No. 834,387. PATENTED OCT. 30, 1906.

G. C. LITTLE.

MILL FOR CRUSHING AND GRINDING.

APPLICATION FILED DEC. 19, 1904.

3 SHEETS—SHEET 1.

Fig. 1.

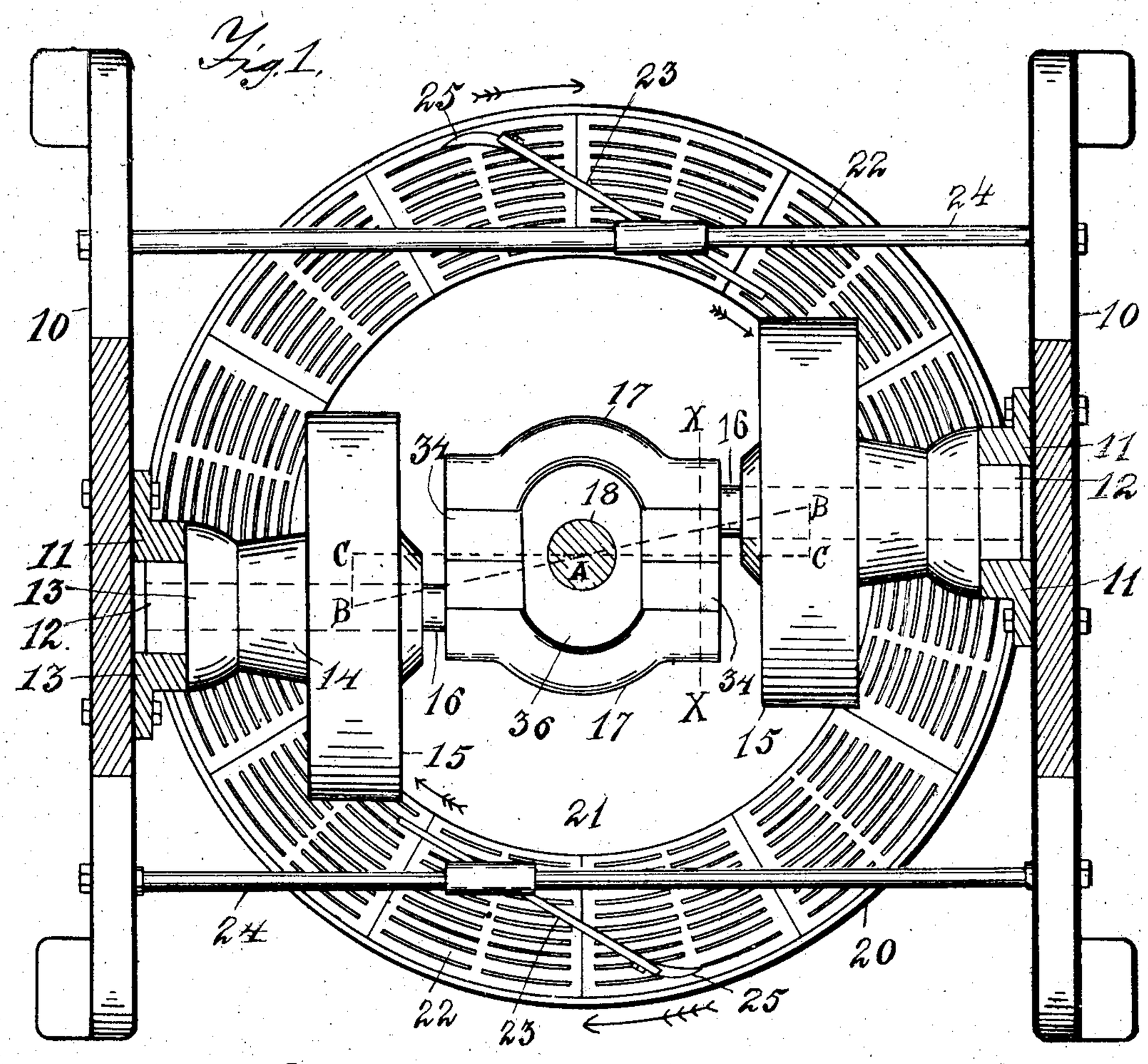


Fig. 2.

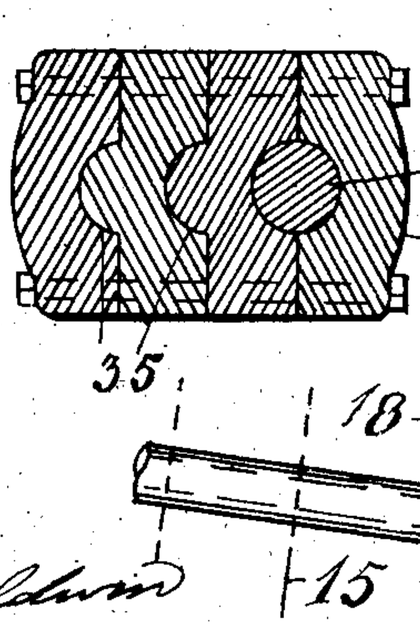


Fig. 3.

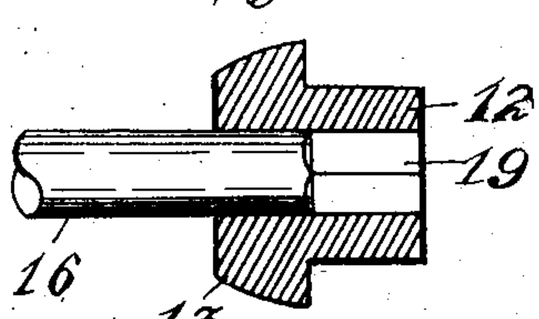
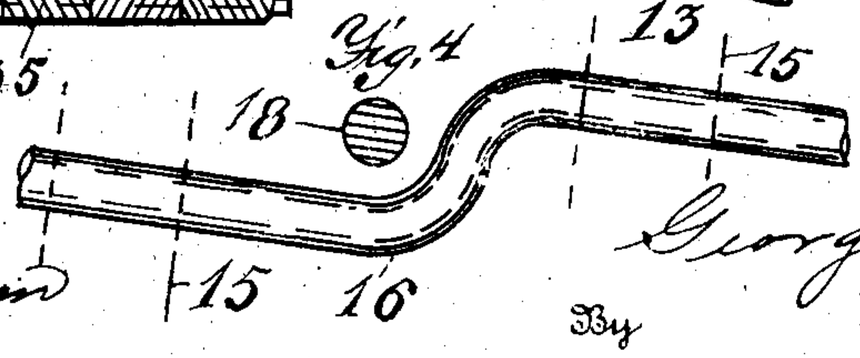


Fig. 4.



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3 SHEETS—SHEET 2.

Fig. 5.

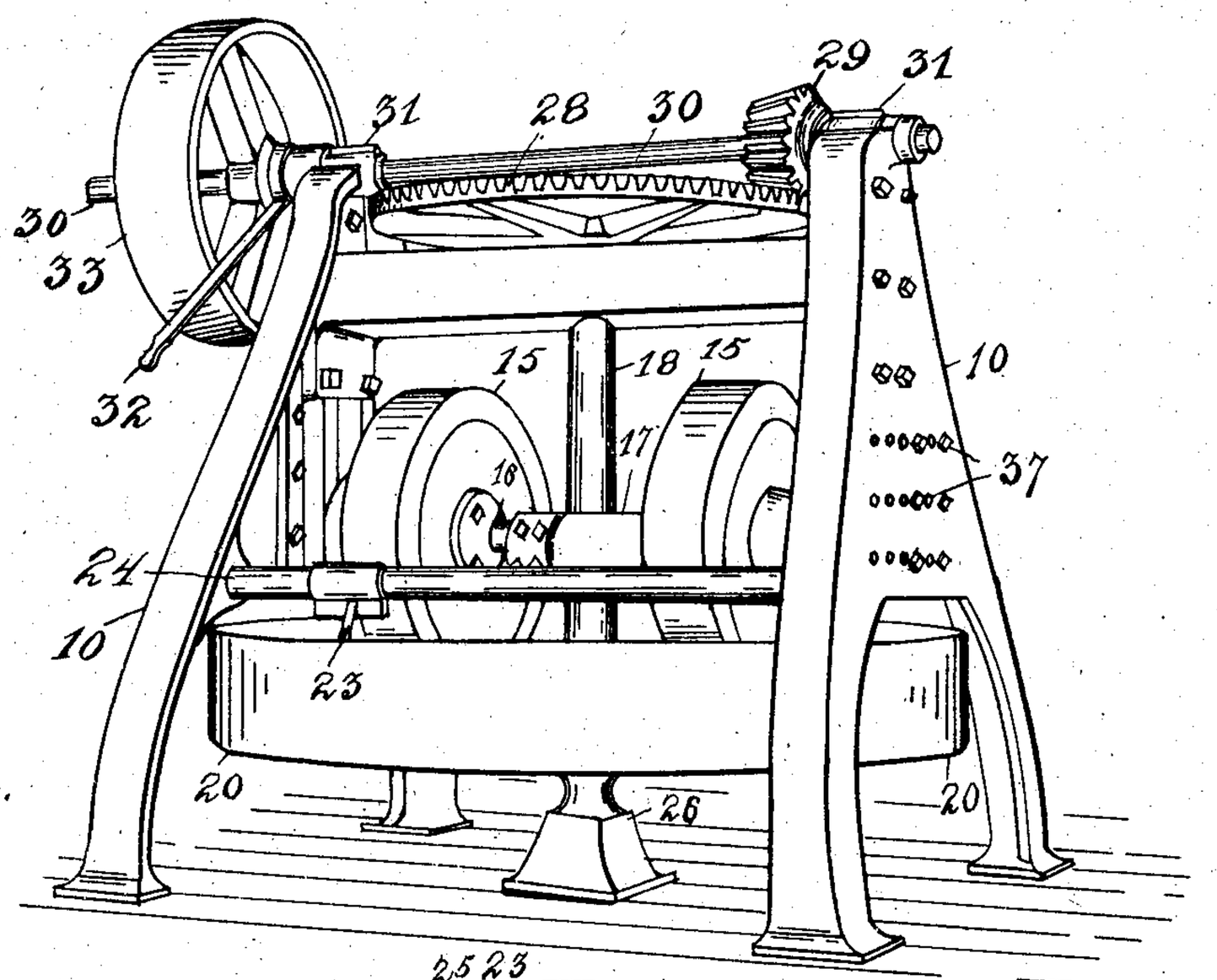
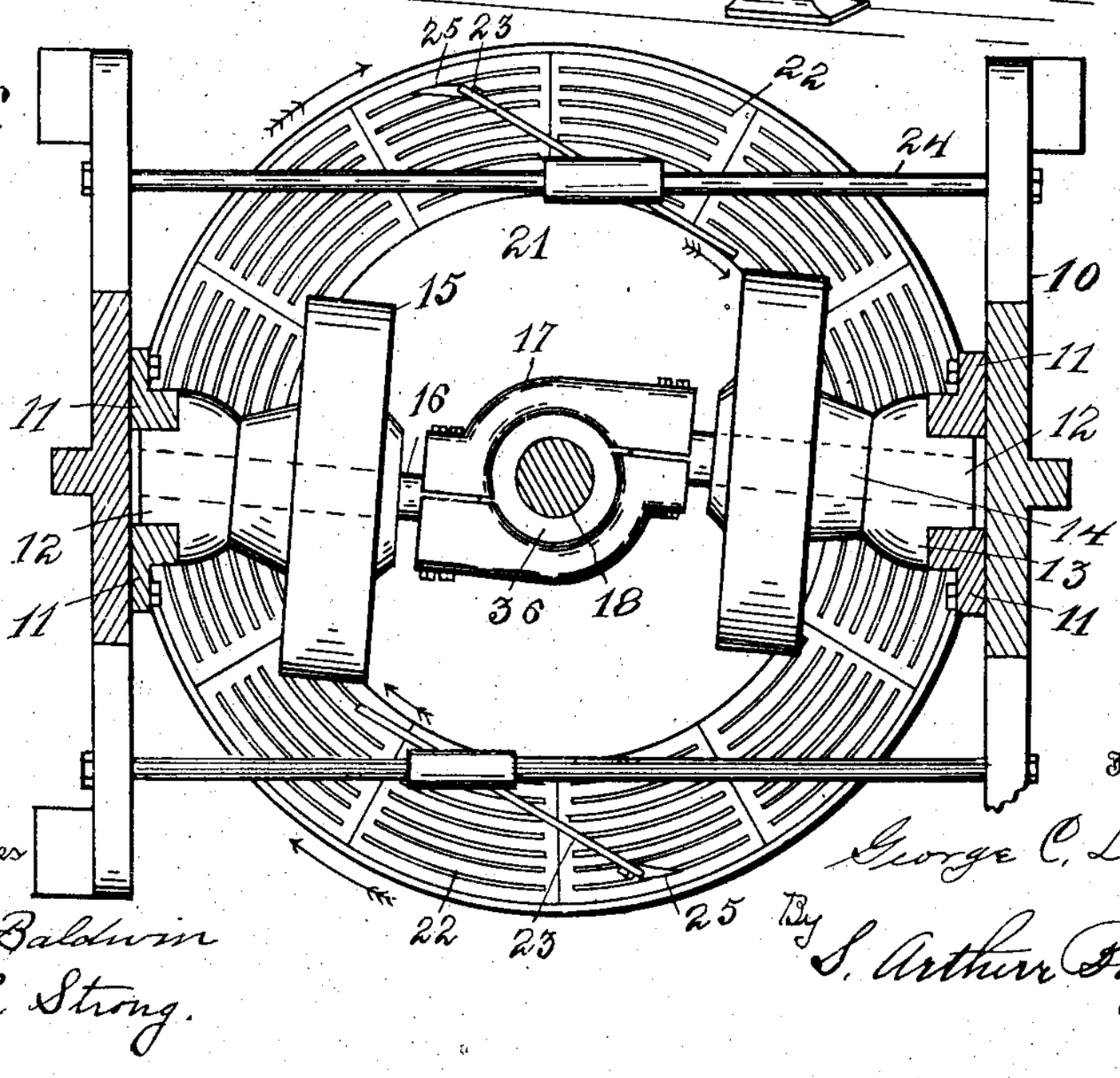


Fig. 6.



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3 SHEETS—SHEET 3.

Fig. 7.

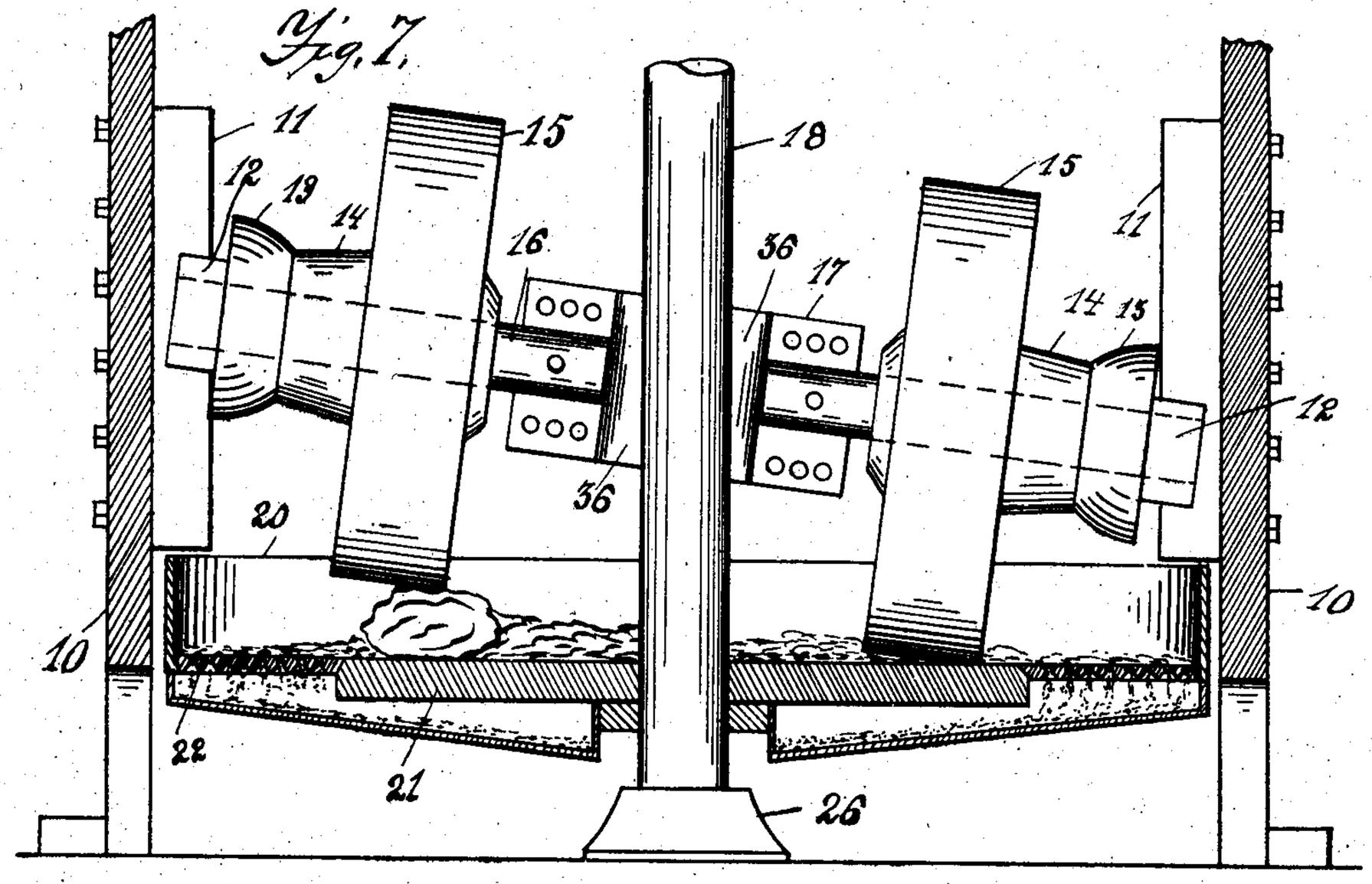
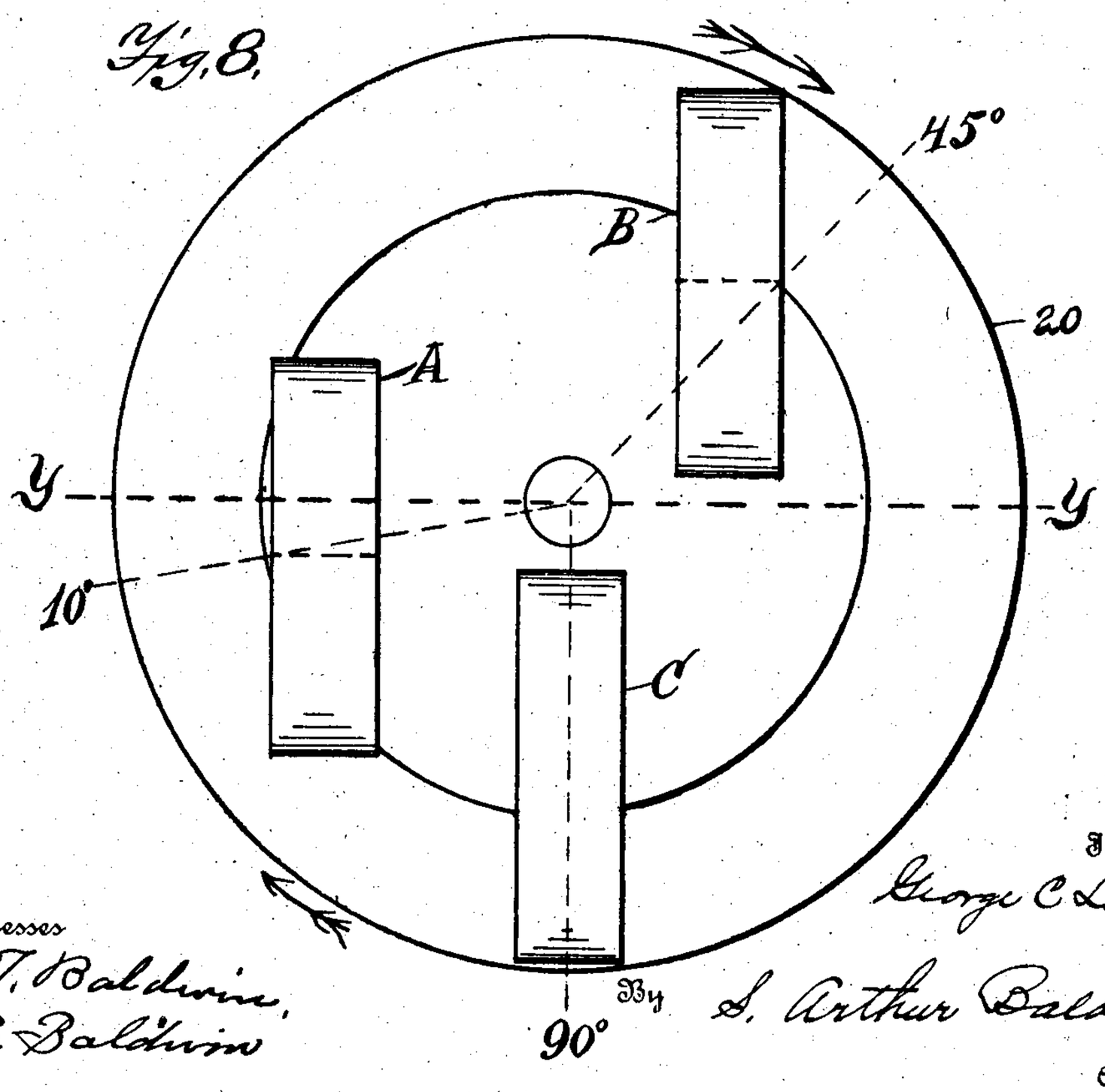


Fig. 8.



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UNITED STATES PATENT OFFICE.

GEORGE C. LITTLE, OF JAMESTOWN, NEW YORK.

MILL FOR CRUSHING AND GRINDING.

No. 834,387. Specification of Letters Patent. Patented Oct. 30, 1906.

Application filed December 19, 1904. Serial No. 237,354.

To all whom it may concern:

Be it known that I, GEORGE C. LITTLE, a citizen of the United States, residing at Jamestown, in the county of Chautauqua and State of New York, have invented a new and useful Mill for Crushing and Grinding, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

My invention relates to millstones, particularly to the form of crushing-mill known as the "Chilian mill," which consists of a revolving pan and two heavy wheels or rollers mounted on a horizontal shaft. The wheels travel in the revolving pan, with scrapers to keep the material in the path of the wheels. This form of mill is often called a "dry" or "wet" pan, according to the condition of the material ground.

The object of my improvement is to form a combined crushing and grinding mill by providing an unyielding means for holding the angle of the axles of both of the wheels or rollers off the radius or tangent of the circle of their revolution in the pan, so that the pan will have a continuous outward slipping movement on the periphery of the wheels, and to provide heavy hubs, buffer-locks, and a frame to withstand the strong outward thrust consequent upon the macerating action or force of the outward or off angle movement of the rotating wheels on the pan. It is experimentally found that the amount of resistance on the working faces of the pan and wheels when the wheels are placed back of and off the radius of the pan in respect to direction of pan rotation is practically in proportion to the amount of execution or grinding efficiency of the mill, and my improved arrangement of the wheels not only doubles and trebles the capacity of the mill, according to the different materials to be ground, but also enables me to grind substances which the old form of mill could not grind. The unyielding nature of this construction, combined with the crushing and grinding movement, forms a macerating action which enables the mill to withstand the shock of large rocks and to pulverize the hardest substances, such as white flint, glass, vitrified brick, and the like.

In the drawings, Figure 1 is a plan view, partly in section, of the pan, wheels, and frame as I usually arrange them, the upper portion of the frame being cut away to reveal the improved arrangement of the wheels and their shaft. Fig. 2 is a sectional view of the central hub or clamp for the horizontal shaft or double axle at line X X in Fig. 1. Fig. 3 is a detail view of the squared outer end of the horizontal shaft and buffer, the latter being in section. Fig. 4 is a modification of the horizontal shaft or axle for the wheels without the central adjusting hub or clamp. Fig. 5 is a perspective view of the complete mill. Fig. 6 is a plan view of a modification of my improved placing of the wheels with the upper portion of the frame cut away, as in Fig. 1. Fig. 7 is a sectional view of the pan and frame and a side elevation of the grinding-wheels and shaft in an angular position caused by a large stone under one of the wheels. One of the parts of the central hub and the shim-blocks of one side are removed to show the opening in the center of the hub around the vertical shaft. Fig. 8 is a chart of the pan, showing the grinding-wheels at different degrees of angular displacement.

Similar characters refer to corresponding parts in the several views.

The numeral 10 indicates the frame, which is made with sufficient weight and strength to withstand the great outward strain of the macerating mill-wheels. Guide-pieces 11, of angle-iron, are bolted to the inner side of frame 10 in a vertical position to form vertical guides in which buffer-blocks 12 13 slide, the portion 12 of the blocks extending in between the guides 11 and the portion 13 bearing upon the edges of the guides. The part 12 does not extend to frame 10, and in consequence the guides 11 sustain the whole weight and wear of the outward strain on the buffer-blocks. This arrangement preserves the frame-piece 10 from wear, and the guide-pieces 11 are easily renewable whenever they become worn. The bearing of the buffer-blocks on the guides should be broad and strong, so as to withstand any amount of shock.

A horizontal shaft or axle 16 is slidably mounted in buffer-blocks 12 13 and held rigidly against turning by means of the squared end 19, as shown in Fig. 3, and the square openings for square ends 19 provided in part 12 of the blocks 12.13. Grinding and crushing wheels 15 are revolubly and slidably mounted on shaft or axle 16 next to the buffer-blocks 13, the hubs 14 of wheels 15 being made large and strong to withstand the wear as they bear against block 13. In order to

obtain the rearward placing of the wheels from the radius, a central divergence or bend is necessary in shaft 16. This might be obtained by a bend as shown in Fig. 4; but I preferably make the shaft 16 in two parts and connect the inner ends by a central yoke or clamp 17, which extends with an open space 36 around the vertical shaft 18 in order to allow for the raising of either end of the shaft and yet preserve a stiff shaft which will not bend or spring between the two wheels which are mounted thereon.

A pan 20 is mounted on a vertical shaft 18 and revolved thereby and has an inner disk-shaped portion 21, which is formed of heavy renewable plates made of hardened metal, upon which the heavy grinding-wheels 15 bear. For a dry or semidry pan a grating or screen portion 22 is arranged around central portion 21, over which the material is thrown by centrifugal force, and through this screen it drops when sufficiently pulverized, and from which it is carried away by suitable conveyers. Wet pans are used for preparing plastic material, and in their construction the screen-plates 22 are dispensed with. My improvement is equally applicable to dry or wet pans. Scrapers 23, supported on cross-rods 24, serve to keep the material in the path of the wheels 15. Scrapers 23 have points 25 at their outer ends to scrape the material from the inner side of the upturned edge of pan 20, as the material is caused to adhere to the said edge by the centrifugal force of the rapidly-revolved pan. Pan 20 is supported on shaft 18, and shaft 18 is revolubly stepped in a base 26 at its lower end and has its upper end supported in a cross-beam 27 of the frame 10 and supports on its upper end the large bevel-gear 28, which meshes in a gear 29 on driving-shaft 30, which is revolubly mounted in suitable boxes 31 on frame 10. The revolution of shaft 30 is controlled by means of lever 32, which operates a friction-pulley 33 to stop and start.

In the ordinary tangential arrangement of the grinding-wheels there is very little slip or macerating movement, whereas in the non-radial location the pan slips on all parts of the periphery of the wheels, more or less, dependent upon the degree of angular displacement of the wheel-axes and pan radius. The word "slip" as above used means to move in continuous contact without rolling, the pan slipping on the periphery of the wheels. The non-radial placing of the wheels in the pan causes a combined slipping and rolling movement between the two. The wheels turn on their shaft as the friction of the revolving pan is applied to them, and the pan, because of the displacement of the wheels, slips or is drawn beneath the surface of the heavy off-placed wheels. Thus in Fig. 8, with the wheel A having its axis on the ten-degree line behind radius Y Y, the pan turning in the direction shown by the arrows will slip about one-tenth of the circumference of the wheel. With the wheel B having its axis at the forty-five-degree point behind radius Y Y the pan will slip one-half and the wheel will rotate one-half of said circumference. The limiting position is given by wheel C in its right-angle position to radius Y Y on the ninety-degree line, in which position the wheel would not turn on its axis at all, but the pan would simply drag under the stationary wheel. It is immaterial how wheel C reaches the limiting position on the ninety-degree line, whether through one quadrant or the other or forward or backward in respect to the direction of pan rotation. The result is the same, and the wheel will drag.

It is obvious that a rotatable wheel driven by the friction of a revolving pan will have an outward throw at any point between that of wheel C on the ninety-degree line and radius Y Y in the quadrant in which wheel A is placed and that as the line Y Y is passed from said quadrant the wheel will have an opposite or inward throw at any point until the other ninety-degree line is reached. Thus, for example, in Fig. 1 the axes of the wheels 15 are shown by the points B B and the radius of the pan by the line C C through the vertical axis A. The wheels 15 therefore are in the rearward quadrants as to radius C C, and hence have an outward motion with the pan revolving in the direction shown by the arrows. Should the wheels 15, however, be placed forward of line C in respect to direction of pan rotation, said wheels would have an inward tendency, and the crushing and macerating action would be largely destroyed. The wheels would run much easier and would hug the inner washer on the shaft, thus needing no provision for outward thrust, as in my placing of the wheels. This inward movement seems to equalize the run of the wheels, and they have almost no macerating slip. The rearward placing with outward throw is necessary in order to obtain this positive slip. I vary this rearward placing of shaft 16 at the inner end by means of shim-blocks 34 and on the outer end by the corresponding sidewise shifting of the sliding-ways 11 by means of suitable bolt-holes 37 in frame 10. Shim-blocks 34 are made with a semicircular opening and extension 35 on opposite sides to fit the inner faces of the parts 17 of the central yoke, so as to clamp shaft 16 therein and at the same time hold the shim-blocks in place. It is apparent that hub or clamp 17 can be enlarged to any desired degree, the opening 36 around vertical shaft 18 being changed from a circular to an elliptical form by the insertion of the shim-blocks.

In order to crush and grind large pieces of rock and like material, the stiff unbendable mounting of the single horizontal shaft 16 17

for both wheels is a necessity. The quartering blow of large pieces of rock upon the angularly-displaced wheel and the impetus given by the rapidly-revolving pan are so great that any resiliency or spring in the mounting of shaft 16 17 for wheels 15 would throw them out onto the light screen-plates 22, as will readily be appreciated by a glance at Fig. 7, wherein the rock has thrown the wheel high in the air, and if the wheel did not have the heavy buffer-block 13 to strike against, guide-pieces 11, and heavy central yoke 17 to withstand the shock and hold the wheels parallel, the bottom of the wheel would be thrown out onto the screen-plate, breaking the same. By the unyielding heavy central yoke, on which a heavy breaking strain falls, the wheel is given a firm tension. The buffer-blocks hold the wheels steadily and firmly to their work of maceration, and the wheel comes down onto the central disk 21 with added crushing force by being held firmly to its work. It strikes the plate not only with a downward blow, but with a side slip from the pan that is irresistible. The shaft of wheel 15 must be unyielding as against this strain, however, and the wheel must not wabble or give in any way as it strikes the rock, as shown in Fig. 7, and it is experimentally found that this macerating shock breaks the hardest flint cobble-stones and other like substances, grinding them to powder. It is also found that the provision of short individual shafts with separate mounting for each wheel produces a construction which it is impossible to control by any known mechanism as against such a blow. It must be borne in mind that my mill is for both crushing and grinding. My arrangement forces the heavy wheels to perform both offices. When it is understood that these grinding-wheels 15 weigh from one to ten tons each, the great importance of my unyielding yoke and shaft construction will be appreciated.

In operating the mill the pan 20 is turned by means of vertical shaft 18, gears 28 and 29, shaft 30, and pulley 33, as above described. The revolution of the pan with the friction of the material to be ground causes the rotation of wheels 15 on shafts 16 as they bear upon it. It is experimentally found, however, that with my improved placing of wheels 15 a reduced amount even of coarse material can be worked in the pan, thereby running easier than the old way and pulverizing the material much more rapidly, since the grinding-surface of the wheels 15 and bed 21 are in closer contact and have also the added macerating movement, which crushes, as above stated, with great rapidity large objects, as well as small, and pulverizes all to a powdered form. Instead of wearing the periphery of the wheels 15 into all manner of irregular indentations by means of the rotating contact with the rough materials to be ground, as in the old form of mill, I find that with my improved arrangement the outer surface of the wheels are kept smooth. Crosswise scratches on the wheels from one to three inches in length are noted over the entire surface, illustrating the rubbing pressure which the heavy wheels exert upon the material to pulverize it. This smoothness of the periphery of the wheels adds greatly to their pulverizing power, since the pan and wheels are brought more closely and uniformly in contact.

It is apparent that the two parts of the horizontal shaft 16 are parallel to the same diametral line, as C C in Fig. 1, of the pan and to each other, though placed in the staggered arrangement. In the modification shown in Fig. 4 this parallel arrangement of shafts 16 shows that though the parts are changed somewhat to allow for the angular placing of the shafts, yet the shafts themselves are vertically parallel and if a rhomboidal form of frame were provided the arrangement would be exactly the same as in Fig. 1. In order, however, to adapt the angular placing of shafts 16 to the square form of frame 10, the openings in buffer-blocks 13 are made at the desired angle and the faces of buffers 13 next to the hubs 14 are made at corresponding angles, so that the wheels 15 are turned at an off angle the same as they would be if placed forward of the radius of the circle of revolution, as shown in Fig. 1. The modification shown in Fig. 4 would attain my purpose, but is not as well balanced as clamp 17.

I claim as new—

1. In a machine for crushing and grinding, a suitable pan and means for turning the same, vertical ways above said pan, a single horizontal shaft having its ends slidably mounted in said ways, a pair of vertical mill-wheels revolubly and slidably mounted on said shaft to the rear of and off the radius of said pan in respect to its direction of rotation, and unyielding buffer-blocks outside of said wheels to resist the outward pressure of said off-placed wheels.

2. In a machine for crushing and grinding, a suitable pan and means for turning the same, vertical ways above said pan, a horizontal shaft having a central divergence therein and its ends slidably mounted in said ways, vertical mill-wheels revolubly mounted on said shaft to the rear of and off the radius of said pan in respect to its direction of rotation by said divergence, and unyielding buffer-blocks on said shaft to resist the outward pressure of said off-placed wheels.

3. In a mill for crushing and grinding, a frame, a pan in said frame on a vertical shaft and means for turning the same, vertical ways on said frame above said pan, buffer-blocks slidably mounted on said ways, a hori-

zontal shaft rigidly mounted in said blocks to prevent turning, vertical mill-wheels revolubly mounted on said shaft to bear against said blocks, and a central divergence in said horizontal shaft placing its ends behind and off the radius of said pan with respect to its direction of rotation.

4. In a mill for crushing and grinding, a frame, a pan in said frame on a vertical shaft and means for turning the same, a horizontal shaft above said pan composed of parts having their outer ends supported on said frame with freedom of vertical movement, a clamping-yoke for the inner ends of said parts, said parts of shaft mounted respectively behind and off the radius of said pan with respect to its direction of rotation, vertical mill-wheels revolubly mounted on said parts of shaft, and unyielding means for controlling the resulting outward motion of the wheels.

5. In a mill for crushing and grinding, a frame, a pan in said frame on a vertical shaft and means for turning the same, adjustable vertical ways on the opposite inner sides of said frame, buffer-blocks slidably mounted in said ways, a rigid horizontal shaft composed of two parts mounted at the outer ends in said blocks to prevent turning, a clamping-yoke having divergent openings on opposite sides for the inner ends of said parts and arranged to receive spreading shim-blocks, and vertical mill-wheels revolubly mounted on said parts of shaft to the rear of and off the radius of said pan in respect to its direction of rotation and bearing against said blocks, substantially as and for the purpose specified.

6. In a mill for crushing and grinding, a frame 10, a pan 20 revolubly mounted on shaft 18 in said frame and means for turning the same, adjustable vertical ways 11 on the opposite inner sides of said frame, buffer-blocks 13 slidably bearing on and in said ways, an unyielding horizontal shaft composed of parts having their outer ends mounted in said blocks to prevent turning and a divergent clamping-yoke 17 for the inner ends of said parts of shaft, an opening 36 for shaft 18 in yoke 17, shim-blocks 34 to spread the parts of yokes 17, and vertical mill-wheels 15 revolubly mounted on shaft 16 to the rear of and off the radius of their rotation in said pan in respect to its direction of rotation and bearing against said blocks, substantially as and for the purpose specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GEORGE C. LITTLE.

Witnesses:
A. L. FURLOW,
S. A. BALDWIN.