(No Model.) 6 Sheets—Sheet 1.

C. E. SEYMOUR.

CENTRIFUGAL MULLER MILL.

No. 589,036. Patented Aug. 31, 1897.

Fig. 1.

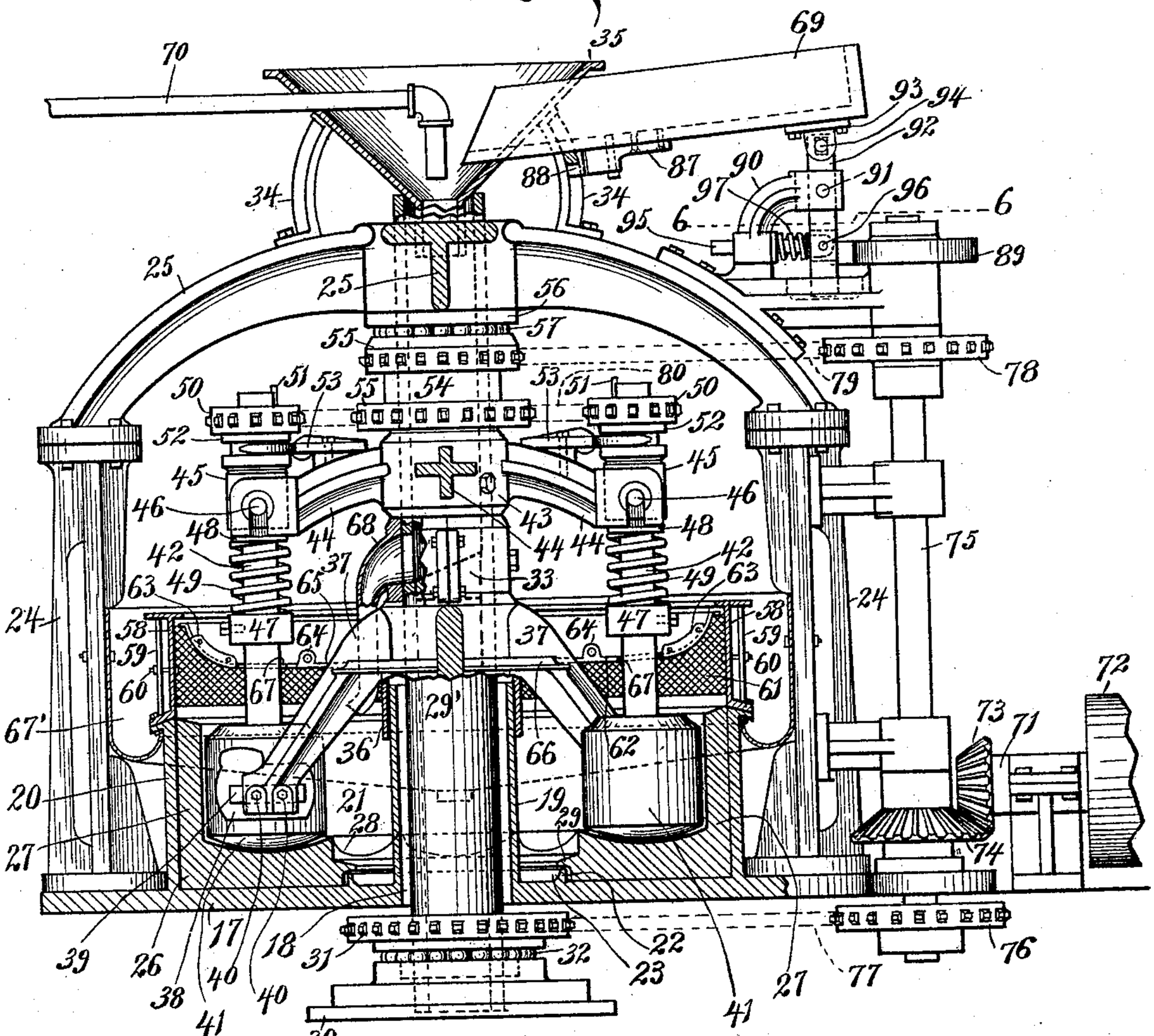
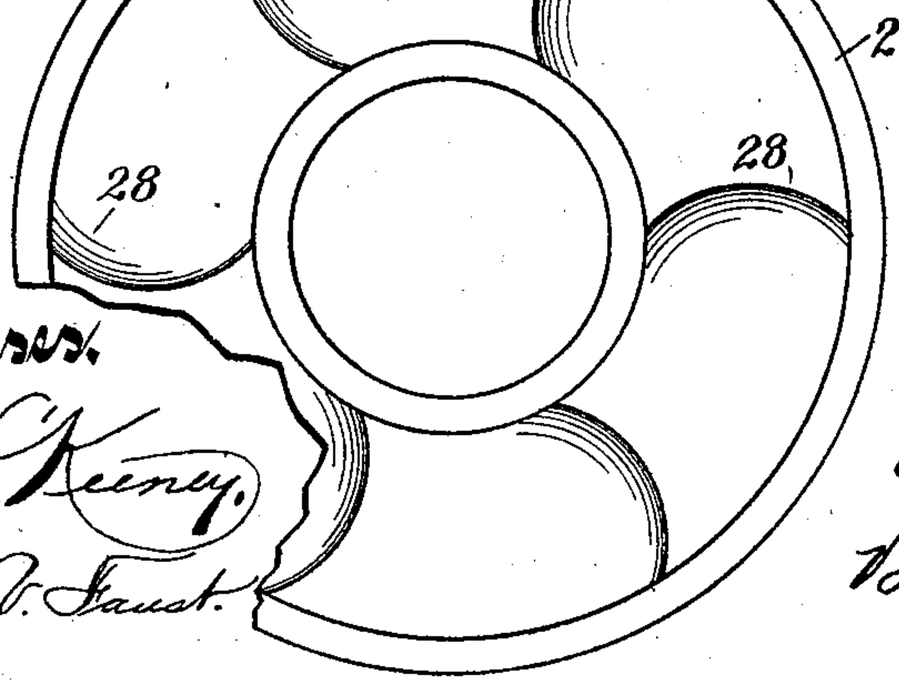


Fig. 3.



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CENTRIFUGAL MULLER MILL.

No. 589,036. Patented Aug. 31, 1897.

Fig. 2.

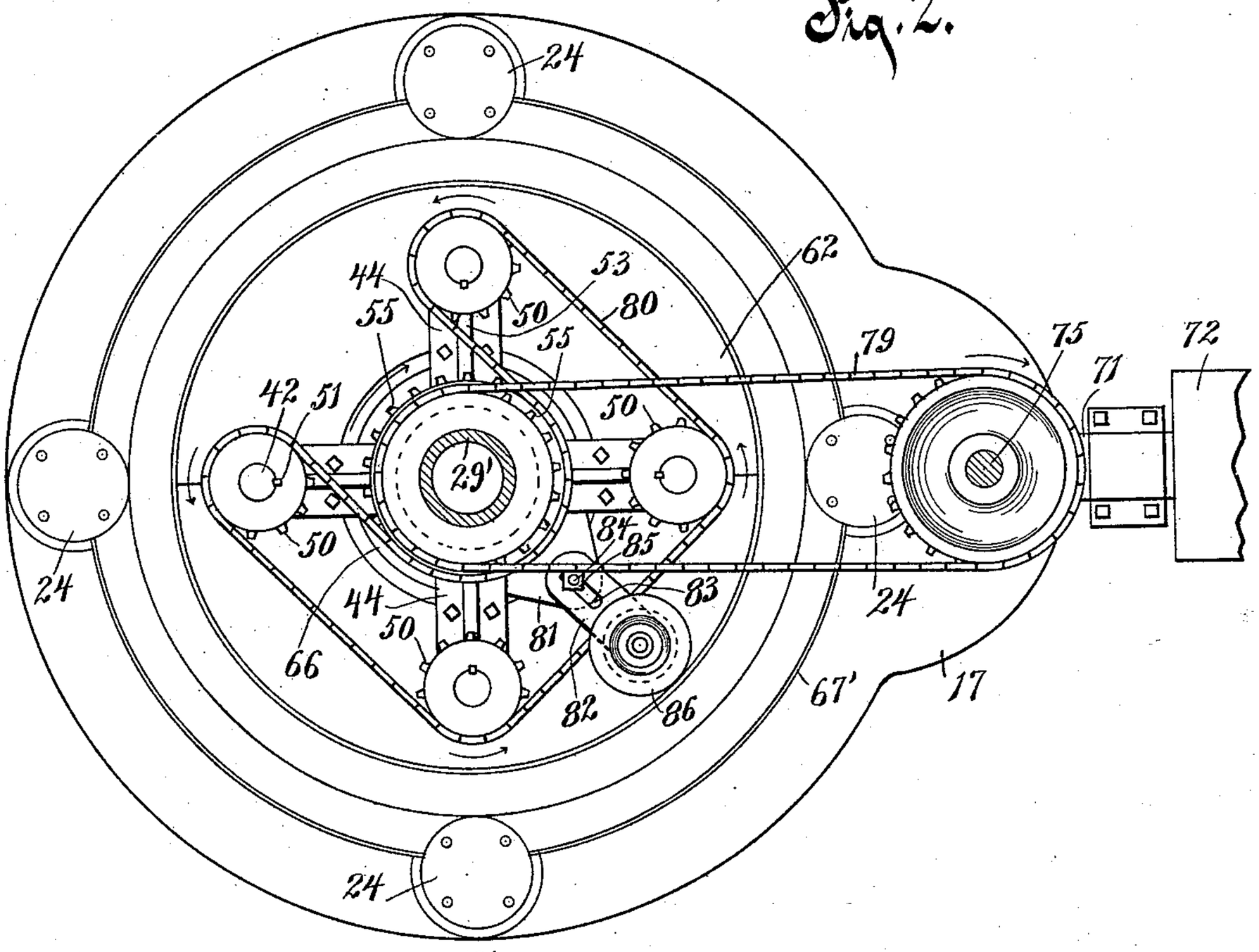


Fig. 5.

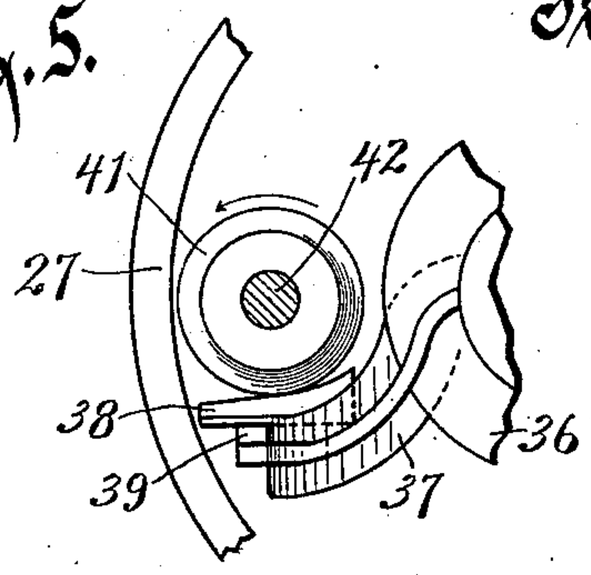


Fig. 4.

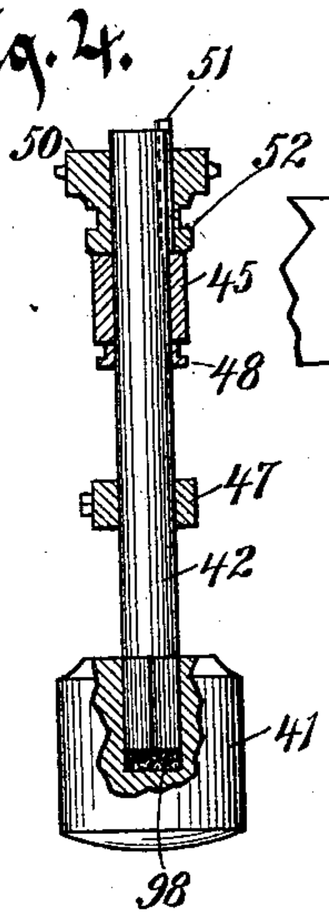
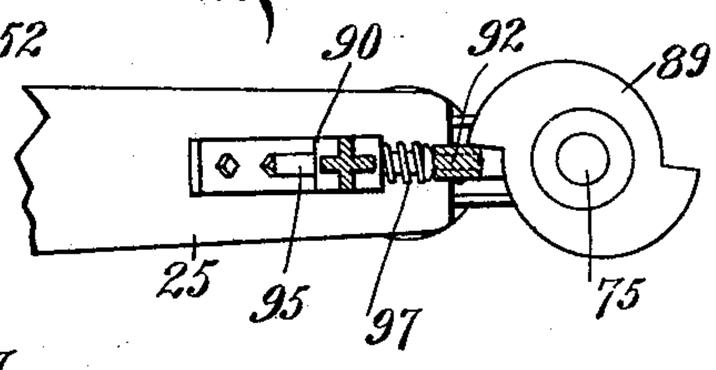


Fig. 6.



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CENTRIFUGAL MULLER MILL.

No. 589,036. Patented Aug. 31, 1897.

Fig. 7.

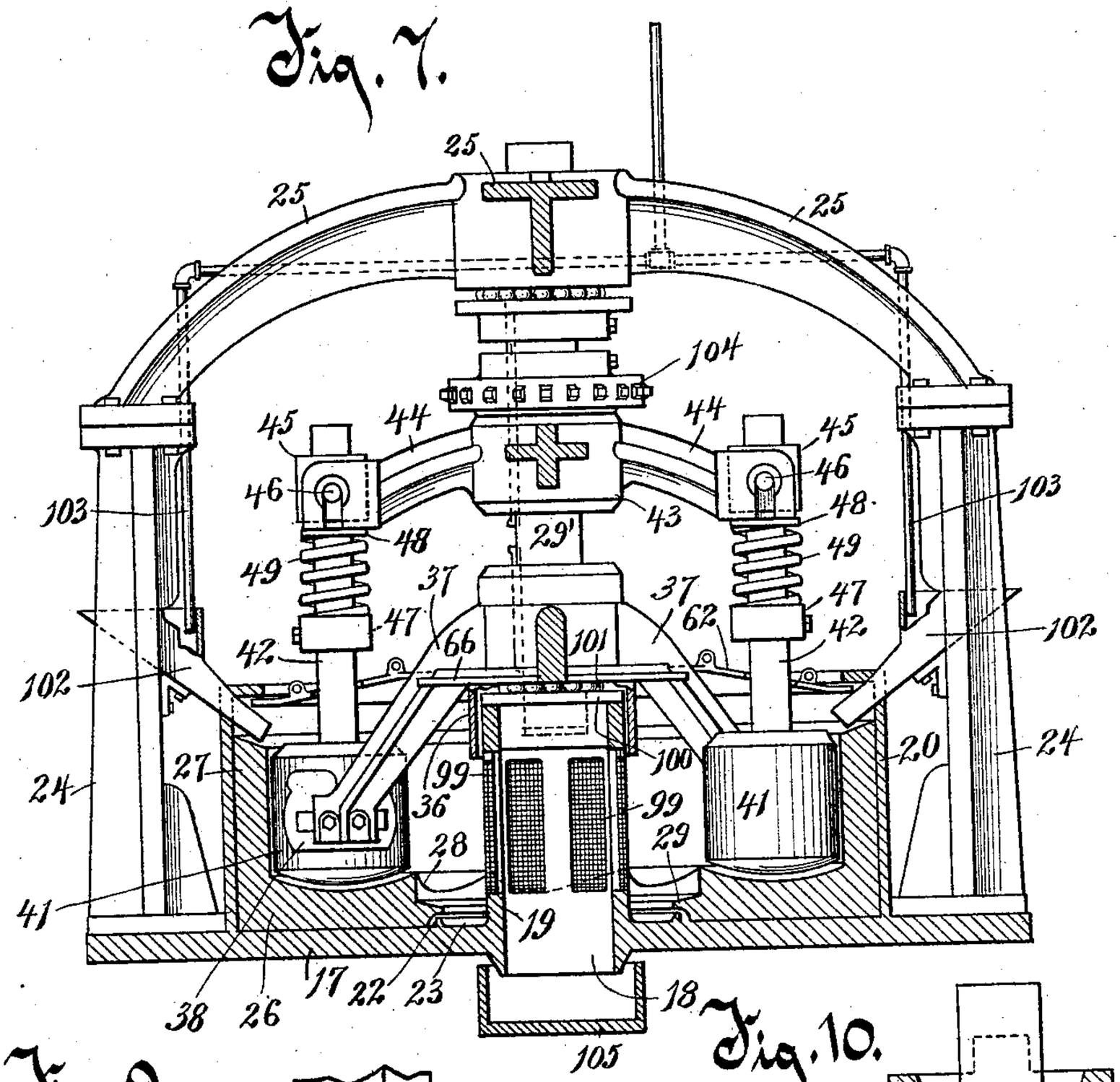


Fig. 9.

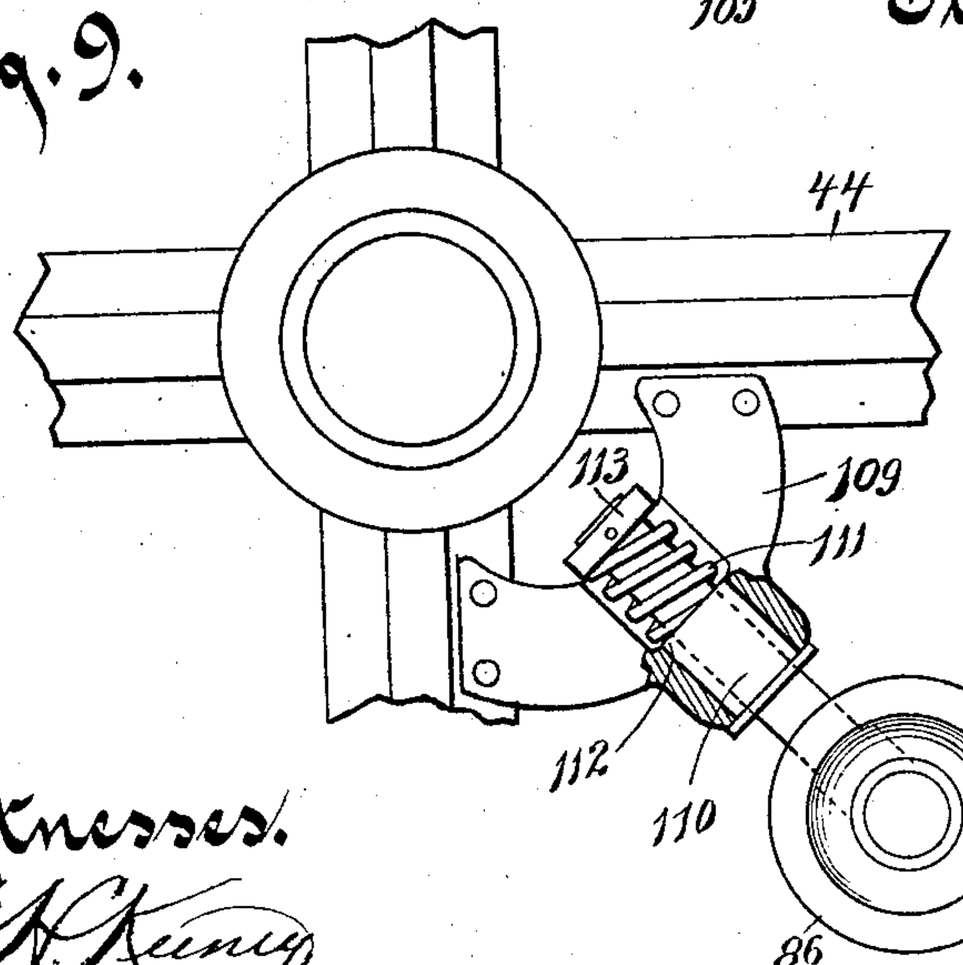
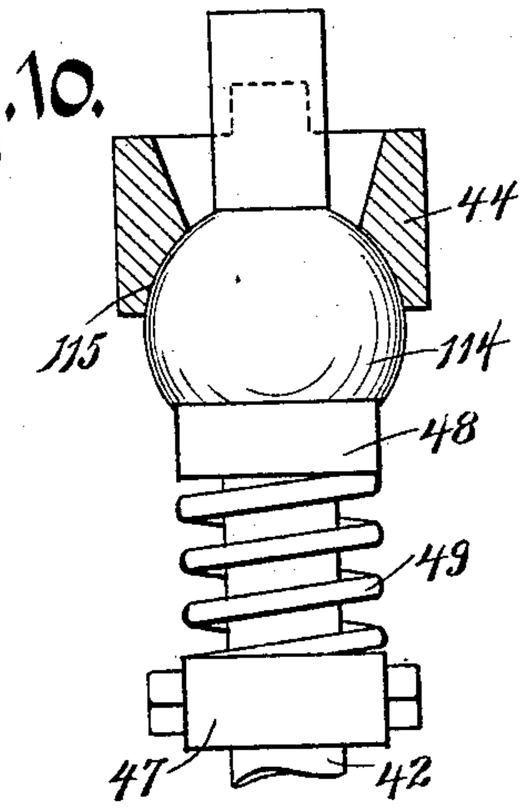


Fig. 10.



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CENTRIFUGAL MULLER MILL.

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Fig. 8.

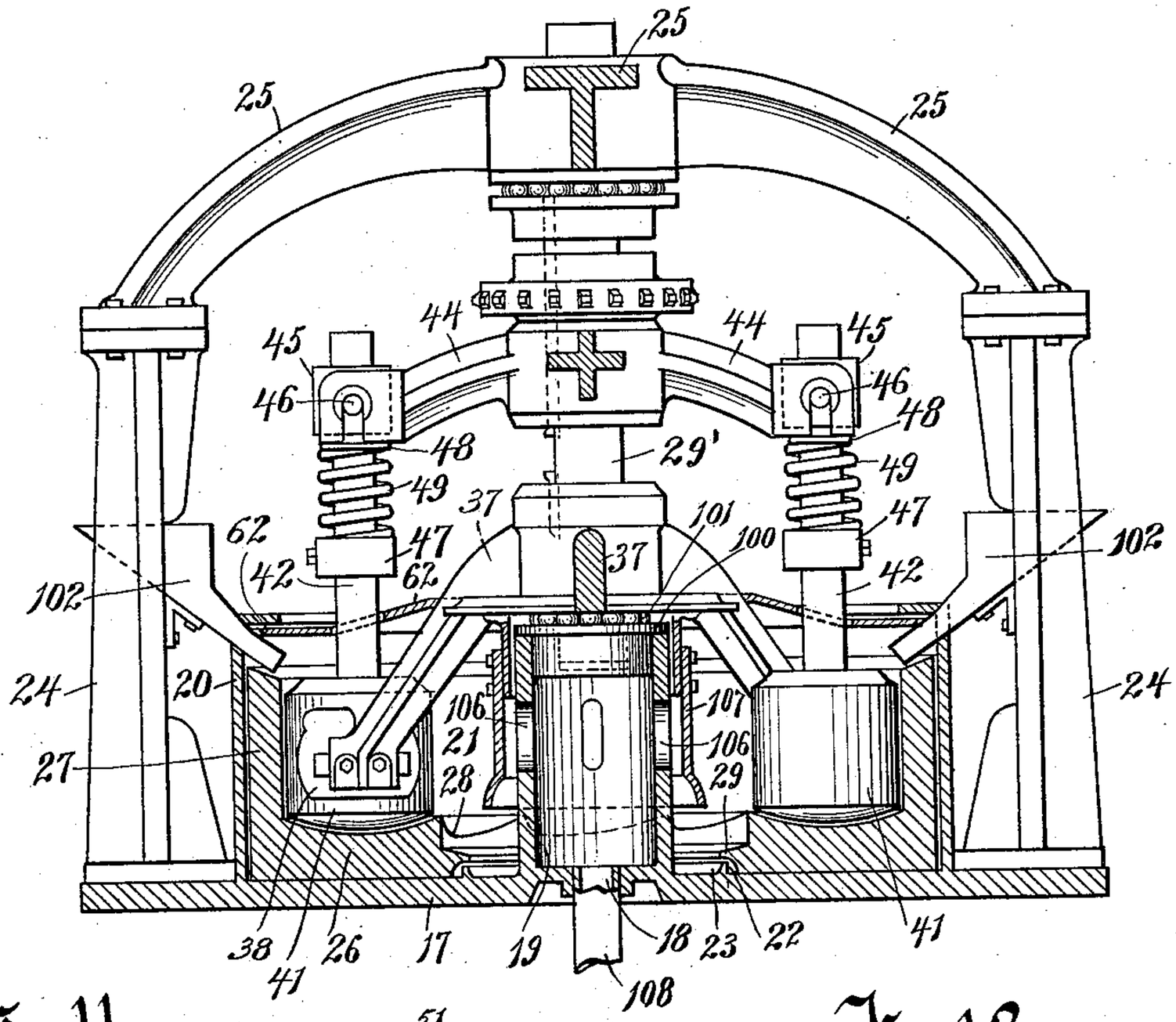


Fig. 11.

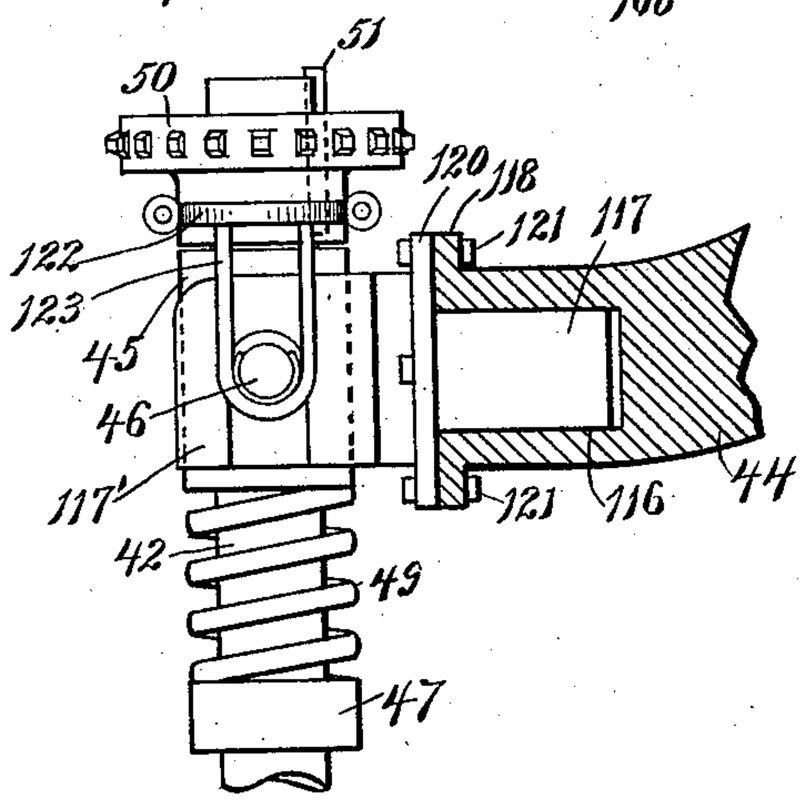
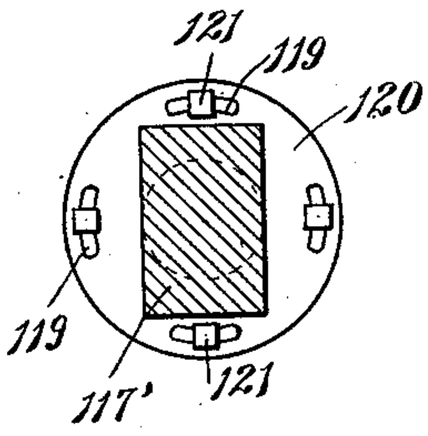


Fig. 12



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CENTRIFUGAL MULLER MILL.

No. 589,036. Patented Aug. 31, 1897.

Fig. 13.

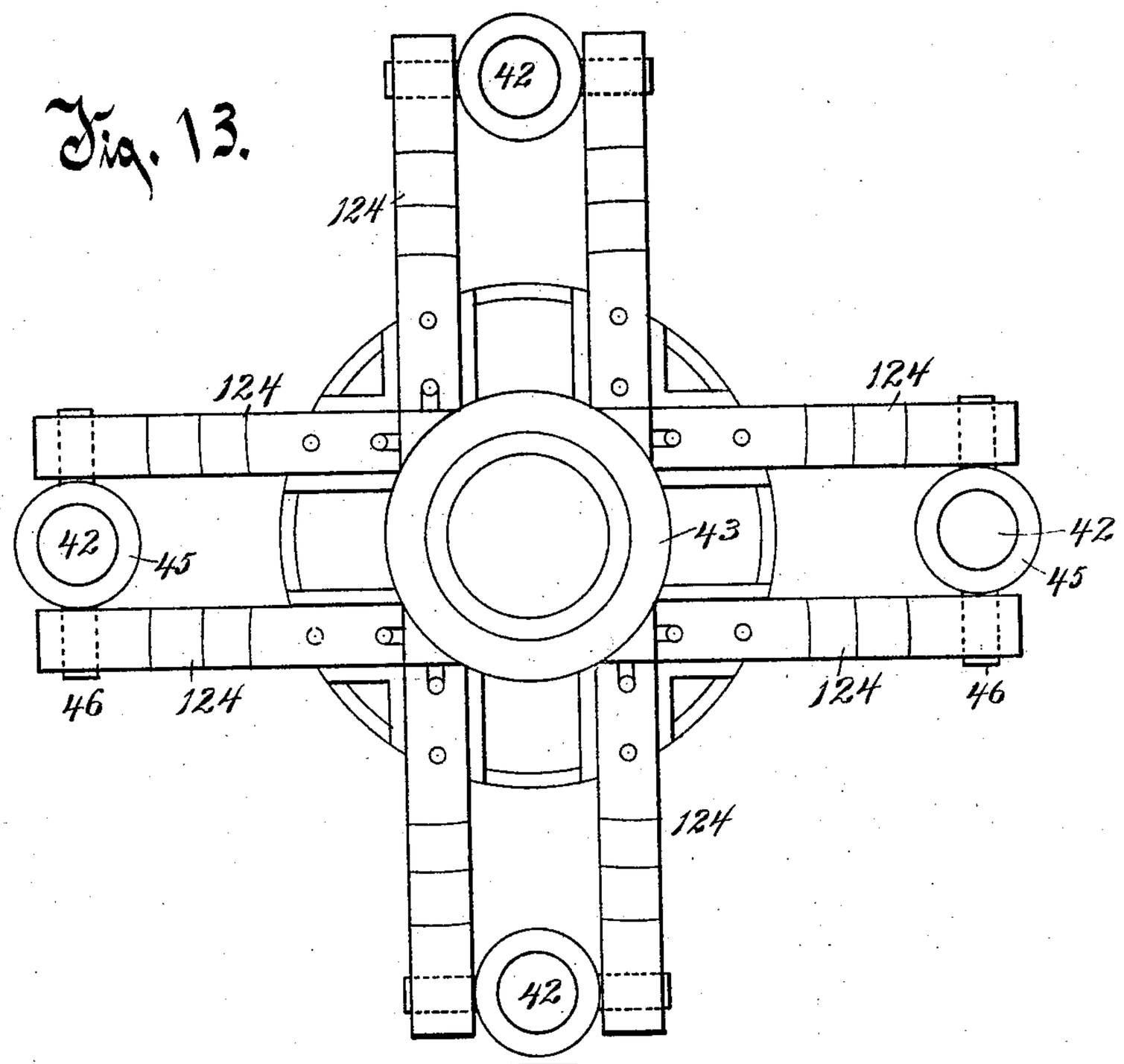
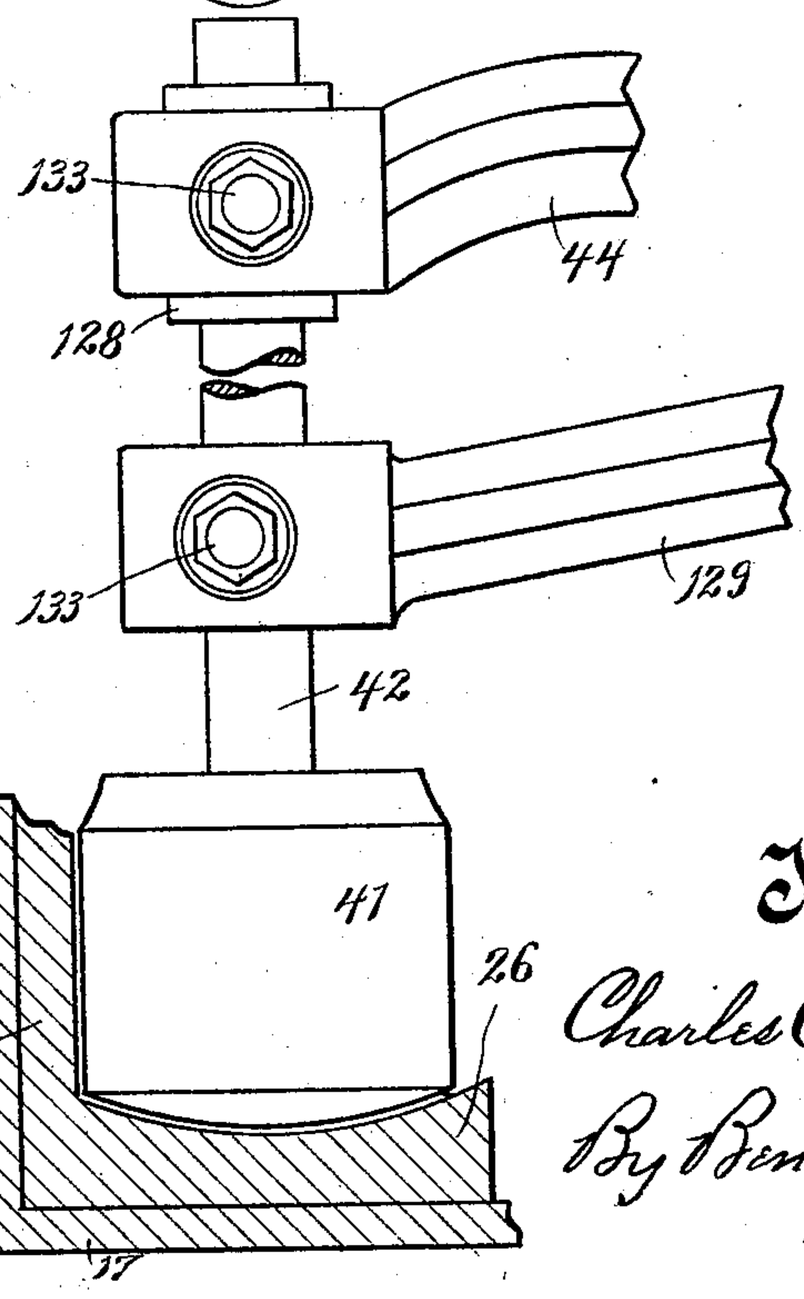


Fig. 15.



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CENTRIFUGAL MULLER MILL.

No. 589,036. Patented Aug. 31, 1897.

Fig. 14.

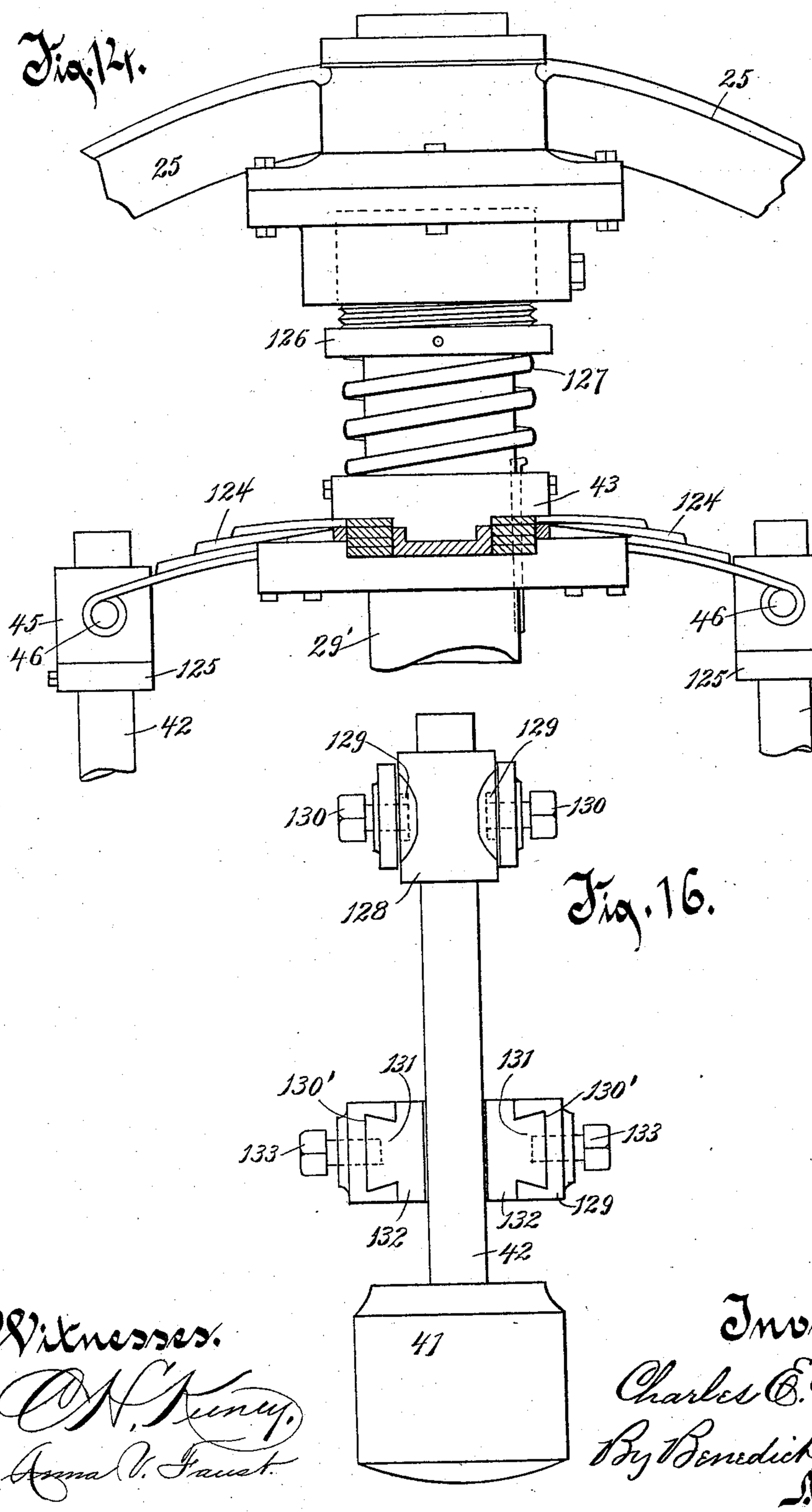

Fig. 16.

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UNITED STATES PATENT OFFICE.

CHARLES E. SEYMOUR, OF LAKE GENEVA, WISCONSIN.

CENTRIFUGAL MULLER-MILL.

SPECIFICATION forming part of Letters Patent No. 589,036, dated August 31, 1897.

Application filed December 11, 1895. Serial No. 571,744. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. SEYMOUR, of Lake Geneva, in the county of Walworth and State of Wisconsin, have invented new and useful Improvements in Centrifugal Muller-Mills, of which the following is a description, reference being had to the accompanying drawings, which are a part of this specification.

My invention relates to improvements in centrifugal muller-mills, having particular reference to means for pulverizing and crushing hard materials, such as ores bearing mineral of any kind. The drawings forming part of this application, however, represent a form more particularly designed for crushing and pulverizing ores carrying valuable minerals—such as gold, platinum, silver, tin, and the other ores which require crushing and pulverizing—to facilitate the extraction of the valuable mineral from the gangue or rock.

In working ores by pulverizing and afterward treating them for the extraction of the values it is in many cases desirable to subject them to the action of a stamping or crushing blow, as such blow breaks the ore in the fracture, and ordinarily this is where in gold ores the value lies. A grinding action is also desirable to reduce the ore to a finer state and scour or brighten the metallic particles, so that they may present a clean surface to quicksilver or amalgam and are readily acted upon by being brought into contact therewith. It is also desirable to have the mineral free and in a clean state where it is worked by chemical processes—as, for instance, what is known as the "cyanid process"—and to produce the desired result in machinery that is compact and easy to transport into the mountains.

With the above objects in view the invention consists in the devices and parts, or their equivalents, as hereinafter more fully described and claimed.

In the accompanying drawings, Figure 1 is an elevation, partly broken away and in section, showing the interior apparatus in section. Fig. 2 is a horizontal section above the wheel 55 of Fig. 1, showing the manner in which the machine is belted with link belts to revolve the stamps. Fig. 3 is a plan view of the step ring-die. Fig. 4 is a detail view of the muller and its shaft, said muller being shown partly broken away to show the squared end of the shaft as it enters the muller and the packing below the shaft to keep the end from battering or upsetting, the view also showing the parts surrounding the muller-shaft in section. Fig. 5 is a detail in plan of one of the mullers and a shoe acting thereagainst. Fig. 6 is a horizontal section on the line 6 6 of Fig. 1. Fig. 7 is an elevation, partly in section, of a modification which omits the means for giving the mullers and shafts an additional revolving and grinding motion and showing modified form for discharging into the center, and also showing solid main shaft with modification of feeding system. Fig. 8 is an elevation, partly in section, showing modified form of discharging ores by an exhaust-fan. (Not shown.) Fig. 9 represents modified means for holding the tightening-pulley. Fig. 10 is a detail of a modified ball-bearing for the upper end of the muller-shaft, which bearing it is desirable to use in pulverizing very hard materials. Fig. 11 shows a modified manner of constructing the arm forming the bearing for the upper end of the muller-shaft, providing for a double action, or a motion inwardly and outwardly as well as laterally, said view also showing a modified form of the clip and fastening to hold the sprocket-wheel from raising as said sprocket-wheel and muller travel up the incline in the revolution of the wheel. Fig. 12 illustrates a front view of the flanges shown in Fig. 11, the arm 117′ being in transverse section. Fig. 13 is a plan view of Fig. 14. Fig. 14 is a fragmentary view of a modification of the main shaft and allied parts, showing the manner of applying the springs. Fig. 15 is a detail view of a modified form of muller and bearings for the shaft of said muller without the use of springs; and Fig. 16 is a front elevation of Fig. 15, showing the bearings clearly.

Like numerals of reference denote like parts throughout the several views.

Referring to the drawings, in Fig. 1 the numeral 17 indicates a base-plate provided with a central opening 18, from which projects upward a central tube 19. Some distance removed from this central tube and concentric therewith is an annular wall 20,

between which wall and the central tube 19 a mortar-chamber 21 is formed. The central tube 19 prevents grit or ore from passing to the lower bearing. The base-plate is also provided with an annular upward-projecting shoulder 22, slightly removed from the central tube 19, which shoulder forms a circular cavity or channel 23 around the central tube. In working free-milling ores a quantity of quicksilver may be placed in this cavity or channel to amalgamate the free metals—such as gold, silver, platinum, &c.—that come in contact with it. The base-plate projects out beyond the annular wall 20, and to the projecting portion are bolted the columns or standards 24, preferably four, to the upper ends of which are bolted the ends of the arms 25 of a truss-frame.

Within the mortar-chamber 21 and confined between the annular wall 20 and the annular upward-projecting shoulder 22 is a step-bearing ring 26. This ring has an outer upward-extending rim 27, which contacts with the annular wall 20. The bottom of this die is formed with a series of steps 28. (Shown clearly in the plan view, Fig. 3.) The die is furthermore provided with a lateral inward-projecting flange 29, which overlaps the upward-projecting shoulder 22 of the base-plate and serves to some extent as a guard against the escape of the contents of the annular cavity or channel 23.

The numeral 29′ indicates a vertical shaft which passes centrally and freely through the central tube 19 of the base-plate. The lower end of this shaft projects below the base-plate and turns in a socket in a suitable step-plate 30. Intermediate the step-plate and the base the shaft carries a sprocket-wheel 31, and between this sprocket-wheel and the step-plate are antifriction-balls 32. The shaft 29′ is preferably tubular throughout, and about centrally within the bore thereof is a block 33, the upper surface of which is inclined.

Secured to the truss-frame 25 and projecting upward therefrom are standards 34 34, said standards secured to and adapted to support a hopper 35, the point of discharge of which hopper extends directly into or over the tubular opening of the shaft.

Surrounding a medial point of the shaft 29′ and secured rigidly thereto, so as to rotate therewith, is a sleeve or hub 36, which projects down far enough to surround the upper end of the central tube 19. From this sleeve or hub project radially downwardly a series of arms 37, preferably four. The numeral 38 indicates a series of shoes attached, respectively, to the lower ends of the arms 37, the attachment being secured, preferably, by casting each shoe with a dovetail lug 39, fitting in the lower end of the arm 37 and held in place by set-screws 40 40, so as to provide for radial adjustment or renewing shoes when worn out.

The numeral 41 indicates a series of cylindrical mullers carried at the lower ends of vertical shafts 42. It will be noticed that the steps 28 of the die 26 are concave and the bottoms of the mullers are of convex form to fit therein. The mullers 41 and their shafts correspond in number to the number of shoes employed, four being therefore shown in the present illustration of my invention.

The numeral 43 indicates another sleeve or hub bolted to the shaft 29′, and from which sleeve or hub projects a series of arms 44, the outer ends of said arms being bifurcated. Within the bifurcated ends of the arms are journal-boxes 45, said boxes provided with laterally-extending trunnions 46, which turn freely in eyes in the bifurcated ends of the arms 44. Arranged medially on the shafts 42 are adjustable collars 47, and between which collars and collars 48 beneath the journal-boxes 45 are disposed coiled springs 49. By providing the journal-boxes 45 with the trunnions 46, entering the bifurcated ends of the arms 44, said boxes are adapted to swing pivotally, thereby providing for an oscillating or swinging movement of the muller-shafts 42, whereby in the rotation of the machine the mullers by centrifugal force bear firmly against the outer rim 27 of the step-bearing ring.

Upon the upper ends of the muller-shafts 42 are sprocket-wheels 50, which wheels engage feathers 51 on the shafts, so as to permit an independent vertical movement of the respective shafts. Depending from the under sides of the sprocket-wheels 50 and integral therewith are grooved collars 52, engaged by the forked ends of arms 53, the inner ends of said arms rigidly attached to the arms 44. The forks of these arms engaging the grooves of the collars 52 serve to hold the sprockets against vertical movement.

On the shaft 29′, above the sleeve or hub 43, is still another sleeve or hub 54, which, however, is loose on the shaft. This sleeve carries at opposite extremities sprockets 55 55. The upper end of the shaft 29′ has its bearing in the truss-frame 25, and encircling the shaft immediately beneath the truss-frame is a grooved collar 56. Between this collar and the upper side of the sprocket-wheels 55 are antifriction-balls 57. It will thus be seen that these balls, together with the balls 32 at a lower point of the shaft, provide ball-bearings above and below, whereby friction is greatly reduced, and thus practically all the power required gives a return in the pulverizing and crushing action.

Bolted to the top of the annular wall 20 are a series of arms 58, the top and bottom flanges of which arms are braced by vertical rods 59. To these arms 58 are attached, by means of bolts 60, an annular screen 61. The screen is covered by a top cover 62, preferably made of two sections, the meeting edges of the sections provided with outer and inner upstanding apertured lugs 63 and 64, respectively, which are suitably bolted together and the

two sections of the cover thus united. The center of the cover is provided with an opening 65, through which the shaft 29′ passes, the bordering edge of said opening having its bearing on a plate 66, fixed to the sleeve or hub 36. The cover is furthermore provided with openings 67 for the passage of the muller-shafts 42, said openings being slightly greater in diameter than the diameter of the muller-shafts, so as to allow for the slight oscillation of said shafts on their pivots. The function of the cover 62 is to confine the spattering and sloshing contents and also to guide the slosh against the screen. The cover of course revolves with the revolving arms 37. The screen can readily be removed by removing the bolts 60, which removal it is sometimes desirable to make quickly in case a screen becomes broken, as is often the case. Through the screen just described the pulverized ore, with water, is sloshed by the action of the mullers in their revolution and drops.

Below the outside of the screen 61 is a circular trough 67′, which is secured to the standards or columns 24. Into this trough the wet ore is caught, and discharged therefrom to the machinery for extracting the values.

Fitted to the medial sleeve or hub 36 is a discharge-tube 68. This tube is preferably made separate from the hub 36 and bolted thereto. Its inner end passes through an opening in the hub slightly above the block 33. The tube revolves with the hub 36 and the arms 37, and its lower end distributes the ore in its revolution clear around the die.

The numeral 69 indicates a shaking-chute which enters the hopper 35 and discharges the material therein. A water-pipe 70 also has its discharge end within the hopper, so that water may be discharged with the ore into the mill.

The numeral 71 indicates a counter-shaft supplied with a pulley 72, connected by belting (not shown) with any suitable motive power. This counter-shaft carries on its inner end a bevel-gear 73, which gear meshes with a corresponding bevel-gear 74 on a vertical shaft 75. This latter shaft is provided on its lower end with a sprocket-wheel 76, which is connected to sprocket-wheel 31 of the main shaft 29 by means of a sprocket-chain 77, whereby rotation is imparted to said main shaft. The vertical shaft 75 carries near its upper end another sprocket-wheel 78, which is connected with the upper sprocket-wheel 55 of the loose sleeve 54 by means of a sprocket-chain 79. Running partially around the lower sprocket-wheel 55 of the sleeve 54, as shown in Fig. 2, is a sprocket-chain 80, which chain is extended to and around the sprockets 50 at the upper ends of the muller-shafts 42, Figs. 1 and 2. Secured to a flange 81, projecting from the sleeve or hub 43, is an arm 82, (see Fig. 2,) said arm provided with an elongated slot 83, which slot receives therethrough a bolt 84, carrying upon its end a locking-nut 85. The outer end of the arm 82 carries a pulley 86, which bears against sprocket-chain 80. By adjusting the arm 82 inward or outward it is obvious that the tension of the sprocket-chain 80 may be regulated.

To the under side of the shaking-chute 69 is secured a block 87, while from one of the standards 34, projecting up from the truss-frame, extends laterally a bumper 88. A lateral bumping motion is given to the chute 69 by a cam 89 on the upper end of the vertical shaft 75. (See Fig. 6.) A curved arm 90 is secured to the truss-frame, said arm provided with an upper vertical opening, in which is pivoted medially, on a transverse pin 91, a lever 92, the upper end of said lever pivoted to a lug 93, depending from the under side of the chute, by a pivot-pin 94, passing through the lug and through an elongated slot in the lever. Near its lower end the lever 92 is connected to a guide-pin 95 by means of a transverse pin 96. The guide-pin projects inward and through an eye near the lower end of the curved arm 90. Between this curved arm and the lever 92 the guide-pin is encircled by a coiled spring 97. In its revolution the cam 89 strikes the connecting-lever 92, turning said lever upon its central pivot-pin 91, and thereby compressing the spring 97 and throwing the chute back. As the cam-point passes away from the lever the spring recoils and throws the chute ahead until the block 87 strikes against the bumper 88. This causes the material in the chute to shoot ahead by jerks.

In the operation of my improved mill rotation is imparted to the vertical shaft 75 through the counter-shaft 71. The vertical shaft 75 in turning rotates the main shaft 29′ through the sprocket-chain 77, while the loose sleeve or hub 54 is rotated by means of the sprocket-chain running from sprocket-wheel 78 to the upper sprocket 55 of the loose hub 54. As this loose hub is rotated the sprocket-chain of lower sprocket-wheel 55 is actuated so as to impart rotation to the sprocket-wheels 50 at the upper ends of the muller-shafts.

In Fig. 2 is clearly indicated by arrows the direction of rotation of the several wheels and shafts. From these arrows it will be seen that the main shaft 29′ is revolved to the right, while the mullers and their shafts, said shafts passing freely through the journal-boxes 45, are by the sprockets 50 revolved to the left. The effect of this is that while the mullers are revolving freely to the left they are also carried completely around the mortar-chamber by the arms 44.

In the feed of the machine the ore is fed to the hopper from the chute 69, and the water through the pipe 70, the ore and water therefore passing down the shaft 29′ to the inclined block 33, from which it passes into the discharge-tube 68, which tube delivers the material to be treated to the ring step-die, said tube, as previously stated, revolving with the arms 37 and distributing the ore in its revolution clear around the die. The cylindrical

mullers in their revolution drop from off the steps of the die and crush coarse ore shoved ahead of the mullers and which was too coarse to come under the mullers in the travel of said mullers up the inclines of the die. Such coarse ore therefore drops off the steps and is in position to receive a blow from the mullers, as said mullers drop not only by gravity, but by the aid of the springs 49 to increase the force of the blow. The step or ring die, where four arms are used, has, preferably, six steps and can be made in sections, if desired, as with six steps only two mullers—viz., the two opposite each other—drop at once, so that the strain is equalized. Where there are only two arms 37 and two mullers used, any number of steps may be employed.

The operation of the stamp-mill is regulated by the feed of the ore to the mill according to the speed the mill is running and the pressure applied to the mullers by the springs, and also to the hardness of the ore being pulverized. The mill should not be overloaded, as feeding the ore faster than the mill is pulverizing decreases its capacity. In view of this fact it is desirable to feed to the mill just as nearly as possible the amount it is capable of pulverizing, as otherwise the mortar becomes packed and pulverizes slowly. The ore comes down a chute or hopper (not shown) and enters chute 69, from which it takes the course previously pointed out. When the ore has been ground fine enough by the mullers, it is discharged through the screen by the slosh of the water caused by the mullers. The operation is kept up continuously unless the mill is required to be stopped to renew any worn-out parts, or in free-milling ores where amalgamating is done to clean up the amalgam.

In Fig. 4 is shown the manner of attaching the muller-shaft 42 to its muller. From this figure it will be seen that the lower end of the shaft is squared and enters a corresponding socket in the muller. Between the lower end of the shaft and the bottom of the socket is a packing 98, of soft or fibrous material, to receive the blow of the muller-shaft and prevent it from battering or upsetting the end. I prefer pressed leather for these disks, but other fibrous material may be used, and, in fact, lead answers the purpose quite well.

The relation of the shoe 38 with respect to the muller 41 is clearly shown in Fig. 5. The shoe 38 acts as a grinder, inasmuch as it will carry against the muller, when carried around by its arm, material that will be pulverized, and the consequent wear will be equal to that of the shoe. By the method of fastening herein shown and described the shoes can be readily replaced by new ones when the wear becomes so great as to impair their efficiency.

Fig. 7 illustrates a modified form which differs from the form illustrated in Fig. 1 in the matter of the location of the feeding mechanism, the use of a solid shaft, the location of the discharge, the location of the ball-bearing, and the omission of sprockets and chains to revolve the mullers faster than they will roll, said mullers receiving their rotation merely from rolling around inside of the step bearing ring-die 26. This modification makes the machine much lighter, and consequently more easily transported over poor roads and into the mountains. In this figure it will be noticed that the central tube 19 is provided with a series of screened openings 99, through which the pulverized product is discharged. The top of the tube 19 is provided with a bearing-plate 100, between which and the under side of the sleeve or hub 36 are disposed anti-friction-balls 101. I wish it to be understood that an ordinary bearing may be employed with satisfactory results in this form of device, as most of the load of the shaft and arms would be carried on the springs 49 49, and consequently on the mullers. The entire load could be carried thereon, if desired, by the use of heavier springs. This would give great pulverizing capacity to the mullers, as they would thereby be thrown down with great force when leaving the steps of the die. The feeding mechanism in this modification consists of chutes or hoppers 102, which have their discharge ends below the cover 62, so that the ore dumped into these hoppers is delivered to the die. Water-pipes 103 103 discharge directly into these hoppers. The sleeve or hub 43 in this form is rigidly keyed to the shaft and carries above the arms 44 a sprocket-wheel 104, fast therewith. The main shaft therefore is rotated by means of a chain extending to this sprocket 104 preferably from a vertical shaft similar to 75, Fig. 1. In the operation of this modification the water and ore are fed into the mortar from the side, and the pulverized material is discharged through the screened openings 99 into a launder or trough 105 at the bottom, by which it may be conducted for future treatment.

In the modification Fig. 8 the construction is the same practically as Fig. 7, excepting the means of discharging the pulverized product. This form of machine is designed to pulverize dry or without the aid of water for discharging the product, and the pulverized material is drawn out by means of a suction blower or fan. The central tube 19, instead of being provided with screened openings, as in Fig. 7, is provided with ports 106, preferably three. Surrounding the tube 19 is an outside casing 107, extending down over the ports. Depending from the base-plate 17 is a pipe 108, to which a suction blower or fan (not shown) is attached. I do not show this blower, as almost any blower or fan can be used and placed in any position. The outside casing 107 extends down over the ports 106, so that coarse material cannot get through said ports unless drawn up through them by the air-blast. The strength of the blast can be regulated so as to draw out coarse or very fine material.

Fig. 9 illustrates a modified means for hold-

ing the tightening-pulley 86, which provides for a yielding motion back and forth. This is advantageous in the working of coarse or hard ores. This means consists in a curved arm 109, having its ends connected to the arms 44 44. A square shaft 110 slips through a bearing in this arm 109, said shaft being encircled by a spring 111, which spring is confined between a shoulder 112 and a collar 113.

Fig. 10 illustrates a modified ball-bearing for the upper bearing of the muller-shaft 42, which ball-bearing it is desirable to use in pulverizing very hard materials. This construction may also be used on any machine of this pattern employing compression-springs to force the muller down with a powerful blow onto the ore and also to produce a great amount of grinding force. It consists merely in passing the upper end of the muller-shaft 42 through a sleeve ball-bearing 114, which ball enters and is free to turn in a corresponding socket 115 in the arm 44.

Figs. 11 and 12 show modified manner of constructing the arms 44, whereby not only an outward and inward swing on the pivots or trunnions 46 46 is obtained, but also a swing at right angles thereto is secured. This form of holding the journal-boxes 45 therefore provides for any movement of the mullers and shafts. This construction consists in providing the arm 44 with a circular recess 116, into which fits a circular extension 117, from a separate bifurcated arm 117′. The arm 44 is also provided with an annular flange 118. This flange 118 fits against a similar flange 120, formed on the bifurcated arm 117′. Bolts 121 pass through elongated curved slots 119 and enter the flange 118. It will thus be seen that the muller-shafts 42 not only provide for a swing in one direction on the trunnions 46, but also in an opposite direction on the bolts 121. I also show in Fig. 11 a modified construction for holding the sprocket-wheel 50 against vertical movement when the muller-shaft 42 is moved vertically. This consists in encircling the sleeve 52 of the sprocket-wheel with two semicircular bands 122, suitably bolted together, said bands provided with depending clips 123, which pass beneath the trunnions 46 46. These clips will provide for a greater swing of the muller-shaft in and out in its revolution.

Figs. 13 and 14 represent a plan view and elevation, respectively, of another modification wherein forcing leaf-springs are used. Instead of employing the arms 44 leaf-springs 124 are secured to the sleeve or hub 43, said leaves projecting out in sets, with a space between the members of each set for the reception therebetween of the journal-boxes 45. The ends of the springs are provided with eyes for the reception of the trunnions 46 of the journal-boxes. These journal-boxes bear against collars 125 on the muller-shafts. Above the hub or sleeve 43 is a screw-threaded collar 126. Between this screw-threaded collar and the hub or sleeve 43 a coiled spring 127 may, if desired, be employed to advantage when working very coarse or hard ores. The screw-threaded collar 126 can be raised or lowered for regulating the pressure of the springs on the muller-shafts. When it is desired that this coiled spring 127 should act, it is of course necessary that the bolts securing the hub or sleeve 43 rigidly to the main shaft should be removed.

Figs. 15 and 16 show a modified form of muller-shaft bearings without means for revolving the muller-shafts and mullers by extra power other than their frictional contact with the side of the step ring-die. In this construction the ends of the arms 44 are bifurcated, as in Fig. 1, and receive in a bifurcated end journal-boxes 128. These journal-boxes have vertically-elongated slots 129 129 therein, (shown in dotted lines,) which receive the ends of pivot-bolts 130 130, extending through the furcated ends of the arms 44. By this means the muller-shafts are permitted to swing upon the pivot-bolts 130 and at the same time have the requisite up-and-down movement. In this construction also, instead of employing the arms 37 of Fig. 1, I employ arms 129, which at their inner ends are secured to the main shaft, so as to rotate therewith, and have their outer ends bifurcated. The inner sides of these furcated ends are provided with dovetail recesses 130′ 130′, in which fit dovetail lugs 131 131, formed on a bearing-surface 132. This bearing-surface is preferably made of hard wood, with the end of the grain to the shaft, and is held by set-screws 133 133, whereby it is readily removed when worn. It will be seen that this lower bearing being inserted in the bifurcated end of the arm 129 and being itself bifurcated to conform to the bifurcation of the arm the free swing of the muller-shaft is not interfered with.

I do not wish to be understood as confining myself to the particular construction of step ring-die here shown and described, as it is obvious that said die, if preferred, may be made part of the mortar-chamber 21 without departing from the spirit and scope of my invention. In small machines this, perhaps, would be the desirable construction.

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

1. In a stamp-mill, the combination, of a die provided with a series of steps or inclines, a revoluble muller acting against the steps or inclines, a muller, an oscillating journal-box in which the shaft has its bearings, and is movable vertically therein, and means for carrying the journal-box, and with it the shaft and muller in a circular path of movement, which muller, as it thus travels in a circular path is caused to drop as it passes over the summit and off the inclines, thereby producing a crushing, as well as grinding, action, substantially as set forth.

2. In a stamp-mill, the combination, of a

die provided with a series of steps or inclines, a revoluble muller acting on the die, a shaft fixed to the muller, a journal-box having a double pivotal connection to permit an inward and outward swing or oscillation, as well as a sidewise swing or oscillation, said journal-box receiving the muller-shaft vertically movable therein, and means for carrying the journal-box, and with it the muller and shaft, in a circular path of movement, which muller as it thus travels in a circular path is caused to drop as it passes over the summit and off the inclines, thereby producing a crushing, as well as grinding, action on the material, substantially as set forth.

3. In a stamp-mill, the combination, of a die, a revoluble muller having its bottom end bearing against the die and grinding material received on the die, said muller provided with a shaft or stem, and independent means for revolving the muller in its revolution, faster than said muller would revolve by frictional contact with the side of the die, whereby an increased amount of grinding force is produced, substantially as set forth.

4. In a stamp-mill, the combination, of a rotatable main shaft carrying a pulley, a grinding-surfaced die, mullers acting on the grinding-surface, shafts fixed to the mullers, said shafts provided with pulleys, and belting connecting the pulleys of the muller-shafts with the pulley of the main shaft, whereby the mullers are caused to be revolved rapidly in their revolution in an opposite direction to the direction of revolution of the main shaft, substantially as set forth.

5. In a stamp-mill, the combination, of a main shaft carrying a sprocket-wheel, a die forming a grinding-surface, mullers acting upon the die, said mullers provided with shafts or stems, arms revolving with the main shaft, the ends of said arms forming bearings for the shafts or stems of the mullers, sprockets on the muller-shafts, a counter-shaft carrying sprockets, a belt transmitting motion from one of the sprockets of the counter-shaft to the sprocket of the main shaft, and another belt connecting the other sprocket of the counter-shaft with the sprockets of the muller-shafts, whereby the mullers are given an independent revolving motion in their circuit around and against the die, substantially as set forth.

6. In a stamp-mill, the combination, of a die provided with a series of steps or inclines, a revolving arm provided with a bifurcated outer end, a journal-box within said bifurcated outer end, said journal-box provided with laterally-extending trunnions turning loosely in apertures in the bifurcated end of the arm, a muller adapted to act on the die, a shaft fixed to the muller, said shaft passing loosely through the journal-box, and provided with a spline or feather, a wheel mounted on the shaft and provided with a groove fitting the spline or feather, and means for preventing vertical movement of said wheel, substantially as set forth.

7. In a stamp-mill, the combination, of a die, an arm adapted to be carried in a circular path of movement, said arm provided at its end with a cylindrical recess, another arm provided with a cylindrical stem held and oscillating within the cylindrical recess of the first-named arm, said last-named arm having a bifurcated outer end, a journal-box within the bifurcated end, said journal-box provided with laterally-extending trunnions fitting loosely in apertures in the bifurcated parts, and a muller adapted to act on the die, said muller provided with a shaft passing through the journal-box, substantially as set forth.

8. In a stamp-mill, the combination, of a mortar, mullers within the mortar provided with shafts, said shafts having pulleys mounted thereon, arms by which the mullers are revolved, means for revolving said arms, a main shaft provided with a pulley, a belt connecting the pulley of the main shaft with the pulleys of the muller-shafts, and a tightening-pulley arranged to take up the slack of the belting as the pulleys are revolved, substantially as set forth.

9. In a stamp-mill, the combination, of a mortar, a muller within the mortar traveling in a circular path of movement, a chute arranged above the mortar, a block secured beneath the chute, a bumper in front of said block, a medially-pivoted lever connected to the under side of the chute, a spring-encircled guide-pin connected to the lever, a cam acting on the lever, whereby a shaking movement is imparted to the chute, and thereby through the block an intermittent bumping action is produced, substantially as set forth.

10. In a stamp-mill, the combination, of a die, a revoluble muller acting on the die, a shaft fixed to the muller, a journal-box having two pivotal points or connections, arranged, respectively, at right angles to each other, one of said pivotal points constructed to permit an inward and outward swing of the journal-box, and the other constructed to permit sidewise swinging of the journal-box, said journal-box receiving the muller-shaft therein, and thereby susceptible to the movement of said muller-shaft, in order to permit the free swinging of the muller both inwardly and outwardly, as well as laterally, and means for carrying the journal-box and the muller and shaft in a circular path of movement.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES E. SEYMOUR.

Witnesses:
CHARLES S. FRENCH,
W. W. SHERMAN.

Correction in Letters Patent No. 589,036.

It is hereby certified that in Letters Patent No. 589,036, granted August 31, 1897, upon the application of Charles E. Seymour, of Lake Geneva, Wisconsin, for an improvement in "Centrifugal Muller-Mills," an error appears in the printed specification requiring correction as follows: In line 124, page 5, the words *shaft fixed to the* should be inserted before the word "muller;" and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 14th day of September, A. D. 1897.

[SEAL.]

WEBSTER DAVIS,
Assistant Secretary of the Interior.

Countersigned:

BENJ. BUTTERWORTH,
Commissioner of Patents.