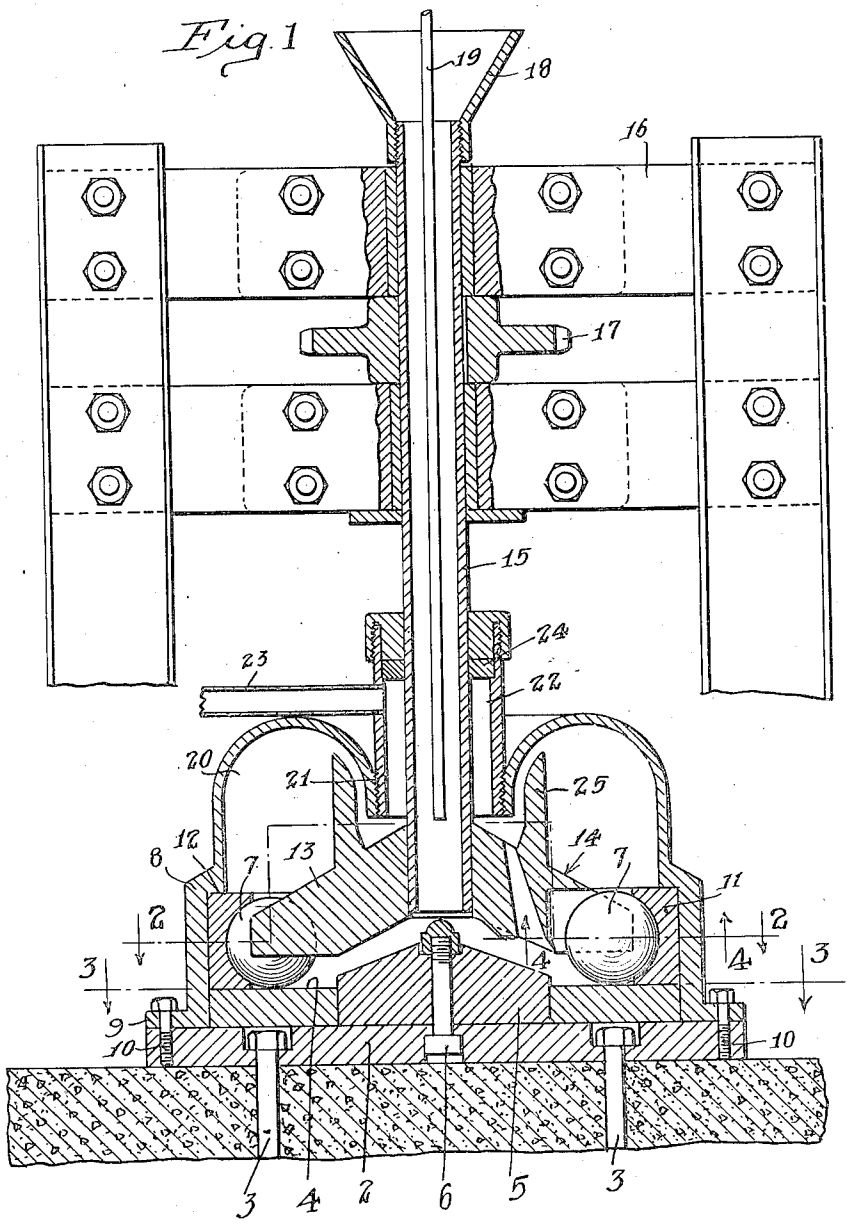
Aug. 24, 1943. W. G. CLARK 2,327,402

GRINDING MILL

Filed June 10, 1940 2 Sheets-Sheet 1

Fig. 1



Inventor

Walter Gordon Clark

By Lyon & Lyon

Attorneys

Aug. 24, 1943. W. G. CLARK 2,327,402

GRINDING MILL

Filed June 10, 1940 2 Sheets-Sheet 2

Fig. 2

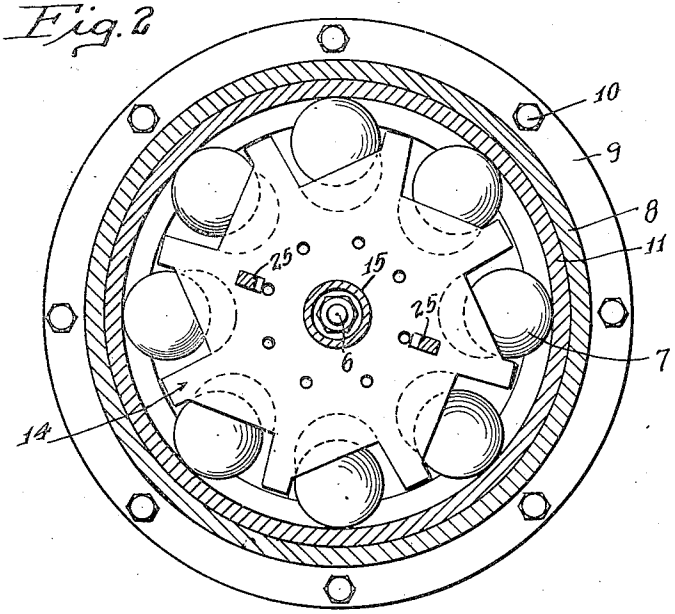


Fig. 3

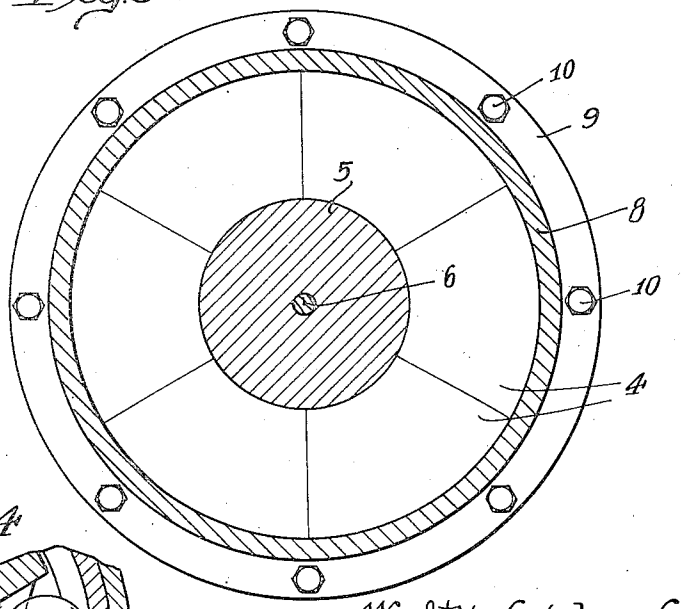
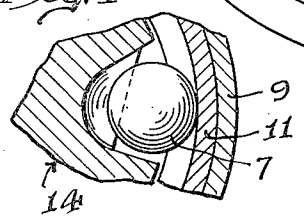


Fig. 4



Inventor

Walter Gordon Clark

By Lyon & Lyon Attorneys

Patented Aug. 24, 1943

2,327,402

UNITED STATES PATENT OFFICE

2,327,402

GRINDING MILL

Walter Gordon Clark, Los Angeles, Calif., assignor to Clarkiron, Inc., Los Angeles, Calif., a corporation of Nevada

Application June 10, 1940, Serial No. 339,712

2 Claims. (Cl. 83—45)

This invention relates to a grinding mill, and refers particularly to a mill intended for grinding or pulverizing sponge metal, such as sponge iron, to a fine powder. The apparatus may be used for pulverizing other materials, such as paint pigments, or other materials intended for reduction to a fine or powdered form.

Sponge iron, such as produced by the process and apparatus described in my Patents Nos. 2,144,618 and 2,166,207, when reduced to a fine powder may be used in producing metallic parts under hydraulic pressure, and there is at present a considerable demand for powdered iron adaptable for the production of metallic parts by hydraulic compression. Heretofore, the production of a fine powder from material such as sponge iron has presented a difficult problem. When attempts are made to grind sponge iron into a powder in the familiar types of grinding mills, the particles of sponge iron are usually hammered or compressed into pieces which are later ground into powdered iron only with great difficulty.

It is a general object of the present invention to provide a grinding apparatus capable of acting on such materials as sponge iron and operative through an abrasion action to quickly reduce the same to a powdered form while impacting of the sponge material to a solid form difficult to grind is avoided.

A further object of the present invention is to provide a grinding apparatus capable of continuous operation and by means of which the intended material to be ground may be continuously supplied and retained in the grinding apparatus until reduced to the desired powdered form, and which apparatus will continuously discharge only the desired powdered product.

The apparatus of the present invention consists essentially of a chamber having a horizontal base or floor supplied with removable and replaceable hard wear members to take the wear off the grinding members and materials subjected to the pulverizing action. The grinding members consist of a number of balls of iron, steel, or other material of a proper degree of hardness and resistance to fracture. The balls are rotated on the horizontal floor of the grinding equipment and caused by centrifugal force to contact with more or less vertical walls of the grinding chamber. The balls are propelled by a vane or spider on a multitude of projections in contact with the ball or balls and propelling the said ball or balls in a horizontal plane and causing the same to move outwardly by centrifugal force against the more or less vertical wall of the grinding chamber, which preferably is somewhat concave to conform with the curvature of the grinding members.

The feed for the grinding apparatus accompanied by a carrier, which may be either gas or liquid depending upon the nature of the material to be ground, enters the center of the grinding chamber, filling the grinding chamber, while the heavier particles of the material to be comminuted move outwardly under the action of the centrifugal force towards the periphery of the grinding chamber where such heavy particles are subjected to an abrasive grinding action capable of reducing the heavier particles to a fine powder. The outlet for the product is provided near the center of the grinding chamber and the fine particles only are carried by the carrier towards the center against the action of the centrifugal force so as to be discharged with the continuous discharge of the carrier.

The grinding mill of the present invention, together with various additional objects and advantages of the same, will be more clearly understood from a description of a preferred form or example of the grinding mill embodying the invention, and for this purpose I have hereinafter described in connection with the accompanying drawings one form or example of a grinding mill embodying the invention.

In the drawings:

Figure 1 represents an elevation partially in section.

Figure 2 is a section on the line 2—2 of Figure 1.

Figure 3 is a section on the line 3—3 of Figure 1.

Figure 4 is a fragmentary section on the line 4—4 of Figure 1.

Referring to the drawings, the grinding mill comprises a horizontal floor 2, which is indicated as anchored in place by the bolts 3. Mounted on the floor 2 are provided the removable and replaceable hard wear members 4 to take the wear off the grinding members and materials subjected to the pulverizing action. The members 4 are indicated circumferentially surounding a central hard steel wear block 5 held to the floor, as indicated at 6, the upper surface of which tapers downwardly and outwardly to direct the incoming material onto the faces of the two members 4. Grinding members 7 are indicated consisting of a number of balls of iron or steel, or other material with the proper degree of hardness and resistance to fracture. The grinding members 7

are rotated on the horizontal floor of the grinding equipment in contact with the vertical or peripheral walls of the grinding chamber. The vertical walls of the grinding chamber are provided by a hood 8 having a flange 9, by which it is bolted to the floor 2, as indicated at 10, and the vertical walls are likewise provided with removable or replaceable wear members 11, which in the preferred form of the invention have concave inner faces conformed with the curvature of the grinding member 7. The hood 8 is preferably provided with a shoulder 12 to bear against the wear members 11 and thereby clamp the two members 11 and 4 against the floor 2.

The grinding members 7 are propelled by vanes 13 of a spider 14. The spider 14 is mounted on a hollow shaft 15 which serves also as an intake conduit for the material entering the grinding chamber. The hollow shaft 15 discharges in the center of the grinding chamber below the spider 14 and immediately above the block 5. The spider 14 and hollow shaft 15 are supported by a frame 16 of any preferred or suitable construction and are there provided with a gear 17 by means of which the same may be rotated by an electrical motor or by any other suitable or preferred form of prime mover.

At its upper end the hollow shaft 15 is provided with a hopper 18 by means of which the material to be ground, such as sponge iron, may be fed to the grinding mill and through the hollow shaft 15, and close to the lower end thereof is a pipe 19 by which a gaseous or fluid carrier may be supplied for carrying the material into and through the grinding chamber. It is understood that in case a gaseous medium, such as air or an inert gas, is employed as a carrier either negative pressure may be applied to the outlet 23 to cause the flow of the carrier through the grinding chamber or a high velocity jet may be used on the end of the intake pipe 19.

The hood 8 of the grinding chamber is indicated as rising considerably above the level of the grinding members 7 to provide a dome-shaped collection chamber 20, and the hood 8 is indicated as connected by threads 21 to a discharge tube 22 surrounding the hollow shaft 15 and communicating with the discharge line 23. Suitable packing means 24 are indicated between the discharge tube 22 and hollow shaft 15 for preventing the escape of the carrier along the hollow shaft. For opposing the discharge of the unpowdered material from the grinding chamber the impeller 14 may be provided with a fan formed by vanes 25, which extend upwardly from the impeller at a point close to the outlet from the grinding chamber.

In the operation of the grinding mill the feed enters the grinding chamber through the hollow shaft 15 propelled either under the impulse of compressed air or other gas, under pressure or vacuum, or propelled by water or oil or other fluid of the required nature. The fluid or carrier whether gaseous or liquid moves with the feed material to be ground against the wall of the pulverizing chamber where the grinding members 7 are moving under centrifugal force so as to thereby roll over the material to be ground, thereby crushing, grinding, and reducing the same to a pulverant or a powdered form. The gaseous or liquid carrier within the grinding chamber is caused to move in a circular path by the action of the impeller spider 14. The carrier in operation is caused to fill the grinding chamber and the pressure of the additional entering carrier causes the carrier to move towards the center or driving shaft against the centrifugal force to the outlet 22, from which it is continuously discharged from the grinding chamber. Simultaneously, the finely ground pulverant or powdered material is carried with the limited carrier current through the exit while the larger particles which have not yet been reduced to a pulverant or powdered condition are retained by centrifugal force in position to be continuously subjected to the grinding or pulverizing action of the ball 7.

One advantage of the apparatus of the grinding mill of the present invention is in fact that it is so constructed that the entire housing 8 with the accompanying steady bearings and gear may be readily lifted free from the grinding members or balls to facilitate replacement of these members or the wear plates within the grinding chamber as conditions of operation may require.

While the particular form of grinding mill herein described is well adapted to carry out the objects of the invention, it is to be understood that various modifications may be made and the invention includes all such changes and modifications as come within the scope of the appended claims.

I claim:

1. A grinding mill comprising a grinding chamber formed by a floor and a detachable and upwardly moving hood providing an annular side wall for said chamber, replaceable wear plates for the floor and side wall of said grinding chamber, a spider mounted upon a hollow shaft for rotation within said grinding chamber, balls individually separated by said spider and arranged in a single circular series and contacted by said spider for positive movement in a horizontal plane and under centrifugal pressure against the wear plates of the side wall of said grinding chamber, said hollow shaft serving as an inlet to said grinding chamber and a concentric outlet for said grinding chamber, above said spider.

2. A grinding mill comprising a grinding chamber formed by a floor and a detachable hood member providing an annular side wall for said chamber, a wear plate on said floor, concave annular wear plate for the side wall of said hood, grinding balls each contacting said wear plates and mounted for movement in a horizontal plane and free to move outwardly under centrifugal force into grinding pressure with the wear plate against said side wall, the hood forming an enlarged chamber above said grinding balls, a spider having a hollow shaft positioned for rotation within said grinding chamber and in contact with said balls for positive rotation thereof, a discharge outlet surrounding said hollow shaft and leading upwardly from the enlargement of said grinding chamber, said spider having vane members extending into the enlargement of said grinding chamber adjacent said outlet.

WALTER GORDON CLARK.