Nov. 24, 1925. 1,562,618

H. K. BURCH

GRINDING SYSTEM FOR ORE, ROCK, ETC

Filed April 1, 1924 2 Sheets-Sheet 1

Fig. 1

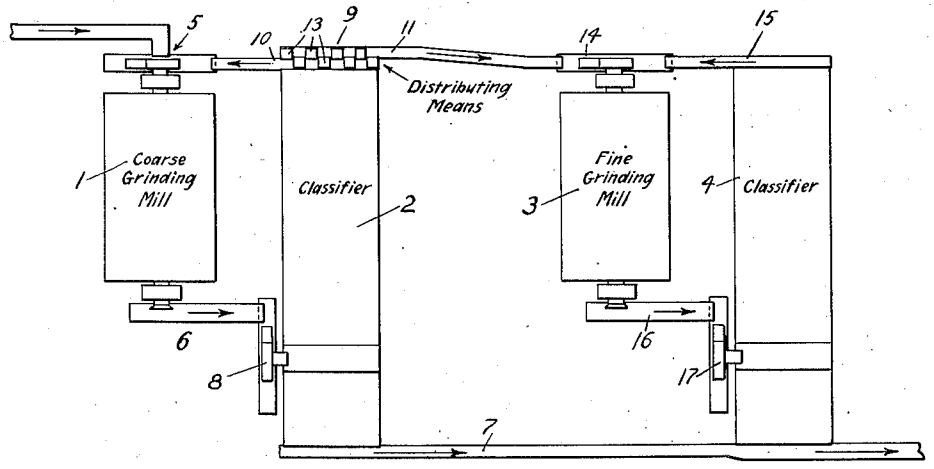


Fig. 2

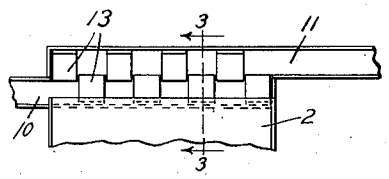
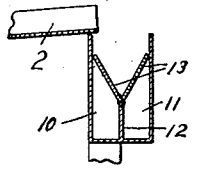


Fig. 3



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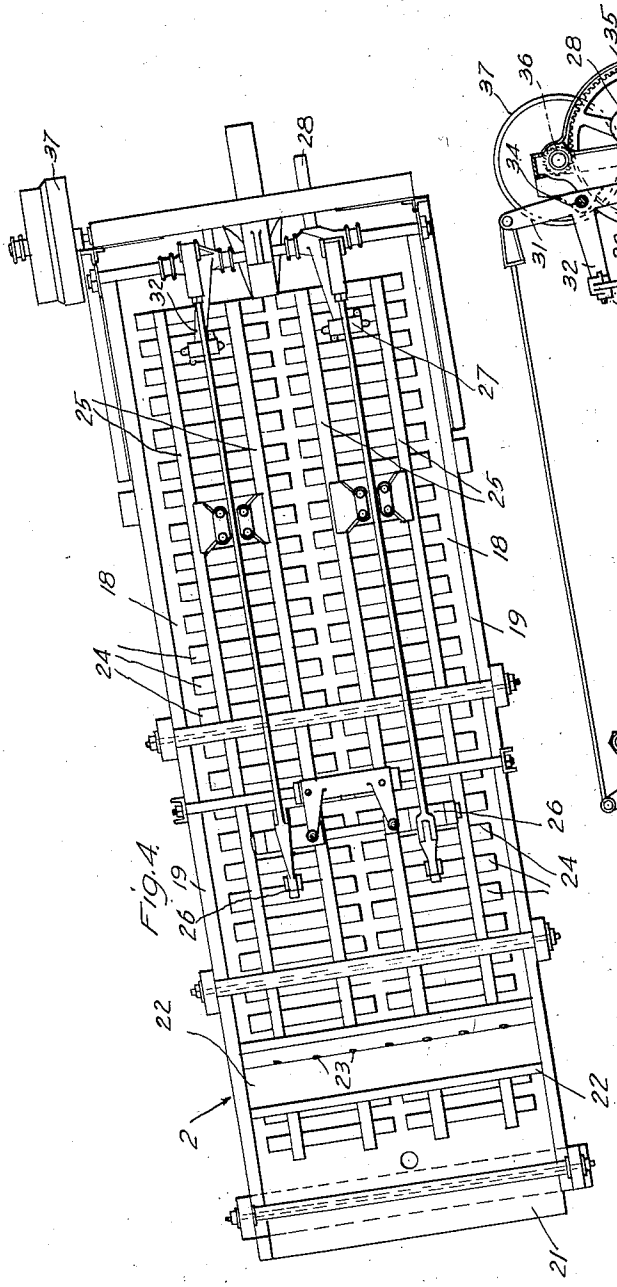


FIG. 4.

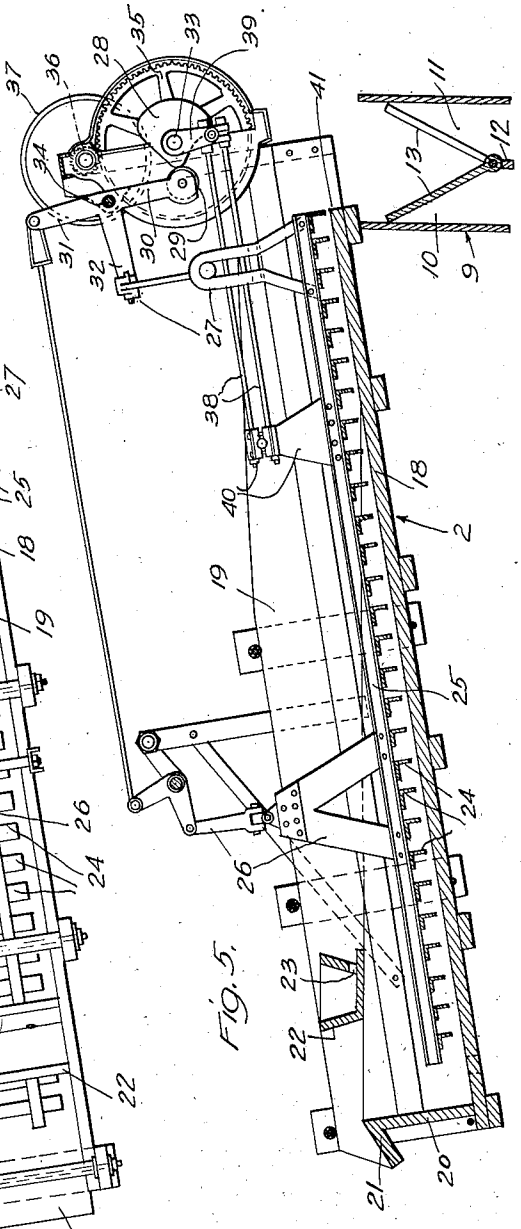


FIG. 5.

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UNITED STATES PATENT OFFICE.

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GRINDING SYSTEM FOR ORE, ROCK, ETC.

Application filed April 1, 1924. Serial No. 703,341.

To all whom it may concern:

Be it known that I, HENRY KENYON BURCH, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Improvement in Grinding Systems for Ore, Rock, Etc., of which the following is a specification.

This invention relates to apparatus for grinding ore, rock, or other material and particularly to a system or apparatus for this purpose comprising grinding mills such as tubular or conical mills using balls or rods as grinding media and adapted to subject the ore or rock to successive grinding operations for progressive reduction in size of such material. My invention is further adapted for application in a system of this kind wherein a classifier is connected to the outlet of each mill aforesaid to receive the ground product from such mill and separate the finely ground material from the coarser material. In practice it has been customary to pass the coarser material from the classifier for the first mill to a secondary grinding mill wherein it is further reduced to a state of finer division. I have found that with such an arrangement of mills or classifiers operating under normal conditions, when the coarser material from the classifier for the coarse grinding mill is all passed to the fine grinding mill, the full efficiency of the coarse grinding mills is not obtained, there being a tendency under such conditions for the coarse grinding mill to be underfed and to operate with less than its full rate of efficiency and capacity.

An important object of the present invention is to overcome the above stated disadvantage and to provide for full working efficiency and capacity of both the coarse grinding and fine grinding mill. This object I attain by providing for returning to the coarse grinding mill of a certain amount of the coarse material separated by the classifier for said mill so as to always maintain a total feed for the coarse grinding mill sufficient to provide for most effective operation thereof.

The accompanying drawings illustrate an embodiment of my invention and referring thereto, Fig. 1 is a diagrammatic plan view of two grinding mills with associated classifiers and with the necessary connections for carrying out my invention in connection therewith. Fig. 2 is a plan view of the splitting means for returning a portion of the coarse material from the first classifier to the first grinding mill. Fig. 3 is a section on line 3—3 in Fig. 2. Figs. 4 and 5 are a plan view and a vertical section respectively of a form of classifier suitable for use in connection with my invention.

The apparatus shown in Fig. 1 comprises a coarse grinding mill indicated at 1 which may be of any suitable construction for example a tube or conical mill using balls, rods, or other grinding media, a classifier 2 connected to receive the product from mill 1, a second or fine grinding mill 3, a classifier 4 associated therewith and suitable connections as hereinafter described. Mill 1 is provided with feed means 5 of any suitable kind for supplying thereto the material to be ground and with delivery means 6 for conducting the ground material from the mill 1 to the classifier 2. Classifiers 2 and 4 may be screens or other classifying means, for example they may be of the usual type of Dorr classifier, as shown for example, on page 1343, Vol. III of "Ore Dressing"—Richards, 1909, first edition, in which the material is supplied into a body or current of water and the coarse material is raked or drawn from said body or current of water onto an inclined table by automatically operated raking means and the fine material is discharged with the water to an outlet 7. An elevator indicated at 8 may be provided for delivering the coarse ground product from means 6 to the classifier 2. A standard type of Dorr classifier well-known in the art which may be used in this connection is shown in Figs. 4 and 5, it being understood however that this type of classifier is shown for illustration purposes only. Said classifier comprises an inclined bed or table 18 provided with side members 19 and an end member 20 at the lower end thereof so as to provide a liquid receptacle at the lower portion of the table 18. Said end member 20 may be provided with liquid overflow means 21. A launder 22 may be provided extending above said liquid receptacle and between the side members 19 so as to receive the material delivered between elevating means 8 above referred to and provided with suitable openings indicated at 23 for distributing or feeding such material into the body of liquid on the table. A plurality of transversely extending rakes 24 are mounted on suitable longitudinal frame means 25, and suitable

means are provided for intermittently raising and lowering said rakes and for moving the same upwardly over the table 18 while in lowered position and moving the same downwardly over said table when in raised position. Lifting means 26 and 27 at the upper and lower ends of the rake means may be provided for this purpose, said lifting means being connected to the frames of said rake means and being operated by means of cam wheel 28 engaging roller 29 at the end of lever 30, said lever being pivoted at 34 and provided with arms 31 and 32 connected for operation of the lifting means 26 and 27 respectively. Said cam member 28 may be mounted on shaft 33 which may be driven in any suitable manner for example by means of gear wheel 35 thereon, pinion 36 and drive pulley 37. The longitudinal movement of the rake means may be effected by means of connecting rods 38 connected to crank 39 on shaft 33 and to a cross-head 40 secured to said raking means. As shown in Fig. 4 two sets of rakes 24 are generally provided at the respective sides of the table, each of said sets being independently mounted on frame means 25 and being provided with separate lifting means and means for longitudinal movement as above described. Upon rotation of shaft 33 cam means 28 will cause lifting means 26 and 27 to be alternately raised and lowered and connecting rod 38 will be operated in synchronism therewith so as to move the rake means upwardly along the table while they are in lowered position and to move the same downwardly toward the lower end of the table while they are in raised position. The two sets of raking means are preferably operated alternately so that one is being raised while the other is lowered. In this manner the coarse material settling to the bottom of the table from the body of liquid thereon is continually raked up along the table and discharged at the upper end thereof as at 41, while the fine material remains suspended in the liquid and passes out therewith over the overflow means 21.

According to my invention the classifier 2 which may be of the type above described or of any other suitable type is provided at its upper end with distributing or splitting means 9 for receiving the coarse material and distributing it partly to the first or coarse grinding mill 1 and partly to the second or fine grinding mill 3. Said distributing means 9 may consist of two troughs or chutes 10 and 11 extending side by side with a partition 12 between them and flanges or deflectors 13 hinged at the top of said partition and adapted to be swung to one side or the other so as to deflect the material into the chute 10 or the chute 11 as the case may be, it being understood that the said chutes are arranged in the path of the material as it is raked off the classifier table and forced by gravity therefrom and that said chutes are sufficiently inclined respectively toward the feed means 5 for mill 1 and toward the feed means 14 for mill 3 to cause the coarse material received by the respective chutes to flow to the feed means for the respective mills.

The operation is as follows:

The material to be ground is supplied by the feed means 5 to the coarse grinding mill 1 and is therein subjected to grinding action, the ground material passing from the coarse grinding mill 1 through the delivery means 6 to the classifier 2. In said classifier the ground material is introduced into a body or current of water (water being supplied with the ground material in the required amount), and the operation of the classifier continually or intermittently rakes the coarser material from such body of water onto an inclined table surface so that it is removed from the water and is eventually discharged over the upper end of the inclined surface of the classifier and falls into the distributing means 9. By suitable adjustment of the deflectors 13 of said distributing means as by tipping some of them to one side and the others to the other side of a vertical position any desired portion of the coarse material delivered thereto can be returned through the delivery means 10 to the feed means 5 for the coarse grinding mill 1. The remainder of such coarse material passes through the delivery means 11 to the feed means 14 for the fine grinding mill 3. By this means I am enabled to maintain each of the mills at full grinding capacity and efficiency. The fine ground product from the fine grinding mill passes through launder or delivery means 16 and feeding elevator 17 to classifier 4, the fine portion thereof being delivered by said classifier to the delivery means 7 for example, and the coarser portion thereof being returned to the fine grinding mill 3 by a return connection 15.

My invention is not limited to a system of two mills, but may be applied to systems in which any number of mills are employed in series, classifiers provided with the above described splitting means being connected to receive the product from each mill and to return a portion of the coarse material to a preceding mill and a portion to the next succeeding mill in the series.

What I claim is:

1. A combination of a coarse grinding mill and a fine grinding mill, a classifier connected to receive the ground material from the coarse grinding mill and adapted to separate the finer portion of such ground material from the coarser portion thereof, and distributing means for delivering a part of the coarser material so separated to

the fine grinding mill and returning another portion of such coarse material to the coarse grinding mill.

2. A combination of a coarse grinding mill, a fine grinding mill, a classifier connected to receive the ground material from the coarse grinding mill and to separate the finer portion thereof from the coarse portion thereof and distributing means adapted to receive the coarser material from the classifier and to return a portion thereof to the coarse grinding mill and to deliver the remainder thereof to the fine grinding mill, said distributing means being adjustable to vary the portion of the coarse material returned from the classifier to the coarse grinding mill.

3. In apparatus for crushing or grinding material comprising a plurality of grinding mills connected in series and a classifier connected to each grinding mill to receive the product therefrom and adapted to separate the finer portion of such product from the coarser portion thereof, distributing means adapted to receive the coarser material from a classifier and to return a portion thereof to a mill preceding such classifier, and to deliver another portion thereof to a succeeding mill.

4. The combination of a plurality of grinding mills, a plurality of classifiers each adapted to receive crushed material from one of said grinding mills and to separate the finer and coarser portions of said crushed material, a plurality of delivery means each adapted to receive coarse material from a classifier and to return the same to the mill from which it was received by such classifier, and delivery means adapted to receive a portion of the coarse material from one of said classifiers and to deliver the same to a succeeding mill.

In testimony whereof I have hereunto subscribed my name this 21st day of March, 1924.

HENRY KENYON BURCH.