R. F. WILLIAMS.

LENS GRINDING MACHINE.

APPLICATION FILED MAR. 16, 1910.

970,674.

Patented Sept. 20, 1910.

5 SHEETS—SHEET 1.

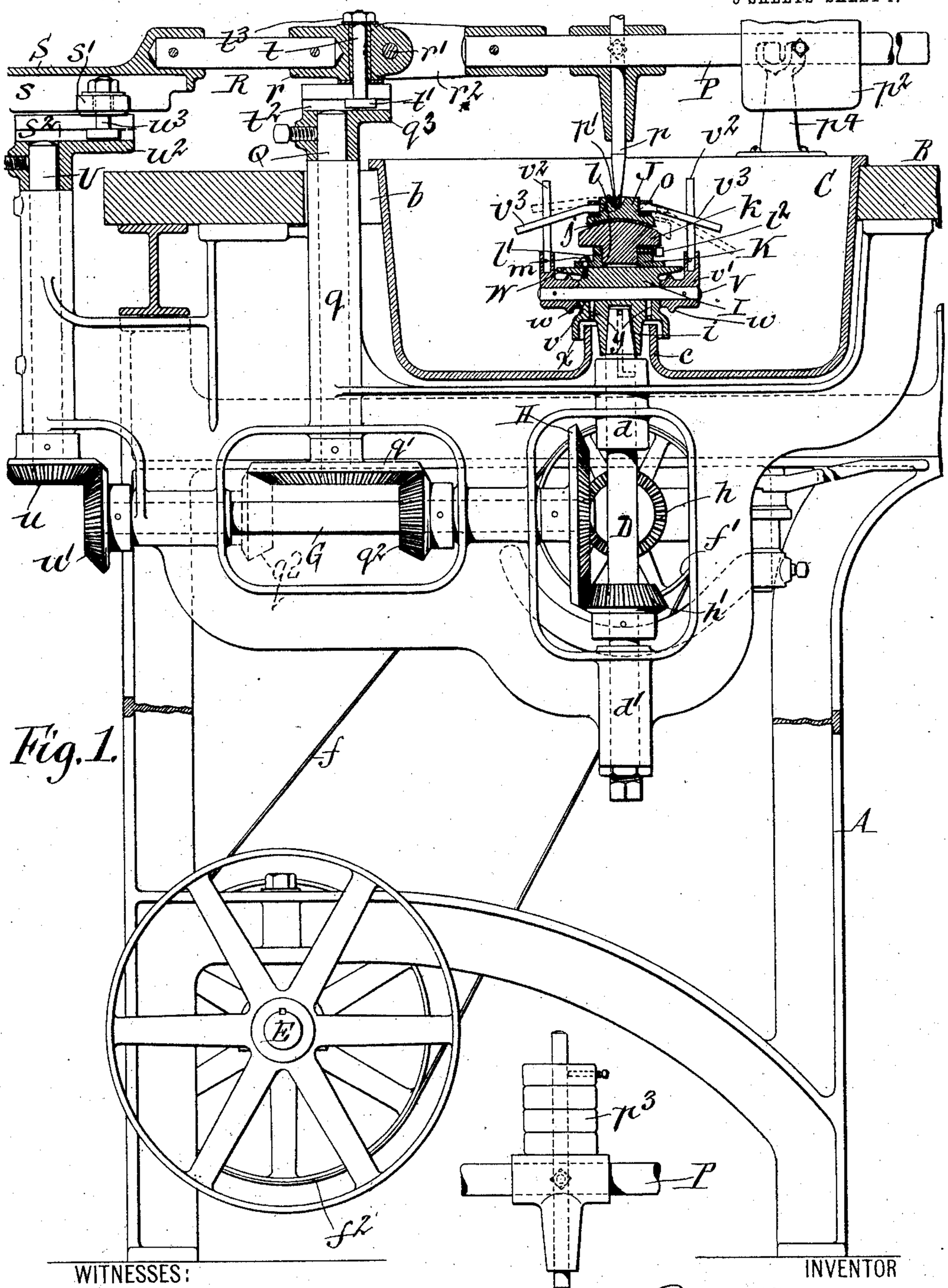

Fig. 1.

Fig. 2.

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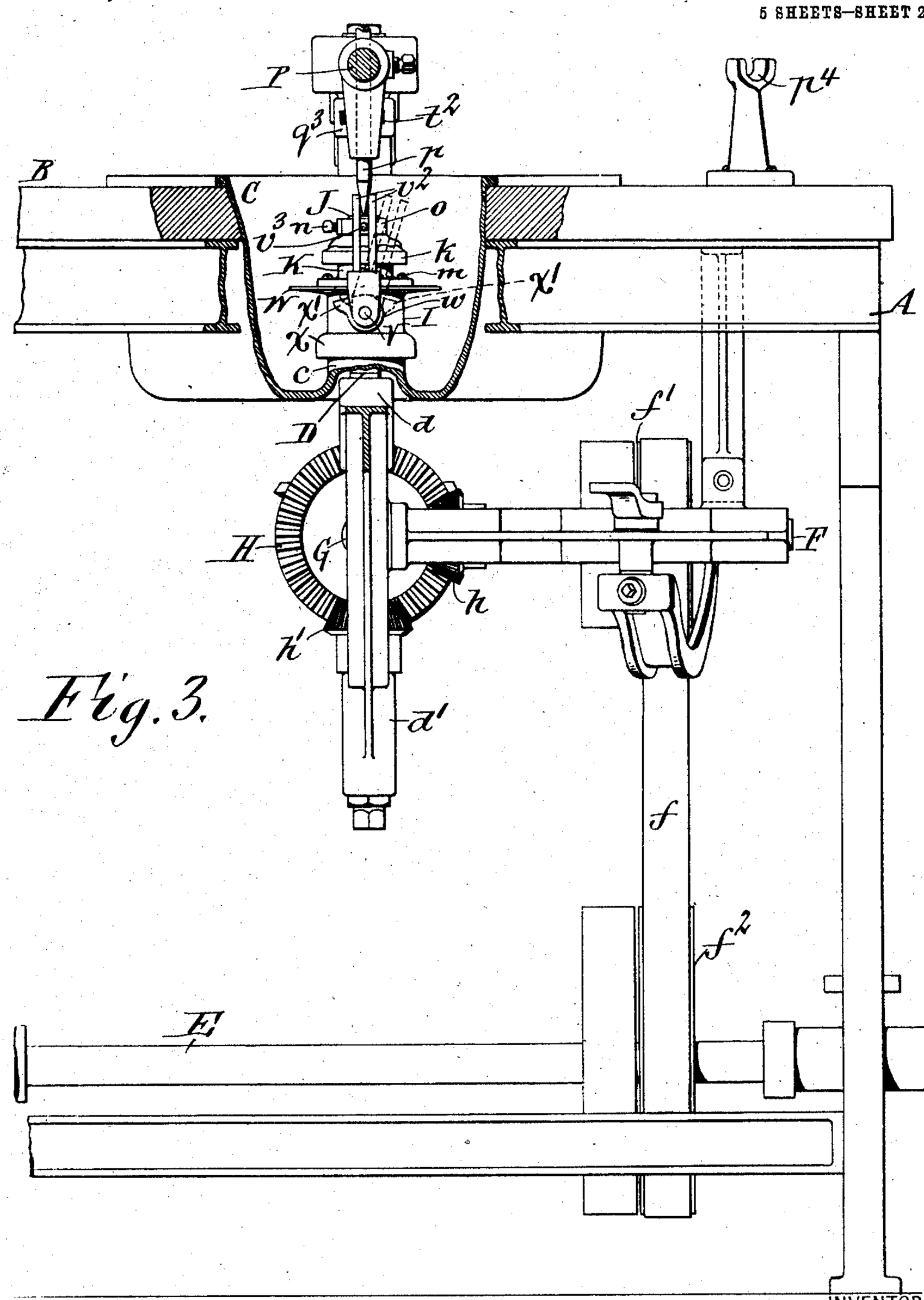

Fig. 3.

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5 SHEETS—SHEET 3.

Fig. 4.

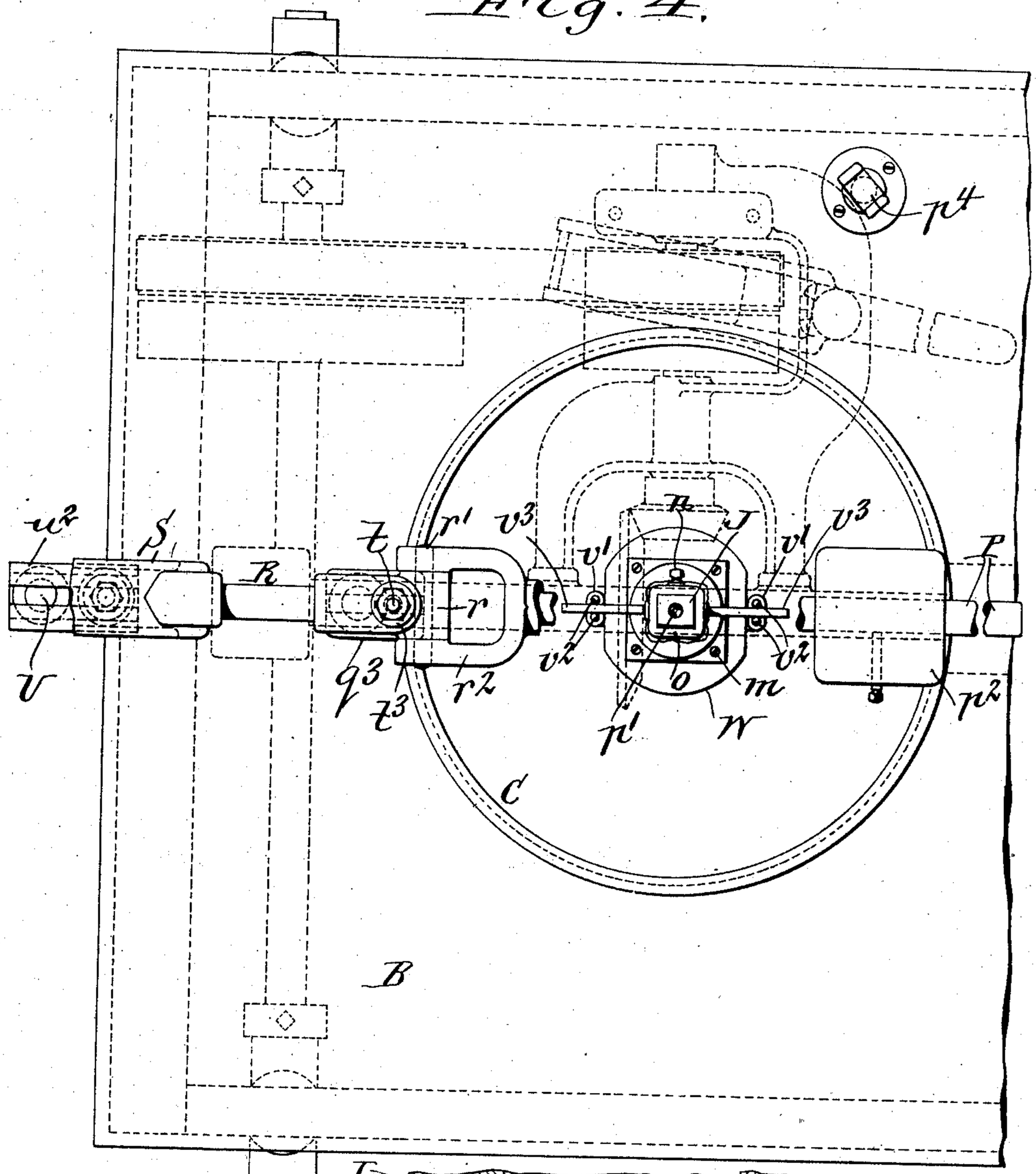

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Fig. 5.

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5 SHEETS—SHEET 4.

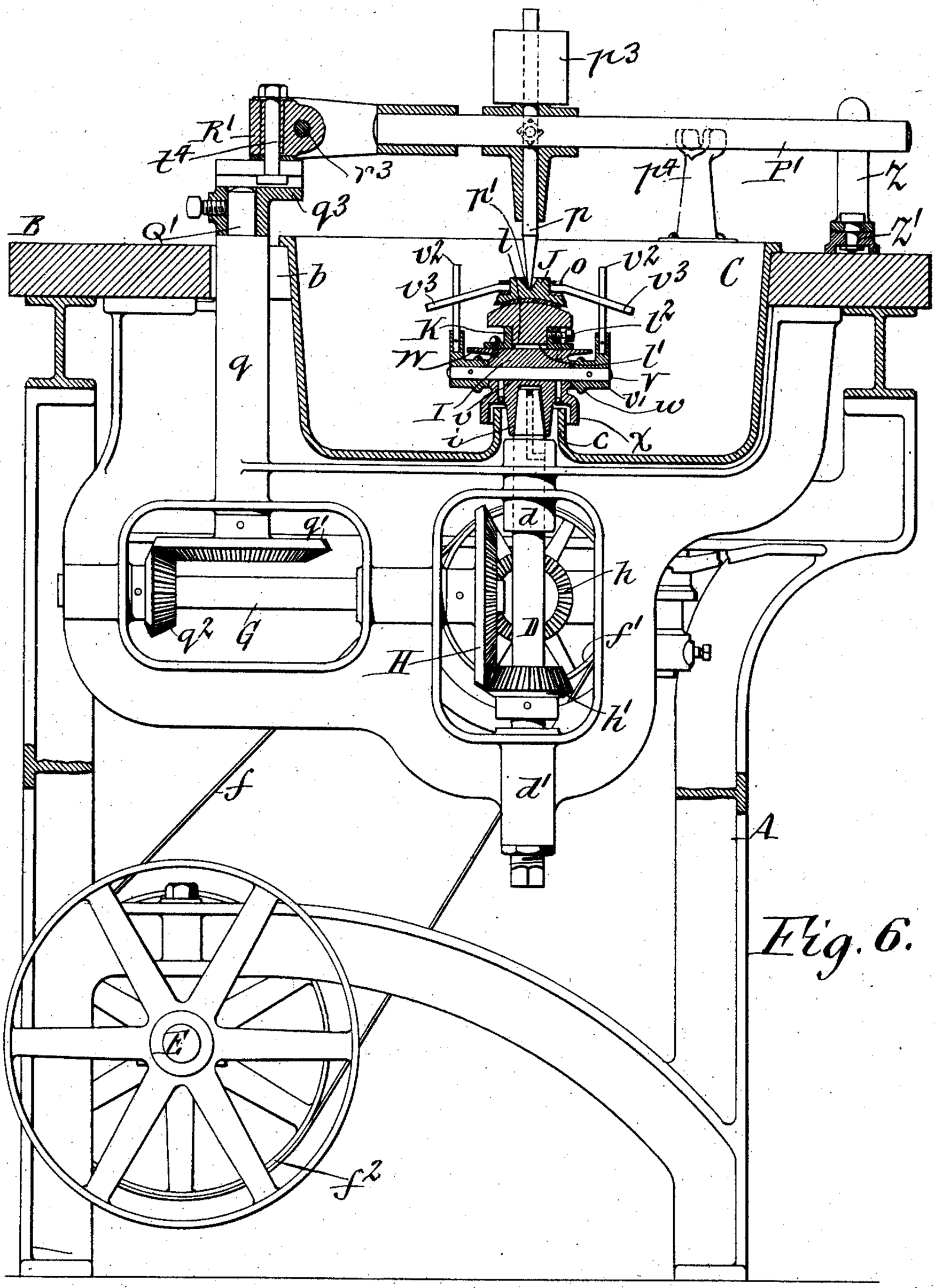

Fig. 6.

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5 SHEETS—SHEET 5.

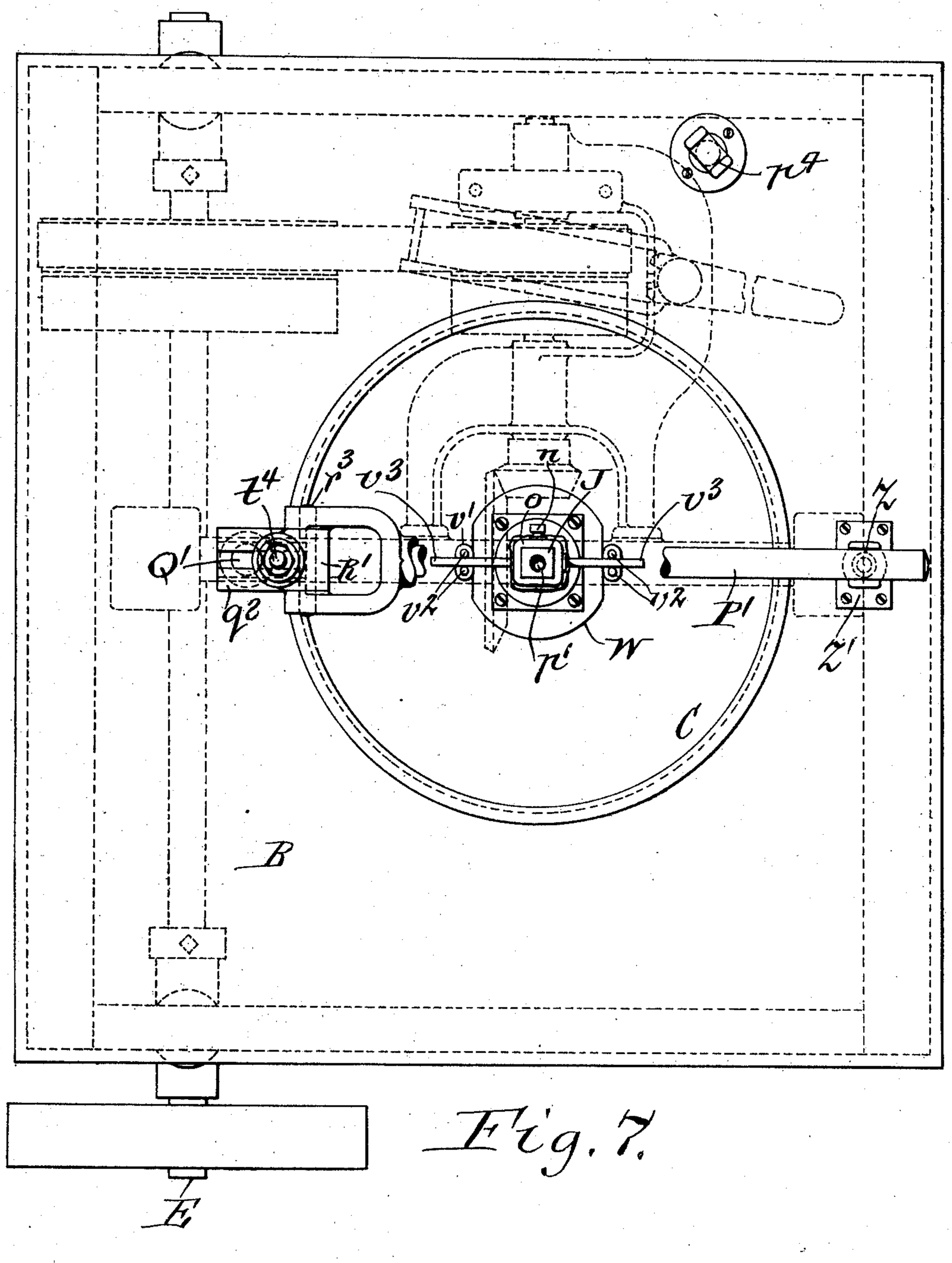

Fig. 7.

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UNITED STATES PATENT OFFICE.

ROGER F. WILLIAMS, OF BUFFALO, NEW YORK, ASSIGNOR OF TWO-THIRDS TO MARTIN L. FAILING AND ALMON J. GRAY, OF BUFFALO, NEW YORK.

LENS-GRINDING MACHINE.

970,674. Specification of Letters Patent. Patented Sept. 20, 1910.

Application filed March 16, 1910. Serial No. 549,692.

To all whom it may concern:

Be it known that I, ROGER F. WILLIAMS, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Lens-Grinding Machines, of which the following is a specification.

This invention relates to a lens grinding machine and has the object to provide a machine for this purpose whereby lenses can be ground more rapidly, which permits the parts to be shifted more quickly when putting in and taking out the lens to be ground, which can be readily adjusted to vary the extent of the grinding action to suit the lens being ground, which is provided with means for preventing the emery or other grinding material from reaching the bearings in which the rocking guide of the upper holder is journaled and also the bearings of the upright grinding spindle or shaft which supports the lower holder and associated parts, and to so construct the means for lubricating the upper holder guide and the grinding spindle so that access of the grinding material to the same is prevented.

In the accompanying drawings consisting of 5 sheets: Figure 1 is a vertical longitudinal section of one form of lens grinding machine embodying my improvements. Fig. 2 is a fragmentary side elevation of the shifting arm and centering pin of the upper holder. Fig. 3 is a fragmentary transverse section of the machine. Fig. 4 is a top plan view of the machine. Fig. 5 is a vertical longitudinal section, on an enlarged scale, showing the means for lubricating the bearings on the chuck for the upper holder guide and also the upper bearing for the grinding spindle. Fig. 6 is a vertical longitudinal section of another form of lens grinding machine containing my invention. Fig. 7 is a top plan view of the same.

Similar letters of reference indicate corresponding parts throughout the several views.

Referring to Figs. 1—5, A represents the main frame of the machine which may be of any suitable construction to support the different working parts of the machine. On the upper part of the frame is mounted a horizontal table B which contains an opening *b*. Within this opening and suspended at its edge from the table is a pan, basin or bowl C the bottom of which is provided centrally with upwardly turned tubular neck *c*. D represents the upright grinding spindle or shaft which projects at its upper end upwardly through the neck of the pan and which is journaled near its upper end and at its lower end in bearings *d*, d^1 on the front part of the frame. This spindle may be driven by various means, those shown in the drawings being preferred and comprising a main driving shaft E journaled transversely in the lower rear part of the frame, a counter shaft F journaled transversely in the upper front part of the frame and driven from the main shaft by a belt *f* and pulleys f^1, f^2, and an intermediate shaft G journaled lengthwise on the upper part of the frame and operatively connected with the counter shaft and spindle by a large bevel gear wheel H arranged on the front end of the intermediate shaft and meshing with bevel gear pinions *h*, h^1 on the adjacent parts of the counter shaft and spindle.

I represents a chuck which is arranged in the lower part of the pan and provided on its underside with a socket *i* which receives the upper end of the spindle, these parts being caused to turn together, preferably by tapering the coöperating surfaces of the socket *i* and the upper end of the spindle so that they are connected frictionally. By this means the chuck may be readily and conveniently removed from the spindle and replaced when required.

J, K represent the upper and lower holders one of which is adapted to carry the lens to be ground and the other the tool whereby the lens is ground. As is well known the lens and tool may be mounted on either of the holders and in practice they are thus interchanged according as to whether a convex or concave surface is desired on the lens and to meet other conditions. As shown in Fig. 1, the lens *j* is mounted on the upper holder and the grinding tool *k* is mounted on the lower holder. The tool is detachably connected with the lower holder by a shank *l* on the underside of the tool secured in a socket l^1 of the lower holder by a set screw l^2. The lower holder is preferably detachably secured to the upper side of the chuck by means of screws *m* passing through an external flange on the lower holder and into the chuck, thereby causing the lower holder and the tool carried thereby to revolve with the spindle. The upper holder is detachably secured by a set screw *n* in a yoke *o*.

The upper holder together with the lens secured thereto are pressed downwardly against the grinding tool by means of a horizontal front shifting bar P provided with a vertical bearing pin p which engages with a socket p^1 in the upper side of the upper holder and weights arranged either on the bar P, as shown at p^2 in Fig. 1, or on the upper end of the bearing pin, as shown at p^3 in Fig. 2.

During the turning of the lower holder the upper holder is revolved bodily with a gyrating movement in a substantially horizontal plane so as to distribute the grinding action of the tool more uniformly over the lens. The revolving movement of the upper holder may be in the same direction as the lower holder and at a different rate of speed than the latter. If, however, it is desired to grind the lens quicker the upper holder is revolved in a direction opposite to that in which the lower holder is rotated, thereby increasing the linear distance which the lens and tool travel relatively to each other and increasing the grinding effect accordingly.

The means shown in Figs. 1, 3 and 4, for effecting the gyrating movement of the upper holder comprises an upright front shaft Q journaled in a bearing q on the main frame in rear of the pan and driven by means of a bevel gear wheel q^1 at its lower end engaging with a bevel pinion q^2 on the adjacent part of the longitudinal shaft, a crank or arm q^3 arranged on the upper end of the front upright shaft Q, a horizontal rear shifting bar R arranged lengthwise over the table in rear of the pan and provided at its front end with a hub r and at its rear end with a guide S, having a longitudinal groove s in its underside, a horizontal pin r^1 which pivotally connects a fork r^2 on the rear end of the front shifting bar P with the hub r of the rear shifting bar, an upright pivot bolt t which pivotally connects said hub of the rear shifting bar with the arm q^3 on one side of its axis, a rear upright shaft U journaled in a bearing on the main frame in rear of the front upright shaft and driven by means of a pair of coöperating miter gear wheels u, u^1 secured respectively to the lower end of the rear upright shaft and the rear end of the longitudinal shaft, a crank arm u^2 arranged on the upper end of the rear upright shaft, and a crank bolt u^3 mounted on the rear arm u^2 on one side of its center and provided with a roller s^1 which moves lengthwise in the groove s of the rear guide S.

The rotation of the front crank arm causes the upper holder to move forward and backward lengthwise of the machine and the rotation of the rear crank arm causes the upper holder to reciprocate transversely of the machine and the combination of these two movements results in a revolution of the upper holder.

When it is desired to have the upper holder turn in the same direction as the lower holder the driving bevel gearing is arranged, as shown in full lines in Fig. 1, in which the bevel wheels at the lower ends of the front and rear upright shafts engage in front of their axes with their companion bevel wheels on the longitudinal shaft and the bevel wheel of the driving or grinding spindle engages with its companion bevel wheel on the longitudinal shaft below the axis of the latter, thereby producing a comparatively slow grinding action on the lens.

For accelerating the grinding action the gearing may be so arranged that the upper and lower holders move circularly in opposite directions, this being effected for instance by shifting the bevel pinion which drives the bevel wheel of the front upright shaft so as to engage this bevel wheel on its left side, as shown by dotted lines in Fig. 1.

As shown in the drawings, the diameter of the bevel wheel q^1 of the front upright shaft is greater than the diameter of the bevel pinion q^2 which drives the same while the miter gears u, u^1 which drive the rear upright shaft are of the same diameter. By this means the upper holder is reciprocated transversely a greater number of times in proportion to the longitudinal reciprocations thereof, whereby the resultant movement of the upper holder corresponds to that of an engraving engine and the grinding action is distributed more uniformly.

For the purpose of permitting of varying the extent of the longitudinal throw of the upper holder to suit the size of the lens and other conditions, the pivot bolt t is mounted on the arm q^3 so as to be capable of radial adjustment thereon, this being preferably effected by engaging the head t^1 of this bolt with an undercut radial slot t^2 in said arm. Upon loosening the nut t^3 of the bolt t the same may be shifted lengthwise in the slot t^2 and after adjustment the same may be held in place on the arm q^3 by tightening the nut t^3.

The throw of the rear crank arm u^2 may also be varied to change the extent of transverse reciprocation of the upper holder to suit the size or character of the lens, this being preferably effected by adjustably securing the head of the bolt u^3 in an undercut radial groove s^2 in the crank arm u^2, as shown in Fig. 1.

The lens is maintained in parallelism so as to grind a cylindrical surface on the same. The preferred means for effecting this comprises a horizontal guide rock shaft V journaled transversely in a bearing v formed in the chuck and extending at its opposite ends beyond the sides of the chuck, upright guide

forks arranged on opposite sides of the chuck and each having a hub v^1 secured to one end of the shaft and two prongs v^2 projecting upwardly from the hub v^1, and two guide arms v^3 projecting laterally from opposite ends of the yoke o and each arranged between the prongs of one of the forks, as shown in Figs. 1, 3 and 4.

As the upper holder moves lengthwise the guide arms v^3 slide lengthwise through the guide forks and as the upper holder moves laterally the guide arms v^3 and the forks move laterally together, thereby always keeping the cylindrical axis of the lens in place.

The arms v^3 are bent or inclined downwardly from the yoke o, thereby permitting of making the guide forks shorter and reducing the amount of obstruction above the holders, so that the parts are more accessible for inspection and more convenient when assembling and dismembering the same.

In the absence of any provision to prevent it the emery or other grinding material will work into the bearing v of the chuck in which the guide shaft V is journaled. To prevent this a deflector or flange W is provided which extends laterally from the side of the chuck over the hubs v^1 of the forks and beyond the space between these hubs and the chuck, as shown in Figs. 1, 3 and 4. Any emery which is washed down by the water from the tool and lens holders is by this deflector carried outwardly beyond the joint between the fork hubs and the chucks and then permitted to drop into the pan, thereby preventing cutting of the bearing v^1 and unduly wearing the same which otherwise would occur if the emery were permitted to reach this bearing. To further prevent any emery from reaching this bearing each of the fork hubs v^1 is provided with an annular guard flange w between the outer edge of the deflector and the inner end of the hub, as shown in Figs. 1 and 5. Any emery dropping from the deflector on to the outer ends of the hubs v^1 is prevented by the guard flanges w thereof from reaching the bearing v but is directed downwardly to the bottom of the pan.

For the purpose of preventing any emery or other grinding material from spilling over the neck of the pan or bowl and reaching the upper bearing of the grinding spindle, a guard device is provided consisting of an annular shield, hood or flange x which depends from the lower part of the chuck and overhangs the outer side of the upper part of the neck c, as shown in Figs. 1, 3 and 5. The emery dropping upon the bottom of the pan is thus prevented from splashing over the upper edge of the neck c and eventually reaching the bearing of the grinding spindle and wearing the same rapidly.

When the upper holder is removed from the machine with the yoke and its arms the lower guide forks would drop down to the bottom of the pan and become coated with emery slush which is objectionable and also inconvenient when it comes to reassembling the parts for continuing the grinding operation. To prevent this a stop device is provided which limits the laterally swinging movement of the forks in both directions. This stop device preferably consists of a stop or lug x^1 arranged on the hub v^1 of each fork and adapted to engage with the underside of the deflector so as to prevent the forks from turning much beyond the extreme range of movement which it is able to take during the operation of the machine. Each of the fork hubs v^1 is provided with but a single stop x^1, one fork hub having its stop on one side of its axis and the other fork hub having its stop on the other side of its axis, whereby the construction is simplified, and but one pattern is required for making both fork hubs, thereby reducing the cost.

When the upper holder is removed from the machine, the front shifting bar P is turned to one side of the center of the pan, so as to clear the space above the holders and at this time said bar is temporarily supported at its free front end in a rest p^4 arranged on the upper side of the table but if desired the same may be folded backwardly over the rear shifting bar.

Oil is applied to the bearing v for lubricating the shaft V by means of two oil openings or ducts y which extend upwardly from the underside of the chuck between the socket thereof and its guard flange or shield. When it is desired to oil the bearing v the chuck is removed from the grinding spindle and inverted to permit the oil introduced into the openings y to flow to the bearing v. These openings are normally closed by spring pressed valves or stoppers y^1, as shown in Fig. 5. By locating the oil openings for the bearing v on the underside of the chuck the same are not liable to become filled with emery and thus interfere with lubrication of the guide shaft.

Lubrication of the upper bearing d of the grinding shaft D is effected through a duct or opening y^2 which leads downwardly from the upper end of this shaft and laterally to the bearing d and which is normally closed by a spring pressed valve y^3 located at the inlet of this duct. Oil can be introduced into this duct when the chuck is removed but when the latter is replaced this duct is protected against the entrance of emery from the pan.

In the modified construction of the machine shown in Figs. 6 and 7, the rear upright shaft and connections are omitted and the front shifting bar P^1 is pivoted by a horizontal pin r^3 to swing vertically on a

block R^1 which is adjustably connected by a vertical pivot bolt t^4 with the crank arm q^3 of the shaft Q^1 and the front end of the bar P^1 engages with an upright fork z which is pivoted at its lower end on a base z^1 secured to the table so as to turn horizontally. As the crank arm q^3 rotates it imparts a horizontally revolving motion to the upper holder and during this movement the shifting bar P^1 slides lengthwise in the fork z and turns horizontally therewith in following the movements of the crank arm q^3.

It will be noted that each of the pivotal connections between the block R and the arm P and crank q^3 in Fig. 1, and between the block R^1 and the arm P^1 and crank q^3 form universal joints which permit the upper tool holder to change its position relative to its operating mechanism without producing binding or cramping. While this form of universal joint is preferred any other suitable form of this joint may be employed.

I claim as my invention:

1. A lens grinding machine comprising cooperating upper and lower holders, an upright spindle which is journaled in fixed bearings and upon which one of said holders is mounted, a shifting bar operatively connected with the upper holder, and means for revolving said bar bodily together with the holder associated therewith in a substantially horizontal plane comprising an upright shaft, a crank arm which is arranged at the upper end of said shaft and a universal joint connecting said crank arm and bar.

2. A lens grinding machine comprising cooperating upper and lower holders, an upright spindle which is journaled in fixed bearings and upon which one of said holders is mounted, a shifting bar operatively connected with the upper holder, and means for revolving said bar bodily together with the holder associated therewith in a substantially horizontal plane comprising an upright shaft, a crank arm which is arranged at the upper end of said shaft, and a block which is pivoted vertically on said crank on one side of the axis of the latter and to which said bar is pivoted horizontally.

3. A lens grinding machine comprising cooperating upper and lower holders, an upright spindle which is journaled in fixed bearings and upon which one of said holders is mounted, a front shifting bar operatively connected with said upper holder, a rear shifting bar connected with the front shifting bar, a crank arm pivotally connected with the rear shifting bar, and another crank arm slidingly connected with the rear shifting bar.

4. A lens grinding machine comprising coöperating upper and lower holders, an upright spindle which is journaled in fixed bearings and upon which one of said holders is mounted, a front shifting bar operatively connected with said upper holder, a front crank arm, a rear shifting bar having a hub pivoted vertically on said front crank arm and to which said front shifting bar is pivoted horizontally, a rear crank arm, and a connection between said rear arm and said rear shifting bar which is slidable lengthwise on the latter.

5. A lens grinding machine comprising coöperating upper and lower holders, an upright spindle which is journaled in fixed bearings and upon which one of said holders is mounted, a front shifting bar operatively connected with said upper holder, a front crank arm, a rear shifting bar having a hub which is pivoted vertically on said front crank arm and to which said front shifting bar is pivoted horizontally, a rear crank arm, a connection between said rear arm and said rear shifting bar which is slidable lengthwise on the latter, a front upright shaft carrying the front arm, a rear upright shaft carrying the rear arm, and a horizontal shaft connected by gearing with said spindle and front and rear shafts.

6. A lens grinding machine comprising coöperating upper and lower holders, means for rotating the lower holder, and means for revolving the upper holder relatively to the lower holder comprising a shifting bar operatively connected with the upper holder, a rotatable crank arm on which one end of said shifting bar is pivotally mounted to turn horizontally, and a guide mounted on a stationary part of the machine and receiving the other end of said bar.

7. A lens grinding machine comprising a pair of coöperating upper and lower holders, a rotatable chuck supporting the lower holder, a horizontal rock shaft journaled in the chuck below its upper end, and upright forks arranged on opposite sides of the chuck and each having a hub secured to one end of said shaft, and provided with an annular flange between its inner and outer end.

8. A lens grinding machine comprising a pair of coöperating upper and lower holders, a rotatable chuck supporting the lower holder, a horizontal rock shaft journaled in the chuck below its upper end, upright forks arranged on opposite sides of the chuck and each having a hub secured to one end of said shaft, and a deflector arranged on the upper part of the chuck and projecting laterally over the hubs of said forks, each of said hubs having an annular flange between its inner end and the outer edge of said deflector.

9. A lens grinding machine comprising a pair of coöperating upper and lower holders, a yoke connected with the upper holder and provided on opposite sides with guide arms, a rotatable chuck supporting the lower

holder, a horizontal rock shaft journaled in the chuck below its upper end, upright forks arranged on opposite sides of the chuck and each embracing one of said guide arms and having a hub secured to one end of said shaft, and a stop device independent of said guide arms for limiting the rocking movement of said shaft and forks when said guide arms are disengaged from said forks.

10. A lens grinding machine comprising a pair of coöperating upper and lower holders, a rotatable chuck supporting the lower holder, a horizontal rock shaft journaled in the chuck below its upper end, upright forks arranged on opposite sides of the chuck and each having a hub secured to one end of said shaft, a deflector arranged on the upper part of the chuck and projecting laterally over the hubs of said forks, and a stop device for limiting the rocking movement of said shaft and forks comprising a single lug arranged on each hub and adapted to engage with the underside of said deflector, the lug of one hub being arranged on one side of the axis of the shaft and the lug of the other hub on the other side of said axis.

Witness my hand this 12th day of March, 1910.

ROGER F. WILLIAMS.

Witnesses:
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