F. I. MATTHEWS.

ROLLER GRINDING MILL.

APPLICATION FILED APR. 29, 1908.

952,269.

Patented Mar. 15, 1910.

2 SHEETS—SHEET 1.

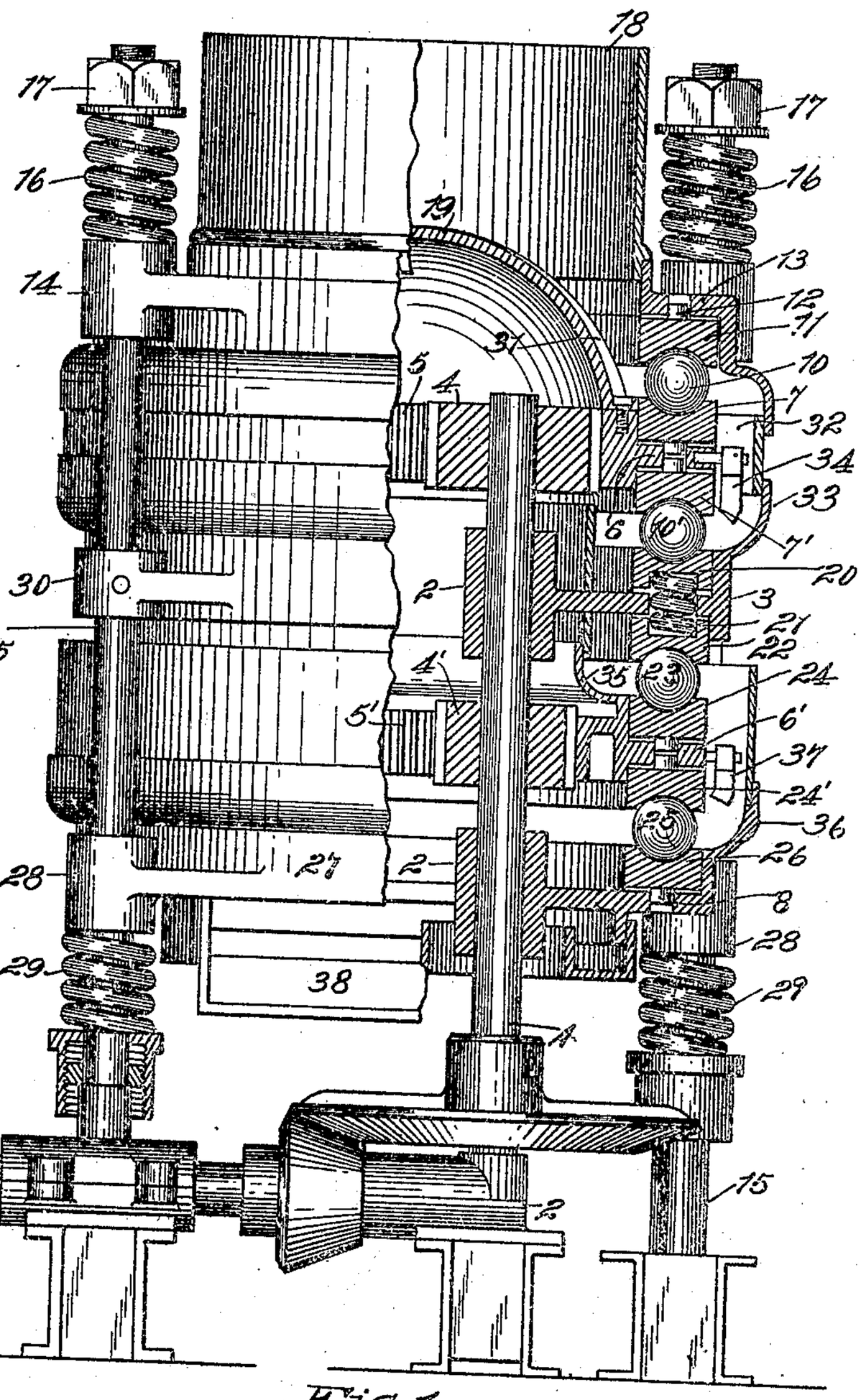

Fig. 1.

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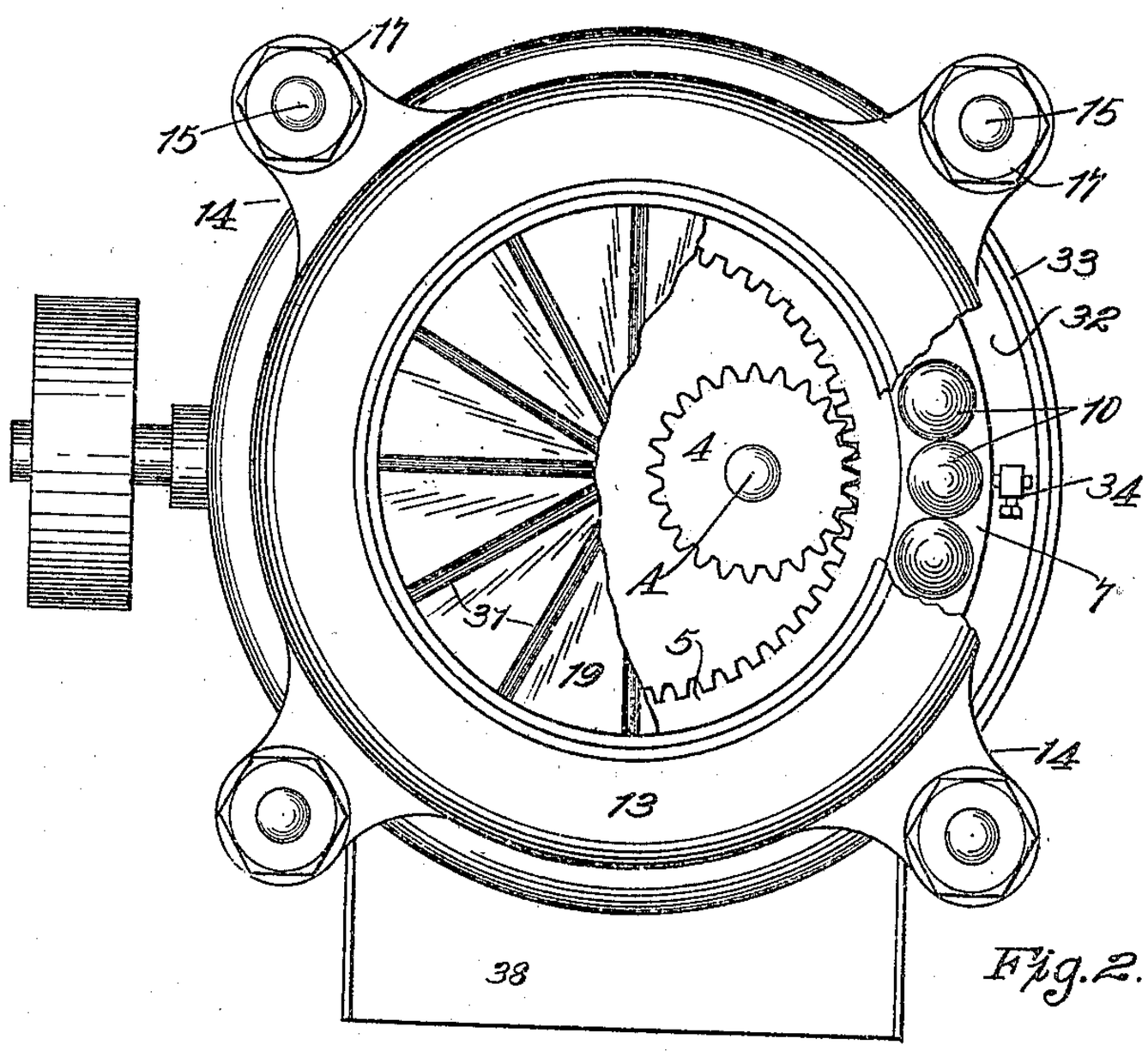

Fig. 2.

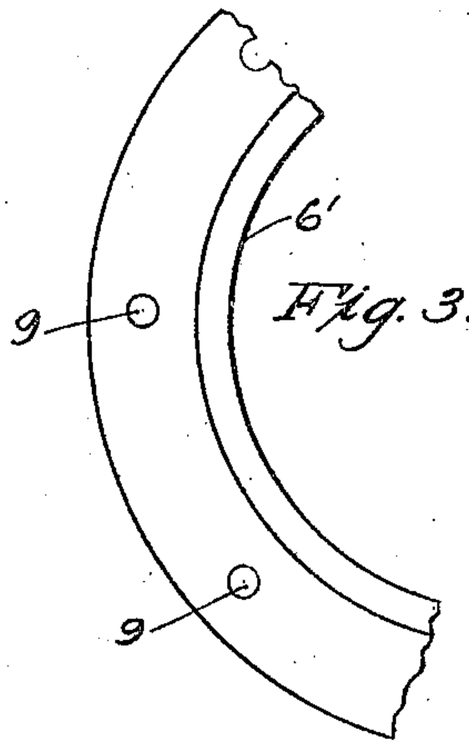

Fig. 3.

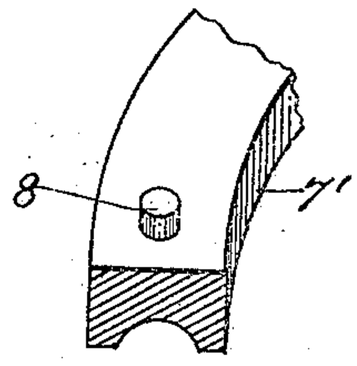

Fig. 4.

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UNITED STATES PATENT OFFICE.

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ROLLER GRINDING-MILL.

952,269. Specification of Letters Patent. Patented Mar. 15, 1910.

Application filed April 29, 1908. Serial No. 430,020.

To all whom it may concern:

Be it known that I, FRANCIS I. MATTHEWS, citizen of the United States, residing at Oakland, in the county of Alameda and State of California, have invented new and useful Improvements in Roller Grinding-Mills, of which the following is a specification.

My invention relates to crushing and grinding-mills, and pertains especially to mills of the roller type for crushing and grinding cement and ores.

The object of the present invention is to provide a simple, cheap, compact, light, durable and practical mill for grinding cement, ores, and the like; to provide a mill in which balls or rollers are employed, and so to arrange these balls or rollers that they will be properly accommodated to the varying character, hardness and size of the granular material fed into the mill; to avoid thrust and strain on the driving mechanism; to provide for the passage of the ore or cement or other material to be ground between a plurality of superposed series of rollers or balls; and to provide for grinding the ore to successive degrees of fineness, if desired, in its passage through the mill.

There are other objects which will be apparent hereinafter.

The invention consists of the parts and the construction and combination of parts as hereinafter more fully described and claimed, having reference to the accompanying drawings, in which—

Figure 1 is a vertical section partly in elevation. Fig. 2 is a plan, partly broken away. Figs. 3 and 4 illustrate fragmentary parts of a carrier and die.

A represents a vertical shaft operated constantly from any suitable source of power, and suitably supported in the fixed bearings 2 on the machine frame. This shaft A carries one or more pinions 4—4′ meshing corresponding internal gears 5—5′. These gears 5—5′ are provided with respective annular flanges 6—6′ on their outer peripheries. Each gear 5—5′ carries a rotary die member, and these die members are preferably made in sections 7—7′ and 24—24′, as here shown. The die sections 7—7′ and 24—24′ are each made in the form of a ring, and they are provided with bosses 8 to fit perforations 9 in the flanges 6—6′, so as to insure the proper rotation of the die members in unison with the internal gears. The upper die section 7 is suitably grooved on its upper surface, and supports the crushing balls 10. A similar race ring and die 11 seats on top of the upper row of balls 10, and this die 11 has bosses 12 fitting into perforations in the header-plate 13. The header-plate 13 has four projecting arms 14 which are perforated to slide on the vertical columns 15. The upward movement of the header-plate and associated parts is limited by springs 16 arranged between the arms 14, and an adjusting nut 17 on the column 15. The header-plate 13 carries a stationary hopper 18 through which the material is fed down on to the conical deflector or distributer 19, which is carried by the topmost internal gear 5. The underneath die section 7′ of the upper series rests on top of a set of balls 10′, and the balls 10′ are supported in turn on an underneath annular die section 20 which is stationary, being suitably supported in guides on a fixed part 30 of the machine frame, and resting on a resilient support, such as the springs 21. These springs 21 counteract against an underneath stationary die ring section 22, which in turn rests upon a set of balls 23. The balls 23 are supported on a traveling die section 24 carried by the internal gear 5′, and this gear 5′ carries the underneath die section 24′ acting on a succeeding underneath series of balls 25; and so on. It is manifest that by multiplying the number of internal gears or equivalent means for imparting rotary motion to the traveling die members the mill may be extended indefinitely. The lowermost series of balls in the mill, irrespective of the number of series, is finally supported on a lower die 26, which is carried by a lower header-plate 27. The header-plate 27 has projecting arms 28 which are slidable on the fixed columns 15, and are supported on the stiff springs 29.

All the stationary annular dies, like 20 and 22, which are intermediate of the upper and lowermost traveling dies, are suitably supported against upward and downward movement, (except as provided by the springs 21 or equivalent devices) as by means of the arms 30, here shown as locked to the columns 15; the object being to prevent a too great accumulation of weight on the lower series of balls, and also to permit an adjustment of the lower series of balls,

independent of the top series, whereby one set may bear with a heavier grinding force than the other. Thus, the springs 16 may be adjusted so that they will press the dies 11 and 20 together under such tension that the balls 10—10′ will exert a different crushing force than is accomplished by the lower balls 23—25.

In practice, the ore or other material to be crushed is fed into the hopper 18 upon the conical distributer 19, which latter is provided with the corrugation or ribs 31 by which the ore is delivered in proper quantities on to the top of the die section 7 and in the path of the upper series of balls 10. With the constant infeed of material, and the constant rotation of shaft A, and correspondingly of the die member 7—7′, the balls 10 are made to turn and act to crush the ore passing under them. The ore which is crushed or partially crushed by the balls 10 is thrown outward or falls from the traveling die section 7 into the annular space 32, where it drops into the bottom of the stationary hopper 33 proximate to the second row of balls 10′. Suitable plows or scrapers 34 carried by the traveling die member operate to scrape the material passing the first row of balls 10 into engagement with the second row of balls 10′. The constant rotation of the gear 5 and of the die section 7′ keeps the balls 10′ in motion, and the ore is thus subjected to a second grinding action. From the balls 10′ the ore passes inward and falls into an annular feed trough 35 which is carried by the next succeeding gear 5′, and the ore so deposited is thrown outward again into the range of action of the third set of balls 23, and the complementary grinding face 24; thence it drops into an outside annular trough 36, whence it is scraped by suitable means, as the plows 37, into the range of action of the next succeeding set of rollers 25. From the rollers 25 the crushed product is delivered internally of the mill into a suitable hopper 38 fixed to the underneath header 27.

The faces of the gears 4—4′ are sufficiently wide, as compared with the width of the gears 5—5′, and the engagement of these sets of gears is sufficiently loose, that the turnable dies may move up and down or rock from side to side in their rotation in encountering larger or smaller pieces of ore, without in any wise binding or twisting or otherwise straining the drive-shaft A; the springs 16—21—29 yielding sufficiently for all necessary purposes.

If desired, the gears 4—4′ may be of different diameter, as here shown, whereby the upper series of dies 7—7′ will travel at a different rate of speed from the lower traveling dies 24—24′. Consequently, the balls 10—10′ will run at a different rate of speed from the balls 23—25, and a different degree of crushing will be effected between these different sets of balls.

Since the material is naturally coarser where it is fed into the machine, it is not always desirable to run the top set of balls at the highest rate of speed. At the same time, it may be advisable to have these upper balls 10—10′ bear harder on their dies than do the lower balls. As the material becomes more finely ground, it is possible, and sometimes more economical, to operate the lower balls and their dies at a higher speed, with less pressure; and the present construction permits of all this.

Manifestly the die sections 7—7′ could be made as one integral member, but they are preferably made separate, in the manner shown, for the sake of rendering them separately replaceable and renewable.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. In a grinding-mill, the combination of a plurality of vertically disposed columns, upper and lower headers slidably mounted on said columns, springs on the columns engaged by said headers, two opposed annular races one of which is movable relatively to the other, means for revolving the movable races, and grinding members between the races.

2. In a grinding-mill, the combination of a plurality of vertically disposed columns, upper and lower headers slidably mounted thereon, springs against which the headers abut, a plurality of annular series of balls, one series of balls being located above the other, suitable grooved supports in which said balls are movable, means for revolving the balls, and means for passing the material to be crushed successively through said series of balls.

3. In a crushing-mill, a plurality of annular series of balls, one series arranged above the other, turnable annular dies between the series of balls, and other dies above and below the balls, means for giving rotary motion to the intermediate dies, and means for pressing all the dies and balls toward each other, said means including upper and lower spring-pressed headers between which the dies are contained, and vertical columns upon which said headers are slidably mounted.

4. In a crushing-mill, the combination of upper and lower spaced headers, vertical columns upon which the headers are slidably mounted, springs on the columns against which the headers are yieldably supported, annular die members carried by said headers, and intermediate revoluble annular die members, with annular series of balls supported between the top of said

movable die member and said headers, and means for giving motion to the movable die member.

5. In a crushing-mill, the combination of upper and lower spaced headers, vertical columns upon which the headers are slidably mounted, annular die members carried by said headers, and intermediate revoluble annular die members, with annular series of balls supported between the top of said movable die member and said headers, means for giving motion to the movable die member, and means for pressing the headers resiliently toward each other.

6. In a crushing-mill, the combination of a plurality of vertical columns surrounding the mill, upper and lower headers pierced to slidably receive said columns, springs against which the headers are yieldably supported, a rotary annular die member, opposed upper and lower die members, balls between the rotary die member and said upper and lower die members, a second rotary die member located below the first one, with coöperating upper and lower die members and corresponding interposed rows of balls, and means for passing the ore successively through the several rows of balls.

7. In a crushing-mill, the combination of a rotary annular die member, opposed upper and lower die members, balls between the rotary die member and said upper and lower die members, a second rotary die member located below the first one, with cooperating upper and lower die members and corresponding interposed rows of balls, means for passing the ore successively through the several rows of balls, and means for revolving one set of balls at a different rate of speed from the other balls.

8. In a crushing-mill, the combination of a rotary annular die member, opposed upper and lower die members, balls between the rotary die member and said upper and lower die members, a second rotary die member located below the first one, with coöperating upper and lower die members and corresponding interposed rows of balls, means for passing the ore successively through the several rows of balls, and means for yieldingly pressing the several series of balls and dies together, said means including upper and lower vertically guided headers between which the balls and dies are contained, and springs against which the headers abut.

9. A crushing mill having in combination upper and lower vertically guided headers, a plurality of vertical guides upon which the headers are slidably mounted, a plurality of annular series of balls, and suitable dies between which said balls run, a plurality of springs against which the headers abut, means for rotating certain of said dies and means for passing the ore in a sinuous path successively through said series of balls.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

FRANCIS I. MATTHEWS.

Witnesses:
CHARLES A. PENFIELD,
CHARLES EDELMAN.