Jan. 7, 1930. H. E. P. TAYLOR 1,742,736

ROLL GRINDER

Filed Nov. 22, 1926 7 Sheets-Sheet 1

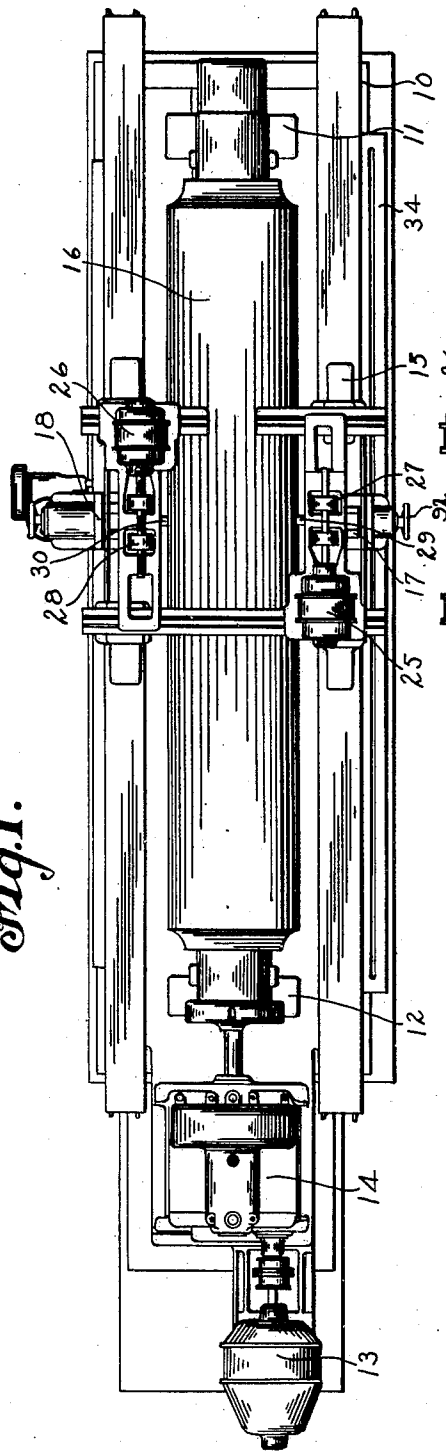


Fig. 1.

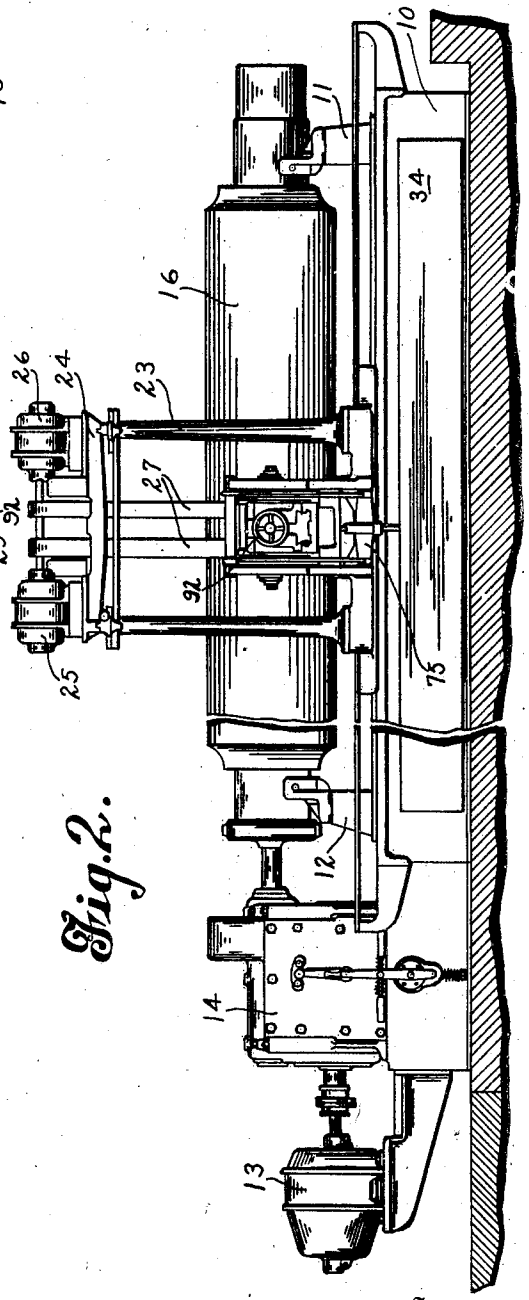


Fig. 2.

Inventor

Henry E. P. Taylor

By Henry E. Rockwell

Attorney

Jan. 7, 1930. H. E. P. TAYLOR 1,742,736

ROLL GRINDER

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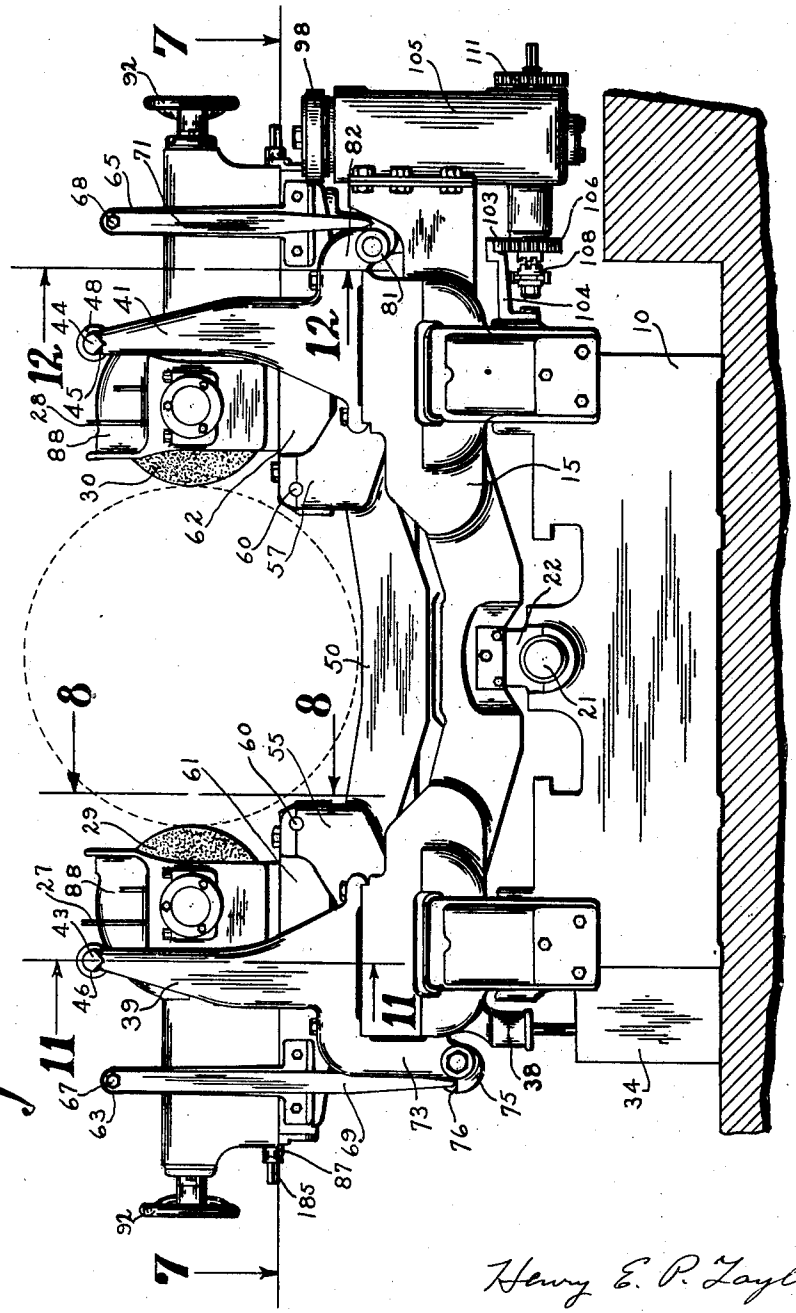


Fig. 3.

Inventor

Henry E. P. Taylor

By Henry E. Rockwell

Attorney

Jan. 7, 1930. H. E. P. TAYLOR 1,742,736

ROLL GRINDER

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Fig. 4.

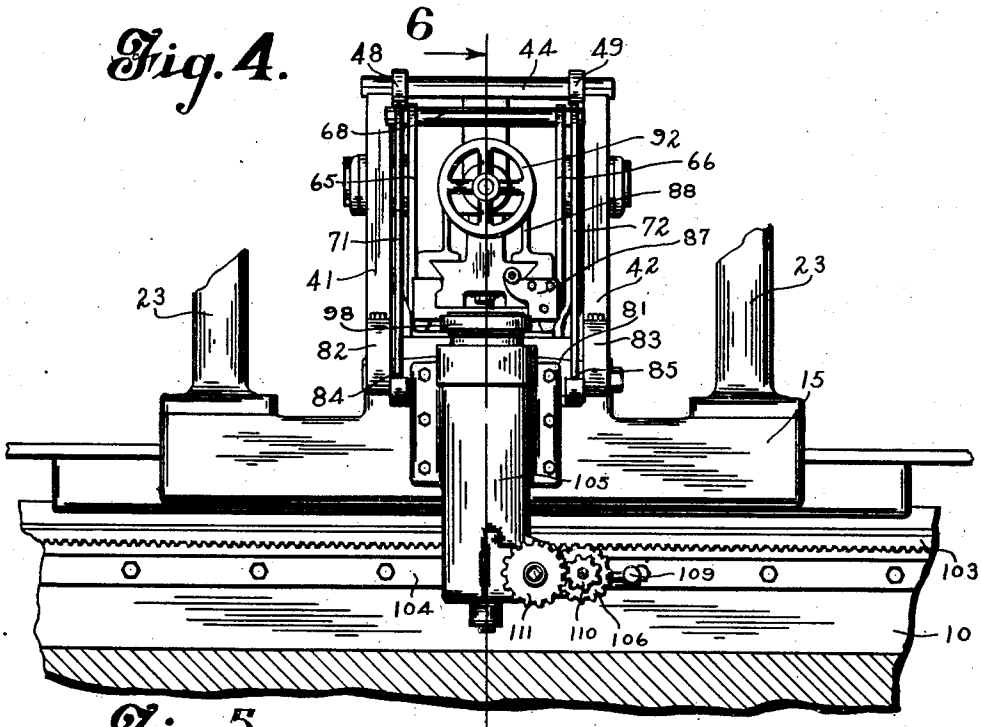


Fig. 5.

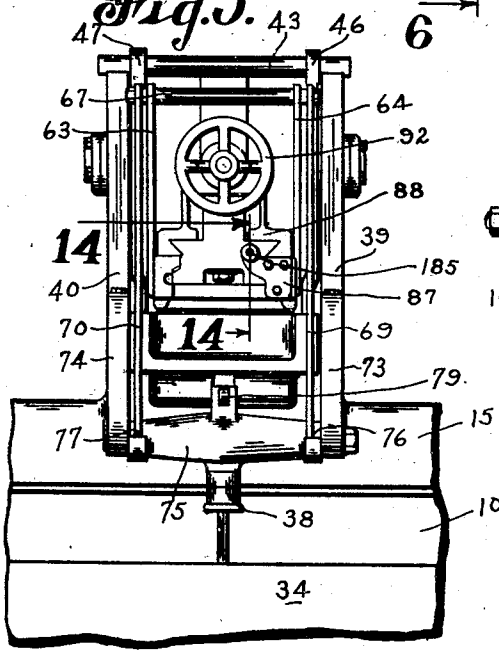
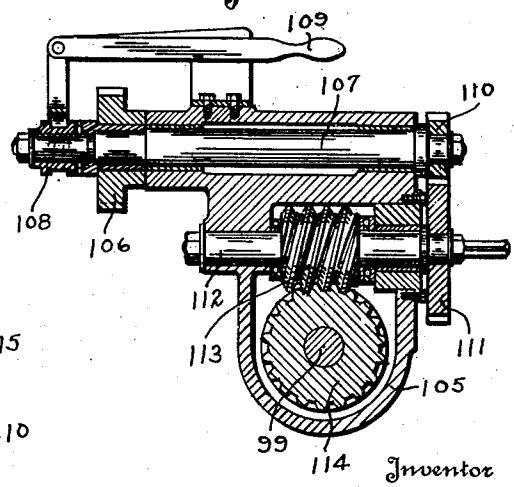


Fig. 10.



Inventor

Henry E. P. Taylor

By Henry E. Rockwell

Attorney

Jan. 7, 1930. H. E. P. TAYLOR 1,742,736

ROLL GRINDER

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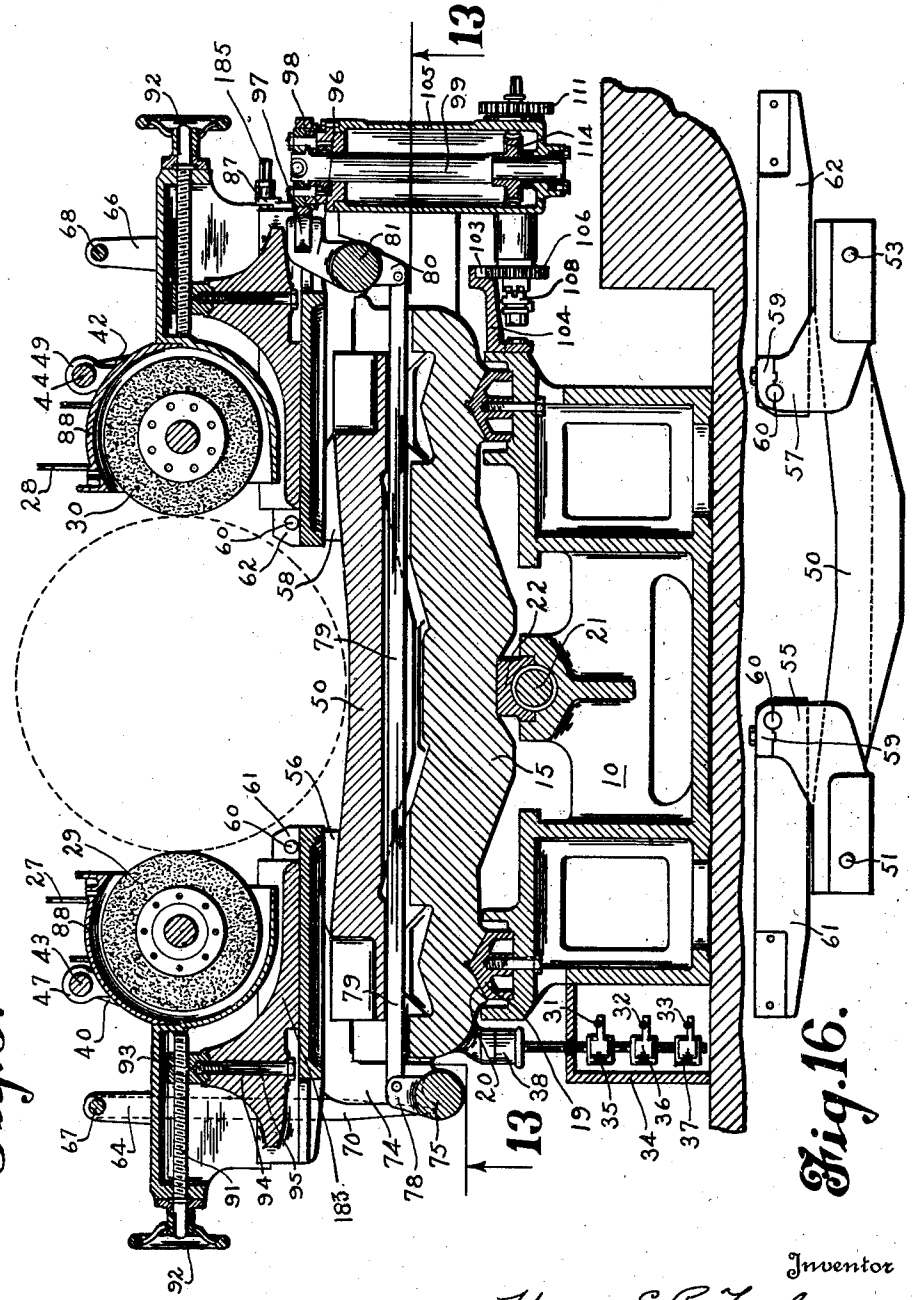


Fig. 6.

Fig. 16.

Inventor

Henry E. P. Taylor

By Henry E. Rockwell

Attorney

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ROLL GRINDER

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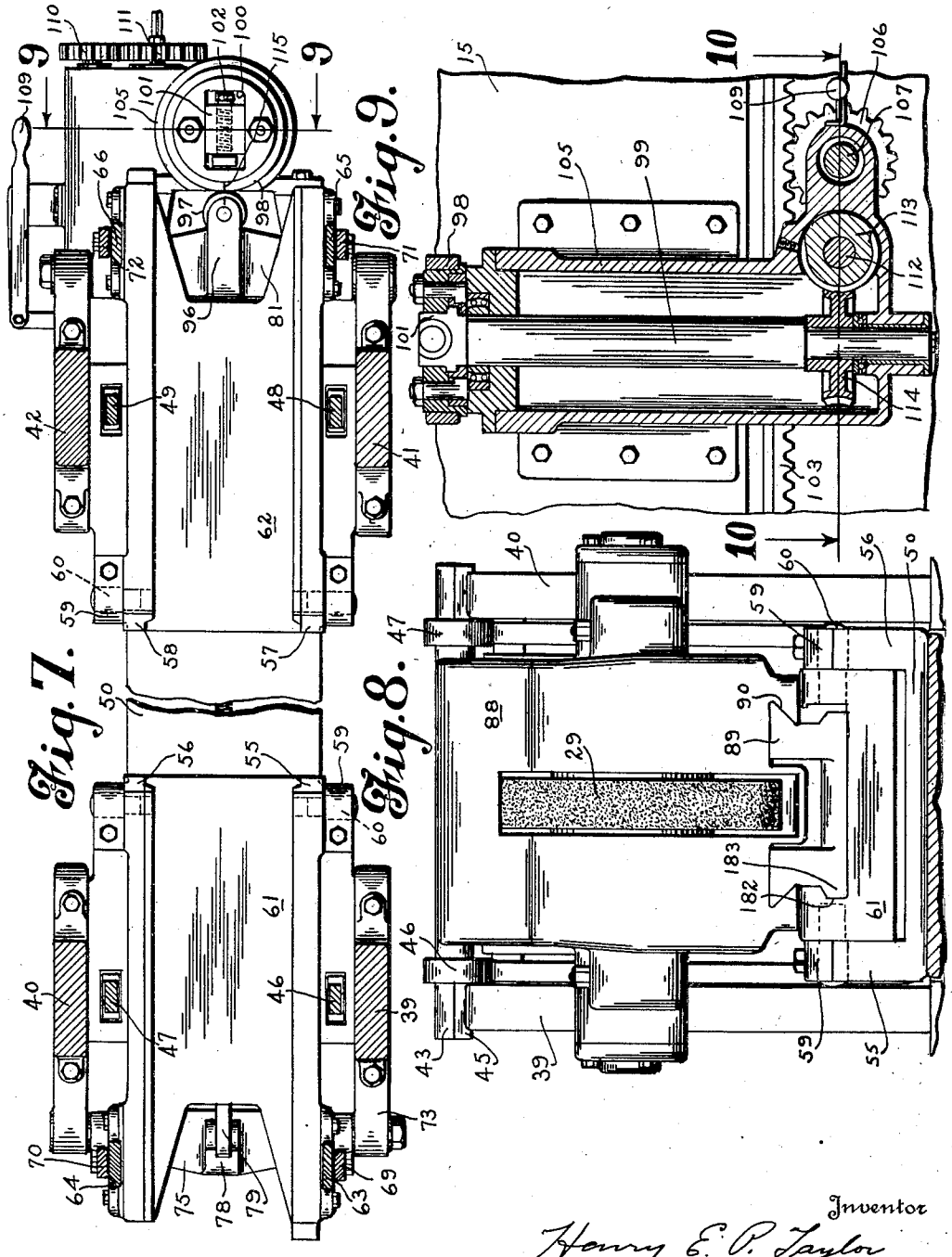


Fig. 7.

Fig. 8.

Fig. 9.

Inventor

Henry E. P. Taylor

By Henry E. Rockwell

Attorney

Jan. 7, 1930. H. E. P. TAYLOR 1,742,736

ROLL GRINDER

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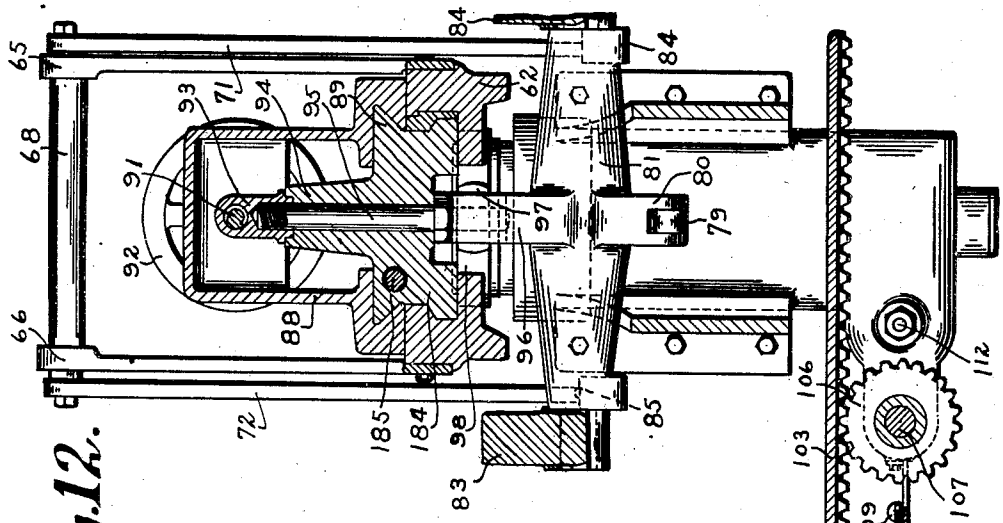


Fig. 12.

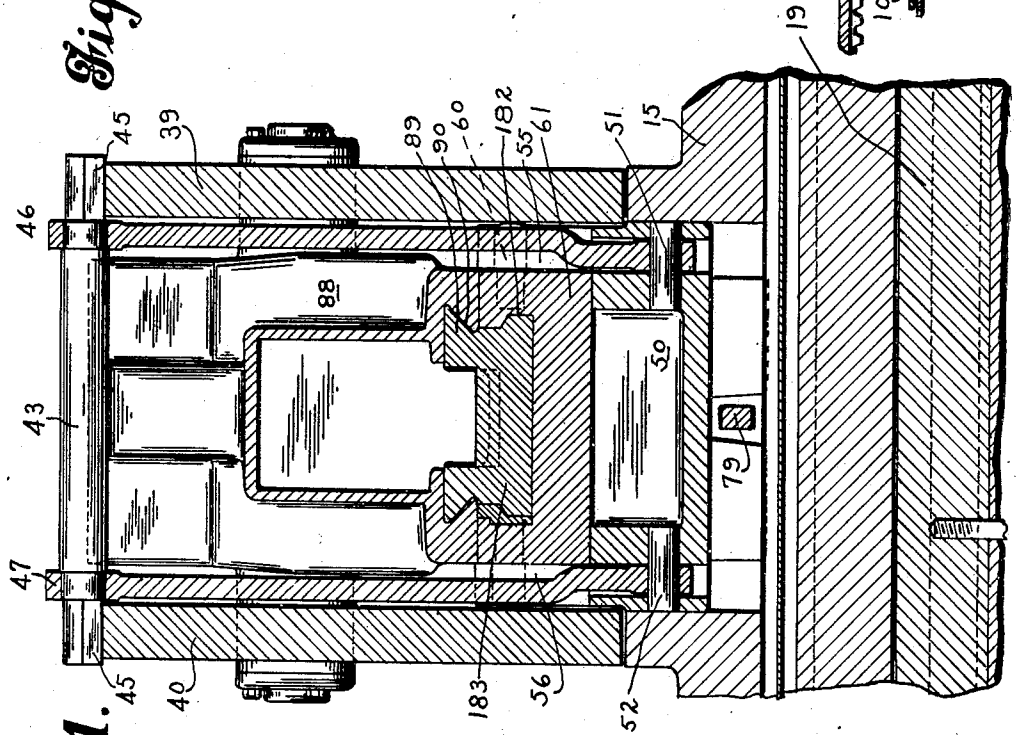


Fig. 11.

Inventor
Henry E. P. Taylor

By Henry E. Rockwell
Attorney

Jan. 7, 1930. H. E. P. TAYLOR 1,742,736

ROLL GRINDER

Filed Nov. 22, 1926 7 Sheets-Sheet 7

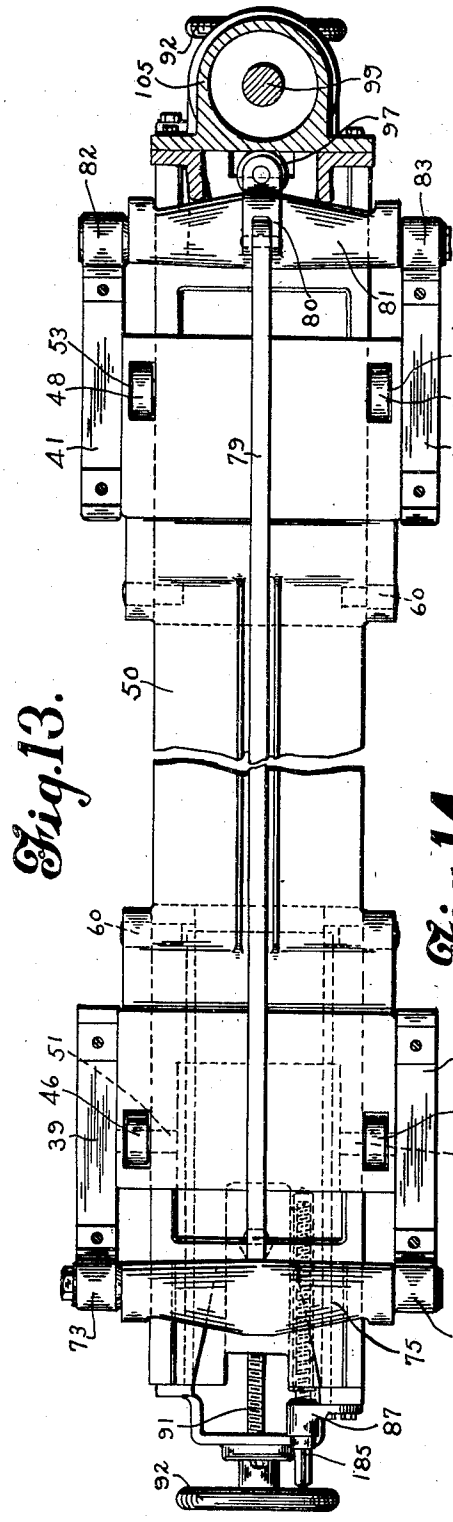


Fig. 13.

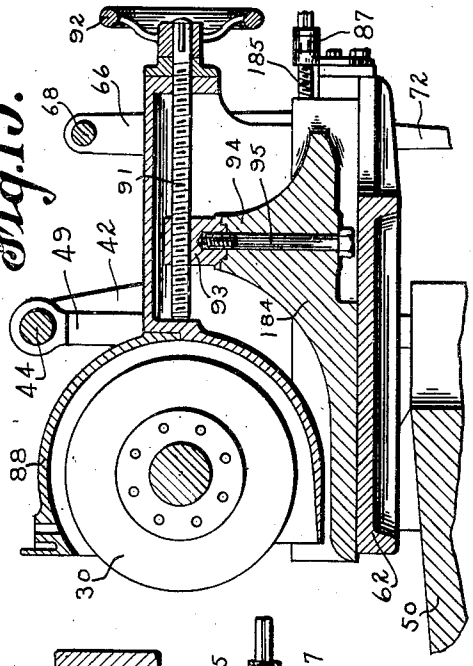


Fig. 15.

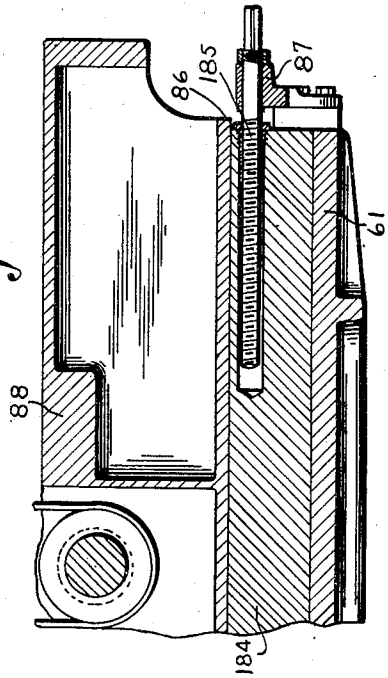


Fig. 14.

Inventor

Henry E. P. Taylor

By Henry E. Rockwell

Attorney

Patented Jan. 7, 1930 1,742,736

UNITED STATES PATENT OFFICE

HENRY E. P. TAYLOR, OF SEYMOUR, CONNECTICUT, ASSIGNOR, BY MESNE ASSIGNMENTS, TO FARREL-BIRMINGHAM COMPANY, INCORPORATED, OF ANSONIA, CONNECTICUT, A CORPORATION OF CONNECTICUT

ROLL GRINDER

Application filed November 22, 1926. Serial No. 150,056.

This invention relates to roll grinding mechanism, and more particularly to that class of grinding mechanism which is employed in grinding rolls such as are used for instance, in connection with rolling mills and calendering machines and other relatively heavy work, though the mechanism may be employed for grinding rolls of a different character and for a wide variety of uses.

In grinding heavy rolls of this character it is frequency desirable to grind them so that the surfaces will be either concave or convex, and it is desirable that the grinding machine be so constructed as to produce, not only a concave or a convex surface when desired, but also to produce, when desired, a roll having a true cylindrical surface.

In some instances, the roll grinders for the above uses are equipped with two grinding wheels, disposed one on each side of the roll to be ground and interconnected by mechanism whereby the two wheels will act in unison. This invention contemplates the provision in a machine of this type of mechanism to connect the two wheels, whereby they will be swingingly supported relatively to the roll.

One object of my invention is to provide a roll grinding machine such that rolls may be evenly cut or formed with the desired crown, or convexity or concavity of surface, the mechanism being readily adjustable for different degrees of crowning and being practically automatic in operation after adjustment.

A still further object of the invention is to provide a roll grinding machine capable of operating upon rolls varying in size between relatively wide limits, and with which truly cylindrical rolls may be formed as well as rolls having convex or concave surfaces.

Another object of this invention is to generally improve roll grinders of the swing rest type, wherein two grinding wheels are arranged to act in unison upon a roll.

A still further object of this invention is to provide a swing rest grinder with a novel form of crowning mechanism, which will operate without interfering with the action of the wheel swinging features and mechanism.

Still another object of this invention is to provide an improved form of swing rest grinder, which will be capable of operating upon rolls varying in size, between relatively wide limits, and by the use of which truly cylindrical rolls may be formed as well as rolls having convex and concave surfaces.

To these and other ends, the invention consists in the novel features and combinations of parts to be hereinafter described and claimed.

In the accompanying drawings:

Fig. 1 is a plan view of a roll grinder embodying the features of my invention;

Fig. 2 is a side elevation thereof;

Fig. 3 is an end view of the same, the roll and roll supports being omitted for the sake of clearness;

Fig. 4 is an enlarged side view of the grinding wheel support;

Fig. 5 is an enlarged view of the side of the grinding wheel support opposite to that shown in Fig. 4;

Fig. 6 is a vertical section on line 6—6 of Fig. 4;

Fig. 7 is a section on line 7—7 of Fig. 3;

Fig. 8 is a view looking in the direction of the arrows 8—8 of Fig. 3;

Fig. 9 is a section on line 9—9 of Fig. 7;

Fig. 10 is a section on line 10—10 of Fig. 9;

Fig. 11 is a section on line 11—11 of Fig. 3;

Fig. 12 is a section on line 12—12 of Fig. 3;

Fig. 13 is a view looking in the direction of arrows 13—13 of Fig. 6;

Fig. 14 is a section on line 14—14 of Fig. 5;

Fig. 15 is a vertical section through one of the wheel supports, showing the parts thereof in another position of adjustment, and

Fig. 16 is a detailed view of the swing rest and wheel housing bases connected thereto, used with the machine illustrated.

The roll grinder selected to illustrate the features of my invention comprises generally the base or frame 10, roll supports 11 and 12, roll driving and rotating means comprising the motor 13 and suitable cooperating gearing disposed in a gear box 14, the grinding wheel supporting carriage 15 upon which is mounted and disposed, one on either side of

the roll 16, wheel supports 17 and 18. The carriage 15 is mounted to reciprocate relatively to the frame 10, being guided thereon by the cooperation of inverted V-shaped guides 19 on the frame, and suitable guideways 20 in the carriage. Means comprising a screw 21 connected to the source of power by a suitable gearing in the gear box 14, cooperates with a threaded nut 22 secured upon the carriage 15 to reciprocate the carriage to and fro upon the frame 10. Standards 23 support a suitable overhead motor supporting structure 24, upon which are mounted motors 25 and 26, which, through the respective belts 27 and 28 drive the grinding wheels 29 and 30, respectively. Power is supplied to motors 25 and 26 from feeders 31, 32 and 33, located in a box 34 mounted upon a side of the frame 10 by means of contacts 35, 36, and 37, secured to a bracket 38 mounted upon and carried by the carriage 15.

A pair of upwardly directed supports 39 and 40 are secured to the carriage 15 upon one side of the roll, and a similar pair of supports 41 and 42 are secured to the carriage upon the other side of the roll. Cross bars 43 and 44 are pivotally mounted upon the upper ends of the pair of supports respectively. Preferably, the bars 43 and 44 are provided with knife edge bearings 45 at each end thereof, which rest upon the top of the supports and provide a fulcrum point, having a minimum amount of friction. Secured to each of the bars 43 and 44 is a pair of depending arms 46, 47 and 48, 49, respectively. The arms 46, 47, and 48, 49, are pivotally secured to a swing rest 50 by means of pivot pins 51, 52, 53 and 54 respectively. It will be noted that due to the above structure, the swing rest 50 is swingable transversely relatively to the carriage 15, to the frame 10, to the direction of reciprocation of the carriage 15 and to the axis of the roll 16.

Two pairs of bearing brackets 55 and 56, and 57 and 58, are provided upon the swing rest 50. A bearing cap 59 is provided for each bracket and with the same forms a bearing for a pivot pin 60. The pivot pins 60 pivotally support wheel housing bases 61 and 62, which are respectively disposed between the brackets 55 and 56 in one instance, and 57 and 58 in the other. Upwardly extending pairs of supports, 63 and 64, and, 65 and 66, are secured to the wheel housing bases 61 and 62 respectively. Cross rods 67 and 68 extend between the members of each pair of supports 63 and 64, and, 65 and 66, the ends of which extend outwardly beyond the same. Pivotally mounted upon the ends of each rod 67 and 68 are depending lifting pawls or bars, 69 and 70, and, 71 and 72 respectively. The lower ends of the pawls 69 to 72, inclusive, are provided with knife edge bearings forming a fulcrum point having a minimum amount of friction.

The supports 39 and 40 are provided with depending bearing arms 73 and 74 respectively, between which is pivotally mounted a lifter shaft 75. At each end of the lifter shaft 75 horizontally projecting arms or shoulders 76 and 77 are provided, which are engaged by the pawls 69 and 70 respectively, whereby rotation of the shaft 75 in one direction will lift the pawls 69 and 70, and through the supports 63 and 64 will rotate the base 61 about the pivot pins 60 in the bearing brackets 55 and 56 of the swing rest 50. A crank arm 78 extends upwardly from the body of the lifting shaft 75 to which is pivoted an end of a connecting bar 79.

The other end of the connecting bar 79 is pivotally secured to a crank arm 80, depending from the body of a lifting shaft 81 which is pivotally mounted between depending bearing arms 82 and 83 formed on the supports 41 and 42 respectively. Horizontally projecting arms or shoulders 84 and 85 provided upon the shaft 81 are engaged by the pawls 71 and 72 respectively, whereby rotation of the shaft 81 in one direction will lift the pawls 71 and 72, and through the supports 65 and 66 will rotate the base 62 about the pivot pins 60 in the bearing brackets 57 and 58 of the swing rest 50.

Through the agency of the connecting bar 79, both of the lifting shafts 75 and 81 will be rotated in unison, insuring that the amount of rotation of one base will be equal to the amount of rotation of the other about the pivot pins 60. This tilting or rotation of the bases 61 and 62 about the pins 60 will not affect the swinging action of the same, due to the fact that they are both mounted upon the swingable swing rest 50.

Each of the bases 61 and 62 is provided with ways 182 in which subbases 183 and 184 respectively, are adapted to slide. Each of the subbases 183 and 184 are adjustable transversely relatively to the roll axis and upon the bases 61 and 62 respectively, by means of an adjusting screw 185, which threadingly engages a threaded bushing 86, secured to each subbase. The screw 185 is rotatably mounted in a bracket 87 secured to the respective base.

A grinding wheel housing 88 is slidingly mounted upon each of the subbases 183 and 184 by the cooperation of guides 89 on the subbase, with guideways 90 in the housing. A screw 91 rotatable by means of a hand wheel 92 threadingly engages a nut 93, which is secured by means of a bolt 95 to a post 94 formed integrally with each subbase. The housings 88, therefore, are also transversely adjustable relatively to the axis of the roll 16. By providing a subbase, which is transversely adjustable, and a housing that is transversely adjustable, the wheels 29 and 30

may be moved toward the roll axis so as to permit the grinding of relatively small diameter rolls in an efficient manner. The provision of a subbase arranged as above described, permits the movement of the wheel housing a greater distance toward the roll than would be practicable were it omitted, due to the support given by it to the housing whereby a rigid structure is provided which prevents vibration and undue chattering of the wheel upon the roll when in operation thereon.

The bases 61 and 62 with the wheel housings 88 and subbases 183 and 184 are supported at the inner ends of each base upon the swing rest 50, by the pivot pins 60, and are supported at the outer ends thereof by the respective lifting shafts 75 and 81, through the medium of the pawls 69 and 70 and 71 and 72 respectively, which engage the outwardly directed portions 76 and 77 of the shaft 75, and 84 and 85 of the shaft 81, respectively. Due to the fact that the crank arm 78 of shaft 75 is oppositely directed relatively to the crank arm 80 of the shaft 81 and is connected therewith by the bar 79, the weight of the above wheel supporting structure acting upon the respective portions 76 and 77 and 84 and 85 tends to tilt the wheels away from the roll 16. To prevent such movement, and also to control the same, means is provided whereby the shafts 75 and 81 are adjustably retained in a predetermined position. This means comprises an arm 96, which is secured to one of the shafts, in this instance, shaft 81, and adjustable means whereby the arm is maintained in a desired position to hold the shafts 75 and 81 against rotative movement in one direction. The means for holding the arm 96 comprises a member which is in engagement with the arm 96 and is adjustable toward and away from this arm to allow relative movement of the member and arm toward and away from each other. The member, which in this instance, maintains the arm 96 to hold the shafts 75 and 81, is a rotatable disk 98, the periphery of which engages a roller 97 carried between the bifurcations in the outer end of the arm 96. The disk 98 is transversely adjustable upon the end of a shaft 99 relatively to the axis thereof, being provided with an elongated opening 100, within which is slidably seated a square end 101 of the shaft 99. An adjusting screw 102 is adapted to move the disk transversely relatively to the axis of the shaft 99 and toward and away from the arm 96. The transverse movement of the disk upon the shaft 99 causes the periphery thereof to become eccentric to the shaft axis.

The rotation of the disk 98 through substantially 180 degrees will, therefore, act upon the arm 96 through the roller 97 to rotate the lifting shaft 81 and through the connecting bar 79 and the lifting shaft 75, whereby the grinding wheels 29 and 30 will be moved either toward or away from the axis of the roll 16 by the tilting of the bases 61 and 62 respectively. The arrangement of the mechanism shown in the drawings is such that when the disk 98 is moved into an eccentric position relatively to the axis of the shaft 99, in a direction toward the arm 96, the bases 61 and 62 will be tilted upwardly about the pivot pin 60, thereby moving the wheels 29 and 30 toward the axis of the roll 16, which action will cause them to grind a concave form upon the roll 16. Should the disk 98 be moved into concentric position relatively to the shaft 99, or prevented from rotating while in any of its adjusted positions, the wheels would grind a straight surface upon the roll 16, inasmuch as the shafts 75 and 81 would obtain no rotative movement from the disk 98. When the disk 98 is adjusted eccentric to the shaft 99 in a direction away from the arm 96, it follows that a convex form will be ground upon the surface of the roll 16.

The disk 98 is rotated through 180 degrees or less, in most instances preferably less. This amount of rotation takes place during each stroke or in each direcion of axial feed, of the carriage 15 relatively to the roll 16. Means is therefore provided for timing the rotation of the disk 98 relatively to the movement of the carriage 15. A rack 103 is secured to the bed or frame 10 of the machine, by brackets 104. A casing 105, adapted to support the shaft 99, is bolted or otherwise secured to the carriage 15. The casing 105 is provided with suitable bearing arms which support a pinion 106 in mesh with the rack 103. The pinion 106 is freely rotatable upon a shaft 107. A clutch 108 keyed to the shaft 107 and operable to engage the pinion 106 by means of the hand lever 109 is slidably mounted upon one end of the shaft 107. A removable gear 110 is secured to the other end of shaft 107 and meshes with a removable gear 111, forming therewith a set of change gears which, in order to obtain various changes in speed for the mechanism driven thereby, may be interchanged with others. The gear 111 is secured to a worm shaft 112, upon which is mounted a worm 113, which is in mesh with a worm wheel 114, secured to the shaft 99. By the proper selection of change gears 110 and 111, the disk 98 may be properly rotated to tilt the grinding wheels toward the roll 16 during their travel axially over the roll, whereby a true and uniform, either concave or convex surface will be ground thereon when the disk 98 is set eccentric to the shaft 99.

When it is desired to grind a concave roll, the machine is set up with the roll 16 in place and connected to its rotating means. The carriage 15 is run up until the grinding wheels 29 and 30 are opposite the center of the roll or

at the point where the center of the concave form will be formed. The disk 98 is rotatably adjusted so that the transverse axis thereof through the adjusting screw 102 is in line with the transverse axis of the roller 97, at which point there is usually provided a scratch mark, as at 115, Fig. 7. The disk 98 is then adjusted eccentrically to the shaft 99 by means of the screw 102. The clutch 108 is actuated to connect the pinion 106 with the shaft 107, and the carriage 15 is moved to one end of the roll 16, or to a position to one side of the point where the center of the concave form will be ground, and the grinding wheels 29 and 30 are fed toward the roll until they engage the surface thereof. The power feed for the carriage 15 is then thrown on and the wheels are carried thereby toward the center of the roll and beyond the same to the other end thereof, this action being reversed by suitable mechanism to carry the wheels along the roll in the other direction. This to and fro movement, during which the wheels are fed transversely toward the work, at intervals, by means of the hand wheels 92, causes the disk 98 to tilt the wheels toward and away from the roll in both directions of their axial travel, whereby the roll is gradually ground into concave form. In like manner, the parts may be arranged for grinding a convex form of roll, except, of course, the disk 98 must be moved eccentrically to the shaft 99 in the opposite direction.

While I have shown and described a preferred form of my invention, it is to be understood that the same is not to be limited to all of the details shown, but is capable of modification and variations, which will lie within the spirit of the invention and the scope of the appended claims.

What I claim is:

1. In combination with a grinding machine having a pair of grinding wheels disposed one on either side of the work to be ground, transversely swingable means supporting said wheels, said wheels being pivotally supported thereon for tilting movement toward and away from the work to be ground, and means to tilt said wheels in unison including a rockable member having part of its periphery eccentric to its axis and operably connected to both of said wheels.

2. In a grinding machine, a pair of grinding wheels disposed one on either side of the work to be ground, means to support said wheels including transversely movable means adapted to move said wheels in unison toward and away from the work, and means to tilt said wheels toward and away from the work to be ground including a rockable member having part of its periphery eccentric to its axis and operably connected to both of said wheels.

3. In a grinding machine, a grinding wheel supporting carriage, a grinding wheel housing rockable relatively to said carriage, and means swingably supporting said housing upon said carriage, for movement transverse to the axis of the work, means to reciprocate said carriage axially relatively to the work, and means to rock said housing relatively to the carriage, including a rotatable member having part of its periphery eccentric to its axis and operably connected to both of said housings, said two last mentioned means being operable in timed relation.

4. In a grinding machine, a work support, a member extending transversely relatively to said work support, and freely swingable transversely relatively thereto, and a grinding wheel support pivoted at one end thereof to said member, and means to support the free end of said wheel support, including a rockable member having part of its periphery eccentric to its axis and operably connected to said wheel support.

5. In a grinding machine, a frame, a carriage longitudinally movable relatively to the frame, and a swing rest mounted upon said carriage for movement transversely relatively to said frame, a grinding wheel supporting member pivoted to said swing rest, for tilting movement toward and away from the work to be ground, means to tilt said member comprising a camming member, means operably engaged by the periphery of said camming member and connected to said supporting member, and means to rotate said camming member.

6. In a grinding machine, a frame, a carriage longitudinally movable relatively to the frame, and a swing rest swingably mounted upon said carriage to swing transversely relatively to said frame, a supporting member pivoted at its inner end to said swing rest and at its outer end to said carriage, a subbase slidably mounted upon said member, and a grinding wheel slidably mounted upon said subbase.

7. In a grinding machine, a frame, a carriage longitudinally movable relatively to the frame, and a swing rest swingably mounted upon said carriage to swing transversely relatively to said frame, a supporting member pivoted at its inner end to said swing rest, a subbase slidably mounted upon said member, and a grinding wheel slidably mounted upon said subbase, and means operably connected to the outer end of said member to tilt said member relatively to said swing rest.

8. In a grinding machine, a frame, a carriage slidably mounted upon the frame for longitudinal movement relatively thereto, a swing rest swingably mounted upon said carriage for free transverse swinging movement relatively to said frame, a grinding wheel support slidably mounted upon each end of said swing rest and having an end

thereof pivoted thereto for tilting movement toward and away from the work to be ground, rockable means to support the free end of each of said supports, and a camming member operably engaging upon its periphery one of said rockable members and means to move said camming member to tilt said supports in synchronism with the longitudinal movement of said carriage.

9. In a grinding machine, a frame, a carriage slidably mounted upon the frame for longitudinal movement relatively thereto, a swing rest swingably mounted upon said carriage for free transverse swinging movement relatively to said frame, a transversely directed member pivoted at its inner end to said swing rest adjacent each end thereof, a grinding wheel support slidably mounted upon each of said members, a member secured to said carriage adjacent the free ends of each of said transversely directed members and operable to support the same, and to raise and lower said free ends, interconnecting means between said last mentioned members whereby the action thereof will be in unison, and control means for said interconnected members whereby the action thereof may be varied, said control means comprising an adjustable eccentrically mounted disk having a camming surface adapted to engage one of said interconnected members and means to rotate said disk.

10. In a grinding machine, a frame, a carriage slidably mounted upon the frame for longitudinal movement relatively thereto, a swing rest swingably mounted upon said carriage for free transverse swinging movement relatively to said frame, a transversely directed member pivoted at its inner end to said swing rest adjacent each end thereof, a grinding wheel support slidably mounted upon each of said members, a member secured to said carriage adjacent the free ends of each of said transversely directed members and operable to support the same, and to raise and lower said free ends, interconnecting means between said last mentioned members whereby the action thereof will be in unison, and control means for said interconnected members whereby the action thereof may be varied, said control means comprising an adjustable eccentrically mounted disk having a camming surface adapted to engage one of said interconnected members, said disk being rotatable in timed relation with the longitudinal movement of said carriage.

11. In a grinding machine, a frame, a carriage slidably mounted upon the frame for longitudinal movement relatively thereto, a swing rest mounted upon said carriage for free transverse movement relatively to said frame, a transversely directed member pivoted at its inner end to said swing rest adjacent each end thereof, a grinding wheel support slidably mounted upon each of said members, and means to support the free outer end of each of said members, said means comprising a rotatable disk, means to dispose said disk eccentric to its axis, and interconnecting mechanism between said disk and said members including a part in engagement with the periphery of said disk.

12. In a grinding machine, a work support, a carriage, means for reciprocating said carriage relatively to the work carried by said support, a swing rest extending transversely across said carriage and swingably mounted thereon, a grinding wheel, a grinding wheel base on which said wheel is mounted, a subbase mounted adjacent each end of said swing rest and in turn supporting said wheel base, said wheel base being transversely movable relatively to the carriage, and said subbase being pivoted upon said swing rest, means for tilting said subbase about its pivot comprising a camming member eccentrically mounted upon the carriage and oscillated through the reciprocation thereof, means to vary the eccentricity of said camming member relatively to said carriage, and a follower operably connected to each of the subbases and resting upon the periphery of said camming member.

13. In a roll grinding machine, a roll support, a carriage, means to move said carriage back and forth relatively to a roll carried by said supports, a swing rest extending transversely across said carriage and transversely movable thereon, a grinding wheel, a base upon which said wheel is carried, said base being mounted upon said swing rest to move transversely of the carriage and to tilt about an axis extending longitudinally thereof, means mounted upon said carriage to rotate the grinding wheel, means to effect the tilting of the base comprising a shaft mounted on said carriage, means to oscillate said shaft synchronously with the reciprocation of said carriage, a cam wheel mounted on said shaft, means for eccentrically adjusting said cam wheel relatively to said shaft, and means pivotally connected to said sub-base and connected to the periphery of said cam wheel.

14. In a roll grinding machine, a main base, work supports mounted on said base, a carriage movably mounted on the base, means for effecting movement of the carriage relatively thereto, a swing rest, a grinding wheel, a grinding wheel base mounted on said swing rest for tilting movement toward and from the work carried in said supports, and means operably connected to said wheel base to tilt the same, including a horizontal shaft mounted on said carriage, a rack mounted on said main base, a pinion rotatably carried by said horizontal shaft and engaged with the teeth of said rack to effect the rotation of the pinion when said carriage is reciprocated, a vertically disposed shaft mounted on said carriage and arranged to

be rotated by the rotation of said pinion, and a cam wheel eccentrically mounted on said vertically disposed shaft and having its periphery operably connected to said wheel base.

15. In a grinding machine, a reciprocable carriage, a swing rest extending across said carriage, and movably mounted thereon, a grinding wheel support having a portion thereof pivoted to said swing rest adjacent each end thereof and a portion thereof being pivoted to said carriage, means to move the portion of each of said supports pivoted to said carriage, including a rotatable disk mounted upon said carriage and inter-connecting means between the periphery of said disk and each of said support portions, said interconnecting means including means to engage the last mentioned portion of said supports, and means to rotate said disk.

16. Means to support a grinding wheel on either side of work mounted in a grinding machine, comprising a member freely swingable transversely relatively to the work, a tiltable member pivotally secured at one of its ends adjacent each end of said swingable member, and a wheel bearing member slidably mounted upon each of said tiltable members for movement toward and away from the work, and means to tilt said tiltable members, including a rotatable camming member having the controlling surface thereof in engagement with an element which controls the movement of the free ends of both of said tiltable members.

17. In a grinding machine wherein a pair of grinding wheels are mounted for free swinging movement transversely relatively to the work to be ground, a grinding wheel supporting structure for each wheel, each of said wheel supporting structures being pivotally supported at one of its ends, and a rotatable member supporting, upon its periphery, the free end of each wheel supporting structure, and interconnecting means between the said rotatable member and each of said wheel supporting structures.

18. In a grinding machine, the combination of a pair of grinding wheels disposed one on either side of the work to be ground, said wheels being transversely movable in unison with respect to the axis of the work, and each being tiltable toward and away from the work to be ground, means to tilt said wheels in unison comprising connected rockable members, and a pawl pivotally connected to each of said wheels, each of said pawls being engaged by one of said members, and a rotatable member having its periphery eccentric with respect to its axis and engaging upon its periphery one of said members, and means to rotate said member.

19. In a grinding machine, the combination of a pair of grinding wheels mounted for free movement transversely relatively to the work to be ground, a rotatable disk-like member mounted upon said machine, a supporting structure for each wheel, each of said supporting structures extending transversely to the axis of the work and being pivotally supported adjacent one of its ends, and having its other end connected with the periphery of said rotatable disk-like member to be supported thereupon and tilted about its pivot thereby.

20. In a grinding machine, the combination of a pair of grinding wheels mounted for free movement transversely relatively to the work to be ground, a rotatable member mounted upon said machine, a supporting structure for each of said wheels, each of said supporting structures extending transversely to the axis of the work and being pivotally supported at one of its ends, and means to connect the other end of each of said supporting structures with a part of the periphery of said rotatable member to be supported thereupon, the part of the periphery of said rotatable member connected to said supporting structure being eccentric to its axis.

21. In a grinding machine, the combination of a pair of grinding wheels mounted for free movement transversely relatively to the work to be ground, a rotatable member mounted upon said machine, a supporting structure for each wheel extending transversely to the axis of the work and being pivotally supported at one of its ends, and at its other end being connected to a part rockably mounted upon said machine, and interconnecting means between the rockable parts of said machine and said rotatable member, including a part resting upon the periphery of said member.

22. In a grinding machine, a work support, a carriage, means for reciprocating said carriage relatively to the work carried by said support, a part extending transversely across said carriage and mounted for transverse movement thereon, a grinding wheel support disposed adjacent each end of said part, said wheel support being pivoted upon said part, means for tilting said support about its pivot comprising a camming member having a part of its periphery eccentric to its axis mounted upon the carriage and oscillated through the reciprocation thereof, and a follower operatively connected to each of said supports and resting upon the eccentric part of the periphery of said camming member.

23. In a grinding machine, a work support, a carriage, means for reciprocating said carriage relatively to the work carried by said support, a part extending transversely across said carriage and mounted for transverse movement thereon, a grinding wheel support disposed adjacent each end of said part, said wheel support being pivoted upon said part, means for tilting said support

about its pivot, comprising a camming member mounted upon the carriage and oscillated through the reciprocation thereof, a follower resting upon the periphery of said camming member, and a part connected to each of said supports and to said follower.

24. Means to support a grinding wheel on either side of work mounted in a grinding machine, comprising a member freely movable transversely relatively to the work, each of said grinding wheels being tiltably mounted on an end of said member, and means to tilt said grinding wheels, including a rockable camming member having the controlling surface thereof in engagement with an element which controls the movement of the free ends of both of said tiltable grinding wheels.

25. In a grinding machine, a frame, a carriage longitudinally movable relatively to the frame, a swing rest swingably mounted upon said carriage for free swinging movement transversely relatively to said frame, a grinding wheel support pivoted adjacent each end of said swing rest for tilting movement transversely relatively to said frame, and means rockably connected to said supports to tilt said supports in unison.

In witness whereof, I have hereunto set my hand this 17th day of November, 1926.

HENRY E. P. TAYLOR.