Sept. 23, 1958 P. L. SCHOONOVER 2,853,246

MOUNTING FOR A ROTARY MILL

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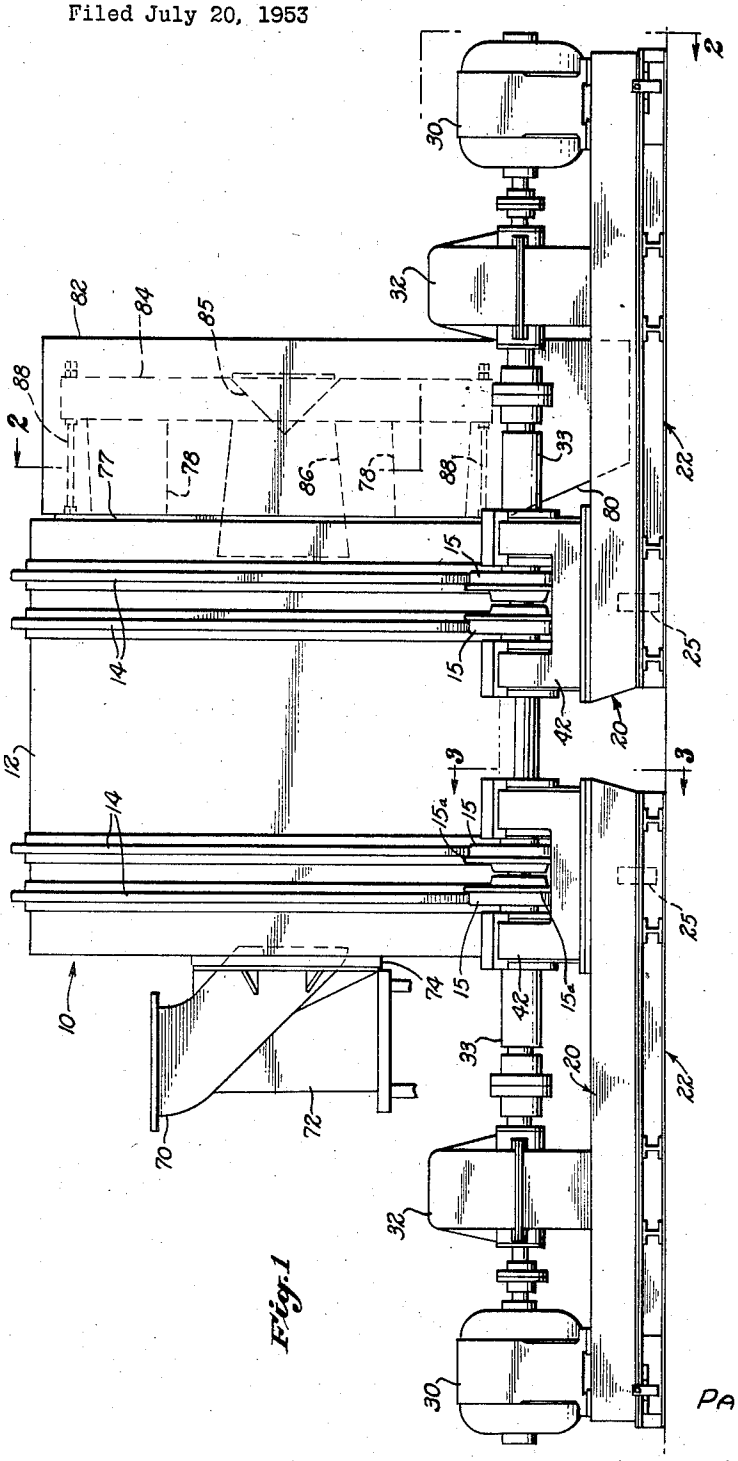


Fig. 1

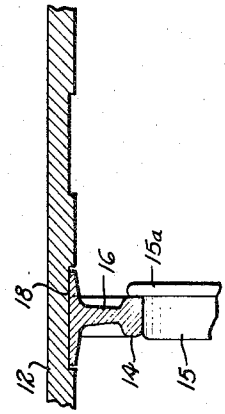


Fig. 1A

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Fig. 2

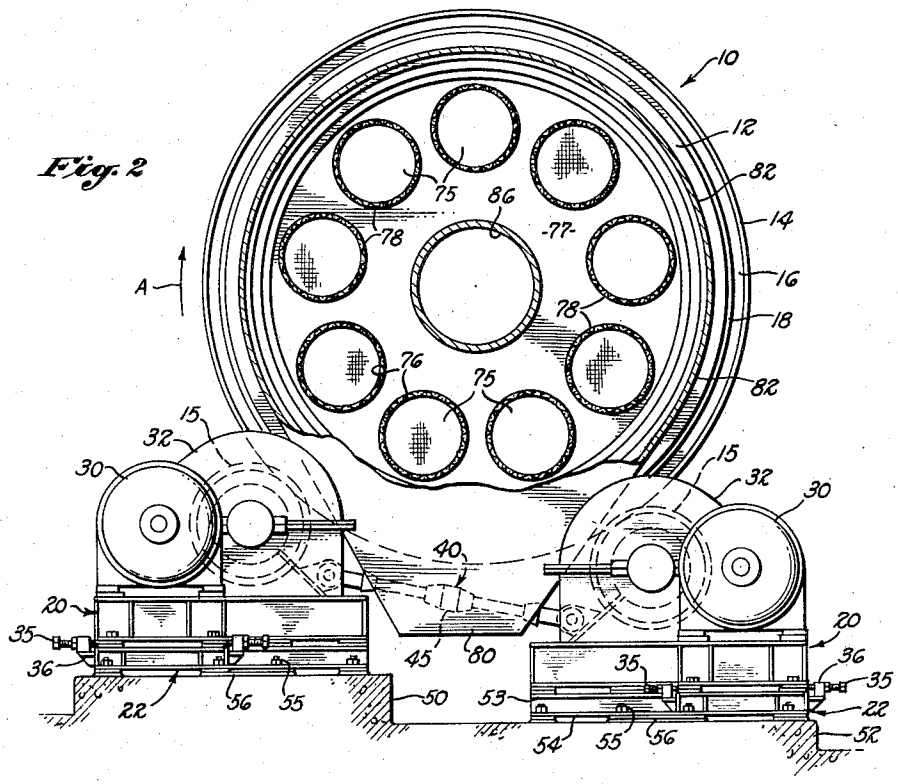
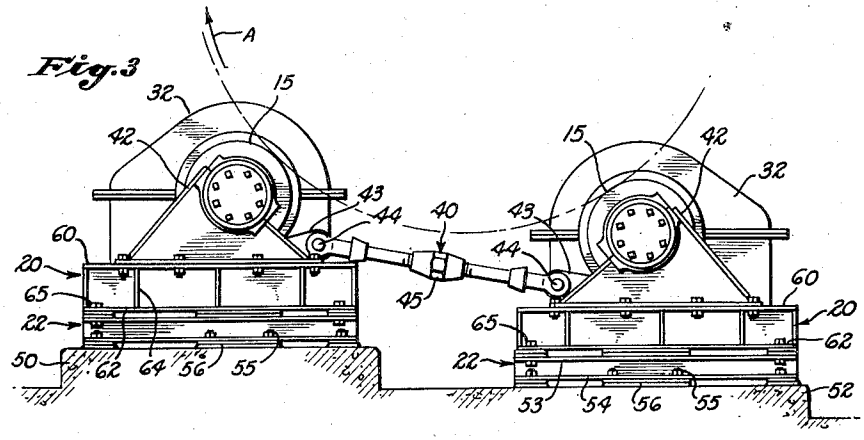


Fig. 3



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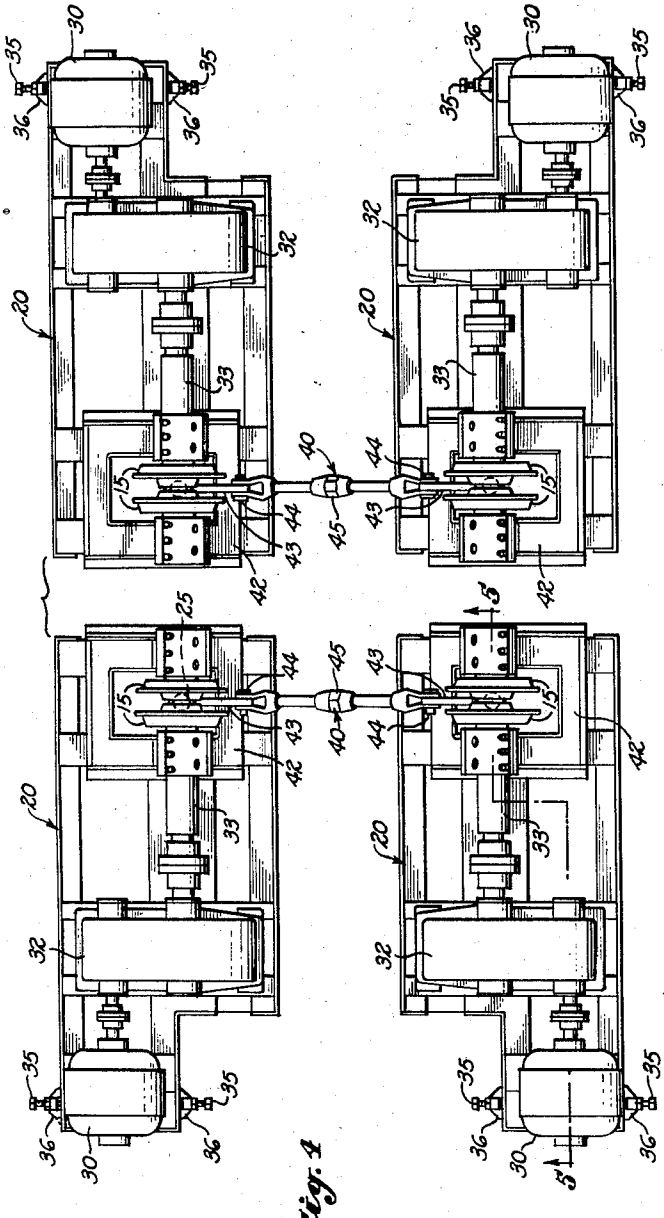


Fig. 4

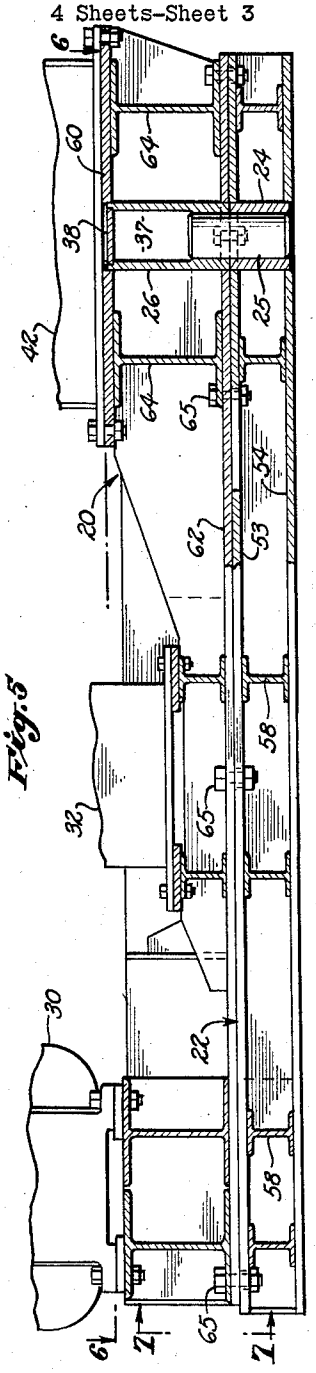


Fig. 5

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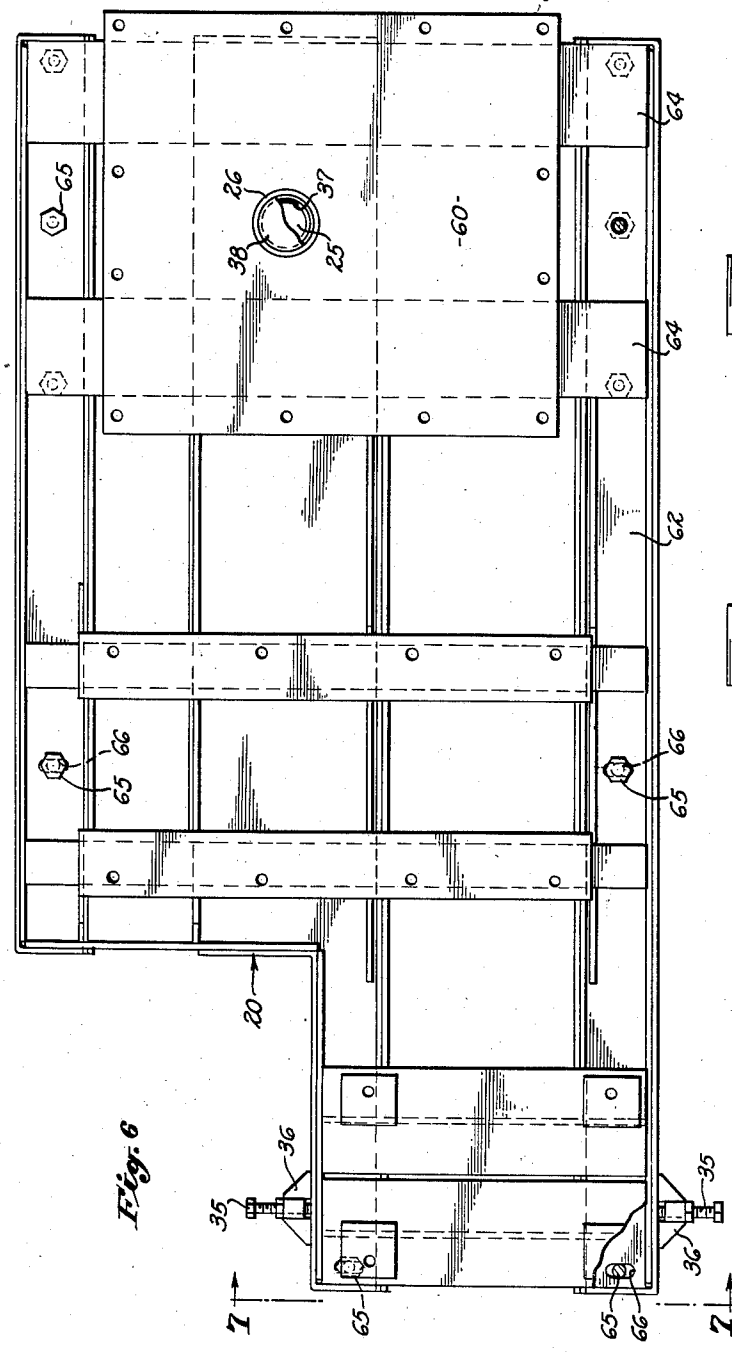


Fig. 6

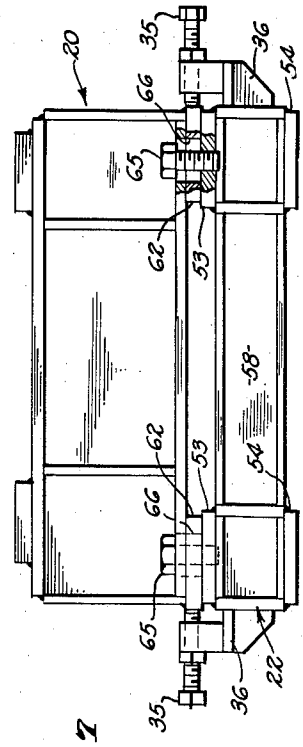


Fig. 7

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2,853,246

MOUNTING FOR A ROTARY MILL

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Application July 20, 1953, Serial No. 369,062

8 Claims. (Cl. 241—178)

This invention relates to grinding mills, and more particularly to the larger types which are rotated upon horizontal axes for grinding by tumbling whereby to reduce to appropriate sizes raw materials such as limestone employed for the making of Portland cement.

A particular object of this invention is to improve grinding techniques for raw materials of the indicated nature, so that very large raw materials may be properly reduced simply by tumbling, and without the necessity for use of balls or rods as commonly employed in operations of this general type wherein the grinding apparatus works upon a horizontal axis.

Another object of this invention is to provide in the type of mill indicated appropriate constructions suitable for very large diameter mills, for example heavy, tumbling mills having diameters in the order of twelve feet to fifteen feet.

It is a further object of this invention to produce heavy structures of the stated nature working upon horizontal axes wherein very high efficiency is obtainable and in which such high efficiency may be accomplished through the medium of high cascading or tumbling rates, such as 15 R. P. M. to 20 R. P. M. of the mills themselves. Rates of this magnitude are rated as very high for apparatus of this type.

It is a further object of the invention to provide mills which shall afford very long apparatus life while at the same time affording very high efficiency.

Another object of the invention is to provide efficient supports at four points of each mill of the indicated nature, each mounting being constructed independently of the other three mountings and each mounting being adjustable independently of the other three mountings. Such independent adjustments provide against undesirable thrusts between rails upon a mill shell by which the mill is supported and flanged wheels which in turn support the rails and the mill and are independently driven as by electric motors for the purpose of rotating the mill.

Heavy mill constructions of this character are in one form accomplished through the medium of an adjustable frame means at each of the four mounting positions. Each mounting includes, for example, a pair of vertical wheels operating upon a horizontal axis, the frame supporting this pair of wheels being rotatable horizontally about a heavy vertical pivot pin fixed in a suitable underlying base and disposed at the exact vertical geometric center of the pair of wheels. A remote portion of each frame is provided with adjusting means to swing the frame about said vertical center provided by said vertical pivot pin. Heavy screw means may be used for swinging such remote portion of the frame. These frames and their respective pairs of wheels are in turn arranged in pairs at the opposite ends of the mill, so that the mill at each end is borne between the two spaced pairs of wheels on the respective spaced frames, thus providing the four required points of support. In addition, heavy tie means, such as appropriate turnbuckle means, are employed between the frames of each co-operating pair of frames at

the respective ends of the mill in line with their pivots to absorb lateral thrusts upon the respective pivot pins, which thrusts would otherwise exist by reason of the spreading tendency of the weight of the mill directed downward into the underlying space intervening between the respective frames.

Other objects of the invention and various features of construction thereof will become apparent to those skilled in this art upon reference to the following specification and the accompanying drawings wherein certain embodiments of the invention are illustrated.

In the drawings:

Fig. 1 is a side elevation of a large tumbling mill mounted in accordance with this invention and showing the positioning of the mounting means for each pair of supporting wheels in two positions at one side of the mill, and also indicating the individual drives for each pair of supporting wheels;

Fig. 1A is a vertical sectional detail of the rail and wheel arrangement and construction;

Fig. 2 is in general an end elevation, as indicated by the line 2—2 of Fig. 1 and showing the positioning of the two pairs of wheels at one end of the mill and the relationships with the corresponding drive motors;

Fig. 3 is an end view of the inner ends of the mountings of two pairs of wheels at one end of the mill, as indicated by the line 3—3 of Fig. 1;

Fig. 4 is a top plan view of the entire supporting structure of Fig. 1 with the mill itself removed;

Fig. 5 is a vertical section taken on the staggered line 5—5 of Fig. 4 to indicate the positioning and mounting of the parts of the mounting for one pair of wheels at one of the four mounting positions of Fig. 4, this section being taken on a larger scale than the plan of Fig. 4;

Fig. 6 is principally a plan view, as indicated by the line 6—6 of Fig. 5, on the same scale as Fig. 5, to show the mounting structure at the respective position of the mill; and

Fig. 7 is an end elevational detail, on a somewhat enlarged scale taken from the lines 7—7 of Figs. 5 and 6.

The drawings illustrate a rotary tumbling mill 10 which is provided with a conventional or preferred cylindrical shell 12 about which is secured adjacent each end a pair of mounting rails 14. In cross section, each of these mounting rails is that of an ordinary railroad rail. Each rail 14 is supported upon two spaced wheels 15, one of which is disposed at each side of the mill as seen in Fig. 2, as well as in Fig. 4, the two wheels 15 at each mill position for the respective pair of rails 14 being thus arranged in pairs as seen in Fig. 1 in elevation and in Fig. 4 in plan. In the preferred form illustrated, the flanges of the wheels of each pair are disposed at opposite sides of the heads of the respective rails so as to resist tendency of the mill to slip longitudinally in either direction. The rails 14 might be shrunk in position on the shell 12, but conveniently they are formed in a plurality of sections bolted together with tie plates and let into slight, annular recesses, or equivalent retaining channels, provided in the mill shell 12, approximately as indicated in Fig. 1A. This figure shows the usual ball or head of the rail 14, its webb 16 and base 18, and each wheel 15 is shown as having the usual flange 15a. The contact faces of the rail heads and the wheels are desirably flattened as illustrated so that the contact points will be in axially directed lines rather than as lesser spots which would be provided if curves and slopes in the respective faces were provided.

Each of the pairs of wheels 15 is independently mounted on an individual frame generally indicated at 20, there being therefore four such frames 20. Each such frame 20 is carried for pivotal adjustment upon a fixed sub-frame or base 22. Each sub-frame 22, as best indicated

in Fig. 5, is provided with a fixed well member or sleeve 24 and in this sleeve 24 there is positioned a heavy pivot pin 25 which extends upward into a sleeve 26 axially aligned with the sleeve 24 and the pin 25 in fixed position in the respective adjustable frame 20. As an indication of the nature of the relatively massive construction which is employed for very large mills of the nature herein indicated, which may be for example twelve feet or fifteen feet in diameter, the diameter of the pins 25 may be about six inches and these pins consist of a section of steel rod. At the opposite end of each adjustable frame 20 there is mounted an individual motor 30 for driving the respective pair of wheels 15, the drive shaft of this motor leading to a suitable gear reduction case 32 containing the necessary reduction gears which are in turn connected to a drive shaft 33 for the respective pair of wheels 15 as probably best indicated in Fig. 4. Horizontal movement of the end of each frame 20 with respect to the corresponding end of its base 22 is effected through the medium of adjusting screws 35 carried in brackets 36 fixed on the opposite sides of the respective portion of the respective stationary base 22 and bearing against opposing members on the under side of the respective adjustable frame 20. Thus, by letting off one screw 35 and advancing the opposite screw 35 in any instance, the adjustable frame 20 may be moved about its pivot pin 25 as required to effect exact positioning of the respective wheels 15 in relation to the sides of the rails 14 with which they engage. Such adjustment is especially necessary with respect to the high wheels 15 seen at the left of Fig. 2, by reason of the fact that such pairs of wheels are desirably positioned for maximum driving efficiency at a higher lever than the opposite pairs of wheels 15 because of the nature of the drive causing the mill shell to rotate at a high rate in a clockwise direction as viewed in this figure. With respect to the pivot pins 25, it is not necessary that they extend all the way up through the respective sleeves 26, and the resultant spaces above the tops of the pins 25 and within the sleeves 26 desirably provide appropriate cavities 37 for grease or other lubricant, the tops of these cavities being conveniently sealed by means of interfitting covers 38 (Fig. 5).

In order to remove from the pivot pins 25 excess lateral thrust being applied thereto by reason of the weight of the mill 10 which is directed into the space between the opposing pairs of wheels 15 at each end of the mill, appropriately heavy tie rods 40 are desirably employed. These tie rods are conveniently in the form of heavy turnbuckles whose ends are fixed to portions of bearing supports 42 for the wheels 15, as through the medium of brackets 43 and pivot pin connections 44. These are aligned in the same vertical planes as contain the axes of the respective pivot pins 25, and, by tightening the nuts 45 of these turnbuckle-type tie rods 40, all unbalancing lateral thrust upon the upper portions of the pins 25 through the adjustable frameworks 20 is relieved.

By this arrangement of individually adjustable mountings for each pair of wheels 15 at the four supporting positions of the mill 10 very large, heavy mill structures may be employed which may be rotated at relatively high rates so that a high degree of cascading of the tumbling materials therein may be effected.

As a result very large raw materials, such as limestone chunks having dimensions around one foot in greatest length, or even up to three feet, may be readily handled without crushing, and adequate reduction in size for the purpose of production of Portland cement or the like easily and quickly accomplished with coincident long life of the mill structure.

From the standpoint of the detailed structural features and mountings of the upper, adjustable wheel-supporting frames 20 and their lower fixed supporting frames 22, it has been indicated that, as illustrated in

Fig. 2, and as also indicated in Fig. 3, the wheels lying on the side of the direction of rotation as indicated by the arrows A should be higher for the purpose of attaining maximum driving efficiency from the motors 30 and rotating efficiency of the mill 10. As a consequence a concrete base 50 carrying the frames for the higher wheels 50 is disposed at a higher level than a concrete base 52 carrying the opposite frames 20 and 22. The lower frames 22 are constructed of suitable upper and lower plates 53 and 54 respectively, and these lower plates are in turn bolted as indicated at 55, and through the medium of such spacers 56 as may be needed, to the underlying concrete bases 50 and 52.

The upper plates 53 are appropriately fixed to and mounted upon the lower plates 54 as through the medium of I-beams 58. The upper frames 20, which are adjustable about the pivot pins 25 as described, are in general similarly composed of upper and lower plates 60 and 62 suitably connected as by means of I-beams or the like 64. While connecting bolts or the like 65 may be used to maintain suitable sliding contacts of the lower plates 62 of the upper frames 20 with the upper plates 53 of the lower, fixed frames 22, appropriate lost-motion slots 66 are, however, necessarily provided in either or both of such contacting plates to permit the swinging movement required about the pivot pins 25. The interfaces providing the bearing surfaces between such upper bearing plates 53 and lower bearing plates 62 are, of course, preferably to be adequately lubricated as may be required to effect necessary adjustments.

As indicated in Fig. 1, the mill may be fed by any suitable hopper or feed neck 70 of appropriate size carried on any convenient support 72 and leading into a conventional or other throat member 74 on the usual mill wall at the feed end. Similarly, as indicated in Figs. 1 and 2, the mill may be discharged through an annular series of screens 75 covering discharge openings 76 in the discharge end 77 of the mill. The fines of the ground material passing the screens 75 pass through adjacent cylindrical horizontally extending screens 78 on the end of the mill and drop into a discharge chute 80 at the lower end of a stationary enclosing housing 82 for the screens 78. The retained coarse materials are discharged from the screens 78 into a corresponding annular series of receivers 84 each of which feeds upon mill rotation to a central return cone 85 directed into a flaring return spout 86 projecting through a central opening in the end wall 77 to return the oversize back into the mill for further grinding. The rotating screens 78, receivers 84, cone 85 and return spout 86 are assembled as a unit and secured to the end wall 77 as by bolts 88.

By the means and method herein described, the relatively high speed of rotation develops a high cascading rate for large materials which effects rapid grinding without the use of the balls or rods commonly used for grinding raw materials for cement making and the like in this type of mill.

Also, with heavy constructions and large diameters, such as indicated, hiwh speed tumbling of large and heavy materials is readily accomplished without injury to the mill or its mounting and driving means.

By providing separate mounts for the mill and providing separate motors for driving the supporting wheels of the different mounts, thoroughly accurate adjustment of each pair of the supporting and driving wheels 15 with respect to the carrying rails 14 of the mill is assured. Also, high speed rotation of the heavy mill is easily effected through the medium of the several motors 30 which will normally be load-balanced or synchronized as may be required. Oversize materials discharged through the end screens 78 are fed back to the mill through the central spout 86 by mill rotation as described.

In operating the tumbling mill of this invention it is possible to feed large raw materials to the mill because of its unusually large diameter, such as 12 to 15 feet.

Thus, crushable run-of-mine materials, such as limestone, are handled with great savings in previously required preliminary treatment. All breaking and crushing is therefore effected merely by tumbling the feed material, which is retained in the mill until reduced to the required fine particle size. Since the mill described may be rotated at high rates of rotation for this art and this type of mill, e. g. 17 to 20 R. P. M., a high cascading effect is accomplished by reason of the fact that both large and small materials are carried high up the mill side in the direction of the arrow of Fig. 2, so that the materials fall back onto lower materials in the mill with impact sufficiently great to produce the necessary grinding or crushing action. If elevating projections are needed on the mill interior, they are used. Proper adjustment of the supporting wheels **15** is readily accomplished with the means described, wear of the parts being thereby reduced to a minimum, and the described rapid rotation with the four motors **30** and incidental high cascading effects are easily obtained. Since the mountings at the opposite ends of the mill are well spaced, the properly reduced, fine product is conveniently discharged from the respective mill end merely by disposing the downwardly directed chute **80** to discharge between the respective mountings at a position adjacent but forward of the respective wheels **15** and their connecting tie rods **40**. The product is then led off to a point of disposition by any conventional or preferred conveyor means, or otherwise as desired.

I claim as my invention:

1. A rotary mill which includes: a rotary mill shell disposed on a horizontal axis; rails disposed around said mill shell adjacent to the opposite ends thereof; pairs of independent mountings for said mill, one of said pairs of mountings being located adjacent to each end of said mill, the mountings of each of said pairs being located on opposite sides of said mill shell; flanged wheel means carried by each of said mountings, said wheel means engaging said rails so as to support said mill shell; stationary base means for each of said mountings; pivot means, connecting each of said base means and the corresponding one of said mountings, each of said pivot means having a vertical axis coinciding with the vertical center of said wheel means on said mounting; and means for turning said mountings upon each of said base means around said pivot means so as to align said wheel means with said rails.

2. A rotary mill which includes: a rotary mill shell disposed on a horizontal axis; rails disposed around said mill shell adjacent to the opposite ends thereof; pairs of independent mountings for said mill, one of said pairs of mountings being adjacent to each end of said mill, the mountings of each of said pairs being located on opposite sides of said mill shell; flanged wheel means carried by each of said mountings, said wheel means engaging said rails so as to support said mill shell; stationary base means for each of said moutings; pivot means connected to each of said base means and the corresponding one of said mountings, each of said pivot means having a vertical axis coinciding with the vertical center of said wheel means on said mountings and each of said pivot means comprising a pivot pin mounted in each of said stationary base means so as to extend therefrom and a bearing sleeve located in each of said independent mountings for receiving one of said pivot pins; and means for turning said mountings upon each of said base means around said pivot means so as to align said wheel means with said rails.

3. A rotary mill which includes: a rotary mill shell disposed on a horizontal axis; rails disposed around said mill shell adjacent to the opposite ends thereof; pairs of independent mountings for said mill, one of said pairs of mountings being adjacent to each end of said mill, the mountings of each of said pairs being located on opposite sides of said mill shell; wheel means carried by each of said mountings, said wheel means engaging said rails so as to support said mill shell; stationary base means for each of said mountings; pivot means connected to each of said base means and the corresponding one of said mountings, each of said pivot means having a vertical axis and each of said pivot means comprising a pivot pin mounted in each of said stationary base means so as to extend therefrom and a bearing sleeve located in each of said independent mountings for receiving one of said pivot pins, the upper portion of each of said sleeves being provided with a well adapted to contain a lubricant, the vertical axis of each said pivot means coinciding with vertical center of each of said wheel means of said mountings; and means for turning said mountings upon each of said base means around said pivot means so as to align said wheel means with said rails.

4. A rotary mill which includes: a rotary mill shell disposed on a horizontal axis; rails disposed around said mill shell adjacent to the opposite ends thereof; pairs of independent mountings for said mill, one of said pairs of mountings being located adjacent to each end of said mill; wheel means carried by each of said mountings, said wheel means on each of said mountings engaging one of said rails so as to support said mill shell; stationary base means for said mountings; vertical pivot pin means connecting each of said base means and the corresponding one of said mountings; and tie means extending between the mountings of each of said pair of mountings, said tie means being aligned with said pivot pin means, said tie means serving to absorb thrust strains tending to move said mountings away from one another.

5. A rotary mill which includes: a rotary mill shell disposed on a horizontal axis; rails disposed around said mill shell adjacent to the opposite ends thereof; pairs of independent mountings for said mill, one of said pairs of mountings being located adjacent to each end of said mill; wheel means carried by each of said mountings, said wheel means on each of said moutings engaging one of said rails so as to support said mill shell; stationary base means for said mountings; vertical pivot pin means connecting each of said base means and the corresponding one of said mountings; tie means extending between the mountings of each of said pair of mountings, said tie means being aligned with said pivot pin means; said tie means serving to absorb thrust strains tending to move said mountings away from one another; and means for turning said mountings upon said base means about said pivot means so as to align said wheel means with said rails.

6. A rotary mill which includes: a rotary mill shell disposed on a horizontal axis; rails disposed around said mill shell adjacent to the opposite ends thereof; pairs of independent mountings for said mill, one of said pairs of mountings being adjacent to each end of said mill, the mountings of each of said pairs being located on opposite sides of said mill shell; wheel means carried by each of said mountings, said wheel means engaging said rails so as to support said mill shell; stationary base means for each of said mountings; pivot means connected to each of said base means and the corresponding one of said mountings, each of said pivot means having a vertical axis and each of said pivot means comprising a pivot pin mounted in each of said stationary base means so as to extend therefrom and a bearing sleeve located in each of said independent mountings for receiving one of said pivot pins; means for turning said mountings upon each of said base around said pivot means so as to align said wheel means with said rails; and tie means extending between the mountings of each of said pairs of mountings in line with said vertical axis of said pivot means for absorbing thrust strains directed toward said pivot means by reason of the weight of said mill shell.

7. A rotary mill which includes: a rotary mill shell deposed on a horizontal axis; rails deposed around said mill shell adjacent to the opposite ends thereof; pairs of

independent mountings for said mill, one of said pairs of mountings being located adjacent to each end of said mills; wheel means carried by each of said mountings, said wheel means on each of said mountings engaging one of said rails so as to support said mill shell; stationary base means for said mountings; vertical pivot pin means connecting each of said base means and the corresponding one of said mountings, each of said pivot pin means having a vertical axis coinciding with the vertical center of said wheel means on said mounting; and tie rod means extending between the mountings on each of said pairs of mountings, said tie rod means being aligned with said pivot pin means, said tie rod means serving to absorb thrust strains tending to move said mountings away from one another.

8. A rotary mill which includes: a rotary mill shell deposed on a horizontal axis; rails deposed around said mill shell adjacent to the opposite ends thereof; pairs of independent mountings for said mill, one of said pairs of mountings being located adjacent to each end of said mills; wheel means carried by each of said mountings, said wheel means on each of said mountings engaging one of said rails so as to support said mill shell; stationary base means for said mountings; vertical pivot pin means connecting each of said base means and the corresponding one of said mountings, each of said pivot pin means having a vertical axis coinciding with the vertical center of said wheel means on said mounting; and tie rod means extending between the mountings on each of said pairs of mountings, said tie rod means being aligned with said pivot pin means, said tie rod means serving to absorb thrust strains tending to move said mountings away from one another; means for turning said mountings upon said base means about said pivot pin means so as to align said wheel means with said rails.

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