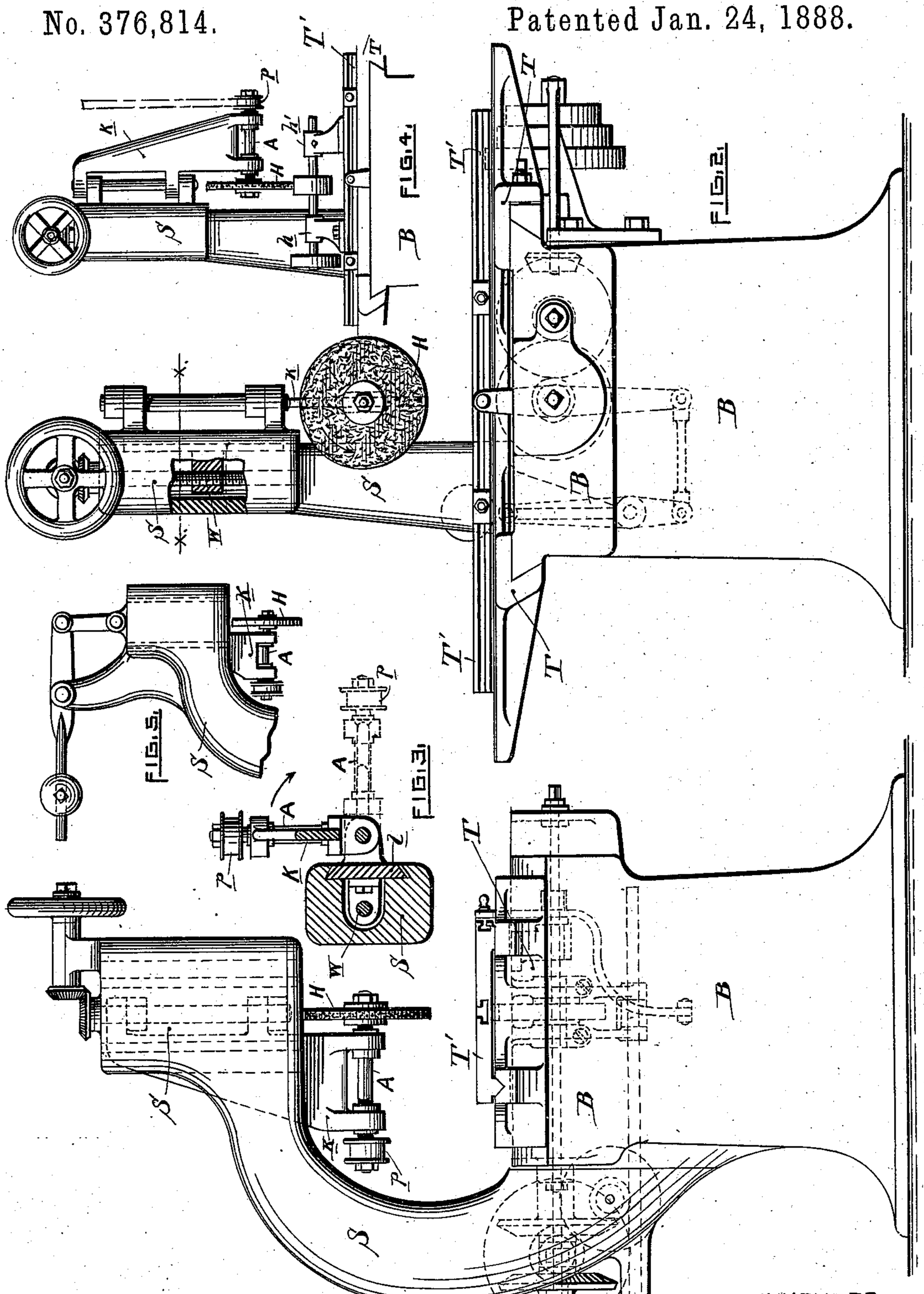
(No Model.) 3 Sheets—Sheet 1.

J. A. COLEMAN.

GRINDING MACHINE.

No. 376,814. Patented Jan. 24, 1888.



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(No Model.) 3 Sheets—Sheet 2.

J. A. COLEMAN.

GRINDING MACHINE.

No. 376,814. Patented Jan. 24, 1888.

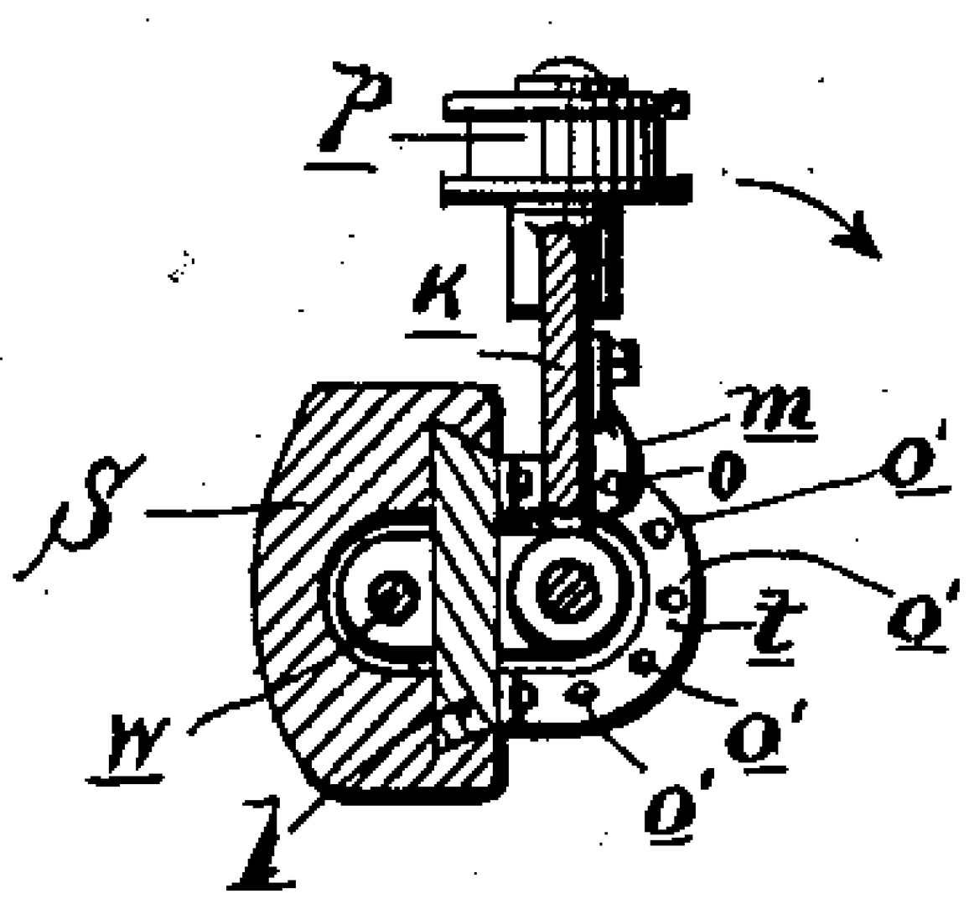

FIG. 9.

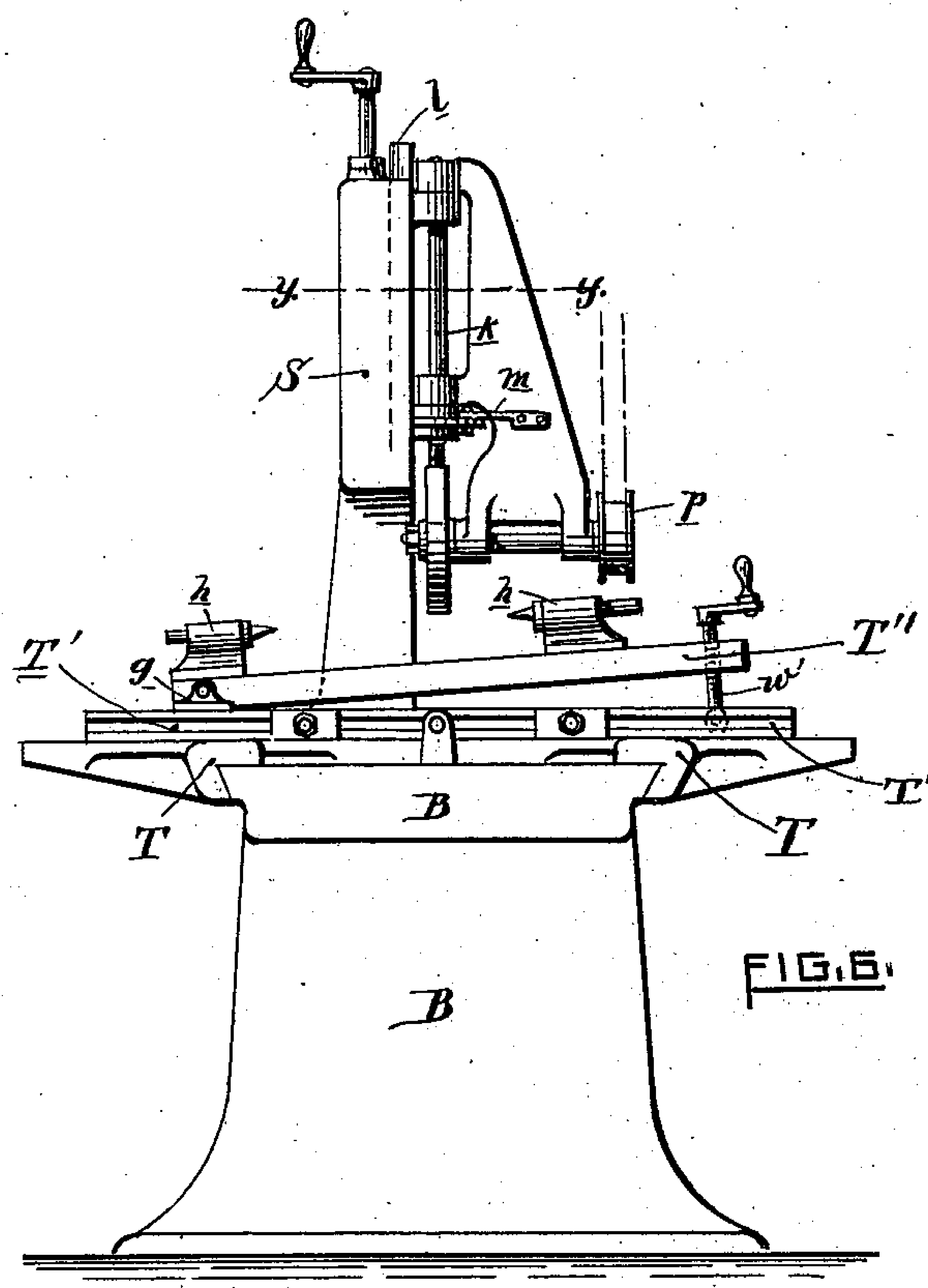

FIG. 6.

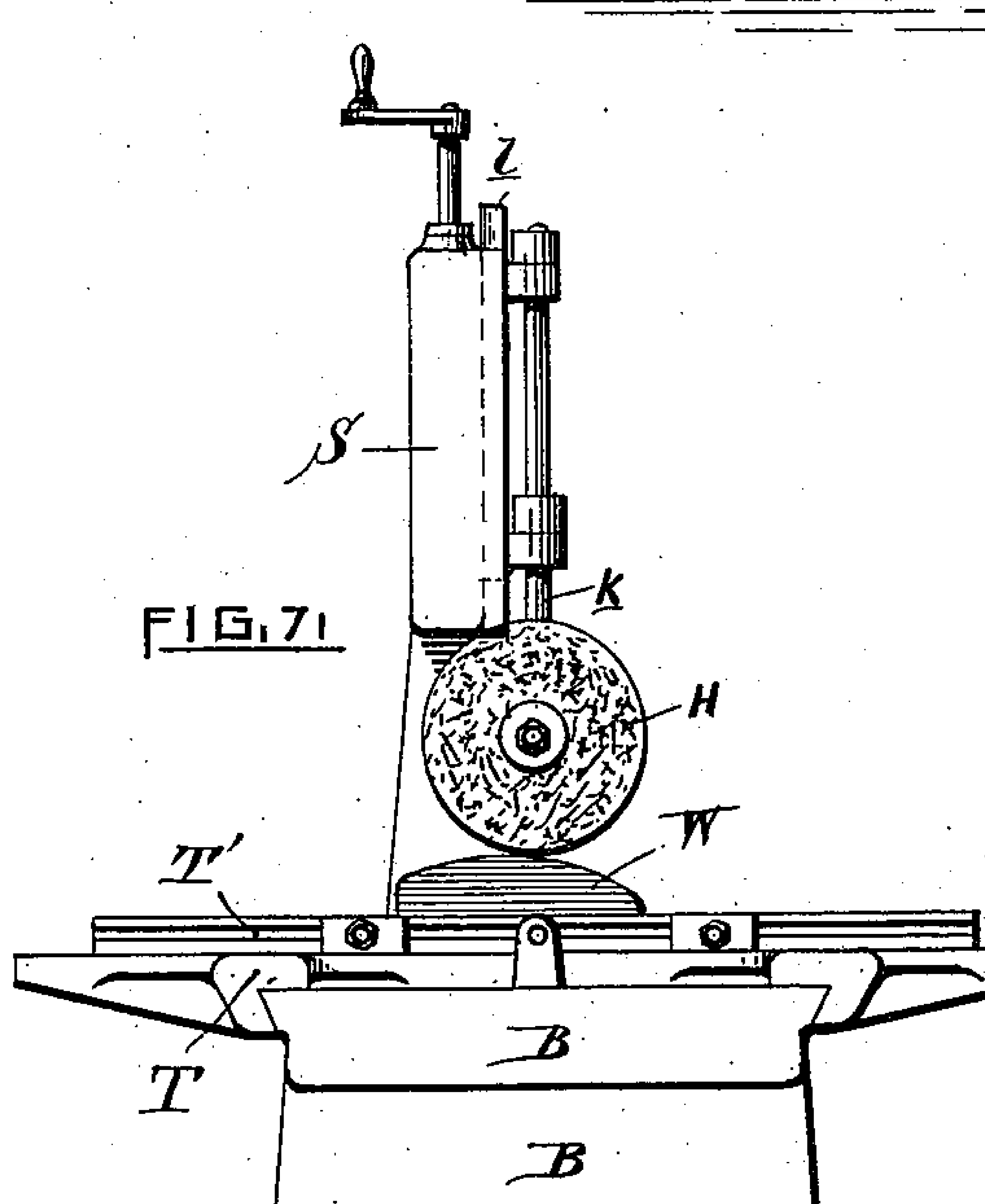

FIG. 7.

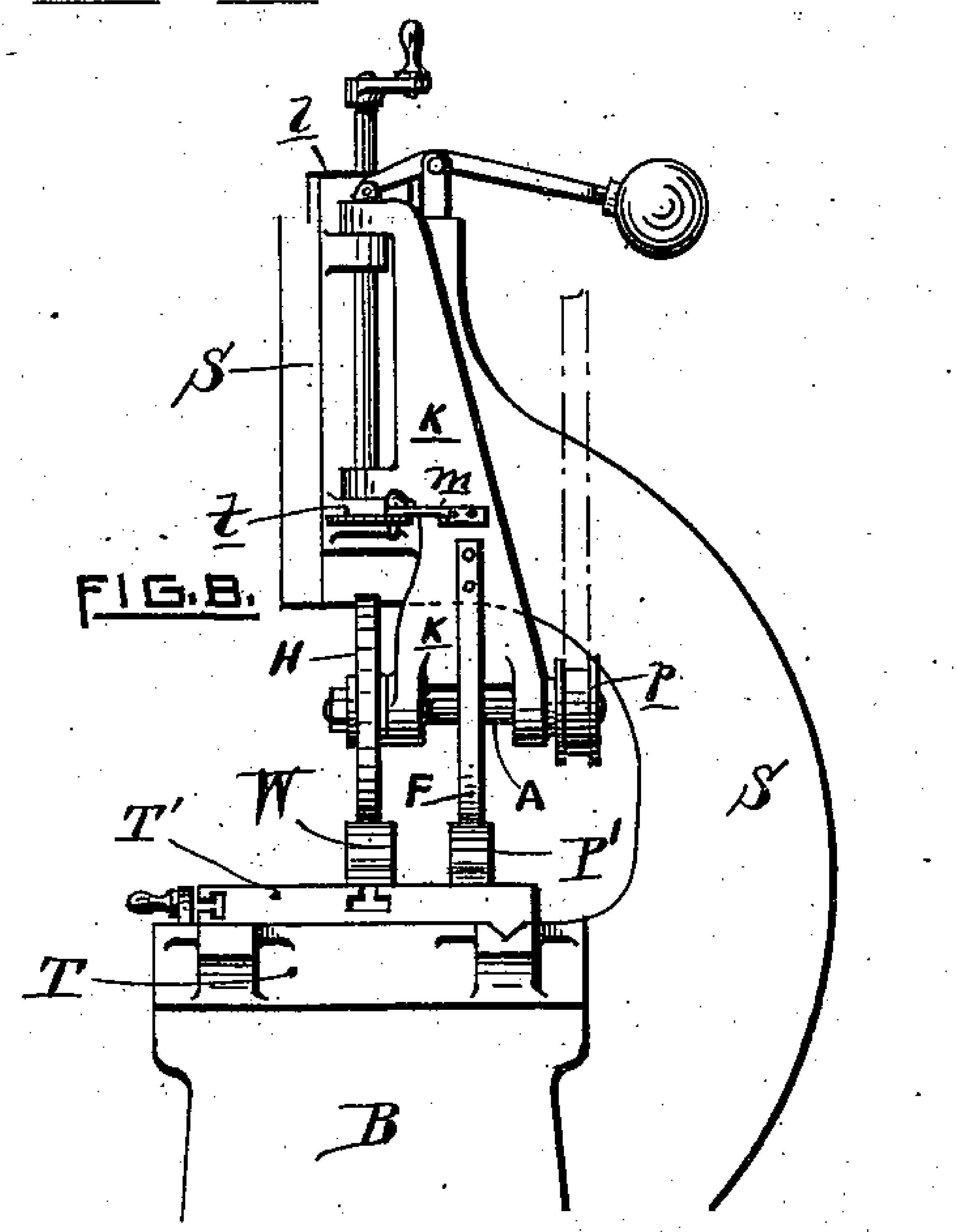

FIG. 8.

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(No Model.) 3 Sheets—Sheet 3.

J. A. COLEMAN.

GRINDING MACHINE.

No. 376,814. Patented Jan. 24, 1888.

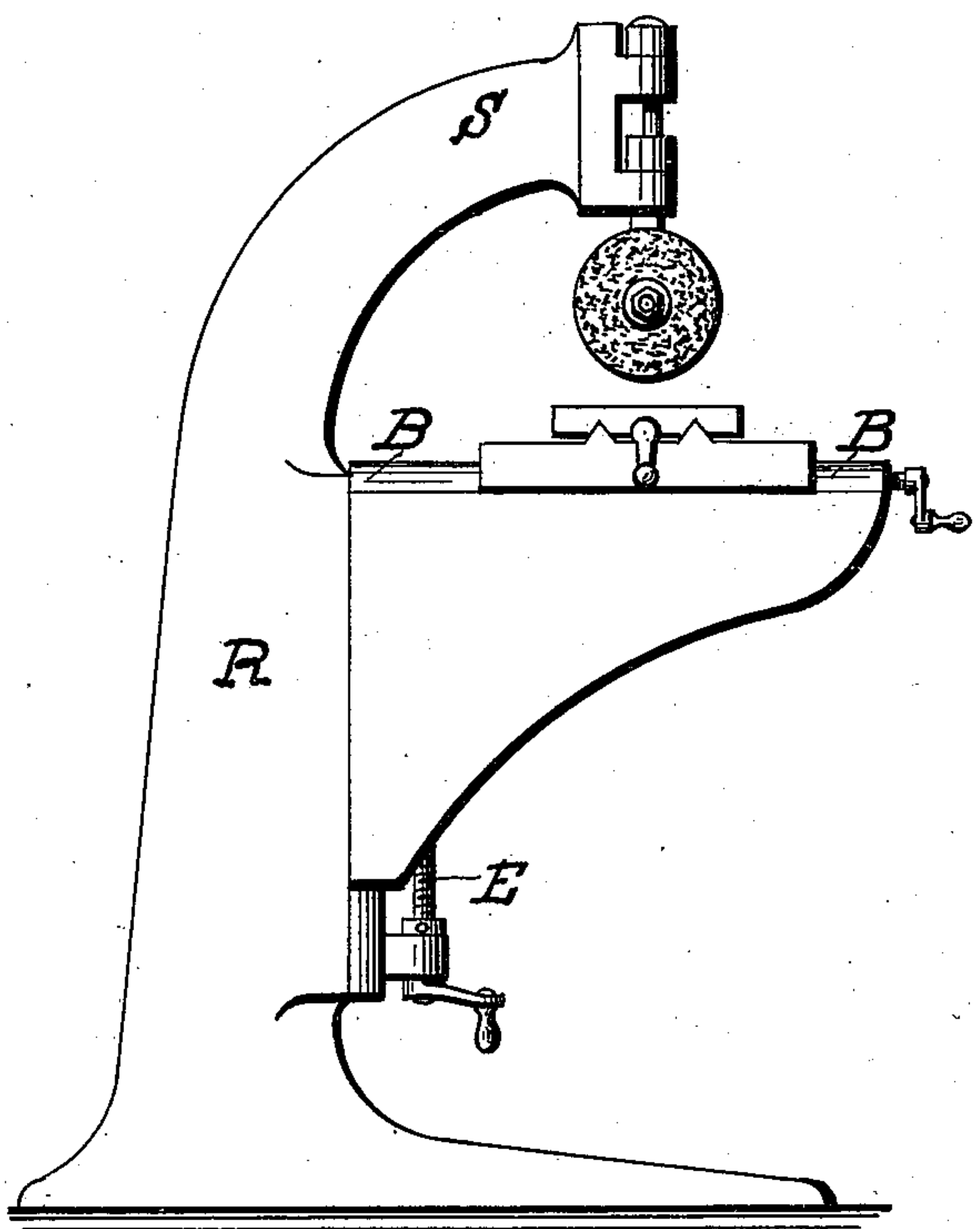

FIG. 11.

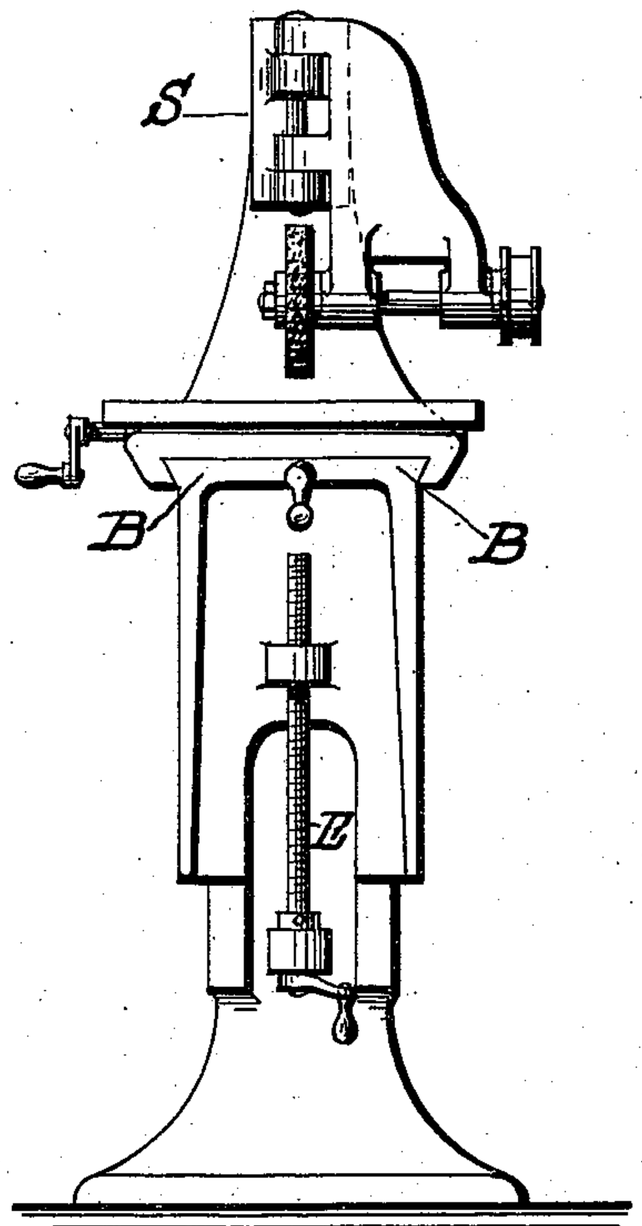

FIG. 10.

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UNITED STATES PATENT OFFICE.

JOHN A. COLEMAN, OF PROVIDENCE, RHODE ISLAND.

GRINDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 376,814, dated January 24, 1888.

Application filed May 23, 1885. Serial No. 166,434. (No model.)

To all whom it may concern:

Be it known that I, JOHN A. COLEMAN, a citizen of the United States, residing in the city and county of Providence, and State of Rhode Island, have invented certain new and useful Improvements in Grinding-Machines, of which the following is a specification.

Hitherto for grinding the surfaces of metals in what are known as "grinding-machines" a specially-organized machine was necessary for grinding cylindrical surfaces and another of different organization for flat or plain surfaces. The former was technically called a "cylindrical grinder" and the latter a "surface-grinder." In such cylindrical grinders the metal to be ground is revolved upon centers, or their equivalents, in standards fixed to a carriage or table, and the axis of the cylindrical body is in a plane parallel with the plane of the table, and this table has a longitudinal reciprocating movement which carries the metal to be ground while in contact with the edge of a grinding-wheel. The grinding-wheel is held in a "head" at one side of the reciprocating table, with the axis of the wheel parallel to the line of direction of the reciprocating table. The axes of the wheel and of the cylindrical metal to be ground lie in the same horizontal plane, and this plane is parallel with the plane of the reciprocating table. The head holding the grinding-wheel is advanced or retracted from the work to be ground in slides at right angles to the slides of the reciprocating table. In operation the work to be ground is revolved against the periphery of the revolving grinding-wheel, and is ground circumferentially and longitudinally as the reciprocating table passes the work across the edge of the wheel.

In a surface-grinding machine flat-surfaced metal to be ground is fastened upon a longitudinally-reciprocating table, and this table moves back and forth in slides upon a lower table, which also moves laterally in slides upon the frame of the machine at right angles to the line of direction of the upper table. The grinding-wheel is hung over the work to be ground, with its axis at a right angle to the line of direction of the upper table carrying the work to be ground. The arbor of the grinding-wheel is supported in a head having a vertical feed movement in slides in an upright standard situated at one side of the bed or frame supporting the tables and attached to and forming part of the machine. In operation the metal to be ground, lying upon the upper table, is passed to and fro beneath and against the edge of the grinding-wheel. The wheel cuts a path in the metal equal to its own width, and at the end of the complete backward-and-forward stroke a new path is effected by feeding the lower table referred to laterally upon its slides in the frame of the machine, and this movement of course carries the upper table with it. After grinding the surface over as described, the operation may be repeated by lowering the wheel upon the work by means of the screw which connects the grinding-wheel head and the standard. In brief, cylindrical grinders have heretofore had wheels with axes parallel with the longitudinal direction of their reciprocating tables, and the wheel has only a horizontal feed to and from the metal to be ground, but no vertical feed, while surface-grinders have wheels with their axes at right angles to the longitudinal direction of their reciprocating tables which carry the work to be ground, and the wheel has only a vertical feed to and from the work, but no horizontal feed, as in the cylindrical grinder. It is obvious, then, that heretofore a cylindrical grinder has been an organization peculiar and distinct from a surface-grinder, and in order to do both kinds of work two distinct and separate machines have been necessary. Cylindrical grinding cannot be done on a surface-grinder, nor can surface-grinding be done upon a cylindrical grinder.

The object of my invention is to obviate the necessity for separate machines to do the two classes of grinding, and to reduce expense by organizing one machine so that it shall possess the capacity to do both kinds of work; and to this end I have, as I believe, for the first time, embodied in one machine a reciprocating table and a grinding-wheel so arranged that by variations in adjustment the grinding-wheel may be made to occupy its proper position with relation to the metal to be ground, whether flat or circular, and to operate at its grinding-face either parallel with the path of the table or at right angles thereto, the gist of my invention being so mounting the table and wheel

with reference to each other that the path of the metal to be ground may be varied from a line which is at right angles to the axis of the wheel to a line which is parallel with said axis.

In the accompanying drawings I have shown mechanism for carrying out my invention, in which—

Figure 1 is an end elevation of a grinding-machine containing my improvements, the grinding-wheel being in position for surface grinding. Fig. 2 is a front elevation of the same, a small portion of the arm supporting the grinding-wheel being broken away to show interior construction. Fig. 3 is a sectional view on line *x x* of Fig. 2, showing the supporting arm and yoke in section; also the arbor of the grinding-wheel supported in the yoke in which it is hung and swung from one position to another. Fig. 4 is a front elevation of the grinding-wheel support, showing the yoke in which the grinding-wheel is hung, an arbor with the grinding-wheel mounted thereon, and pulley and belt for driving the same, the wheel being faced in the proper direction for circular grinding. There is also shown a piece of circular work to be ground, mounted on centers upon a table. Fig. 5 is a side view of the upper portion of the supporting overhanging arm, showing a weighted lever attached to a slide in the side of the supporting-arm, the slide being shown in broken lines; also a portion of the yoke carrying the arbor and grinding-wheel, the yoke being attached to the slide and the whole arranged to be counterbalanced by the weighted lever. Fig. 6 is a side view of a grinding-machine, showing the grinding-wheel and its support, the wheel being turned in the proper direction for grinding circular forms. There is also shown an auxiliary table on which to mount tapering or conical forms to be ground. Fig. 7 is a side elevation of a grinding-machine with my improvements, showing the grinding-wheel operating upon an irregular surface. Fig. 8 is an end elevation of the same, showing a former or pattern fixed on the table, having upon its face the configuration to be given to the work to be ground; also the pattern-guide regulating the height of the grinding-wheel in conformity to the pattern. Fig. 9 is a section on line *y y* of Fig. 6, showing means for locking the yoke in which the wheel is hung in various positions into which it may be swung. Figs. 10 and 11 illustrate a machine embodying certain features of my invention in a modified form.

B is the bed of the machine, upon which is mounted the lower table, T, arranged to slide laterally by usual and well-known means.

T′ is the upper or work-supporting table, which has a longitudinally-reciprocating motion upon the lower table in slides and supports the work to be ground. These tables are provided with means for accurately adjusting and operating them; but all the foregoing construction of tables and bed being well known, I make no further allusion to them.

S is a strong standard attached to the bed of the machine, and is made to overhang the table. In this standard is a slide, *l*, working vertically or to and from the table and positively controlled and adjusted by a screw, *w*, or its equivalent, or, being disconnected from the screw, is left free to play up and down or to and from the table. The slide and the screw on the back side of the slide are indicated by broken lines in Fig. 1, and the slide is also similarly indicated in Figs. 2 and 5. A yoke, *k*, is hinged to this slide to swing like a door or rudder on its hinges, and across this yoke, in a position parallel to the top of the bed, is placed an arbor, A, in bearings, carrying the grinding-wheel H and a pulley, *p*, for driving the same. The grinding-wheel hangs in this instance directly under the pivotal hinge of the yoke *k*, so that when the yoke is swung into various positions the wheel hangs over the same spot; but the position of the wheel may be varied without departing from the invention so long as the pivot referred to stands in such relation to the arbor that the wheel may be faced in different directions when the supporting mechanism of the arbor is swung upon its pivot. By this slide *l* and yoke *k* the wheel may be advanced toward and retracted from the work on the table, as desired, and may also be swung so as to face in any required direction.

In the drawings the swinging yoke *k*, which gives direction to the face of the wheel, is locked at the various points to which it is swung by a semicircular plate, *t*, fastened to the slide *l*, and an arm, *m*, attached to the yoke, one end of which lies over the semicircular plate *t*. In the end of the arm *m* is a hole, *o*, to receive a pin or screw, which passes through it and into either of the corresponding holes, *o′ o′ o′ o′*, in the plate, according to the position into which the yoke is swung. It is obvious, however, that various devices may be applied to that purpose, the choice of which may depend upon the details of construction adopted for mounting the wheel and its arbor.

For cylindrical grinding, centers *h h′* are placed on the longitudinally-moving table T′, in which cylindrical bodies may be mounted to be ground. The cylindrical work is revolved on these centers in the usual manner as it is passed to and fro before the grinding-wheel.

The wheel may be brought against the side of the cylinder to be ground, or it may be directly over the same. In the first case the work is fed against the wheel by moving the lower table, T, laterally. In the latter case the wheel is fed down upon the work by operating the slide *l*, which is simply a carrier moving in a right line to and from the work.

It is believed that the shaft or arbor of the grinding-wheel will not be required to move through more than ninety degrees to accomplish both surface and cylindrical grinding. In such case the driving of the arbor is best

effected from a driving-drum overhead and mounted on swinging arms with a counterbalancing-weight attached, in a manner well known, so that the arbor will be run either with the belt twisted or open, according to the position in which the wheel has been adjusted.

To operate the machine for surface-grinding, a piece of work is fastened upon the top table, T′, the centers *h h′* being removed. The yoke is swung so that the grinding-wheel arbor is at a right angle to the longitudinal direction of the table and the wheel is over the work. As the table T′ moves forward, a cut is made by the wheel and the table comes back again. The under table, T, is then fed laterally for another cut, of course carrying the top table and work with it, and the forward-and-back motion repeated, and so on until the work is entirely ground across its face. If the work is to be ground again, the space between the wheel and table is lessened; or, in other words, the wheel is lowered and the operation repeated.

If cylindrical work is to be ground, it is placed on centers fastened to the top table, T′, and revolved on the centers in the usual manner. The yoke *k* is swung so that the arbor of the grinding-wheel is parallel with the direction of the longitudinally-reciprocating table T′. The wheel may be lowered so that its face will operate upon the side of the cylindrical work to be ground, in which case the wheel will be fastened and the work fed against it by feeding the lower table, T, laterally, of course carrying the reciprocating table T′ with it. A slow reciprocating movement is given to the table T′, the work at the same time revolving and pressing against the face of the grinding-wheel. At each end of the stroke of the top table the lateral feed of the lower table is applied for a repeated cut, and so on until the work is finished.

If the wheel were placed over the work instead of at the side, the lateral feed of the tables would not be used; but repeated cuts would be made by feeding the wheel down upon the work at each complete stroke of the reciprocating table.

In order to grind tapering or conical forms, an auxiliary table, T″, is placed upon the table T′. One end of the table T″ is hinged, as at *g*, upon the table T′, and the other end carries a screw, *w′*, or other suitable means, for elevating and depressing that end of the table. The centers *h h″*, for holding cylindrical work, are attached to the auxiliary table and the work revolved therein. The grinding-wheel is placed over the work in this case, so that the lowest point of the wheel is directly over the axis of the work to be ground. The revolving work is reciprocated past the face of the wheel, and if repeated cuts are desired the wheel is fed downward upon it by its own mechanism.

It is obvious that other devices for inclining the axis of the tapering circular work to suit the taper and enable it to be ground may also be employed without departing from the invention.

For grinding forms of irregular surface, P′ is a pattern attached to the table T′. F is a guide-finger with its lower end curved to the same sweep as the curve of the grinding-wheel, and this guide-finger is suitably attached to the yoke *k*. W is an irregularly-shaped piece of work to be ground, attached to the table T′ beside the pattern P′. The curved end of the guide-finger rests upon and follows the configuration of the pattern P′.

In operation for this class of work the grinding-wheel arbor would be swung into the same position as for surface-grinding—at a right angle to the direction of the reciprocating table T′. The positive screw-feed of the slide *l* is detached, leaving the finger F to rest upon the pattern by gravity, and as the table T′ moves back and forth the guide F, following the configuration of the pattern P′, causes the wheel to give the same configuration to the work to be ground. The reciprocating movement of the table T′ and the lateral feeding of the table T would be the same as for plain surface-grinding.

In place of advancing the wheel toward and retracting it from the surface of the table in a line perpendicularly thereto, the counterpart thereof may be employed—of moving the table to and from the wheel in the same perpendicular line, as is common in some surface-grinding machines, and this mode of placing the wheel and the metal into and out of contact might have been illustrated in connection with Figs. 1 and 2; but for its better illustration I have preferred to resort to additional figures, and to therein clearly indicate that when the metal to be ground is moved vertically toward and from the wheel the latter need not necessarily be vertically adjusted.

In Figs. 10 and 11 I have shown a front and end view of a grinding-machine in which the bed supporting the tables is mounted on a heavy standard in such a manner that it is readily raised and lowered by means of a screw. The arrangement for raising and lowering the bed is not new, and therefore does not require elaborate description. The bed B is shown as a bracketed table gibbed to an upright support, R, and raised and lowered by the screw E. The said Figs. 10 and 11 show the wheel pivotally mounted, as before described, on the standard S; but the slide *l* is omitted, its office being performed by the sliding bed.

It is obvious from what has been shown that this invention has for the first time brought together into a single machine the capacities of surface and cylindrical grinding by means of the simple devices for facing the grinding-wheel in different directions, the same being always located over the face of the table in a machine employing the longitudinally and laterally reciprocating tables of a surface-grinding machine without change.

I make no claim in this application to that feature of my invention, hereinbefore shown

and described, whereby the table or bed is made movable to and from the pivotally-movable wheel, and illustrated in Figs. 10 and 11 of the drawings, which feature I reserve for a divisional application which I am about to file, wherein I intend to claim the same.

As hereinbefore indicated, it is to be understood that single sliding tables and duplex sliding tables have heretofore been employed in grinding-machines with grinding-wheels incapable of the pivotal movement as now provided for by me; and it is also to be understood that in machines for grinding wood-planing-machine knives the grinding-wheels have been pivoted, as, for instance, as shown in United States Letters Patent, July 16, 1872, No. 129,548, where the grinding-wheel is so mounted that only a portion of its periphery is available for grinding, because it is diametrically obstructed by the frame-work in which it is mounted, thereby rendering it impracticable for use in my machines, not only because it would prevent close observation when in service, but also because one of the most useful portions of the periphery is rendered wholly unavailable.

It will be seen that my grinding-wheels have an unobstructed grinding surface, and that the periphery of the wheel in the horizontal plane occupied by its axis, as well as all of the periphery below said axis, is available for grinding, and this is absolutely essential in my machines.

Having now described the parts of the machine and their various modes of operation, what I claim as new, and desire to secure by Letters Patent, is—

1. In a grinding-machine, the combination, substantially as described, of a sliding table for supporting material to be ground and an overhanging grinding-wheel which is supported in a frame and is thereby pivoted at right angles to its axis, whereby said wheel may be adjusted for service either with its axis parallel with or at right angles to the path of the table.

2. In a grinding-machine, the combination, substantially as described, of a sliding table for supporting material to be ground, an overhanging grinding-wheel supported in a frame and thereby pivoted at right angles to the axis of the wheel, and means, substantially as described, for varying the space between the grinding-face of the wheel and the table.

3. In a grinding-machine, the combination, substantially as described, of a grinding-wheel supported in a frame and thereby pivoted at right angles to its axis, and a work-supporting sliding table below the wheel and mounted upon a second sliding table, affording a line of movement which is at right angles to the path of the work-supporting table.

4. In a grinding-machine, the combination, substantially as described, of a sliding table for supporting material to be ground and an overhanging grinding-wheel having an unobstructed grinding-periphery and supported in a frame and thereby pivoted at right angles to its axis and adjustable toward and from the surface of said table and at right angles thereto.

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