

R. C. NEWHOUSE.
COMMINUTING MILL.
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1,361,280.

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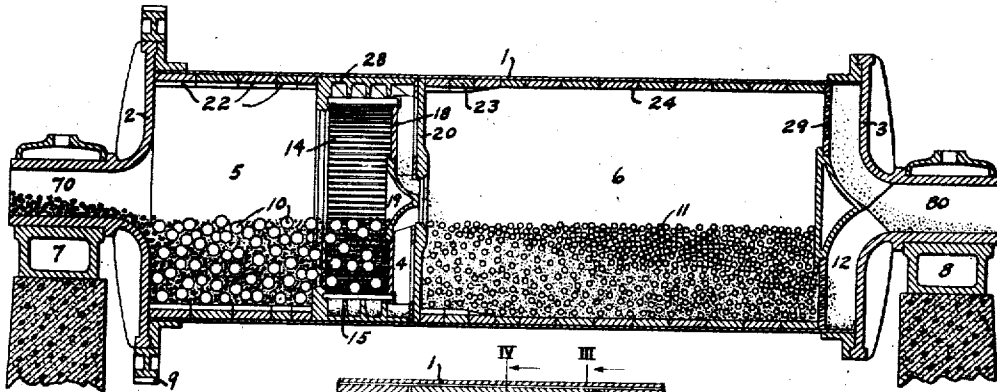


Fig. 1

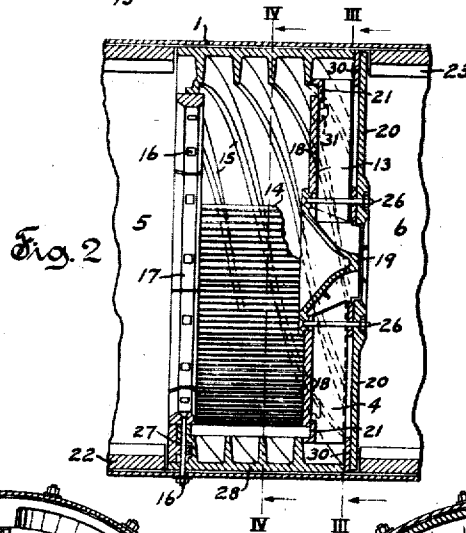


Fig. 2

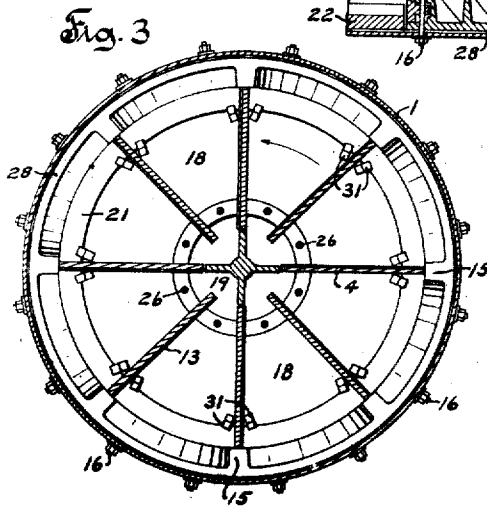


Fig. 3

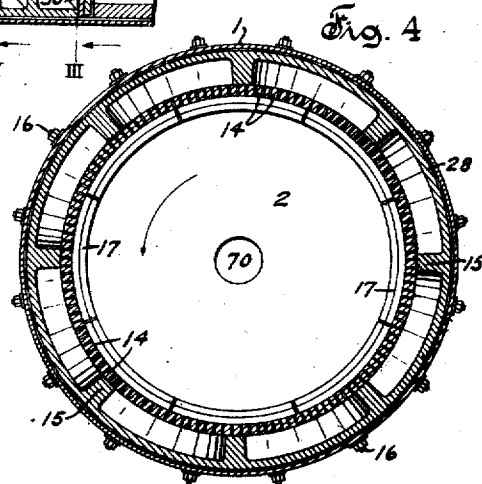


Fig. 4

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COMMINUTING-MILL.

1,361,280.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, RAY C. NEWHOUSE, a citizen of the United States, residing at Wauwatosa, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Comminuting-Mills, of which the following is a specification.

This invention relates generally to improvements in the construction and operation of mills for comminuting cement-making materials, coal, rock, ore and the like substances, and specifically to improvements in that type of comminuting mills known as combination mills.

An object of the invention is to provide a comminuting mill of the combination type, which is simple and compact in construction and efficient in operation.

One of the more specific objects of the invention is to produce a combination mill of maximum capacity by providing ample screening area between the successive comminuting chambers.

Another specific object is to provide a division head between two successive chambers of a combination mill, which will serve both as a holdback for the grinding bodies and as a discharge sizing screen for permitting free passage of the material delivered from the first chamber.

A further specific object is to provide means for varying the relative sizes of successive chambers without affecting the screening area, this object being attained by making the sizing screen and the division partition simultaneously adjustable longitudinally of the mill.

Still another specific object is to provide a durable, simple and readily renewable screening device for the material discharged from one of the comminuting chambers, and means for rapidly conveying the screened material into a subsequent comminuting chamber.

A further specific object is to provide various details for facilitating construction of mills of the combination type and for reducing to a minimum the cost of installation and maintenance.

A clear conception of an embodiment of the invention may be had by referring to the drawing accompanying and forming a

part of this specification in which like reference characters designate the same or similar parts in the various views.

Figure 1 is a diagrammatic central vertical section through a combination mill embodying a longitudinally adjustable division head for varying the volumetric capacities of the several chambers, the length of the fine grinding chamber having been reduced in order to facilitate disclosure of other details of construction.

Fig. 2 is an enlarged fragmentary central vertical section through a combination mill, taken adjacent the division head.

Fig. 3 is an enlarged transverse vertical section through a combination mill, the section being taken along the line III—III of Fig. 2 looking in the direction of the arrows.

Fig. 4 is an enlarged fragmentary central vertical section through a combination mill, the section being taken along the line IV—IV of Fig. 2 looking in the direction of the arrows.

The combination comminuting mill herein illustrated comprises in general a rotary drum or shell 1' having uniform diameter throughout its length, the shell being provided with feed and discharge end heads 2, 3 respectively, and having an adjustable partition or division head dividing the shell 1 into coarse and fine grinding chambers 5, 6 respectively. The mill is rotatably mounted in trunnion bearings 7, 8 located adjacent the end heads 2, 3 respectively, and is adapted to be rotated by means of power applied to the driving gear 9 in the usual manner.

The coarse grinding chamber 5 is ordinarily filled to substantially the center line of the shell 1, with relatively large comminuting bodies 10, usually balls, while the fine grinding or finishing chamber 6 is filled substantially to the center line of the shell 1, with relatively small comminuting bodies 11, usually of spherical, cylindrical or other form. The bodies 10, 11 are preferably formed of iron, steel or other material adapted to withstand abrasion. The coarse grinding chamber 5 is supplied with relatively coarse material through a feeding trunnion 70 and delivers the material after having been partially reduced by the bodies 10, through the combined holdback and siz-

ing screen and past the division partition, to the finishing chamber 6 from which the final product is delivered through a discharge plate or screen 29, upon elevating vanes 12 which discharge the material from the mill through a discharge trunnion 80.

The mill division head comprises a combined holdback and screening device surrounding the discharge end of the coarse grinding chamber 5, and a division partition located between the coarse grinding and finishing chambers 5, 6. The division head is adjustable longitudinally of the mill, as will be later described, in order to vary the relative lengths of the successive grinding chambers 5, 6. The finishing chamber 6 is ordinarily four or five times as long as the coarse grinding chamber 5, this approximate proportion having been found to produce excellent commercial results.

The combined holdback and screening device comprises a sizing screen forming a support for the adjacent grinding bodies 10 and consisting of an annular series of parallel rectangular bars 14 extending longitudinally of the shell 1 and terminating at the wall or plate 18. The forward extremities of the bars 14 rest upon and are detachably secured to the cast element 28 by means of a segmental renewable retaining ring 17. The opposite extremities of the bars 14 rest upon a ring 21 and are retained in position by the periphery of the plate 18. The bars 14 are preferably spaced equal distances apart by means of distance pieces located between the adjacent bar ends and secured to the bars in any suitable manner. The spacing of the screen bars 14 is such that any material passing therebetween is sufficiently fine to be further efficiently reduced by the relatively small grinding bodies 11 in the finishing chamber 6. These bars are furthermore preferably formed of wear-resisting material such as tool steel, and may be formed by merely sawing or otherwise cutting bars of commercial tool steel into proper lengths and securing the distance pieces to the ends thereof. The element 28 extends along the annular space between the series of bars 14 and the shell 1 and is provided with a plurality of integral inwardly projecting helical conveyor ribs 15, the inner edges of which directly engage the bars 14 and form supports for the medial portions of these bars. Each conveyor rib 15 has opposite ends adjacent diametrically opposite portions of the shell 1, thus causing each rib to engage substantially one half of the bars 14. The end of the element 28 adjacent the segmental ring 17, is provided with a renewable ring liner 27 which is held in place by means of the same bolts 16 which secure the segments of the ring 17 in place.

The division partition comprises a pair

of segmental walls or plates 18, 20 formed of abrasion resisting material spaced apart longitudinally of the shell 1 and having a series of substantially radial elevating or lifting vanes 4 in the space between them. The outer ends of the vanes 4 communicate with the spaces between successive conveyor ribs 15 while the inner ends thereof are directed toward a discharge cone or element 19. It will be noted that the conveyor ribs 15 extend up to the plate 20 and correspond in number to the vanes 4, one of the ribs 15 terminating adjacent the end of each vane 4. The vanes 4 are provided with suitable liners 13 for resisting abrasion, and are formed integral with the ring 21 and with the spider 30. The plates 18, 20, discharge element 19, ring 21, spider 30 and vanes 4 are firmly united by means of clamping bolts 26. The forward plate 18 is located adjacent an end of the bars 14 and is preferably formed in two or more sections provided with integral hooks 31 which engage the ring 21 and prevent displacement of the plate sections and of the bars 14. The rear plate 20 is also preferably formed in sections which coact directly with the adjacent spider 30 formed integral with the vanes 4 and the ring 21.

The coarse grinding chamber 5 is provided with relatively heavy or thick sectional liners 22 of which the liners directly adjacent the discharge screen are of less length than those remote from the screen, as indicated in Fig. 1. The portion of the fine grinding or finishing chamber 6 directly adjacent the division partition is provided with sectional liners 23 of a thickness substantially equal to that of the liners in the chamber 5 and of length substantially equal to that of the short liners 22 in the chamber 5. The remaining portion of the chamber 6 is preferably provided with relatively thin sectional liners 24, a smooth junction between these thick and thin liners 23, 24 in the chamber 6, being provided by liners of graded thickness. It should be noted that it is not essential to have the liners in the several compartments or chambers 5, 6 of different thicknesses.

During normal operation of the mill, the shell 1 is rotated causing the grinding bodies 10, 11 to cascade over each other, the relatively coarse material being fed into the grinding chamber 5 through the feed trunnion 70 where it is partially reduced by the tumbling grinding bodies 10. The material passing through the chamber 5 eventually reaches the discharge screen adjacent the division head, whereupon the sufficiently reduced material passes through the spaces between the screen bars 14 and drops into the helical chambers between the conveyor ribs 15. As the rotation of the mill continues, the revolving conveyor ribs 15 urge

the partially reduced material toward and deposit it upon the lifting vanes 4. The lifting vanes 4 elevate this material and eventually deliver it to the cone element 19 which discharges the material into the finishing chamber 6. As the material passes through the finishing chamber 6, it is reduced to the desired fineness by the bodies 11 in this chamber, the final product passing from the end of the chamber 6 through the discharge screen 29 and into the path of the revolving elevating vanes 12. The vanes 12 lift the fine material and discharge the same from the mill through the discharge trunnion 80.

If it is desired to vary the relative capacity of the chambers 5, 6, this may be accomplished by adjusting the division head longitudinally of the shell 1, thereby varying the relative lengths of the chambers 5, 6. Adjustment of the division head may be effected by removing one or more annular series of liners 22, 23 adjacent the division head and sliding the head to any desired position along the shell 1. The liners may then be properly reinserted and secured in the mill to firmly maintain the division head in its adjusted position. By providing liners of several different widths, any desired degree of adjustment of the division head may be made. The charges of grinding bodies 10, 11 must of course be varied to correspond to a given adjustment of the lengths of the chambers 5, 6.

It will be noted that by providing an annular screen extending longitudinally of the mill, and means for rapidly removing the material passing through the screen, ample screening area is provided between the two chambers 5, 6. The division head may be adjusted without affecting the screening area since both the screen and the partition plates are moved as a unit during adjustment of the division head. The formation of the screen as an annular series of bars 14, also provides maximum screening area for minimum length of bars, and makes it possible to place the entire screening device within a shell 1 of uniform diameter throughout its length. The bars 14 may be made of sufficient length to produce the required amount of screening area without materially affecting the mill capacity, and may be readily formed at minimum cost from commercial stock. By utilizing the screen as a hold-back as well as for the purpose of sizing material, the necessity of providing separate devices to perform these several functions is eliminated and the cost of construction is thereby further reduced. The screen bars 14 may be readily removed and replaced when worn by merely removing the bolts 16, 26. The liner elements 13, 17, 27 and the plates 18, 20 may also be replaced when worn, without removing the end heads of the mill, as these elements are preferably formed of

such size that they may be readily inserted and removed through a manhole in the mill.

By making the conveyer ribs 15 of relatively steep pitch as shown, rather than substantially parallel to the mill axis, the material delivered through the screen is urged rapidly into the path of the elevating vanes 4, thereby enhancing the screening action. As the ribs 15 coact directly with the adjacent screen bars 14, these bars are effectively supported to withstand the pressure of the charge of grinding bodies 10 thereagainst. Due to the fact that the ribs 15 extend beyond the front plate 18 and up to the plate 20; the material is positively urged into the space adjacent the ends of the vanes 4. As the successive ribs 15 terminate directly adjacent the ends of the successive vanes 4, the material delivered between each set of successive ribs 15, is discharged upon one of the elevating vanes 4, thereby uniformly distributing the wear upon the liners 13.

It should be understood that it is not desired to be limited to the exact details of construction herein shown and described, for obvious modifications may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:—

1. In combination, a rotary shell, and a head dividing said shell into a plurality of chambers, said head comprising a wall, a continuous annular screen extending longitudinally of said shell and transversely of said wall, and a conveyer rib between said screen and said shell extending past said wall.

2. In combination, a rotary shell, and a head dividing said shell into a plurality of chambers, said head comprising a wall, a continuous annular screen extending longitudinally of said shell and transversely of said wall, and a conveyer rib between said screen and said shell, said rib directly engaging a medial portion of said screen and forming a support therefor.

3. In combination, a rotary shell, and a head dividing said shell into a plurality of chambers, said head comprising a wall, a screen extending longitudinally of said shell and transversely of said wall, and a conveyer rib between said screen and said shell, said rib terminating at approximately diametrically opposite portions of said shell.

4. In combination, a rotary shell, and a head dividing said shell into a plurality of chambers, said head comprising a wall, a lifting vane associated with one side of said wall, a series of screen bars extending longitudinally of said shell and terminating at the other side of said wall, and a conveyer rib between said bars and said shell having an end terminating at the side of said vane remote from said wall.

5. In combination, a rotary shell, and a

head dividing said shell into a plurality of chambers, said head comprising spaced walls, lifting means between said walls, a series of screen bars extending longitudinally of said shell and terminating at one of said walls, and a conveyer rib between said bars and said shell terminating at the other of said walls.

6. In combination, a rotary shell, and a head dividing said shell into a plurality of chambers, said head comprising a pair of spaced walls, a lifting vane in the space between said walls, an annular series of screen bars extending longitudinally of said shell and terminating at one of said walls, and a helical conveyer rib between said bars and said shell, said rib directly engaging successive bars of said series and terminating at the other of said walls.

7. In combination, a rotary cylindrical shell, and an adjustable head dividing said shell into a plurality of chambers, said head comprising a pair of walls spaced apart longitudinally of said shell, a lifting vane in the space between said walls, an annular series of screen bars spaced from said shell and terminating at one of said walls, and a helical conveyer rib between said bars and said shell, said rib directly engaging succes-

sive bars of said series and terminating at the other of said walls.

8. In combination, a rotary shell forming a comminuting chamber, a wall at an end of said chamber, a continuous annular screen extending longitudinally of said shell and terminating at said wall, and a conveyer rib between said screen and said shell extending past said wall.

9. In combination, a rotary shell forming a comminuting chamber, a wall at an end of said chamber, a screen extending longitudinally of said shell and transversely of said wall, and a conveyer rib between said screen and said wall, said rib directly engaging said screen and forming a support for a medial portion of said screen.

10. In combination, a rotary shell forming a comminuting chamber, a wall at an end of said chamber, a screen extending longitudinally of said shell and terminating at said wall, and a conveyer rib between said screen and said wall, said rib directly engaging and supporting a medial portion of said screen and extending past said wall.

In testimony whereof the signature of the inventor is affixed hereto.

RAY C. NEWHOUSE.