E. H. HURRY.

CENTRIFUGAL PULVERIZING MILL.

APPLICATION FILED MAY 9, 1902.

963,046.

Patented July 5, 1910.

4 SHEETS—SHEET 1.

Fig. 2.

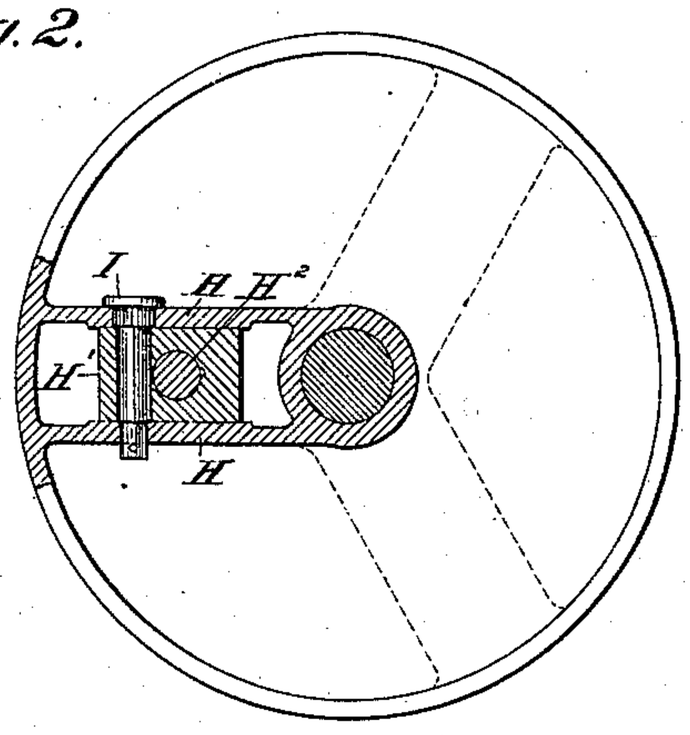
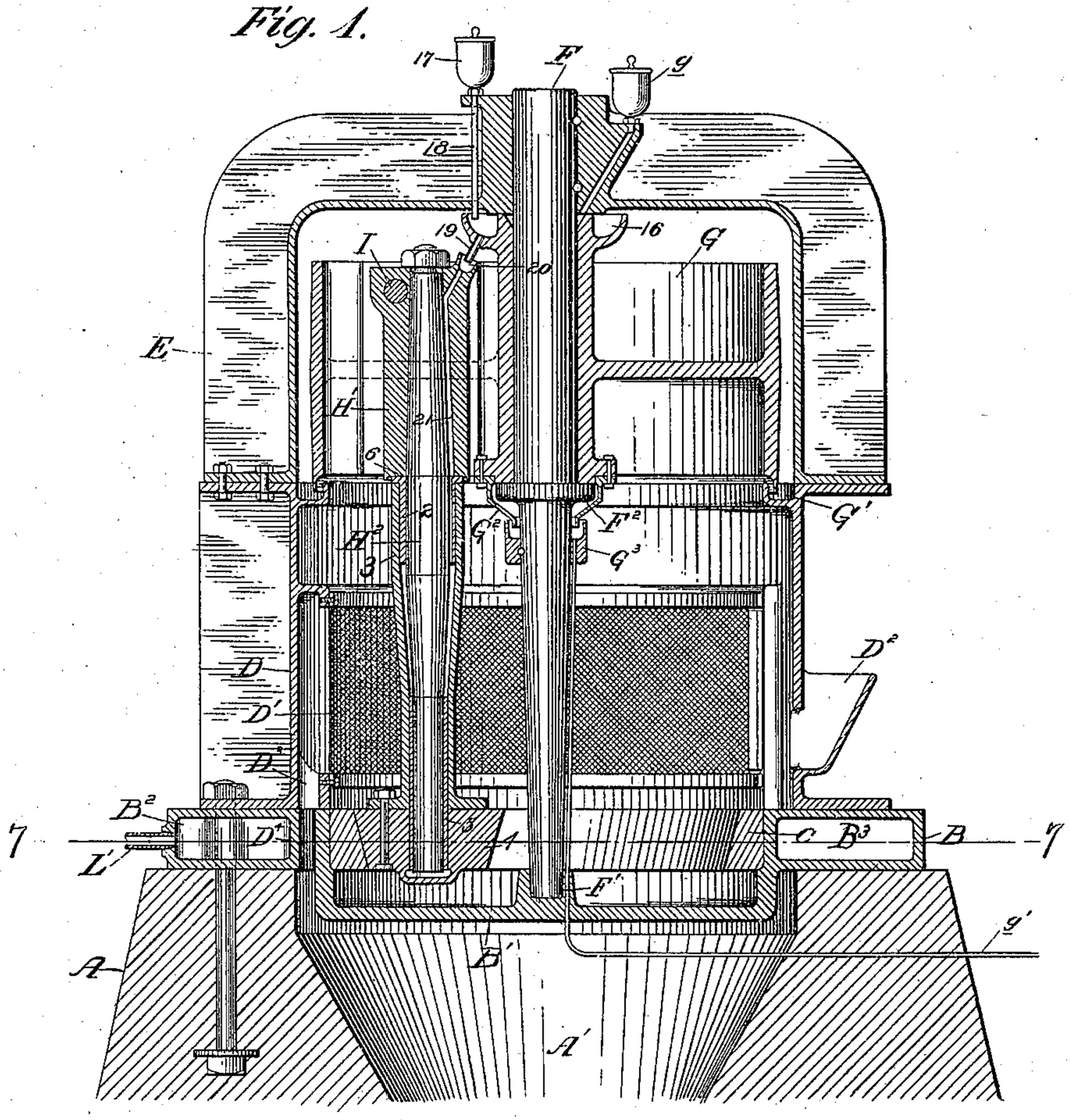


Fig. 1.



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4 SHEETS—SHEET 2.

Fig. 3.

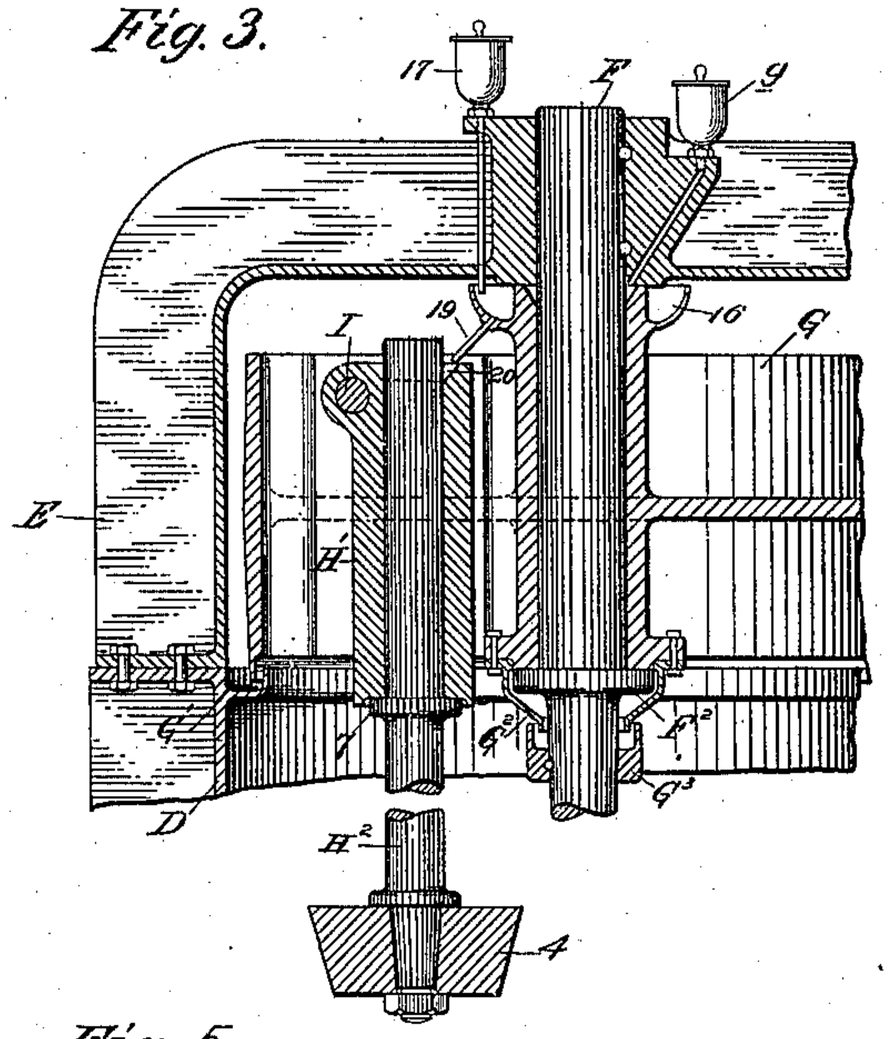
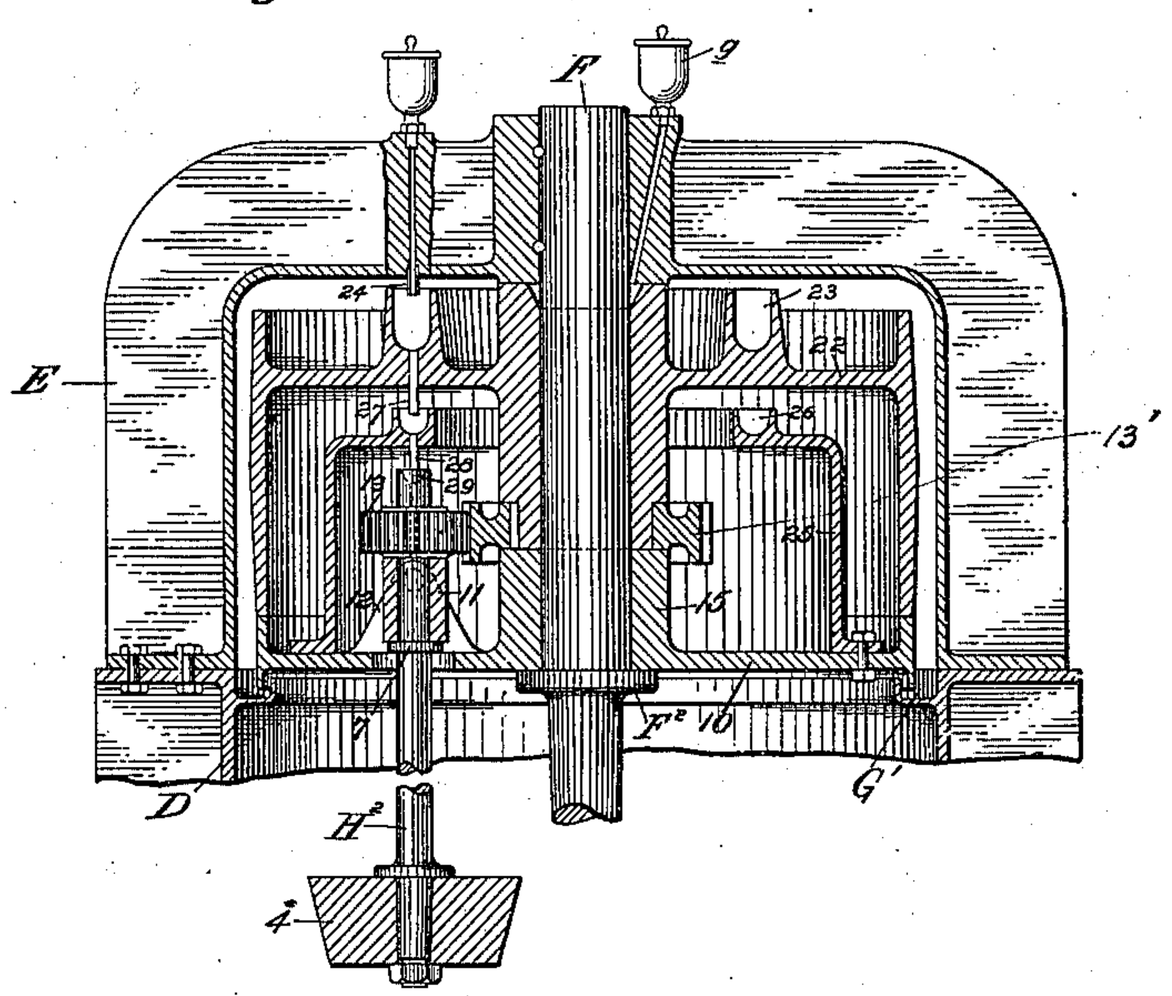


Fig. 5.



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4 SHEETS—SHEET 3.

Fig. 6.

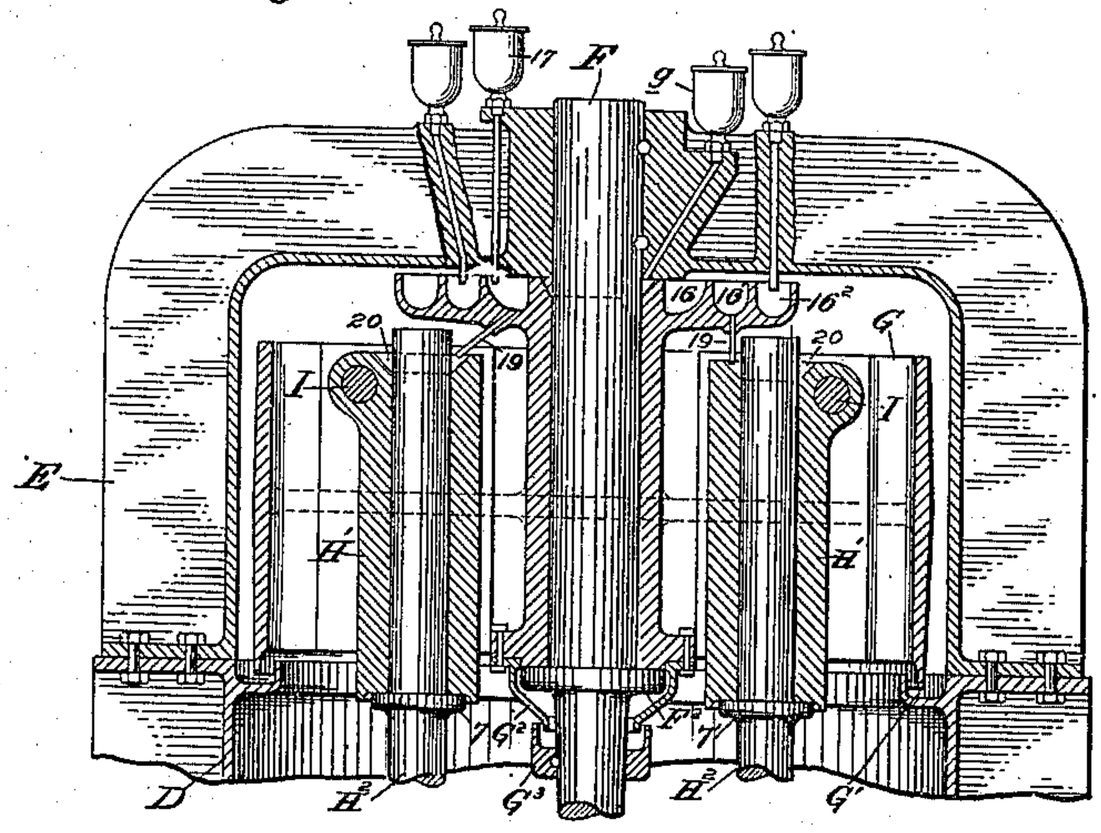
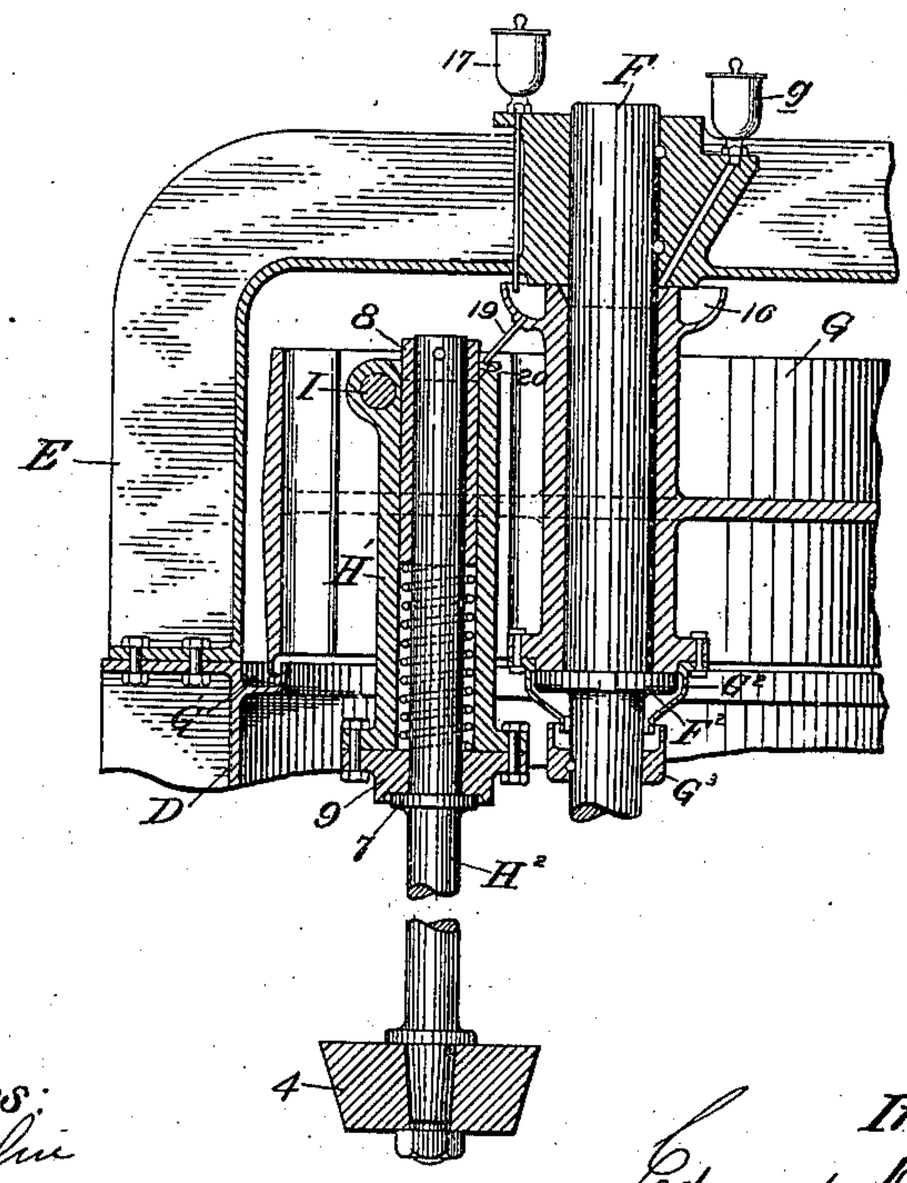


Fig. 4.



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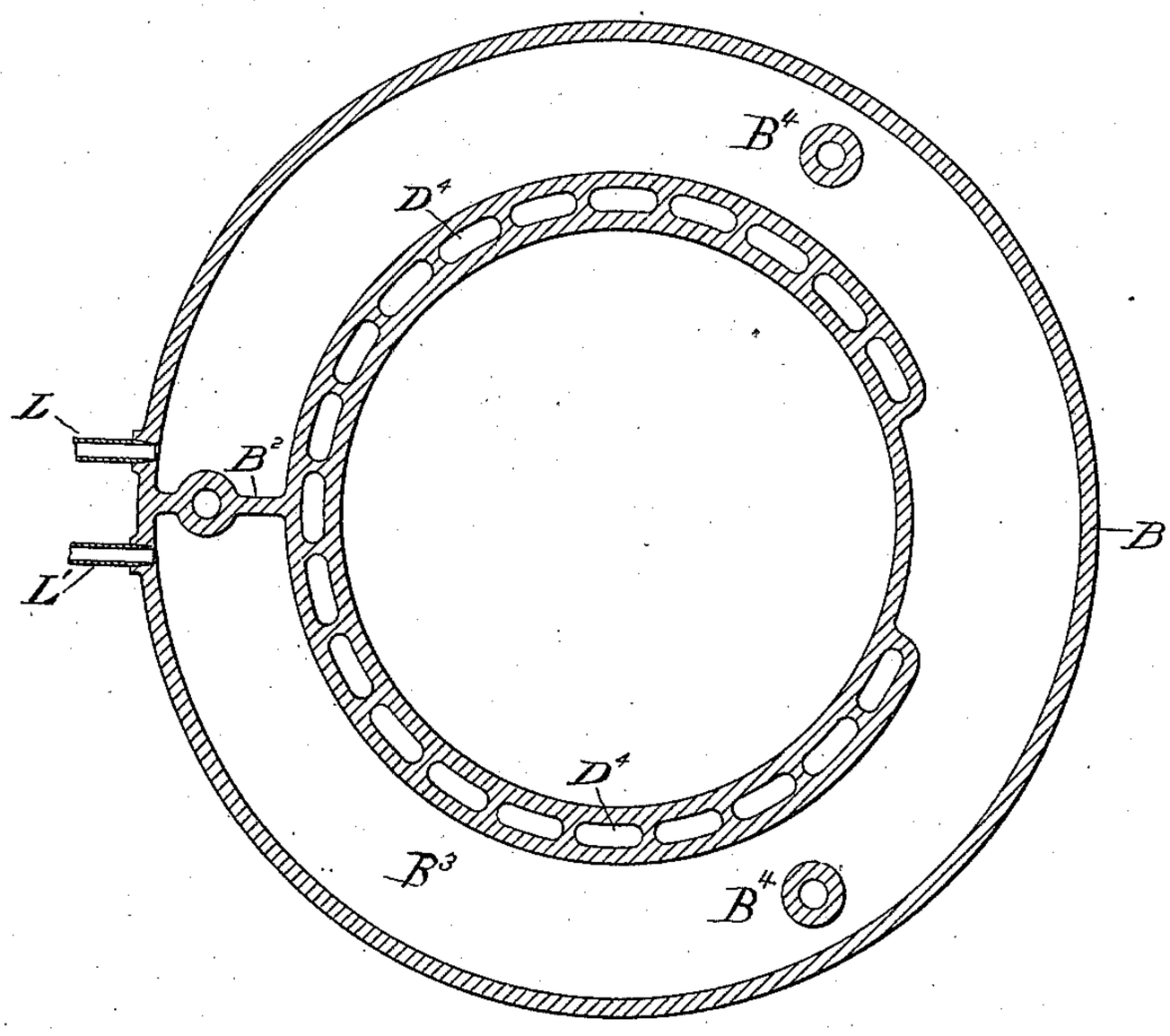
4 SHEETS—SHEET 4.

Fig. 7.



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UNITED STATES PATENT OFFICE.

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CENTRIFUGAL PULVERIZING-MILL.

963,046. Specification of Letters Patent. Patented July 5, 1910.

Application filed May 9, 1902. Serial No. 106,544.

To all whom it may concern:

Be it known that I, EDWARD HENRY HURRY, a subject of the King of Great Britain, residing at Bethlehem, county of Northampton, State of Pennsylvania, have invented certain new Improvements in Centrifugal Pulverizing-Mills, of which the following is a specification.

This invention relates to pulverizing mills of the class in which a revolving roll actuated by a power propelled driver coöperates with or chases around a grinding track contained within a suitable casing. There are numerous styles of such mills, and while this invention is not, boardly speaking, limited to a particular type thereof, it is primarily, an improvement upon the centrifugal mill described and claimed in my application No. 699,132, filed December 13, 1898.

The chief object of the invention is to secure proper lubrication of, and exclusion of dust or dirt from the bearings associated with the roll, or rolls, and which afford rotary motion about its axis.

The principles of construction and operation inherent in my invention may be embodied in various forms. Those shown in the accompanying drawings have been demonstrated by experience to be practical and efficient embodiments of the invention, and are the best now known to me.

Figure 1 is a vertical longitudinal central section showing the preferred construction. Fig. 2 is a detail horizontal section of the rotating driver or pulley shown in Fig. 1. Fig. 3 is a partial vertical section showing a modification or another embodiment of the invention. Fig. 4, a similar view showing another form. Fig. 5, a like view showing still another form. Fig. 6, a similar view showing multiple annular oil troughs, one for each roll; and, Fig. 7, a horizontal section on the line 7, 7, of Fig. 1.

The general construction shown is substantially that disclosed in my application above mentioned and is as follows: On a suitable foundation A and over a discharge chute or receptacle A′ is mounted a frame B carrying a pan B′ in which is removably mounted an annular upwardly flaring grinding track C. To the frame B is bolted a casing D provided with a wire screen D′ and a feed hopper or opening D^2, and on each side of the feed opening, the space between the wall of the casing and the screen is connected by passages D^3 with corresponding passages D^4 in the frame B through which the pulverized material passes into the chute A′. To the top of the frame D is attached a spider frame E in the hub of which is keyed a stationary vertical shaft F supported at F′ on the pan. A pulley G, adapted to be driven by an appropriately arranged belt, rotates upon the shaft within the spider frame being supported by an annular flange or collar F^2 on the shaft. The lower edge of the pulley runs in annular gutter G′ formed at the upper interior edge of the casing D, and which may be filled with oil or other appropriate liquid to form a dust guard or seal. The cap or sleeve G^2, applied to the hub of the pulley and embracing the shoulder or collar F^2, similarly runs in an annular groove formed in a block G^3 applied to the shaft. Oil is to be fed from a cup *g* to the pulley bearing and will descend finding its way into the trough in the block G^3 from which a pipe *g′* may lead through the bottom of the pan, and thence laterally to the exterior of the foundation for discharge of surplus oil.

As indicated in Fig. 2, the mill shown is provided with three roll shafts which may be mounted and arranged as follows: The pulley is formed at three equidistant points with pairs of parallel radial webs H, H, between which, and adapted to swing radially, is a block H′ carrying a roll shaft H^2. In the present construction, the block H′ rocks upon a pivot bolt I passing through the parallel webs H, H. The roll shaft H^2, which may have a tapered fit in this block, has a nut applied to its upper end. In the particular construction disclosed in Fig. 1, a sleeve 3 enveloping the shaft has secured in its upper end a flanged bushing 2 free to slide on the shaft. At the lower end of the sleeve is a roll 4, the periphery of which tapers inwardly and downwardly and the lower end of its bearing is completely closed, as shown. Below the bushing 2, the roll shaft is shown as tapered to a reduced diameter and the sleeve is correspondingly shaped and preferably an annular space is left at this point between the sleeve and the shaft. Below this tapered portion, the sleeve is provided with a bearing bushing 5 to receive the cylindrical lower portion of the shaft.

A proper lubricant should be supplied to the bearing of the sleeve 3 in any appropriate manner. The particular method of lubrication shown in the drawing constitutes a feature of this invention which is hereafter described.

When the mill is not in operation, the roll, or the rolls if there be more than one, will descend, carrying the sleeve 3 with it until arrested upon the bottom of the pan without, however, passing entirely out of peripheral engagement with the track. When the pulley or driver G is rotated at a suitable speed, the centrifugal force developed, and the consequent reaction engendered between the track and roll, cause the roll to rise into complete coöperative relation to the track, as shown in Fig. 1. Further upward tendency, however, is arrested by the flange of bushing 2, which may be considered a collar or radial bearing surface, pressing against the under radial face 6 of the block H′, and positively closing the bearing. This face and upper end of the sleeve should be ground, and, of course, if desired, a suitable packing may be interposed. Thus, when the mill is in operation, there is a complete closure of the bearing, preventing entrance of dust or dirt. Should any particles of dust settle upon these opposed or radial surfaces when the mill slows down and the roll, sleeve and bushing 2 have descended, in the further operation of the mill, when the bushing again bears against the radial face 6, they would be naturally expelled by the centrifugal force developed by the rotation of the bushing, assisted by the outward flow of the lubricant. Experience has demonstrated that such deposits of dust upon the surface do not occur to any appreciable extent. In the described construction, the sleeve and roll rotate upon the non-rotating roll-shaft. In Fig. 3, the roll is fixed to the lower end of the roll shaft, and the upper end of the shaft rotates within the block H′ and is formed with, or has attached to it, a collar or annular flange 7, which, when the roll is in its upper position is, by the upward stress of the roll, forced against a seat on the bottom of the block H′ forming, while the mill is in operation, a perfect closure of the bearing at that point against entrance of dust. In this construction the bearing affording the rotary motion of the roll is that of the shaft within the block H′.

In Fig. 4, the construction is analogous to that shown in Fig. 3, the difference being that a sleeve or bushing 8 is pinned to the upper end of the shaft and a shoe 9 bolted to the bottom of the block H′. Between the lower end of the sleeve and the face of the shoe 9, and around the contained shaft H², is interposed a coiled spring, the reaction of which tends, at all times, to keep the collar or flange 7 against the seat in the lower face of the shoe 9. This spring may be of such strength as to maintain, at all times, the collar 7 against the seat with sufficient pressure to completely exclude dust and dirt from the bearings. In that event, the tendency of the roll to rise because of the reaction between the roll and track and centrifugal force developed will become unimportant in respect to effecting a closure of the bearing but, as described in my prior application, the upward thrust would tend to throw upon the roll shaft the weight of the block and pulley and apply it incidentally to the grinding operation upon the surface of the track, and this would result in a reduction of friction at the pulley bearing.

In Fig. 5, the casing is closed by a plate 10 having a downwardly projecting flange running in the trough or gutter G′. The roll shaft passes through an opening in the bottom of this plate and is adapted to slide in a bearing block 11, trunnioned in lugs 12 rising from the face of the plate. A spur pinion 13 fast on the shaft, above the bearing block 11, meshes with a spur gear 13′ fast on the hub of the pulley which is now supported by the hub 15 of the plate 10, which, in turn, is supported by the flange or collar F² on the central shaft. When the pulley is driven, the roll shaft is rotated and the rolls derive their orbital motion around the track by frictional contact therewith carrying with them their shafts and the rotatable plate 10. Here again, a flange or collar 7 on the roll shaft abuts, when the mill is in operation and the roll shaft has an upward tendency, against the bottom face of the bearing block 11, effecting a complete closure of the lower end of the bearing. The vertical movement of the shaft may occur without carrying pinion 13 out of engagement with gear 13′. The oil trough applied around the flange or collar F², in Fig. 1, is, of course, equally applicable and may be employed in the construction shown in Fig. 5. By this construction, I am enabled to effectively protect the bearing from dust and dirt far more satisfactorily and efficiently, as experience has demonstrated, than is feasible with the various kinds of packing glands, dust guards, etc. that have heretofore been used. So far as this feature of the invention is concerned, the lubricant may be supplied to the bearings in any appropriate way. The mode shown, however, I have found, by experience, to be effective, and to be particularly appropriate, with the general construction of this mill.

In Fig. 1, the upper end of the pulley hub is provided with an external enlargement in which is formed an annular gutter or trough 16, to which oil is supplied from a stationary cup 17, mounted on the hub of the spider, through a pipe 18. A nipple 19, ap-

plied to the bottom of the trough 16, opens to an oil receptacle 20 formed at the top of the trunnion block H′ from which an oil duct extends to the seat of the shaft in the block and there communicates with an internal groove 21. The construction is the same in Figs. 3 and 4.

In Fig. 5, the radial web 22 of the pulley may be solid, and, however the construction is in that regard, it has a vertical annular flange formed with an oil channel or trough 23 supplied by a stationary oil cup located on one of the spider arms and having a pipe 24 delivering oil to the channel 23. The plate 10, in which the trunnion blocks of the roll shafts are mounted, has attached to it an upwardly extending frame 25 which may be an inverted cup-like structure having a central opening for the hub of the pulley, and, in a raised part around that opening, an annular oil channel or trough 26. One or more oil pipes 27 leading from the bottom of the oil trough 23 on the pulley discharge into the trough 26, and from the latter there extends downwardly an oil pipe 28 which opens into a cavity 29 in the end of the roll shaft connected by appropriate oil ducts with the shaft bearing, or interior of the trunnion blocks. With this construction, the oil cups are all mounted upon a stationary part of the frame so that they may be filled at any time and whatever may be the velocity at which the machine is operated, the oil is uniformly and readily supplied to the bearings. In the construction of Fig. 1, the oil supply may be such, at least in the beginning, as to fill the entire sleeve.

I have indicated in Fig. 2 the employment of three roll shafts. There might, however, be but one. Preferably, there would be at least two in order that the stress of the upward tendency of the roll may be applied symmetrically with reference to the axis of rotation of the driver and the revolving parts be in balance when the machine is in operation.

Where more than one roll is employed I find the best results, as to lubrication, are obtained by providing a separate oil trough for each bearing. Thus in Fig. 6, which contemplates the use of three rolls, there are three oil troughs 16, 16″, 16^2, each having a nipple or discharge pipe to supply one bearing.

In this specification the opposed surfaces forming the closure of the bearing have been termed radial faces. Of course they need not be faces lying in planes at right angles to the axis of the roll or roll shaft. It is sufficient if they are opposed surfaces serving to close the bearing.

The frame B to which the casing D is bolted is shown in horizontal section in Fig. 7, from which it will be seen, that in the present construction, it has a closed annular chamber B^3 surrounding the part in which the passages D^4 are formed. This chamber is divided radially by a partition B^2 having an enlarged apertured portion through which one of the bolts for securing the casing passes. Provision is made for two other bolts at B^4, B^4, which represent apertured posts extending between the top and bottom walls of the chamber. Pipes L, L′, communicating with the chamber on opposite sides of the partition B^2 afford means for circulation of a cooling medium, such as air or water. In dry grinding, particularly where the material is refractory, considerable heat is developed, and it is advantageous to keep the temperature down.

I claim as my invention:

1. In a centrifugal pulverizing mill, the combination of an upwardly flaring grinding track, a downwardly tapering roll cooperating therewith, a driver, the roll shaft, a sleeve carried by the roll, enveloping the shaft and having a bearing-closing surface, a second bearing-closing surface that does not rotate with the sleeve and against which the first named surface bears to close the bearing of the sleeve when the mill is in operation and an upward tendency is imparted to the roll and sleeve by the centrifugal force developed and the consequent reaction between the roll and track.

2. In a centrifugal pulverizing mill, the combination of an upwardly flaring annular grinding track, a downwardly tapering grinding roll coöperating therewith, a downwardly extending roll shaft, a bearing which affords rotary motion of the roll about its axis, and a closure for the bearing comprising opposed surfaces which are forced together, when the mill is in operation, by the upward tendency imparted to the roll by the centrifugal force developed and the consequent reaction between the roll and track.

3. In a centrifugal pulverizing mill, the combination of an upwardly flaring annular grinding track, a downwardly tapering roll coöperating therewith, a downwardly extending roll shaft, a bearing affording motion of the roll about its axis and a closure for the bearing comprising opposed faces that are pressed together by upward tendency imparted to the roll during its rotation to exclude dust from the bearing.

4. In a centrifugal pulverizing mill, the combination of an upwardly flaring annular grinding track, a downwardly extending roll shaft, a downwardly tapering roll cooperating with the track and rotating on the shaft, a sleeve extending upwardly from the roll and enveloping the shaft, the organization being such that the roll and sleeve are capable of limited axial movement on the shaft and a closure for the bearing of the sleeve and roll comprising op-

posed faces forced together by the tendency of the roll and sleeve to rise imparted by the centrifugal force developed.

5. In a centrifugal pulverizing mill, the combination of an upwardly flaring annular grinding track, a downwardly tapering roll adapted to travel around the track, an upwardly extending sleeve attached to the roll, a roll shaft extending into the sleeve and a collar attached to the roll shaft against which the sleeve presses when the mill is in operation.

6. In a centrifugal pulverizing mill, the combination of an annular grinding track, a roll having an upward tendency, when the mill is in operation, coöperating therewith, a downwardly extending roll shaft, a bearing affording motion of the roll about its axis and a closure for the bearing comprising opposed faces that are so arranged as to be adapted to be pressed together because of the upward tendency of the roll as it rotates in the normal operation of the machine, to exclude dust from the bearing.

7. In a centrifugal pulverizing mill, the combination of a grinding track, a rotating driver located above the track, multiple downwardly extending roll shafts operatively connected with the driver, a grinding roll associated with each shaft, a bearing affording motion of each roll about its axis, annular oil troughs, one for each bearing, formed in an appropriate part of the driver, stationary means for supplying oil to the troughs, and means for delivering oil from each trough to its corresponding bearing.

8. In a centrifugal pulverizing mill having a plurality of rolls and a driving head, annular oil gutters in the driving head, one to each roll, each roll bearing being connected by a duct to one of the gutters.

In testimony whereof, I have hereunto subscribed my name.

EDWARD HENRY HURRY.

Witnesses:
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A. A. BECKER.