E. H. CALLAWAY.

PULVERIZING OR GRINDING MILL.

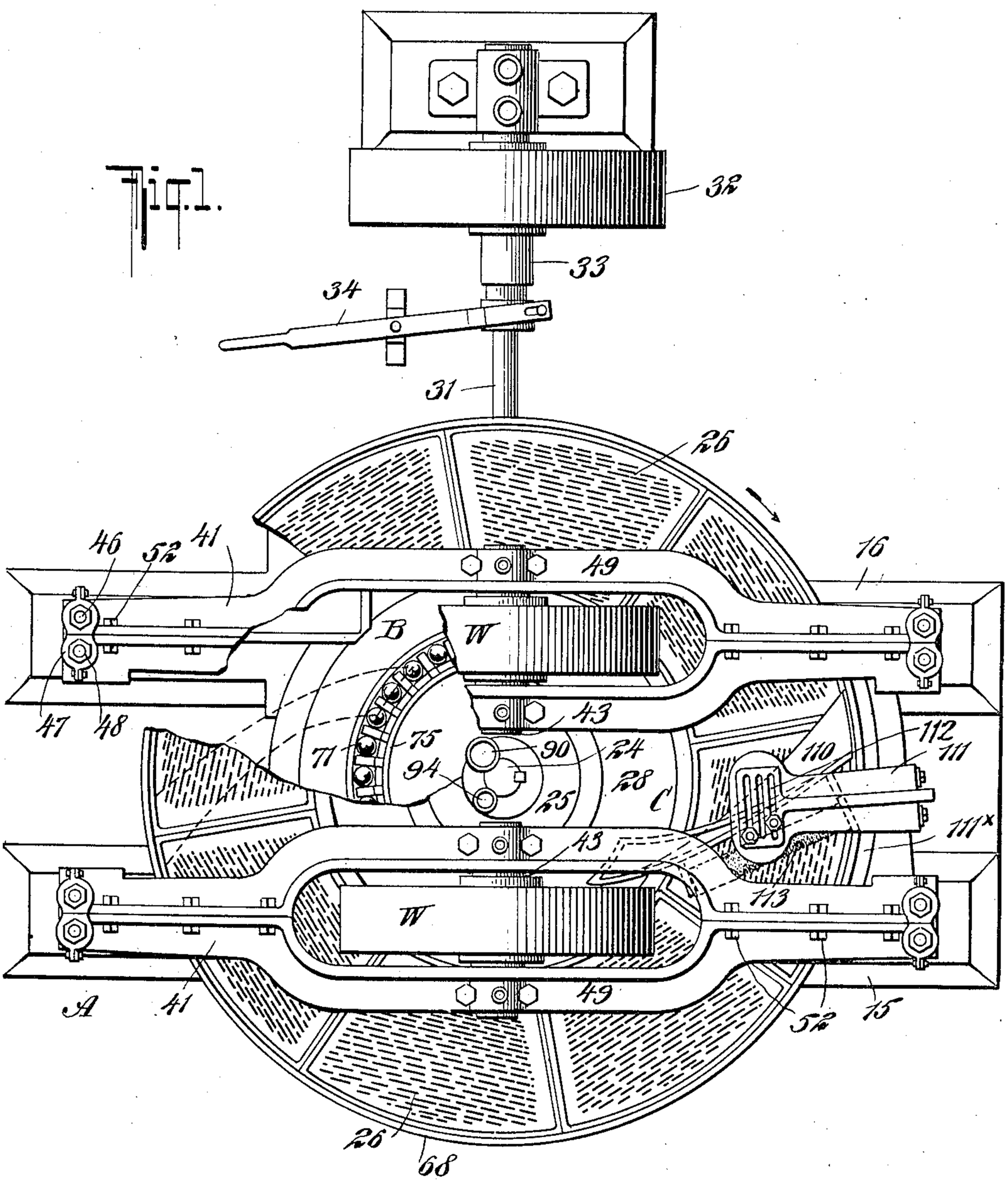
APPLICATION FILED MAR. 18, 1907.

944,073.

Patented Dec. 21, 1909.

6 SHEETS—SHEET 1.

Fig. 1.



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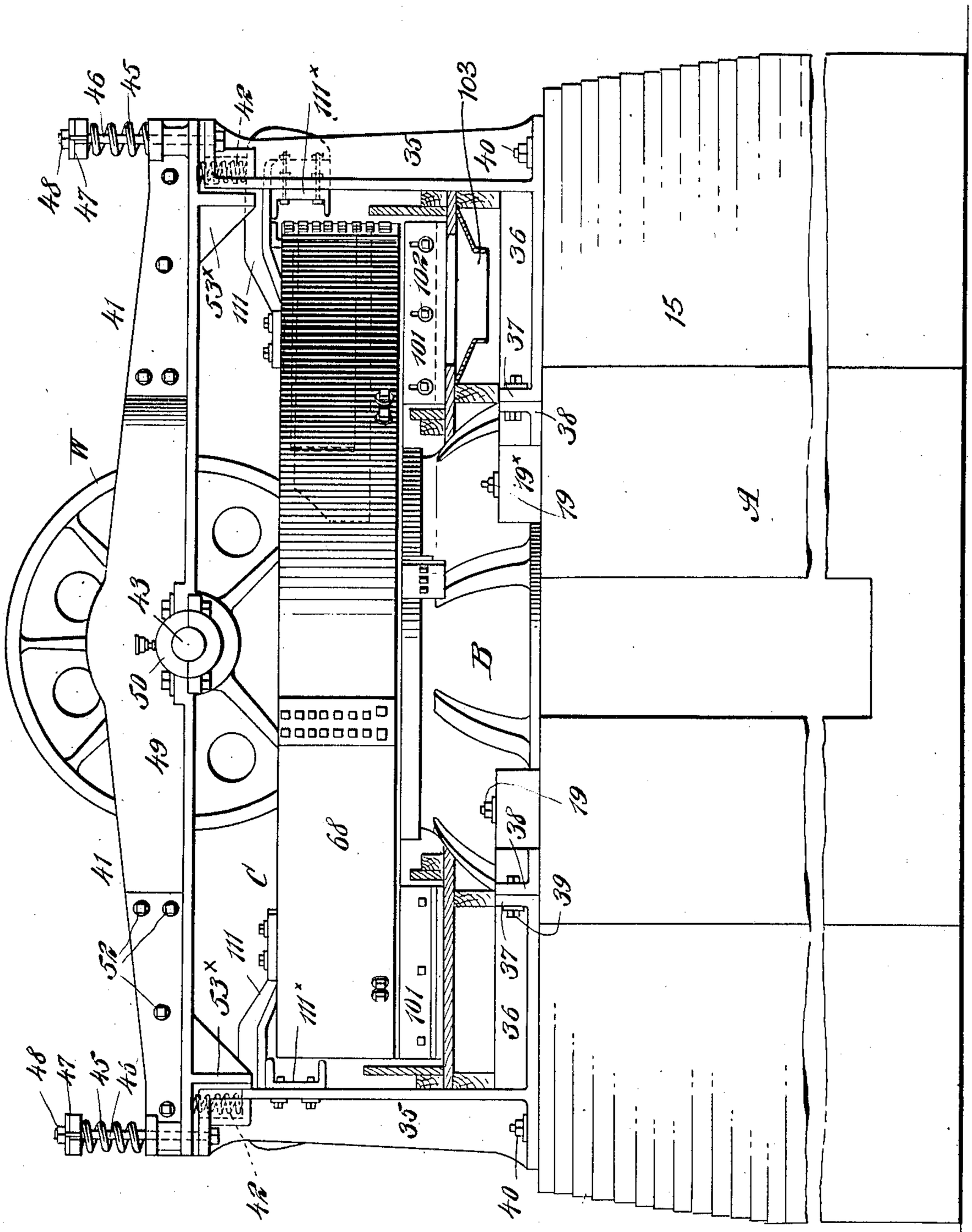
6 SHEETS—SHEET 2.



WITNESSES

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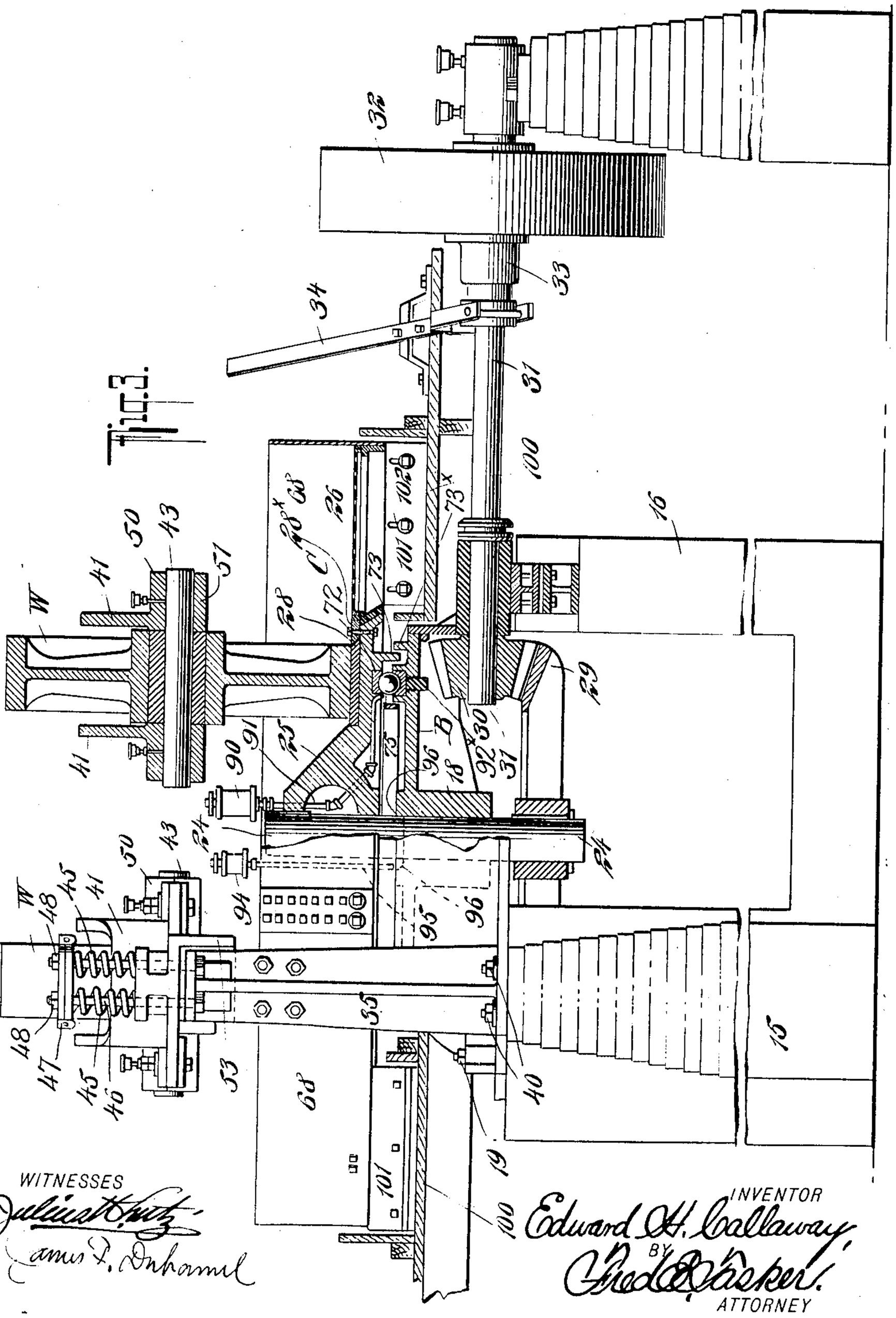
6 SHEETS—SHEET 3.

Fig. 3.



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6 SHEETS—SHEET 4.

Fig. 4.

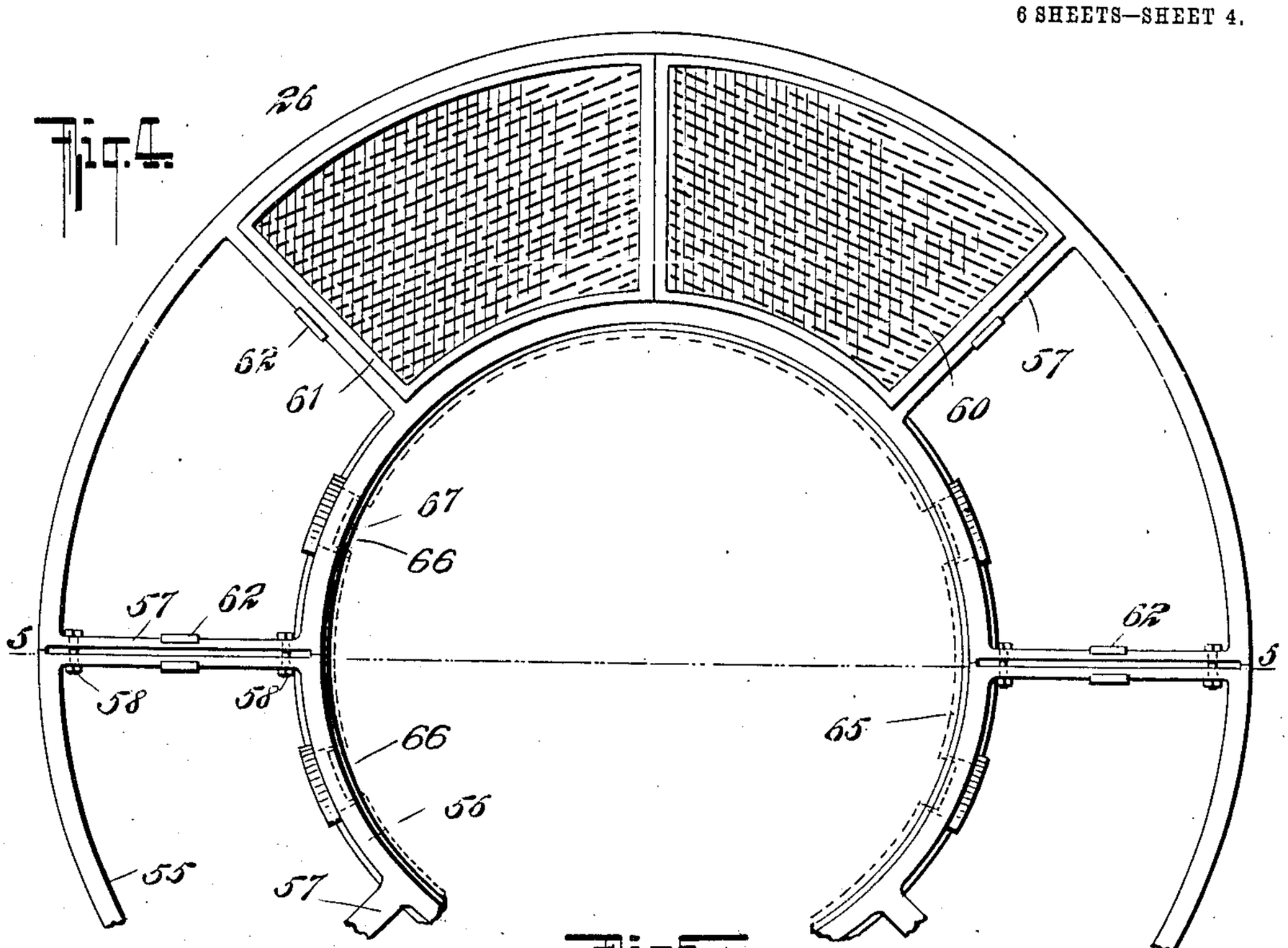


Fig. 5.

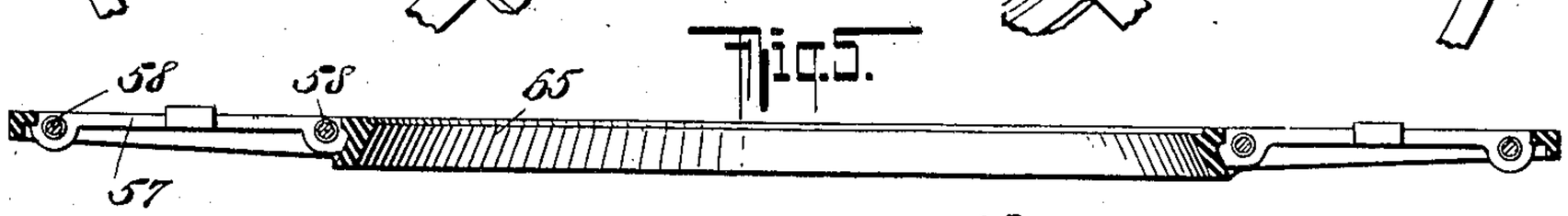


Fig. 6.

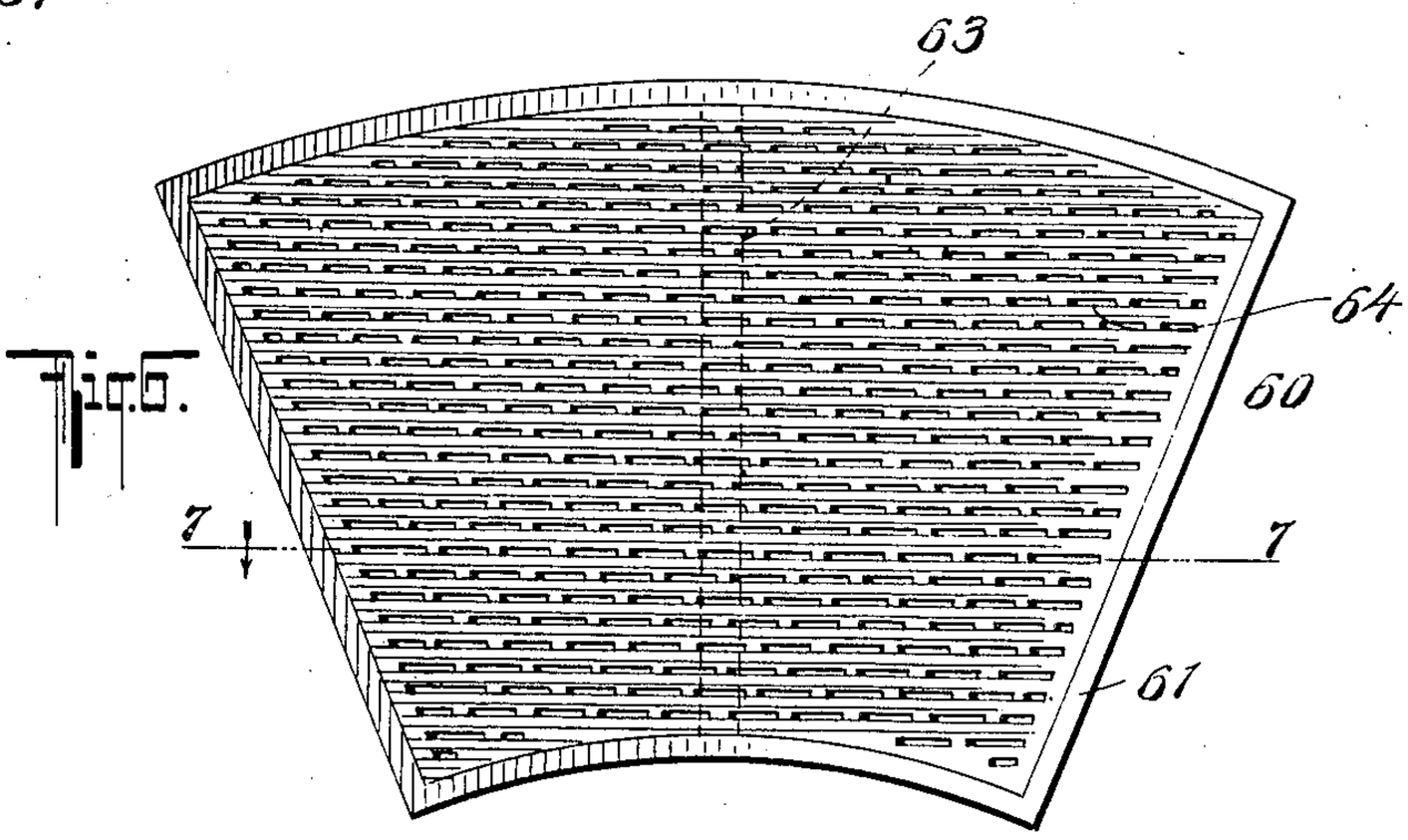
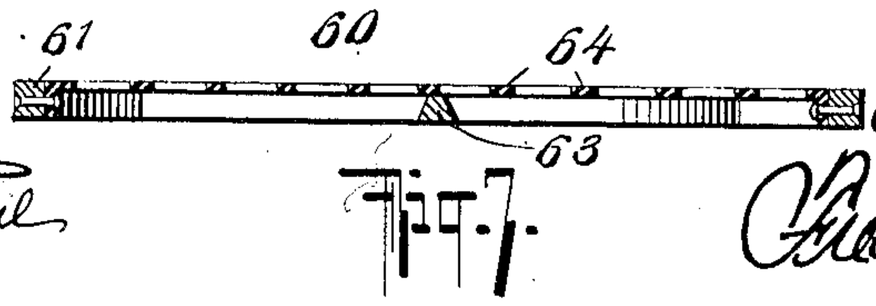


Fig. 7.



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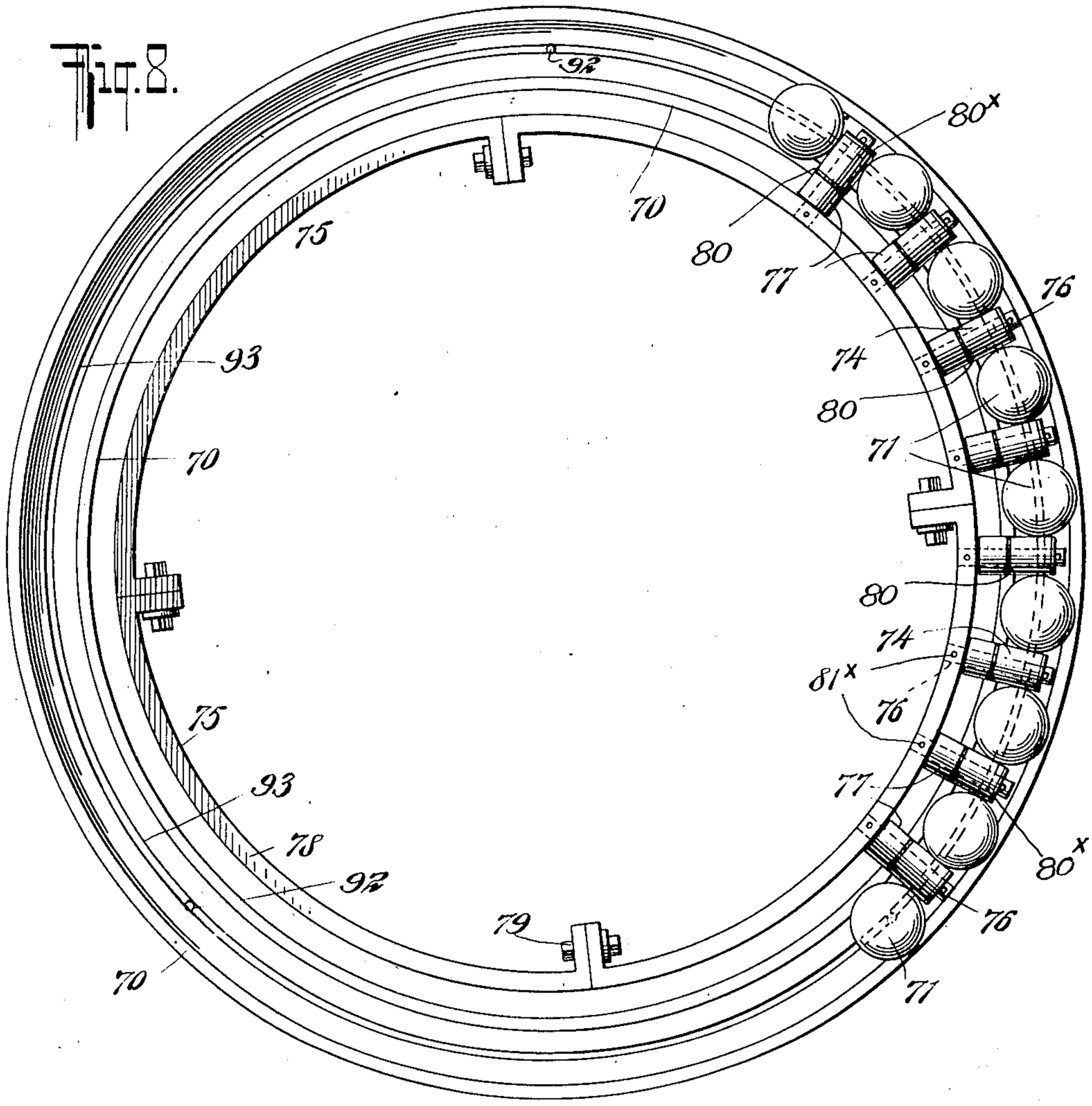
944,073.

Patented Dec. 21, 1909.

6 SHEETS—SHEET 5.

Fig. 8.



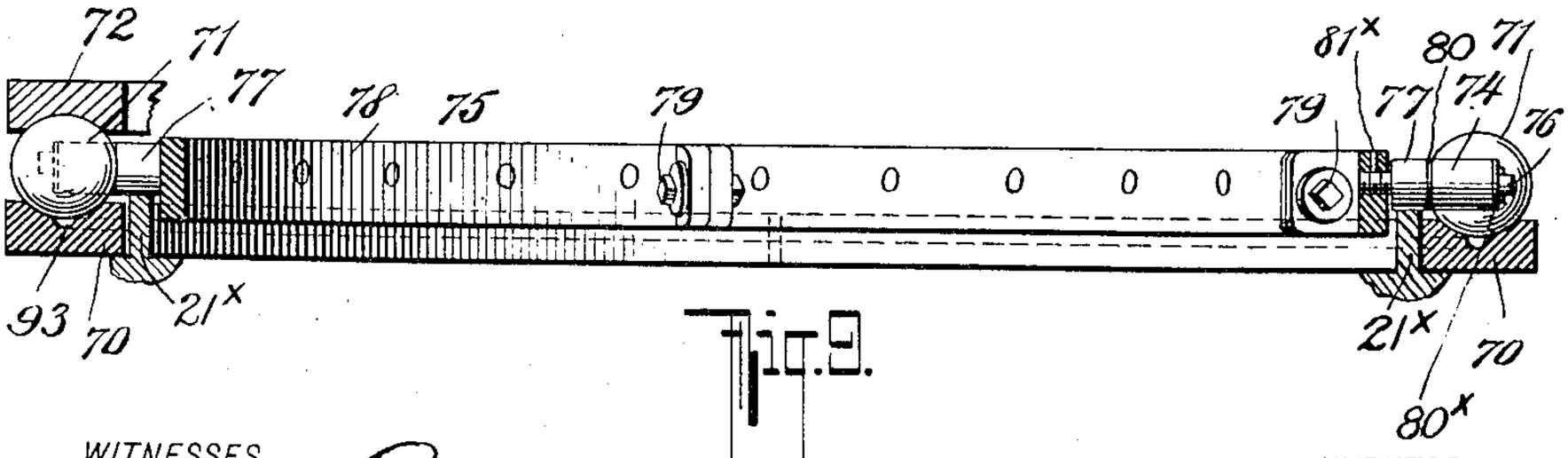


Fig. 9.

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944,073.

Patented Dec. 21, 1909.

6 SHEETS—SHEET 6.

Fig. 10.

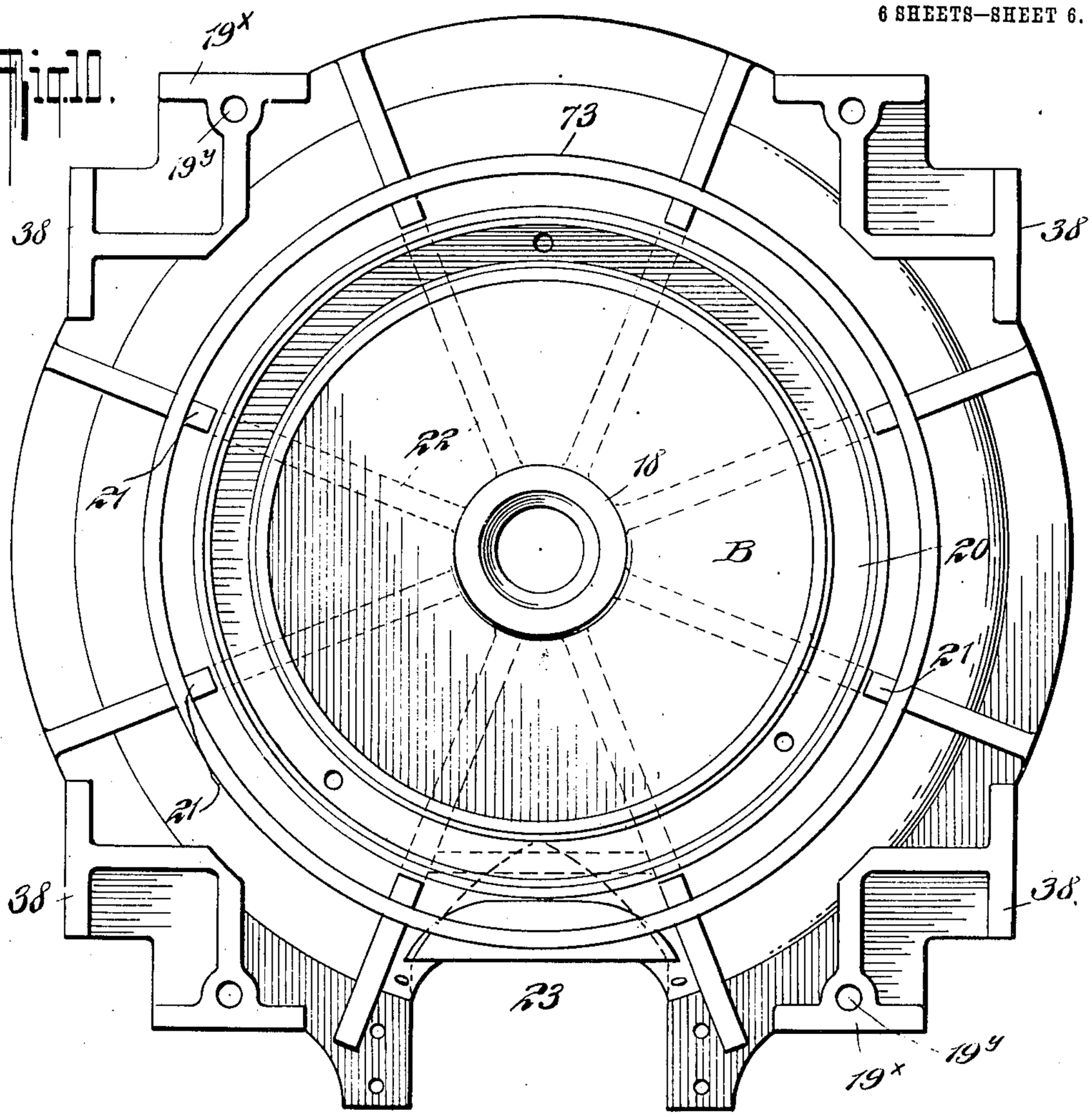
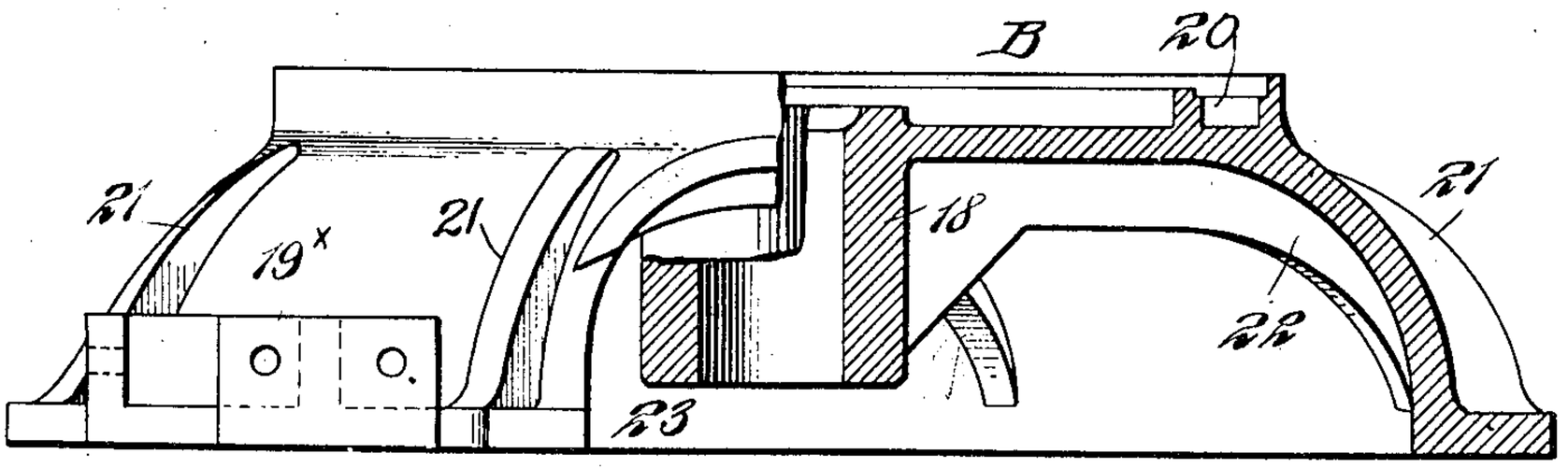


Fig. 11.



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UNITED STATES PATENT OFFICE.

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PULVERIZING OR GRINDING MILL.

944,073. Specification of Letters Patent. Patented Dec. 21, 1909.

Application filed March 18, 1907. Serial No. 362,835.

To all whom it may concern:

Be it known that I, EDWARD H. CALLAWAY, a citizen of the United States of America, and a resident of Westfield, county of Union, State of New Jersey, have invented certain new and useful Improvements in Pulverizing or Grinding Mills, of which the following is a specification.

This invention relates to grinding or pulverizing mills, and particularly to mills of this description such as are used to pulverize or grind clay and similar substances and employed in brick-making and kindred arts.

The invention has among its objects to provide a mill in which the use of heavy and cumbersome grinding rolls, or mullers, acting merely by gravity on the substance to be ground, is done away with, and the same result attained by lighter means.

A further object of the invention is to furnish a construction in which the pressure between the opposing grinding surfaces may be regulated as desired and in an improved manner.

The invention also contemplates the provision of an improved arrangement of the grinding surfaces whereby the clay or other material may be readily supplied to said grinding surfaces, and in which this material is screened immediately after having been supplied to said surfaces, the material which is ground sufficiently then passing through the screen or sieve while that which is still too coarse is returned to the grinding surfaces and ground until it will pass through the screen.

The invention also aims to furnish a construction in which the pan carries one of the bearing surfaces and is rotated in order to grind the material, this rotation also producing automatically the screening of the ground material.

Further objects of the invention are to provide an improved form of rotary pan; to mount such pan in an improved manner; to provide simple and efficiently operating means for returning the lumpy or coarse clay or other material, from the screen-portion of the pan to its grinding surface; to furnish means for keeping the openings of the screen clear; and to provide means for discharging the ground material from beneath the sieve.

With these ends in view, the invention consists in the novel features of construction and combinations of parts to be hereinafter described and then recited in the claims.

In the accompanying drawings, Figure 1 is a top-plan view, partially broken away, of a grinding or pulverizing mill constructed in accordance with the invention, Fig. 2 is a side elevation, partly in section, Fig. 3 is an end elevation, partly in section, Fig. 4 is an enlarged plan of the outer screen portion of the pan, with parts removed, Fig. 5 is a section on line 5—5, of Fig. 4, Fig. 6 is an enlarged plan view of one of the sections of the screening surface, Fig. 7 is a section on line 7—7, Fig. 6, Fig. 8 is an enlarged view of the bearing for the pan, Fig. 9 is a transverse section of Fig. 8, Fig. 10 is a top-plan view of the base in which the pan-carrying shaft is journaled, and Fig. 11 is a side elevation, partly in section, of Fig. 10.

Iu the drawings A denotes the masonry bed for the mill, which comprises, for example, upright parallel walls 15 and 16, upon which is seated a cap-shaped base B of cast metal. See Fig. 11. Said base is provided with a central vertical shaft-bearing 18, as shown in Figs. 3, 10 and 11, and at its corners with upright flanges 19^x having bolt holes 19^y by which it is bolted to the bed by means of bolts 19. The base B is further provided upon its upper surface with an annular groove 20, the function of which will appear later, and with radial reinforcing ribs 21 extending outwardly therefrom. Radial reinforcing ribs 22 are also formed upon the under surface of the base and extend to the central bearing 18. One side of the base is provided with an opening 23, to accommodate the drive shaft and gearing.

Rotatable in the bearing 18 of the base B is an upright shaft 24 which has keyed thereto at its upper end a rotary pan C mounted to rotate on the base. Said pan is of circular shape and comprises a central imperforate web 25, preferably of cast metal, which is so fixed to the shaft 24 that the latter is held in its vertical position; and an outer screen-portion 26, the particular construction of which will be hereinafter described. At the outer upper portion of the web 25 there is provided a shallow, relatively wide, annular groove or seat in which is seated a wide flat plate or ring 28 of hard metal, which forms the wearing plate or one of the grinding surfaces, as will later appear, said plate be-

ing preferably a segmental ring of a suitable number of segments, say, eight for example. The pan C is rotated by means of a large bevel-gear 29 keyed to the upright shaft 24 beneath the base B and which engages a small bevel-gear 30 mounted on the end of a horizontal driving-shaft 31 journaled in the masonry bed and extending through the opening 23 in the side of the base. Upon the driving-shaft 31 a pulley 32 is mounted, whereby the shaft may be rotated by a belt driven from a suitable source of power, this pulley being clutched and unclutched from the driving shaft by means of a clutch 33 operated by a lever 34. However, the particular manner in which the driving shaft is rotated and controlled is not an essential part of the invention. The wearing plate 28 is preferably beveled on one edge and is held in place in its seat by means of a beveled ring 28× which is secured alongside of it in the seat by means of bolts fastened to the web 25.

Mounted on the walls 15, 16 at the corners of the base B and extending upwardly beside the pan C, are four standards 35, preferably constructed of T-shaped cross-section. These standards are provided at their lower ends with laterally-extending portions 36, also preferably T-shaped in cross-section, which rest by their flat faces on the masonry and are provided at their ends with upright flanges 37 whereby they are bolted to corresponding flanges 38 at the corners of the base B by means of bolts 39, as shown in Fig. 2. Each standard is bolted to the masonry by means of bolts 40 passing through the base-web at opposite sides of the outwardly extending flange of the upright portion. Beams 41 connect the members of each pair of standards 35 that are mounted on the same masonry wall. Said beams rest above the upper ends of the standards by means of cushioning springs 42 arranged in sockets at the upper ends of the standards and each has journaled therein at its intermediate or middle portion a grinding wheel, or muller, W, bearing on the wearing plate 28 of the pan C. These wheels differ greatly from ordinary mullers as now commonly used in this art inasmuch as they are relatively very light in weight and have comparatively narrow grinding surfaces. Furthermore, their grinding surfaces do not cooperate with each other, but with the wearing plate or ring of the pan, said surfaces of the mullers which are formed by the outer flanges, or rings, being of substantially the same width as said grinding ring. The two wheels bear against said ring at diametrically opposite points, as shown.

The heavy weight of the mullers now in use has been thought essential to secure the requisite pulverizing or grinding action; but I secure as good and better results by the use of the light-weight mullers which are carried by heavy beams 41 whose weight is aided and augmented by the springs bearing thereon as will now be explained. The proper functioning of the mill when such very light grinding elements are employed, is produced by means of strong helical follower springs, by which the pressure between the grinding surfaces may be readily adjusted as required. These springs, denoted by reference character 45, act directly on the supporting beams 41 for the mullers, there being preferably four springs for each beam, two at each end. Each spring is mounted on a stem or rod 46 extending upwardly from the upper end of the corresponding standard through the beam and interposed between the latter and collars 47 loose on the two stems at each end of said beam. The compression of each spring is adjusted by means of a nut 48 threaded on the stem at its upper end. In this manner the springs are caused to force the beams downwardly, overcoming the resistance of the cushioning springs 42, thus forcing the inullers W against the grinding surface of the pan with the required degree of pressure. By the arrangement described this pressure may be made very great and is equalized or equipoised to exert the same amount of leverage on both ends of each beam, the muller axles serving as a fulcrum therefor.

It is apparent that the standards 35 must be of such height that when the grinding wheels are pressed against the rotary horizontal grinding surface of the pan, the beams do not contact directly with the upper ends of the standards.

The beams 41 may be constructed in a variety of ways, and in one or more pieces; but in the example illustrated in the drawing, each beam 41 is made in two longitudinal sections of angular cross-section, each of which is bulged laterally at its intermediate portion, as indicated at 49, to accommodate the corresponding grinding wheel or muller W, the shaft 43 of which is journaled between the said sections in a bearing 50 carried by said bulged portions at their lower parts. The removable parts 51 of each bearing are disposed at the under surface of the beam and may be readily unbolted, whereby the wheel may be easily removed and replaced, it being merely necessary to remove the said lower part of the bearing. The upright flanges of the beam-sections are bolted together throughout the distance from the bulged portions to their ends by means of bolts 52, and the lower horizontal flanges of the sections meet to form a bearing surface to rest on the cushioning springs 42. Angular depending brackets 53 formed integral with the beam-sections adjacent their ends slide on the in-

ner faces of the standards 35 and guide each beam vertically, meanwhile imparting greater rigidity to the construction.

The beams or beam-sections 41 are also provided with integral angular brackets or depending brackets 53^x which are at right-angles to the angular brackets 53, and are in contact with the opposing faces of the members of each pair of standards 35, as shown in Fig. 2, said angular brackets 53^x having the function of keeping said standards 35 properly spaced apart, as shown. It is to be furthermore noted in this connection that the standards 35 are connected together by horizontal cross-bars 111^x, which will be hereinafter referred to and which carry the scrapers. In this way, by means of the beams 41 which are provided with the brackets 53 and 53^x, and also by means of the cross-bars 111^x all arranged in combination with the standards 35, a very solid, compact and rigid arrangement is provided.

The particular construction of the pan C will now be described. As before stated, said pan comprises a central web portion 25 which is keyed to the shaft 24, and an outer screen-portion 26. Said portion comprises a circular main frame having an outer rim 55 and an inner rim 56 and radial connecting strips 57 between said rims, as shown in Figs. 4 and 5. Said frame is divided diametrically into two parts which are bolted together by bolts 58 passing through the adjacent strips 57 of the two parts.

Set over each part of the frame defined between the inner and outer rims and two adjacent cross-strips 57 is a screen-section 60, one of which is clearly shown in detail in Figs. 6 and 7. These sections are divided from each other radially of the pan and are formed of frames 61, the straight side edges of which meet over the strips 57. Said frames are removably positioned on the pan frame by means of lugs 62 formed on the strips 57, as shown in Figs. 4 and 5, said lugs engaging in seats or recesses in the frames 61. Extending across the small section-frames 61 are cross-strips 63, and set in the former and supported on said cross-strips are screen-sheets 64, preferably made of perforated sheet-metal, as shown. These sheets or plates are provided with downwardly turned edges riveted or otherwise suitably secured to the section frames 61, as shown in Fig. 7, the upper surface of said plates lying flush with those of said frames. The cross-strips 63 support the plates 64 at their middle part and prevent their bending or buckling under ordinary conditions. The screen-portion 26 of the pan is detachably secured to the web 25 by means of a ring 65 applied to the under surface of the inner rim 56 of the main screen frame. Said ring 65 is beveled, as shown in Fig. 5, and fits over the correspondingly beveled periphery of the web 25, as shown in Fig. 3. Said frame is freely movable vertically with respect to said web, but these parts are locked together in horizontal direction, so that the former will be rotated with the latter, by means of lugs 66 on the web entering recesses 67 of said ring 65, or other complemental means for preventing relative movement angularly of the pan-shaft 18.

By the arrangement described the screen-portion of the pan may be readily placed on and removed from the supporting web. Inasmuch as the main screen frame and the screening surface are divided into sections, repairs can be easily and economically made. The parts may also be very readily assembled and the pan made very light. The pan is provided at its edge with an upright rim 68 by which the material is confined. This rim is preferably constructed of sections bolted together and secured to the outer rim of the main screen frame, as shown.

The upper surface of the screen portion 26 is engaged by fixed scrapers 110 carried by brackets 111 detachably fixed to horizontal cross-bars 111^x connecting the upright standards 35. These scrapers are curved and disposed obliquely to the radius of the pan C and cause the material to be pushed inwardly toward the grinding surface and under the muller W. The brackets 111 are provided at their inner ends with a series of transverse slots 112 by which the scrapers may be adjustably bolted thereto. Rotary brushes 113 of wire, wood, or other suitable material have their bristles engaging the openings or perforations in the screen-sections, whereby said openings are kept clear. By the movement of the pan these brushes are caused to rotate, as will be understood. These brushes 113 are supported in any suitable manner, as for instance by arms loosely connected to the scrapers, as shown in dotted lines in Fig. 1. In this rotation of the pan, the scrapers act on the coarse material, and the brushes on the fine material, and the brushes also clean the surface of the screen sections, and prevent the openings therein from becoming clogged up with the clay or other material.

The arrangement of the pan, by which it is rotatably mounted on the base B, will now be described. As previously mentioned, the base is provided upon its upper surface with an annular groove 20. This groove is formed by two upstanding flanges and there is placed in this groove a ball-raceway 70 in which run a plurality of balls 71, as shown in Figs. 8 and 9. An annular raceway 72 carried by the web 25 at its under portion and near its outer edge runs on the balls 71. A depending annular flange 73 formed on the under surface of said web coöperates with the outer flange of the groove 20 preventing the entrance of dust and the like to

the ball-bearing thus formed. There is also another rib 73× between which and the outer flange of groove 20 is formed a groove securing the flange 73, which groove is filled with oil or water or other fluid so that dust cannot pass through it.

Interposed between the balls 71 are anti-friction rollers 74 carried by a ring 75 by means of radially extending spindles 76 on which said rollers rotate. Said ring also carries on said spindles 76 narrow anti-friction rollers 77 which roll on the inner flange 21× of the groove 20, as shown in Figs. 8 and 9, whereby said ring is freely and rotatably supported. The ring is preferably made in sections 78 bolted together by bolts 79. Between the rollers 74 and 77 on the same spindle are interposed washers 80. The rollers are removably held on their spindles by means of cotter-pins 81, there being washers 80× interposed between the ends of the rollers and the cotter-pins.

By the provision of the rollers between the balls, the friction is greatly reduced, as the balls do not bear directly against each other and as they rotate in the same direction. The rollers 74 of course rotate in the opposite direction. The ring 75 travels freely on the flange 21× of the base by means of its rollers 76. The ends of the spindles 76 are screwed into the ring 75, as shown, and are held therein and prevented from working loose by means of dowel pins 81×. This feature of the ball and roller bearing combination is one of the important features of the present invention.

Lubricant is fed to the balls and their raceways from a lubricant-cup 90 mounted on the web 25 of the pan and connected with a pipe 91 which discharges the lubricant on the balls, as shown in Fig. 3. The groove 20 for the lower raceway is provided with orifices 92 by which the lubricant can be drained off when desired. Plugs 92× are screwed or otherwise secured in small openings in the web which communicate with the groove 20 which receives oil through holes 92 from the narrow channel 93 in the bottom of the raceway, as shown in Figs. 8 and 9. Thus the lower raceway is removable for the plugs 92× may be screwed up against it enough to lift it from its seat in the groove 20 and enable it to be grasped by the hand, this being done in taking the ball bearing apart. The bearing 18 of the base is also lubricated from a cup carried by the web 25. 94 denotes said cup, which is connected with a small pipe or duct 95 leading to a groove 96 in the upper part of said bearing, as shown in Fig. 3.

Beneath the pan there is provided a trough 100 which is circular and extends beneath the screen portion 26, being concentric therewith. The trough receives the ground material from the screen. Scrapers 101 adjustably secured to the pan by slot and bolt connections 102 extend downwardly into engagement with the bottom of the trough and cause the ground material to be moved out of the same, also preventing the material from clogging on the trough bottom. The trough is provided with a discharge 103 from which the ground material is received.

The stationary bed plate B rests upon a casing of brick or other masonry, as indicated in Figs. 2 and 3, A denoting the same, which I have heretofore referred to as being a bed having walls on which the machinery rests. This casing incloses the gearing and keeps it free from dust and other things which might clog its free working. Said casing has an opening, as indicated in Fig. 2, through which the drive shaft passes. The shape of the casing may vary being either round, hexagonal, octagonal, or any polygonal form. It is found that a dust-proof casing of this kind for the operating gearing is of great value.

It is further to be noted that an important feature of my construction consists in locating the ball or other bearing on which the pan rotates directly beneath the grinding surface of the mullers. Reference to Fig. 3 will indicate that the mullers and the ball bearing on which the pan rotates are vertically in line with each other. There is obviously a great strain upon the wearing-plate of the pan, and if there were no bearing beneath to take this strain and counteract it, there would of course be a severe torsional strain brought to bear upon the pan and its central drive shaft. This feature, of course, is not restricted to any particular form of bearing beneath the rotary pan, and as to this part of the invention, therefore, the bearing may be a ball or rotary bearing, or any other kind of a bearing, it being only essential that it should be located under the pan beneath the point where the mullers exert their grinding action upon said pan.

The operation of the mill is as follows: By means of the transmission mechanism described, horizontal rotary motion, in the direction of the arrow in Fig. 1, is imparted to the pan C, and the springs 45 having been properly adjusted to give the required pressure, the material to be ground is thrown into the said pan C. That part of the material which is already sufficiently fine will pass through the screen-plates into the trough, while the lumpy or coarse part will be forced by the scrapers 110 on to the wearing-plate 28 where it is crushed by passing under the mullers W, traveling in contact with said plate and acted on by the springs 45. The rotation of the pan causes the material which has thus been ground to be thrown to the outer screen portion of the pan by centrifugal force, and this produces the screening off of the material which is

sufficiently fine. The lumpy or coarse material is returned to the grinding surfaces by the stationary scrapers. Thus by the movement of the pan an intermittent movement of the material between the grinding and screening surfaces in both directions is obtained and complete grinding to the required degree of fineness insured. During the rotation of the pan, the perforations of the screening surface are kept open by the rotary brushes, which act on the fine material. The scrapers 101 operate to deliver the ground material from the trough 100.

The clay or other material may be easily fed to the rotating pan, and the mullers act on a large amount of material during a given time. These advantageous results are obtained and at the same time the construction of the mill is rendered less cumbersome by doing away with heavy grinding rolls. Further, the combination of the grinding and screening surfaces in the manner described is of great advantage as by it the screening is effected by the rotation of the grinding surface and a simple construction provided by which the complete grinding and screening of the material is produced in one operation. And likewise great ease of motion is secured by the use of the ball-bearing I have described, whereby the power needed to drive the machine is greatly reduced.

Many changes and variations may be made without departing from my invention.

Having thus described my invention, I claim:

1. In a grinding mill, a horizontally rotating web having an upper grinding surface, upright beam-supports upon the outside of said rotary web, a horizontal beam bridging and extending beyond said web and surface and connected to rise and fall at both ends in relation to said supports, guides at the opposite ends of the beam, said beam having a central oblong loop, a grinding wheel journaled to said beam and revolving in said loop, follower springs at the opposite ends of the beam for forcing it downwardly, and cushioning springs for the beam.

2. In a grinding mill, a rotary grinding element, supports parallel to the axis of said element, a beam bridging said element and having a central oblong loop from which its opposite ends extend to overlap and be supported by said supports, a centrally disposed grinding element fixed to turn within the loop on an axle mounted on and crosswise of said beam, downward forcing springs at the opposite ends of said beam, and weaker cushioning springs interposed between the beams and their supports.

3. The combination with a rotary grinding web and the means for rotating it, of the upright standards arranged in pairs, of beams bridging said web and provided with suitable bearings, one of which beams being supported by each pair of standards, angular means on the beams engaging opposing faces on the standards, other angular means on the beams engaging other faces on the standards, and grinding wheels journaled in the said beams.

4. In a grinding mill the combination with the base and the rotary pan having cooperating raceways, of balls running in said raceways, a freely rotatable ring, and rollers rotatably mounted on said ring and interposed between adjacent balls.

5. In a grinding mill the combination with the fixed base and rotary pan having coöperating raceways, of balls running in said raceways, a ring carrying radial spindles, rollers mounted on said spindles and interposed between the balls, and means for guiding and sustaining the ring.

6. In a grinding mill the combination with the fixed base having a ball-raceway and an annular flange adpacent thereto, of the rotary pan having a raceway to coöperate with the first, balls running in said raceways, and a ring carrying anti-friction devices interposed between the balls, said ring traveling on said flange of the base.

7. In a grinding mill, the combination with the fixed base having a ball-raceway and an annular flange adjacent thereto, of the rotary pan having a raceway to coöperate with the first, balls running in said raceways, a ring having radially-disposed spindles, rollers mounted on said spindles and interposed between the balls, and rollers likewise mounted on said spindles and traveling on said flange of the base.

8. In a grinding mill, the combination with a drive shaft and means for actuating it, of a pan comprising a central web secured to said shaft, an outer screen portion consisting of an annular outer frame set on said web and locked against independent angular movement, said frame embodying inner and outer rims and radial connecting strips between said rims, and said frame being divided diametrically into two parts removably connected together, screen sections set in said frame, said sections being divided from each other radially of the pan, and means on the radial strips engaging seats or recesses in the screen sections for connecting the parts together.

Signed at New York city, this 9th day of March 1907.

EDWARD H. CALLAWAY.

Witnesses:

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