C. MILLS.

GRINDING MACHINE.

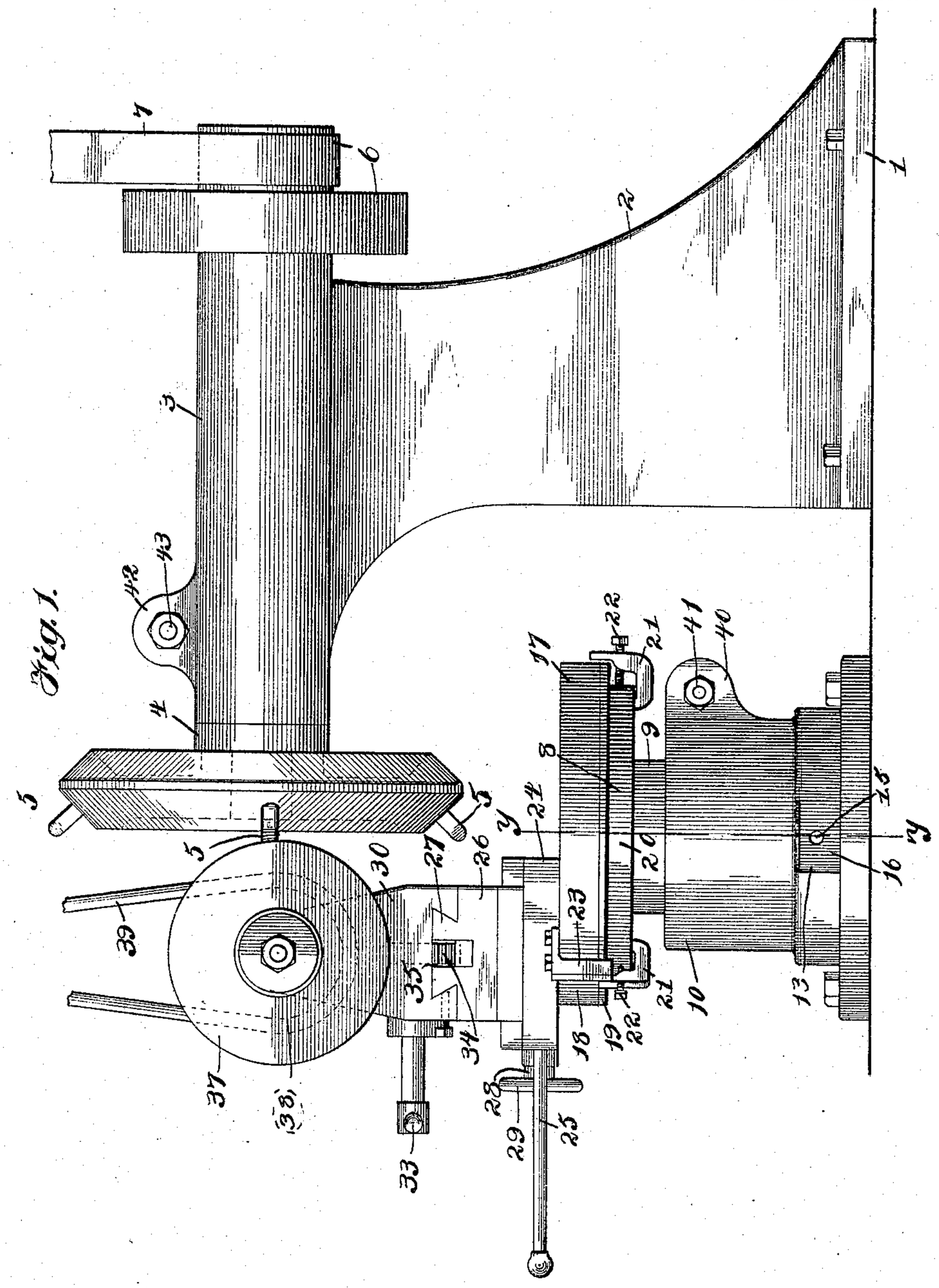
APPLICATION FILED MAY 23, 1903.

899,421.

Patented Sept. 22, 1908.

3 SHEETS—SHEET 1.

Fig. 1.



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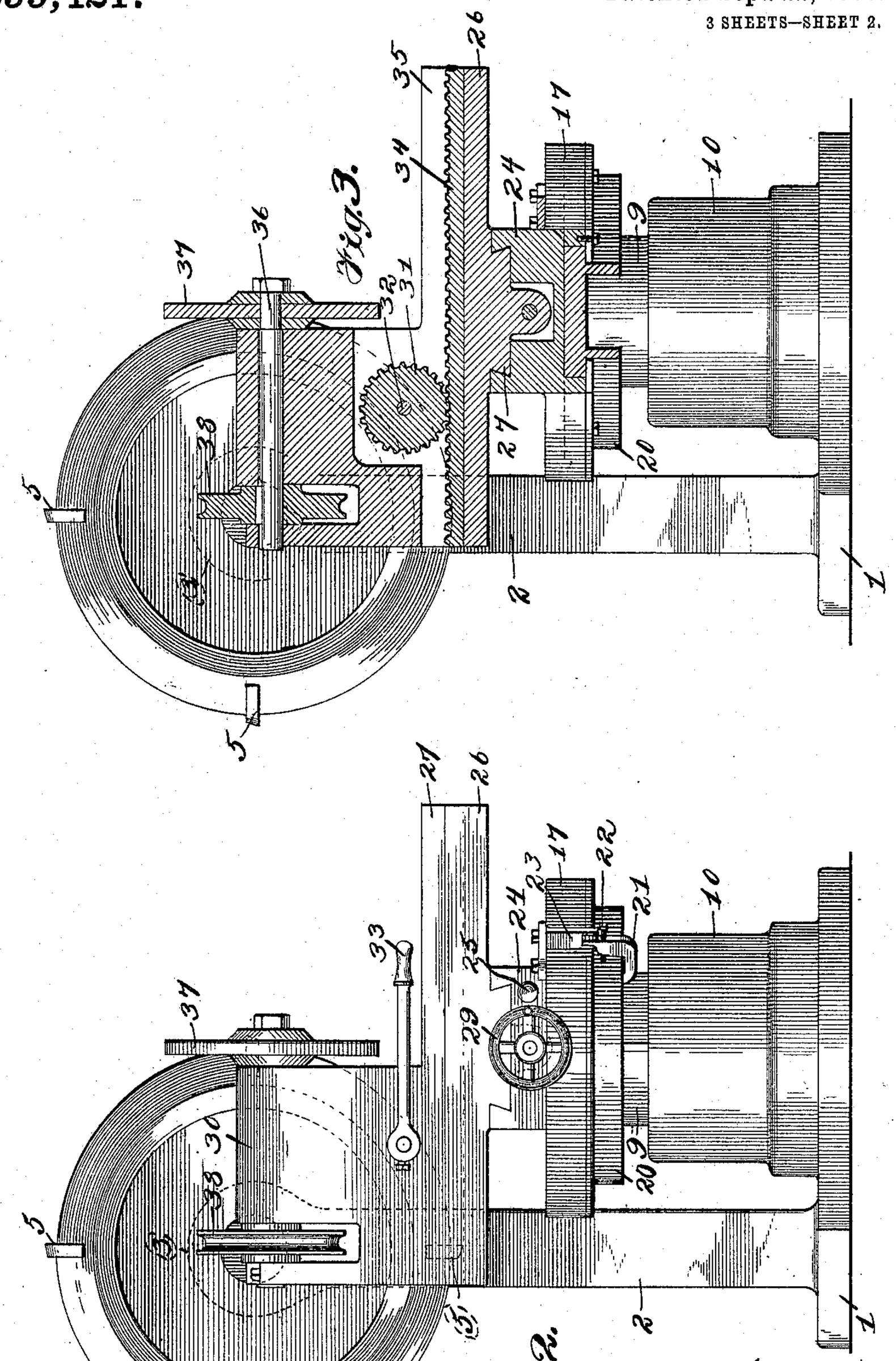

Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 4.

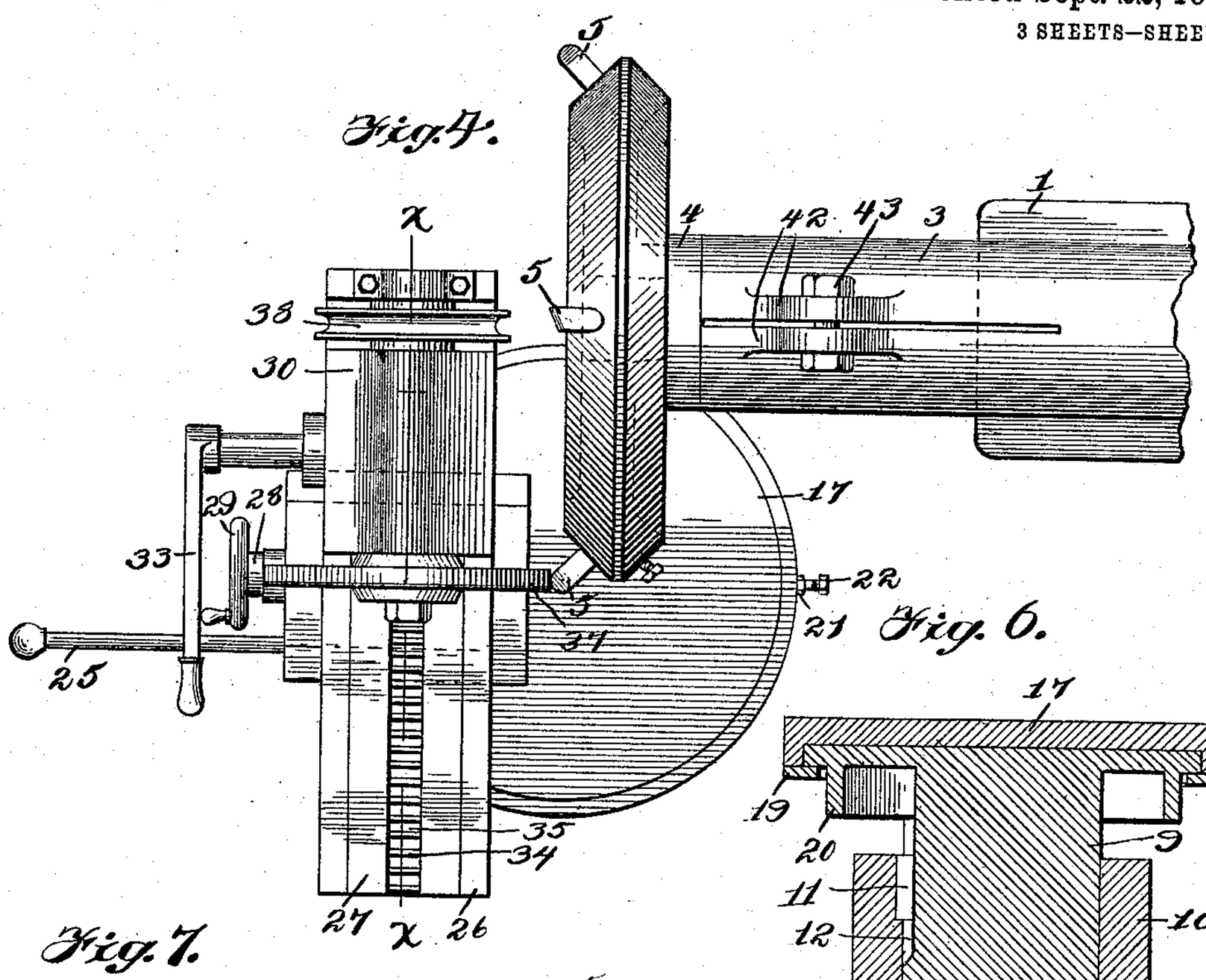

Fig. 6.

Fig. 7.

Fig. 5.

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UNITED STATES PATENT OFFICE.

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GRINDING-MACHINE.

No. 899,421. Specification of Letters Patent. Patented Sept. 22, 1908.

Application filed May 23, 1903. Serial No. 158,446.

To all whom it may concern:

Be it known that I, CHARLES MILLS, a citizen of the United States, residing at Newton Upper Falls, in the county of Middlesex and State of Massachusetts, have invented a certain new and useful Improvement in Grinding-Machines, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates particularly to grinding machines, it having been designed for the purpose of producing a structure in which the support for the grinding wheel may be revolved about the support for the article to be ground, so that the device may be readily utilized for grinding curved surfaces.

In the preferred embodiment of my invention, the grinding wheel is mounted upon a support, which is arranged to revolve about the article to be ground. Of course, the results which I seek might be obtained in other ways, as by mounting the support for the tool or other article to be ground so that it could be revolved about the grinding wheel.

The details of the device which I have designed for practical purposes is illustrated in the accompanying drawings, but it is evident that the invention may take many other forms, and that the parts therein shown may be subject to many variations.

In said drawings Figure 1 is an elevation of my improved grinding machine; Fig. 2 is also an elevation of my device, viewing the same at right angles to the position assumed in Fig. 1; Fig. 3 is a sectional view taken on the line *x*—*x* of Fig. 4; Figs. 4 and 5 are plan views of my device, showing the table which supports the emery wheel in different positions; Fig. 6 is a sectional view on the line *y*—*y* of Fig. 1, which discloses more particularly the means for vertically adjusting the table on which the grinding wheel is mounted; and Fig. 7 is a view showing another form of a milling cutter to be ground and the emery or grinding wheel in engagement therewith.

Throughout said drawings like reference characters designate similar and corresponding parts.

Upon a suitable base or pedestal, 1, is bolted a bearing or standard, 2, which has at its upper end a suitable journal box, 3, in which is journaled a spindle, 4. This spindle at one end is formed to support tool, 5, which is here shown as a milling cutter, which consists of a circular block, having the teeth inserted in the periphery thereof at an inclination. The spindle at the opposite end of its bearing has pulleys, 6, for revolving said spindle by the belt, 7.

Above the base is situated a stationary table, 8, which has a circular top and a centrally depending stem, 9. The stem 9 enters a socket or post, 10, it being vertically movable to adjust the height of said table. The stem 9 is preferably prevented from rotating in the socket by a key, 11, secured in the socket and projecting into a vertical slot, 12, in the periphery of the stem. The lower end of the stem is preferably contracted and threaded, and screwed upon this contracted portion is a threaded nut, 13, which is arranged within a recess, 14, formed in the socket and held in position by the shoulders of said recess. This nut is preferably circular and its periphery is provided with a series of holes, 15, into which an implement may be inserted for turning the nut to vary the vertical adjustment of the table by raising and lowering the same. The side of the socket at 16 is cut away to permit the insertion of said implement into the recesses or holes in the periphery of the nut. On top of the stationary table is mounted to revolve a second table or plate, 17, which has a downwardly depending circular flange, 18, which embraces the edges and the top of the stationary table and guides said revolving table in its movement. To the lower edges of said flange is secured by bolts a ring, 19, which projects inwardly under the top of the table and retains the revoluble table from being lifted from the stationary table. Just inside of the ring 19 is situated a ring, 20, which is formed on the under side of the stationary table. To this ring are adjustably secured stops, 21, each of which has a cut-out portion to receive the flange or ring 20, and a bolt, 22, for gripping the stop 21 in any desired position upon said flange. The vertical table is provided with a dog, 23, preferably secured thereto by bolts or other means and arranged to engage said stops so as to limit the movement of the vertical table in operating the same.

At one side of the center on the top of the rotary table is raised a block, 24, to which is attached a handle, 25, for revolving the rotary table upon its swivel. Upon the block

24 is slidably mounted a carriage, 26, which is guided by a dovetailed projection, 27, on said carriage, which slides in a correspondingly shaped groove extending radially from the center of the rotary table in the block 24. The movement of the carriage in its adjustment towards and from the center of the table is accomplished by a screw, 28, provided with a hand wheel, 29, for turning the same. On the top of the carriage is mounted, to slide in a direction transverse to the movement of the carriage, a post or bearing, 30, which is guided upon said carriage by a dovetailed projection of said carriage, which extends into a correspondingly formed groove in the bottom or base of said post. A gear, 31, is mounted on a shaft, 32, which is journaled in said post, and which has a lever, 33, for turning the same. This gear or pinion meshes with a rack, 34, arranged in a slot, 35, in the carriage, and by moving the lever to turn the shaft the post may be adjusted transversely to the adjustment of the carriage. At the top of the post is journaled a spindle or mandrel, 36, which carries at one end a grinding or emery wheel, 37, and at its opposite end a pulley or sheave, 38, for revolving the spindle from a suitable source of power by a belt 39.

The grinding or emery wheel 37 and the article or tool 5 to be ground are interchangeable, and will be hereafter referred to as a pair of grinding elements.

The emery or grinding wheel is situated in such a position with respect to the support for the article to be ground or shaped that by the adjustment of the carriage or the post which supports the wheel, said wheel may be brought into engagement with the article to be ground. By turning the rotary table the periphery of the grinding wheel at the point which engages the article to be ground will be caused to traverse a curved path, and therefore the surface of the article may be ground to have a curve corresponding to the rotation of the grinding wheel caused by the movement of the rotary table. The adjustable stops mounted on the stationary table, which are arranged to be engaged by the dog on the rotary table, may be adjusted to limit the arc in which the rotary table may be turned, and thereby the arc of the surface being ground also limited. The adjustment of the carriage and post on which the grinding wheel is mounted enables the grinding wheel to be brought into contact with the surface which it is desired to grind in various relations, and said grinding wheel may be raised and lowered by turning the nut on the stem of the stationary table in the proper direction.

The socket for the stem of the stationary table is preferably split and provided with ears or lugs, 40, through which passes a bolt, 41, for drawing the ears together and clamping the socket around the stem to hold the same in a fixed position when the emery wheel has been adjusted to the proper height. The journal box for the spindle which carries the article being ground is also preferably split and provided with ears, 42, through which passes a bolt, 43, for drawing said ears together to clamp the journal box around the spindle and prevent rotation of the latter, as will be hereinafter explained.

The general construction of the device herein shown and described having been explained, I will now describe the operation thereof in grinding a milling cutter of the character shown. As before stated, this cutter consists of a circular block, which has a plurality of teeth inserted in the periphery thereof in an inclined position. These teeth have rounded cutting edges, which are "backed off" or under-cut to provide a sharp cutting edge. The edges of these teeth must all be correspondingly formed and arranged at an equal distance from the center of the cutter; therefore, when the cutter is placed in position on the spindle, the spindle is caused to revolve and rotate the cutter. The grinding wheel then has its center brought into a horizontal plane with the center of the cutter by adjusting the stationary table. After the stationary table is adjusted to its proper position, it is clamped by the bolt 41. Next the stops on the stationary table are adjusted to limit the arc of movement of the table to such an extent that when the table is turned between said stops the emery wheel will pass over the entire curved surface which it is desired to grind upon the teeth of said cutter. The emery wheel is then caused to revolve and is brought into engagement with the teeth of the milling cutter, which is also being revolved, by the adjustment of the carriage and post upon which said wheel is supported. While the grinding wheel and milling cutter are thus rotated in contact with each other, the rotary table is moved through the arc defined by the stops. The grinding of the teeth thus being effected, the grinding wheel is moved inwardly by the adjustment of its supports until the edges of said teeth have been ground true. The grinding wheel is then withdrawn from the milling cutter and lowered by turning the nut on the stem of the stationary table until its axis is in a horizontal plane, slightly below the center of the milling cutter. The spindle on which the milling cutter is mounted is then locked so that one of its teeth will be in a position which is in a horizontal plane with the center of the milling cutter. The grinding wheel, while still revolving, is then moved inwardly until it engages said tooth, and then the rotary table is again turned. This movement of the rotary table causes the emery wheel to be under-cut or "backed off" each

tooth. After one tooth has been "backed off," the succeeding teeth are brought into position one by one and similarly ground until all the teeth have been under-cut or "backed off." The grinding of the milling cutter will then have been completed and a new article may be placed in position for grinding.

In Fig. 7 is illustrated another form of milling cutter, which comprises a circular block, 44, which has a plurality of bits, 45, set radially in recesses formed in the periphery thereof. These bits have their side cutting edges as well as outer cutting edges, and the corners of the cutting edges of said bits are rounded. When this milling cutter is first put upon the machine to be ground it is revolved, with the revolving emery wheel engaging therewith, until the edges thereof have been trued. The rotary table, of course, will only be turned when the corners of the bits are to be rounded. The side and outer edges are ground by moving either the carriage or the post which supports the emery wheel back and forth in a straight line. When the bits have all been trued, the emery wheel is slightly lowered to under-cut the teeth, and then it is operated to under-cut the edges and corners of the bits. The emery wheel is shown in Fig. 7 of the drawings in the position it occupies when the side edges of the teeth are being undercut.

By the term "grinding wheel," which I hereinafter employ in the claims, I mean to comprehend any form of rotary device for grinding or cutting surfaces of materials or articles.

Many other uses of my invention other than what I have herein described may be apprehended, and it is manifest that the details of construction of this machine may be varied in many respects without in any way departing from the spirit of my invention. The device herein shown is only one form of my invention which will accomplish the result which I seek. I therefore reserve the right to make such modifications as fairly fall within the scope of my invention, and I do not limit myself to details of construction, arrangement and combination of parts as herein shown and described.

What I claim and desire to secure by Letters Patent is:

1. In a device for grinding convex surfaces, the combination with a grinding element, of an article holding element, said grinding element being movable relative to the other in an arc having its center on the center of the arc to be ground, and adjustable radially and on a chord of the arc.

2. In a device for grinding convex surfaces, the combination with a revoluble grinding element, of a revoluble article holding element, said grinding element being movable relatively to the other in an arc having its center on the center of the arc to be ground, said movable member being also adjustable radially and on a chord of said arc.

3. In a device for grinding convex surfaces, the combination with a supporting element, a grinding element, a suitable support for said supporting element, a post for supporting said grinding element, an adjustable turn-table for supporting said post and arranged to freely move the element carried thereby about the opposite element in an arc having its center on the center of the arc to be ground, during the operation of grinding.

4. In a device of the character described, the combination with a support for the article to be ground, of a grinding element for operating upon said article, a post for supporting said element, and a vertically adjustable turn table for supporting said post arranged to freely move said grinding element about the article in the arc of a circle centered upon the center of the arc to be ground, during the operation of grinding.

5. In a device for grinding convex surfaces, the combination with a suitable support for the article to be ground, of a grinding element for operating thereon, a turn table, and a transversely and laterally adjustable support for said grinding element mounted upon said table, said table being arranged to freely move said grinding element about the article to be ground in an arc having a center on the center of the arc to be ground, during the operation of grinding.

6. In a device of the character described, the combination with a suitable support for the article to be ground, of a grinding element for operating thereon a vertically adjustable turn table, and a transversely and laterally adjustable support for said grinding element mounted upon said table, said table being arranged to freely move said grinding element about the article to be ground in an arc having a center on the center of the arc to be ground, during the operation of grinding.

7. In a device for grinding convex surfaces, the combination with a revoluble support for the article, of a revoluble grinding element for operating upon said article, and a support for said grinding element arranged to permit the same to move about the article in an arc centered upon the center of the arc to be ground, during the operation of grinding.

8. In a device of the character described, the combination with a suitable support for the article to be ground, of a turn table, a post adjustable upon said turn table, a spindle carried by said post, and a grinding element carried by said spindle, said turn table being arranged to freely move said grinding element about the article to be ground in an arc centered upon the support for the article, during the operation of grinding.

9. In a device of the character described,

the combination with a suitable support for the article to be ground, of a vertically adjustable turn table, a carriage adjustably mounted upon said turn table, a post mounted upon said carriage, a spindle mounted in said post, and a grinding element carried on said spindle, said turn table being arranged to freely move said grinding element about the article in an arc centered upon the support for the article, during the operation of grinding.

10. In a device of the character described, the combination with a suitable base, of a support swiveled thereon, a carriage adjustable in two directions upon said support, a grinding device mounted upon said carriage, a second support for the article to be ground, said grinding device being freely movable in an arc centered upon the supporting device, during the operation of grinding.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

CHARLES MILLS.

Witnesses:
W. C. SWIFT,
W. C. JOHNSON.