

Feb. 3, 1942.

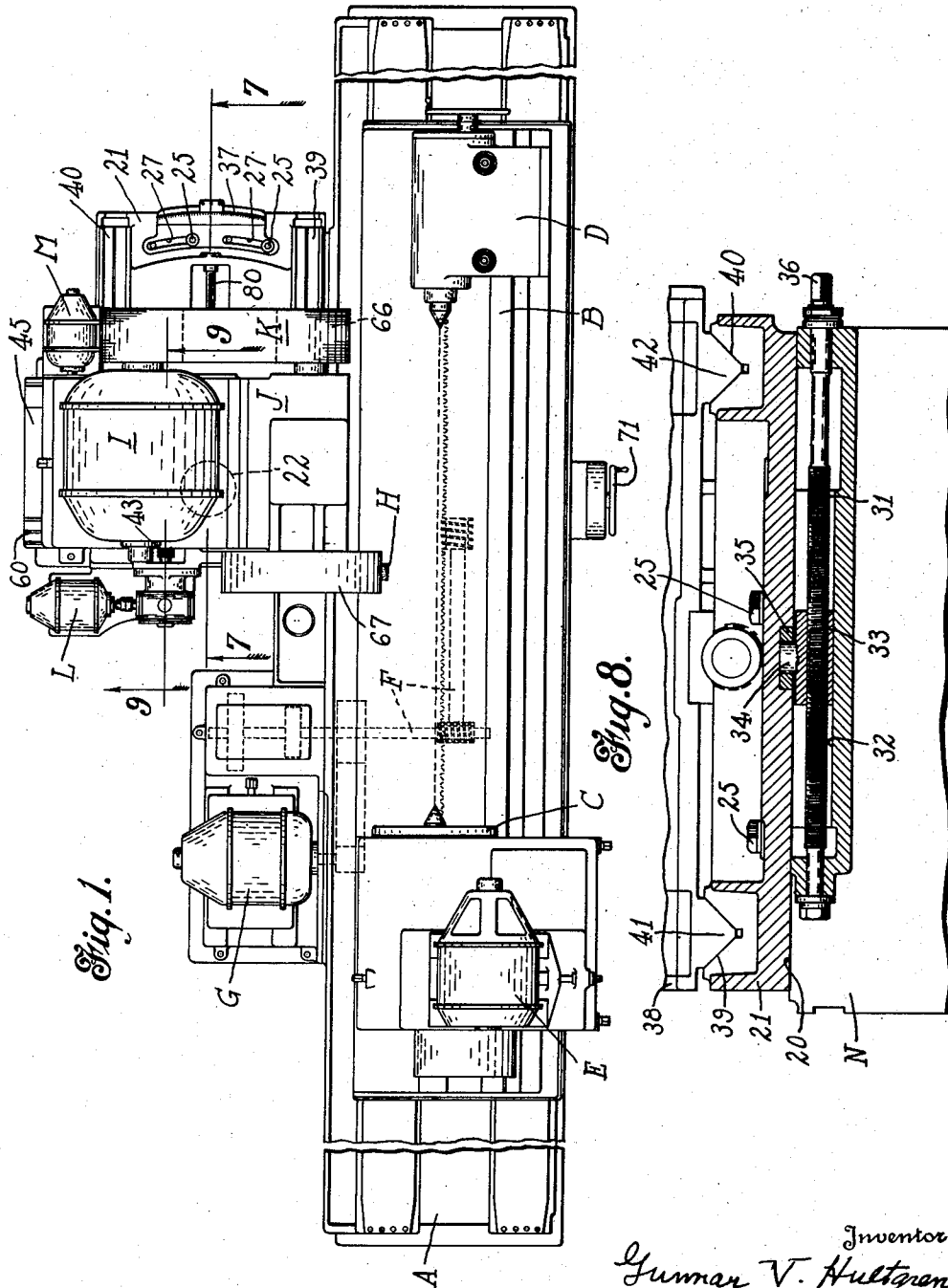
G. V. HULTGREN

2,272,088

ROLL GRINDER

Filed Sept. 22, 1939

6 Sheets-Sheet 1



Inventor
Gunnar V. Hultgren

By *Rockwell Bartholomew*

Attorneys

Feb. 3, 1942.

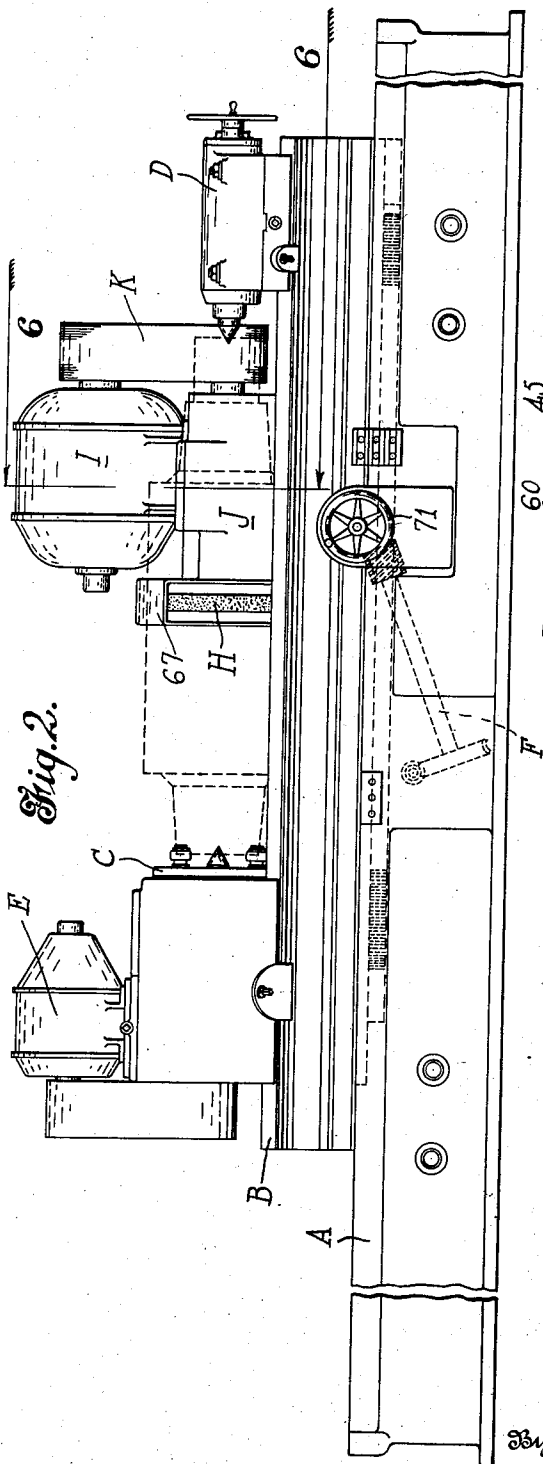
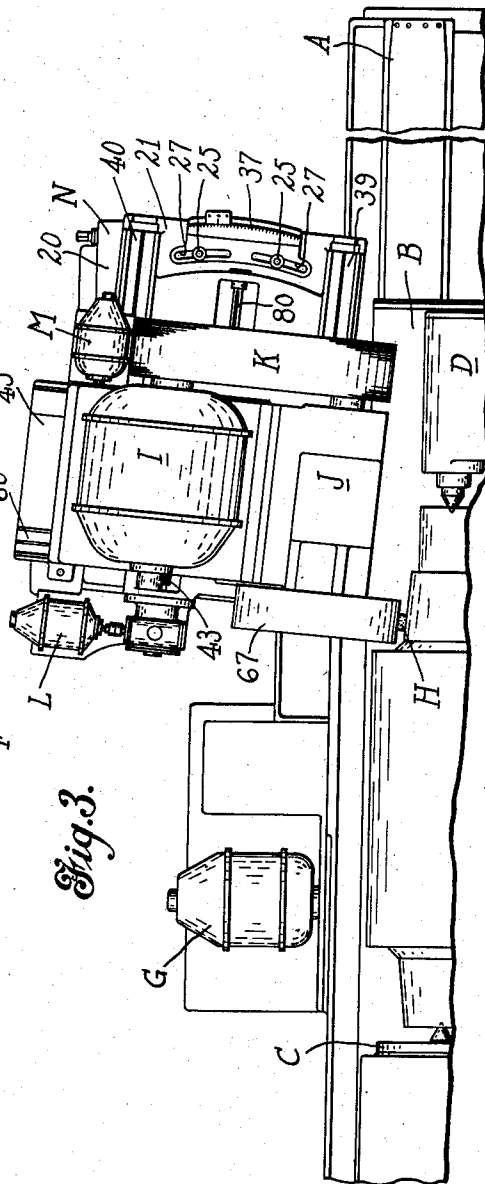
G. V. HULTGREN

2,272,088

ROLL GRINDER

Filed Sept. 22, 1939

6 Sheets-Sheet 2



Inventor
Gunnar V. Hultgren
Rochelle Bartholomew

Attorneys

Feb. 3, 1942.

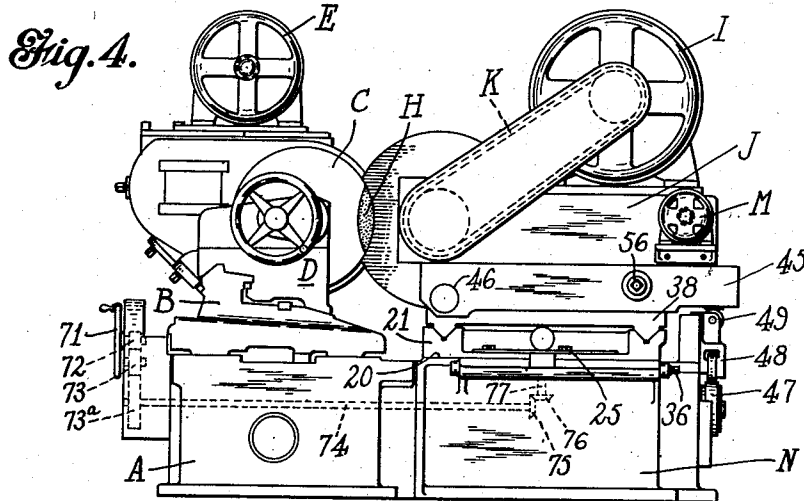
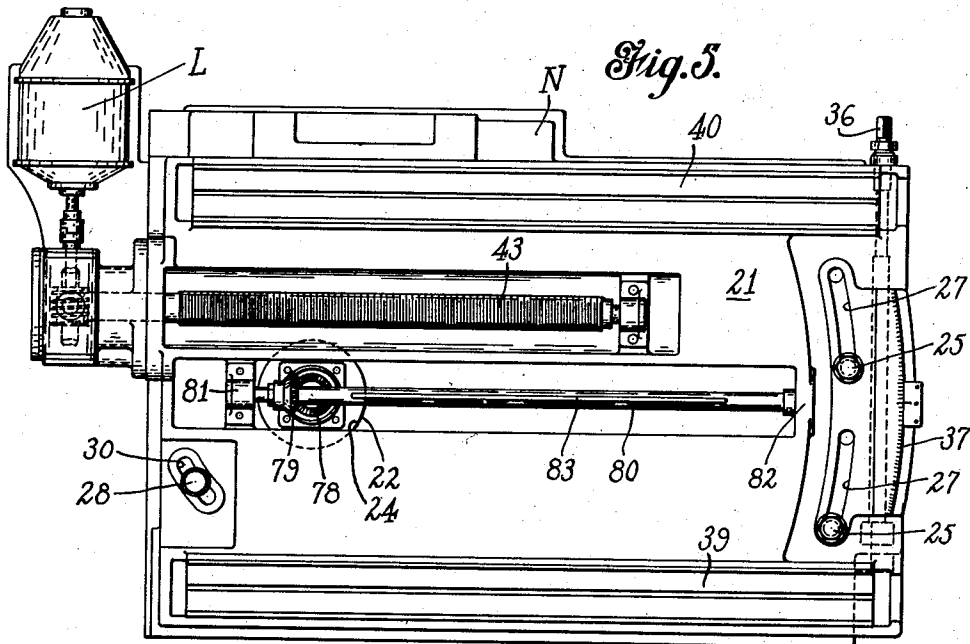
G. V. HULTGREN

2,272,088

ROLL GRINDER

Filed Sept. 22, 1939

6 Sheets-Sheet 3



Inventor

Gunnar V. Hultgren

By

Rockwell Bartholomew

Attorneys

Feb. 3, 1942.

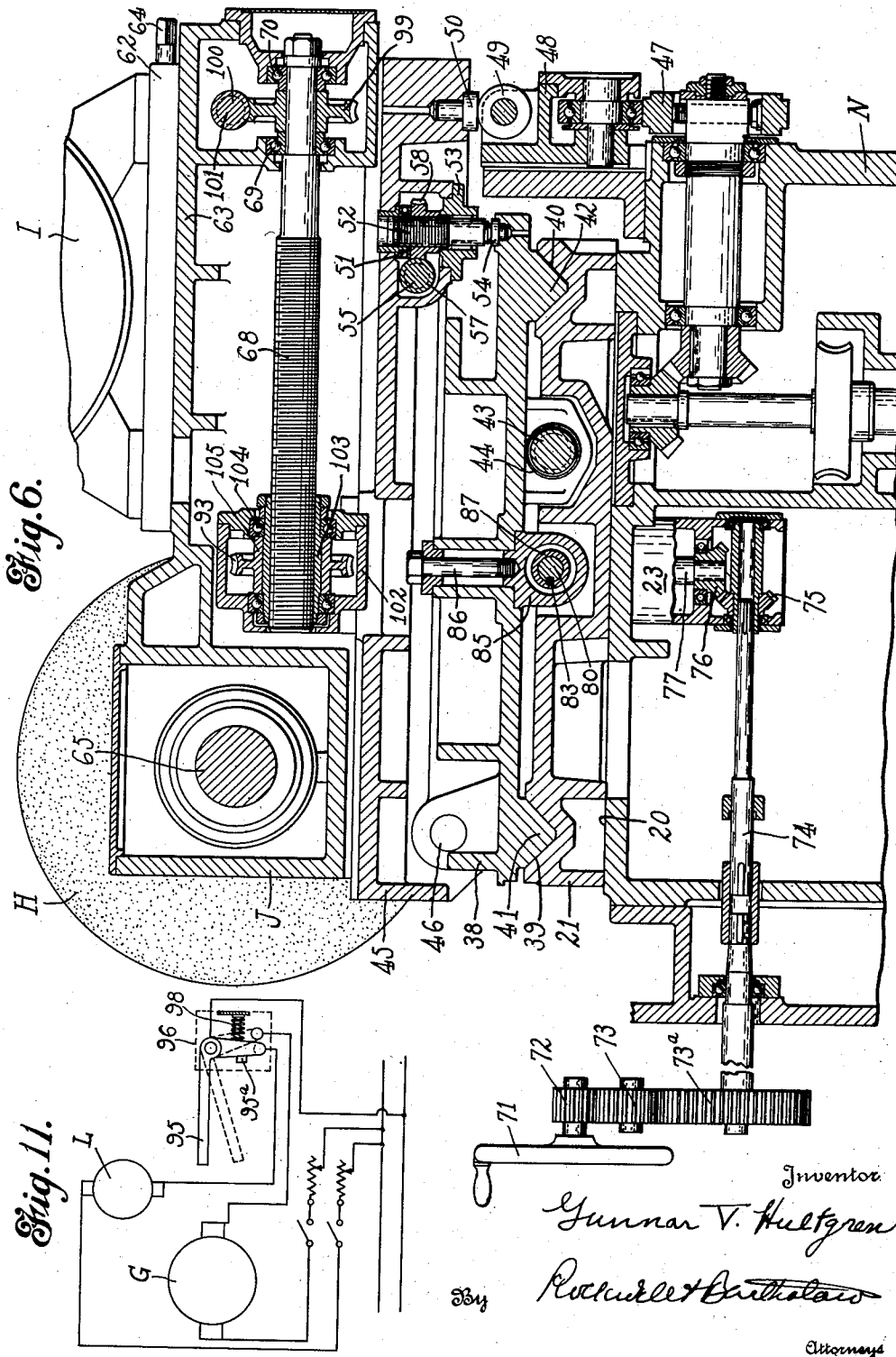
G. V. HULTGREN

2,272,088

ROLL GRINDER

Filed Sept. 22, 1939

6 Sheets-Sheet 4



Feb. 3, 1942.

G. V. HULTGREN

2,272,088

ROLL GRINDER

Filed Sept. 22, 1939

6 Sheets-Sheet 5

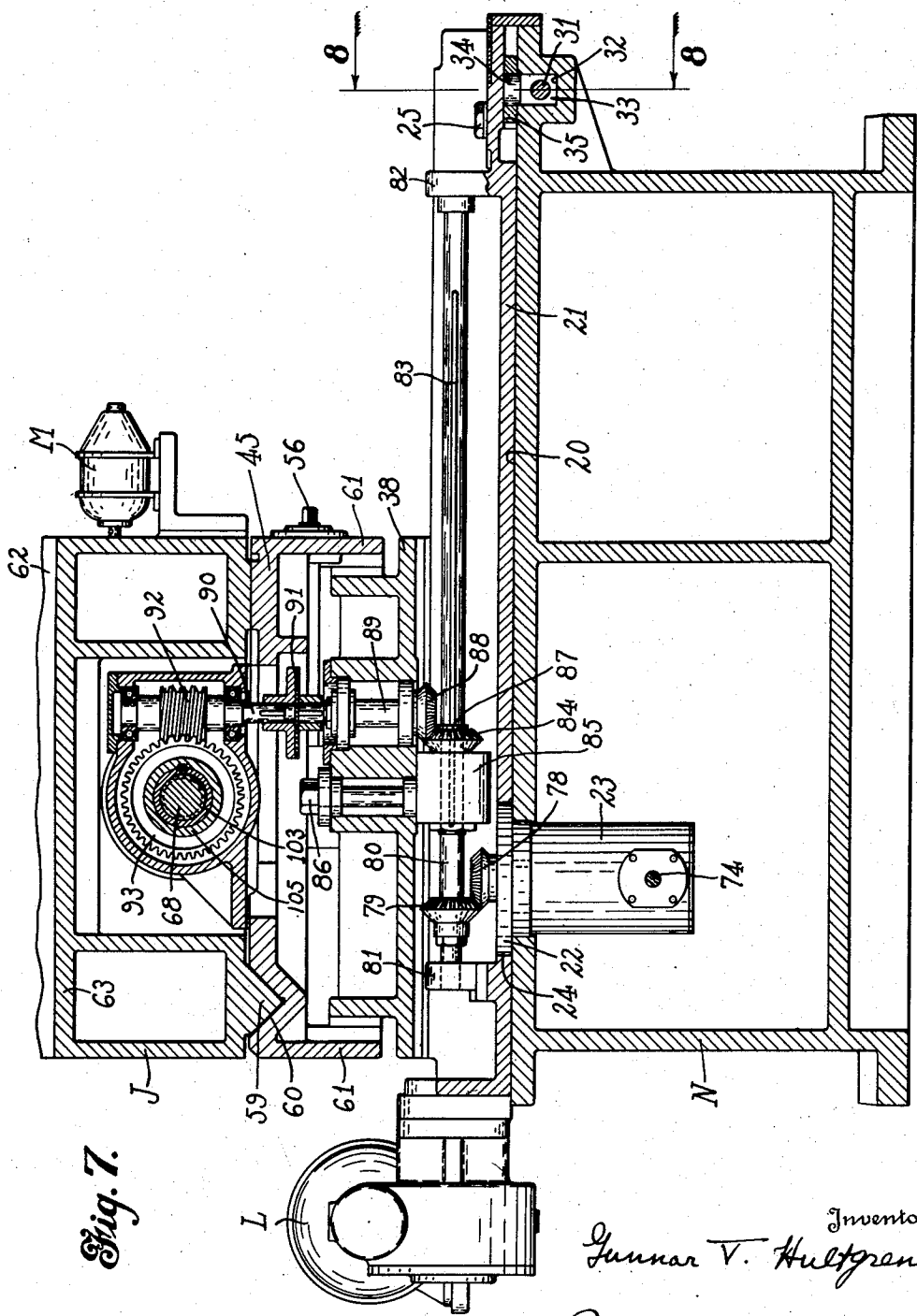


Fig. 7.

Inventor
Gunnar V. Hultgren

By *Richard H. Bartholomew*

Attorneys

Feb. 3, 1942.

G. V. HULTGREN

2,272,088

ROLL GRINDER

Filed Sept. 22, 1939

6 Sheets-Sheet 6

Fig. 9.

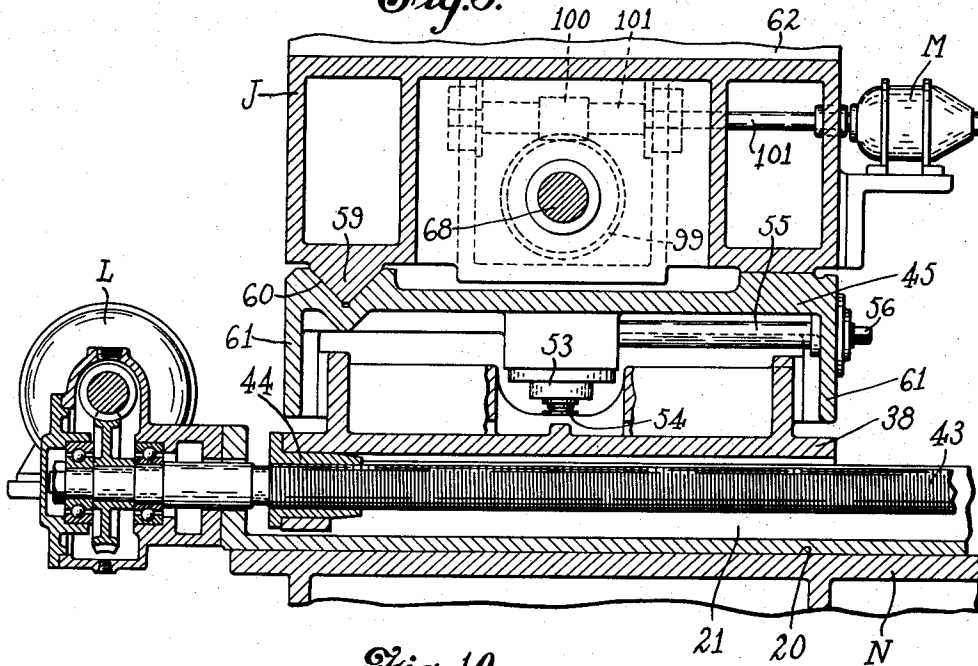
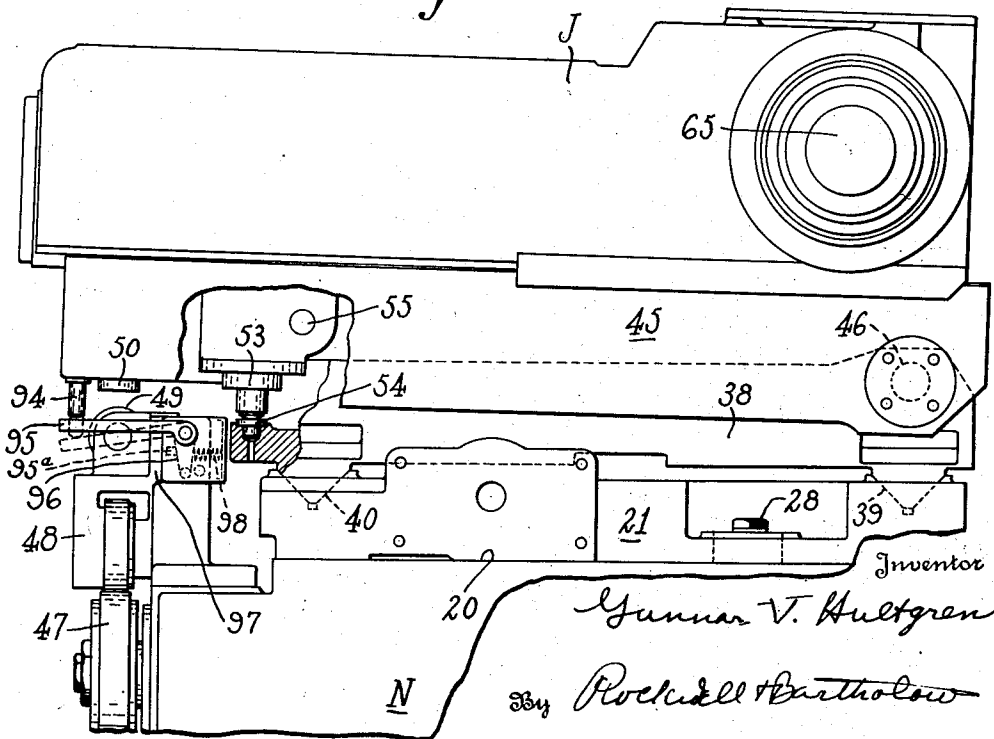


Fig. 10.



UNITED STATES PATENT OFFICE

2,272,088

ROLL GRINDER

Gunnar V. Hultgren, Ansonia, Conn., assignor to
Farrel-Birmingham Company, Inc., Ansonia,
Conn., a corporation of Connecticut

Application September 22, 1939, Serial No. 296,032

15 Claims. (Cl. 51—49)

This invention relates to improvements in roll grinders.

My new roll grinding machine is particularly adapted for the grinding of large rolls such as steel mill rolls, and heavy shafting.

Within recent years there has been an increasing demand for the grinding of tapers on the roll necks or journal sections of rolls, and also on the body or ends of heavy shafting. Various attempts have been made to accomplish this tapered grinding, and various difficulties have been encountered. Grinders of the work-moving type have been built in which the carriage which carries the roll is made in two pieces, the separation being in a horizontal plane; the lower piece being constructed to fit the ways of the bed, the upper piece being attached to the lower so that it can be swiveled with respect to it, the arrangement being such that the upper half of the carriage, with the roll or shaft mounted thereon, could be set with its axis at an angle to the center line of the lower half. In this position, by traversing the entire assembly in front of the grinding wheel, a taper can be ground. However, in such a machine the carriage lacks rigidity, which is important for accuracy, unless the carriage is made very heavy and cumbersome, and, moreover, in the grinding of long or steep tapers the upper half of the carriage has to be swung so far away from the center line of the lower carriage section that the upper half overhangs the lower half at the ends, and this further increases the conditions of instability, as well as causing an interference or prejudicial proximity between the upper half section and the support for the grinding element.

Another machine which has been used more recently is of the wheel-moving type having a support for the roll which is fixed against longitudinal movement and being provided with a back bed upon which are mounted two distinct wheel head carriages, one of which is used in grinding the body of the roll and the other of which has provisions for traversing the wheel head in an inclined direction for grinding the taper on the neck of the roll. Such a machine was quite expensive to build, and it was also necessary either to have two distinct wheels and wheel heads, one on each carriage, or to transfer the wheel and wheel head from one carriage to another, as required for grinding the body and neck, respectively, of the roll.

It has also been proposed to grind the tapers of roll necks by providing a geared connection to the in-feed of the grinding unit so that the grind-

ing wheel would be fed in at a uniform rate to form a taper. This also was open to serious practical objections, among which was the fact that as the wheel was not positioned normally to the grinding surface, and owing to the spring of parts and back-lash in the gearing, etc., the wheel would grind in only one direction of cut, and on the return movement would clear the work, which obviously delayed the rate of grinding.

One of the objects of the present invention is to provide a roll grinding machine in which the above-mentioned defects and drawbacks are eliminated.

Another object is a marked improvement in the accuracy and speed of operation in a machine for grinding heavy rolls and heavy shafting, in which it is possible to grind tapered surfaces.

Another purpose of my invention is to simplify the structure of the machine and enhance its convenience of operation, and also to provide a novel and improved method of grinding necked rolls and shafts.

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 grinding machine embodying my improvements;

Fig. 2 is a front elevation of the same;

Fig. 3 is a partial plan view illustrating the machine as adjusted for grinding the neck of a roll;

Fig. 4 is an end elevation looking from the right-hand end of Fig. 1;

Fig. 5 is a plan view of the rear bed or base frame showing the mounting of the swivel base thereon, certain parts being omitted;

Fig. 6 is a section on line 6—6 of Fig. 2;

Fig. 7 is a section on line 7—7 of Fig. 1;

Fig. 8 is a section on line 8—8 of Fig. 7;

Fig. 9 is a section on line 9—9 of Fig. 1;

Fig. 10 is an end elevation of a portion of the machine showing the wheel unit jacked up off of the crowning device and in position to grind a roll neck; and

Fig. 11 is a diagram showing one means of controlling the traverse motor for the roll carriage and the traverse motor for the wheel head.

In using the machine shown in the drawings the roll or other work is mounted in a carriage adapted to be traversed by means including an electric motor, along a base frame or bed, and past a grinding wheel mounted on a wheel head

located at one side of the bed. In the operation of grinding the body of the roll or the like the roll is traversed and the wheel head held against movement in a direction lengthwise of the work. Upon conclusion of the grinding of the body of the roll or other work, however, it is possible to position the grinding wheel adjacent the roll neck or other part to be taper ground, and then, with the roll held against lengthwise movement, to traverse the wheel in an angular direction with respect to the work axis so as to grind the taper. These ends are achieved by providing, in association with the wheel head and a base frame for supporting the wheel head, certain parts which permit the wheel head to be traversed at an angle or set in fixed position with its axis parallel to the work axis.

In the drawings the work-supporting bed is shown at A, the work-supporting carriage at B, the headstock at C, the tailstock at D, and the work-rotating motor at E. These parts can be of any suitable or preferred construction, and the carriage B can be traversed by any suitable means, for example, a shaft and gear drive generally indicated at F in Fig. 1, the traverse mechanism being operated from an electric motor G, arranged in this instance at the back of the machine. At the rear side of the machine is the grinding element or wheel H driven in this case from motor I on wheel head J by means of a belt K. For traversing the wheel head an electric motor L is employed, and for feeding the wheel head rapidly toward or from the work an electric motor M is used. The wheel head J is supported from a base frame N of relatively short length arranged at the rear of the work-holding bed in the relation shown in Figs. 1 and 4, and a number of parts interposed between base N and wheel head J and operating in the manner hereinafter described permit the traversing of the wheel head at an angle to the work axis in grinding tapered roll necks and the like.

The base frame N is provided with a flat top 20 (Fig. 6) upon which rests a swivel base member 21 adapted to be arranged at different inclinations to the work axis. This swivel base 21 is swiveled to member N to swing in a horizontal plane, the swivel point being adjacent the left-hand end of the base frame and the left-hand end of the swivel base (Fig. 7). The base frame and the swivel base in this particular embodiment are approximately co-extensive in length. In this particular case the swivel connection or pivot between them is provided by an annular flange 22 provided on a gear case 23 located in the base frame, said flange 22 occupying a round hole 24 in the lower web portion of the swivel base in the manner indicated in Fig. 7. It will be understood that by this arrangement the swivel base can be swung so as to lie parallel to the work axis or at an angle thereto. For clamping the swivel base in the adjusted position, two bolts 25 may be employed at the right-hand end of the swivel base (Fig. 5), passing through slots 27 in the swivel base. It will also be seen from Fig. 5 that at the left-hand end of the swivel base a further clamping bolt 28 is provided, the same passing through a short slot 30 in the swivel base. By these means the swivel base can be firmly locked in place after it has been adjusted to the desired position. Preferably the swivel base is moved to the desired position by applying pressure to the right-hand end thereof (Fig. 5), and the preferred adjusting and moving means comprises

a threaded spindle 31 arranged in the base frame transversely thereof and occupying a groove 32 in said base frame, said spindle having a nut 33 threaded thereon, as best shown in Fig. 8, and said nut operating in the groove 32. This nut is provided with an upwardly projecting pin 34 entering a round hole in a bearing member or washer 35 set into the lower face of the swivel base. This provides a pivotal connection between the nut 33 and the swivel base. The nut preferably engages the central portion of the swivel base. The threaded spindle 31 has a head 36 projecting out of the base frame at the rear side of the latter, and by turning the head 36 by means of a wrench or the like the swivel base can be swung on its pivot to the desired position. A vernier scale 37 enables a very exact adjustment to be made. This vernier scale is preferably located adjacent the right-hand end of the swivel base (Fig. 5).

On top of the swivel base 21 there is provided a longitudinally sliding table 38 adapted to be traversed along said swivel base. In the preferred construction the swivel base is provided on its upper surface with longitudinal V grooves 39 and 40 located adjacent the side margins of the swivel base, and the sliding table 38 is provided with corresponding V-shaped guide ribs 41 and 42 (Fig. 6). For traversing the sliding table a threaded spindle 43 is provided, this spindle being driven by suitable gearing from motor L, previously mentioned. This spindle is located substantially in the plane of the swivel base, as shown in Fig. 6, and is adapted to be engaged by a nut 44 depending from the sliding table 38, so that as the spindle 43 is rotated in one or the other direction, the sliding table will be shifted lengthwise either to the right or left. The usual or any desired provisions are employed for reversing the direction of movement of the sliding table when it reaches the limit of its travel in one direction, and as these are well known in the art I do not consider it necessary to refer to them further. Fig. 9 shows the nut 44 as being at the left-hand side of the sliding table, which is the preferred arrangement. The spindle 43 is provided with appropriate end bearings carried by the swivel base 21.

Above the sliding table 38 there is provided a sub-base 45, this sub-base supporting and guiding the grinding wheel head J, previously mentioned. The sub-base provides a pivotal mounting for the grinding wheel inasmuch as the sub-base is mounted for movement in vertical planes relatively to a pivot adjacent the front or forward side of base frame N. This pivot is constituted by a pin or member 46 by means of which the sub-base adjacent its forward side is pivoted to the sliding table adjacent its forward side, as shown in Fig. 6.

The pivoted sub-base 45 is of utility in connection with the crowning or concaving of roll and other surfaces, the rear end of the sub-base being raised to move the grinding wheel in the direction of the work, and the lowering of the rear end of the sub-base being effective to move the grinding wheel away from the work. For these purposes a suitable crowning device is provided having means for engaging and raising and lowering the rear end of the sub-base. In the present instance I have shown the crowning device as comprising an adjustable cam or disk 47 of the general type disclosed in the Taylor Patent 1,700,422, said disk as it is turned on its axis (by well-known means not necessary to illustrate

in detail) being effective to raise or lower a small sliding carriage 48 at the rear face of the base frame, and said carriage having a roller 49 adapted to engage a depending hardened plug 50 on the rear portion of the sub-base. Such crowning devices in themselves are well known, and it is thought that further detail description in this respect will be unnecessary.

In the practice of my invention it is necessary at times to place the crowning device out of operation, and in order to do this I prefer to provide means for raising the sub-base and holding it at such an elevation that it will not be affected by the operation of the cam or disk 47 and its associated parts. In the construction which I prefer a jack is interposed between the sliding table and the sub-base for separating them to the required extent, and this jack may be a screw jack 51 carried by the sub-base adjacent the rear end thereof, and having a screw reacting against a portion of the sliding table. In the form shown the jack comprises a screw member 52, adapted to protrude at its lower end out of a bushing 53 adjacent the lower face of the sub-base, the lower end of the screw 52 resting on a hardened member 54 set into the sliding table 38 at a point adjacent the rear margin of said sliding table. The jack screw 52 may be operated from a distance by suitable means, such as an adjusting spindle 55 having a head 56 projecting out of the sub-base at one side of the latter and adapted to be engaged by a wrench or the like. The spindle 55 is provided with a worm portion 57 engaging a worm wheel 58 having interior threads engaging the threads of the jack screw 52, and suitable means are provided for taking up end thrust on the worm wheel 58. It will be obvious that by this arrangement the turning of spindle 55 in one or the other direction by the use of a wrench or the like will be effective in raising or lowering the rear portion of the sub-base, provided the sub-base is in a proper position for such action, and that by the means described the sub-base may at times be raised to such an extent and held at such an elevation that the crowning device will no longer have any effect upon it.

The wheel head J is of the usual or any preferred construction. It is guided on the sub-base for movement in a direction transverse or generally transverse to the work axis, so that the wheel can be fed in and out. Preferably the guide means for the head includes a V-shaped rib 59 on the wheel head at one side thereof engaging the corresponding V-shaped groove 60 in the sub-base. This is shown in Fig. 7, and in that figure there are also shown the side flanges 61, which depend from the sub-base and extend over and enclose the end portions of the sliding table and also act as guides. The grinding wheel motor I, previously mentioned, is provided with a base 62 mounted on the top wall 63 of the wheel head adjacent the rear portion of the latter, and the motor base 62 is adjustable on the wheel head by means such as an adjusting screw 64. At the front of the wheel head the shaft 65 of the grinding wheel has suitable bearings, and at one end the shaft 65 carries a pulley 66 (Fig. 1) engaged by the drive belt K. The grinding wheel H is enclosed in a suitable case 67, as usual.

The wheel head J has enclosed therein and fixed against longitudinal movement with respect thereto a feed spindle 68 (Fig. 6). At the rear portion of the wheel head this spindle is 75

mounted in anti-friction bearings 69, 70 supported in the walls of the wheel head. Between the bearings 69 and 70 a worm wheel 99 is fixed, and this worm wheel is adapted to be rotated by a worm 100 on a shaft 101 mounted transversely in the head and driven by motor M, previously mentioned, for the purpose of obtaining quick in-and-out adjustments of the wheel. This drive is arranged adjacent the rear end of the screw spindle 68. Adjacent the front end of said spindle 68 is a housing 102 rigid with the sub-base 45 and extending upwardly therefrom into the wheel head, and the spindle 68 extends into this housing, where it has threaded engagement with a sleeve 103 journaled in the housing in anti-friction bearings 104. Fixed to this sleeve 103 at the exterior thereof is a sleeve 105 carrying a worm gear 93. The worm gear 93 is adapted to be rotated by a worm 92, which is operable from a hand wheel at the front of the machine, as hereinafter described. When the worm 92 is rotated, the sleeve 105 is turned to rotate the threaded sleeve 103, the latter sleeve being in the nature of a nut, and as this nut is rotated and held by housing 102 in fixed relation to the sub-base, the nut moves the spindle to shift the wheel head in one direction or the other by pushing or pulling the rear end portion of the wheel head. When the motor M is actuated for producing a quick feeding of the wheel, the spindle 68 is rotated in one direction or the other, causing the spindle to be screwed in or out in the nut so as to produce a pull or push of the spindle on the wheel head.

For the purpose of providing in-and-out or feeding movements of the grinding wheel by manipulation of a device easily accessible by the operator at the front of the machine, regardless of the position of the wheel head unit relatively to the swivel base, the following mechanism is provided: At the front of the machine, in association with the bed A, there is provided a hand wheel 71 adapted to rotate through reducing gears 72, 73 and 73^a a spindle 74, a portion of which spindle is shown in detail in Fig. 6. On the end of the spindle or shaft 74 is a beveled gear 75. This gear engages and is adapted to rotate a beveled gear 76 on a vertical shaft 77. This shaft 77 and gears 75 and 76 are located in the gear casing 23, previously mentioned, whose flange or cap 22 serves to swivel the swivel base, and it will be noted that the shaft 77 is co-incident with the axis of swiveling of the swivel base, so that rotation of shaft 77 can take place regardless of the angular position of the swivel base. At the upper end of the shaft 77 above the casing 23 and within the lines of the swivel base is a beveled gear 78 engaging a beveled gear 79 fixed to a shaft 80 having end bearings 81 and 82 in the swivel base. It will be understood that this shaft 80 can be rotated by manipulation of the hand wheel 71. The shaft 80 is provided with a long spline 83, and this spline fits a groove in a beveled gear 84, which is slidable along shaft 80 and is adapted to be rotated thereby. The gear 84 is adapted to be pushed along the shaft 80 in one direction or the other by means of the sliding table 38, and for this purpose the sliding table carries at its lower part a sleeve 85, held in place relatively to the sliding table by a bolt 86, the sleeve member 85 surrounding the shaft 80 for a portion of its length, and also surrounding a sleeve or hub 87 to which the beveled gear 84 is attached, and the arrangement is such

that as the sliding table 38 is moved in either direction the gear 84 will be correspondingly moved while still rotatable by hand wheel 71. The beveled gear 84 is in permanent engagement with a beveled gear 88 on the lower end of a sectional shaft member 89, 90. Section 89 is arranged within the sliding table, and the section 90 of the shaft is arranged within the sub-base and wheel head, and a sliding connection 91 between the sections 89 and 90 permits the section 90 to be rotated from section 89 irrespective of the vertical position of the sub-base and wheel head (within certain limits) relatively to the sliding table. Within the wheel head the shaft section 90 is provided with the worm 92, which upon being rotated in one or the other direction will move the wheel head inwardly or outwardly. Through the connections described this feeding in and out of the grinding wheel can be effected by an operator standing at the front of the machine and manipulating the hand wheel 71, and this inward or outward movement of the wheel head can take place regardless of the longitudinal position of the wheel head unit with respect to the swivel base.

In Fig. 10 I have shown the sub-base and wheel head in an elevated position such that the crowning device will not be effective upon the sub-base. It will be noted that there is a substantial space between the roller 49 and the part 50. At the rear end of the sub-base the latter is provided with a switch-operating member 94 which may be in the form of a downward projection adapted to contact and operate a swinging switch arm or member 95 associated with a switch mechanism 96. This switch mechanism can be made in any of a number of different ways, and for the most part it is illustrated only diagrammatically in Figs. 10 and 11. The switch mechanism 96 is preferably attached to the sliding carriage 48 by means such as a bracket 97. Switch 96 controls the circuits of the work-traversing motor G and the wheel-head-traversing motor L. The arrangement should be such that these motors cannot be operated simultaneously, and the drawings illustrate one form of mechanism for this purpose. A spring 98 acts on the arm 95, and when the sub-base is raised, carrying the projection 94 upward, a circuit will be made for the wheel-head-traversing motor L, or at least the circuit of this motor will be closed at this point, whereas on the other hand it will be impossible to operate the work-traversing motor because of its circuit being opened by the upward movement of the arm 95. It will also be understood that when the sub-base is lowered the arm 95 will be necessarily depressed to a position in which the work-traversing motor can be actuated and the head-traversing motor cannot be actuated. With the crowning device in cooperative association with the sub-base it is impossible to start the wheel-head-traversing motor. Upward movement of arm 95 beyond the position shown in Fig. 10 is prevented by a stop 95'.

As indicated by the dotted lines in Figs. 1 and 2, the traversing means for the work carriage includes worms or like means which render the work carriage self-locking, so that when its movement is arrested in any position the carriage cannot be moved endwise in either direction by extraneous means. There is thus provided a means for locking the carriage against endwise movement when this is desired.

In accordance with my new method of grind-

ing rolls having tapered necks, I grind the body of the roll by traversing the work carriage with its roll past a grinding wheel or other grinding element which is fixed against movement in the direction of the work axis. While the body of the roll is being ground the swivel base 21 will be in an adjustment in which it is parallel to the work axis. The motor G will have its circuit closed by the switch device shown in Figs. 10 and 11, and it will therefore be impossible for the wheel-head-traversing motor L to operate, and the wheel head will remain and be held in a fixed position relatively to its supporting base frame N. In this operation spindle 43 and nut 44 will serve to hold and lock the wheel head fixedly in any longitudinal position to which it has previously been moved. If it be desired to crown the roll body, the crowning device will operate in the usual manner and swing the sub-base on its pivot in such a manner as to give the roll body the desired contour.

Now when it is desired to grind a tapered neck on a roll, for example, one having the contour shown in Fig. 3, the first step is to move the roll carriage endwise by its traverse mechanism to a point where the neck portion of the roll is opposite the grinding wheel. When the work carriage comes to rest in this position it will be locked therein for the reason previously explained. The sub-base is then jacked up by manipulation of the jack screw in the manner previously described. By this operation the opening of the circuit of the work-traversing motor will be automatically effected, as previously described, because of the upward movement of the projection 94, permitting the lifting of the switch arm 95, and the head-traversing motor L will be permitted to operate because of the closing of the gap in its circuit. The swivel base is placed in the desired angular position for grinding the taper, and locked in that position. Then the traversing of the wheel head unit can be commenced, and the wheel head will be moved to and fro to grind the taper, the grinding wheel being normal to the tapered surface and operating upon the work when the wheel is moved in both directions. After grinding one of the roll necks has been completed, the machine can be manipulated in an obvious way to move the other neck opposite the grinding wheel, and thereafter grind the taper of the other neck, the swivel base being set at the proper angle for this purpose. The machine can also be used for grinding tapers on large shafts, and shafts with large-diameter flanges can be accommodated in the machine. The device will taper equally well in either direction. There is no back-lash or deflection in the machine parts which will make grinding difficult and result in a poor grinding finish. The device can be set very accurately to give the required amount of taper without the use of additional adjustments of other units of the machine.

One of the important advantages brought about by my invention is that a roll with tapered necks can be finish-ground in the machine without disturbing the original setting of the roll. This will aid in bringing about a true roll and also cut down the grinding time. Another important advantage arises from the fact that the tapering attachment is controlled from the operator's position in front of the machine, the operator while in front of the machine being able by manipulation of a hand wheel or the like to move the grinding wheel in or out as required. Another advantage arises from the fact that while, when

returning to straight body grinding from tapering, the swivel base should be brought back to the center line parallel to the axis of the roll, a slight error in this adjustment will not cause any damage, as the grinding wheel will be dressed parallel to the axis of the roll. This is in contradistinction to machines having an adjustable split work table or carriage, where extreme accuracy in effecting this angular adjustment is most important.

It is also an advantage of my new machine that the same hand wheel for the in-feed of the grinding wheel is used in the case of body grinding as in the case of tapering. The wheel can be moved to or away from the work during the traversing of the grinding wheel, although in most cases all feeding is done at one end or the other of the stroke, at which time the grinding wheel unit is at a standstill.

By my invention the unit which is to be swiveled so as to provide for the grinding of a taper need be no longer than necessary to grind the longest taper anticipated, which is usually relatively short compared to the work being ground. This greatly simplifies the construction of the machine, and does away with the necessity of splitting the work-supporting carriage as it has been split in previous machines of the work-moving type. On the other hand, as compared to previous machines of the wheel-moving type, the provision of two distinct wheel-moving carriages is no longer required, nor is it necessary to provide more than one wheel head or to move the wheel head from one carriage to another. All that is required in addition to the work-holding bed and work-holding carriage is a relatively short back bed or base frame on which is mounted a wheel head adapted to be held in a fixed position for body grinding and adapted to be traversed at an angle for taper grinding. Moreover, in operating the machine the transition from body grinding to taper grinding, and vice versa, is easy and convenient.

While I have described with particularity a preferred form of machine embodying my invention, it will be understood that the invention is susceptible of many and various embodiments, and that various modifications and changes in the details may be made without departing from the principles herein explained or the scope of the claims.

What I claim is:

1. In a roll grinding machine, a work bed, a work carriage, means including an electric motor for traversing the work carriage, a back bed, a wheel unit on said back bed having a vertically shiftable wheel, means including an electric motor for traversing said wheel unit on said back bed along the work, and means insuring individual operation only of said motors and preventing their concurrent operation, said last-named means being controlled in its operation by the vertical position of the grinding wheel.

2. In a roll grinding machine, the combination of a work bed, a work carriage, means including an electric motor for traversing the work carriage on the work bed, a wheel unit comprising a vertically swingable grinding wheel, a back bed on which said wheel unit is mounted, means including an electric motor for traversing said wheel unit on the back bed at an angle to the work axis, and a circuit-closing device for said motors controlled by the swinging of the grinding wheel and arranged so that when either of said motors operates the other is inoperative.

3. In a roll grinding machine, a work bed, a work carriage, means for traversing the work carriage on the work bed, a back bed, a wheel unit thereon having a tiltable wheel, a crowning device cooperating with the tiltable wheel, means for rendering the crowning device ineffective to control the wheel, and means operable only when the crowning device is inoperative for traversing the wheel unit on the back bed.

4. In a roll grinding machine, a work bed, a work carriage, means for traversing the work carriage on the work bed, a back bed, a wheel unit thereon having a tiltable wheel, a crowning device cooperating with the tiltable wheel, means for rendering the crowning device ineffective to control the wheel, and means operative only when the crowning device and the work-traversing device are out of operation for traversing the wheel unit on the back bed at an angle to the work axis.

5. In a roll grinding machine, a work bed, a work carriage, means for traversing the work carriage on the work bed, a back bed, a grinding wheel unit on the back bed including a sub-base pivoted to move vertically, a crowning device associated with the back bed for cooperating with and supporting the sub-base so that the work is ground with a crown, means for raising the sub-base and holding it at such elevation that the crowning device is ineffective, and means for traversing the grinding wheel unit on the back bed at an angle to the axis of the work.

6. A combined work-moving and wheel-moving grinder having a work carriage, a wheel carriage, electric motors for operating the respective carriages, means insuring the operation of each motor only when the other motor is inoperative, said machine having a crowning device, means for rendering the crowning device inoperative, and means for preventing operation of the wheel carriage when the crowning device is operative.

7. In a roll grinding machine, a work bed, a work carriage, means for traversing the work carriage on the work bed, a back bed, a wheel unit on the back bed adapted to be locked in place so as to remain stationary while the work is traversed, means for traversing the wheel unit at an angle to the work axis, and means for preventing such traverse except when the work carriage traverse means is inoperative.

8. In a roll grinding machine, a work bed, a work carriage, means for traversing the work carriage, a short back bed, a swivel base mounted on the back bed to turn in a horizontal plane, a sliding table guided by the swivel base, a sub-base pivoted to the sliding table to swing vertically, a wheel head mounted on the sub-base, and means for traversing the sliding table.

9. In a roll grinding machine, a work bed, a work carriage, means for traversing the work carriage, a short back bed, a swivel base mounted on a back bed to turn in a horizontal plane, a sliding table guided by the swivel base, a sub-base pivoted to the sliding table to swing vertically, a wheel head mounted on the sub-base, means for traversing the sliding table, a crowning device associated with the back bed cooperating with the sub-base to lift the same, and means adapted to raise the sub-base out of cooperation with the crowning device so that the latter is ineffective.

10. In a roll grinding machine, a wheel head movable toward and from the work, a bed in front of said head on which the work is mounted, means for traversing said head along the work

at any of various angles to the work axis, a transverse spindle associated with the wheel head for adjusting the same toward and from the work, means operating on the rear end portion of said spindle for effecting a power adjustment of the wheel head, and means operable on the front end portion of said spindle for manually adjusting the wheel head toward and from the work, said last-named means having an operating member adjacent the front portion of said bed, said two adjusting means being operative when said head is in different traversing positions.

11. In a roll grinding machine, the combination of a work bed, a work carriage thereon, means on said carriage for holding and rotating a roll, means for traversing the carriage along the bed, a back bed substantially parallel to said work bed, a grinding wheel unit on said back bed, and means for traversing said grinding wheel unit along the roll with the wheel axis at an angle to the roll axis only while the work carriage is stationary, said carriage traversing means on the other hand being operable only when said wheel unit traversing means is inoperative.

12. In a roll grinding machine, the combination of a work bed, a work carriage thereon, means on said carriage for holding and rotating a roll, means for traversing the carriage along the bed, a back bed substantially parallel to said work bed, a grinding wheel unit on said back bed, and means for traversing said grinding wheel unit along the roll with the wheel axis at an angle to the roll axis only while the work carriage is stationary, said back bed being a relatively short bed located between the ends of the work bed.

13. In a roll grinding machine, the combination of a work bed, a work carriage thereon, means on said carriage for holding and rotating a roll, means for traversing the carriage along the bed, a back bed substantially parallel to said work bed, a grinding wheel unit on said back bed, and means for traversing said grinding wheel unit along the roll at an angle to the roll axis while the work carriage is stationary, said wheel-unit-traversing means being constructed so that when arrested it locks the wheel unit in position for traverse of the roll past the wheel.

14. In a roll grinding machine, a work bed, a roll-holding carriage, a back bed, a wheel unit on said back bed arranged to be locked in place on the back bed or to be traversed along the roll with the wheel axis at an angle to the roll axis, means including an electric motor for traversing said roll-holding carriage on the work bed past the wheel unit, means including an electric motor for traversing the wheel unit along the roll at an angle to the roll axis, and means for preventing concurrent operation of said motors.

15. In a roll grinding machine, the combination of a work bed, a work carriage, means for traversing the carriage along the bed, a wheel unit comprising a vertically swingable grinding wheel, a crowning device associated with the work bed and cooperating with said wheel unit, a back bed on which said wheel unit is mounted, means for feeding the wheel unit toward and from the work, and means for traversing said wheel unit on the back bed at an angle to the work axis.

GUNNAR V. HULTGREN.