No. 791,570. PATENTED JUNE 6, 1905.

G. H. NEWTON.

GRINDING MACHINE.

APPLICATION FILED NOV. 7, 1904.

4 SHEETS—SHEET 1.

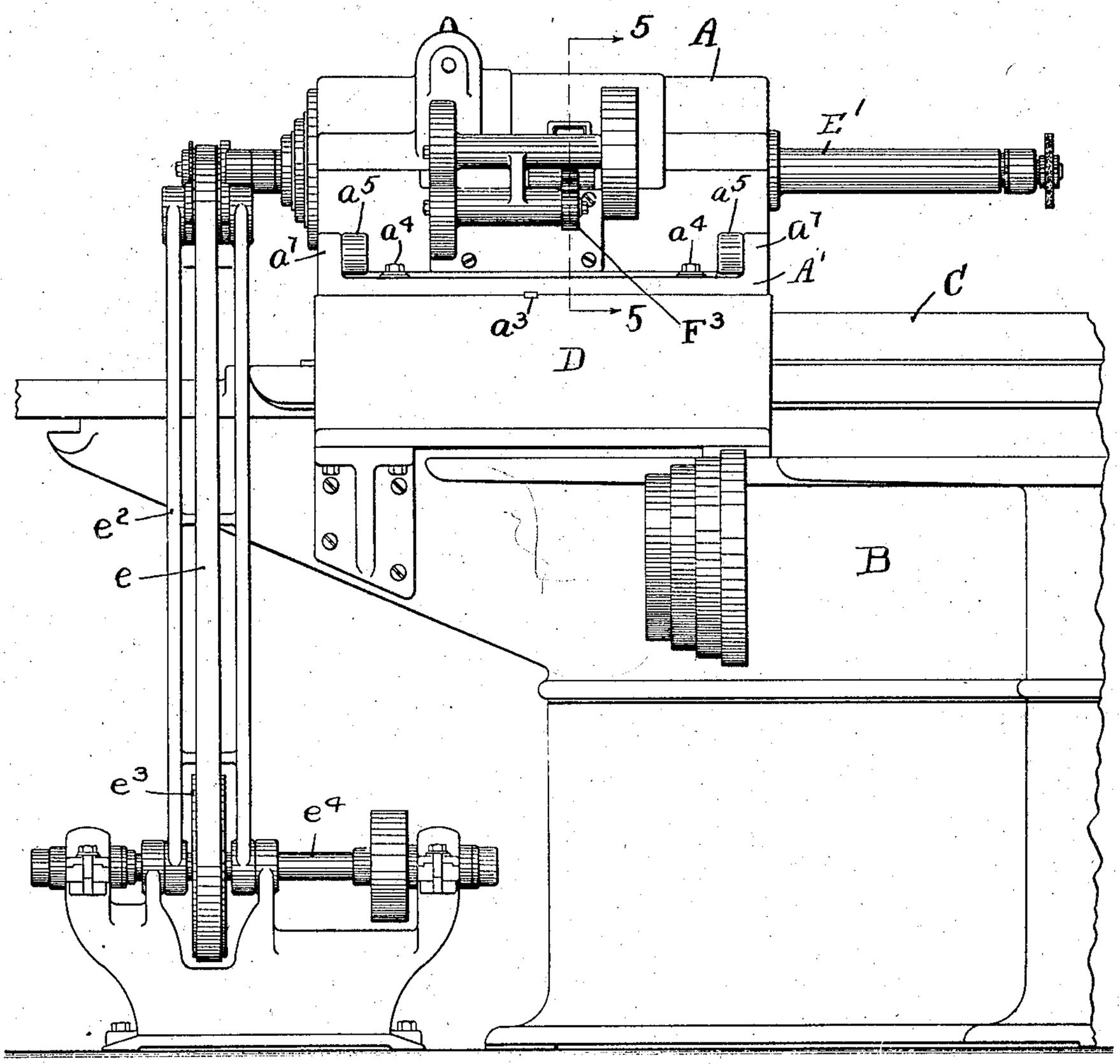

FIG. 1.

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4 SHEETS—SHEET 2.

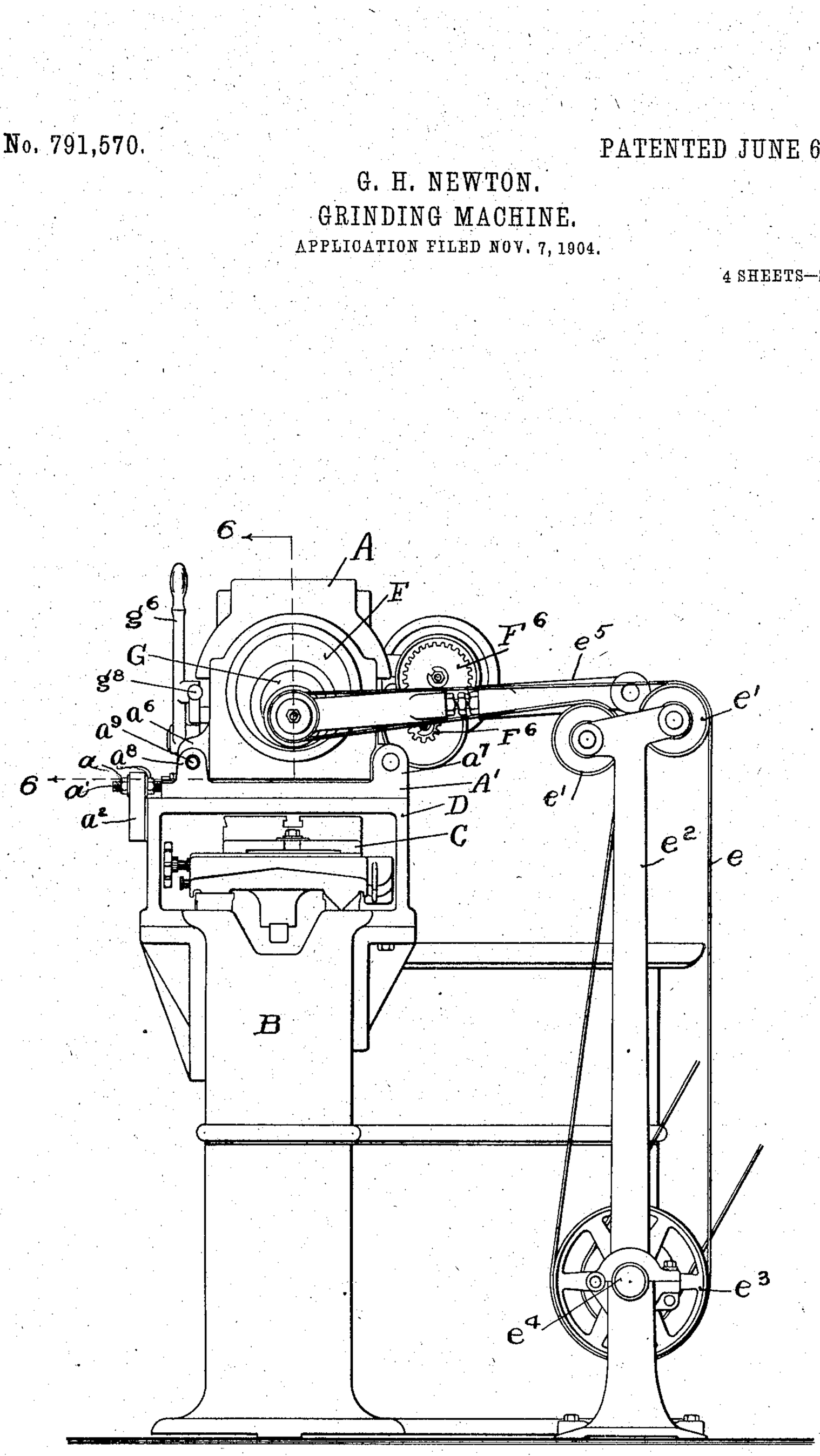

FIG. 2.

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4 SHEETS—SHEET 3.

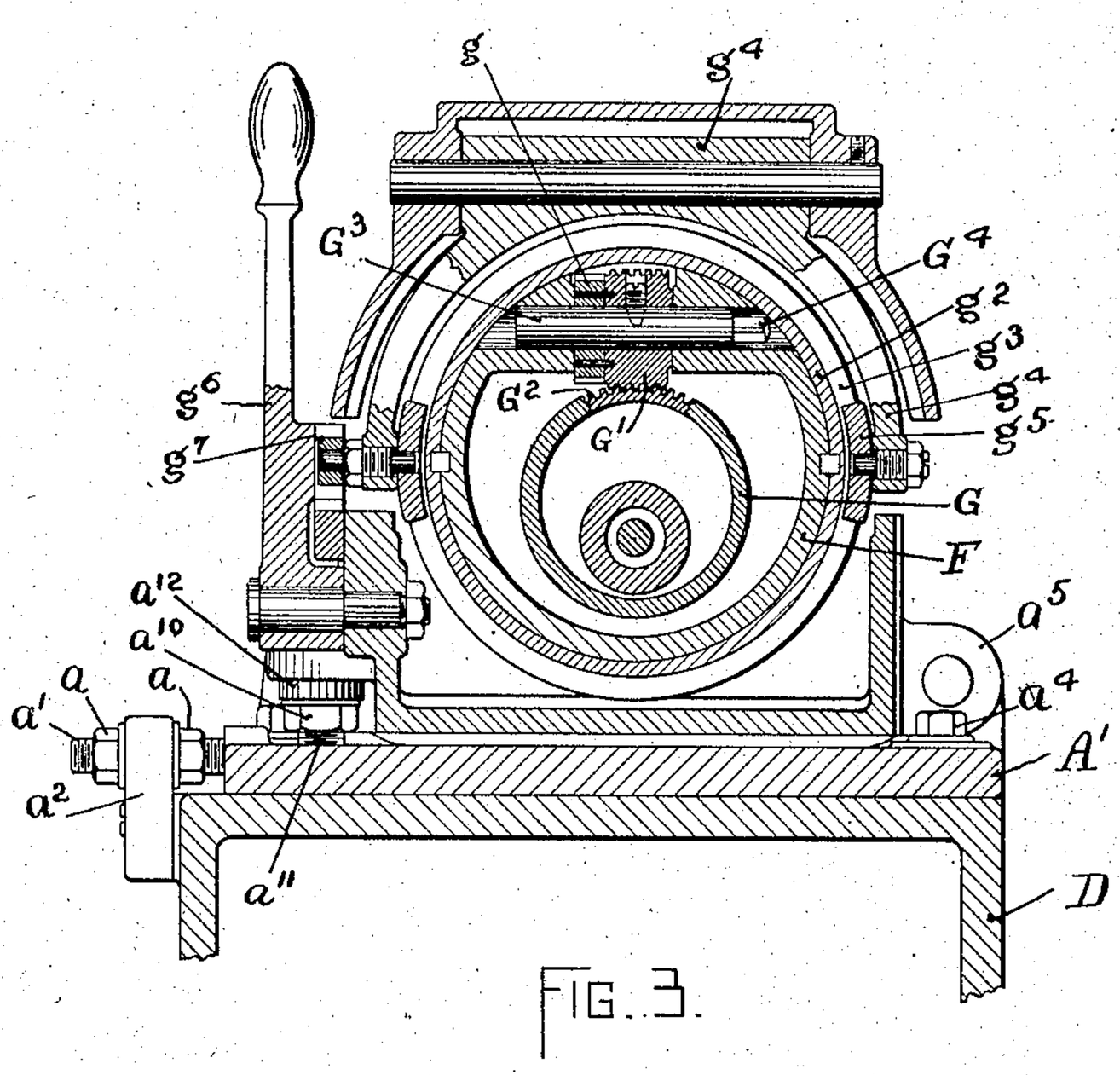

FIG. 3.

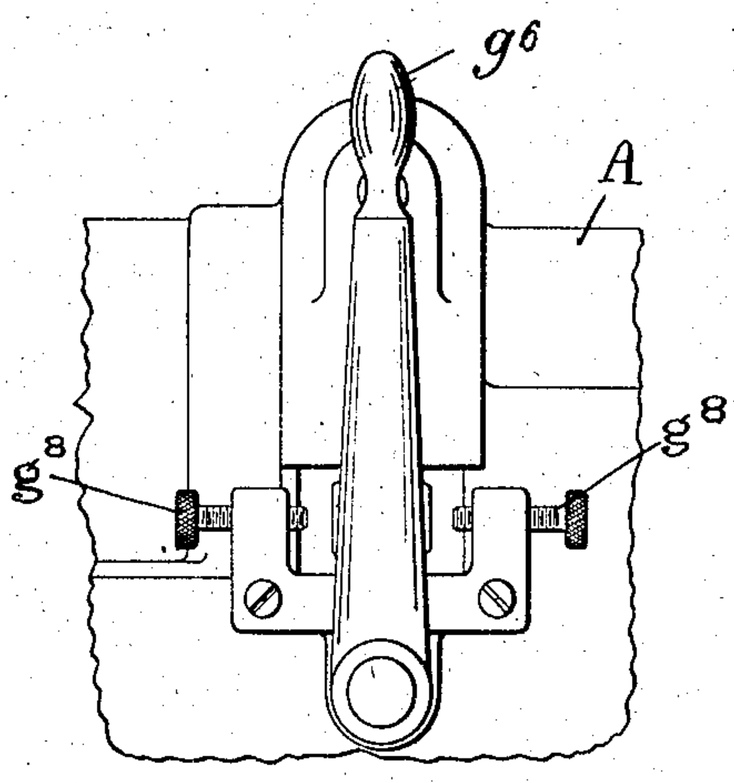

FIG. 4.

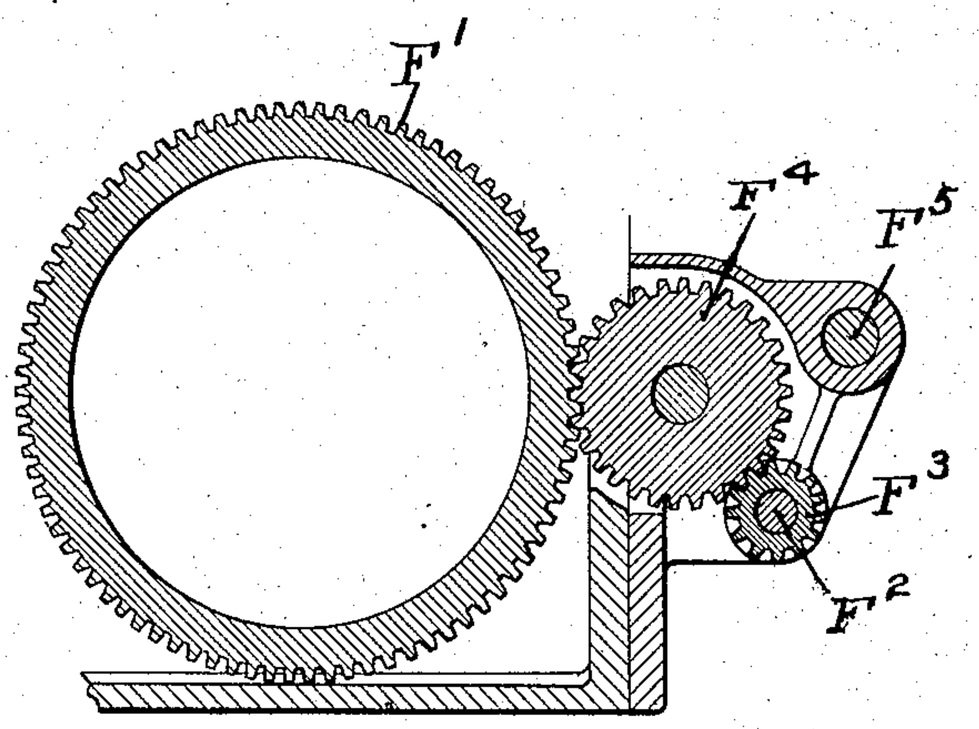

FIG. 5.

WITNESSES

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4 SHEETS—SHEET 4.

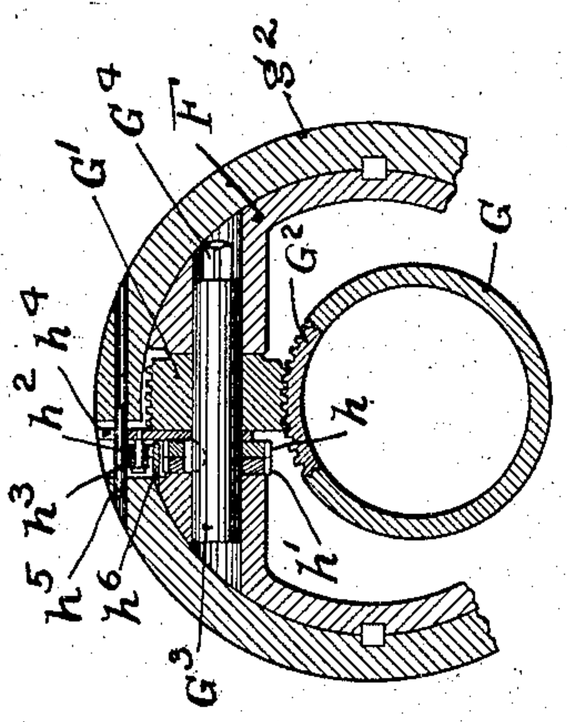

FIG. 8.

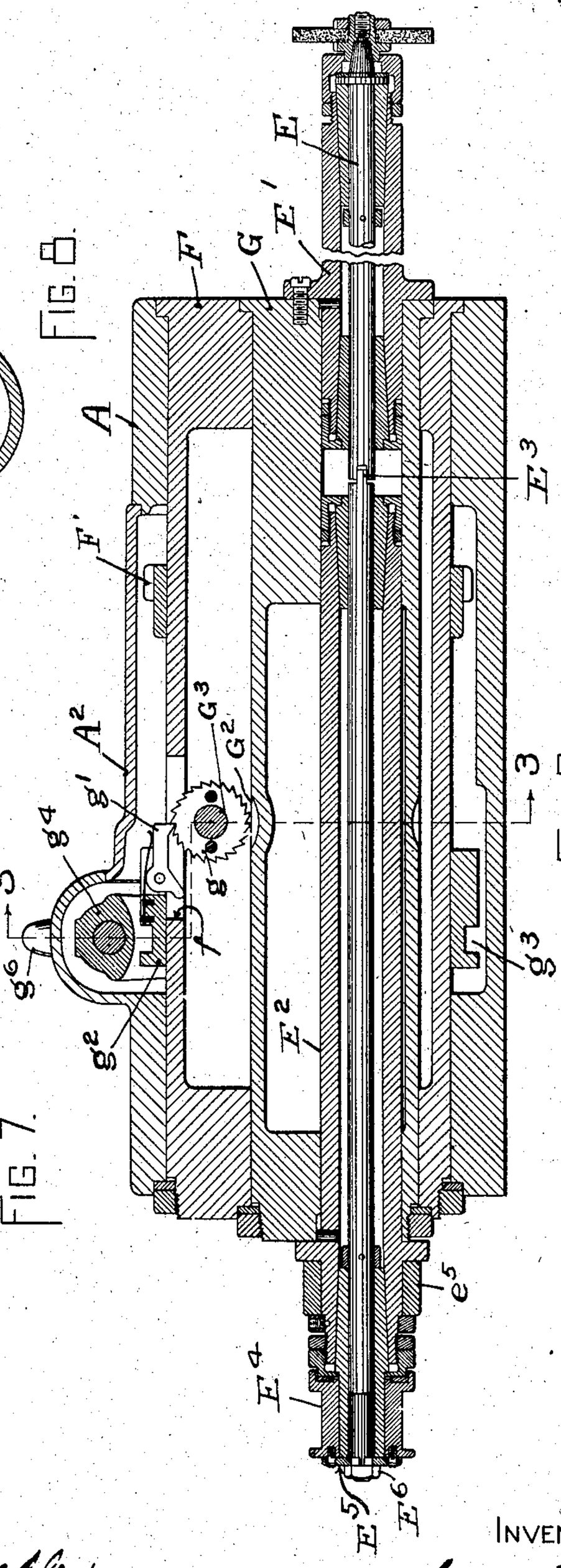

FIG. 6.

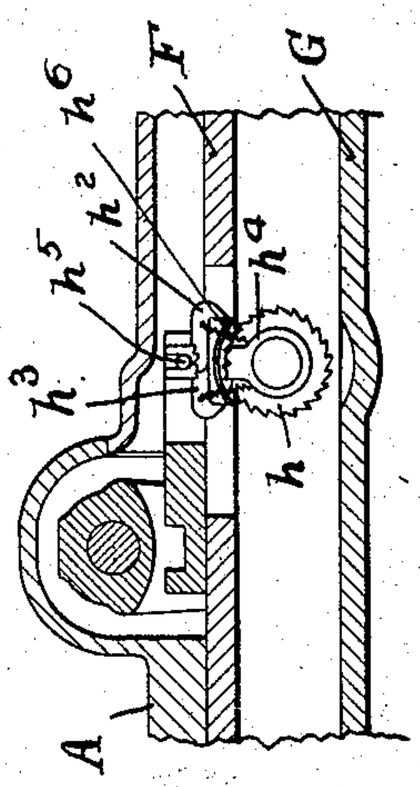

FIG. 7.

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PHOTO-LITHOGRAPHED BY SACKETT & WILHELMS LITHO. & PTG. CO. NEW YORK.

No. 791,570. Patented June 6, 1905.

UNITED STATES PATENT OFFICE.

GEORGE H. NEWTON, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO BROWN AND SHARPE MANUFACTURING COMPANY, OF PROVIDENCE, RHODE ISLAND, A CORPORATION OF RHODE ISLAND.

GRINDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 791,570, dated June 6, 1905.

Application filed November 7, 1904. Serial No. 231,746.

To all whom it may concern:

Be it known that I, GEORGE H. NEWTON, residing in the city and county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Grinding-Machines; and I do hereby declare the following specification, taken in connection with the accompanying drawings, forming a part of the same, to be a full, clear, and exact description thereof.

The invention relates to grinding-machines, and more especially to a construction of head-stock which may be employed in grinding out cylinders or in grinding other internal surfaces. The head-stock may form a permanent part of a grinding-machine or may be constructed as an attachment to be used upon grinding-machines such as are ordinarily employed for grinding external surfaces.

For the purpose of illustration I have shown the invention embodied in an internal grinding attachment adapted to be applied to a grinding-machine which is provided with a reciprocating work-carrying table.

The various features and combinations comprised within the invention will be set forth in the claims and will be understood from the following detailed description of the attachment above referred to.

In the drawings, Figure 1 is a rear elevation of the attachment and so much of one end of a grinding-machine as is required to show the application of the attachment thereto. Fig. 2 is an end elevation looking toward the right in Fig. 1. Fig. 3 is a transverse sectional view through the head-stock on line 3 3, Fig. 6. Fig. 4 is a partial elevation looking toward the right in Fig. 3. Fig. 5 is a sectional view on line 5 5, Fig. 1, certain of the parts being omitted. Fig. 6 is a longitudinal sectional view on line 6 6, Fig. 2; and Figs. 7 and 8 are longitudinal and transverse sections, respectively, showing a modified form of the device for adjusting the spindle-carrying cylinder.

As shown in the drawings, the head-stock A, in which the grinding-wheel spindle and devices for actuating the same are mounted, is secured upon one end of the bed B of the grinding-machine so that the spindle extends above the work-carrying table C and parallel to its line of reciprocation. The head-stock is supported upon a frame D, secured to the base B of the machine and surrounding the work-table, as indicated in Fig. 2. The head-stock is mounted upon a base A′, which may be adjusted laterally upon the frame D by means of nuts a, threaded upon a screw-rod a', projecting from the base, the nuts being arranged to engage opposite sides of a lug a^2, secured to the frame D. By manipulating the nuts a the head-stock may be adjusted laterally in bringing the parts carried thereby into proper alinement with the work on the work-table C. The base A′ is guided in its lateral movements by a key a^3 and is clamped in adjusted position by clamping-bolts a^4, Figs. 1 and 3.

In order that the head-stock may be adjusted vertically in bringing the parts carried thereby into proper alinement with the work, it is adjustably secured upon the base A′. As shown, the head-stock is provided with lugs a^5 a^6, the rear lugs a^5 being pivotally connected with similar lugs a^7 on the base and the front lugs a^6 being connected with lugs a^8 on the base by means of clamping-bolts a^9, which pass through slots in the lugs a^6 and are threaded in the lugs a^8. When the clamping-bolts a^9 are loosened, the head-stock may be adjusted vertically by means of nuts a^{10}, (only one of which is shown,) threaded upon a screw-rod a^{11}, extending vertically from the frame D through a lug a^{12} on the head-stock.

During the grinding operation the grinding-wheel is rotated at a high rate of speed about its own axis and at the same time is caused to travel about the axis of the surface which is being acted upon. In order that the wheel may have this traveling movement about the axis of the work, the grinding-wheel spindle E is mounted eccentrically in a revolving drum F, supported in bearings in the head-stock, and in order that the distance between the axis of the spindle and the axis of the revolving drum may be varied in accordance

with the curvature of the surface being ground the spindle E is eccentrically supported in a cylinder G, which is in turn eccentrically mounted in the drum F. With this construction the distance between the axis of the spindle E and the axis of the revolving drum F may be accurately and conveniently adjusted by turning the cylinder G in its bearings, and thus the grinding-wheel may be adjusted so that its periphery will travel in a circular path of any required diameter. The drum F is rotated continuously during the grinding operation through a gear F′, secured thereto and connected with a shaft F^2 by means of a pinion F^3 and an intermediate gear F^4. The shaft F^2 is driven from a pulley-shaft F^5 through gears F^6.

The cylinder G may be turned in the drum F to vary the adjustment of the spindle E by means of a worm G′, engaging a worm-wheel G^2, formed on the cylinder G. The worm is secured to a shaft G^3, mounted in the drum F and provided with a squared end G^4 for the reception of a wrench. When the drum F is at rest, the cylinder G may be turned by applying a wrench to the squared end G^4 of the shaft G^3, the guard A^2 being removed to give access to the end of the shaft, or a hole may be made in the guard A^2 for the passage of the wrench. By this means the spindle E may be adjusted to bring the grinding-wheel into close proximity to the surface to be ground in setting up the machine for any given piece of work. When the cylinder G has been once adjusted, it will be held accurately and rigidly in position by the engagement of the worm with the worm-wheel. This adjusting means also enables a fine and accurate adjustment of the grinding-wheel to be made. In order that the spindle may be adjusted during the grinding operation to bring the grinding-wheel against the surface to be ground or in setting the grinding-wheel for taking a fresh cut, means are provided for operating the worm G′ during the rotation of the drum F. This means consists of a ratchet-wheel g, secured to the worm and arranged to be engaged by a pawl g', pivoted in a sleeve g^2, which is mounted to slide upon and turn with the drum F. The sleeve g^2 is provided with an annular groove g^3 and is connected with a pivoted yoke g^4 by means of shoes g^5, carried by the arms of the yoke and engaging the groove. The yoke may be swung about its pivot to move the sleeve g^2 backward and forward upon the drum F by means of an operating-lever g^6, pivoted to the head-stock and connected with the yoke by means of a roll g^7, mounted on one arm of the yoke and engaging a groove in the operating-lever. These connections between the operating-lever and the sleeve g^2 enable the sleeve to be operated without interfering with its rotary motion.

When the operating-lever is moved toward the left in Fig. 6, the pawl g^2 rides idly over the ratchet-teeth of the wheel g until the tail of the pawl engages the rear end f of the slot in the drum F, in which the pawl travels, when the pawl is lifted out of engagement with the ratchet. With the pawl in this position the worm may be turned to rotate the cylinder G in either direction. When the operating-lever is moved toward the right in Fig. 6, the pawl g' immediately engages the teeth of the ratchet-wheel, and as the movement of the lever continues the pawl acts to turn the worm-wheel, thus turning the cylinder G and changing the adjustment of the grinding-wheel spindle E. The range of movement of the operating-lever may be limited and regulated by means of two adjusting-screws g^8, arranged to engage opposite sides of the lever, Fig. 4. By this arrangement the movement of the operating-handle may be regulated to give a very fine and accurate adjustment to the grinding-wheel.

In Figs. 7 and 8 a modified form of operating means for the worm G′ is shown, by which the worm may be turned in either direction during the rotation of the drum F. In this construction two oppositely-arranged ratchet-wheels h h' are secured to the worm-shaft, and two oppositely-arranged pawls h^2 h^3 are pivoted on a pawl-carrying arm h^4, which is mounted on the worm-shaft. The pawl-carrying arm is connected with the sleeve g^2 by means of a pin h^5, working in a slot in the end of the pawl-carrying arm. When the operating-lever g^6 is in mid-position, both pawls h^2 h^3 are held out of engagement with the ratchet-wheels by a plate h^6, arranged between the ends of the pawls and the ratchet-wheels. If the arm is moved toward the right, the pawl h^2 will ride off the edge of the plate h^6 and operate upon the ratchet-wheel h' and turn the worm forward. During this movement of the operating-arm and sleeve g^2 the pawl h^3 will ride idly on the plate h^6. If the operating-lever is moved from mid-position toward the left, then the pawl h^3 will act upon its ratchet-wheel to turn the worm in a reverse direction, the pawl h^2 riding idly on the plate h^6.

The bearings in which the grinding-wheel spindle is journaled are mounted in two sleeves or bushings E′ E^2, secured eccentrically in the cylinder G. The front sleeve E′ projects forward from the end of the drum F and cylinder G, so that the grinding-wheel may extend the required distance within the cylinder or other work being ground. It is desirable that this sleeve or bushing E′ should be of sufficient diameter to rigidly support the outer end of the grinding-wheel spindle in order that the wheel may act efficiently and accurately upon the work.

Since the necessary requirements as to the size and length of the sleeve E′ vary with different pieces of work, it is of advantage to be able to vary the extent to which the spindle

extends beyond the end of the drum F and also to be able to vary the size of the supporting-sleeve for grinding-wheels of different size and for different classes of work. I have made provision for such variation by employing a front sleeve E′, which may be removed and replaced with a sleeve of different size, and by also forming the spindle in two sections, the front section being mounted in the sleeve E′ so that it is removable therewith. The rear section of the spindle is mounted in the rear sleeve E^2, and the two sections are connected together by a coupling E^3, which does not interfere with the removal of the sleeve E′ and front section and is readily engaged when a different front sleeve and front spindle-section is secured in place.

The spindle is driven through a pulley E^4, mounted upon the rear bearing for the spindle and connected with the end of the spindle by means of a plate E^5 and nut E^6. The belt *e*, which drives the spindle, passes over the pulley E^4, over two idle pulleys *e*′, carried by a frame e^2, and around a pulley e^3, secured to a driving-shaft e^4. In order to accommodate the rotary travel of the spindle, the frame e^2 is pivoted on the driving-shaft e^4 and is connected with the sleeve E^2 by means of a link e^5, one end of which is pivoted to the frame e^2 and the other end of which surrounds a bearing formed on the outer end of the sleeve E^2.

The construction described forms an efficient and reliable mechanism for grinding internal surfaces in which the spindle may be accurately and conveniently adjusted either when the drum F is in motion or when it is at rest and in which the spindle when adjusted is rigidly and accurately held in position, so that the work may be accurately and rapidly ground.

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

1. The combination of a spindle, a rotary drum in which the spindle is eccentrically mounted, and means for varying the eccentricity of the spindle during the rotation of the drum.

2. The combination of a spindle, a rotary drum in which the spindle is eccentrically mounted, an adjustable part carrying the spindle, a worm-wheel connected with said part, a worm coöperating therewith to effect the adjustment of said part, and means for operating the worm during the rotation of the drum.

3. The combination of a spindle, a cylinder in which said spindle is eccentrically mounted, a revolving drum in which the cylinder is eccentrically mounted, and means for adjusting the cylinder during the rotation of the drum.

4. The combination of a spindle, a cylinder in which the spindle is eccentrically mounted, a revolving drum in which the cylinder is eccentrically mounted, and means for adjusting the cylinder in either direction during the rotation of the drum.

5. The combination of a spindle, a cylinder in which the spindle is eccentrically mounted, a revolving drum in which the cylinder is eccentrically mounted, a worm-wheel on the cylinder, a worm on the drum for adjusting the cylinder in the drum and means for operating the worm during the rotation of the drum.

6. The combination of a spindle, a cylinder in which the spindle is eccentrically mounted, a drum in which the cylinder is eccentrically mounted, a worm-wheel on the cylinder, a worm mounted on the drum, a ratchet-wheel connected with the worm, a sleeve mounted to slide on the drum, a pawl on said sleeve, and a fixed operating device for operating said sleeve.

7. The combination of a spindle, a cylinder in which the spindle is eccentrically mounted, a revolving drum in which the cylinder is eccentrically mounted, a worm-wheel on the cylinder, a worm on the drum, a ratchet-wheel connected with the worm, a sleeve mounted to slide on the drum, a pawl carried by the sleeve, an operating-lever, and connections between said lever and said sleeve for operating the same.

8. The combination of a spindle, a revolving drum in which the spindle is eccentrically mounted, means for adjusting the eccentricity of said spindle during the rotation of the drum, and devices for regulating the movement of said adjusting means.

9. The combination of a spindle, a revolving drum in which said spindle is eccentrically mounted, a lever, connections between said lever and spindle for varying the eccentricity of the spindle, and regulating-screws determining the movement of the lever.

10. The combination of a head-stock, a revolving drum mounted therein, a spindle eccentrically mounted in the drum, means for adjusting the head-stock laterally, and means for adjusting the head-stock vertically.

11. The combination of a head-stock, a revolving drum mounted therein, a spindle eccentrically mounted in the drum, means for adjusting the eccentricity of the spindle, means for adjusting the head-stock laterally, and means for adjusting the head-stock vertically.

12. The combination of a revolving drum, a spindle eccentrically mounted therein and formed in sections, a removable sleeve projecting from the drum and carrying the front section of said spindle.

13. The combination of a rotary drum, a cylinder eccentrically mounted therein, a rear sleeve mounted in said cylinder and provided with bearings for the spindle carried by said sleeve, a removable front sleeve mounted in said cylinder and provided with bearings for the spindle, a rear spindle-section mounted in

the rear sleeve, a front spindle-section mounted in the front sleeve, and means for coupling said sections together.

14. The combination of a revolving drum, a removable sleeve eccentrically mounted in said drum and projecting therefrom, bearings in said sleeve for a spindle-section, a second sleeve mounted in said drum in line with the removable sleeve, bearings in said second sleeve, a second spindle-section, and a coupling device for connecting the spindle-sections when the sleeves are in place.

15. The combination of a spindle, a cylinder in which the spindle is eccentrically mounted, a revolving drum in which the cylinder is eccentrically mounted, two oppositely-arranged ratchets connected with said drum to operate the same, two pawls for operating said ratchets in opposite directions, and means for operating either of said pawls during the rotation of said drum.

16. The combination of a spindle, a cylinder in which the spindle is eccentrically mounted, a revolving drum in which the cylinder is eccentrically mounted, a worm-wheel on the cylinder, a worm on the drum, two oppositely-arranged ratchet-wheels connected with the worm, two pawls, and a fixed operating device for operating said pawls.

17. The combination of a spindle, a cylinder in which the spindle is eccentrically mounted, a revolving drum in which the cylinder is eccentrically mounted, two oppositely-arranged ratchets connected with the cylinder to move it in opposite directions, two pawls, an operating device therefor, means for holding said pawls out of operation and for bringing them alternately into operation as the operating device is moved from mid-position in opposite directions.

18. The combination of a spindle, a cylinder in which the spindle is eccentrically mounted, a revolving drum in which the cylinder is eccentrically mounted, a worm-wheel on the cylinder, a worm on the drum, two oppositely-arranged ratchet-wheels connected with the worm, a sleeve mounted to slide on the drum, two oppositely-arranged pawls connected with said sleeve, and a fixed operating device for operating the sleeve.

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