No. 670,116.

Patented Mar. 19, 1901.

# T. L. & T. J. STURTEVANT.

## GRINDING MILL.

(No Model.)

(Application filed Jan. 30, 1900.)

2 Sheets—Sheet 1.

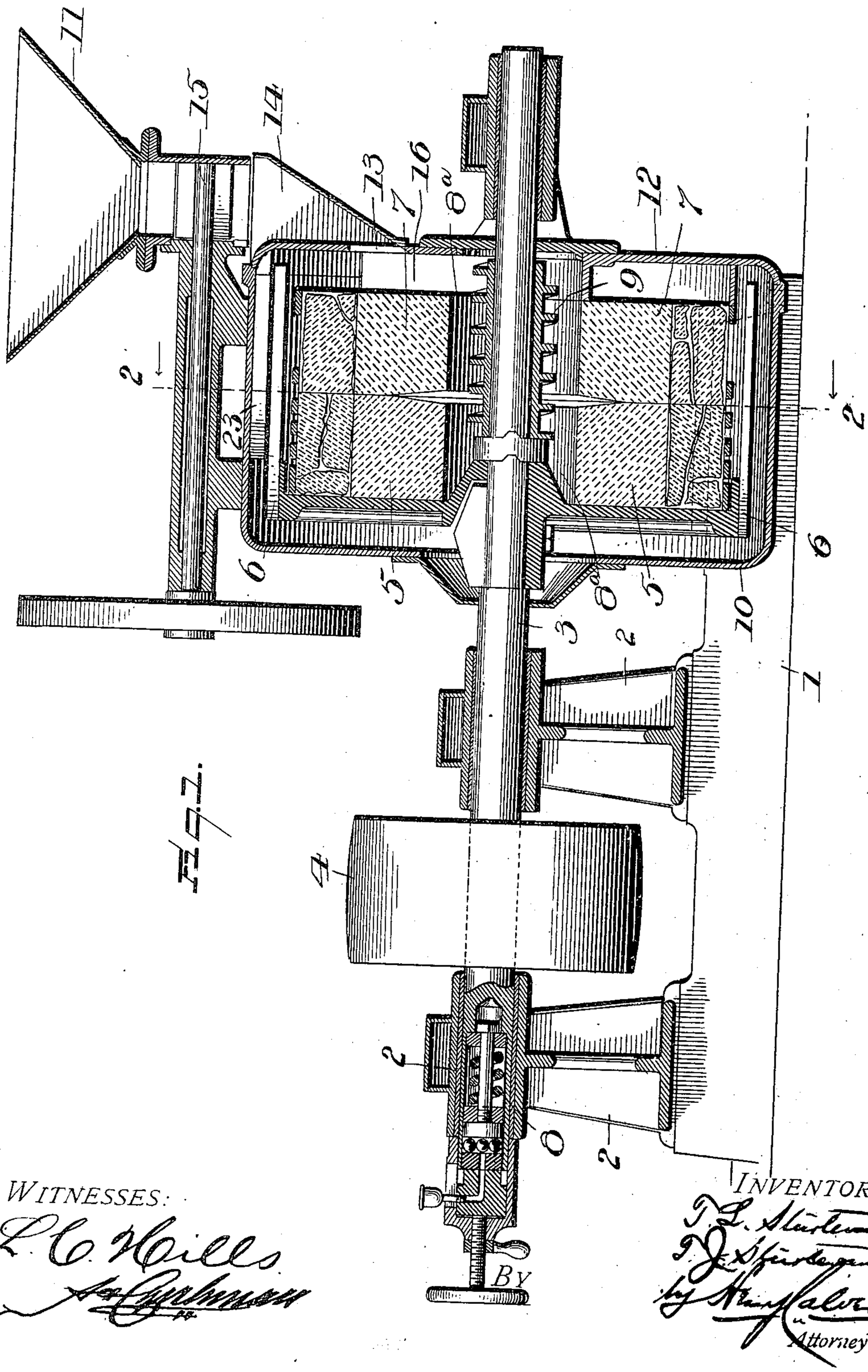


FIG. 1.

WITNESSES:

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[illegible]

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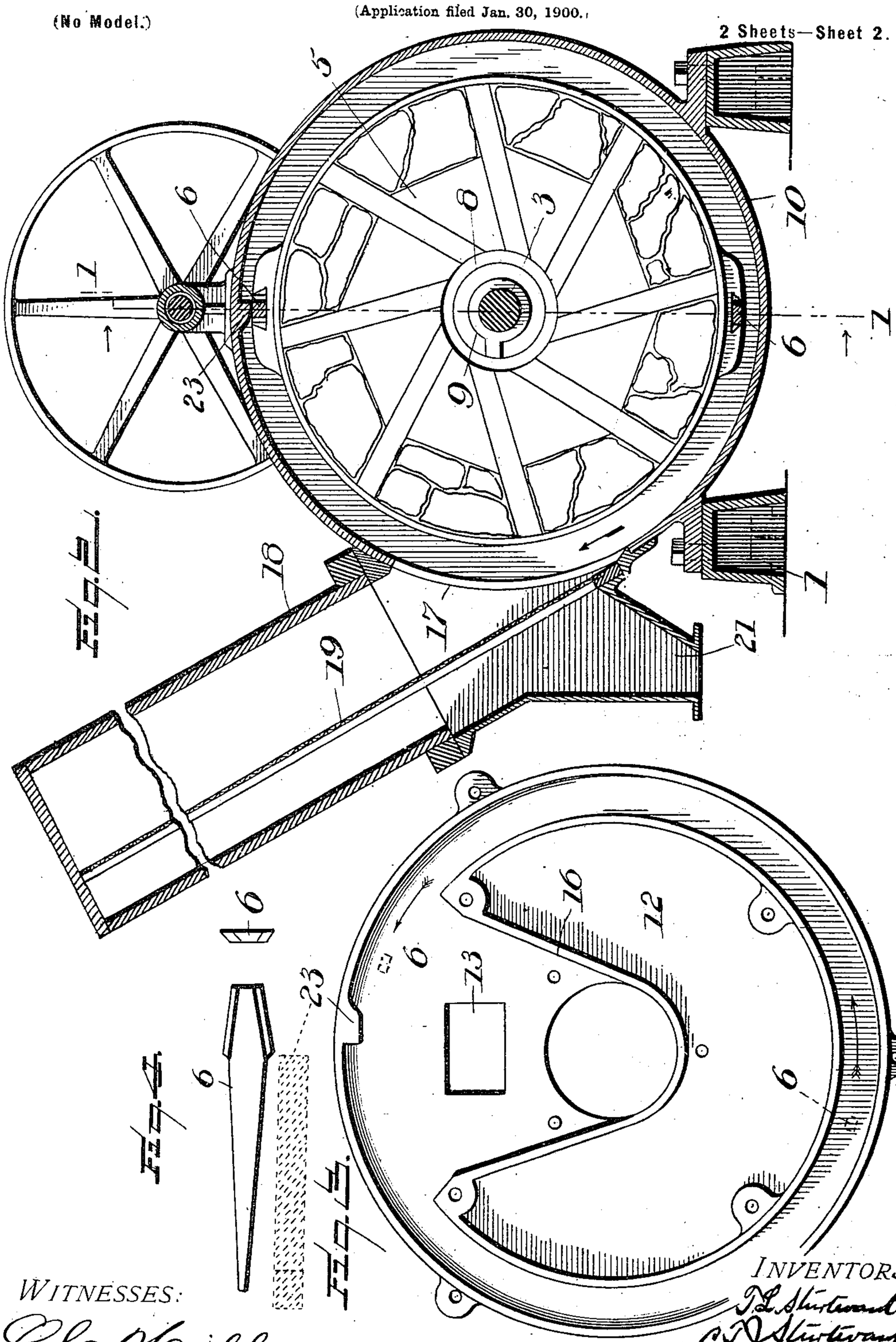


Fig. 2.




Fig. 3.




Fig. 4.

Fig. 5.

WITNESSES:

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# UNITED STATES PATENT OFFICE.

THOMAS LEGGETT STURTEVANT, OF QUINCY, AND THOMAS JOSEPH STURTEVANT, OF NEWTON CENTER, MASSACHUSETTS.

## GRINDING-MILL.

SPECIFICATION forming part of Letters Patent No. 670,116, dated March 19, 1901.

Application filed January 30, 1900. Serial No. 3,289. (No model.)

*To all whom it may concern:*

Be it known that we, THOMAS LEGGETT STURTEVANT, residing at Quincy, in the county of Norfolk, and THOMAS JOSEPH STURTEVANT, residing at Newton Center, in the county of Middlesex, State of Massachusetts, citizens of the United States, have invented certain new and useful Improvements in Grinding-Mills, of which the following is a specification, reference being had therein to the accompanying drawings.

Our invention relates to grinding-mills or pulverizers, and particularly that type in which rotating grinding instrumentalities—such as grinding-disks, rotary beaters or disks, and interposed crushing-balls—are used to crush or pulverize the material.

The particular features of grinding-mills to which our invention relates are the feeding and screening agencies used in connection with the grinding instrumentalities, and they are shown in the present case as applied to a grinding-mill of the vertical-disk type, although it will be understood that we do not limit ourselves to their use with the specific form of mill herein shown, as our invention is applicable to other types and constructions of rotary grinding or crushing mills.

In the drawings accompanying and forming a part of this specification, Figure 1 is a central vertical longitudinal section of a vertical-disk grinding-mill of the well-known "Sturtevant Rock Emery" type on line 1 1 of Fig. 2 looking in the direction of the arrows. Fig. 2 is a transverse section of the same, taken on the line 2 2 of Fig. 1. Fig. 3 is a view in elevation of the front head of the mill-casing to show the return-feed chute; and Fig. 4 is a detail view of one of the return-feed carriers, the stop projection coöperating therewith being shown in dotted lines in operative relation thereto.

Referring to the drawings by numerals, like numerals indicating like parts throughout the several views, 1 indicates the base or bed of the mill, provided with suitable bearings 2, in which is mounted a horizontally-arranged shaft 3, provided with a driving-pulley 4. Secured to said shaft so as to rotate therewith is a runner stone or disk 5, said runner-stone or its supporting-disk being provided at its periphery with a series of scrapers or carriers 6, to which reference will be made hereinafter. Opposed to said runner-stone is the bed-stone 7, which is fixedly mounted in the mill-case, the runner-stone 5 being forced against said bed-stone 7 with a yielding pressure by means of the spring 8, mounted in the end bearing or box 2, so as to give a longitudinal thrust to the runner-stone shaft 3. The grinding-disks 5 and 7 are provided with the usual central eye 8, through which the material to be ground passes to the grinding-stones, said shaft 3 being preferably provided with a feed-screw 9, which projects slightly beyond the bed-stone 7, and receiving the material to be ground as it falls from the hopper carries it through the feed-eye 8 to the bosom of the stones. Surrounding the said grinding-stones is a casing 10, said casing supporting the main hopper 11 and having a front plate 12, provided with an opening 13, which is connected with the hopper 11 by means of a chute 14, a stirring device 15 being preferably mounted in the throat of the hopper to prevent clogging of the material. The bed-stone 7 is preferably suitably attached to the said front plate 12. On the inner face of said front plate 12 is an auxiliary hopper or trough 16, which directs the material fed in from the hopper 11 to the feed-screw 9, said auxiliary hopper 16 having a wide flaring mouth.

The casing 10 is provided at one side with a discharge-opening 17, as clearly shown in Fig. 2, and which discharge-opening communicates with the chamber of an inclined screen box or casing 18, which is outside of the mill-casing 10 and in which is mounted an inclined screen 19, said screen being preferably tangentially placed relative to the circular casing 10 and to the path of movement of the grinding-disk 5 and the path of movement of the carriers 6, rotating with said disk, the box or screen casing 18 having a discharge-spout 21 at its lower end. The box or casing 18, partly broken away in Fig. 2, is closed at its upper end to prevent escape of the material projected into the chamber thereof and also to prevent any air-blast or suction therethrough. The discharge-opening 17 and screen-box 18 are located on the up-

wardly-running side of the grinding-disk or grinding device.

The inclined screen 19 is located at a distance from and is thus wholly independent of the feed-inlet of the mill-casing, so that it is not subjected to wear by the incoming coarse or unreduced material.

As the crushed material is discharged from the grinding-disks it is caught by the revolving carriers 6, and is thus given a circular movement. The tendency of the material is of course to leave the casing at a tangent, and when the crushed material swept along by the carriers 6 reaches the discharge or screen opening 17 it is by centrifugal force thrown tangentially through said opening into the chamber of the screen box or casing 18 and in such a manner that it will mainly strike against the inclined closed upper side of said box or casing and be deflected against or fall on the inclined screen 19 in the said screen-box at sharp angles to said screen, and in any event but little or none of the material will be thrown directly on the said screen by the rotating parts of the mill. The material being thus discharged upon the screen at sharp angles thereto will first have a tendency to travel upward slightly on said screen, and then owing to gravity and the jarring action of the machine it will slide down the inclined screen, and that portion of the material which passes through the screen will be discharged at the spout 21, while the tailings or coarser portions of the material will in the form of mill herein shown be returned to the mill-casing.

It is well known that with a given mesh of screen a much finer output is secured when the material is sifted by being passed down an inclined screen than when the material is sifted by being discharged directly upon the screen at or about a right angle to the latter, so that our inclined screen, upon which the material is discharged tangentially, will enable us to secure a fine output with a comparatively coarse-wire screen, which is much stronger and which will withstand much more wear than a fine-mesh screen would. A further and very important advantage secured by locating the screen outside of and at an inclination to the mill and the grinding agencies is that such screen is not subjected to the wear and tear of the moving mass of ground and unground material, as would be the case were the screen located within the mill-casing and not, as shown, in a box independent thereof and communicating therewith through a tangential discharge-opening, so that only the ground and fine products pass through the discharge-opening and fall upon the screen. As a result of this arrangement the life of the screen is prolonged, and means for protecting the screen from the destructive action of the rapidly-moving mass of material within the mill-casing may be dispensed with. Again, the screen being inclined tangentially to the path of movement of the material under treatment does not have to withstand the direct impact of the ground material, which is being carried around by the pulverizing means and projected through the discharge-opening; but the material to be screened is thrown into the screen-box and spends its force both by reason of its tangential flight and its impact against the inclined upper side of the inclined screen-box, so that it will be deflected upon the screen, and thus is not forcibly projected against the screen by the rotating parts of the mill, but only strikes the screen when its force is spent and then mostly at sharp angles.

The coarse material returned by the screen to the mill-casing will be taken up again by the rotating carriers 6 and owing to the inclined arrangement of the faces of said carriers will be gradually worked toward the right, Fig. 1, until it is discharged from the ends of said carriers into the auxiliary hopper 16, whence it passes to the eye of the stones and is fed inward to be reground by the revolving feed-screw 9. The lateral movement of the material and discharge of the same at the top of the mill-casing is assisted by the stop projection 23, with which the interior of the casing is preferably provided and which, opposing the rotating movement of the material with the carriers, has a tendency to cause the material to travel laterally and also causes it to be deflected downward, so as to be discharged into the auxiliary hopper 9.

The rotating carriers 6, as herein shown, are formed tapering, as illustrated in the detail view Fig. 4, for the purpose of providing the same with inclined faces for working the material laterally. It will be understood, however, that a mere inclined arrangement of said rotating carriers on the runner-stone would effect the same result.

One of the advantages of a mill provided with an inclined screen such as is above described, and shown in the drawings, is, as has already been suggested, that a much heavier screen for securing a given output may be used and one capable of withstanding greater wear than the screening arrangements now in use in mills of this type, it having been found that an inclined screen of substantially twenty mesh to the linear inch, arranged as shown and described, will give an output as fine as a screen of forty mesh where the material is thrown against the screen at right angles thereto. A further advantage of the inclined screen arranged as shown is that it will return the unreduced material to the mill-casing for further pulverization.

The combination of carriers and return-feed which coöperate in carrying the unground products to the grinding agencies for further reduction insures the grinding of the material to the desired degree of fineness, for it will be seen that the only discharge from the mill is through the screen-box feed-dis-

charge spout 21 out, of which the material passes after it has gone through the meshes of the screen, and such material as is not ground to a sufficient degree of fineness to pass through the meshes of the screen will be returned to the mill to be again subjected to the action of the grinding devices.

We do not wish to be understood as limiting our invention to the particular kind of grinding-mill with vertically-placed grinding-disks herein shown, as our inclined screen located outside of the mill-casing and upon which the material is thrown by centrifugal force may be used either with or without means for returning the tailings to the mill to be reground and in connection with any grinding or reducing instrumentalities adapted to throw the crushed material onto the inclined screen by centrifugal action.

There is great advantage in the arrangement herein shown and described of a screen outside of the mill-case, in that a screen thus arranged is not exposed to the rough usage to which it would necessarily be subjected if arranged within the mill-case.

So far as we are aware all attempts heretofore made to use fine screens in the cases of mills have been more or less unsuccessful for the reason that such screens could not stand the wear and tear to which they are necessarily exposed when thus arranged, while our present arrangement of the screen outside of the mill-case permits the use of a comparatively fine screen without liability of injury to the same.

Having thus described our invention, we claim and desire to secure by Letters Patent—

1. In a pulverizing or grinding mill, the combination with a mill-casing having a feed-inlet and a discharge-opening, of rotating reducing means within said mill-casing, an inclined screen box or casing located outside the said mill-casing and on the upwardly-running side of said rotating reducing means, said screen box or casing having a closed upper end and an inclined upper side against which latter the material is mainly projected by the rotating parts of the mill, the chamber of said screen-box communicating with the chamber of said mill-casing through said discharge-opening, and an inclined screen in said screen-box which receives the reduced material deflected from the upper side of the screen-box, and which inclined screen is at a distance from and is thus independent of the said feed-inlet to the mill-casing, so that it is not subjected to wear by the incoming coarse or unreduced material.

2. In a pulverizing or grinding mill, the combination with a mill-casing having a feed-inlet and a discharge-opening, of rotating reducing means within said mill-casing, an inclined screen box or casing located outside of said mill-casing and on the upwardly-running side of said rotating reducing means, said screen-box having a closed upper end and an inclined upper side against which latter the material is mainly projected by the rotating parts of the mill, the chamber of said screen-box communicating with the chamber of said mill-casing through said discharge-opening, an inclined screen in said screen-box which receives the reduced material deflected from the upper side of the screen-box, and rotating means, independent of said screen, for returning the tailings discharged by said screen into the mill-casing to the reducing devices to be reground.

3. In a pulverizing or grinding mill, the combination with a mill-casing, having a feed-inlet and a discharge-opening, of rotating grinding means within said mill-casing, revolving scrapers or carriers, an inclined screen box or casing located outside of said mill-casing and on the upwardly-running side of said rotating reducing means, said screen-box having a closed upper end and a closed upper side, the chamber of said screen-box communicating with the chamber of said mill-casing through said discharge-opening, and an inclined screen in said screen-box which receives the material projected into the chamber of the screen-box by the rotating devices of the mill and first mainly thrown by said rotating devices against the closed upper side of the said screen-box, said inclined screen being located at a distance from and being thus independent of said feed-inlet to said mill-casing so that it is not subjected to wear by the incoming coarse or unreduced material.

4. In a pulverizing or grinding mill, the combination with the casing thereof, and a rotating reducing device in said casing, of rotating scrapers or carriers, an inclined screen located outside of said casing and upon which the material is thrown by the said rotating scrapers or carriers, and independent stationary means, within said casing, for causing the screen rejections or tailings to be discharged from said rotating carriers at or near the top of the casing and to be returned to the reducing device to be reground.

5. In a pulverizing or grinding mill, the combination with a mill-casing having a feed-inlet and a discharge-opening, of reducing means rotating in a vertical plane within said mill-casing, an inclined screen box or casing outside said mill-casing and the chamber of which communicates with the chamber of said mill-casing through said discharge-opening, said screen-box having a closed upper end and an inclined closed upper side, and said box being located on the upwardly-running side of said rotating reducing means, so that the reduced material projected into the chamber of said casing by the rotating parts

of the mill strikes mainly against said inclined upper side of said box, and an inclined screen in said screen-casing which receives the reduced material thrown into the chamber of said casing after it has been deflected from the said inclined upper side of said screen-box, said inclined screen being located at a distance from and being thus independent of said feed-inlet to said mill-casing so that it is not subjected to wear by the incoming coarse or unreduced material.

6. In a pulverizing or grinding mill, the combination with the casing thereof, and a rotating reducing device within said casing, of a screen located outside of said casing and upon which the reduced material is thrown by centrifugal action, and rotating carriers located within said casing and having their acting faces inclined relative to their plane of action, and stationary means, as stop projection 23, within said casing, and coöperating with said rotating carriers to work the material laterally, and means, also within said casing, for returning the unreduced material discharged from said carriers to the reducing devices to be reground.

7. In a pulverizing or grinding mill, the combination with the casing thereof, and rotating grinding means within said casing, of an inclined screen located outside of said casing and arranged to return the tailings from said screen to the chamber of said casing to be reground, rotating carriers within said casing for raising the screen rejections or tailings to, or near to, the top of the latter, an auxiliary hopper within said casing into which the screen rejections or tailings are discharged from said carriers, and means for feeding the material from said auxiliary hopper to the grinding devices.

8. In a pulverizing or grinding mill, the combination with a mill-casing having a feed-inlet and a discharge-opening, of a fixed bed-stone mounted in said casing in a vertical position, a horizontal shaft, a vertically-placed runner-stone carried by said shaft and coöperating with said bed-stone, a screen box or casing outside said mill-casing and the chamber of which communicates with the chamber of said mill-casing through said discharge-opening, said screen-box having a closed upper end and a closed upper side against which latter the reduced material projected into the chamber of said screen-box by the rotating parts of the mill is mainly thrown, and an inclined screen in said screen-box which finally receives the reduced material projected into the chamber of said box, said inclined screen being located at a distance from and being thus independent of said feed-inlet to said mill-casing so that it is not subjected to wear by the incoming coarse or unreduced material.

9. In a pulverizing or grinding mill, the combination with the casing thereof, of a bed-stone fixedly mounted within said casing in a vertical position, a horizontal shaft, a vertically-disposed runner-stone carried by said shaft, an inclined screen-casing located outside of said mill-casing and having a closed upper end, an inclined screen housed in said screen-casing and upon which the reduced material is indirectly thrown by centrifugal action, and carriers rotating with said runner-stone and serving to throw the reduced material onto the said screen as also to carry the screen rejections or tailings upward in said casing to be returned to the grinding devices to be reground.

10. In a pulverizing or grinding mill, the combination with the casing thereof, of vertically-placed bed and runner stones, the latter of which rotates in a vertical plane, of an inclined screen-box having a closed upper end and located outside of the said mill-casing and the chamber of which box communicates with the chamber of said mill-casing, an inclined screen within said box and arranged to return its tailings to said mill-casing, a discharge-spout below said screen for the egress of the reduced material, rotating carriers within said casing for assisting in the return of the screen rejections or tailings to the grinding devices, and means, coöperating with said carriers, for feeding the returned material to the grinding-stones.

11. In a pulverizing or grinding mill, the combination with the casing thereof, and rotating reducing means within said casing, of a screen-casing located outside of said mill-casing and having a closed upper end, an inclined screen housed within said screen-casing, and upon which the reduced material is indirectly thrown by centrifugal action, said screen being so arranged as to return its tailings to the chamber of said mill-casing, rotating scrapers or carriers for lifting the screen rejections or tailings in said mill-casing, means, coöperating with said carriers, for feeding the returned material to the reducing device to be reground, the said mill-casing being provided at its upper portion with stationary means for deflecting the material lifted by said scrapers laterally and downward to assist in its return to the reducing device.

12. In a pulverizing or grinding mill, the combination with a mill-casing having a feed-inlet and a discharge-opening, of rotating reducing means within said mill-casing, a screen box or casing located outside said mill-casing and on the upwardly-running side of said rotating reducing means, said screen box or casing having a closed upper end and being also closed on its side toward the said mill-casing, the chamber of said screen box or casing communicating with the chamber of said mill-casing through said discharge-opening, an inclined screen in said screen box or casing and which screen receives and

screens the material thrown outward from the said mill-casing by the rotating parts of the mill, said inclined screen being located at a distance from and being thus independent of said feed-inlet to said mill-casing so that it is not subjected to wear by the incoming coarse or unreduced material, and said screen also being arranged to return the tailings to the said mill-casing to be further reduced, and rotating devices, independent of said screen, for carrying the tailings to the rotating reducing means.

In testimony whereof we affix our signatures in the presence of two witnesses.

THOMAS LEGGETT STURTEVANT.
THOMAS JOSEPH STURTEVANT.

Witnesses:
LLOYD MAKEPEACE,
L. H. STURTEVANT.