

July 2, 1940.

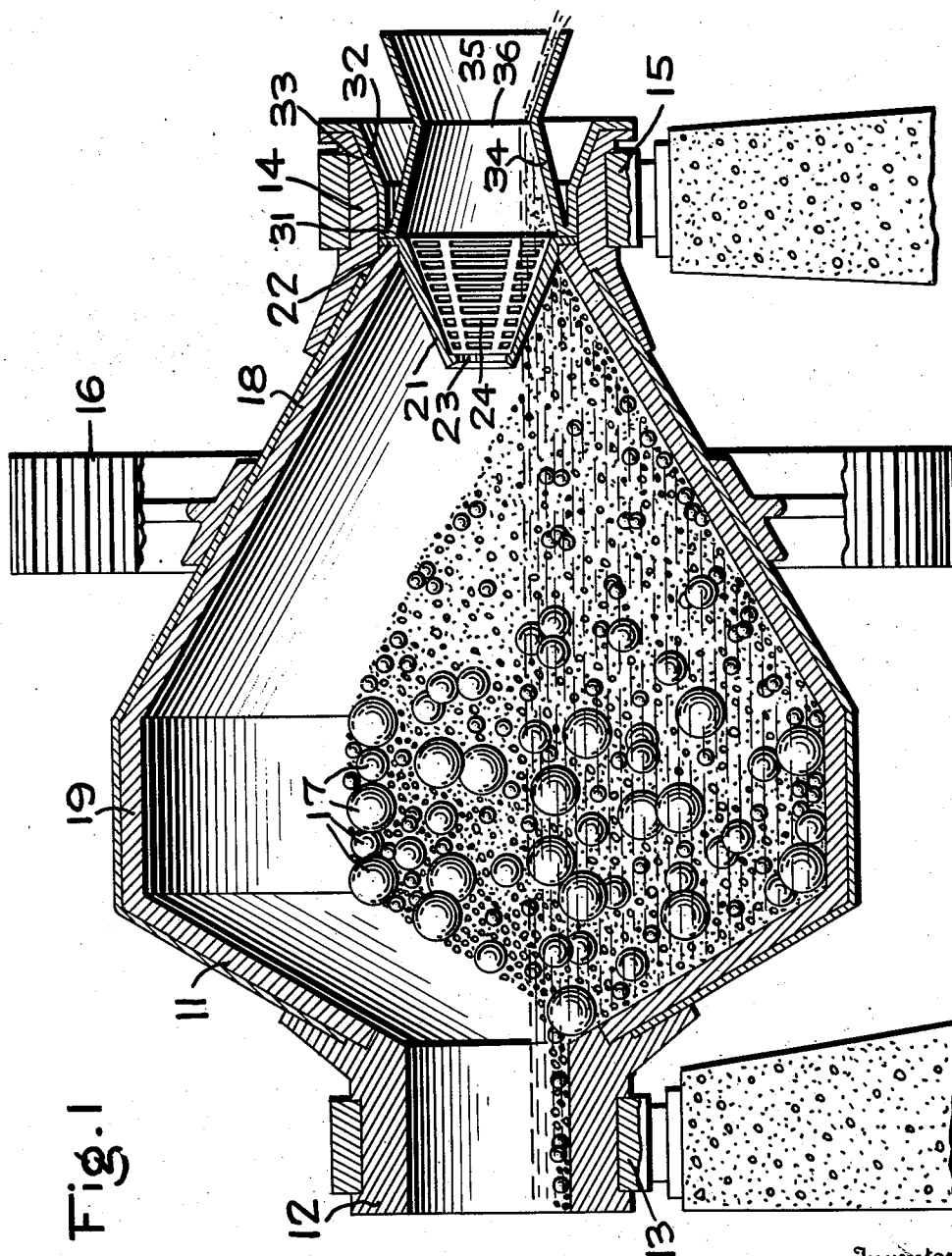
H. HARDINGE

2,206,477

GRINDING MILL

Filed July 30, 1937

2 Sheets-Sheet 1



Inventor

HARLOWE HARDINGE

By Malcolm F. Barnett Attorney

Attorney,

July 2, 1940.

H. HARDINGE

2,206,477

GRINDING MILL

Filed July 30, 1937

2 Sheets-Sheet 2

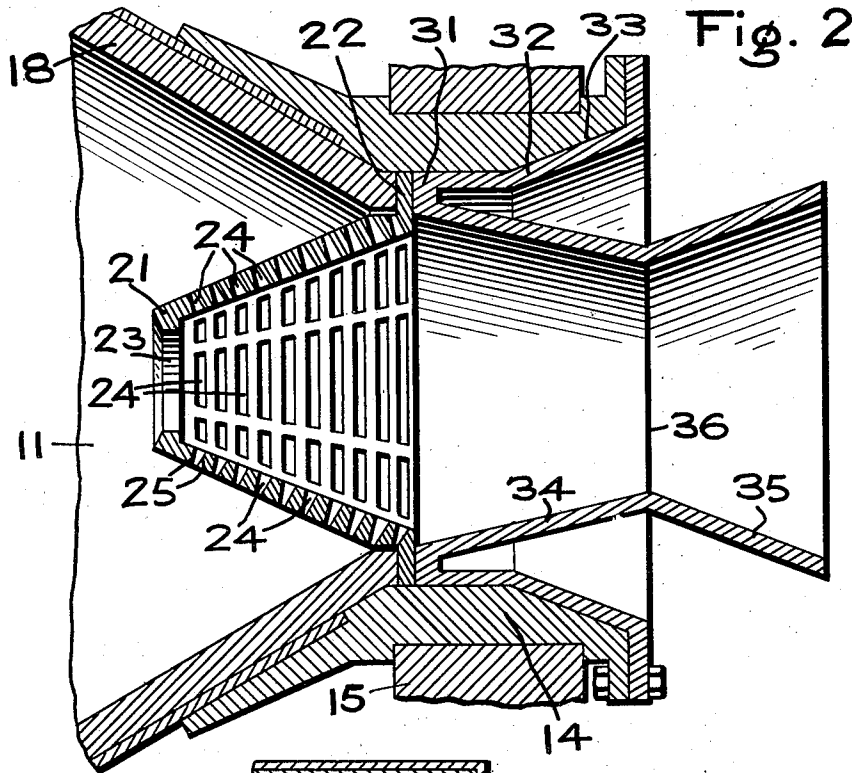
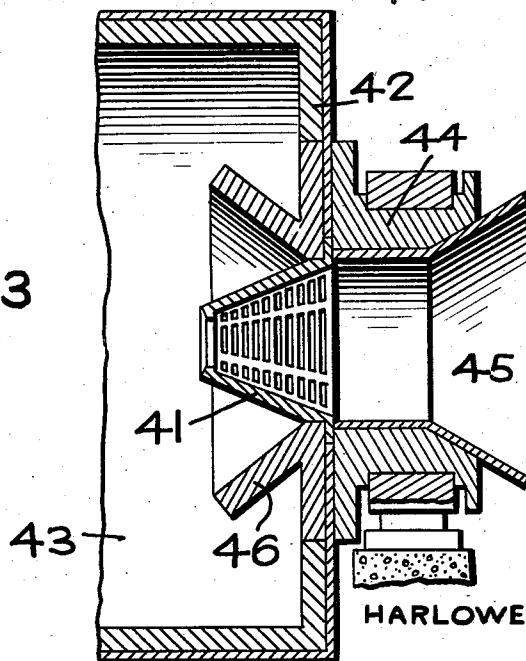


Fig. 3



Inventor

HARLOWE HARDINGE

By *Malcolm F. Samuels*
Attorney

UNITED STATES PATENT OFFICE

2,206,477

GRINDING MILL

Harlowe Hardinge, York, Pa., assignor to
Hardinge Company, Incorporated, York, Pa.,
a corporation of New York

Application July 30, 1937, Serial No. 156,440

10 Claims. (Cl. 83—9)

This invention relates to grinding mills and more particularly to discharge means therefor.

An object of the invention is to provide improved discharge means at the discharge end of a grinding mill which will operate to strain the pulp carrying pulverized material from the mill and permit the same to pass out of the mill, while at the same time operating to return balls and oversize material which comes in contact therewith.

Another object of the invention is to provide improved discharge means in the form of conical shaped members which are carried by the mill during its rotation and which are so constructed as to restrict the discharge opening in the mill so as to build up the pulp level.

Another object of the invention is to provide improved discharge means including a cone-shaped cage mounted within the mill in front of the discharge trunnion opening and which is so constructed that small balls, tramp oversize, and other objectionable materials which would otherwise pass out of the mill through the discharge trunnion, are caught between the outer surface of the cage and the wall of the mill, and as the mill rotates such material and objects are carried up high and are discharged across the top of the cage, back into the mill, thereby keeping the discharge end of the mill free of this relatively small material, which would otherwise tend to block the cage.

With the foregoing and other objects and advantages in view, the invention consists in the construction and arrangement of the several parts which will be more fully described and claimed.

In the accompanying drawings—

Figure 1 is a vertical longitudinal section of a conical type of grinding mill embodying the invention;

Fig. 2 is an enlarged section of a portion of the structure shown at the right, Fig. 1; and

Fig. 3 is a detail section of a portion of a cylindrical grinding mill, showing the application of the invention thereto.

Referring to Fig. 1, the conical type of grinding mill comprises a rotatable drum 11 having an inlet trunnion 12 and a bearing 13 therefor, and an outlet trunnion 14 and a bearing 15 therefor.

The drum 11 is provided with a gear 16 for rotating the drum from a suitable source of power.

Grinding media, such as balls, pebbles or other suitable material, indicated at 17, may be employed with the mill.

Material to be ground is fed into the drum 11 through the inlet trunnion 12, pulverized to the desired fineness, and then leaves the drum with the water or other liquid used in the grinding process through the discharge trunnion 14.

The mill illustrated has a conical discharge portion 18 and, as is well understood, different sizes of material being ground within the drum and the grinding media assume positions within this conical portion 18 in accordance with their relative sizes. That is, as the drum rotates, the larger particles become located in the vicinity of the cylindrical portion 19 of the drum, and the remaining material classifies itself according to size, with the finer particles thereof graded toward and located at the discharge end of the mill.

While mills of this type need not necessarily be provided with discharge means of the character about to be described, it has become the practice to operate grinding mills under overload conditions, with the result that coarse material (and sometimes balls) is likely to be discharged at the discharge end of the mill, and therefore, under these circumstances, it becomes desirable to use discharge means which will prevent the discharge of coarse material and grinding media.

The discharge means of my invention comprises a conical cage 21 having its base portion formed with a flange 22 by which the cage can be mounted in the discharge portion 18 of the drum 11 adjacent to the junction of such discharge portion with the trunnion 14.

The cage 21 projects inwardly of the drum 11 and its apex portion is formed with an opening 23 of suitable diameter.

The conical wall of the cage 21 is formed with a plurality of openings 24 of such size as to differentiate between the grinding media and the fines.

As shown in Fig. 2, the openings 24 may be in the form of elongated slots arranged on the conical wall of the cage 21 in a direction transversely to the longitudinal axis of the drum, such slots thus preferably being disposed longitudinally with respect to the direction of rotation of the drum.

Since the wall of the cage 21 is somewhat thick, in order to prevent the fines which pass through the slots 24 from clogging or otherwise closing said slots, the opposite side walls of the slots 24 are preferably formed inclined to each other, as indicated at 25, so that the slots will be narrower at the outer surface of the cage 21 than at the interior of the wall of said cage. In this way, the fines carried in suspension in the water which enters the slots 24 from the exterior of the cage

will flow freely through the slots due to the increasing area of said slots towards the outlets thereof.

By constructing the cage 21 in the above described manner, the pulp level within the drum is built up to a level higher than that heretofore obtainable in the ordinary conical type of mill, because the restrictions provided by the tapered slots 24 prevent the free discharge of the pulp until the fines have attained a predetermined degree of fineness.

The cage 21 is not subject to excessive wear, since the grinding media at the discharge end of the drum 11 do not cascade, but merely roll among themselves.

Another advantage of this type of discharge means is that as the small balls, tramp oversize and other objectionable materials that would otherwise get out of the drum, have a tendency to wedge between the cage 21 and the wall of the discharge portion 18 of the drum. As the drum rotates, these are carried up high and are discharged across the top of the cage 21, back into the drum, thus keeping the discharge end of the drum free from this relatively small material, which would otherwise tend to block the cage 21.

A substantially convergent-divergent sleeve or insert 31 is mounted in the hollow discharge trunnion 14, for the purpose of providing a restricted outlet for increasing the height of the level of the pulp within the drum 11.

The member 31 has an outer or circumferential portion 32 which fits snugly in the discharge trunnion 14, the interior of the trunnion having an outwardly flared wall 33 of well-known form.

Within the portion 32 of the member 31 is a convergent conical portion 34 having its base abutting the base portion of the cage 21.

The convergent portion 34 of the sleeve 31 extends outwardly a suitable distance and connected to the outer end thereof is the divergent conical portion 35 of the sleeve.

A pronounced throat 36 is formed at the point where the two portions 34 and 35 of the sleeve 31 meet, and this throat forms a restriction which provides means for raising the level of the pulp within the drum 11 an appreciable amount, since the diameter of the discharge opening of the mill is reduced considerably with respect to the diameter of the hollow trunnion 14.

As the pulp leaves the drum through the openings 24 in the cage 21, the pulp passes through the sleeve 31 and discharges over the lip provided by the outer divergent portion 35 of said sleeve.

In other known types of grinding mills where the pulp level is raised and an ordinary screen is used, there is no way to keep the tramp oversize and the small balls away from the screen, and consequently the mill chokes up.

It has also been demonstrated in actual practice that raising the pulp level of the mill, increases the grinding capacity without increasing the power and thereby materially increases the efficiency. Hence, the use of the cage 21 mounted in the discharge portion of the drum in combination with the convergent-divergent outlet 31 is a very important feature which enhances the productiveness of grinding mills of the type herein referred to.

There is another advantage in the use of the cage 21, in that this element has a much greater area of discharge opening than other forms of screening elements heretofore used in the discharge ends of grinding mills. This is due to the shape of the cage, the arrangement of the

openings or slots 24 therein, and the disposition of the cage within the drum 11.

As shown in Fig. 3, when it is desirable to incorporate the invention with a cylindrical type of grinding mill, a cage 41, similar in form to the cage 21 of Fig. 1, is mounted on the end wall 42 of the cylindrical drum 43 adjacent to the trunnion 44 having a discharge spout 45 mounted therein.

Surrounding the cage 41, is a conical ball retractor 46 which is also carried by the end wall 42 of the drum 43. The apex portion of the ball retractor 46 is disposed adjacent to the end wall of the drum, so that the diverging wall of the ball retractor is inclined outwardly with respect to the converging wall of the cage 41.

The ball retractor 46 will deflect the balls and other materials which are carried up high in the drum 43, away from the cage 41, thus keeping the discharge end of the mill free from this objectionable material, which would otherwise interfere with the free flow of the fines through the cage.

Having thus described my invention, what I claim is:

1. A grinding mill comprising a rotatable drum having a hollow supporting trunnion through which material passes, and a cone-shaped member extending into the drum and surrounding the hole in the trunnion, said cone-shaped member being fastened to the end portion of the drum adjacent to said trunnion, and a cone-shaped cage mounted within said cone-shaped member and having its base portion disposed adjacent to the junction of said hollow trunnion with said drum and its apex portion disposed within the drum.

2. A grinding mill comprising a rotatable drum having a lining and a casing, a hollow supporting trunnion through which material passes and having an internal cylindrical portion at the inner end thereof, a sleeve fitting within the trunnion, and a frusto-conical member extending into the drum and having an outwardly projecting flange formed on its base portion, said flange being disposed intermediate the end of the drum lining and the trunnion sleeve, and said frusto-conical member being apertured to permit the discharge of ground material from the mill.

3. A grinding mill comprising a rotatable drum having a hollow trunnion extending outwardly from the end of the drum, said trunnion having an internal cylindrical portion at the inner end thereof, and a separate sleeve mounted within the hollow trunnion and extending from the inner end of said trunnion outwardly, said sleeve having a convergent conical interior wall providing a discharge opening for the mill, and an exterior wall which is cylindrical for a portion of its length and divergent for a portion of its length.

4. A grinding mill comprising a rotatable drum having a hollow supporting trunnion through which material is discharged from the drum, and inner and outer frusto-conical members for controlling the discharge from the drum, said inner member having its base portion secured to the mill at the junction of the inner end of the trunnion with said drum and its apex portion disposed within the drum, said outer member being in the form of a sleeve the interior wall of which is frusto-conical having its base disposed adjacent to the base of the inner member and extending outwardly through the trunnion from the base portion of the inner member.

5. A grinding mill comprising a rotatable drum having a hollow supporting trunnion through

which material is discharged from the drum, the internal wall of said trunnion being cylindrical in form from the junction of the inner end of the trunnion with the wall of the drum outwardly of the trunnion to a point midway the length of the trunnion and being outwardly flared from the cylindrical portion to the outer end of the trunnion, a cone-shaped cage having its base disposed adjacent the junction of the inner end of said discharge trunnion with the drum and its apex portion disposed within the drum, the apex portion of said cage being open and the conical wall of said cage having a plurality of elongated slots through which the fines are adapted to pass towards the discharge outlet of the mill, said slots being arranged around the cage in a direction transversely to the longitudinal axis of the drum and being disposed longitudinally with respect to the direction of rotation of the drum, the opposite longitudinal side walls of said slots being inclined toward each other so that the slots are narrower at the outer surface of the cage than at the interior of the wall of said cage, whereby the fines will flow freely through the slots due to the increasing area of said slots towards the outlet thereof, and a convergent-divergent sleeve within the hollow trunnion, said sleeve extending from the base portion of said cage outwardly beyond the outer end of said trunnion and constituting an outlet for the material passing through said cage.

6. A grinding mill comprising a rotatable drum, hollow supporting trunnions extending from each end of said drum, one of said trunnions constituting the feed end of the mill and the other trunnion constituting the discharge end of the mill, a cone-shaped cage having its base disposed adjacent the junction of the inner end of said discharge trunnion with the drum and its apex portion disposed within the drum, the apex portion of said cage being open and the conical wall of said cage having a plurality of elongated slots through which the material is adapted to pass towards the discharge outlet of the mill, said slots being arranged around the cage in a direction transversely to the longitudinal axis of the drum, said hollow trunnion having an internal wall cylindrical in form from the junction of the inner end of the trunnion with the wall of the drum outwardly of the trunnion to a point substantially midway of the length of the trunnion, the internal wall of said hollow discharge trunnion being flared outwardly from the outer end of the cylindrical portion to the outer end of said trunnion, and a sleeve mounted within said hollow discharge trunnion and having its exterior corresponding in form to the contour of the bore through the discharge trunnion, said sleeve having an interior convergent-divergent wall, the convergent portion of the interior of said sleeve extending from the base portion of said cage outwardly a distance corresponding substantially to the length of said discharge trunnion, and the divergent portion of said sleeve extending outwardly from the outer end of said discharge trunnion.

7. A grinding mill comprising a rotatable drum

having a hollow discharge trunnion extending outwardly from the end of the drum, a cone-shaped cage having its base portion disposed adjacent the junction of the inner end of said trunnion with the drum and its apex portion disposed within the drum, and a separate conical sleeve mounted within the hollow trunnion and extending outwardly from the base portion of said cage, said sleeve having an outer circumferential wall snugly fitting the interior of said trunnion and an inner convergent-divergent tubular portion which is spaced from the outer circumferential wall of the sleeve, said inner portion of the sleeve being connected to the outer wall of the sleeve adjacent the base of said cage.

8. A grinding mill comprising a rotatable drum having a hollow discharge trunnion extending outwardly from the end of the drum, a cone-shaped cage having its base portion disposed adjacent the junction of the inner end of said trunnion with the drum and its apex portion disposed within the drum, and a separate conical sleeve mounted within the hollow trunnion and extending outwardly from the base portion of said cage, said sleeve having an outer circumferential wall snugly fitting the interior of said trunnion and an inner convergent-divergent tubular portion which is spaced from the outer circumferential wall of the sleeve, said inner portion of the sleeve being connected to the outer wall of the sleeve adjacent the base of said cage, the outer end of the interior portion of said sleeve terminating beyond the outer end of said trunnion.

9. A grinding mill comprising a rotatable drum adapted to contain grinding media and the material to be ground, a hollow trunnion at one end of the drum for the discharge of ground material, said trunnion having an internal cylindrical portion at the inner end thereof, a removable sleeve in the trunnion, a frusto-conical screen cage having a body portion disposed within the drum and an outwardly radially projecting flange formed on the base of the body portion, said flange being firmly seated in the trunnion intermediate the end of the drum and the trunnion sleeve to thereby hold the screen cage in fixed position.

10. A grinding mill comprising a rotatable drum adapted to contain grinding media and the material to be ground, a hollow trunnion at one end of the drum for the discharge of ground material, said trunnion having an internal cylindrical portion at the inner end thereof, a removable sleeve in the trunnion through which the discharged material passes, said sleeve having a restricted outlet, a frusto-conical screen cage having a body portion disposed within the drum and an outwardly radially projecting flange formed on the base of the body portion, said flange being firmly seated in the cylindrical portion of the trunnion intermediate the end of the drum and the trunnion sleeve to thereby hold the screen cage in fixed position and at the same time permitting ready removal of the cage upon removal of the trunnion sleeve.

HARLOWE HARDINGE.