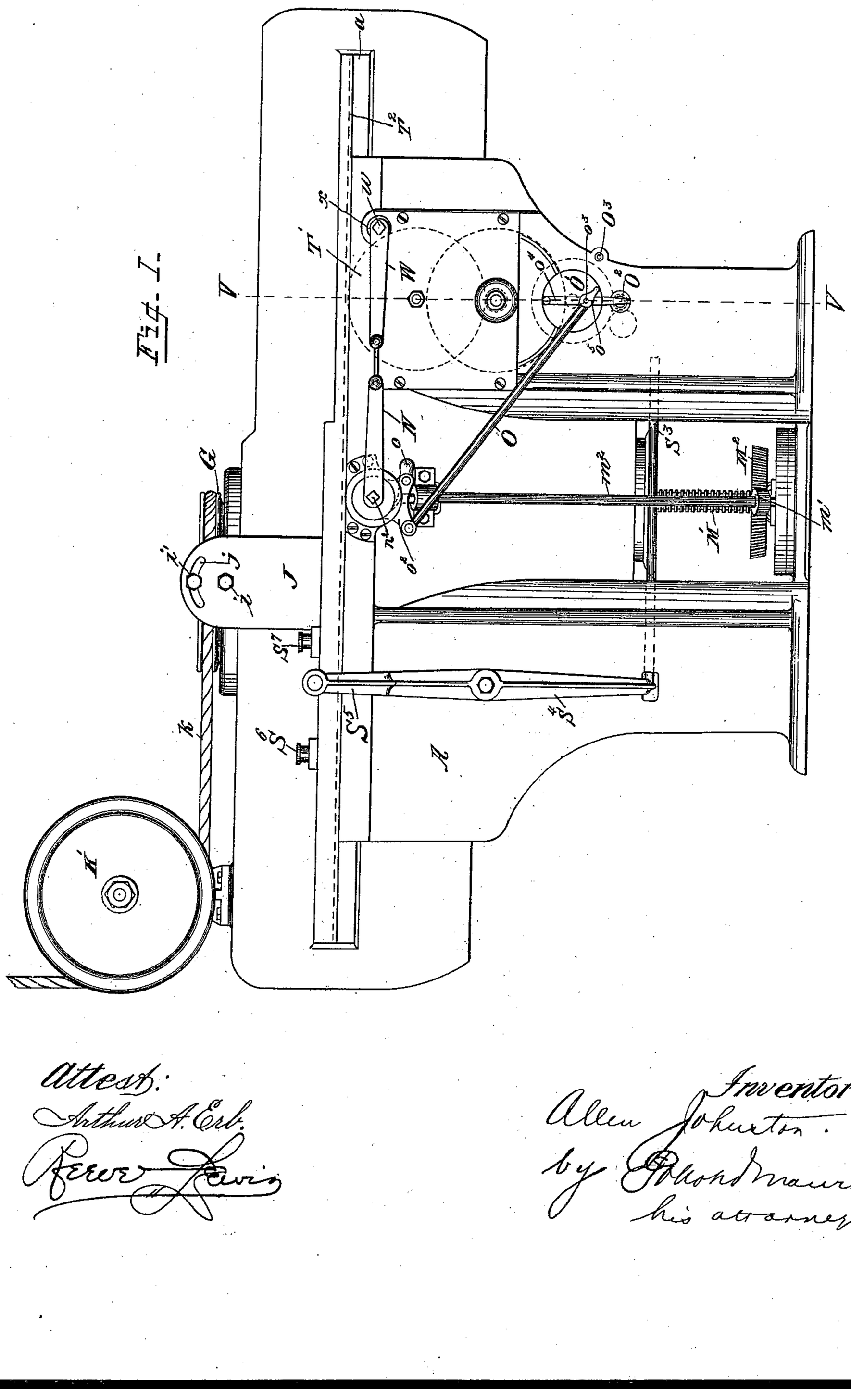
(No Model.) 4 Sheets—Sheet 1.

A. JOHNSTON.

GRINDING MACHINE.

No. 504,389. Patented Sept. 5, 1893.



Attest:
Arthur A. Erb.
Peter Lewis

Inventor:
Allen Johnston.
by Edmond Munn.
his attorneys

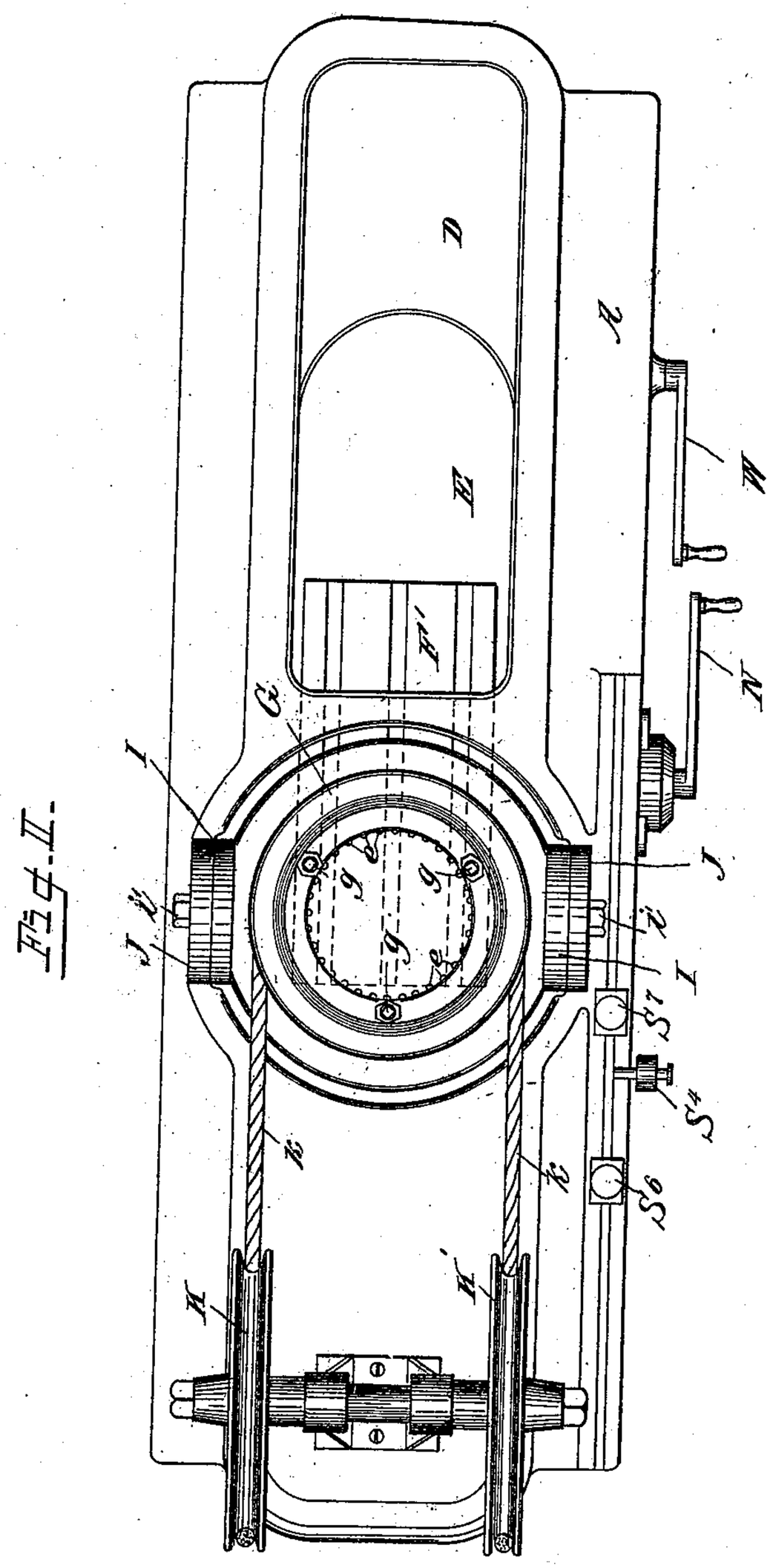
(No Model.)

4 Sheets—Sheet 2.

A. JOHNSTON.

GRINDING MACHINE.

No. 504,389. Patented Sept. 5, 1893.



Attest:
Arthur A. Ezl.
Peter Lewis

Inventor:
Allen Johnston
by Edward Mann.
his attorneys.

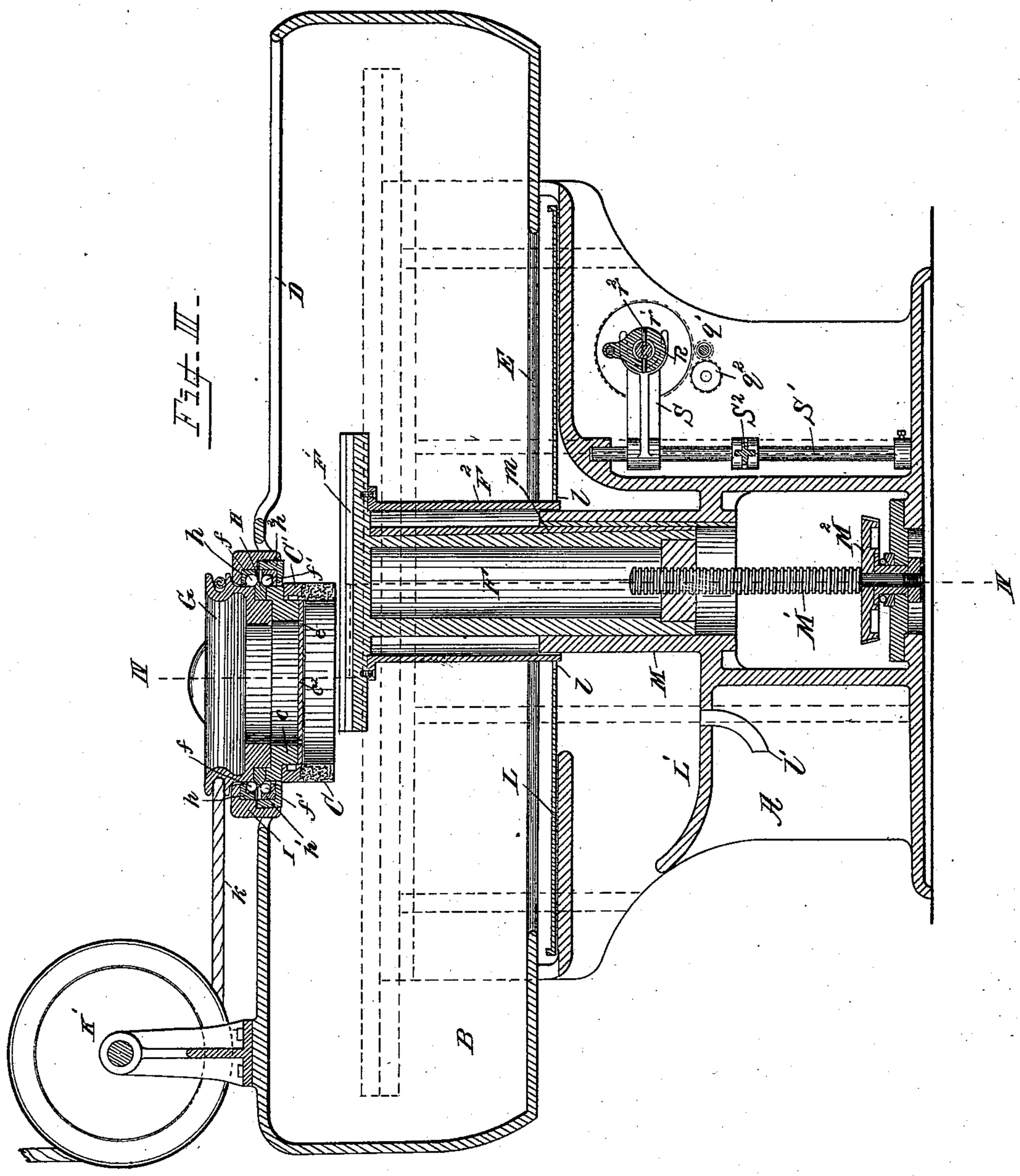
(No Model.) 4 Sheets—Sheet 3.

A. JOHNSTON.

GRINDING MACHINE.

No. 504,389. Patented Sept. 5, 1893.

FIG. III.



Attest.
Arthur A. Erb.
Peter Lewis

Inventor:
Allen Johnston
by Peter Lewis,
his attorney.

(No Model.) 4 Sheets—Sheet 4.

A. JOHNSTON.

GRINDING MACHINE.

No. 504,389. Patented Sept. 5, 1893.

Fig. IV.

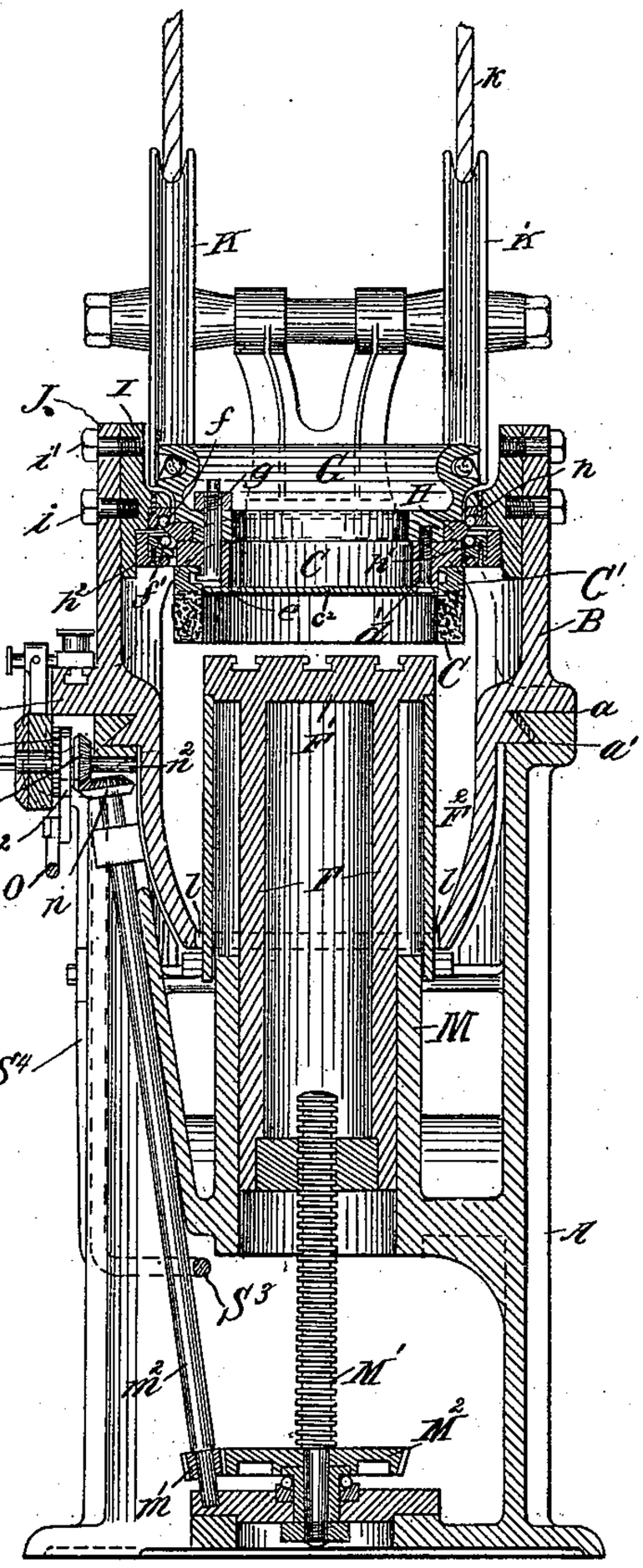


Fig. V.

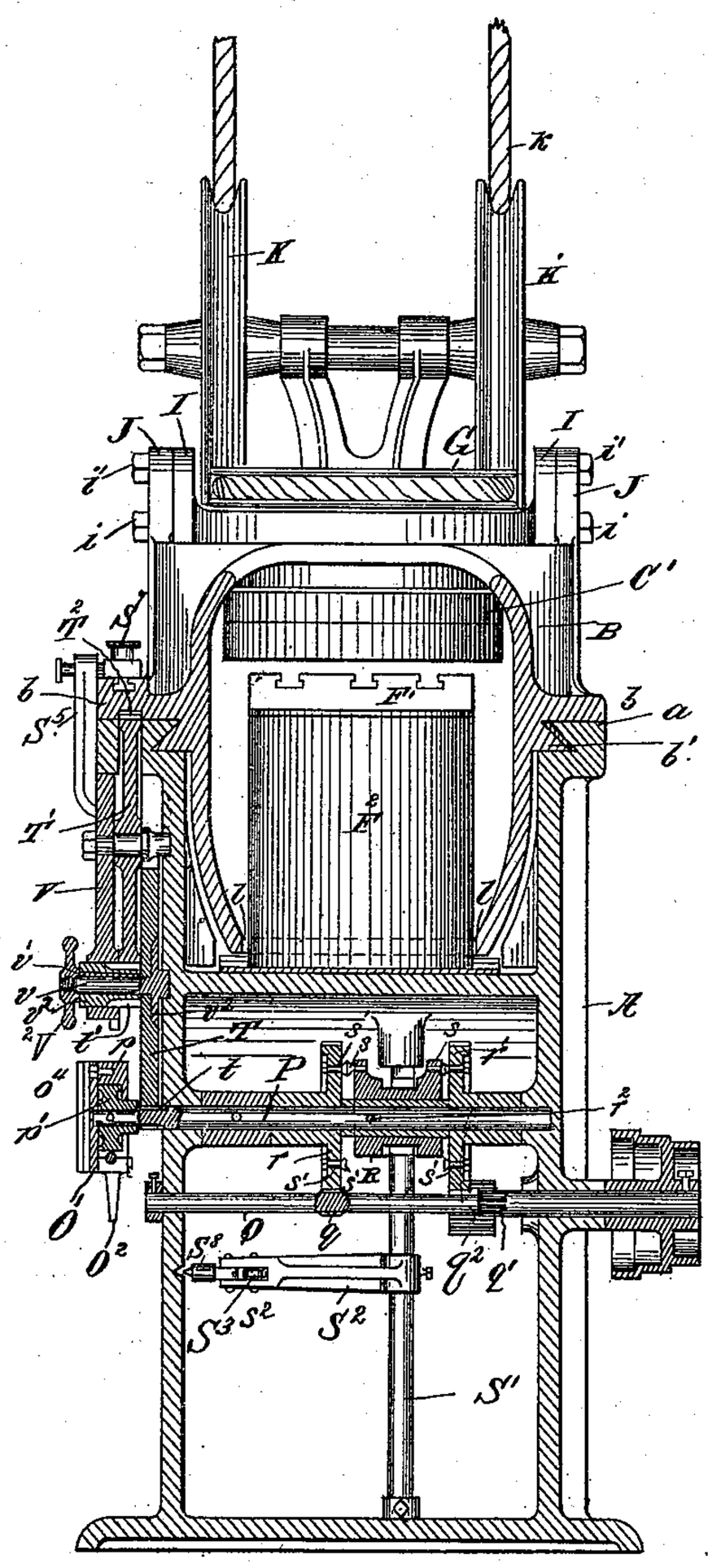
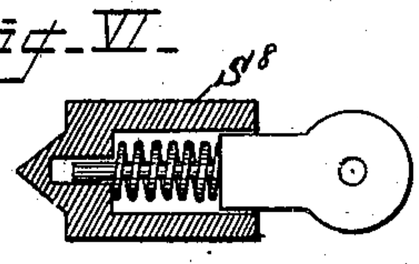


Fig. VI.



Attest:

Arthur A. Erb.

Reeve Lewis

Inventor:

Allen Johnston

by Bakewell Mann

his attorneys.

UNITED STATES PATENT OFFICE.

ALLEN JOHNSTON, OF OTTUMWA, IOWA.

GRINDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 504,389, dated September 5, 1893.

Application filed May 12, 1893. Serial No. 473,991. (No model.)

To all whom it may concern:

Be it known that I, ALLEN JOHNSTON, of Ottumwa, Iowa, have invented a new and useful Improvement in Grinding-Machines, which is fully set forth in the following specification.

This invention relates to the construction of grinding machines employing cup-shaped or ring grinding wheels, the machine being of the same general character as that described in Letters-Patent No. 465,478, granted to me December 22, 1891.

The general object of the invention, which is attained in the construction of the machine as hereinafter explained, is to facilitate the grinding of iron and steel surfaces, to improve the character of the work, and to effect economy in the operation. According to the present invention the cup-shaped or ring grinder is supported in an inverted position so that its grinding surface is underneath, and the work-holder is beneath the wheel, instead of above or at one side, as usually arranged heretofore. This arrangement is of great practical utility. It permits the workman to keep the operation of the grinder upon the work under constant observation and to note how the wheel is cutting at each reciprocation of the feed. In many cases it avoids the necessity of checking or clamping the work. On this account the grinding of certain classes of articles is greatly expedited. In the case, for example, of die-blocks or plates which require the whole surface to be cut it is only necessary to employ holding pins at the sides of the article, which is dropped into its place on the holder, ground and removed without delay. Moreover, this arrangement of the wheel facilitates the application of the water in regulated quantity. The water is supplied from above through the hollow wheel in regulated quantity, and being spread evenly around the wheel by centrifugal action, falls upon the work at the place where the grinding is being done.

The invention furthermore consists in mounting the wheel upon a horizontal reciprocating bed, and combining it with a stationary work-holder; although many of the improvements are applicable as well to machines in which the work-holder reciprocates and the wheel is stationary. The bed-carrying the wheel is hollow, and embraces the work-holder which is in the form of a vertical column, provided with means for adjusting it toward and away from the wheel.

The invention includes a particular mode of mounting the wheel so as to sustain the end thrust. In using cup-shaped or ring grinders (whether the axis be horizontal or perpendicular) it is evident that the great pressure and wear is in line of the axis of the wheel, and as it is practically impossible to keep the end of a shaft or spindle oiled the operation of cup-grinders has been attended with difficulty, and with excessive friction and wear. In ordinary grinders, which grind on the edge or periphery, the thrust is lateral to the axis, and this is more easily provided for. Moreover, to produce the best results with cup-grinders there must be no end play, which would affect the depth of cut. This fact also distinguishes a cup-grinder from an ordinary edge-grinder, as in the latter case slight end play is more easily avoided, and if it occurs is of little consequence. I have succeeded in avoiding the difficulty of end thrust by mounting the hub or support of the wheel, or its spindle (according to the special construction employed) upon ball bearings. In order to provide against end-play and wear, and the effect of expansion and contraction I employ two sets of balls which are on opposite sides of a circular plate or ring turning with the wheel, and means are provided for pressing the two series of balls toward each other, so as to hold the plate, and consequently the wheel, firmly against end play.

The invention includes other features of construction, as well as combinations of the several parts or elements as hereinafter pointed out.

I will now describe one form of grinding machine in which the present invention is embodied, reference being had to the accompanying drawings which form part of this specification, and in which—

Figure I, is a front elevation; Fig. II, a plan view; Fig. III, a vertical longitudinal section; Fig. IV, a vertical section on line IV (Fig. III); Fig. V, a vertical section on line V (Fig. I), and Fig. VI, a detail of a spring pin.

A represents the main frame which is a casting whose shape is clearly shown and requires no description. It has horizontal up-

per edges a and under-cut grooves a' constituting guides and slide-ways for the bed B, which carries the grinder C. As shown in the cross-section views (Figs. IV and V) the upper part of the main frame is trough-shaped and the bed B is set within the two sides of the frame. Along the sides of the bed B are horizontal ribs b, b' which fit into the guides of the main frame in such manner as to permit movement of the bed in a longitudinal direction only. Bed B is oblong and is entirely closed on the sides and ends. On top it has an opening D for introduction of the work and underneath another opening E for admission of the vertical column F which supports the work-holder.

The grinding wheel C, which is of the cup or ring form is supported upon the reciprocating bed B in an inverted position, so that its grinding surface is undermost. It is mounted upon a supporting ring or base C', and the latter is attached to the driving pulley G by means of hook-bolts g which pass through an intermediate collar c and engage in a groove in the base C'. Beneath collar c is a horizontal plate c^2 held by screw bolts d', which pass through collar c into the flange of the pulley G. This plate has a series of perforations e, so that water delivered into the chamber above the plate will be supplied in regulated quantity around the rim of the wheel C, and spread thence over the surface of the work beneath it.

Between the collar c and the flange of the pulley G is set a steel bearing ring H having upper and lower inclined bearing surfaces. These surfaces bear against two sets of friction-balls $f f'$. The upper set f takes the end thrust of the wheel when grinding, and the lower set f' sustains the weight and downward pressure of the wheel. The friction balls $f f'$ as well as bearing rings h, h' are contained in a recessed or chambered ring I which is attached by bolts i i' to the ears J on bed B, and is adjustable as presently explained. The balls are in contact with the bearing rings h h' which are angular in cross section so as to present two contact surfaces to the balls. This construction is of some importance, because when friction-balls have contact with two surfaces only they wear untrue in a short time. As shown, the balls f f' touch at three points, one on ring H and two on ring h or h', and by constantly rolling on these three surfaces they wear evenly, and obviate a loose joint, which would result in end play. Ring h' is carried by a clamping collar h^2, which is screwed into ring I and clamps the bearing ring H firmly between its two sets of balls h h', so that the grinding wheel cannot play in the direction of its axis. The importance of this result in the operation of cup-grinders has already been pointed out. The support I of the wheel is pivoted on the screw-bolts i in ears J, as already stated. The bolts i' pass through curved slots j in the ears J (Fig. I). By loosening bolts i' the support I with the wheel can be tilted at any desired inclination to the work holding table, thus enabling the machine to execute certain classes of concave or convex grinding. The grinding wheel is driven in either direction through the medium of a rope or cord k which passes around pulleys K K' supported in bearings upon, and movable with, the bed B, and also around the grooved pulley G attached to wheel C. The vertical column F supports a horizontal table or bed F' which, as shown has longitudinal dovetailed grooves in its upper surface, into which can be fitted work-holders of different kinds according to the work to be done. Column F has at its upper part an outer cylinder F^2 which extends downwardly past the bottom of the hollow bed B acting as a guard to the water which flows off table F' and is caught by a drip pan L. The water escapes at the center of this pan through an annular opening l around cylinder F^2 into a basin L' which is part of the main frame, and thence is discharged through a pipe l' (Fig. III). Column F fits inside a sleeve M, which is also part of the main frame and is prevented from turning therein by a key m. Cylinder F^2 fits outside this sleeve, which constitutes a guide to the column in its vertical adjustment. This adjustment to compensate for wear is effected automatically by mechanism similar in principle to that described in my application filed October 18, 1892, Serial No. 449,249. Movement is imparted to the column by a screw M' which has on its lower end a bevel gear M^2, engaged and driven by a pinion m' on spindle m^2 (Figs. I and IV). Spindle m^2 is actuated through pinions n n' the latter being on a short shaft n^2, to which may be fitted a crank-handle N as shown in Fig. I when the column is to be raised or lowered by hand for the purpose of initial adjustment. During the operation of the grinder the shaft n^2 is moved intermittently through a pawl o which engages a ratchet wheel o' on shaft n^2. Pawl o is carried by a plate o^2 swung loosely on shaft n^2 to which is pivoted one end of a pitman O. The other end of the pitman is connected to a pin o^3 set eccentrically in a T-groove o^4 on the face of a disk O', the pin being adjustable in said groove to vary the throw of the pitman. Disk O' is attached to a collar p (Fig. V) which embraces a boss p' on the end of an oscillatory shaft P, which communicates reciprocatory movements to bed B, as presently explained. Collar p holds to boss p' by friction only, so that the operation of raising the work-holding column is as follows: Disk O' turns with shaft P, advancing pitman O and then withdrawing it, until an arm O^2 carried by disk O' strikes a pin O^3 in the frame A (Fig. I) when the disk stops and is stationary during the remainder of the feed in that direction. When the shaft P reverses the same action takes place until disk O', now moving in the opposite direction, is again arrested by pin O^3. A nut o^5 provided with a handle is shown on the end of pin o^3

for clamping the pin to and releasing it from the disk.

Motion is communicated to the bed B by means of automatic feed-mechanism which I will now describe. This mechanism is the same in principle as that described in my aforesaid Patent No. 465,478. Q is the main shaft having pinions q q'. Pinion q drives directly a gear r, loose on shaft P, and pinion q' drives, through an intermediate pinion q^2, a gear r' also loose on shaft P. Gears r r' therefore turn in opposite directions. Shaft P receives motion alternately from these gears through the action of a sliding clutch R mounted on shaft P between the gears r r' and guided while caused to turn with said shaft by a pin r^2 engaging in a slot in the slide R. The latter has on each side pins s adapted to engage similar pins s' on the inner faces of gears r r' as described in my last named patent. Clutch or slide R is actuated by an arm S (Fig. III) having a forked end which embraces a groove in said slide, said arm being mounted on a rock shaft S'. Shaft S' has another arm S^2 to which the end s^2 (Fig. V) of a pitman S^3 (Figs. I and IV) is pivoted. The other end of this pitman is connected to the vertical lever S^4 whose free end S^5 lies in the path of the adjustable stops S^6 S^7 on bed B. Consequently, by the contact of these stops with lever S^4 the clutch R is shifted reversing the movements of the wheel. To insure the reversal of the feed motion, the end of arm S^2 is provided with a spring actuated pin S^8 (Fig. VI) whose point bears in a hole in the main-frame A (Fig. V) so that the spring acts to snap the arm S^2 one way or the other, as soon as rock shaft S has passed the center, completing the movement of the clutch by a quick action. Shaft P transmits motion to bed B through pinion t, gear T, pinion t', and gear T'. The latter engages a rack T^2 on the under side of the horizontal rib b of bed B. Gear T is mounted on a shaft v which also carries pinion t' the latter being connected to the shaft by a slip key v' (Fig. V) extending through a bearing plate V. The outer end of shaft v is screw threaded and its inner end carries a disk v^2 set into the side of gear T. A clamping nut V' adapted to be turned by hand is screwed on the end of shaft v and by it gear T is normally clamped tightly between the disk v^2 and pinion t', but by unscrewing the nut v^2 the gear T is made loose, and will rotate idly. This is done when it is desired to disconnect the automatic feed mechanism and reciprocate the bed by hand in executing special kinds of work. For operating the feed by hand a crank W (Fig. I) is provided connected with a shaft w which carries a pinion x meshing with gear T', the latter being in engagement with the rack T^2 as already pointed out.

It will be obvious from an inspection of the drawings that the special construction and arrangement of parts shown and described, constitute a grinding machine of great compactness, strength and efficiency and with little complication. Through the opening D in the bed the work is exposed to the operator each time the wheel moves back (to the left) so that he can note at each reciprocation of the bed just how the wheel is cutting. This exposure of the work to observation is of great importance in economizing time and diminishing the likelihood of faulty grinding.

It will be obvious that some of the improvements described can be used without others, if so desired; and that modifications may be made without departing from the spirit of the invention; as for instance, the whole rotating part to which the grinding wheel is attached may be in one piece made of any suitable hard material such as hardened steel in which case there would be no separate ring for the ball bearings.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a grinding machine the combination with a horizontal work-holding table, of a hollow reciprocating bed, a ring-grinder supported in an inverted position upon said bed and having its grinding face inclosed thereby, means for rotating said grinder and means for reciprocating said bed, substantially as described.

2. The combination with a horizontal work-holding table, of a hollow reciprocating bed and a rotating ring-grinder carried by said bed and having its grinding surface inclosed thereby, said grinder being provided with a water chamber and passages for supplying water to the inner edge of the grinding ring, substantially as described.

3. The combination of the upright column or support for the work-holder, of a hollow reciprocatory bed embracing the upper part of said column or support, and a grinder carried by said bed, substantially as described.

4. The combination of the trough-shaped main frame having horizontal edges constituting slide-ways, a hollow bed set in the main frame and adapted to slide on the edges thereof, an upright work-holder projecting through an opening in the under side of the bed, and a grinder carried by the bed above the work-holder, substantially as described.

5. The combination of the trough-shaped frame, the work-holder carried thereby, the hollow bed provided with an opening through which the work-holder projects and an opening above for introduction of the work, a grinder carried by said bed, and means for reciprocating the bed upon the frame, substantially as described.

6. The combination of the main frame having an upright sleeve, the work holding column extending through said sleeve and having a cylinder outside of the latter, a hollow reciprocating bed supported upon the frame and embracing the upper part of said column, and a grinder carried by said bed, substantially as described.

7. The combination of the main-frame pro-

vided with a drip basin, and with an upright sleeve surrounded by said basin, a work-holding column extending through said sleeve and provided with a cylinder outside the latter, a hollow bed movable upon said frame and embracing the upper part of said column, and a grinder carried by said bed, substantially as described.

8. The combination with a ring-grinder having its grinding surface undermost, of a reciprocatory bed carrying said grinder and a vertically adjustable work-holder beneath the grinder, substantially as described.

9. The combination with the grinder, its supporting bed and means for reciprocating the bed, of a work-holder beneath the grinder, and means for intermittently feeding said work-holder toward the grinder, substantially as described.

10. The combination with the grinder, its supporting bed, and means for reciprocating the bed, of a work-holder beneath the grinder, intermittently acting feed-mechanism for raising the work-holder, and means for regulating the amount of feed at each motion, substantially as described.

11. The combination with the work-holder, of an adjusting screw therefor, gearing for turning said screw, a rod or pitman for actuating said gearing, a rotatable disk, and a crank pin to which the rod or pitman is attached, adjustably connected to said disk, substantially as described.

12. The combination with a ring grinder, of a bearing ring rigidly connected thereto, an annular chambered supporting ring around the bearing ring, and two sets of friction balls in said chambered supporting ring, between which the bearing ring engages, substantially as described.

13. The combination with a ring grinder, of a bearing ring rigidly connected thereto, an annular chambered supporting ring around the bearing ring, two sets of friction balls in said chambered supporting ring, and an adjustable clamping collar engaging against one set of balls, substantially as described.

14. The combination of a vertical column for the work-holder a horizontally reciprocating bed, a grinder carried thereby, automatic feed-mechanism for reciprocating said bed, and means actuated from a shaft of said feed-mechanism for lifting said column, intermittently, substantially as described.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

ALLEN JOHNSTON.

Witnesses:
J. T. HACKWORTH,
A. G. HARROW.