

Jan. 6, 1931.

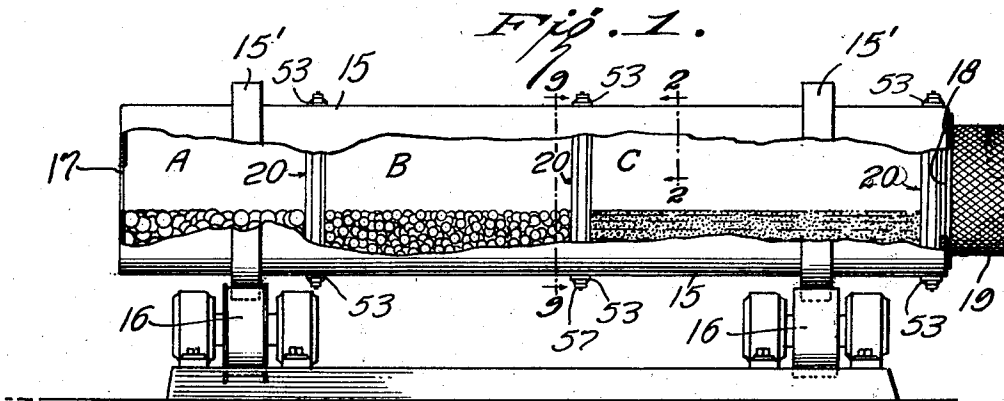
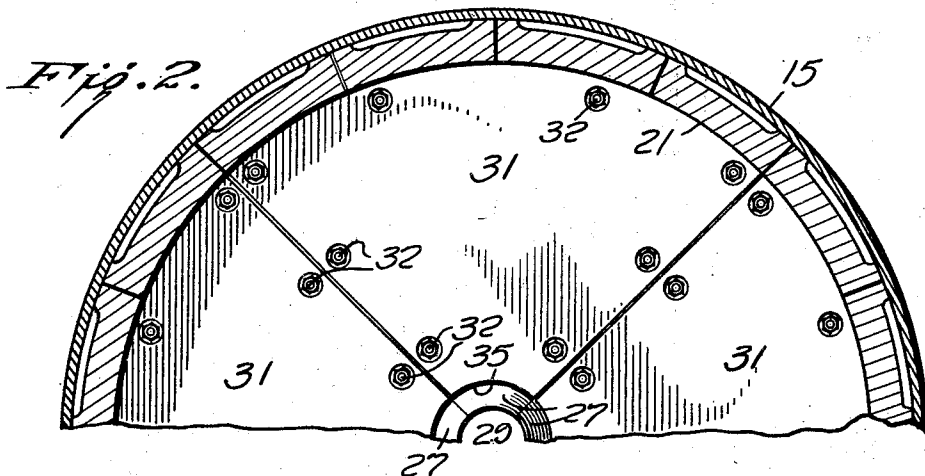
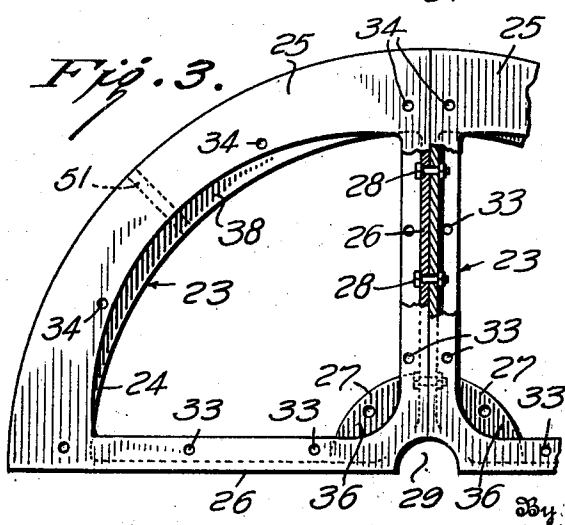
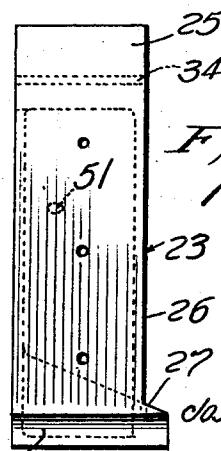
J. V. DURNIN

1,787,897

COMPARTMENT TUBE GRINDING MILL

Filed Aug. 13, 1929

3 Sheets-Sheet 1



Inventor

JOSEPH V. DURNIN,

BPJ/Whitman

Attorney

Jan. 6, 1931.

J. V. DURNIN

1,787,897

COMPARTMENT TUBE GRINDING MILL

Filed Aug. 13, 1929

3 Sheets-Sheet 2

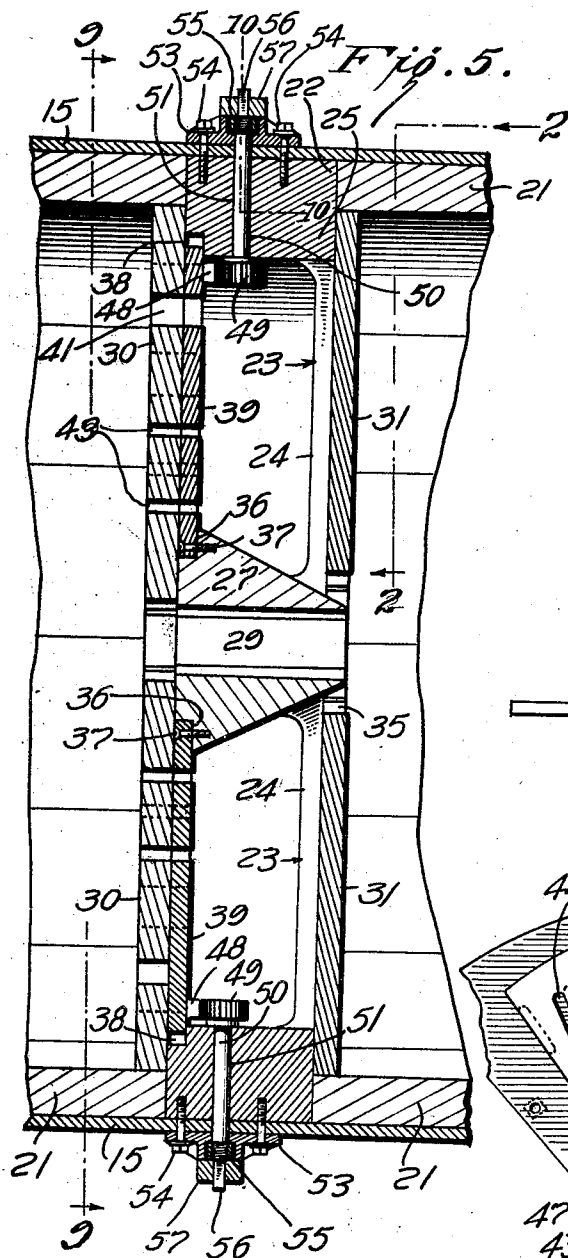


Fig. 6.

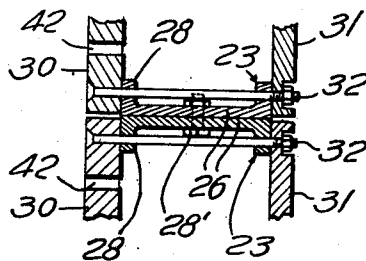
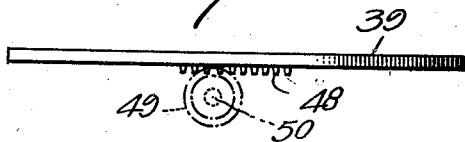
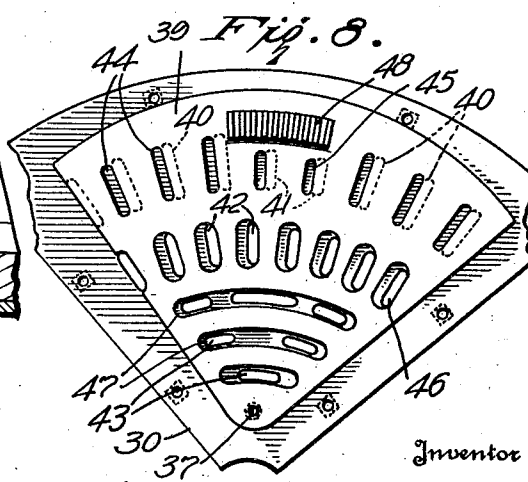


Fig. 7.



Inventor
JOSEPH V. DURNIN,

By *B. M. Williams*

Attorney

Jan. 6, 1931.

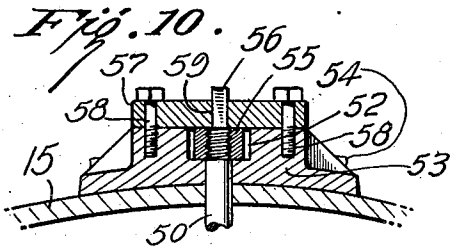
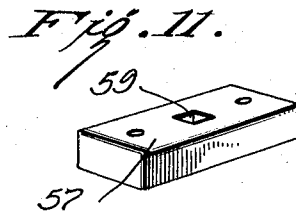
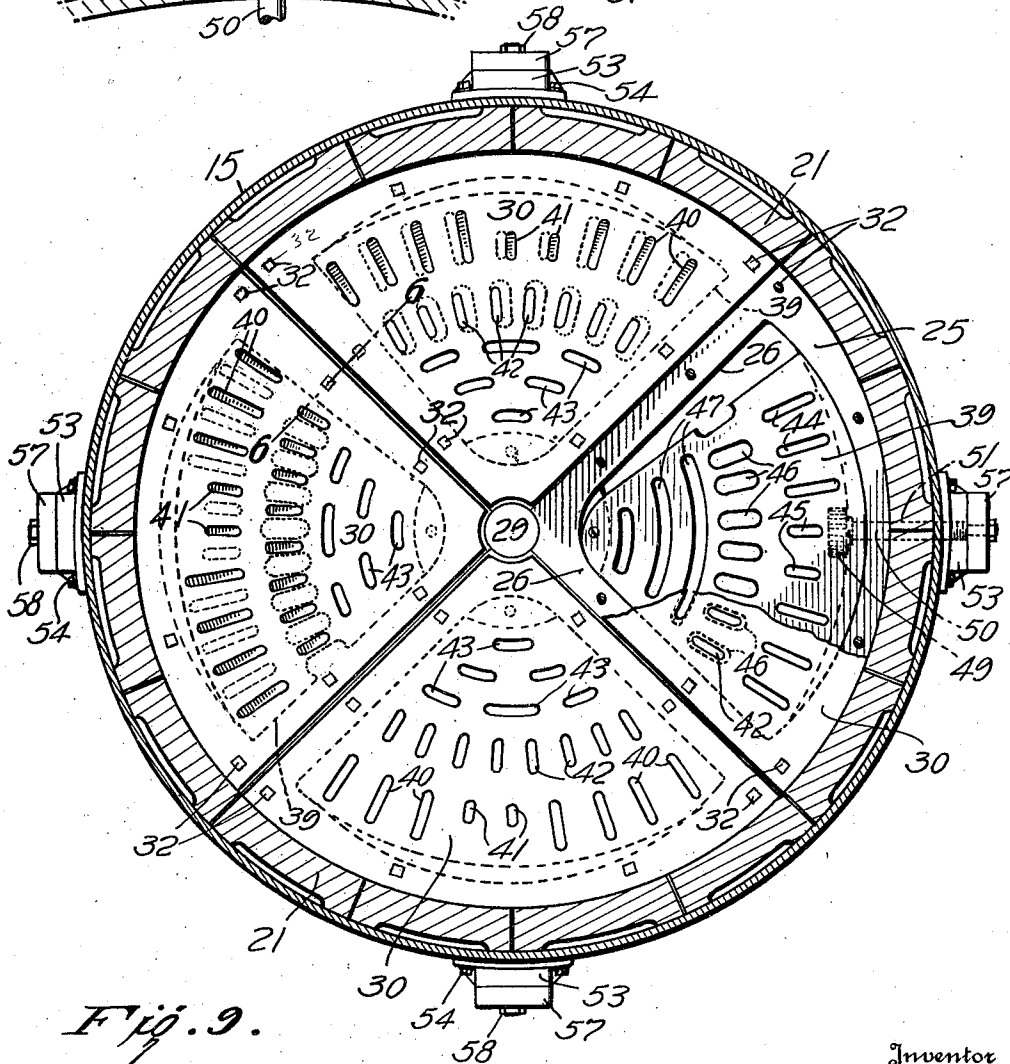
J. V. DURNIN

1,787,897

COMPARTMENT TUBE GRINDING MILL

Filed Aug. 13, 1929

3 Sheets-Sheet 3



Inventor

JOSEPH V. DURNIN,

ಹೆಚ್. ಬಿ. ಜುಬ್ಬಾ

Attorney

UNITED STATES PATENT OFFICE

JOSEPH V. DURNIN, OF ALLENTOWN, PENNSYLVANIA

COMPARTMENT TUBE GRINDING MILL

Application filed August 13, 1929. Serial No. 385,679.

My invention relates to improvements in compartment tube grinding mills.

The efficiency of any tube grinding mill, of the single or multi-compartment type, operating upon cement clinkers or other material, is determined by the tonnage of fine particles ground per kilowatt of power input. The reduction of the material from the feed size to the required fineness is controlled by four factors; first, the speed of rotation of the grinding mill with relation to its diameter, for producing the required cascading action of the grinding media; second, the weight of the grinding media; third, the length of the compartment; fourth, the size of the openings or holes in the partition controlling the discharge of the material from the compartment.

In view of these factors, it will be seen that it is essential to efficiency to keep the cement clinker or other material in the grinding chamber or compartment, for a sufficient length of time, until it is ground to the desired fineness, and then to discharge the ground material from the chamber or compartment, so that the unground material may be more readily acted upon by the grinding media. In practice, it has been observed that the grindability of the material often changes, due to the fact that the raw material is secured from a quarry or a mine and the chemical or physical properties of the raw material change from time to time. This change in the properties of the raw material will throw out of adjustment any grinding tube mill which has been calibrated or graduated, so as to produce the maximum grinding efficiency upon a given material.

The present invention provides an adjustable partition, by means of which the material may be retained in the grinding chamber for the required length of time. The adjustment of the device is highly flexible inasmuch as the area of the partition embodies a plurality of segments, one or all of which

may be adjusted to control the volume of material passing through the partition. This enables the ground material to pass in proper amounts from one compartment to the other, until it finally discharges into the screen. To effect the adjustment of the partitions, it is only necessary to stop the rotating tube or casing, as the adjusting elements extend to the exterior of the tubes. After adjustment, the elements are locked in the adjusted position. The openings of the several partitions may be graduated with respect to the openings in the other partitions, permitting of material to pass from one compartment to the other in graduated sizes.

The construction of the partition is strong and durable and is formed in segments which may be separate, whereby repair or replacement may be easily accomplished.

In the accompanying drawings, forming a part of this specification, and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is a side elevation of a grinding tube mill embodying my invention,

Figure 2 is a transverse section taken on line 2—2 of Figure 5,

Figure 3 is a side elevation of two of the spider segments,

Figure 4 is an end elevation of one spider segment,

Figure 5 is a central vertical longitudinal section through one of the partitions,

Figure 6 is a detailed transverse section taken on line 6—6 of Figure 9,

Figure 7 is a plan view of one of the pivoted shutters,

Figure 8 is a side elevation of the same,

Figure 9 is a transverse section taken on line 9—9 of Figure 5,

Figure 10 is a detailed transverse section taken on line 10—10 of Figure 5,

Figure 11 is a perspective view of a lock block.

In the drawings, wherein for the purpose

of illustration, is shown a preferred embodiment of my invention, the numeral 15 designates the casing or tube of the mill, which is preferably horizontally arranged, and provided upon its exterior with rings 15', engaging supporting and driving means 16, whereby the casing is rotated upon its longitudinal axis. The casing is provided at its rear end with an inlet opening 17, for receiving the rock to be ground and is provided at its forward end with an outlet opening 18, discharging into a screen 19. Disposed within the casing 15 in spaced relation, are adjustable partitions 20, affording compartments A, B and C. These adjustable partitions are identical, and a detailed description of one will suffice for all.

The compartments contain grinding balls, to act upon the clinkers to be ground, and the casing 15 has its inner surface covered by a lining 21, formed of metal or the like, to protect the casing. This lining terminates at the ends of the compartments, and is spaced to provide an annular recess 22, Figure 5, for receiving the elements of the partition.

Each partition embodies a spider 23, including spider segments 24. Each spider segment includes a solid curved rim segment 25, connected at its ends with radial arms 26, preferably integral therewith. These radial arms are integral with a tapered hub segment 27. The arms 26 are provided with radial flanges 28, extending inwardly and laterally beyond the arms 26. The arms 26 of the adjacent spider segments, Figures 3 and 6, are connected by bolts 28'. The assembled hub segments provide a tapered or conical hub having a central opening 29. The rim segments 25 fit within the annular recess 22, as shown. Disposed upon the forward side of the spider segments are segmental discharge plates 30, engaging the rim segments 25 and flanges 28, and segmental inlet plates 31, are arranged upon the opposite or rear side of the spider segments and engage with the rim segments and flanges 28. The discharge and inlet segmental plates are preferably in alignment, and are rigidly held in place upon the spider segments by bolts 32, Figures 3 and 6, passing through these plates and through openings 33, formed in the flanges 28 and openings 34 formed in the rim segments 25, as shown. The hub segments 27 are tapered forwardly and produce, when assembled, a tapered or conical hub, decreasing in diameter forwardly, and the inner ends of the segmental inlet plates 31 are spaced from this conical hub, affording an annular passage 35, through which the ground rock discharges into the next forward compartment. The purpose of the inlet plates 31 is to protect the interior of the partition and the elements housed therein from the action of the grinding balls and rock, and permitting of the proper discharge of the ground material

from one compartment to the next forward compartment. The assembled spider segments and their hubs are concentric with the casing 15.

The hub segment 27 of each spider segment is provided upon its rear or large end with a recess 36, having an opening formed therein for receiving a pivot element or screw 37, and the rim segment 25 is provided with a curved recess 38, Figures 3 and 5, and this recess is concentric with the pivot element 37. A shutter-plate or element 39 is mounted within each recess 38 and is disposed at the rear of and in contact with the segmental discharge plate 30, and is pivotally mounted upon the pivot element 37, at its inner end. The shutter-plate is, therefore, capable of partaking of swinging movements with relation to the segmental discharge plate 30.

Each segmental discharge plate, Figure 9, is provided with an outer curved group of radial slots or openings 40 and 41, and an intermediate curved group of radial slots or openings 42, which are staggered with relation to the openings or slots 40 and 41. Inwardly of the slots 42, the segmental discharge plate is provided with a plurality of groups of circumferentially extending slots 43. Each co-acting shutter-plate 39 is provided with an outer curved group of slots or openings 44 and 45, adapted for movement into and out of registration respectively with the slots 40 and 41. The shutter-plate is provided with an intermediate curved group of slots or openings 46, disposed in staggered relation to the slots 44 and 45 and being twice as wide as these slots. Slots 46 are adapted for movement into and out of registration with slots 42. Circumferentially extending slots 47 are formed in the inner end of the segmental shutter-plate and are adapted for permanent registration with the slots 43. When slots 44 and 45 are in registration with slots 40 and 41 respectively, slots 46 will register with slots 42.

When the shutter-plate is turned sufficiently so that slots 44 and 45 are just out of registration with slots 40 and 41 respectively, slots 46, due to their increased width will still register with slots 42. A further turning movement of the shutter-plate will bring slots 46 out of registration with slots 42 while slots 44 and 45 will still remain out of registration with slots 40 and 41 respectively. The circumferential slots 47 remain in permanent registration with slots 43.

Separate means are provided to turn each segmental shutter-plate 39, comprising a rack 48 secured upon the inner side of the shutter-plate 39, near its outer end, and preferably formed integral therewith. This rack is engaged by a pinion 49, rigidly mounted upon a radial shaft 50, extending through an opening 51, formed in the rim segment 25. The shaft 50 also extends through an opening in

the casing 15 and leads into a recess 52, formed in a block 53, which is attached to the casing 15 and to the rim segment by bolts 54, or the like. The rim segments may be rigidly attached to the casing 15 by additional means, if desired. The shaft 50 has a screw-threaded portion within the recess 52, for receiving a nut 55, which is rotatable within the recess and serves to prevent longitudinal displacement of the shaft 50. This screw-threaded portion carries a reduced portion 56, which is square in cross section, and is adapted to be engaged by a suitable tool when it is desired to turn the shaft 50. The numeral 57 designates a lock plate, adapted to be secured to the block 53 by bolts 58 or the like, and this lock plate has an opening 59, square in cross section, to receive the extension 56 and thereby positively hold the shaft 50 against rotation.

In view of the foregoing description, it will be seen that each shutter-plate may be independently turned or adjusted upon its pivot, and this adjustment may be such that the slots 40 and 41 will be covered while slots 42 remain uncovered, and slots 40, 41 and 42 may all be covered and the slots 43 remain uncovered. Of course, the invention is in no sense restricted to the particular arrangement of slots or openings, as the same may be varied.

By this means, the passage of the ground clinker from one compartment to the other is controlled, and the length of time that the material will remain in each compartment, may be regulated. This is found to be necessary for the efficient operation of a grinding mill, as the character of the clinker to be ground frequently varies, even when taken from the same source. It is apparent that the shutter-plates may be quickly and conveniently adjusted from the exterior of the casing of the mill, without necessitating dismantling the machine. The arms 26 of the spider serve as lifting elements, raising the material, which falls upon the tapered guide element or hub, and is conducted thereby to and through the opening 35 in the inlet plate means.

It is to be understood that the form of my invention, herewith shown and described, is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts, may be resorted to without departing from the spirit of my invention, or the scope of the subjoined claims.

Having thus described my invention, I claim:—

1. In a compartment tube grinding mill, a casing, an adjustable partition arranged therein, comprising a spider, discharge plate means secured to one side of the spider and having openings for the passage of material, a plurality of cover plates arranged within

the spider and disposed adjacent to the discharge plate means and having openings adapted for movement into and out of registration with the first named openings, means to shift the cover plates with relation to the discharge plate means, and inlet plate means secured to the opposite side of the spider and having a central opening for the passage of the material.

2. In a compartment tube grinding mill, a casing, an adjustable partition arranged therein, comprising a spider, segmental discharge plates secured to one side of the spider and having openings for the passage of material, a plurality of segmental cover plates arranged within the spider and corresponding in number and arrangement to the discharge plates and having openings adapted for movement into and out of registration with the first named openings, means to pivot each cover plate to the spider, separate means to swing each cover plate upon its pivot, and a plurality of inlet plates arranged upon the opposite side of the spider and secured thereto and corresponding in number and arrangement to the discharge plates and having an outlet opening at their inner ends.

3. In a compartment tube grinding mill, a casing, an adjustable partition arranged therein, comprising a spider including a plurality of segmental spider sections, each spider section comprising a rim segment and a hub segment, and radial arms connecting the same, means for connecting the radial arms of the several spider sections, a plurality of discharge plates arranged upon one side of the spider and corresponding in number and arrangement to the spider segments, said discharge plates having openings formed therein, segmental inlet plates arranged upon the opposite side of the spider and corresponding in number and arrangement to the spider segments, bolts passing through the segmental discharge plates and the segmental inlet plates to secure them to the spider segments, the assembled segmental inlet plates having a central opening for the passage of material, segmental cover plates arranged within the spider segments and corresponding in number and arrangement to the segmental discharge plates and having openings adapted to register with the first named openings, means to pivot each cover plate to the corresponding hub segment, and means to turn each cover plate upon its pivot.

4. In a compartment tube grinding mill, a casing, an adjustable partition arranged therein, comprising a spider including a plurality of spider segments, each spider segment including a rim segment and a hub segment and radial arms connecting the same, the hub segments being tapered whereby they produce a conical hub when assembled, means for connecting the radial arms of the spider segments, a plurality of segmental discharge

plates disposed upon one side of the spider and corresponding in number and arrangement to the spider segments and having openings formed therein, a plurality of segmental inlet plates disposed upon the opposite side of the spider and corresponding in number and arrangement to the spider segments, said inlet plates having their inner ends spaced from the reduced end of the conical hub for providing a central opening for the passage of material, means to secure the discharge plates and the inlet plates to the corresponding spider segments, a plurality of segmental cover plates disposed within the spider segments and corresponding in number and arrangement to the discharge plates and having openings adapted for registration with the first named openings, means to pivot the inner ends of the cover plates with the hub segments, and adjustable means engaging the outer ends of the cover plates to turn them upon their pivots.

5. A partition for a tube grinding mill, comprising a spider including spider segments, each spider segment including a rim segment and a hub segment and radial arms connecting the same, means for connecting the arms of the several spider segments, each hub segment having a recess, a pivot element within the recess, each rim segment having a curved recess which is concentric with the pivot element, a segmental discharge plate secured to the side of the spider segment adjacent to the said recesses and having openings, a segmental cover plate mounted within the recesses and connected with the pivot element and having openings to register with the first named openings, a rack carried by the outer portion of the cover plate, a pinion engaging said rack, and means operable from the exterior of the rim segment to turn the pinion.

6. A partition for a tube grinding mill, comprising a spider including spider segments, each spider segment including a rim segment and a hub segment and radial arms connecting the same, means for connecting the arms of the several spider segments, each hub segment having a recess, a pivot element within the recess, each rim segment having a curved recess which is concentric with the pivot element, and also having a radial opening, a segmental discharge plate secured to the side of the spider segment adjacent to the said recesses and having openings, a segmental cover plate mounted within the recesses and connected with the pivot element and having openings, a rack carried by the outer portion of the cover plate, a pinion engaging the rack, a shaft secured to the pinion and extending through the radial opening to the exterior of the rim segment so that it may be turned, and means to lock the shaft against turning movement.

7. In a compartment tube grinding mill,

a casing, an adjustable partition therein, comprising a spider embodying separate connected spider segments, separate segmental plates secured to the corresponding spider segments and having openings formed therein, a corresponding number of segmental cover plates having openings formed therein and arranged adjacent to the said segmental plates, means to pivotally support each segmental cover plate so that it may turn in a plane substantially parallel with the face of its segmental plate, and means to swing each segmental cover plate upon its pivot.

8. In a compartment tube grinding mill, a casing, an adjustable partition arranged therein, comprising a spider embodying hollow separate spider segments, a segmental plate secured to each spider segment and having openings formed therein, the several segmental plates being separate, a cover plate for each segmental plate arranged within each hollow spider segment and pivotally supported in a manner to swing parallel with the face of its segmental plate, the segmental cover plates being separate and separate means to swing each segmental cover plate upon its pivot.

9. In a compartment tube grinding mill, a casing, an adjustable partition arranged therein, comprising a hollow spider, cover plate means secured to the spider adjacent to one side thereof and having openings, a plurality of separate segmental cover plates pivoted within the hollow spider and having openings formed therein and arranged adjacent to said plate means to swing in a plane parallel with the face of the plate means, separate means to turn each cover plate upon its pivot, and a plate secured to the hollow spider adjacent to its opposite side and having an opening formed therein for the passage of material, the two plates carried by the spider serving to enclose the cover plates so that they are free from contact with the grinding medium.

10. In a compartment tube grinding mill, a casing, an adjustable partition arranged therein, comprising discharge plate means having openings, cover plate means having openings and arranged to co-act with the discharge plate means, inlet plate means spaced from the discharge plate means and having a generally central opening, a guide element arranged between the discharge plate means and inlet plate means and adapted to direct the material to the opening in the inlet plate means, and lifting elements arranged between the discharge plate means and inlet plate means.

11. In a compartment tube grinding mill, a casing, an adjustable partition arranged therein, comprising discharge plate means having openings formed therein, inlet plate means spaced from the discharge plate means and having a generally central opening, cover

plate means arranged between the discharge
plate means and inlet plate means and hav-
ing openings formed therein for co-action
with the openings in the discharge plate
5 means, a guide element arranged between the
discharge plate means and inlet plate means
and tapered toward the opening in the inlet
plate means to direct material to such open-
ing, and lifting elements arranged between
10 the discharge plate means and inlet plate
means for raising the material and discharg-
ing the same upon the tapered guide element.
In testimony whereof I affix my signature.

15 JOSEPH V. DURNIN.