Producing Same, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide an improved instrumentality or device for grinding and pulverizing hard material, and a process or method of producing and maintaining such instrumentalities. It consists in the elements and features of formation of the instrumentalities described, and the steps of the process for producing it, as fully set out and indicated in the claims.

In the drawings:—

Figure 1 is a top plan view of a structure comprising grinding instrumentalities produced according to and embodying this invention.

Fig. 2 is a section at the line, 2—2, on Fig. 1.

Fig. 3 is a section at the line, 3—3, on Fig. 2.

Fig. 4 is a partly sectional side elevation of a different structure from that shown in the preceding figures; and embodying the invention in a different form.

Fig. 5 is a bottom plan view of the fixed grinder.

Fig. 6 is a detail section at the line, 6—6, on Fig. 5.

In the form of this invention which is illustrated in Figs. 1, 2 and 3, A and B, are parallel-mounted cylinders being as shown of the same diameter, though this is not essential, the cylinders being mounted in bearings for revolving in contact, and geared together for revolving in opposite directions about their respective axes, whereby they revolve in the same direction at their proximate sides in contact. C and D are the gears by which the two cylinders are geared together for rotation of one of them at a much higher speed than the other. As illustrated, the ratio of their speeds is as 3 to 1. An electric motor, E, is represented driving the shaft, *a*, of the cylinder, A, which has the higher speed. Any other mode of communicating driving power

which is found convenient may be employed. F is a hopper by which the material to be ground is fed between the two rolls at their upper side. G is a spout by which the ground material is delivered from between the rolls at the lower side.

The essential characteristic of the grinding cylinders, A and B, is that as to their outer portion affording the grinding surfaces, they are made of soft metal, preferably soft iron, into which the very fine granules or dust particles of the material treated become embedded, furnishing a self-reproducing grinding surface.

Previous to this invention, so far as I am aware, grinding and crushing devices consisting of two parts rolling together for gripping the material to be grated between them, have been operated either upon the principle that the material to be ground must be crushed by the hardness of the rolls,—this principle calling for the making of the rolls as hard as possible,—or upon the principle that the rolls or feeding devices being hard enough, generally speaking, to crush the material treated, should be soft enough so that particles of considerable size gripped between them may be embedded in them and carried through by the grip resulting from such embedment, the two rolls or other form of devices coöperating, having the same speeds at their engaging surfaces. I have found that with hard rolls, no adequate feeding engagement of the material is obtained to make the devices effective for rapid grinding or pulverizing of the material treated, and that with rolls soft enough to cause hard particles to be impressed into them, the rolls revolving at the same speed, there is an entirely inadequate grinding effect produced, because all the harder particles will be passed through by embedment, being dropped upon the farther side, leaving the roll full of pits or cavities, in which subsequently-arriving particles are engaged even when they would otherwise be crushed; so that the resulting output of such a machine comprises only a small proportion of material which is ground fine.

The principle of construction and operation of the devices embodying the present invention and of the process which constitutes the essence of the invention is, that the material treated, as it is crushed between the

cooperating rolls or other form of crushing devices employed, is ground into the surface of the soft metal of the rolls, by the rubbing of the one roll upon the other due to their difference of circumferential speed. This results in the creation of a new surface upon the rolls, rendering them self-feeders by reason of the fine roughness of this surface, resulting from the particles of the material first crushed and ground, not being simply pressed into the soft metal, but being ground down fine by the rubbing of the two rolls of different speeds upon each other. This process causes the embedded dust particles to be uniformly distributed over the surface of the rolls, and interwoven with the soft metal of the rolls by the drawing of the latter, due to the rubbing of the rolls upon each other; and there is thus developed upon the roll a skin of material much harder than the original substance of the roll, and which affords a feeding surface for gripping the subsequently-entering material and causing it to be crushed between the rolls without leaving behind any unfilled holes. The exterior stratum of the rolls which may be referred to as a "skin", soon reaches a maximum thickness, consisting substantially of very fine particles of the material crushed, completely inter-penetrating and being inter-penetrated by the original soft metal of the rolls. This stratum is both tough and hard and has a grinding and abrasive quality which thereafter gains from the material crushed as much as it loses from the resistance of that material in its operation, so that after very extended use, there is not discoverable any perceptible or measurable diminution in the weight or dimensions of the rolls. In addition to this quality of self-maintenance by use, I have found that such grinding rolls or disks have scarcely any observable tendency to become heated in operation; which indicates that probably there is a constant interchange of the granular or pulverulent material which is ground into the rolls, so that the stream of material delivered from them constantly, comprises a portion which has been previously ground into the rolls and afforded the grinding surface, and which in being supplanted by subsequently-arriving material, carries away the heat developed by the process, the supplanting particles being relatively cold; and the operating surface of the rolls at all times seems to be substantially cold, notwithstanding the heavy work which is performed.

One form of the invention is shown in my copending application No. 138,557, filed December 23, 1916, in which the specific construction there shown is claimed, and that specific construction is not to be claimed herein, it being the purpose of this application to claim a grinding or pulverizing ele-

ment having the grinding surface of the character above described, and the process of producing such grinding element which is above described, and is exemplified in the different forms of device herein shown.

In the form of the structure shown in Figs. 4, 5 and 6, instead of two cylinders revolving in contact at different speeds, there is shown a fixed disk, M, and a revolving disk, M¹, the cooperating faces of the two disks being substantially horizontal, and the material being delivered through a central aperture in the fixed disk, which thereby forms a hopper, onto the upper face of the revolving disk which is below the fixed disk, and being distributed out over that lower disk by the centrifugal force resulting from rotation of that disk at comparatively high speed, the two disks having their faces sloped,—or at least one of them being sloped, so that being slightly separated at the inner circumference of the fixed disk or margin of the hopper, they approach each other from that point outward, and are in substantial rubbing contact for a portion of their surfaces toward the outer circumference. The detail construction of the form shown in these Figs. 4, 5 and 6, requires no further description beyond the statement of the fact that the upper one is provided with fixed supports, indicated by the standard, O, and that the lower one having its shaft, N¹, suitably stepped in the support is provided with means for rotating it, indicated in a general way by bevel gears, R¹, R¹.

Incidentally it may be pointed out that at m there are shown in the fixed disk, M, deflecting protuberances which are designed to prevent excessively hard substances which may be in the material treated from becoming inextricably wedged between the disks and separating their surfaces which should be in grinding relation to each other.

I do not in this application make claim for the specific construction of the grinding machine illustrated, claims for this construction being made in a divisional application showing these machines more fully in detail.

I claim:—

1. The process of producing a grinding surface which consists in revolving one soft metal body relatively to another in contact therewith, engaging between them at their surfaces while thus in contact and moving relatively to each other, hard material adapted to be rendered pulverulent by pressure and abrasion; whereby the particles of pulverulent material are embedded into the soft metal and the latter drawn about them by the rubbing of the two bodies upon each other.

2. The process of producing a grinding surface which consists in revolving two soft metal bodies in contact with each other at

different speeds at their areas of contact and engaging between them as they thus revolve, a hard material adapted to be rendered pulverulent by pressure and abrasion; 5 whereby the particles of pulverulent material are embedded in the soft metal and the latter is drawn around said particles in each of the revolving bodies, in the direction of the relative rotation of the other of 10 them.

3. A grinding and pulverizing instrumentality, consisting of a soft metal base adapted to be mounted for rotation about an axis, and having a surface generated by a 15 line revolving about said axis, said surface being formed by pulverulent material embedded in the soft metal, and having the

latter drawn between and about the particles of said material.

4. In a grinding and pulverizing instrumentality, comprising a pair of solids of 20 revolution of soft metal mounted for revolution about their respective axes with their surfaces of revolution in contact; means for delivering between them hard material 25 adapted to be rendered pulverulent by crushing, and means for rotating said metal bodies at different speeds at their areas in contact.

In testimony whereof I have hereunto set 30 my hand at Chicago, Illinois, this 20th day of September, 1917.

ROBERT FORSYTH.