J. A. LINCOLN.

LENS GRINDING MACHINE.

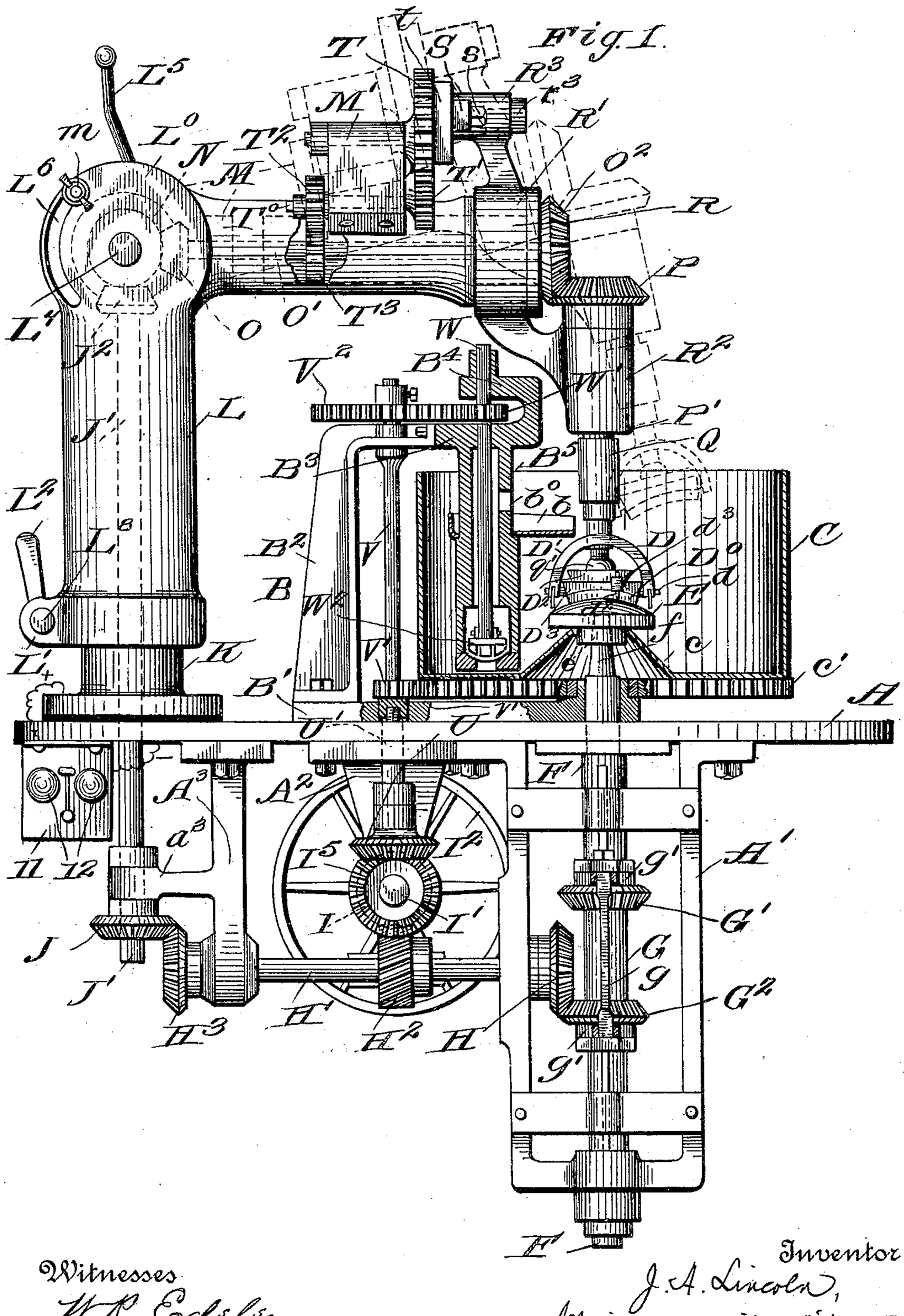
APPLICATION FILED MAR. 9, 1910.

978,764.

Patented Dec. 13, 1910.

6 SHEETS—SHEET 1.

Fig. 1.



Witnesses

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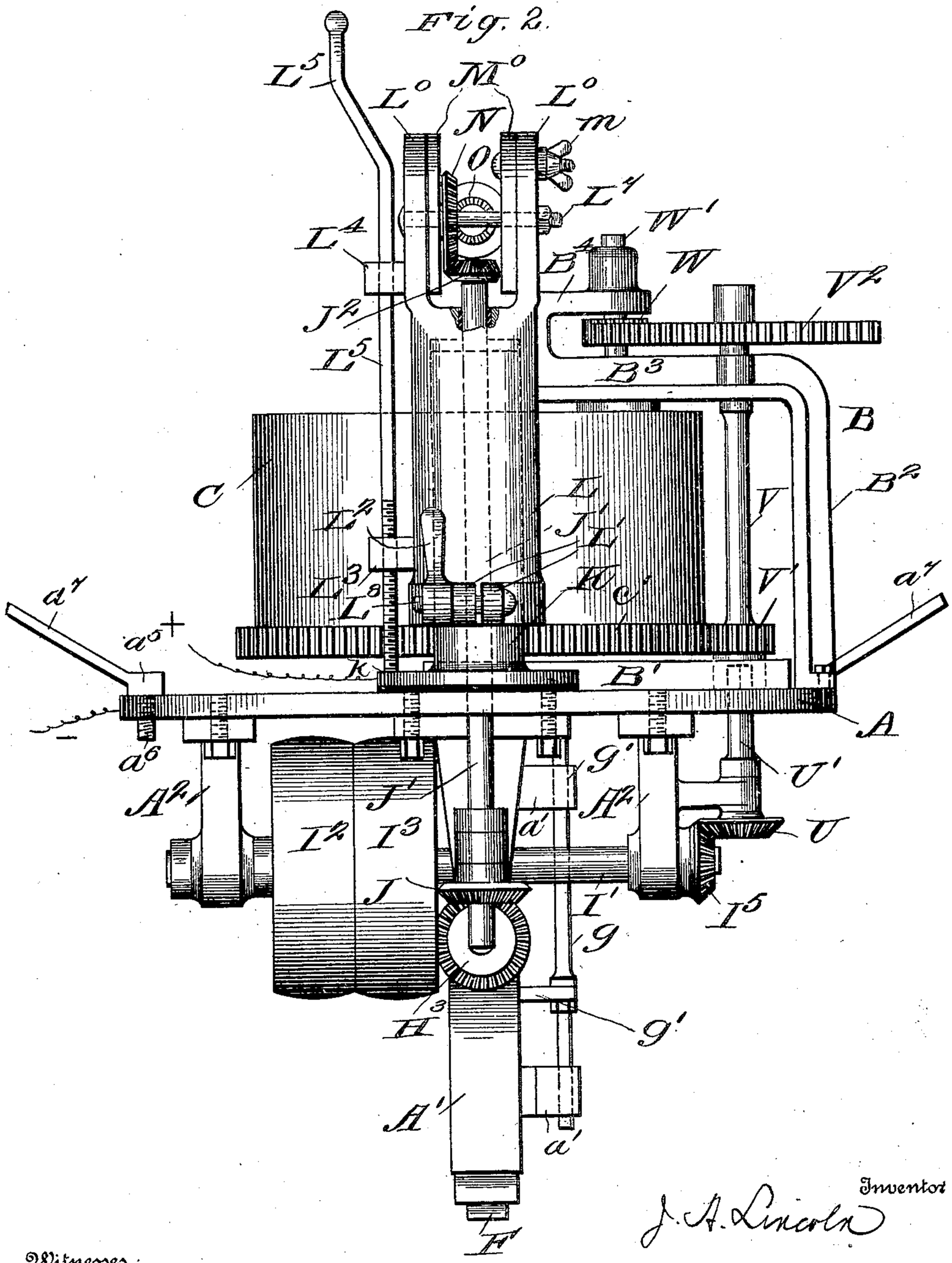
6 SHEETS—SHEET 2.

Fig. 2.



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6 SHEETS—SHEET 3.

Fig. 3.

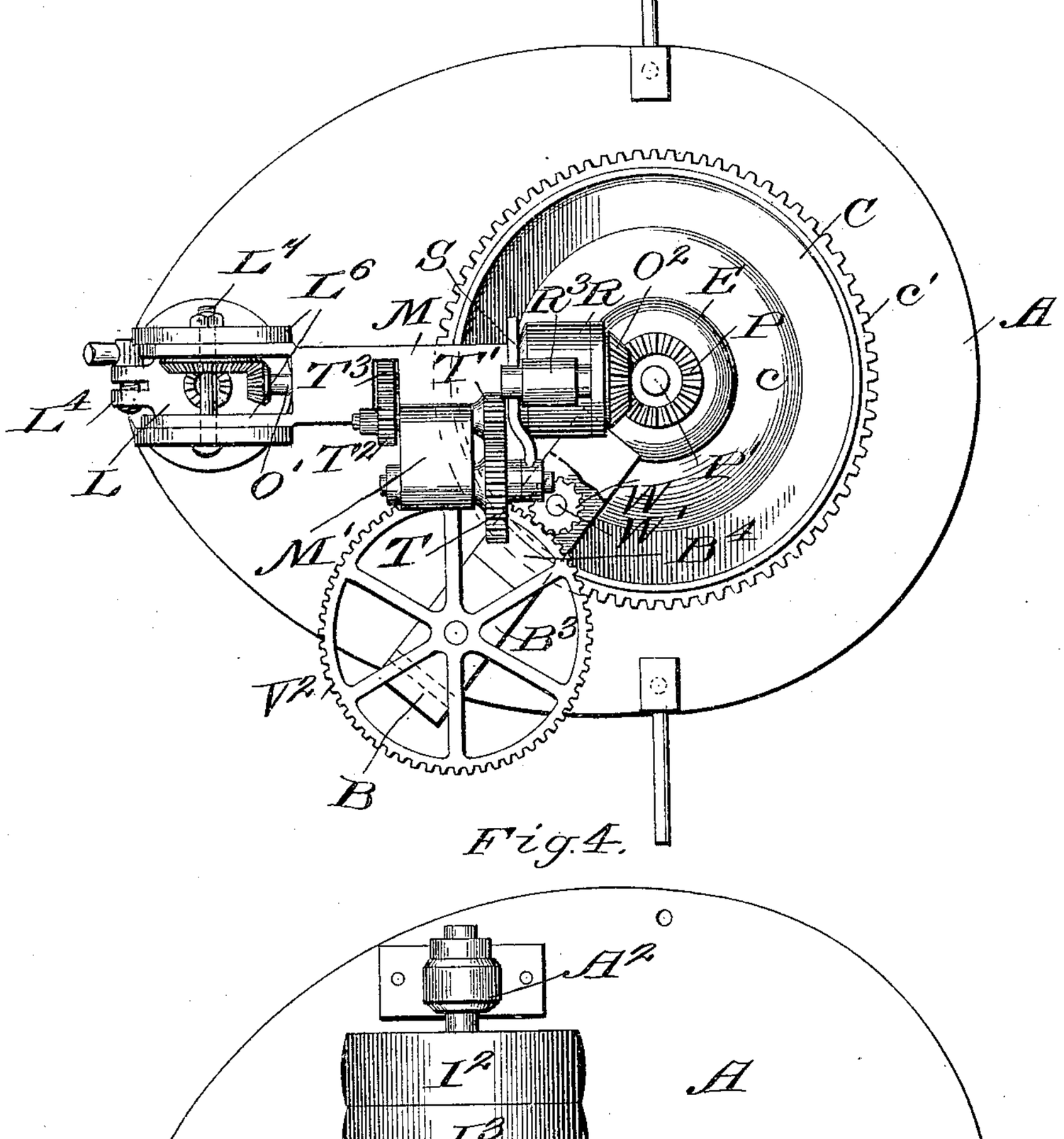
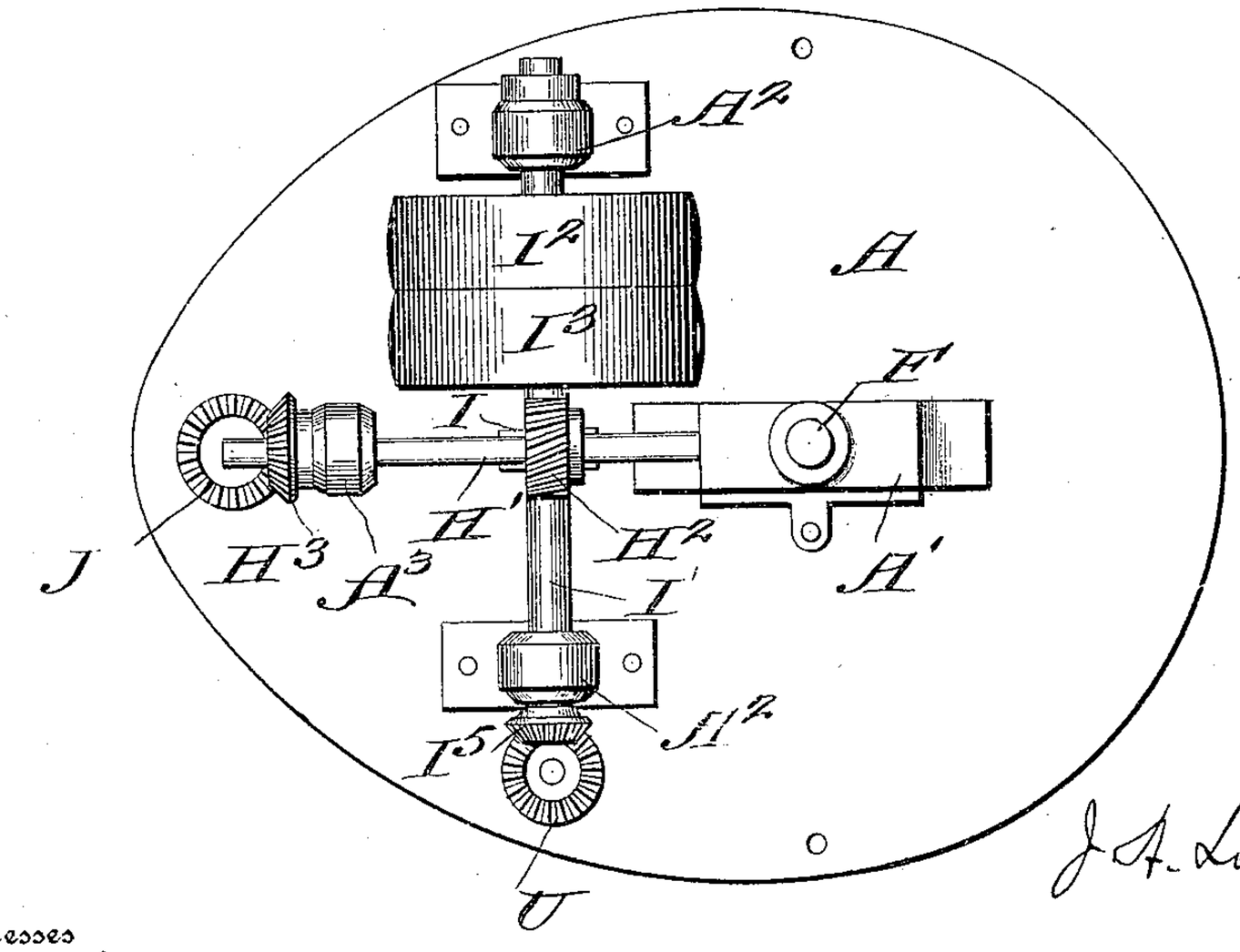


Fig. 4.



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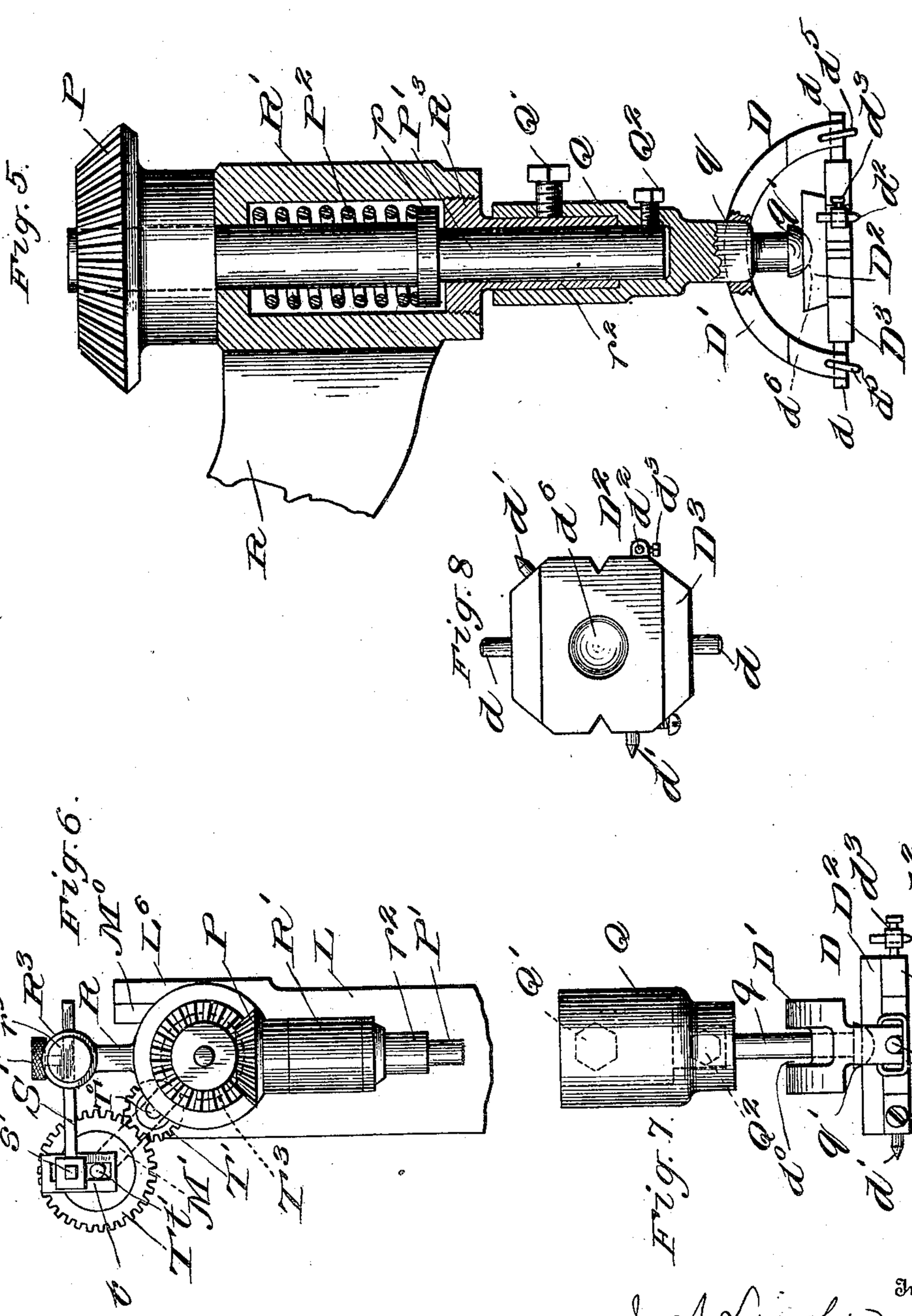
6 SHEETS—SHEET 4.



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6 SHEETS—SHEET 5.

Fig. 9.

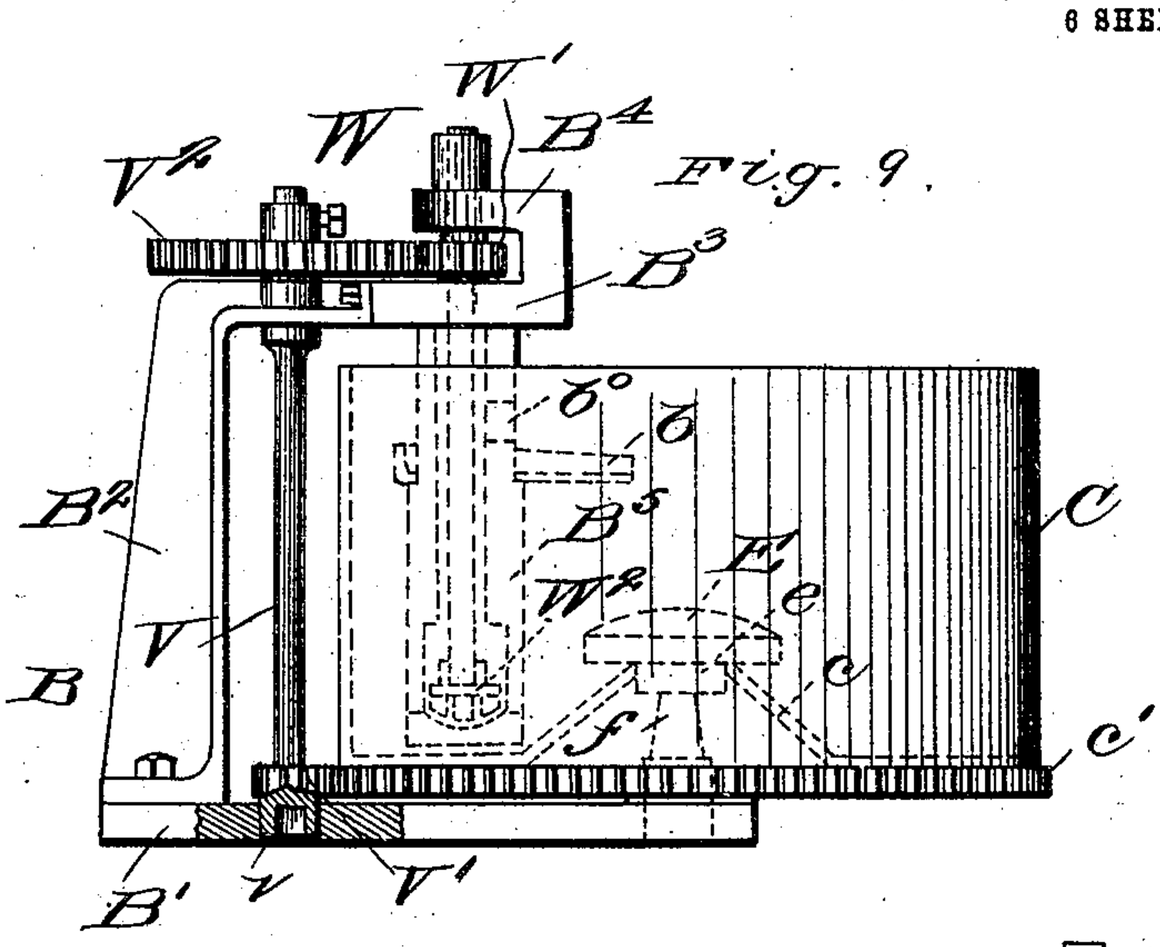


Fig. 10

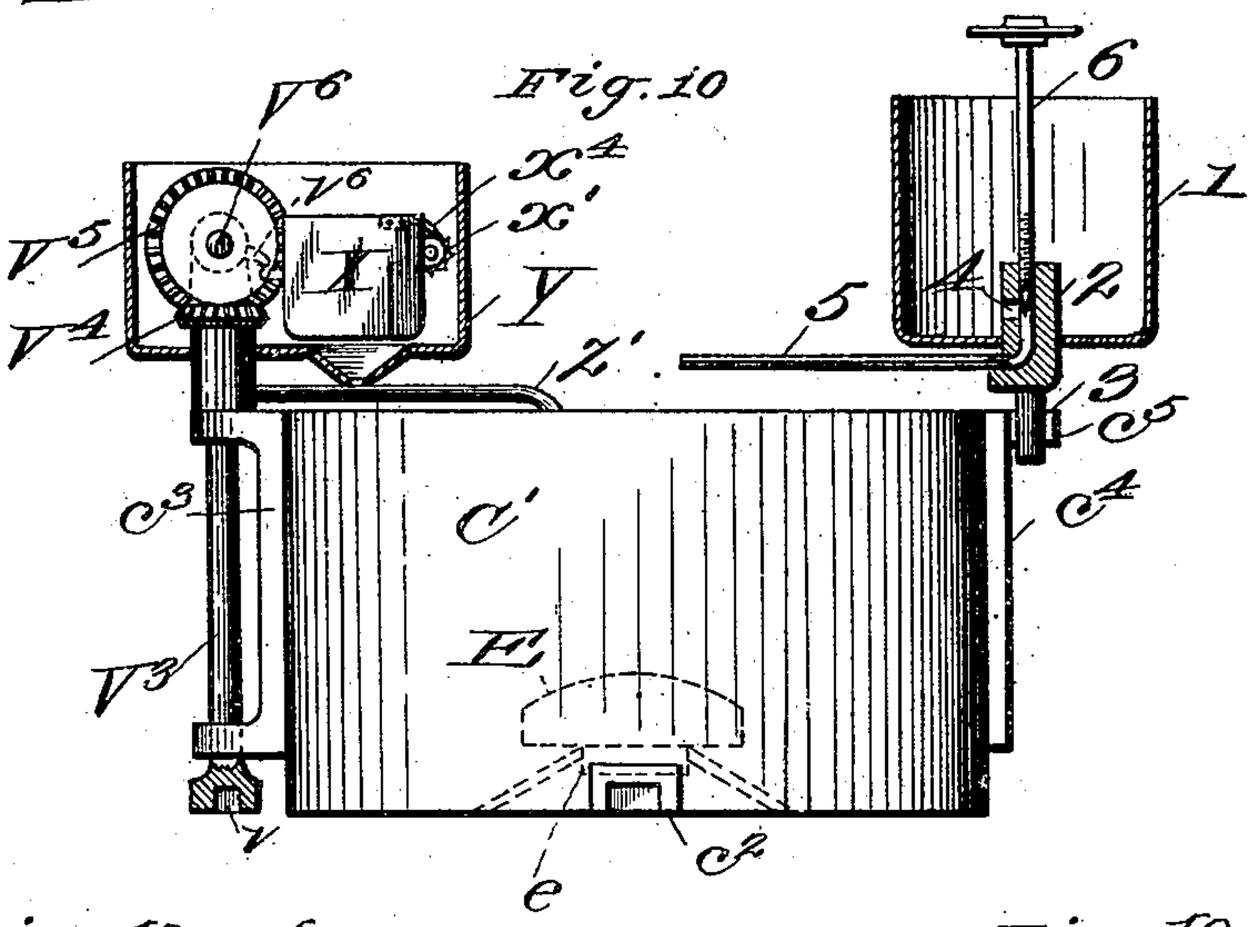


Fig. 11.

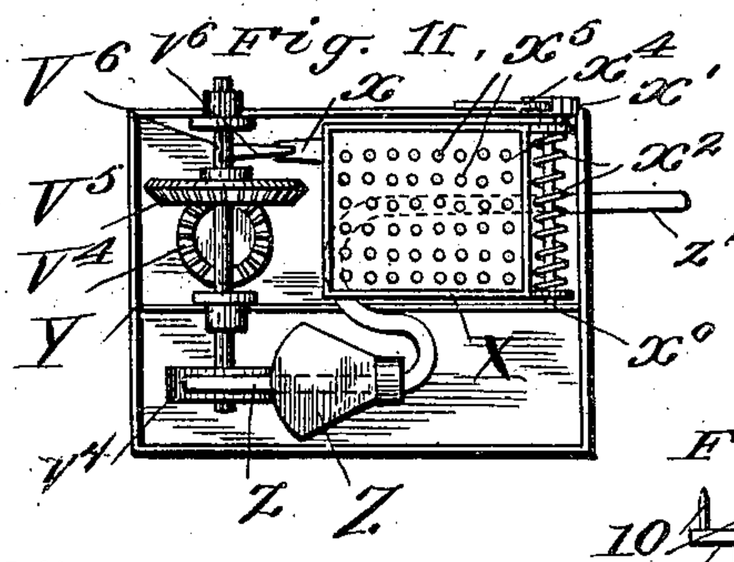


Fig. 12.

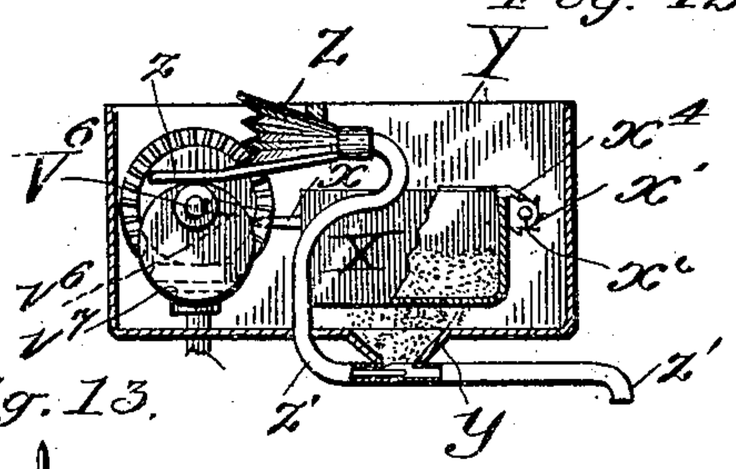
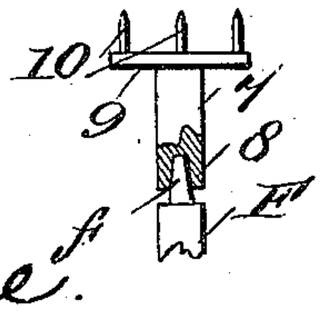


Fig. 13.



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APPLICATION FILED MAR. 9, 1910.

978,764.

Patented Dec. 13, 1910.

6 SHEETS—SHEET 6.

Fig. 14.

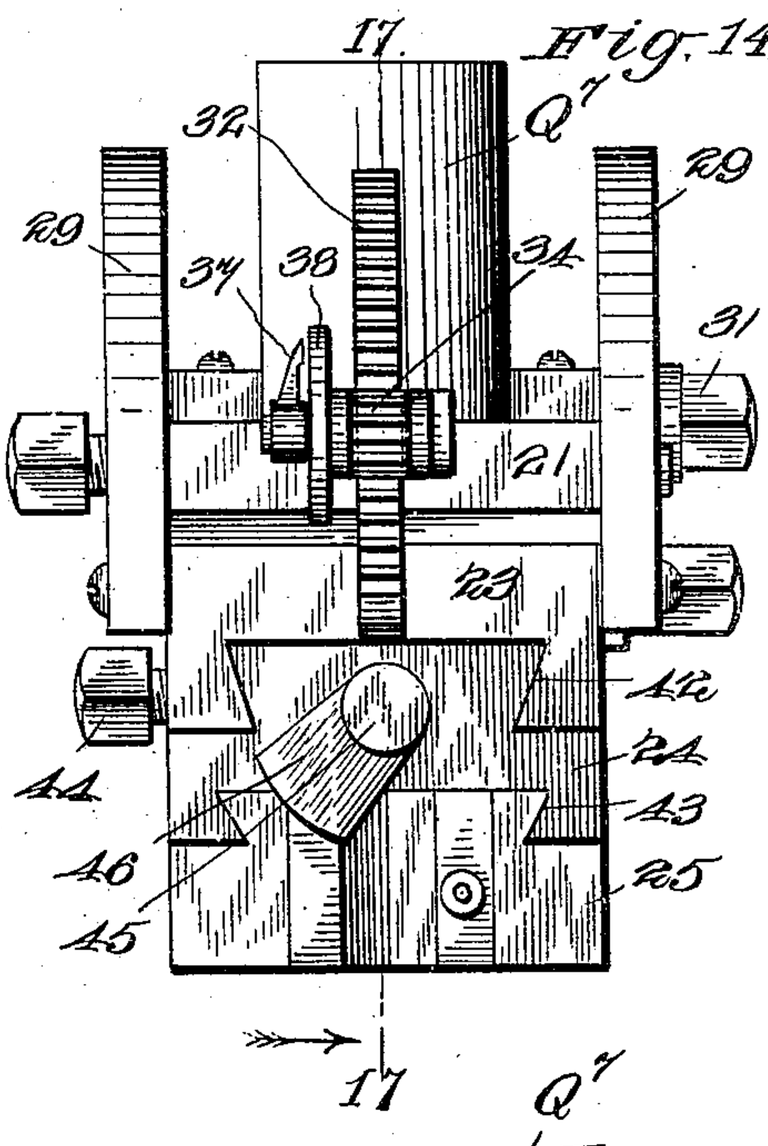


Fig. 16.

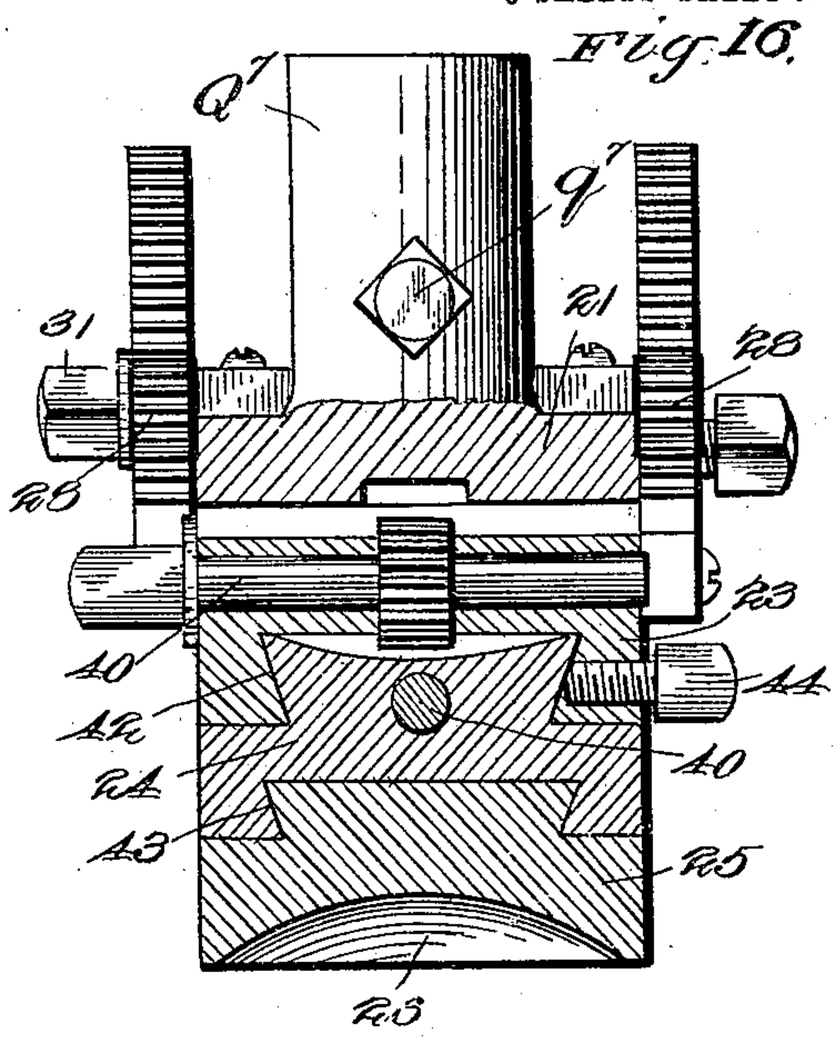


Fig. 15.

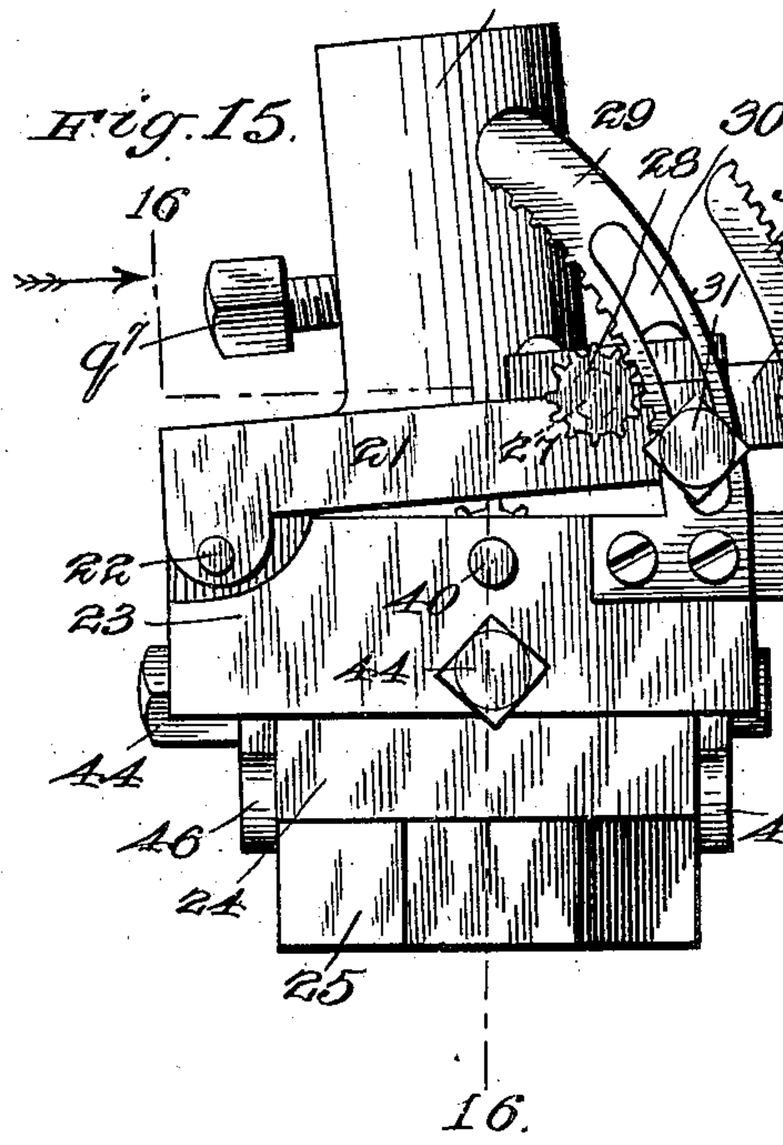
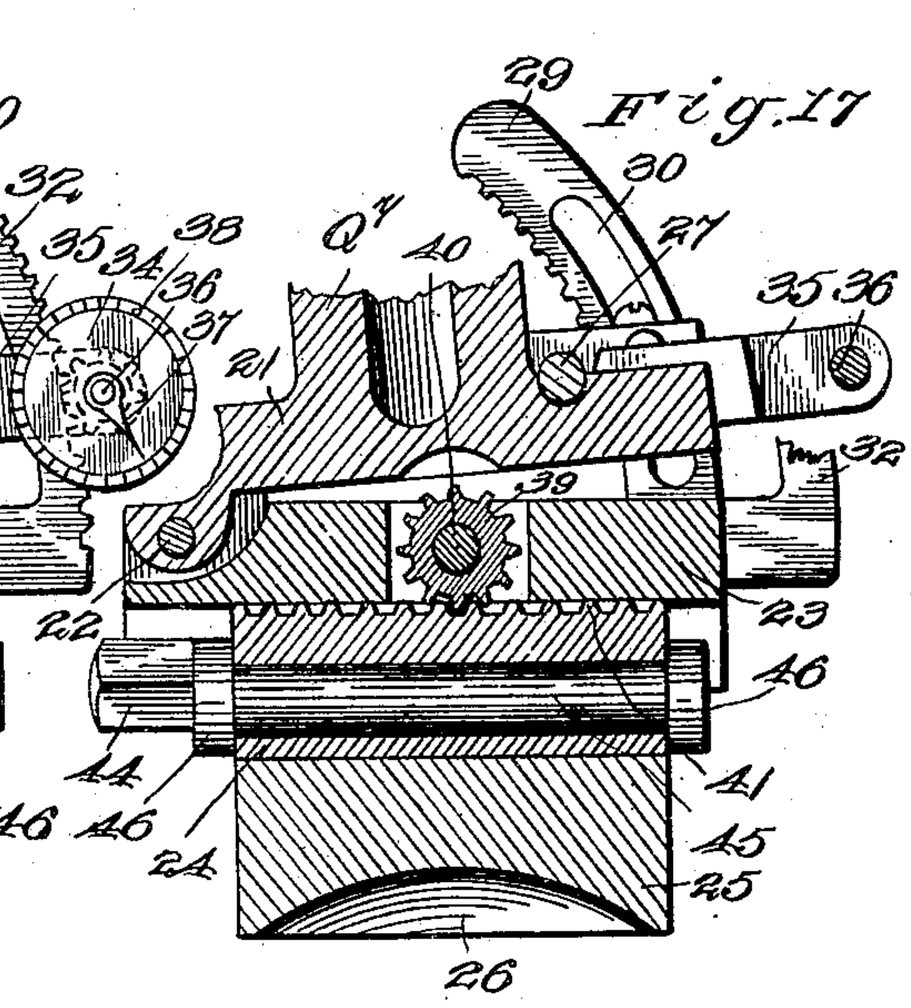


Fig. 17.



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UNITED STATES PATENT OFFICE.

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LENS-GRINDING MACHINE.

978,764. Specification of Letters Patent. **Patented Dec. 13, 1910.**

Application filed March 9, 1910. Serial No. 548,252.

To all whom it may concern:

Be it known that I, JOSHUA ANTHONY LINCOLN, a citizen of the United States, residing at New Orleans, in the parish of Orleans and State of Louisiana, have invented certain new and useful Improvements in Lens-Grinding Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in apparatus for grinding lenses.

It is especially intended to provide an apparatus adapted to perform mechanically in any of the features of grinding that are ordinarily performed by hand.

In the ordinary process for grinding lenses, the lens is first secured to a suitable holder, as by cementing the same to said holder, and the process of grinding consists of four separate steps. In the first step, the rough grinding takes place, using coarse emery; during the second step, finer emery or carborundum is used with closer approximation to the desired result. In these two first steps, the emery or carborundum is used wet; in the third step the powdered emery or carborundum is used either slightly moistened or dry, and in the fourth step the ground lens is polished with the use of suitable polishing material. According to my invention, the same general design of mechanism is used for all four steps, and the major portion of the mechanism is used in all of the steps, but in shifting from the coarser to the finer wet grinding, or from the wet to the dry grinding or polishing, a substitution of parts is desirable, as will be hereinafter more fully described.

Reference is had to the accompanying drawings, in which the same parts are indicated by the same letters and numerals throughout the several views.

Figure 1 is a side view of the complete machine as used in either of the wet steps of the process, parts being broken away, the pan being shown in central vertical section, and the supports for the table being omitted, for the sake of clearness in the drawings. Fig. 2 is an end view of the device shown in Fig. 1, as seen from the left of said figure, parts being broken away, and the support for the table being omitted. Fig. 3 is a plan view of the mechanism shown in Figs. 1 and 2, but on a smaller scale. Fig. 4 is an inverted plan view of the mechanism shown in Figs. 1 and 2, but with the supports for the table omitted for the sake of clearness in the drawings. Fig. 5 shows a swinging head carrying the revoluble lens holder, parts being shown on a larger scale than in the preceding figures. Fig. 6 is a front view of the end of the swinging and vibrating arm carrying the lens holder. Fig. 7 shows the lens holder and support for the same detached from the apparatus. Fig. 8 is a detail view, showing in plan the block to which the lens is attached. Fig. 9 shows in elevation the pan and attached parts, used in the wet process, detached from the machine, the said parts being shown in section in Fig. 1. Fig. 10 shows the pan and attached parts used in the dry or partly dry steps of the operation, parts being shown in section. Fig. 11 is a plan view of the apparatus for delivering and distributing the polishing dust, detached from the pan. Fig. 12 is a sectional view of the apparatus shown in plan in Fig. 11. Fig. 13 is a fragmentary view showing a gage for setting the hinged arm carrying the lens holder. Figs. 14 to 17 show a modified form of holder for use in grinding prismatic lenses, the device being shown detached from the machine and on an enlarged scale. Fig. 14 is an end view of the device. Fig. 15 is a side view. Fig. 16 shows a section along the broken lines 16—16 of Fig. 15, and looking in the direction of the arrows, and Fig. 17 shows a section along the lines 17—17 of Fig. 14, and looking in the direction of the arrows.

Referring first to Figs. 1 to 9, inclusive, A represents a table or platform mounted upon suitable supports, not shown, and provided with dependent frames A', A^2, A^3 (see Figs. 1, 2, and 4), in which dependent frames shafts are journaled, as will be hereinafter described.

B, shown in Figs. 1, 2, 3, and 9 represents a removable frame, which is mounted on top of the table A, and is provided with a bottom piece or bed plate B', a vertical pillar B^2, and an arm B^3, bent over at B^4 to form a yoke, as shown in Figs. 1 and 9. Journaled on the bed plate B' is the pan C, provided with a bottom whose center is a truncated cone *c*, provided with an opening in the center thereof, as shown in Fig. 1. Fast

to this pan is a circular rack c', by which said pan may be turned as hereinafter described.

D represents the lens holding attachment, holding the lens D^0, the details of which attachment will be hereinafter more fully described.

E represents the lens grinding disk, shown in the drawings as convex, and therefore adapted to grind the concave side of the lens. Where the convex side of the lens is to be ground, this disk would, of course, be concave, or if the lens is to be ground plane, then a flat disk would be employed. This disk E is provided with a conical socket e, which slips over the conical end f of the shaft F, journaled in the frame A', and projecting through the table A, as shown most clearly in Fig. 1. This shaft has a spacing sleeve G loosely mounted thereon, see Fig. 1, at each end of which are reversely disposed bevel gears G', G^2, adapted to engage, respectively, with a bevel gear H. These two gears G', G^2 are splined to the shaft F, and are held against the sleeve G, but in revoluble contact therewith by means of a frame having arms g' connected to the rod g, which rod is adapted to slide in bearings a' on the frame A', and suitable reversing means for moving this rod are provided, whereby one or the other of the bevel gears G', or G^2, is thrown into engagement with the shaft H, and thus the shaft F may be rotated in reverse directions at the will of the operator. This bevel gear H is mounted on a shaft H' (see Fig. 1), which shaft carries a worm gear H^2, meshing in a worm I, shown in dotted lines in Fig. 1, fast on the shaft I'. This shaft I' carries fast and loose pulleys I^2 and I^3, driven from a suitable belt, not shown. Obviously, any other suitable means for driving the shaft I' may be adopted, if desired. The other end of the shaft H' carries a bevel gear H^3, meshing with the bevel gear J, on the shaft J', which shaft is journaled in the arm a^3 of the frame A^3, and projects up through the cylindrical block K, carried by the table A.

L represents a housing adapted to be adjusted vertically upon the block K, as by means of the ears L' and the clamp nut L^2, which engages the screw L^8. This housing L is provided with an arm L^3, internally screw-threaded to engage the screw-threads on the lower portion of the adjusting rod L^5, the lower end of which rod bears against the flange on the block K, shown in Fig. 2. This adjusting rod L^5 rotates in the guide L^4, shown in Fig. 2. This housing L is provided at its upper end with a yoke having two parallel plates L^0, in which the end plates M^0 of the hinged arm M are hinged on the bolt L^5, and this arm M is set at a desired angle with the housing L, by means of the clamp screw m, which passes through the slot L^6, in one of the plates L^0, as shown in Figs. 1 and 2.

Journaled on the bolt L^7 is a bevel gear N (see Figs. 1 and 2) meshing with the bevel gear J^2 on the shaft J', and also with a bevel gear O on the shaft O', which shaft is journaled in the hinged arm M, as shown in Fig. 1. Secured to the outer end of this shaft O' is a bevel gear O^2, which meshes with the bevel gear P, journaled in the sleeve R^2 on the frame R, which frame is revolubly mounted on the hinged arm M, as b ymeans of a sleeve R', journaled on said arm M, as shown in Fig. 1. The purpose of revolubly mounting this frame R on the hinged arm is to provide a rocking movement to the lens holder, as will be hereinafter described.

The bevel gear P (see Figs. 1 and 5) is mounted on a shaft P', having an annular rib or washer p, pressed against by a spring P^2, mounted in the sleeve R', which tends to press said shaft downward. This shaft is journaled in the sleeve R^3, secured in the sleeve R', as shown in Fig. 5, said sleeve R^3 having a reduced portion r^2, beyond which the lower end of the shaft P' projects, as shown in Figs. 5 and 6.

Q represents a socket, adapted to slip over the lower end of the shaft P', and the reduced portion r^2 of the sleeve R^3, and this socket carries two clamp screws Q' and Q^2, adapted to engage the part r^2 and the shaft P', respectively, as shown in Fig. 5. The lower end of the socket Q is preferably flattened, as at q, to pass through the slot d^0 in the curved bar D, and the lower end of the socket piece terminates in a ball bearing g', adapted to engage a similar bearing d^6 in the top of the block D^2 (see Figs. 5, 7 and 8).

The block D^3 is secured to, or integral with, the block D^2, and is provided with pivot lugs d, engaging in notches in the ends of the curved bar D, and these lugs may be held in place in any convenient way, as by means of clips d^5 (see Figs. 5 and 7).

d' represents a guide pin; d^2 an electric contact adjustably mounted in the block d^3, attached to the block D^3, as shown in Figs. 5 and 7.

The frame R has at its upper end a sleeve R^3, in which is journaled a block r^3 (see Figs. 1 and 6) through which slides the arm S, which arm is clamped into said block r^3 in any suitable way, as by means of the clamp screw r^4 (see Fig. 6). The other end of this rod S is adjustably pivoted in the guide t, carried by the gear T, which gear is mounted on the shaft t', journaled in the piece M', carried by the arm M. This same piece M' has journaled therein the shaft T^0, carrying at one end the gear T', meshing with the gear T, and at the other end the

gear T^2, meshing with the gear T^3, which latter is inclosed in the hollow hinged arm M, as shown in Figs. 1 and 3. It will be noted that the rotation of the gear T^3, which is fast on the shaft t', will transmit motion to the gear T, and this will impart a slight rocking movement to the frame by means of the rod S, the extent of this rocking movement depending upon the position of the pivot s' with regard to the axis of the shaft t' (see Fig. 6). It will be evident that, if the center of the pivot s' and the axis of the shaft t' coincide, the rocking movement of the frame R will be *nil*. It will be noted that the rotation of the main drive shaft I' in a constant direction will transmit motion to the shaft H', and that the bevel gear at one end of this shaft H' may be caused to rotate the shaft F, and with it the grinding disk E in either direction, according to whether this bevel gear H is thrown into engagement with one or the other of the bevel gears G', G^2. By throwing both of these bevel gears G', G^2 out of engagement with the said bevel gear H, the positive drive of the shaft F, carrying the grinding disk E may be stopped, if desired.

At the same time that the bevel gear H is driving the grinding disk in either direction, as already described, the lens itself is being rotated and rocked by means of the bevel gear H^3, carried by the other end of the shaft H'. This bevel gear H^3 drives the shafts J' and O', and the shaft O', carrying the gear T^3, drives the train of gearing, terminating in the gear T, which rocks the frame R, and imparts slight rocking motion to the lens holder. The bevel gear O^2, carried by the shaft O', drives the shaft P', which, in turn, may be caused to rotate the lens holder, or not, as may be desired. Thus, if the set screw Q^2 be eased up, (see Fig. 5), and the set screw Q' be screwed down, the socket piece Q will be held against rotation, and therefore the lens holder will not rotate, but will have only the slight rocking motion of the frame R. If, on the other hand, the set screw Q' is eased up, and the set screw Q^2 is screwed down, the socket Q, and with it the lens holder, will rotate with the shaft P', but at the same time it will have the rocking movement of the frame R as before.

By having the rotary movement of the grinding disk E reversible, the relative speed between the grinding surface and the lens may be varied between the sum of the two rotary velocities of the lens holder and the grinding disk E, and the difference between those two velocities, so that a fast or slow grinding movement may be effected. Furthermore, the linear velocity of the grinding surface, relative to the lens being ground, may be varied by moving the lens toward or away from the axis of the grinding disk. The purpose of imparting the slight vibratory motion to the lens while being ground is to prevent any "streaking."

The lens is attached to the lens holder by cementing, in the usual way.

The apparatus as thus described in detail is applicable to any of the four steps hereinbefore mentioned incident to the grinding and polishing of the lens. With this apparatus, as just described, a separate series of removable pans is preferably provided, one for each step in the process.

Figs. 1, 2, 3 and 9 show the preferred form of pan for wet grinding. Fig. 9 shows the frame B with the pan and the gear for driving same mounted in said frame, detached from the machine. The parts thus removable at one operation comprise the frame B, the pan C, the shaft V, provided with a socket v, and carrying the pinion V' and the gear V^2; the pump having the rotary shaft W, pinion W', meshing with the gear V^2 and the pumping blades W^2, the pump barrel B^5 provided with the opening b^0, and the chute b. This socket v slips over the square end of the shaft U' (see Fig. 1) which shaft carries a bevel gear U, meshing with the bevel gear I^5 on the shaft I'. The rotation of the shaft I' turns the shaft V, and causes the pinion V', meshing with the rack c', to turn the pan slowly, while at the same time the gear V^2 on the shaft V gives a rapid rotary movement to the pump, which pumps the water, carrying emery in suspension, up to the chute b, and thus delivers it on the disk E. The emery is supplied to the pan in any convenient way, and the pump chamber B^5 serves to stir up the sediment as the pan revolves, and the water carrying emery in suspension is pumped up over and over again. In order to remove a pan after each step, or to supply a fresh pan at any time, the hinged arm M is swung upward, as indicated in dotted lines. In practice, it is more convenient to swing this arm up vertically beyond the center, having the slot L^6 sufficiently long for this purpose, so that the hinged arm will remain of its own weight in the elevated position; but it may be clamped at any desired angle by means of the clamp screw m, in order to provide an automatic check against the excessive grinding of the lens during either of the first two steps. The lens holder may be provided with an adjustable electric contact d^2, mounted in a socket d^3, as shown in Figs. 1, 7 and 8, so that when the lens is ground down to the desired thickness, this point d^2 will make contact with the grinding disk E, and will complete a circuit, causing bell 12 to ring. This bell may be mounted in the box 11 (seen to the left of Fig. 1) carried beneath the table A. In order to complete the circuit, the necessary insulation should be supplied wherever needed, as shown, for in-

stance, beneath the part K, and around the shaft J′, as shown in Fig. 2. This electric attachment, however, may be omitted, if desired. In order to adjust the position of the hinged arm M, so that its weight may not rest upon the lens while being ground, and so that the spring P^2 (see Fig. 5) may be caused to give the proper thrust downward, I provide a suitable gage, shown on a small scale in Fig. 13, in which the bar 7 is provided with a socket 8 to fit over the tapered end *f* of the shaft F. This bar 7 carries a plate 9, having four prongs 10. The hinged arm M is eased down from the position shown in dotted lines in Fig. 1 until the lens rests on the three prongs 10, when the position of the clamp screw *m* in the slot L^6 is marked. The arm is then swung up again, the grinding disk is put in place, and the arm is eased down until the clamp screw *m* marks the position and the arm is clamped. The grinding may then be proceeded with.

In order to provide for dry grinding, or moist grinding or polishing, incident to the last two steps of the process, I provide the pan and attachments, such are shown in Fig. 10. In this case, the pan C′ remains fixed, it being provided with one or more notched lugs c^2 adapted to slip over the heads a^5 of the bolts a^6 (see Fig. 2), which bolts, for convenience of assembly, may be secured to handles a^7. Thus, these bolts may be conveniently moved from the table when desired. In this form of the apparatus, the shaft V^3 is journaled at one side of the pan in the bracket c^3, and is provided with a socket *v*, engaging the squared end of the shaft U′, as before, whereby this shaft V^3 is driven. This shaft V^3 carries a bevel gear V^4, meshing with a bevel gear V^5 on the shaft V^6, which shaft carries a striker v^6, adapted to engage an arm *x*, carried by the box X, containing the powdered polishing material. This box is pivoted on the shaft x^0, and is normally held in a substantially horizontal position by means of a coil spring under compression, x^2, the tension of which spring may be adjusted by the ratchet and pawl arrangement *x′*, x^4, the tension of the spring being varied according to the weight of the material to be carried in the box X and the quickness of the rebound desired. The bottom of the box is perforated, as at *x′*, and the box is mounted above a hopper *y* in the outer casing Y. The shaft V^6 also carries an eccentric v^7, which engages the lever *z*, which operates the bellows Z, which bellows blows air through the pipe *z′*. This air draws with it more or less of the powdered polishing material, as indicated in Fig. 12, and this polishing material is thus supplied to the top of the grinding disk E. In place of the bellows Z, any suitable rotary pump for blowing air may be driven by the shaft V^6, or an independent air blast may be provided, if desired. In order to supply more or less water in the last two steps of the process, if desired, I provide a water feed device, shown to the right of Fig. 10, in which 1 represents the water cup, mounted on the block 2, which is provided with the tail piece 3, fitting in the socket c^5 of the bracket c^4 at the side of the pan. This block 2 is perforated as at 4, which perforation is connected to a pipe 5, from which the water drips onto the grinding disk E, all as shown in Fig. 10. The supply of water is controlled, or cut off altogether by the needle valve 6. It will be obvious that the pan, shown in Fig. 9, may be removed or replaced on the machine, if desired, and the pan, shown in Fig. 10, may be substituted for that shown in Fig. 9 without affecting the remainder of the apparatus.

In the apparatus already described, provision is made for grinding either concave or convex lenses, or plano-concave or plano-convex lenses; but frequently prismatic lenses are required, and in order to make the machine a complete apparatus for grinding any of the ordinary forms of lenses required by opticians, I provide a prism grinding attachment, which is intended to be substituted for the socket Q and the lens holder and the other parts shown in Fig. 7. This prism grinding attachment is shown in detail in Figs. 14 to 17, which will now be described. Q^7 represents a similar socket piece to the socket piece Q, shown in Figs. 1, 5 and 7, having one or more clamp screws q^7, similar to the clamp screws Q′ and Q^2, already described. This socket Q^7 fits over the end of the shaft P′ in a similar way to the socket Q. This socket piece Q^7 has a base plate 21 hinged at 22 to the block 23, beneath which is mounted the sliding block 24, beneath which is mounted another block 25, sliding at right angles to the block 24, which block 25 has a recess 26 for the cement, used in connection with the prism. The plate 21 has journaled across the same a shaft 27, carrying at each end pinions 28, which mesh in curved racks 29, secured to the block 23. These curved racks are slotted, as at 30, to receive the clamp screw 31, by means of which the angle between the plate 21 and the block 23 may be adjusted. In order to measure this angle, another curved rack 32 is provided, which is secured to the plate 23, and meshes with a pinion 34, carried by the arm 35 on the plate 21. On the shaft 36 of this pinion 34 is a pointer 37, moving over a circular scale 38. Thus as the block 23 is swung through an angle relative to the plate 21, this angle will be indicated by the pointer 37 moving over the scale 38.

In order that the block 24 may have longitudinal movement relative to the block 23,

I provide a pinion 39, mounted on the shaft 40, mounted in this block 23, which pinion meshes with the rack 41 on the top of the block 24. The blocks 24 and 25 are dovetailed into the blocks 23 and 24, respectively, as indicated at 42 and 43, so that they may be readily removed. The block 24 is clamped at the desired position by means of the clamp screw 44 (see Fig. 16) and the block 24 carries a pin 45, having stop lugs 46 to hold the block 25 securely in the block 24 after it has been slid therein.

The various clamp screws and bolts are preferably provided with squared heads, so that they may be turned by the same wrench, and thus most of the parts of the machine may be assembled or disassembled without the use of any special tools.

It will be noted that the prism to be ground may be cemented to the block 25, which may be then moved laterally by turning the pinion 39 to the desired position, and may be then turned to the desired angle relative to the plate 21 by turning the shaft 40. It will be evident that the grinding disk for use in grinding prisms may be flat or convex or concave, as may be desired.

The operation of the apparatus has been described in a fragmentary way incident to the various steps and the various modifications required, but to state the operation consecutively, we will assume that the piece of glass from which the lens is to be ground is secured to the lens holder, while the latter is detached from the machine, and that the swinging arm M is swung up to the vertical position, and that the pan used in the first step of the wet grinding is in place, and the machinery at rest. The lens holder is affixed to the hinged arm, which is then lowered in the position shown in full lines in Fig. 1, and the pan C being supplied with water and emery, power is applied to the drive shaft, which will begin the process of grinding. The grinding disk E will be turned in either direction, as may be desired, but at the same time the lens holder is revolved in a constant direction, or is clamped against revolution, as may be preferred, and the lens holder is automatically given more or less of a vibratory motion, so as to avoid streaking. The drive shaft also rotates the pan, and drives the pump, the emery being stirred up as the pan revolves, and the mixed water and emery being pumped on the grinding disk. As soon as the first rough grinding has been completed, which may be ascertained by the electric signal already described, or by any other suitable means, the hinged arm M is swung up past the vertical position, the frame B carrying the pan C and the other parts shown in Fig. 9 is removed, and a similar frame having a pan and attachments is put in place for the second wet grinding, in which finer abrading material is used. The hinged arm is then lowered down to its position again, and the process of grinding, as indicated in the first step, is substantially repeated. As soon as the second wet grinding has been accomplished, the second pan is removed, as before, and a pan and attachments, similar to that shown in Fig. 10, is placed on the table A, centered over the shaft F. This pan does not revolve, but the revolution of the shaft V^3 sifts fine abrading or polishing material onto the grinding or polishing disk E. Water, if needed, is supplied from the cup 1. After this first step of the dry or moist grinding or polishing is effected, this pan is removed, and a similar pan, like that shown in Fig. 10, is put in place for the final act of polishing, the polishing material being sifted onto the top of the polishing disk E, as before. In this final act of polishing, the water cup 1 may be removed from the pan, if desired. This will complete the grinding of one side of the lens, when the half finished lens will be turned over, adjusted on the lens holder, and the grinding of the second side of the lens will be accomplished in the same way as with the first side.

In grinding prismatic lenses, the principal difference is that prisms should be set at the requisite angle before the prism holder is attached to the machine, and the proper lateral adjustment made, but the operation of the device is substantially the same with prisms as with other forms of lenses.

It will be obvious that the number of steps already desscribed may be increased or diminished, if desired, thereby reducing or increasing the number of pans and other removable parts used in the various steps.

By the use of the hereindescribed apparatus, I find that more accurate results are secured in much less time than with the methods now in vogue.

It will be obvious that various modifications might be made in the hereindescribed apparatus, other than those suggested in the specification, which could be used without departing from the spirit of the invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent of the United States, is:—

1. In a lens grinding machine, the combination with a grinding disk and means for rotating same, of a lens holder, means for pressing said lens holder toward said disk, means for rotating said lens holder, and means operated by said rotating means for imparting an oscillatory movement to said lens holder while it is being rotated, substantially as described.

2. In a lens grinding machine, the combination with a grinding disk and means for rotating same in either direction as may be desired, of a lens holder, means for pressing said lens holder toward said disk, means for

rotating said lens holder, and means for imparting an oscillatory movement to said lens holder while it is being rotated, substantially as described.

3. In a lens grinding machine, the combination with a grinding disk and means for rotating same, of a lens holder, means for pressing said lens holder toward said disk, automatic means for rotating said lens holder, means for imparting an oscillatory movement to said lens holder while it is being rotated, and means for automatically signaling when the lens has been ground to a predetermined thickness, substantially as described.

4. In a lens grinding machine, the combination with a drive shaft, of a grinding disk, a lens holder, and means operated by said drive shaft for rotating said disk, means also operated by said drive shaft for rotating said lens holder and means operated by said drive shaft for imparting an oscillatory movement to said lens holder while it is being rotated, substantially as described.

5. In a lens grinding machine, the combination with a grinding disk and means for rotating same, of a lens holder, means for pressing said lens holder toward said disk, means for rotating said lens holder, means for imparting an oscillatory movement to said lens holder while it is being rotated, means for varying the extent of said oscillatory movement, and means for automatically signaling when the lens has been ground to a predetermined thickness, substantially as described.

6. In a lens grinding machine, the combination with a grinding disk and means for rotating same in either direction as may be desired, of a lens holder, means for pressing said lens holder toward said disk, means for rotating said lens holder, and means for automatically signaling when the lens has been ground to a predetermined thickness, substantially as described.

7. In a lens grinding machine, the combination with a grinding disk and means for rotating same in either direction as may be desired, of a lens holder, means for pressing said lens holder toward said disk, means for rotating said lens holder, means for imparting an oscillatory movement to said lens holder while it is being rotated, and means for supplying water and abrading material to said grinding disk, substantially as described.

8. In a lens grinding machine, the combination with a grinding disk and means for rotating same in either direction as may be desired, of a lens holder, means for rotating said lens holder, means for imparting an oscillatory movement to said lens holder while it is being rotated, and means for varying the extent of said oscillatory movement, substantially as described.

9. In a lens grinding machine, the combination with a grinding disk and means for rotating same, of a lens holder, means for rotating said lens holder, means for imparting an oscillatory movement to said lens holder while it is being rotated, and means for varying the extent of said oscillatory movement, with means for automatically signaling when the lens has been ground to a predetermined thickness, substantially as described.

10. In a lens grinding machine, the combination with a grinding disk and means for rotating same, of a lens holder, means for rotating said lens holder, a pan surrounding said grinding disk, a pump projecting into said pan, and means for simultaneously rotating said pan and driving said pump, substantially as described.

11. In a lens grinding machine, the combination with a grinding disk and means for rotating same in either direction as may be desired, of a lens holder, means for pressing said lens holder toward said disk, means for rotating said lens holder, a pan surrounding said grinding disk, a pump projecting into said pan, and means for simultaneously rotating said pan and driving said pump, substantially as described.

12. In a lens grinding machine, the combination with a grinding disk and means for rotating same, of a lens holder and universal bearings therefor, means for rotating said lens holder, and means operated by said rotating means for imparting an oscillatory movement to said lens holder while it is being rotated, substantially as described.

13. In a lens grinding machine, the combination with a grinding disk and means for rotating same, of a lens holder, means for either rotating said lens holder or for holding same against rotation, as may be desired, and means operated by said rotating means for imparting an oscillatory movement to said lens holder while it is being rotated, substantially as described.

14. In a lens grinding machine, the combination with a grinding disk and means for rotating same, of a lens holder, means for pressing said lens holder toward said disk, means for either rotating said lens holder or for holding same against rotation, as may be desired, and means operated by said rotating means for imparting an oscillatory movement to said lens holder while it is being rotated, substantially as described.

15. A lens grinding machine, comprising a platform, a rotary grinding disk mounted above said platform, a hinged arm carried by said platform, a rotary lens holder carried by said arm, means for rotating said lens holder, and means carried by said arm for imparting an oscillatory movement to said lens holder while it is being rotated,

a pan surrounding said grinding disk, a pump projecting into said pan, and means for simultaneously rotating said pan and driving said pump, substantially as described.

16. A lens grinding machine, comprising a platform, a rotary grinding disk mounted above said platform, a hinged arm carried by said platform, means for clamping said arm at any desired angle relative to the grinding disk, a rotary lens holder carried by said arm, means for rotating said lens holder, means carried by said arm for imparting an oscillatory movement to said lens holder while it is being rotated, a pan surrounding said grinding disk, a pump projecting into said pan, and means for simultaneously rotating said pan and driving said pump, substantially as described.

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

JOSHUA ANTHONY LINCOLN.

Witnesses:
SALOMON MARX,
FRANK MELNHOFF.