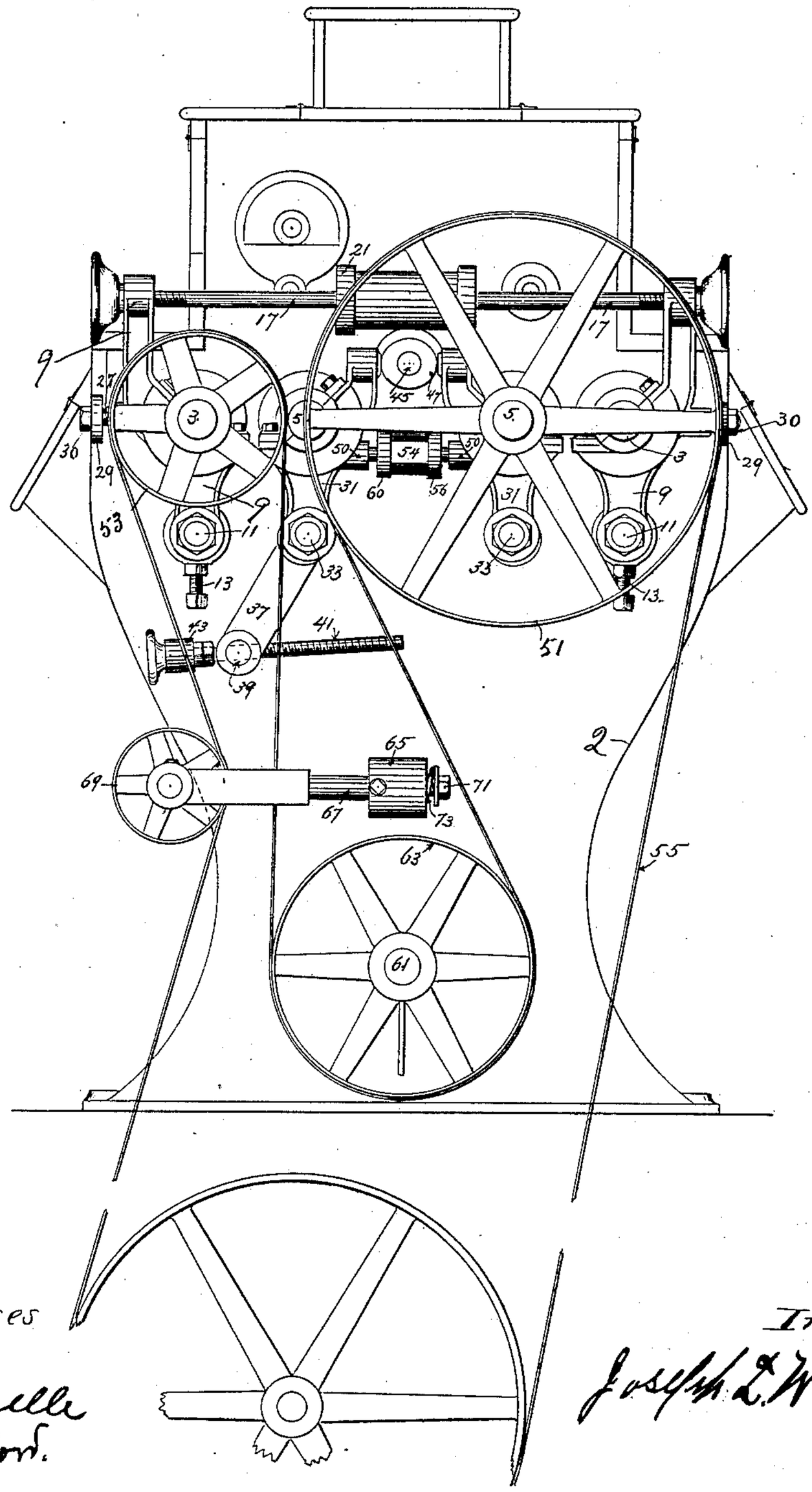
(No Model.) 3 Sheets—Sheet 1.

J. L. WILLFORD.

ROLLER MILL.

No. 367,570. Patented Aug. 2, 1887.

Fig. 1.



Witnesses

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(No Model.) 3 Sheets—Sheet 2.

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ROLLER MILL.

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Fig. 2.

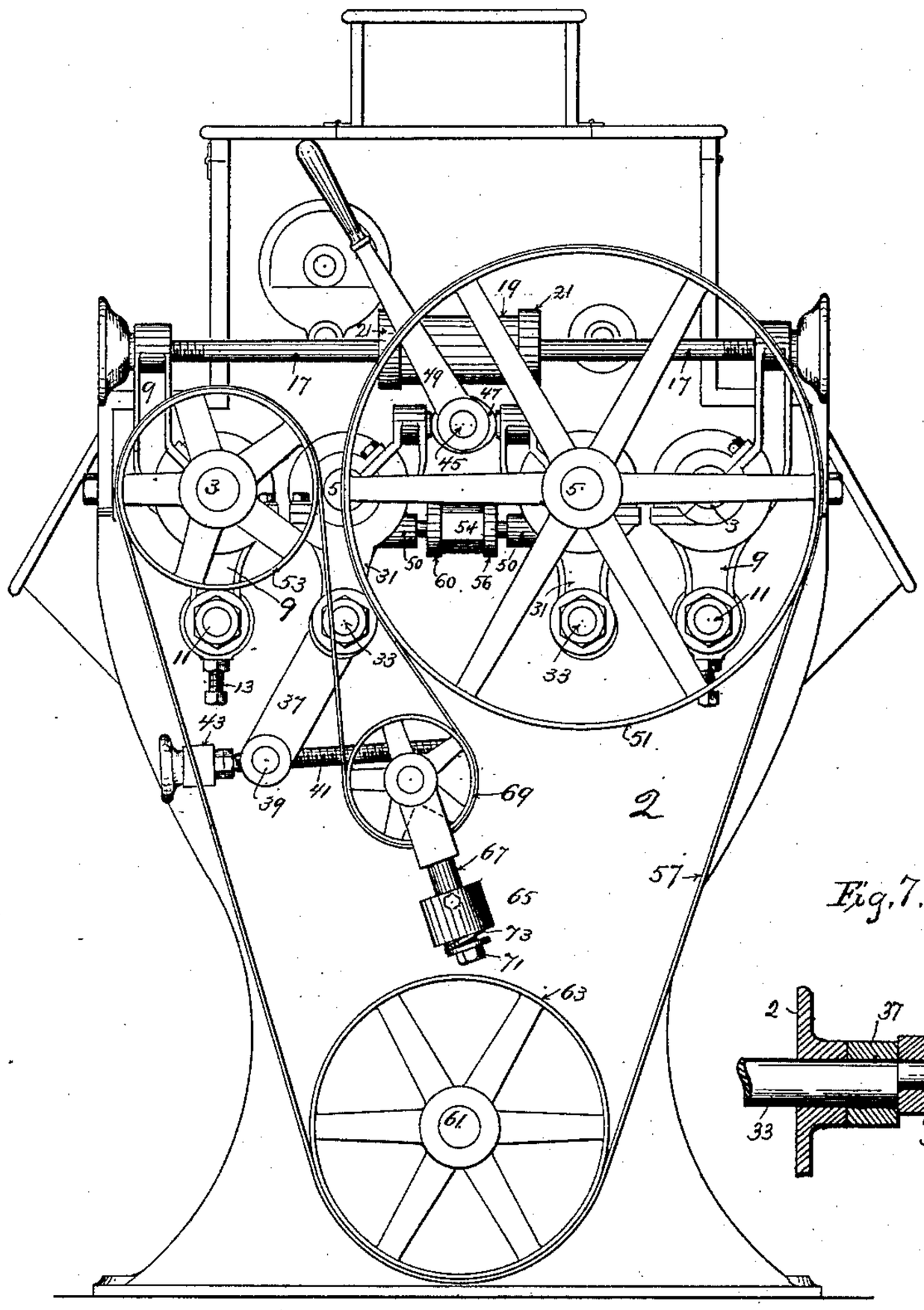


Fig. 7.

Fig. 5.

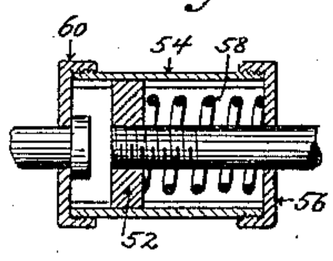
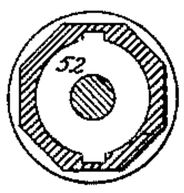


Fig. 6.



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(No Model.) 3 Sheets—Sheet 3.

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ROLLER MILL.

No. 367,570. Patented Aug. 2, 1887.

Fig. 3.

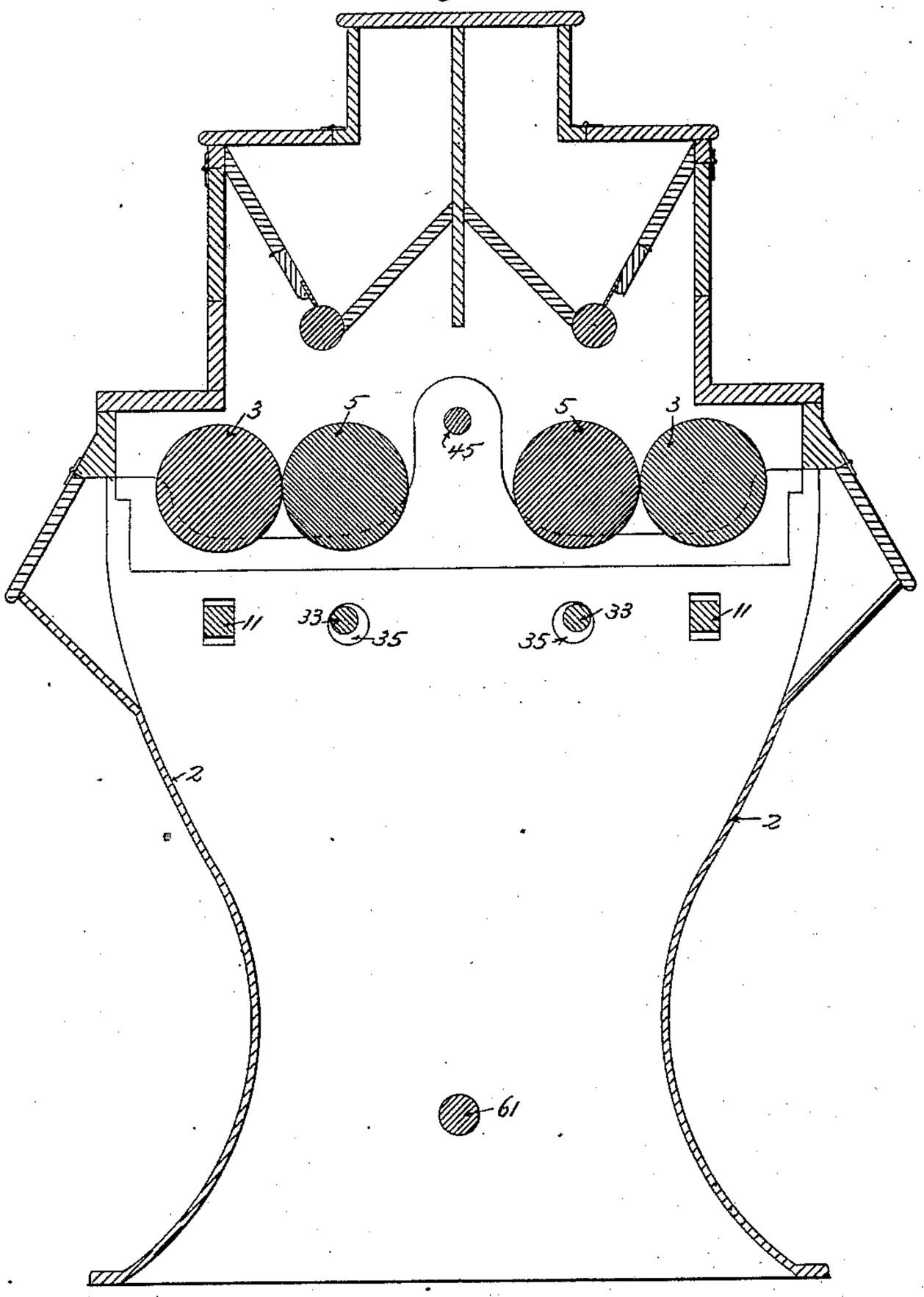
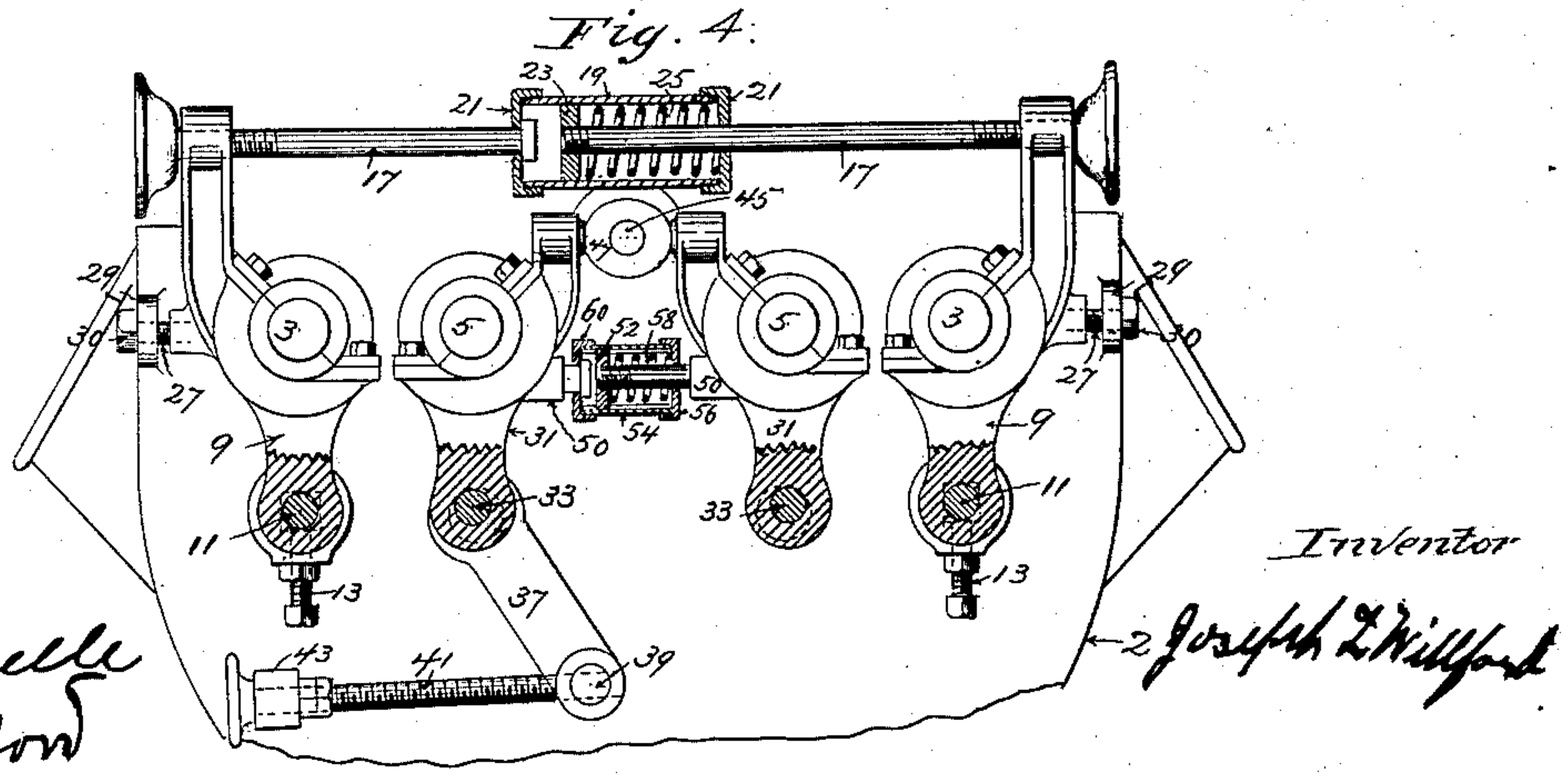


Fig. 4.



Witnesses
C L Frizzell
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UNITED STATES PATENT OFFICE.

JOSEPH L. WILLFORD, OF MINNEAPOLIS, MINNESOTA.

ROLLER-MILL.

SPECIFICATION forming part of Letters Patent No. 367,570, dated August 2, 1887.

Application filed July 22, 1886. Serial No. 208,701. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH L. WILLFORD, of Minneapolis, in the county of Hennepin, State of Minnesota, have invented certain Improvements in Roller-Mills, of which the following is a specification.

This invention relates to improvements in roller-mills for grinding or reducing grain, and particularly to that class of roller-mills in which two sets of rolls are arranged side by side on a single casing or frame.

The object of my invention is to provide a roller-mill with an improved means for throwing the non-yielding rolls into or out of grinding contact with the yielding rolls and regulating the grinding adjustment without changing the tension of the yielding rolls.

Another object is to provide a four-roller mill with common tension devices for both of its yielding rolls, so that the same tension is constantly applied to both yielding rolls.

Another object of the invention is to provide means for taking up any lost motion resulting from the wear of the parts, thus providing for a positive adjustment of the rolls and preventing their running together when the feed is off and wearing off their corrugations.

Another object of the invention is to render all of the adjustments easy and positive.

Other objects of the invention will appear from the following detailed description.

In the accompanying drawings, forming a part of this specification, Figure 1 is a side elevation of my improved machine. Fig. 2 is an elevation of the opposite side thereof. Fig. 3 is a vertical section of the hopper, rolls, and casing. Fig. 4 is an elevation and partial section of the rolls and their supporting and adjusting means. Figs. 5 and 6 are details of the spring-withdrawing device for the non-yielding rolls. Fig. 7 is a detail plan view in section of one of the eccentric journals and its bearings.

In the drawings, 2 represents any suitable frame or casing. It is preferably formed as a cast-metal shell, upon the upper part of which the hopper-casing is supported. The grinding-rolls 3 3 and 5 5 are arranged across the upper part of the casing in the usual way. The outer rolls, 3 3, are yielding and the inner rolls, 5 5, are non-yielding. The yielding rolls are mounted in bearings formed in arms 9, that are pivoted on bars 11. These bars are preferably rectangular in cross-section, and extend through the casing from one side to the other. They are preferably provided with adjusting-screws 13, by means of which the yielding rolls may be vertically adjusted and made parallel with the other rolls. This means for vertically adjusting the yielding rolls is shown and described in my Patent No. 315,201, granted April 7, 1885.

Each of the supporting-arms for the yielding rolls preferably extends above its roll-bearing, and in a four-roller mill such as shown in the drawings the arms upon each side of the casing are provided with a single tension device, which tends to draw the two arms together, and holds both yielding rolls against the non-yielding rolls with an equal tension upon both. Any suitable tension device may be used for this purpose.

The device that I have shown and prefer to use is arranged as follows: Each arm 9 is provided with a rod, 17, that extends through its upper end. These rods are threaded and are provided on their outer ends with threaded nuts or hand-wheels. A tube or pipe, 19, having caps 21, is arranged between the two rods, and a follower, 23, upon one of the rods, is arranged within the tube. A spring, 25, surrounds the rod within the tube and bears at one end against the follower 23 and at the other on the inside of the cap. The other rod is connected to the other cap of the tube. The expansive force of the spring tends to move the follower into the tube, and through the rods 17 and arms 9 the tension of the spring is at all times exerted equally upon both outer rolls.

The arms 9 are each provided at a point about opposite the axes of the rolls with a projecting bolt or stud, 27, which passes through a lug or projection, 29, on the frame of the machine, and is provided with an adjustable nut, 30. These nuts encounter the projections 29, and thereby limit the inward movement of the yielding rolls. As the spring tension devices draw the upper ends of the arms inward, the nuts 30 strike on the projections, which act as fulcrums about which the arms turn, their lower ends being thrown outward and held to a positive bearing, even

though they may be loose upon their pivots. When any foreign substance comes between the rolls of either set, the yielding roll of that set is thrown out and the nut 30 is moved away from the lug 29. At all other times, however, the arms bear upon these fulcrums, whether the other rolls are in contact with the yielding rolls or not. If these fulcrums are not used, and the arms become loose upon their pivots, their lower ends will be thrown out as the feed is turned on, thus carrying their rolls out of grinding contact with the other rolls and necessitating further "setting up" of the arms to bring the rolls back to grinding contact, and when the feed is turned off and the grinding-pressure removed the lower ends of the arms will move in, carrying their rolls toward the others and allowing the rolls of each set to run together, thereby grinding off the corrugations and causing serious injury to the rolls. These objections, which are common in roller-mills having their yielding rolls mounted in pivoted arms, are entirely obviated by the means described, and in addition the advantage of an equal tension upon both yielding rolls is secured.

It is usual to provide roller-mills with means by which the yielding rolls are moved from the non-yielding rolls for the purpose of "spreading" the rolls or throwing them out of grinding contact. This, however, unduly distends or compresses the tension-springs and destroys or impairs their action, and is therefore always objectionable, even when separate tension devices are used for each yielding roll. When a single tension device is used for both rolls, it would soon be impaired and rendered unreliable if the rolls were "spread" by moving the yielding rolls.

In order to secure the advantages resulting from the use of the common tension devices without impairing these devices in spreading the rolls, I mount the non-yielding rolls in movable and adjustable bearings, by means of which they may be moved to or from the yielding rolls, so as to bring them into or out of grinding contact with them, and also to provide a fine adjustment, by which they may be set more or less closely, according to the degree of fineness required in the break, so that whereas in a four-roller mill, where the yielding rolls alone are movable and the common tension device is applied, such tension device, when the rolls are spread, is stretched and strained, as it must yield sufficiently for the movement of both rolls; but under the present invention the inner or non-yielding rolls are moved to spread the rolls, and the common tension devices are never unduly distended, so that there is obtained all the advantages of the common tension devices, and the rolls are separated without unduly stretching the springs of the tension devices.

The non-yielding rolls are mounted in bearings formed on the pivoted arms 31. Shafts 33 extend through the casing, and are mounted in bearings therein. Upon each end of these shafts an eccentric journal, 35, is formed, and these journals form the pivots upon which the arms 31 are mounted. A lever, 37, is secured to one end of each shaft 33, and has a nut, 39, pivoted to it. An adjusting-screw, 41, is held in a pivoted sleeve, 43, on the casing, and engages the nut 39. By turning the screw 41 the lever 37 is moved back and forth, and thereby the shaft 33 is turned on its axis, moving its eccentric journals 35, and with them the arms 31, and the roll 5 toward or from the other roll.

A shaft, 45, extends through the casing between the arms 31, and has upon each end a double eccentric, 47, and at one or both ends a handle or lever, 49. These eccentrics are adapted to bear upon the arms 31 and force the rolls 5 toward the rolls 3 and hold them unyieldingly in this position. A spring-tension device is provided for the arms 31, which holds them against the eccentrics and draws the rolls 5 away from the rolls 3 when the eccentrics are turned to release the arms. This tension device is preferably composed of a rod, 50, secured to one of the arms 31, and having a threaded end. A follower, 52, on this rod is fitted into a tube, 54, in which it is adapted to slide longitudinally, but not to turn on its axis, a cap, 56, on one end of the tube, through which the rod 50 passes, a spring, 58, within the tube, bearing at one end on the follower 52 and at the other end on the inner side of the cap 56, and a cap, 60, on the opposite end of the tube, to which the other rod is attached. This spring holds the arms against their seats and spreads the rolls as soon as the eccentrics are turned away from the arms. The tube is polygonal in cross-section on its outer surface, and when it is desired to increase the tension of the spring the tube may be turned by a wrench applied thereto and the follower 52 screwed farther up on the rod 50, thereby compressing the spring and increasing the tension.

To throw the rolls into or out of grinding contact, the arms carrying the non-yielding rolls are turned on their axes by means of the lever and the double eccentric. To adjust the rolls the eccentric pivots upon which the arms of the non-yielding rolls are mounted are moved toward or from the yielding roll. These pivots or journals are formed eccentrically upon the shafts 33, so that by giving the shafts a partial revolution the pivots and the arms carried by them are moved toward or from the yielding rolls. The shafts are turned by means of the arm 37, nut 39, and screw 41.

Several important advantages arise from this construction besides those already set forth, viz: The rolls may be thrown together by means of the lever and double eccentric, and a fine adjustment may then be made by means of the eccentric pivots upon which the swinging arms are mounted. The rolls may be thrown apart and returned to grinding position without altering their adjustment, or either non-yielding roll may be thrown out of

contact with the other roll of the set by means of its movable eccentric pivots. The non-yielding roll is also supported by means that prevent any lost motion in adjusting this roll. The pivoted arms in which this roll is journaled are held at their upper ends against the eccentrics, and their lower ends are constantly drawn back against their pivots, and should the arms become loose upon the pivots no lost motion will result. With this construction and arragement the rolls may be accurately adjusted.

It is usual in roller grinding-mills to drive one roll of each set at a greater speed than the other, and hence to obtain a differential speed of the two rolls in each set. One roll is generally designated as the "fast" and the other as the "slow" roll. The belt-pulleys on the rolls are usually placed alternately on the opposite sides of the frame, the pulleys on the fast rolls being on one side and the pulleys on the slow rolls on the other. In some instances the roll-pulleys are all of the same size and one belt is driven at a greater speed than the other. In other instances the pulleys on the fast rolls are smaller than the pulleys on the slow rolls and the belts have substantially the same speed.

The drive that I prefer to employ for a four-roller mill comprises two belts that are driven at the same speed and each driving one fast and one slow roll at one side of the machine. A large pulley, 51, is mounted on the journal of one of the rolls, and a smaller pulley, 53, is mounted on the journal of one of the rolls of the other set. Similar pulleys 51 and 53 are mounted on the other rolls at the other side of the machine. A driving-belt, 55, passes over the pulleys 51 and 53 on one side of the machine, and another belt, 57, passes over the pulleys on the other side of the machine. These belts may be arranged in any convenient manner. I prefer to provide a counter-shaft, 61, in the lower part of the casing having similar belt-pulleys, 63, near its ends. The belt 55 passes from any convenient power-shaft around one of the roll-pulleys, thence around one of the pulleys on the counter-shaft, and thence around the other roll-pulley. Two of the rolls and the counter-shaft are driven by this belt. The other belt is passed around the pulley on the other end of the counter-shaft, thence over one of the roll-pulleys, thence around an idler placed below the rolls, and thence over the other roll-pulley. This belt is driven from the counter-shaft and drives the other rolls. Both belts have substantially the same speed, and each drives one fast and one slow roll. There are many advantages in this drive. Both belts having the same speed wear equally and are equally stretched. A large and a small pulley can be placed on the same side of a small frame where two large pulleys could not be placed, and none of the pulleys project beyond the casing.

Spring-tighteners are provided for each of the belts. The preferable construction of these is as follows: A sleeve, 65, is pivoted upon each side of the casing above the counter-shaft; a rod, 67, slides in this pivoted sleeve and has a yoke upon one end, in which an idler-pulley, 69, is mounted. The opposite end of the rod is provided with a nut, 71. A spring, 73, surrounds the rod between the nut and the sleeve, and tends to draw the pulley toward the sleeve.

The tightener is adapted to be turned up into the position shown in Fig. 2 and allow the short belt to be wrapped around it, or to be swung out into the position shown in Fig. 1 and take up the slack in the main driving-belt.

If preferred, the counter-shaft may be driven by an independent belt and the rolls driven by belts passing from the counter-shaft to their pulleys.

As the sleeves in which the tightener-pulleys are supported are centrally pivoted, the tighteners may be swung either to the right or to the left, and the main belt may be arranged at either side of the machine. The two sides of the machine being alike the short belt may be arranged at either side. The large pulleys are preferably placed on the inside rolls, as when thus located they do not project beyond the casing.

I claim as my invention—

1. The combination, in a roller-mill, of a yielding roll, a non-yielding roll, pivoted arms supporting said non-yielding roll, means for turning said arms upon their pivots for throwing said non-yielding roll into or out of grinding contact with the yielding roll, and means for adjusting said pivots toward or from the yielding roll for regulating the grinding adjustment, substantially as described.

2. The combination, in a roller-mill, of the yielding roll, the non-yielding roll, a shaft extending through the casing and having eccentric journals upon its ends, arms pivoted at their lower ends upon said journals and supporting said non-yielding rolls, means for moving the upper ends of said arms toward or from the yielding roll, and means for turning the eccentric journals and adjusting the lower ends of the arms toward or from the yielding roll, substantially as described.

3. The combination, in a four-roller mill, of the yielding rolls, pivoted arms supporting said yielding rolls, tension devices common to both yielding rolls, non-yielding rolls, pivoted arms supporting said non-yielding rolls, means for turning said arms upon their pivots and moving said non-yielding rolls toward or from the yielding rolls, and means for moving said pivots toward or from said yielding rolls, substantially as described.

4. The combination, in a four-roller mill, with the yielding rolls, of the non-yielding rolls, means for simultaneously moving both non-yielding rolls into or out of grinding contact with the yielding rolls, and means for independently adjusting either non-yielding roll toward or from the co-operating yielding roll, substantially as described.

5. The combination, in a roller-mill, of the

yielding rolls, the shaft 33, having the eccentric journals 35, the arms 31, pivoted on said journals, the roll 5, supported upon the arms 31, the lever 37, secured to the shaft 33, means for turning said arms 31 upon their pivots for throwing the non-yielding roll into or out of grinding contact with the yielding roll, and means for adjusting said pivots toward or from the yielding rolls for regulating the grinding adjustment of the rolls, substantially as described.

6. The combination, in a four-roller mill, of the inner non-yielding rolls, pivoted arms supporting said rolls, means for adjusting said rolls, the outer yielding rolls, pivoted arms supporting said yielding rolls, and tension devices common to both yielding rolls, substantially as described.

7. The combination, in a roller-mill, of the movable rolls 5, the rolls 3, the pivoted supporting-arms 9, the rods 17, the tube 19, and the spring 25, drawing said arms 9 toward each other, for the purpose set forth.

8. The combination, in a roller-mill, of the rolls 5, pivoted arms 31, supporting said rolls 5, the eccentrics 47, the tube 54, the rods 50, the follower 52, secured upon one of said rods and arranged in the tube 54, the spring 58, and means for adjusting said follower on said rod, all substantially as described.

9. The combination, in a four-roller mill, of the movable non-yielding rolls, the yielding rolls, pivoted arms supporting said yielding rolls, tension devices common to both yielding rolls tending to move both of said rolls toward the non-yielding rolls, and adjustable stops limiting the movement of the yielding rolls toward the non-yielding rolls, substantially as described.

10. The combination, in a roller-mill, of the movable non-yielding rolls, yielding rolls, arms pivoted at their lower ends and supporting said yielding rolls, tension devices connected with the upper ends of said arms and holding them with a yielding pressure, and adjustable stops connected with said arms between the pivots and the tension device, and limiting the movement of said arms, substantially as described.

11. The combination, in a roller-mill, with the casing and driving-belts, of the countershaft 61, journaled in said casing, the similar pulleys, 63, on the opposite ends of said shaft, the sleeves 65, pivoted centrally upon opposite sides of the casing, the sliding rods 67, carrying the idlers 69, and the springs 73, tending to draw said idlers toward the pivoted sleeves, whereby the driving-belt may be applied at either side of the mill, all substantially as described.

JOSEPH L. WILLFORD.

In presence of—
C. L. FRIZELLE,
R. H. SANFORD.