MILL DISCHARGE MEANS

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7 Claims.

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This invention relates to the milling of ores and similar material and, more particularly, to the wet grinding and classifying of ores, preferably in the manner known as closed-circuit grinding. Specifically, the invention contemplates the provision of a novel device and a novel arrangement of apparatus elements whereby ground material discharged from a grinding mill, such as a ball mill, pebble mill, rod mill or the like, may be elevated to a point higher than the mill discharge so that it can flow by gravity to a classifier or other desired destination which may be at an elevation higher than that of the mill discharge, all in a simple, economical and highly efficient manner.

In the milling of ores and other mineral matter it is customary to subject the crushed ore to grinding in a rotating mill containing suitable grinding media such as balls, pebbles or the like, generally together with water or other liquid, whereby the ore is reduced to relatively finely divided condition, thus enabling the valuable constituents to be recovered in subsequent treatment stages. It is also customary to treat the material discharged from the mill in a mechanical or other type of classifier such as a Dorr rake classifier, to separate the finer constituents from the coarser. Where a uniform relatively small size is desired, it is customary to return the coarser material separated by the classifier to the feed inlet of the mill for further grinding and reduction to finer size.

In transferring the mill discharge from the mill to the classifier, or to any other desired destination, it is manifestly preferable for economic and other reasons that the mill discharge be enabled to flow to its destination by gravity. In many instances this achievement is impossible or impractical, particularly with large size classifiers, because the point at which the feed must be introduced into the classifier is located at an elevation substantially the same or higher than that where the ground material discharged from the mill. In certain instances various means have been utilized to elevate the mill discharge into the classifier or to a point from where it may flow by gravity into the classifier or other desired destination. For instance, pumps are sometimes used and compressed air lifts have also been utilized for this purpose. Manifestly any such means requires the trouble and expense of appropriate power for operating the lifting means.

It is an object of this invention to provide a device, readily attachable to almost any horizontal rotary mill which will operate with the mill and elevate material discharged from the mill to a locality at an elevation higher than that of the mill discharge in a simple, efficient and economical fashion and without necessitating an additional power source.

Another object is to provide a device for closing the circuit between a grinding mill and a classifier which, without requiring additional power or motivating means, will elevate the mill discharge so that it may flow by gravity into the classifier.

With these and other objects in view, the invention consists in the construction and novel combination and arrangement of parts herein-after fully described, illustrated in the accompanying drawings, and set forth in the claims hereto appended. It being understood that various changes in the form, proportion and minor details of construction, within the scope of the claims, may be resorted to without departing from the spirit of the invention or sacrificing any of the advantages thereof.

In the drawings—

Fig. 1 is a side elevation of a conventional conical type ball mill having a mill discharge elevating device embodying the features of the present invention attached thereto.

Fig. 2 is an enlarged end elevation, partly in section, of the elevating device of the invention.

Fig. 3 is a vertical section taken on the line 3—3 of Fig. 2.

Fig. 4 is an enlarged detail fragmentary view showing the elevating scoops or pockets of the invention.

Generally speaking the invention comprises a wheel or circular member adapted to be attached to the discharge end of a horizontal rotary mill and is provided with pockets which are adapted to receive the material discharged from the mill and, by rotation of the wheel, carry the discharged material to a locality higher than its point of discharge. At substantially the highest point in the circular travel of the pockets the material supported therein, being of a fluid nature, is allowed to discharge from or flow out of the pockets into a suitable launder or other receptacle from whence the material may flow by gravity to any desired destination, in most instances a classifier for separating the material into coarse and fine products.

In Fig. 1 the numeral 5 designates generally a horizontal rotary mill of the conical type and comprises a hollow drum or shell of substantially
the shape indicated, although the invention is equally applicable with mills of other suitable shape. The shell 5 is supported upon pedestals 6 and 7 by means of trunnions or bearings indicated generally at 8 and 9. The mill is shown to be provided at its feed end with a combination scoop feeder 10, new feed entering the feeder at the point 11 and oversize material returned from the classifier or other separating stage entering the mill by means of the scoop 12 which dips down into a suitable tank or hopper, not shown, at such revolution of the mill and scoops up a quantity of the returned material. The drum 5 is provided with a circumferential gear 13 rigidly attached thereto and adapted to engage with a driving pinion, not shown, for the purpose of rotating the entire mill at a suitable speed. It will be understood that the drum 5 contains conventional grinding media such as balls, pebbles, rods or the like, which are introduced into the mill to disintegrate it into relatively finely divided condition by impact and attrition. The discharge end of the mill will be seen in section in Fig. 3 wherein the shell 5 is seen to terminate in an outwardly projecting annular flange 14 to which is attached, by a corresponding annular flange, an internal discharge liner 15 shaped to provide a reduced discharge throat 16 and a somewhat outwardly flared annular discharge lip 17.

It will be understood that the construction so far described is that of a well known type of mill and forms no part of the present invention. The mill discharge elevating wheel of the present invention is readily attachable to the shell 5 by co-operation with the annular flange 14. The device preferably comprises a circular disky member 18 having a relatively large central opening indicated at 19 and is provided, adjacent the periphery of the opening, with a substantially L-shaped annular flange 20, the vertical or free leg of which is adapted to be attached to the shell 5 by means of bolts 21 passing through the annular flange 14, through the flange on the liner 15 and through appropriate openings in the free leg of the L-shaped flange carried by the member 18. If desired, webs 22 may extend from the disk 18 to the L-shaped flange for the purpose of reinforcing the structure.

Attached, by means of rivets or bolts 23, to the disk member 18 adjacent its periphery and extending circumferentially thereof is a flat strip or backing member 24 which is substantially circular in plan. The member 24 supports a plurality of pockets or scoops 25 which extend outwardly from the backing member substantially at right angles thereto and form pockets for receiving, elevating and discharging material emitted from the mill discharge spout 17 as will presently be described. In Figs. 3 and 4 the pockets or scoops 25 will be seen to be formed of sheets or strips of metal bent or otherwise shaped into a curved configuration and to have their outer edges somewhat inwardly flared as indicated at 26. Furthermore, a space, indicated at 27, is preferably provided between the outer flared lip of each pocket and the back extremity of the succeeding pocket. While this is the preferred and best known arrangement it is obvious that the pockets 25 may take the form of any shape and configuration that will enable them to receive and hold substantial quantities of fluid or plastic material and, in certain instances, the openings 27 need not be present, and each pocket 25 be joined to each succeeding pocket, or the exterior periphery of the wheel may be constructed to present a solid unbroken surface in any other desired fashion. An annular strip or facing member 28 is provided for closing the outer ends of the pockets 25 and is attached to the outer edges of the same in any suitable manner. It will be understood that the pockets 25 at each end thereof to the backing member 24 and to the facing strip 28, although it is obvious that any other suitable joining method might be used.

Supported on pedestals 29 is a trough or box 30 which is positioned so that the lower half of the elevating wheel structure extends into it and is completely surrounded and enclosed thereby. The front wall 31 of the trough 30 should extend well upwardly so that it is at least as high as the highest point on the discharge lip 17 to prevent any of the discharged material from splashing out of the trough. It will be understood that the fluid or plastic material discharging from the lip 17 will fall downwardly and be caught in the pockets 25 as they travel through the lowermost point of their travel by the outwardly flared edges 26 and through the openings 27. The accumulation of mill discharge in the trough 30 is therefore reduced to a minimum.

If the mill and elevating wheel were not rotating there would, of course, be a tendency for the fluid mill discharge to run out of the pockets 25, when in their lowermost position, through the openings 27. This tendency is practically completely overcome, however, by the centrifugal action due to the constant rotation of the elements when in use. With the mill and wheel rotating in the direction of the arrow in Fig. 2, centrifugal action will cause the material discharging from the spout 17 to fall slightly to the right of, or at least never to the left of the perpendicular. Thus the discharged material will always fall into the pockets 25 as they start their ascent and never when they are inclined downwardly. Furthermore, centrifugal force, acting upon the contents of the pockets, tends to throw the material away from the openings 27 toward the backs of the pockets so that there is little tendency for it to escape.

While there has been shown a trough 30 completely surrounding the lower part of the elevating wheel, the said trough might, in some instances, be dispensed with. In that event there could be provided an apron or splash plate opposite the free side of the wheel and closely adjacent the same and extending upwardly as high as the point of mill discharge. The splash plate, of course, could carry a deflector vane or baffle similar to the deflector 32 and for the same purpose. Obviously, any other suitable means could be employed to encourage mill discharge to enter the pockets 25 and to prevent the material from splashing out onto the floor or ground.
An inclined launder is shown fragmentarily at 33, supported in any suitable manner and discharging at its lower end into any suitable apparatus or receiving means which, in most cases, will be a classifier for separating the mill discharge into coarse and fine products. The launder 33, preferably in practice, is supported in any suitable manner and discharging at its lower end into any classifier or whatever is the other desired destination.

Thus it will be seen that a device which will lift or elevate fluid material discharged from a grinding mill to a locality considerably higher than that of the mill discharge position from whence the material may flow by gravity to a point of ultimate use or disposal. The device is readily adapted to any rotary horizontal mill and uses only the rotation of the wheel to effect the desired elevation of the mill discharge. Thus no extraneous operating or power means is required to convey the mill discharge to a point of ultimate use which may be at an elevation higher than that of the discharge spout of the mill. The device is simple, rugged and positive in operation and will continuously lift the mill discharge to an elevated locality in a simple, efficient and economical fashion.

I claim:

1. For use with a rotary grinding mill having a relatively constricted discharge end portion, a device for elevating material discharged from said discharge end portion to a point above said discharge end portion, comprising a wheel attachable to said discharge end portion to be rotatable therewith and having pockets disposed about the periphery of said wheel and for receiving mill discharge material at a low point in the rotation of said wheel and for discharging the material at a high point, a container surrounding at least the lower portion of said wheel, the container wall at the free side of the wheel being provided with a deflector face adapted to direct mill discharge into said pockets across a clearance between said container wall and said wheel.

2. A device according to claim 1, in which each pocket is designed and adapted to scoop up material from said container.

3. A device according to claim 1, in which said deflector face is represented by a semi-circular strip.

4. A device according to claim 1, in which each of said pockets terminates in an outwardly flared lip spaced closely from the back extremity of the next succeeding pocket.

5. A device according to claim 1, with the addition of means for receiving material discharged from said pockets at a location substantially above that of the mill discharge opening, said means comprising a conduit extending at a downward incline and substantially transversely of the axis of rotation of said mill and substantially close to the free side of said wheel, and a discharge receiving portion extending from said chute to intercept the material at said higher point of the wheel.

6. In combination with a rotary grinding mill having a relatively constricted discharge end portion, a device for elevating material discharged from said discharge end portion to a point above said discharge end portion, comprising a wheel attachable to said discharge end portion to be rotatable therewith and having pockets disposed about the periphery of said wheel and for receiving mill discharge material at a low point in the rotation of said wheel and for discharging the material at a higher peripheral location substantially above that of the mill discharge opening, each pocket also being de-
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signed and adapted to scoop up material, a container surrounding at least the lower portion of said wheel, which container receives excess material from said mill discharge end, and from which container material is scooped up by said pockets in addition to that received by them from said mill discharge end, and conduit means for intercepting the material from said higher peripheral location.

7. A device according to claim 6, in which each of said pockets terminates in an outwardly flared lip spaced closely from the back extremity of the next succeeding pocket.

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