(No Model.) 4 Sheets—Sheet 1.

J. L. WILLFORD.

ROLLER MILL.

No. 420,026. Patented Jan. 21, 1890.

Fig. 1.

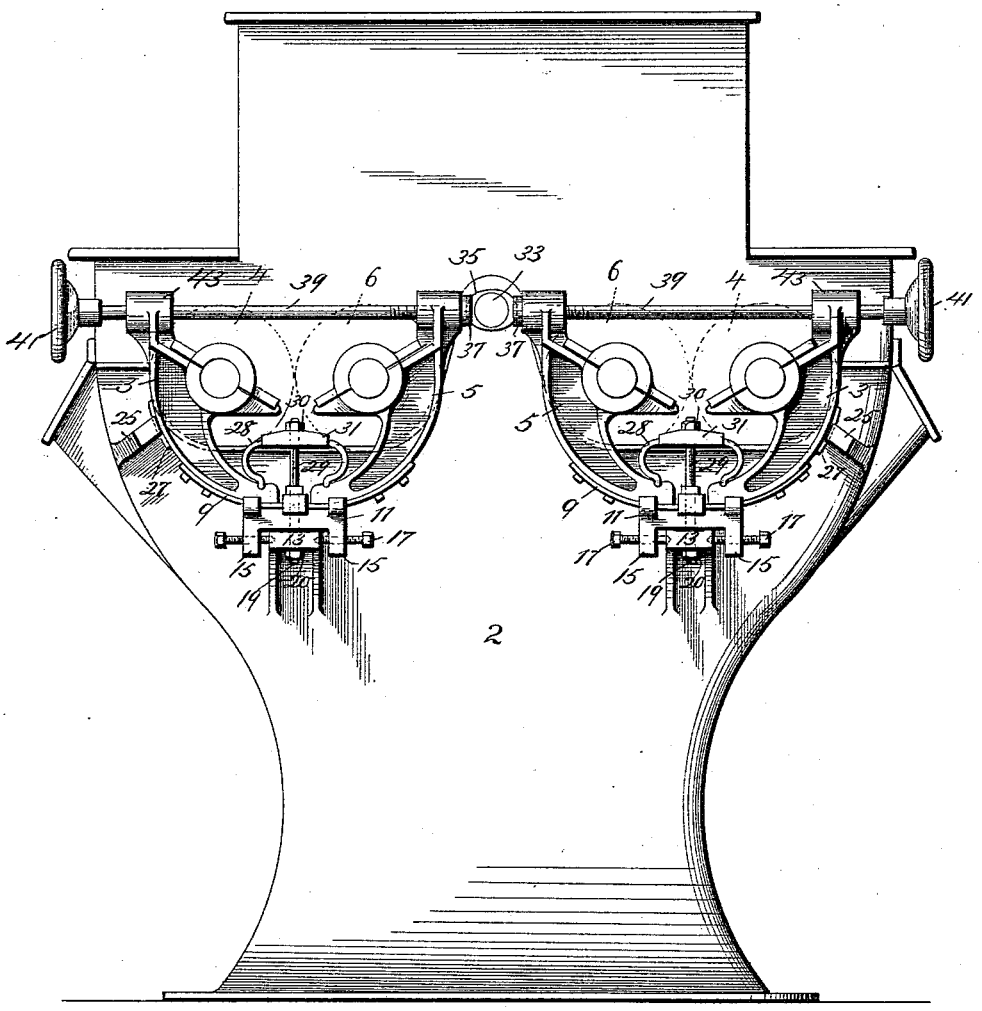
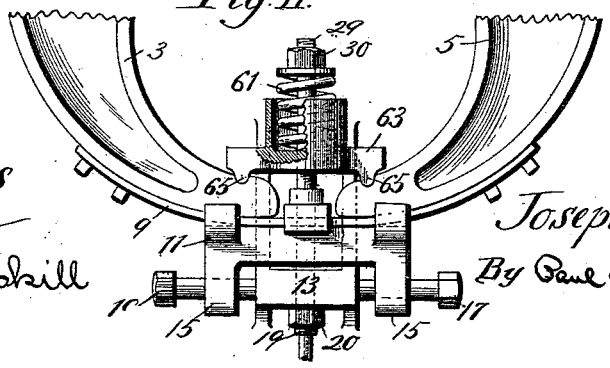


Fig. II.



Witnesses
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(No Model.) 4 Sheets—Sheet 2.

J. L. WILLFORD.

ROLLER MILL.

No. 420,026. Patented Jan. 21, 1890.

Fig. 2.

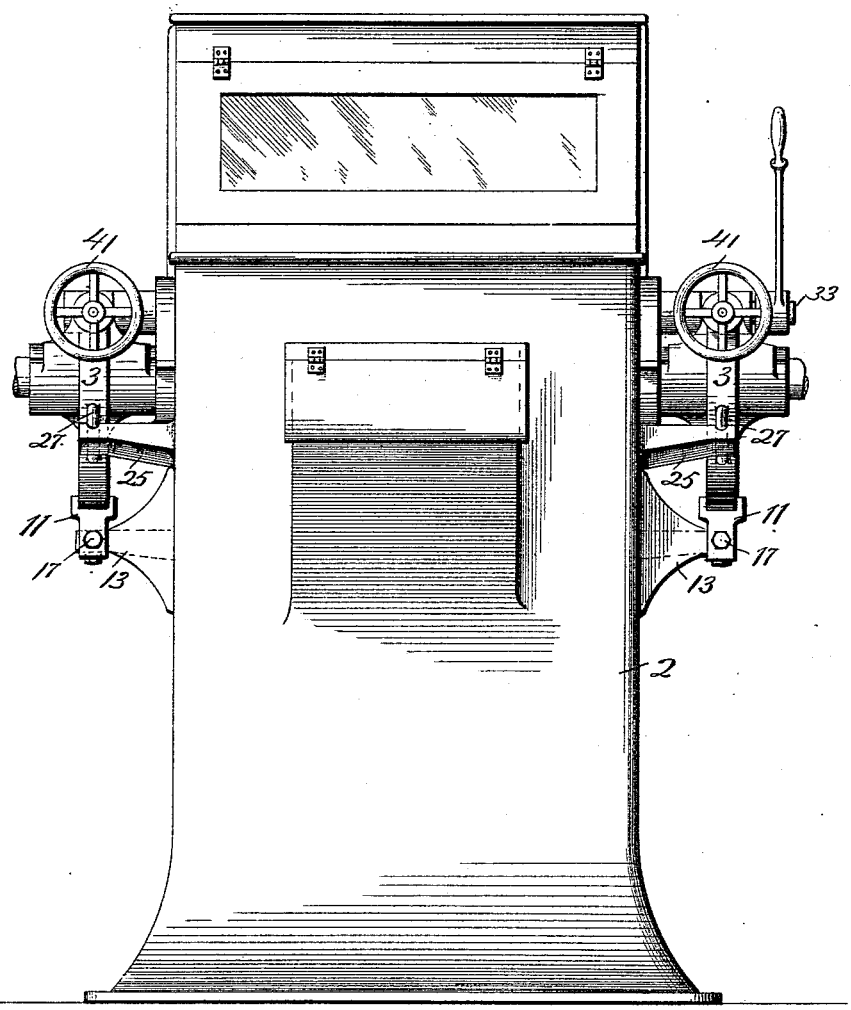
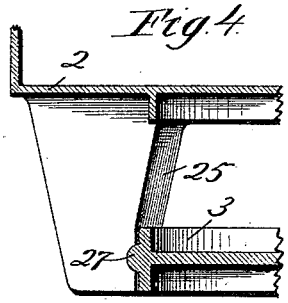


Fig. 4.



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(No Model.) 4 Sheets—Sheet 3.

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ROLLER MILL.

No. 420,026. Patented Jan. 21, 1890.

Fig. 3.

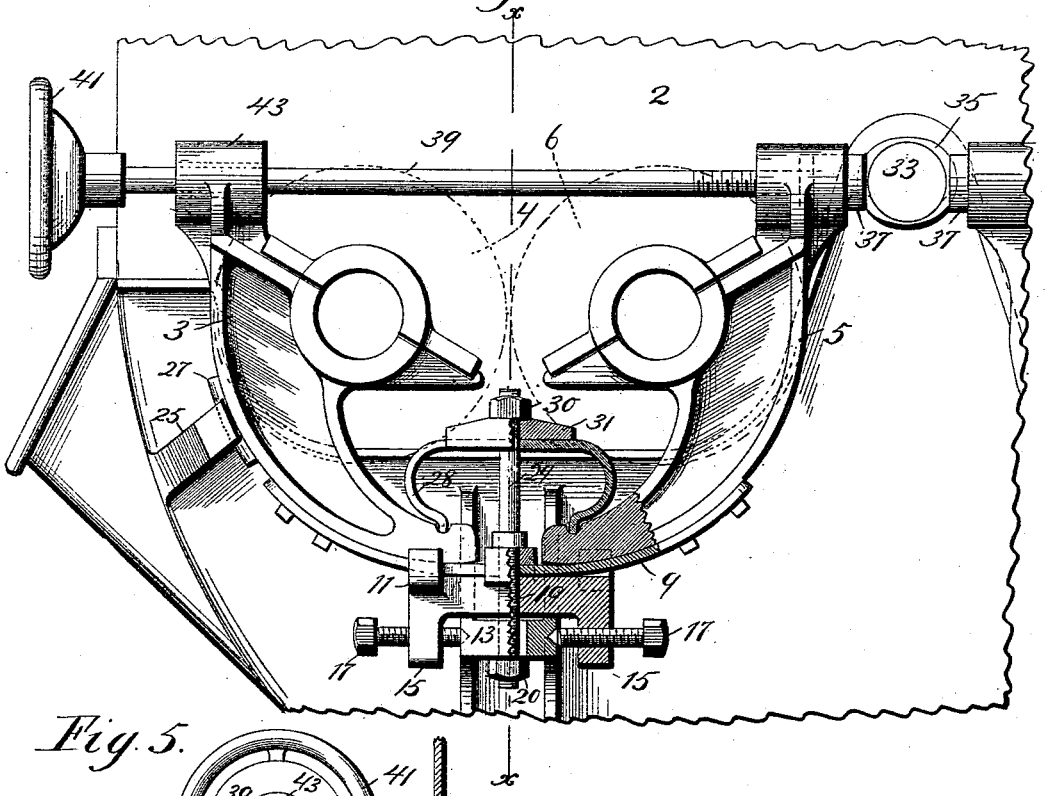


Fig. 5.

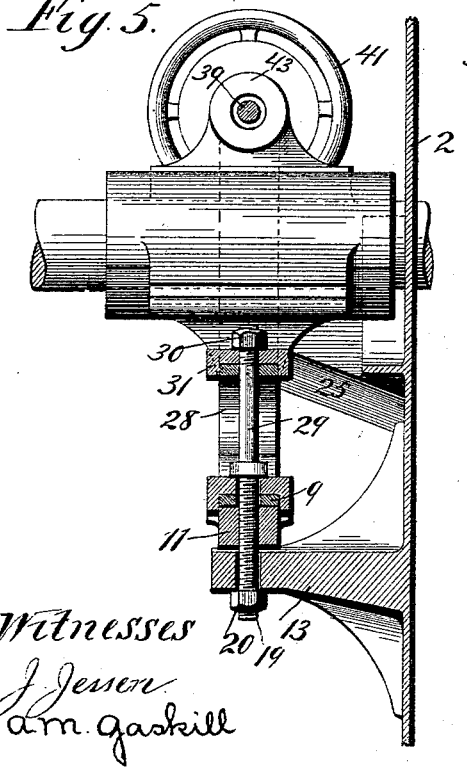


Fig. 6.

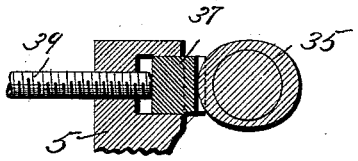
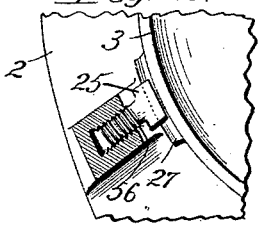


Fig. 12.



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(No Model.) 4 Sheets—Sheet 4.

J. L. WILLFORD.

ROLLER MILL.

No. 420,026. Patented Jan. 21, 1890.

Fig. 7.

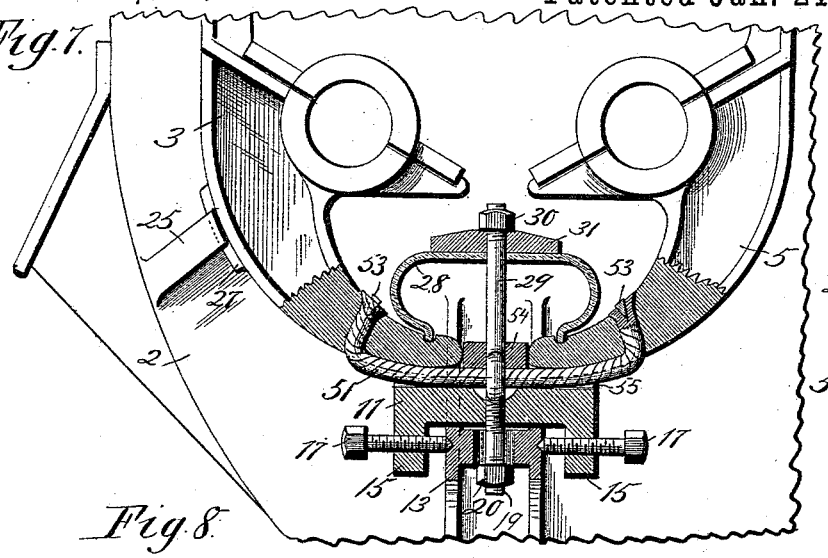


Fig. 10.

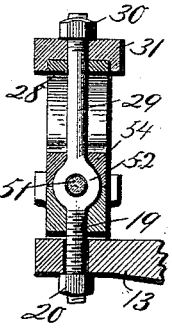


Fig. 8.

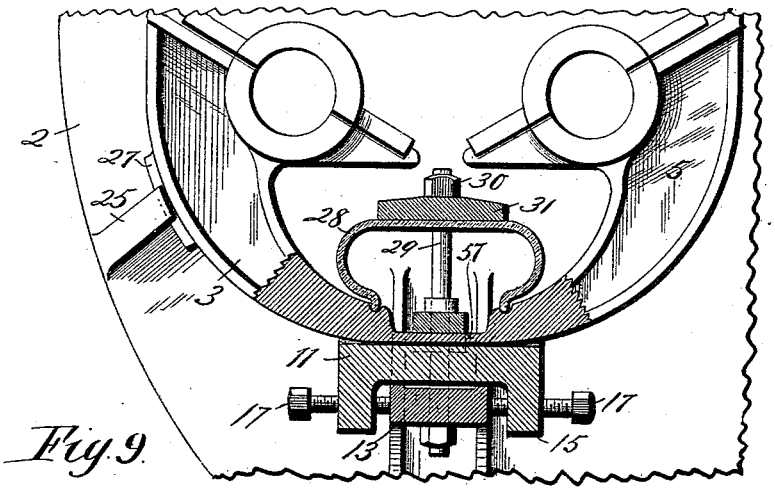
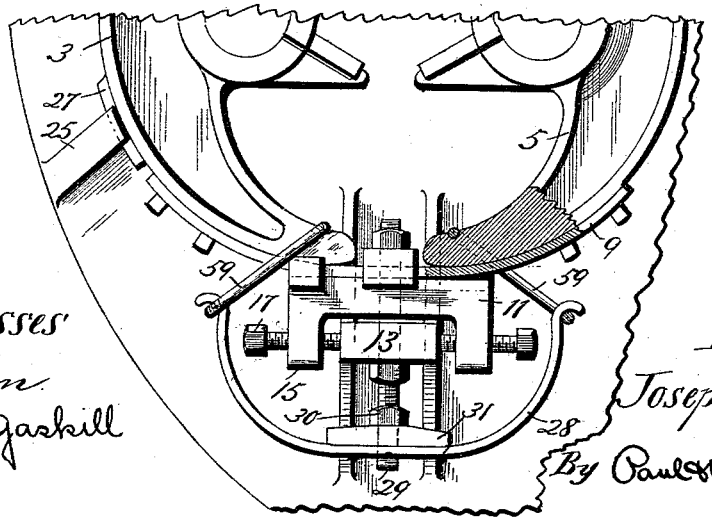


Fig. 9.



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UNITED STATES PATENT OFFICE.

JOSEPH L. WILLFORD, OF MINNEAPOLIS, MINNESOTA.

ROLLER-MILL.

SPECIFICATION forming part of Letters Patent No. 420,026, dated January 21, 1890.

Application filed November 2, 1889. Serial No. 329,071. (No model.)

To all whom it may concern:

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

This invention relates to improvements in roller grinding-mills. As certain types of such mills are usually constructed, they are provided with one or more pairs of rolls, and the material to be ground is passed between the rolls and thus subjected to a grinding or crushing action. In such mills one roll of each pair is generally mounted in fixed bearings, while the other roll is mounted in yielding bearings for the purpose of allowing it to yield to permit any hard substance to pass between the rolls without injury to their surfaces. The yielding roll is either mounted in a pivoted arm or in a sliding box, and suitable springs are arranged to force its bearings toward the other roll. Stops are also provided to limit the inward movement of the bearings, these stops being usually made adjustable, and the tension-springs are also usually provided with adjusting devices for the purpose of regulating the tension of the springs. One of the rolls, usually the yielding one, is also generally provided with means for moving it away from the stationary roll and returning it when desired to its former position. The objections to these usual constructions are that where the upright swinging arms are used there must be a loose fit of these arms on their pivots and another loose fit in the rods that hold the upper ends of the arms, thus making two points at which there is lost motion. When the feed is on and the material is passing between the rolls, this lost motion will be taken up by moving the rolls outward; but when the feed is off this lost motion permits the rolls to move inward, causing the two rolls to run together. When there is a loose fit of the swinging arms upon their pivots, the roll mounted in these arms, being the fast roll, will climb on the other roll, when the feed, if heavy, as far as permitted by this loose joint and drop when the feed is light, thus causing a "clattering" motion and an unequal grinding. Similar objections exist to the use of the sliding box, with which there is always more or less lost motion, which is taken up by the forcing of the rolls apart when the feed is on and by permitting the rolls to run together when the feed is off.

It is the object of my invention to overcome these objections, and to provide a roller-mill, in which the rolls are held in the desired position with no possibility of any lost motion, while permitting one of the rolls to yield in case any undue strain comes between them.

To this end my invention consists in a roller-mill having the rolls of each pair mounted in rocker-arms, each of said arms being held against two bearings by suitable springs. The axis of one of the rolls is arranged above (or, by a reversal of the parts, it might be below) both of the bearings against which each of its rocker-arms are held, so that when a hard substance passes between the rolls the rocker-arm supporting this roll will rock upon the bearings nearest the said roll against the tension of the springs, moving away from the other bearings, and thus permitting the roll to move away from the other roll, and when said substance has passed the arms are brought back by said springs to their original position. The other roll is arranged between the bearings of the rocker-arms, and the arms are held against said bearings by springs. One of the bearings of this roll is preferably made adjustable, so as to permit of an adjustment of the position of the roll, and this bearing is also movable for the purpose of permitting the spreading of the rolls. The lower ends of the rocker-arms at each end of the rolls are preferably arranged upon a common bearing, and this bearing at one or both ends of the roll is made laterally adjustable. By adjusting this bearing laterally one of the rocker-arms is rocked upward and the other downward, thereby causing the corresponding end of one roll to be raised and of the other to be lowered, thus permitting the "tramming" of the rolls.

Other objects of this invention will appear from the following detailed description, taken in connection with the accompanying drawings, in which—

Figure 1 is an elevation of a four-roller mill having my invention applied thereto. Fig. 2 is an elevation looking in a direction at right angles to the plane of Fig. 1. Fig. 3

is an elevation, partly in section, of the means for supporting the ends of two of the rolls, Figs. 4, 5, and 6 are details. Figs. 7, 8, 9, 10. and 11 are details of modifications. Fig. 12 is a detail showing means for adjusting one of the bearings.

In the drawings, 2 represents a suitable casing, which is preferably formed of cast metal and supports the operative parts of the machine.

3 and 5 are rocker-arms, upon which are formed the journal-bearings for the rolls. The arms 3 are arranged at the opposite ends of the mill and support the journal-bearings of one roll, and the arms 5 are arranged at opposite ends of the mill and support the journal bearings of the other roll. The arms 3 and 5 are preferably secured to a strip of spring metal 9, which is preferably attached to said arms at a point between their bearings. The spring 9 forms a flexible connection between the arms and prevents them from slipping on their bearings.

The lower ends of the arms 3 and 5, together with the spring 9, are preferably supported upon a suitable block 11, and the block 11 is preferably supported upon a lug 13, formed upon or secured to the casing 2. The block 11 is preferably provided with depending ears 15, and adjusting-screws 17 extend through these ears and engage the lug 13. A bolt 19 passes through the spring-plate 9, through the block 11, through a slot in the lug 13, and is provided at its lower end with a suitable nut 20. The hole in the block 11, through which the bolt 19 passes, is screw-threaded, and the bolt is screwed into this block, so that the nut 20 may be loosened without loosening the spring 19. By this means the plate 9, to which the arms are fastened, is rigidly secured to the block 11, and said plate and block are secured to the lug 13. Arranged on the outside of each arm 3 is a projection 25, formed on or secured to the casing 2. This projection is preferably provided with a groove in its face, and a rib 27 upon the arm 3 engages this groove. The projection 25 forms one bearing and the block 11 another.

A suitable spring is provided which tends to hold the rocker arm at all times against both of these bearings. Any preferred arrangement of spring may be used for this purpose. I prefer to provide a spring 28, that engages the lower end of both of the rocker-arms at points a short distance outside of the points at which they bear upon the block 11. The bolt 19, by which the block 11 is clamped in place, is preferably provided with an upward extension 29, which passes through the spring 28, and is provided at the upper end with a suitable nut 30. A suitable block 31 is arranged upon the spring 28 beneath the nut 30, and through the block the bolt 29 passes. The tension of the spring 28 is exerted upon the arm 3 at a point between its two bearings, so that said spring tends to hold said arm at all times in engagement with both of said bearings, and if said arm is at any time rocked upon one of said bearings, and thereby moved away from the other bearing, it must be done by a force sufficient to overcome the tension of said spring, and as soon as said force ceases to act upon said arm said spring will return the arm to its former position. The roll bearing upon the arm 3 is located at a point above the projection 25, and in this bearing the roll 4 is journaled. This brings the center of said roll above both of the bearings of said rocker-arm, and as the other roll 6, which is mounted as hereinafter described, is located directly opposite said roll 4, and when in use is held rigidly, if any hard substance passes between the rolls, so that the pressure tending to separate the rolls is greater than the force exerted by the spring 28, the upper end of the arm 3 will move outward the portion of said arm that bears upon the projection 25, rocking upon said bearing, and the lower end of said arm rising slightly from its bearing upon the block 11, thus permitting the roll 4 to move away from the roll 6. As soon as the hard substance has passed the rolls, the springs 28 will rock the arm 3 back upon its bearing 25, thus returning the roll to its original position.

The rocker-arm 5 bears at its lower end upon the block 11 in a manner similar to the arm 3, and it is likewise engaged by the spring 28. A suitable shaft 33 is mounted in the frame of the machine at a point near the upper end of said arm 5, and a suitable eccentric 35 is arranged upon said shaft. This eccentric forms a second bearing for the rocker-arm 5. A block 37 is arranged in a recess in the arm 5 and engages the eccentric 35. This block is preferably provided with a groove, into which the edge of the eccentric extends. A rod 39, having a screw-threaded end, engages the rocker-arm 5, passing into a threaded opening therein, so that its end strikes the block 37. This rod may be extended to the front of the machine, passing through a lug 43 upon the arm 3, the perforation in the lug being sufficiently large, so that the rod does not interfere with the desired movements of the arm, and being provided with a hand-wheel 41. By turning this rod 39 the block 37 may be adjusted, and thereby either end of the roll adjusted independently toward or from the other roll. The spring holds the rocker-arm at all times in engagement with the eccentric 35. When the shaft 33 is rotated so as to bring its short axis in line with the block 37, the rocker-arm 5 will be rocked back upon its lower bearing, and the roll carried by it will be moved away from the other roll. The bearing upon the arm 5 for the roll 6 is arranged opposite the roll bearing upon the arm 3 and between the bearing-points of the arm 5, and as said arm is at all times held by the springs against both of its bearings the roll carried by said arm will be incapable

of yielding and will constitute the "fixed" roll. I prefer to arrange the block 11 at one or both ends of the machine, so that by turning the set-screw engaging the lug 13 said block 11 and the rocker-arm supported by it may be moved laterally, and by so doing one of said arms will be moved upward and the other downward, thereby moving one end of one roll up and the other down. By this means the rolls may be readily and accurately "trammed."

In the accompanying drawings I have shown the invention applied to a four-roller mill, in which instance the eccentric shaft is preferably located between the rocker-arms 5 of the two sets of rolls, the rocker-arms 5 being the inner arms of each pair and the arms 3 being the outer arms, as shown in Fig. 2. By this means both sets of rolls may be simultaneously spread or brought into grinding position.

In some instances, in place of using a spring-plate 9 for forming a flexible connection between the rocker-arms, I use other devices for this purpose. For instance, in Fig. 7 I have shown the rocker-arms connected by a wire rope 51, the ends of which pass through openings in the arms, and is secured therein by means of wedges 53. The upper surface of the block 11 is provided with a groove 55, and the under surface of the arm is provided with a similar groove, and in these grooves the rope lies. The bolt 19 is provided in this instance with an eye 52, through which the wire rope passes, as shown in Figs. 7 and 10. A block 54 will in this instance preferably be arranged between the ends of the arms on the bolt 19 for the purpose of keeping the arms apart.

Instead of connecting the rocker-arms by an independent flexible plate or rope, they may be formed of spring-steel and be joined by a thin flexible portion 57, formed integrally with said arms, as shown in Fig. 8.

Instead of arranging the spring 28 above the arms, it may be arranged below them, as shown in Fig. 9, with links 59 connecting the ends of the springs with the arms, as shown in that figure.

Instead of using a flat spring engaging directly with the rocker-arms, I may use a coiled or spiral spring 61, that is arranged upon the bolt 19, with its lower end arranged in a socket in a bearing-bar 63, which is provided upon its under surface with ribs 65, that engage the rocker-arms, as shown in Fig. 11. The bearing 25 may be made adjustable, as by mounting it upon a screw-threaded bolt 56, which engages a threaded opening in a lug on the frame, as shown in Fig. 12. It will be seen that with this construction I provide a roller-mill in which the tension-springs act to hold the rolls apart, so that they can never come in contact with each other, and that the springs at the same time permit one roll to yield when undue strain comes between them, and when such strain is relieved brings them back at once to their former position. There is no chance for lost motion, as each rocker-arm has two bearing-points on the frame of the machine, and against both of these points the arm is held by its spring.

As the arms are flexibly connected, they form self-adjustable bearings for the rolls, having the function of ball-and-socket bearings. When the rolls are put into their bearings in the arms, said arms adjust themselves so as to bring their bearings into perfect alignment with the rolls, and this alignment will be maintained when the arms are moved for tramming the rolls.

I do not wish to be confined to the details of construction or arrangement shown in the accompanying drawings.

I claim as my invention—

1. In a roller-mill, a roll-supporting rocker-arm, bearings upon which said arm rests, and a spring holding said arm in engagement with said bearings.

2. In a roller-mill, a rocker-arm, a roll supported upon said rocker-arm, bearings upon which said rocker-arm rests arranged below the axis of said roll, and a spring holding said arm in engagement with said bearings.

3. The combination, in a roller-mill, with the bearings 11 and 25, of the rocker-arm 3, resting upon said bearings and provided with a journal-bearing located above said bearings 11 and 25, and a suitable spring tending to hold said arm in engagement with said bearings.

4. The combination, in a roller-mill, with a roll-supporting rocker-arm, of a laterally-adjustable bearing, upon which the lower end of said arm rests, the bearing 25, and a spring tending to hold said arm in engagement with both of said bearings.

5. In a roller-mill, the combination, with a roll-supporting rocker-arm, bearings for said arm upon the frame of the mill, and a flexible connection between said arm and one of said bearings, for the purpose set forth.

6. The combination, in a roller-mill, of a roll-supporting rocker-arm, a bearing supporting the lower end of said arm, an adjustable bearing supporting the upper end of said arm, and a spring holding said arm against both of said bearings.

7. The combination, in a roller-mill, of the roll-supporting rocker-arm 5, the block 11, forming a bearing for the lower end of said arm, the shaft 33, provided with an eccentric 35, forming a bearing for the upper end of said arm, and a spring engaging said arm at a point between said bearings and holding the arm against both of said bearings.

8. The combination, in a roller-mill, of the roll-supporting arm 5, the laterally-adjustable block 11, supporting the lower end of said arm, a flexible connection between said block and said arm, and the eccentric engaging the upper end of said arm.

9. The combination, in a roller-mill, of roll-

supporting rocker-arms 3 and 5, a laterally-adjustable bearing supporting the lower ends of said arms, and bearings supporting the upper portions of said arms.

10. The combination, in a roller-mill, of the roll-supporting rocker-arms 3 and 5, the laterally-adjustable block 11, a flexible connection between said arms, the bearing 25, against which the arm 3 rests, the eccentric forming a bearing for the upper portion of the arm 5, and a suitable spring holding said arms in engagement with their bearings, substantially as described.

11. The combination, in a roller-mill, of roll-supporting rocker-arms, two bearings supporting each of said arms, and a spring holding each arm in engagement with both of its bearings.

12. The combination, in a roller-mill, of roll-supporting rocker-arms, a laterally-adjustable bearing supporting the lower ends of both of said arms, bearings supporting the upper portions of said arms, and a spring holding each of said arms against its bearings.

13. The combination, in a roller-mill, with the rolls, of rocker-arms supporting said rolls, and springs engaging said rocker-arms and holding the rolls apart, substantially as described.

14. The combination, in a roller-mill, with the rolls, of rocker-arms supporting said rolls, bearings upon which said arms rest, and springs holding said rolls apart and said arms in engagement with their bearings.

15. The combination, in a roller-mill, of roll-supporting rocker-arms, a bearing supporting the lower ends of both of said arms, a bearing engaged by one of said arms at a point below its roll, a movable bearing engaged by the other arm at a point above its roll, and springs holding said arms in engagement with their bearings.

16. The combination, with the rocker-arms 5, provided with the bearing-block 37, of the shaft 33, provided with the eccentric 35, engaging said block, the adjusting-screw 39, engaging said block, and a spring holding said arm with the block 37 against said eccentric, substantially as described.

17. The combination, in a roller-mill, of roll-supporting rocker-arms, bearings upon which said arms rest, a flexible connection between said arms, and a spring holding said rolls apart and said arms in engagement with their bearings.

18. The combination, in a roller-mill, of rocker-arms supporting the rolls, bearings outside of said arms upon which said arms rest, and springs holding both of said arms in contact with their bearings, substantially as described.

In testimony whereof I have hereunto set my hand this 24th day of October, 1889.

JOSEPH L. WILLFORD.

In presence of—
A. C. PAUL,
A. M. GASKILL.