No. 679,347.

Patented July 30, 1901.

R. P. THOMPSON.

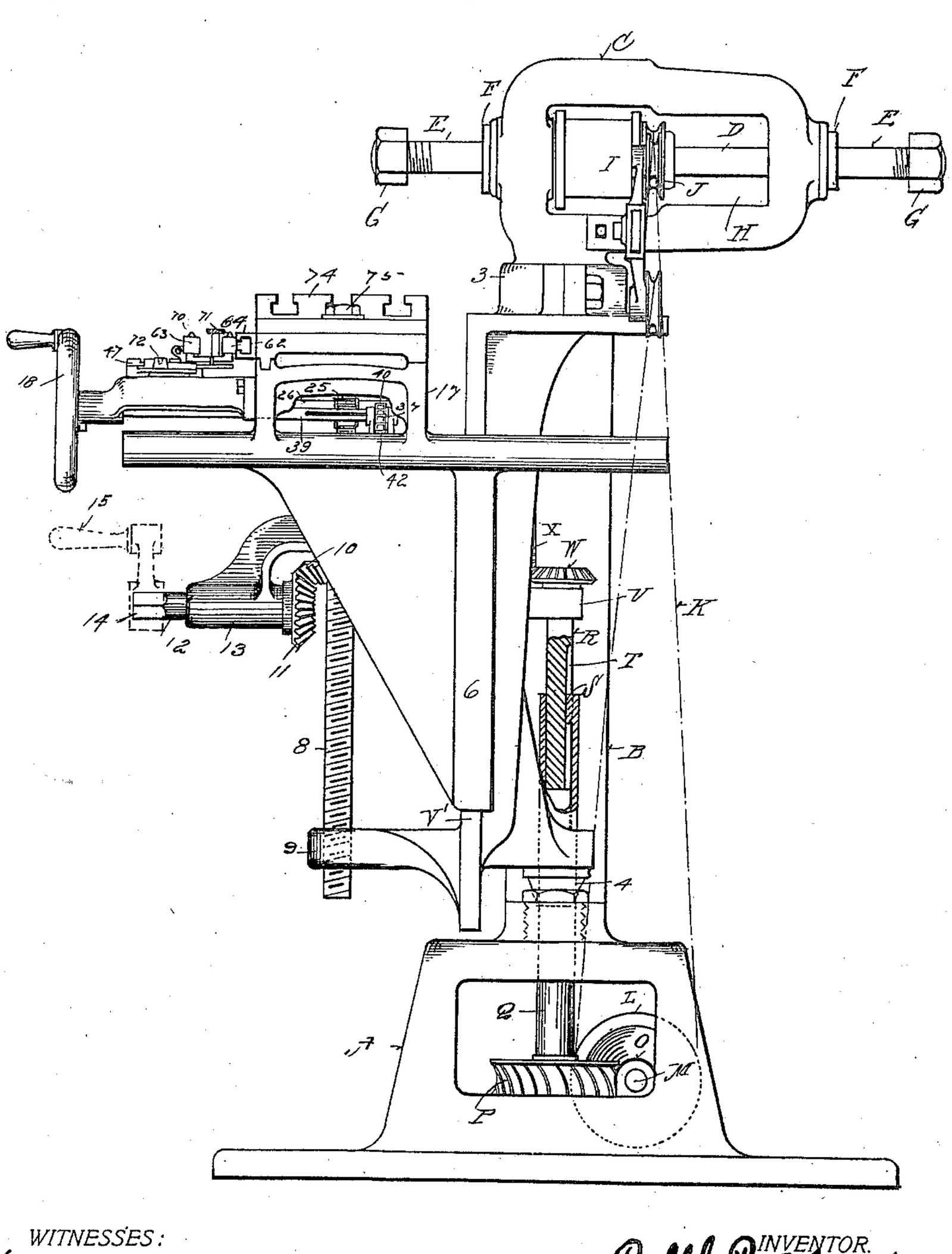
GRINDING MACHINE.

(Application filed Oct. 4, 1900.)

(No Model.)

6 Sheets—Sheet 1.

Fig. 1



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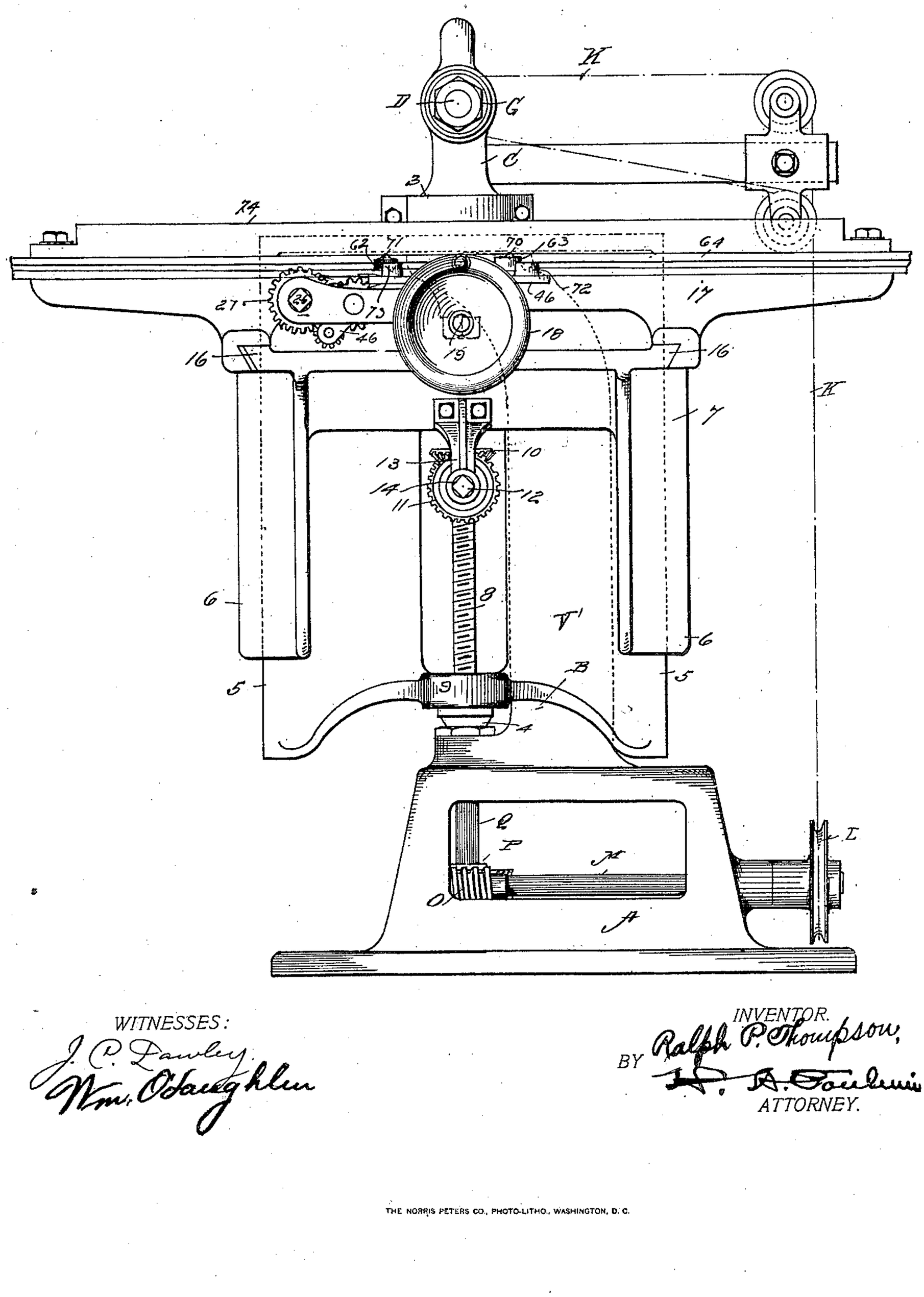
(No Model.) 6 Sheets—Sheet 2.

Fig. 2.



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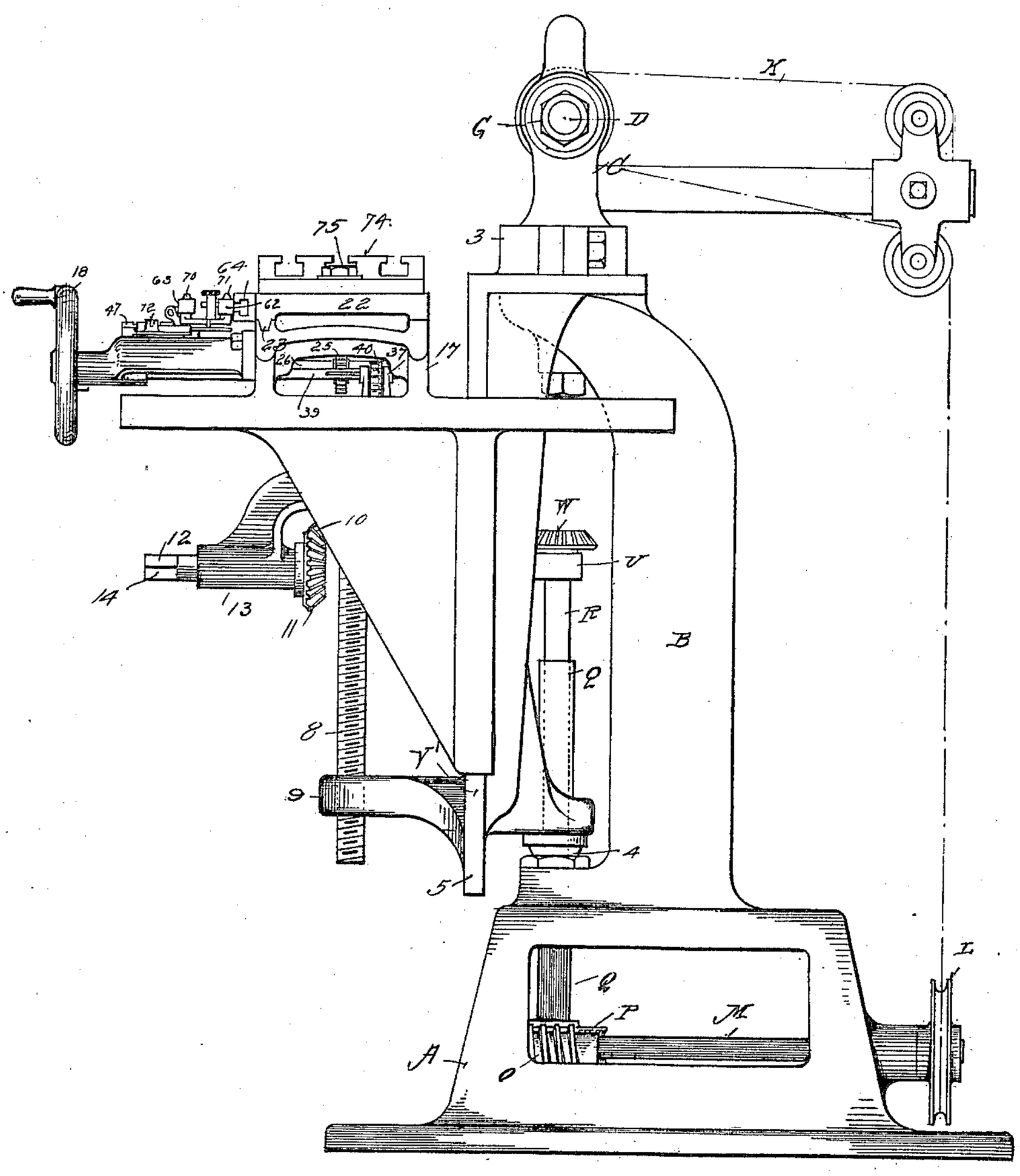
(No Model.) 6 Sheets—Sheet 3.

Fig. 3.



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6 Sheets—Sheet 4.

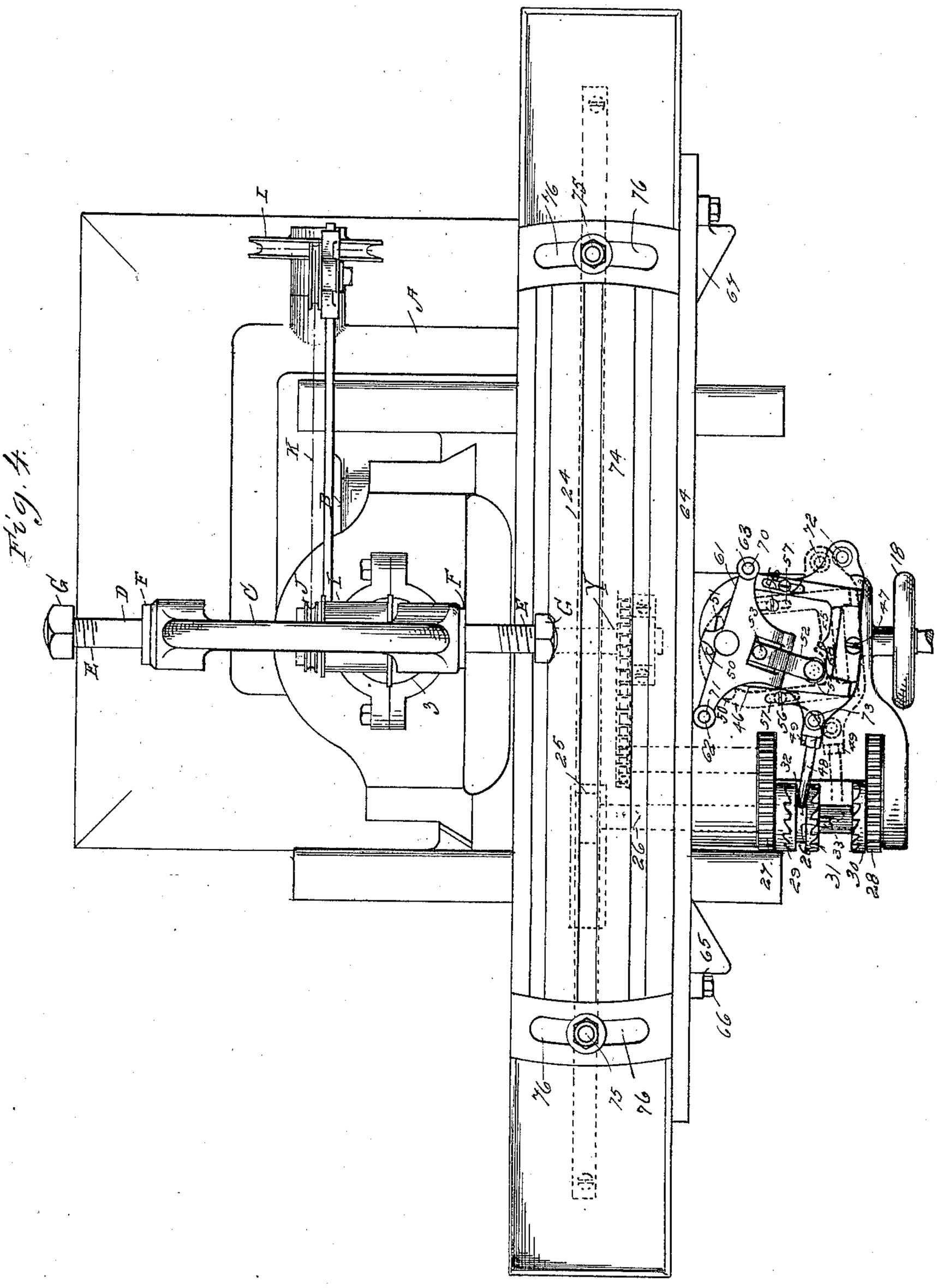

Fig. 4.

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(No Model.) 6 Sheets—Sheet 5.

Fig. 5.

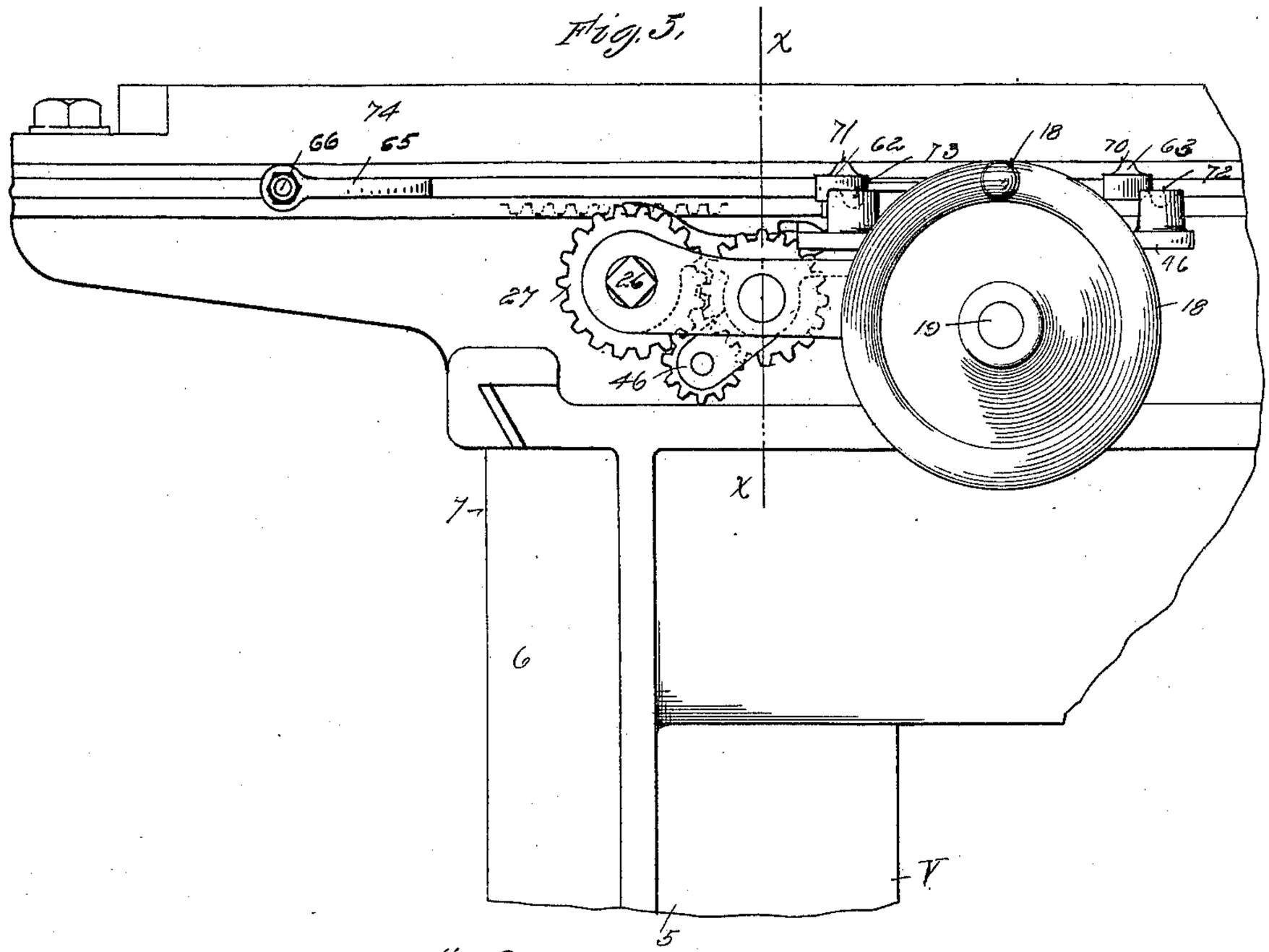
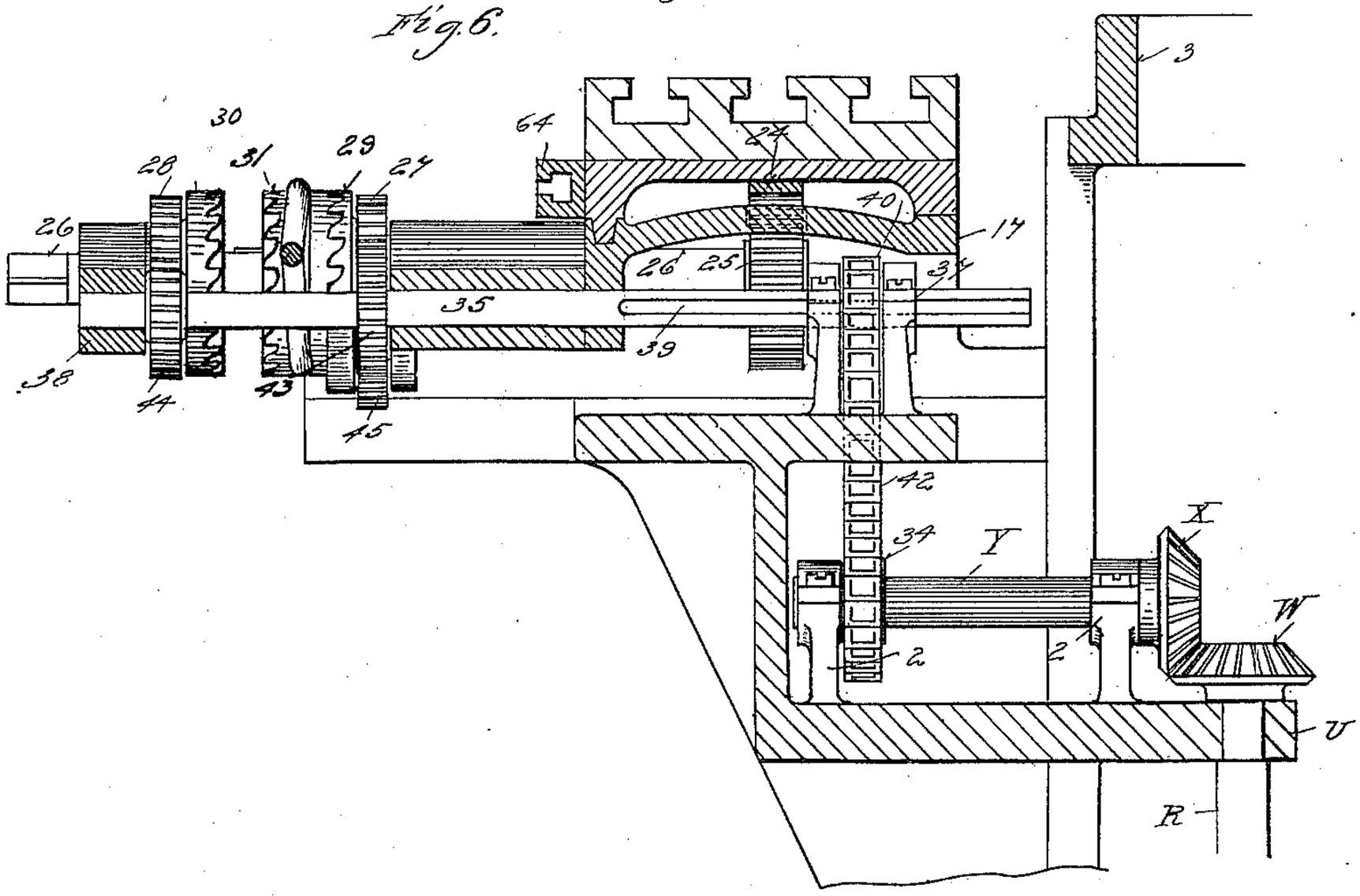


Fig. 6.



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(Application filed Oct. 4, 1900.)

(No Model.) 6 Sheets—Sheet 6.

Fig. 7.

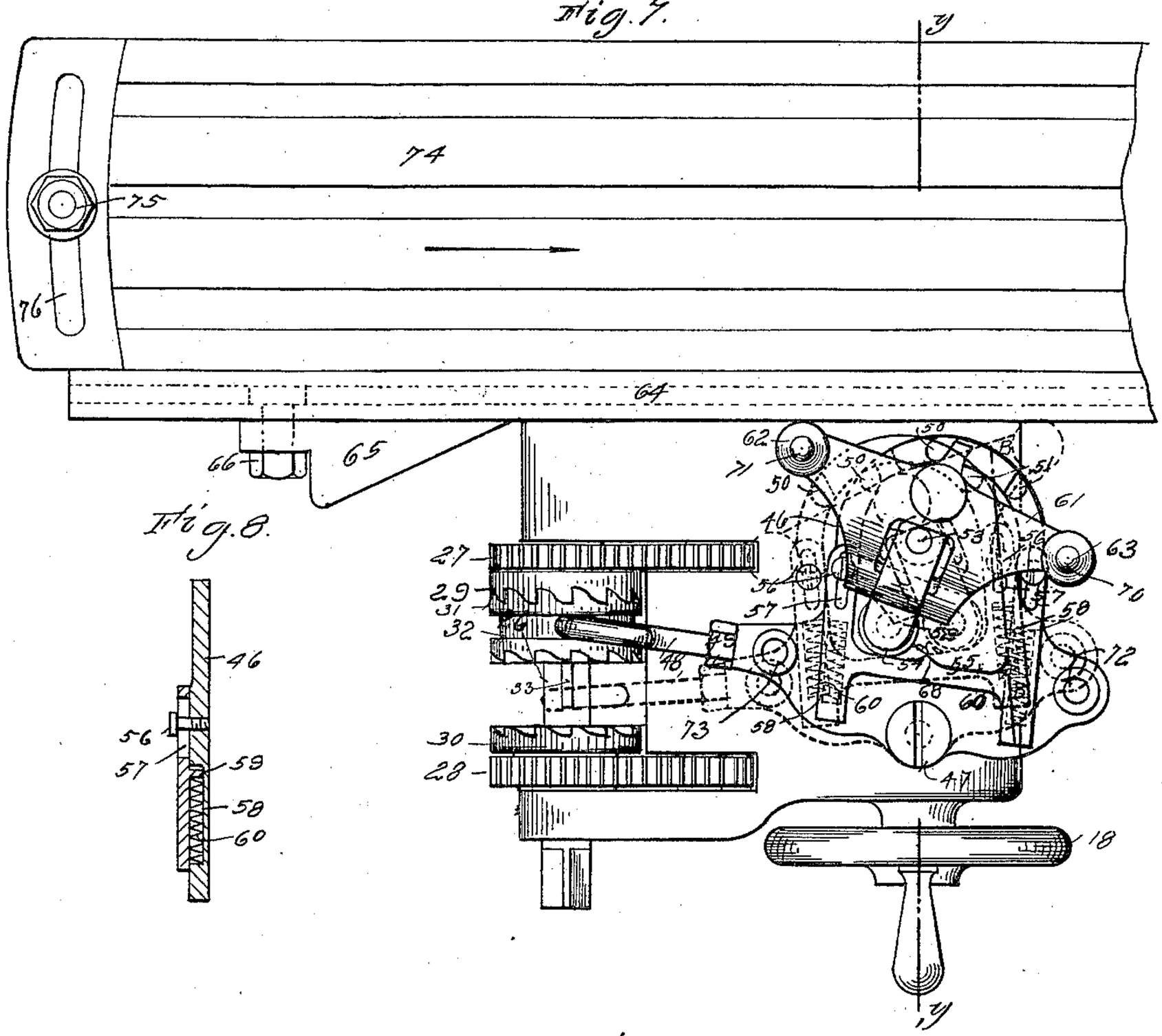
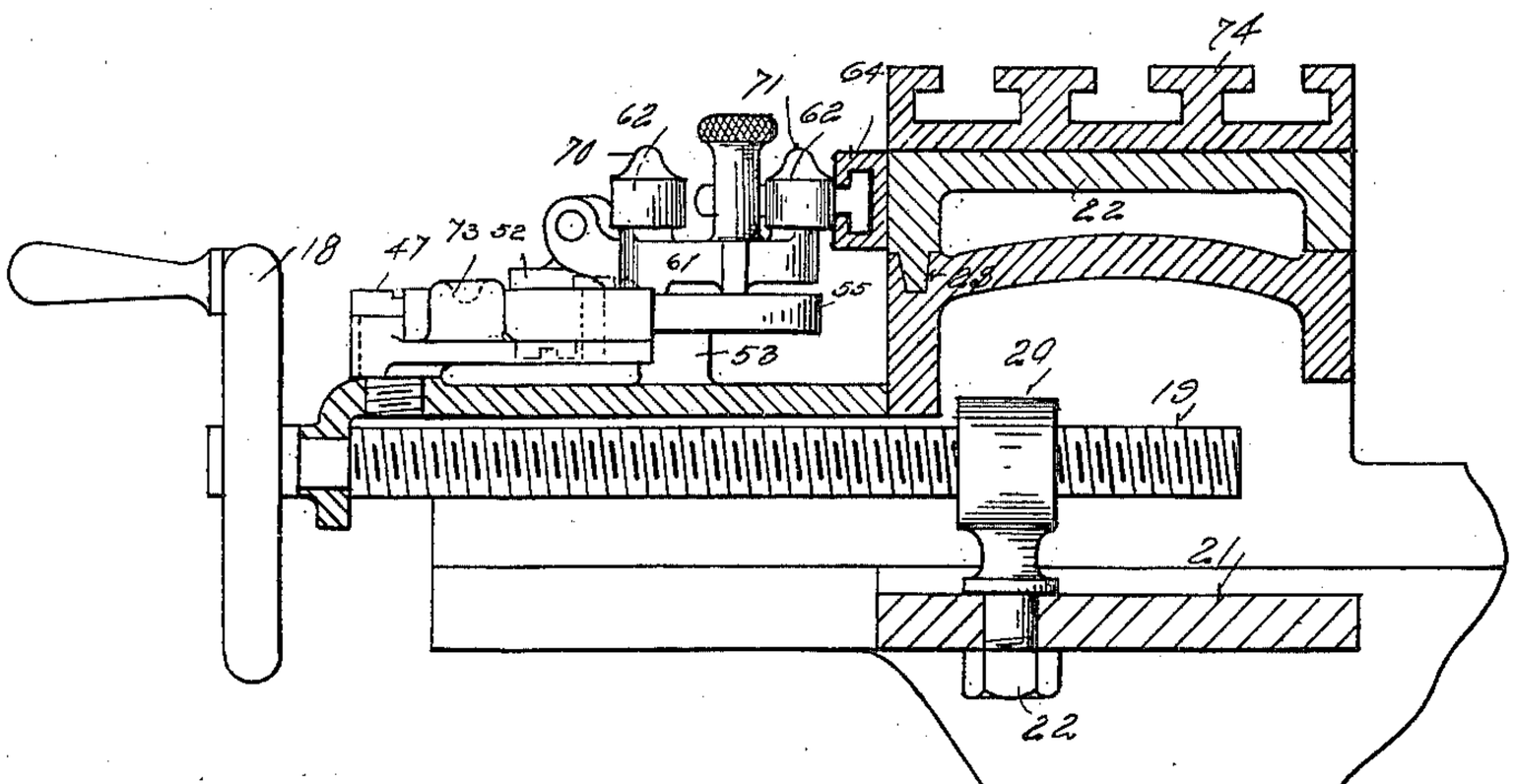


Fig. 8.

Fig. 9.



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UNITED STATES PATENT OFFICE.

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GRINDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 679,347, dated July 30, 1901.

Application filed October 4, 1900. Serial No. 31,946. (No model.)

To all whom it may concern:

Be it known that I, RALPH P. THOMPSON, a citizen of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Grinding-Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to certain new and useful improvements in grinding-machines.

One of the general objects of my invention is to combine in a single machine devices by the use of which all forms of metal grinding may be accomplished in shopwork when treating metal.

Another object of my invention is to provide a grinding-table which may move automatically when in any relative position with respect to the grinding-wheels.

Still another object of my invention is to provide an improved reverse mechanism for the grinding-table, whereby the initial movement transmitted to such mechanism releases a clutch member and also operates such reverse mechanism, so that it will continue or complete the reversing operation after the grinding-table comes to a standstill. This object is carried out by pivotally mounting a table-bracket upon a standard or support in such a manner that such bracket, together with the automatically-operated table, may be freely swung about a common center coincident with an operating-spindle, whereby the driving mechanism for said table constantly maintains the same relative relation to said operating-spindle.

My invention also relates to details of construction and organization hereinafter appearing and particularly pointed out in the claims.

In the accompanying drawings, on which like reference characters indicate corresponding parts, Figure 1 represents an end elevation of my improved grinder complete; Fig. 2, a side elevation showing the table and table-operating mechanism at right angles to the grinder-spindles; Fig. 3, a similar view to Fig. 2, but showing the table and table-operating mechanism turned parallel to the grinder-spindles; Fig. 4, a plan view with parts in the same position as indicated in Fig. 2; Fig. 5, a detail view of a portion of the table-supporting bracket, table, and mechanism for operating said table; Fig. 6, a detail sectional view on the line $x\,x$ of Fig. 5 with parts removed; Fig. 7, a detail view of a portion of the table, together with the reverse mechanism for reversing the movement of the table; Fig. 8, a detail sectional view on the line B B of Fig. 7 looking in the direction of the arrows, and Fig. 9, a partial sectional view on the line $y\,y$ of Fig. 7.

The letter A represents a suitable base, upon which is mounted a standard or support B. To this support is bolted or otherwise secured a head C, carrying a grinding-spindle shaft D, which projects beyond said head at each end thereof (see Figs. 1 and 4) to form spindles E for the reception of emery-wheels of any suitable or desired form. (Not shown.) Such spindles are held in place between the respective collars F and nuts G, the latter of which are screwed upon the ends of the spindles. (See Figs. 1, 3, and 4 particularly.) The head C is cut out, as shown at H, and upon the spindle D is mounted a pair of pulleys I and J, respectively, in any suitable manner within the cut-out portion H. The head C is securely fixed in position, so that the spindles E are also maintained in a fixed position, although they may freely rotate in the head. A belt, as indicated at K, passes over the pulley J and down around a pulley L, the latter of which is fixedly mounted upon a shaft M, rotatably supported in the base A. The shaft M also carries a worm-gear O, which meshes with a worm-gear P, carried at the lower end of a hollow shaft Q. This hollow shaft is also mounted in the base, so as to rotate therein in any suitable manner. A shaft R telescopes within the shaft Q and is made to rotate with the shaft Q by means of a key S, which fits into a spline T in the shaft R. The upper end of the shaft R extends through a bracket U, projecting from a table-bracket V, hereinafter described. Upon the upper end of the shaft R is mounted a bevel-gear W, which meshes with a bevel-gear X, mounted on the inner end of a shaft Y, supported in bearings 2 by a table-bracket 7, hereinafter described. It will be observed

from Figs. 1 and 3 particularly that an apron V′ is pivotally connected at its upper end to the head C, as indicated at 3, while at its lower end it is also pivotally supported in a conical bearing 4, carried by the base A. The shafts R and Q pass up through the bearing 4, so that the apron V′ is pivoted about the shaft Q, while the upper pivotal connection of said apron with the head C is vertically over the conical bearing 4. Consequently the pivotal center of the apron and the pivotal center of the shafts R and Q are coincident with each other, so that the apron may swing on its pivots and at the same time the bevel-gear X on the shaft Y and the bevel-gear W on the shaft R will always intermesh with each other, the bevel-wheel X simply riding around on the bevel-wheel W as the apron is swung about its center. The apron V′ is fixed in regard to vertical movement, yet at the same time may freely swing about its axis. Each side of the apron is provided with guides 5, which fit within ways 6 in a table bracket or support 7, so that the table-bracket is capable of vertical movement on the apron V′. This is accomplished by means of a screw-threaded shaft 8, which is screwed into a projection 9 from the apron V′ and which is provided at its upper end with a bevel-gear 10, meshing with a bevel-gear 11, carried by a stud 12, mounted on a bracket 13, bolted or otherwise secured to the table-bracket 7, as clearly seen in Fig, 2. The outer end of the stud 12 is angular, as indicated at 14, for the reception of any suitable crank, as indicated at 15, so that as the crank is turned the bevel-wheels 10 and 11 will also be operated, together with the screw-threaded shaft 8, thereby causing the table-bracket to raise and lower on the guides 5, according to the position in which it is desired to place the table hereinafter referred to.

From Fig. 2 particularly it will be seen that the table-bracket 7 is provided with a guide 16 at each end thereof and at right angles to the guides 5. Upon these guides 16 is mounted a table-rest 17, so that such table-rest may have a sliding movement on the table-bracket 7 to or away from the emery-wheel, such sliding movement being controlled by a crank 18, mounted on the outer end of a screw-threaded shaft 19, which passes through a thimble 20, supported by the table-bracket 21, and is held in position by a nut 22 or in any other suitable manner. As the crank 18 is rotated, the table-rest is moved in or out or to or away from the emery-wheels, so that it has two movements with respect to the emery-wheel spindles—namely, a vertical movement and a parallel movement. It will be observed that one of the spindles projects beyond the pivotal center of the machine more than the other spindle. This is for the purpose of doing different kinds of work or cutting out different parts of the device to be ground without the necessity of changing emery-wheels. Upon the table-rest 17 is mounted a reciprocating table proper, such as indicated at 22, for supporting the work. This table is mounted to slide in a groove 23 in the upper face of the table. From Fig. 6 it will be observed that this table carries a rack 24, extending substantially the length thereof, (see Fig. 4 particularly,) and which engages with a spur-gear 25, fixedly mounted upon a shaft 26, extending out through the side of the table-rest and carrying a pair of pinions 27 and 28, respectively, as also a pair of clutches 29 and 30. Each of these clutches and pinions is loosely mounted upon the shaft, yet at the same time they are held from sliding thereon in any suitable manner. A sliding clutch member 31, having an annular groove 32 therein, is mounted upon the shaft 26 in such a manner that it will rotate with the shaft, yet may slide thereon. This is accomplished either by means of a stud projecting from the clutch member 31 into a groove or spline 33 in the shaft 26 or in any other suitable manner. Thus as the sliding clutch member 31 engages with one of the clutch members 29 or 30 the shaft 26 will rotate therewith; but when the clutch member 31 is out of engagement with both of the clutch members 29 and 30 the shaft 26 will remain at rest.

From Fig. 6 particularly it will be seen that upon the shaft Y is mounted a sprocket-wheel 34, while on a shaft 35, which extends through the side of the table-rest and which is supported in bearings 37 and 38, carried by the apron and table-rest, respectively, is mounted a sprocket-wheel 40. The shaft 35 is provided with a spline 39, into which projects a key 41 from the sprocket-wheel 40. Thus the shaft 35 may be adjusted in or out in the bearing 37 as the table-rest is adjusted in or out on the guides 16 and at the same time is rotated by a sprocket-chain 42. Upon the shaft 35 is also mounted a pair of gears 43 and 44, respectively, the gear 44 meshing with the gear 28, carried by the shaft 26, while the gear 43 engages with an idler 45, carried by fixedly-mounted arms 46, in such a manner that it engages with the gear 27. Consequently the gear 27 rotates in one direction, while the gear 28 rotates in the opposite direction, and inasmuch as the clutch members 29 and 30 are rigid with or form a part of the respective gears 27 and 28 when the clutch member 31 is in engagement with the member 29 the shaft 26 is driven in one direction, while when the sliding clutch member 31 is in engagement with the clutch member 30 the shaft 26 is driven in the opposite direction. This will cause the reciprocating top to move first in one direction and then in the opposite direction, according to which of the clutch members 27 and 28 is engaged by the clutch member 31.

I will now refer to the mechanism for operating the sliding clutch member automatically, so that it will be thrown first into engagement with the clutch member 29 and

then into engagement with the clutch member 30.

From Figs. 2, 4, and 7 it will be observed that upon the table is pivotally mounted a yoke 46 by means of a screw 47, which screws into the table, and yet at the same time permits the yoke to pivot about it. This yoke carries a bifurcated arm 48, which fits in the annular groove 32 in the clutch 31, a nut 49 on said arm acting to slightly adjust it lengthwise and hold it in adjusted positions. A pair of lugs 50 51 project upward from the yoke near its inner end for a purpose hereinafter appearing. Within this yoke is pivoted a lever 52 upon a stud 53, projecting upward from the table. One end of this lever projects sufficiently to engage with the lugs or projections 50 and 51, extending upward from said yoke in a manner hereinafter appearing, while the other end of the lever carries a roller 54, which normally engages with an auxiliary trip device 55, secured to the yoke by means of screws 56, which extend through slots 57 therein. The screws are turned down sufficiently to hold the auxiliary trip device firmly against the yoke, and yet at the same time permits said auxiliary trip device to move back and forth on the yoke, such slots permitting such movement. As shown in Fig. 8, the yoke 46 has a longitudinal depression or groove 58 therein, into which projects a lug 59 from the auxiliary trip device. A spring 60 is mounted in said depression and one end abuts against the lug 59, while the other end abuts against one end of the elongated depression. In practice there is a lug at each side of the auxiliary trip device, and in the yoke there are two rectangular depressions and also a spring for each depression. These springs normally act to hold the lugs substantially against the inner ends of the depressions. This permits the auxiliary trip device to normally press against the roller 54. It will be seen that to the lever 52 is pivoted a plate 61, which carries a pair of rollers 62 and 63, respectively, at its outer ends, such plate being pivoted near its central portion to swing vertically, but which is rigid in the opposite direction. As viewed in Fig. 7, the roller 62 is adjacent to the table-rest 17.

From Figs. 2, 3, 5, and 7 particularly it will be observed that the outer edge of the table-rest is provided with a bar 64, which has a T-shaped groove therein. Within this groove fits a wedge 65 and also a bolt 66, such bolt extending through the wedge to hold it in position, as indicated in Fig. 7. By loosening the nut of the bolt 66 the wedge may be shifted along in the T-shaped groove to whatever point desired. Near the opposite end of the table-rest is mounted another wedge similar to the wedge 65, as indicated at 67, this latter wedge inclining oppositely to the wedge 65. Let it be supposed that the clutch 31 has one of its clutch-faces in engagement with the clutch member 29. This causes the shaft 26 to rotate in the proper direction to run the table 22 in the direction of the arrow, as indicated in Fig. 7, so that the wedge 65 will engage with the roller 62, and thereby throw the plate 61 into the position indicated in dotted lines in Fig. 7. This movement of the plate also causes the lever 52 to engage with the lug or projection 50 on the yoke 46, so that as the wedge 65 forces the roller away from the traveling plate the inner end of the lever contacting with the lug 50 causes the yoke 46 to pivot about its pivotal point 47, thereby at the same time forcing the clutch 31 out of engagement with the clutch member 29. While this is taking place the roller 54 passes the point 68, and at the same time the auxiliary trip device is forced backward or outward, thereby compressing the springs 60. As soon as the roller passes over the point 68, the springs pressing against the auxiliary trip device act upon the roller 54 to throw it against the side 59. This movement of the plate 61 causes the bifurcated arm 48 to advance the clutch 31 into engagement with the clutch member 30. This will instantly change the direction of motion of the shaft 26, and the gear 27, meshing with the rack 24, will cause the grinding-table to move in the opposite direction. The movement of the plate 61 just described, however, causes the roller 63 to be thrown adjacent to the grinding-table, so that as the wedge 67 strikes the roller 63 such roller is thrown away from the top, and the inner end of the lever 52 contacts with the lug 51, thereby swinging the yoke in the opposite direction and at the same time returning the roller at the outer end of the lever 52 across the point 68, so that the springs act to still further throw the roller 63 away from the reciprocating top, whereby the clutch 31 is again moved into engagement with the clutch member 29. Thus with my organization I provide wedges which act upon the plate 61 to cause the yoke 55 to partially swing about its pivotal point, while the auxiliary trip device acts to still further swing such yoke in the same direction, according to which wedge acts upon the plate. Should the table only be required to reciprocate short distances, the wedges are placed closer together, while where it is required to reciprocate through long distances the wedges are placed farther apart.

In order that I may reciprocate the grinding-table by hand, if desired, I have hinged the plate 61 to the lever 52. (See Fig. 9.) Consequently the plate may be thrown back about its hinge until the lugs 70 71, projecting above the respective rollers 63 and 62, are thrown into cups 72 and 73, respectively, carried by the yoke. With this construction the wedges may pass over the top of the yoke 55 without throwing the clutch 31. When it is desired to change the direction of movement of the top plate, the clutch 31 may be thrown into engagement with another one of the clutch members by hand.

Upon the reciprocating grinding-table is mounted a platform 74 for receiving the work to be ground. This platform may be adjusted at various angles by loosening bolts 75, which pass through transverse slots 76 in the grinding-table. Thus with this adjustable platform the work to be ground may be set at different angles to the grinding-wheel without swinging the table. By swinging the table the work may be set at a different angle to the grinding-wheel. By swinging the table around to the opposite side of the standard from that illustrated in Fig. 4 more of the surface of metal may be ground, for the reason that the spindle on such side projects farther than the spindle at the opposite side. In practice an emery-wheel of one shape may be placed upon one spindle, while upon the other spindle an emery-wheel of a different shape and designed to do different work may be employed, so that without changing the emery-wheels the work to be ground may be ground at any angle and in a great variety of shapes.

I wish to lay broad claim to a machine of this character in which the spindle for operating a grinding-table upon which work is adapted to be mounted is coincident with a swinging support which acts to support such table.

I do not wish to confine myself to the particular arrangement of belt for driving the table-operating spindle-shaft, as the shaft may be driven in any suitable manner.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a grinding-machine, the combination, with a fixed standard and a spindle mounted thereon and provided with a grinding-table, of a vertical spindle mounted in the standard, an apron pivotally mounted thereon and adapted to swing around said standard and vertical spindle, a grinding-table supported by said apron, means for connecting said table with and disconnecting it from said vertical spindle, and means connecting said vertical spindle with the grinding-spindle, substantially as described.

2. In a grinding-machine, the combination with a spindle, a fixed standard therefor, of an apron pivotally supported by said standard, a reciprocating grinding-table supported by said apron, and mechanism connected with said spindle for automatically driving said reciprocating table, substantially as described.

3. In a grinding-machine, the combination with a standard, of an apron pivotally supported by said standard, a reciprocating grinding-table supported by said apron, and driving mechanism for said table, one member of which has its axis coincident with the axis of said apron, substantially as described.

4. In a grinding-machine, the combination with a standard, of an apron pivotally mounted thereon, a grinding-table supported by said apron, driving mechanism for said table, one member of which has its axis coincident with the axis of said apron, and reversing mechanism for automatically reversing the direction of movement of said table, all substantially as shown and described.

5. In a grinding-machine, the combination with a standard carrying a grinding-spindle, of an apron pivotally supported by said standard, a table-bracket adjustably mounted on said apron, a grinding-table mounted on said bracket, means for adjusting said grinding-table bracket, and driving mechanism engaging with said reciprocating grinding-table and having the axis of one of its members coincident with the axis of said apron, all substantially as shown and described.

6. In a grinding-machine, the combination with a standard carrying a grinding-spindle, of an apron pivotally supported by said standard, a table-rest carried by said apron, a grinding-table supported by said rest, mechanism for driving said table, one member of which is coincident with the axis of said apron, and mechanism for automatically changing the direction of movement of said table, all substantially as shown and described.

7. In a grinding-machine, the combination with a standard, of a fixed head mounted thereon, a grinding-spindle carried by said head, a base, a shaft carried by said base, an apron pivotally supported by said standard, a grinding-table reciprocatingly supported by said apron, mechanism for driving said table, one member of which is coincident with the pivotal axis of said apron and another member of which consists of clutches, and means for automatically operating said clutches for changing the direction of movement of said table, all substantially as shown and described.

8. In a grinding-machine, the combination with a standard carrying a grinding-spindle, of an apron pivotally supported by said standard, a grinding-table bracket vertically slidably mounted on said apron, a reciprocating table supported by said table-bracket, and driving mechanism for driving said reciprocating table, one member of which is coincident with the pivotal axis of said apron, substantially as described.

9. In a grinding-machine, the combination with a standard carrying a grinding-spindle, of an apron pivotally mounted upon said standard, a table-bracket slidably mounted upon said apron, a table-rest adjustable at right angles to said table-bracket adjustment, a grinding-table mounted on said table-rest, mechanism to automatically reciprocate said table, one member of which is coincident with the pivotal axis of said apron, and means to engage said mechanism with and also disengage it from said table, all substantially as shown and described.

10. In a grinding-machine, the combination with a standard, of a table-rest supported thereby, a grinding-table carried by said rest, driving mechanism for operating said table, one member of which consists of a three-part

clutch, a trip mechanism carried by said rest and connected with one member of said clutch, means for partially operating said trip mechanism to release two of said clutch members from each other, and other means for continuing the operation of said trip mechanism, whereby the part to which said trip mechanism is connected will engage with the third clutch member, the movement of said table being in one direction when the first two members of said clutch members are in engagement with each other and in the opposite direction when the second and third clutch parts are in engagement with each other, substantially as described.

11. In a grinding-machine, the combination with a standard, of a table-rest pivotally supported by said standard, a grinding-table carried by said rest and adapted to reciprocate thereon, mechanism for reciprocating said table, one member of which is coincident with the pivotal support of said table and the other member of which consists of a clutch having a shiftable part and two non-shifting parts, means to rotate said non-shiftable parts in opposite directions, and trip mechanism for automatically operating said shiftable part of said clutch into and out of engagement with each of said non-shiftable parts, respectively, whereby said table is automatically reciprocated in both directions, substantially as described.

12. In a grinding-machine, the combination with a table-rest, of a grinding-table slidably mounted thereon, trip mechanism carried by said rest, driving means connected with said table, one member of which constitutes a three-part clutch, two of which parts rotate in opposite directions from each other and are separated from each other and the other of said parts being shiftable into and out of engagement with first one part and then the other part of said non-shiftable parts, trip mechanism engaging with said shiftable part of said clutch, and means carried by said table for engaging with said trip mechanism, whereby said shiftable clutch member is operated, all substantially as shown and described.

13. In a grinding-machine, the combination with a table-rest and grinding-table, of mechanism for operating said table in both directions, trip mechanism carried by said table-rest, said trip mechanism consisting of a yoke pivotally mounted on said rest, and a lever also pivotally mounted on said rest studs or projections extending from said yoke with which said lever is adapted to contact, one at a time, means for rocking said lever first in one direction and then in the opposite direction for contacting with said pins to rock said yoke, and means for connecting said yoke with said operating mechanism to drive said table first in one direction and then in the other, all substantially as shown and described.

14. In a grinding-machine, the combination with a table-rest, of a grinding-table slidably mounted thereon, said table having a T-shaped groove therein at one edge, bolts having their heads fitting within said groove, wedges held on by said bolts, one at one side of the center of said table and the other at the other side of the center of said table, trip mechanism mounted on said table-rest, said trip mechanism consisting of a pivoted yoke having lugs projecting therefrom and a pivoted lever for engaging with one of said lugs at a time, a plate hinged to said lever carrying a pair of rollers at its outer ends, one at each side of said lever, said rollers normally standing in the path of said wedges, and an auxiliary trip device carried by the first-named yoke having a cam-surface along one edge thereof, said roller engaging with said cam-surface, springs for normally holding said cam-face under a spring-pressure against said lever, mechanism for operating said grinding-table, one member of which is a three-part clutch, and means for connecting said three-part clutch with the first-named yoke, whereby when said lever is operated by said wedges said clutch parts will be separated from each other, said yoke also acting to engage two of said clutch members with each other upon being still further operated through the action of said springs on said lever, substantially as described.

15. In a grinding-machine, the combination with a table-rest, of a grinding-table mounted thereon, means for operating said table in both directions, trip mechanism carried by said table-rest and connected with said operating means to change the direction of movement of said grinding-table, said trip mechanism consisting of a pivoted yoke, a spring-controlled yoke mounted thereon, a lever pivoted on a stud carried by said grinding-table, lugs projecting from the first yoke with which said lever engages, and a pair of arms carrying rollers, said second or cam yoke acting to further operate said lever after being operated upon by said wedges, all substantially as shown and described.

16. In a grinding-machine, the combination with a table-rest, of trip mechanism mounted thereon consisting of a pivoted yoke and a pivoted lever, pins projecting from said yoke with which said lever engages, one at a time, a cam-yoke slidably mounted on said first-named yoke, a roller on said lever which contacts with the cam-surface of said cam-yoke, a plate pivoted to said lever, a roller carried at each end of said plate, a reciprocating grinding-table carried by said table-rest, means carried by said table for engaging one of said rollers at a time, whereby said lever is partially operated in one direction, one or more springs engaging with said cam-yoke for pressing against said lever-roller to operate said first yoke, as also said lever, to complete the stroke of said lever and yoke, and means connected with said first yoke and with said grinding-table whereby when said first yoke is operated the grinding-table will

be moved in either direction, all substantially as shown and described.

17. In a grinding-machine, trip mechanism consisting of a pivoted yoke and a slidable yoke connected with said pivoted yoke, as also a pivoted lever, a roller-carrying plate pivoted to said lever, a roller carried at one end of said lever and engaging with the cam-surface on said slidable yoke, springs to normally hold said slidable yoke in contact with said lever-roller, a pair of lugs or projections extending from one face of said pivoted yoke adapted to be engaged by said lever, and means to automatically throw said plate and lever first in one direction and then in the other, whereby said pivoted yoke will also be operated first in one direction and then in the other, said plate being hinged to said lever, whereby it may be thrown out of operating engagement with its operating means, all substantially as shown and described.

18. In a grinding-machine, the combination with a standard, of an apron pivotally mounted thereon, a grinding-table bracket vertically slidably mounted on said apron, means for screwing said table-bracket up and down on said apron, a table-rest mounted on said table-bracket and adapted to slide in a horizontal plane, means connected with said bracket and with said table-rest for shifting the rest in such horizontal plane, a grinding-table mounted on said table-rest having a rack beneath it, a shaft carried by said table-rest and extending beneath said rack, a pinion mounted on said shaft and engaging with said rack, a pair of loosely-mounted pinions also mounted on said shaft and each carrying a clutch member, a slidable clutch member engaging with said shaft for engaging with said loosely-mounted clutch members, one at a time, another shaft also carried by said table-rest and by said table-bracket and carrying a pair of gears, one of which engages with one of said clutch-pinions, an idler for engaging with the other of said gears and also with the other of said clutch-pinions, whereby the respective clutch-pinions are rotated in opposite directions, a sprocket-wheel mounted on said last-named shaft and held from sliding with the shaft, yet permitting the shaft to slide through it, a driven shaft having its center coincident with said apron and carrying a bevel-gear at its upper end, a shaft carried by said table-bracket and having a sprocket-gear, as also a bevel-gear, the latter meshing with said last-named bevel-gear, and a sprocket-chain for connecting said sprocket-wheels with each other, and trip mechanism automatically shifting said slidable clutch member first into engagement with one of said loosely-mounted clutches and then into engagement with the other of said loosely-mounted clutches, whereby said grinding-table is automatically reciprocated, all substantially as shown and described.

19. In a grinding-machine, the combination with a standard having a vertical hole or opening through a portion of its base and an overhanging portion near its top in line with said vertical opening, and a conical bearing supported in said vertical opening, an apron carrying a conical bearing and pivoted about said standard in line with said first conical bearing, and a grinding-table reciprocatingly supported by said apron, a spindle extending through said conical bearing and coincident with the pivotal axis of said apron, and means connected with and driven by said spindle and also connected with said reciprocating table for reciprocating it, and means for driving said spindle, all substantially as shown and described.

20. In a grinding-machine, the combination with a standard, of an apron pivoted thereto, a reciprocating grinding-table supported by said apron, a telescoping spindle having its axis coincident with the axis of said apron, means for connecting said spindle with said grinding-table, and means for elevating said grinding-table and for elongating said spindle to accommodate itself to the elevated position of said table, all substantially as shown and described.

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

RALPH P. THOMPSON.

Witnesses:
B. BLACKBURN ESTERLINE,
WM. O'LAUGHLIN.