U. STEINER.

GRINDING MACHINE.

APPLICATION FILED APR. 17, 1912.

1,145,816.

Patented July 6, 1915.

3 SHEETS—SHEET 1.

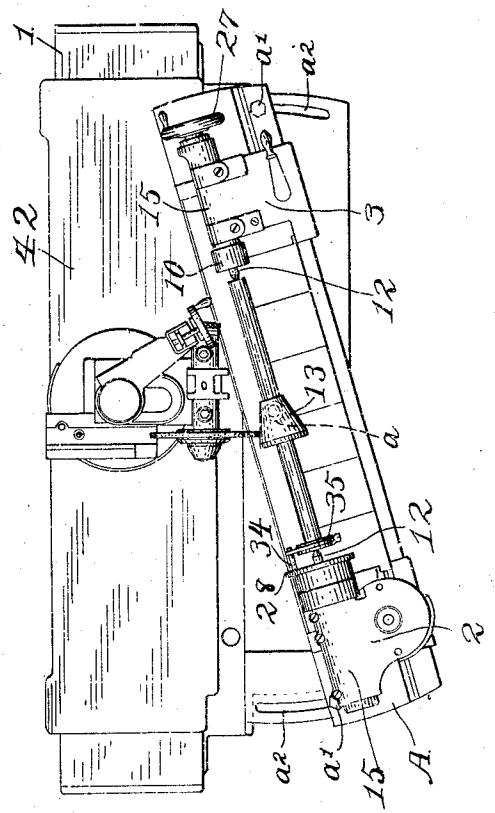


Fig. 1.

Witnesses
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3 SHEETS—SHEET 2.

Fig. 2.

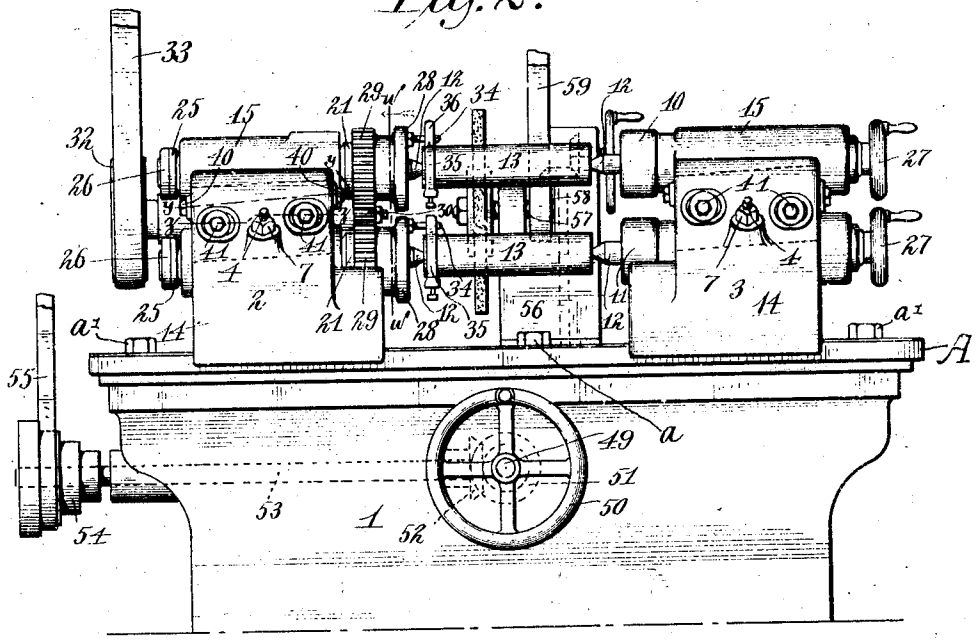


Fig. 3.

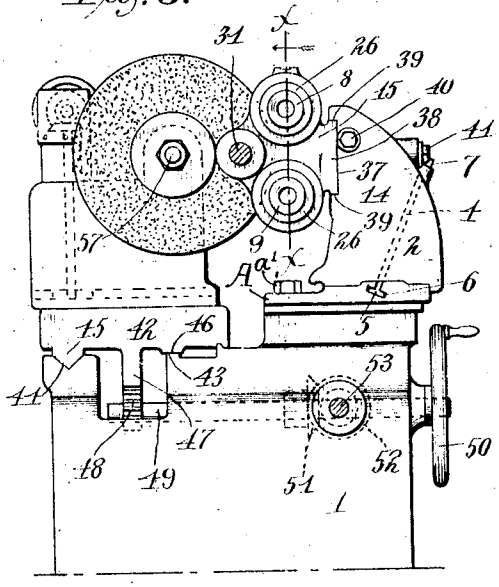
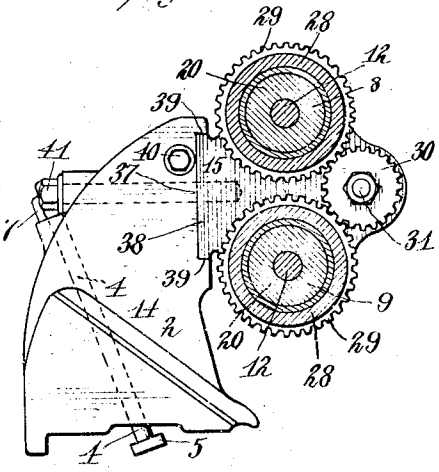


Fig. 4.



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3 SHEETS—SHEET 3.

Fig. 5.

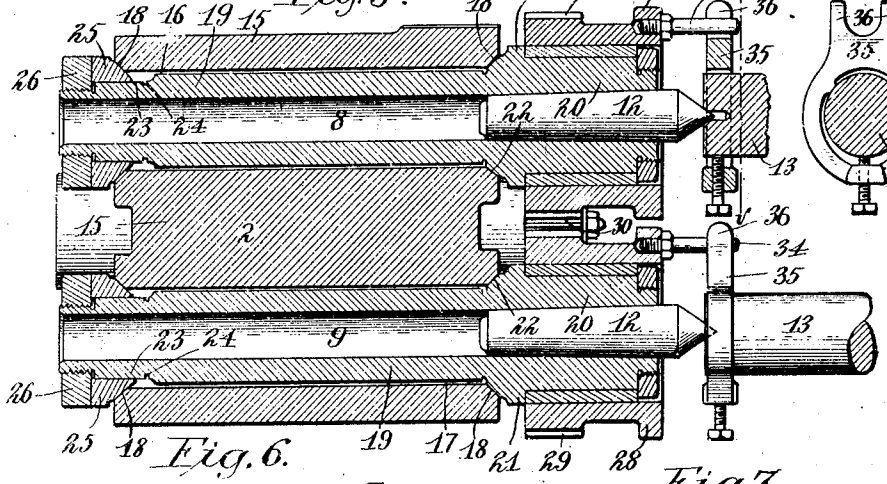


Fig. 10.

Fig. 6.

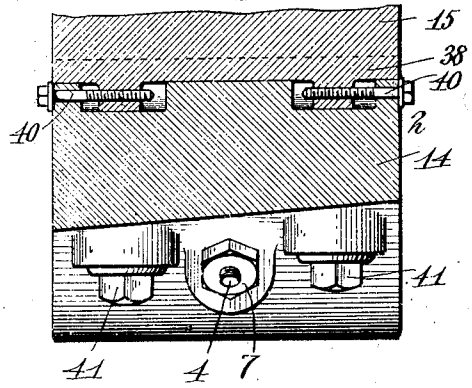


Fig. 7.

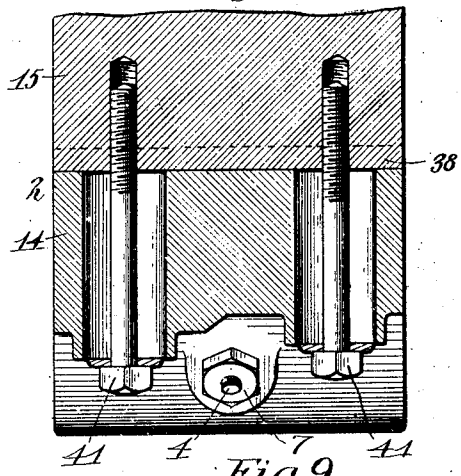


Fig. 8.

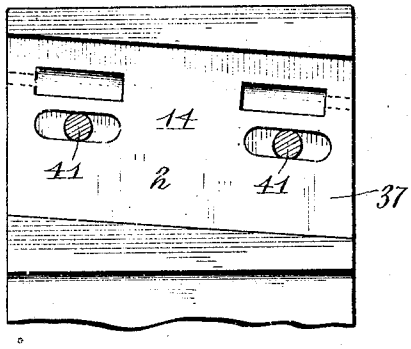
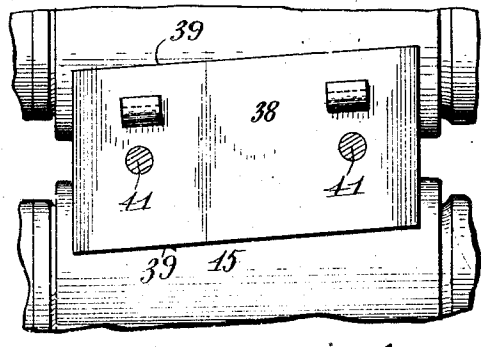


Fig. 9.



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UNITED STATES PATENT OFFICE.

ULRICH STEINER, OF WAYNESBORO, PENNSYLVANIA, ASSIGNOR TO LANDIS TOOL COMPANY, OF WAYNESBORO, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

GRINDING-MACHINE.

1,145,816. Specification of Letters Patent. Patented July 6, 1915.

Application filed April 17, 1912. Serial No. 691,466.

To all whom it may concern:

Be it known that I, ULRICH STEINER, a citizen of the United States, residing at Waynesboro, in the county of Franklin and State of Pennsylvania, have invented certain new and useful Improvements in Grinding-Machines, of which the following is a specification.

My said invention consists in various improvements in the details of construction and arrangement of parts of grinding machines particularly for grinding cylindrical work of straight or tapered form, whereby such a machine is adapted for grinding two or more pieces of work simultaneously and with a single grinding wheel, thereby increasing the capacity of the machine and saving a large percentage of labor in the production of a given quantity of work.

Another object of my invention is the provision of means for adjusting the centers of the head-stock spindles with respect to the foot-stock spindles so as to bring and retain them in perfect alinement, thus assuring an even grinding action on the plurality of work-pieces and also assuring an even grinding action throughout the length of each work-piece.

With these and other objects in view my invention consists in a plurality of pairs of work-supporting spindles and a grinding element so related to said spindles that it will simultaneously act upon a plurality of work-pieces supported by said spindles.

It further consists in the novel features and construction and arrangement of parts to be described hereinafter and pointed out in the subjoined claims.

Referring to the accompanying drawings, which are made a part hereof and on which similar letters of reference indicate similar parts, Figure 1 is a top or plan view of a grinding machine illustrating the means of swiveling the work table to bring the work to any angle desired in relation to the grinding wheel for grinding tapered work, Fig. 2 a side elevation of a cylindrical grinding machine equipped with my invention, said machine being only representative of one type to which my invention can be adapted, Fig. 3 an end view with the driving pulley removed, Fig. 4 an enlarged transverse section taken on line w—w, Fig. 2, Fig. 5 an enlarged longitudinal section taken on line x—x, Fig. 3, Fig. 6 an enlarged substantially horizontal section taken on line y—y, Fig. 2, Fig. 7 an enlarged substantially horizontal section taken on line z—z, Fig. 2, Fig. 8 a rear view of a portion of one of the stocks, Fig. 9 a front elevation of one of the spindle-cases, and Fig. 10 a cross-section taken on line v—v, Fig. 5, looking into the direction of the arrow crossing said line.

Referring now to the drawings in detail, the reference numeral 1, designates the frame or body of the machine which may be of any approved construction, 2 is the head-stock and 3 the foot-stock, both mounted on the work table A which is swiveled on said frame or body by means of the pivot-bolt a and secured by clamping bolts a^1 engaging segmental grooves a^2 therein. Said head-stock and said foot-stock are secured on said work-table by bolts 4, which have heads 5 engaging in longitudinal T-shaped slots 6 in said work table, said bolts passing up through said head and foot-stocks and having nuts 7 applied to their projecting ends whereby said stocks are secured in position. As is common in machines of this type, the head and foot-stocks may be adjusted toward and from each other upon loosening said nuts and after being positioned where desired, it is only necessary to tighten the nuts 7 in order to retain the stocks in position. Obviously, the stocks are positioned to the length of the work-pieces to be placed therebetween. The head-stock has two work-supporting spindles 8, 9, and the foot-stock is also provided with two work-supporting spindles 10, 11, having their axes coincident with those of the spindles 8, 9. The spindles 8 and 10 and the spindles 9 and 11 are paired, and each spindle has the inner end of its bore slightly flared to receive a tapered centering pin 12, as is common. Between the centering pins of each pair of spindles, a work-piece 13 is supported.

The head and tail-stocks each comprise a main portion 14 and a spindle-case 15 adjustable vertically and horizontally on said main portion. Each spindle-case has two longitudinal bores 16, 17, the ends of the bores in the head-stock being counterbored to provide beveled seats 18 for a purpose to presently appear.

Each of the spindles of the head-stock comprises a sleeve 19 fitting loosely within

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the spindle-case but having at its inner end an enlargement 20 and between said enlarged end and the intermediate portion having a collar 21 with a beveled or conical face 22 fitting the adjacent counterbore or beveled seat 18 of the spindle-case. Near the opposite end of said sleeve it is reduced in diameter, as at 23, and between said reduced portion and the intermediate portion is an annular groove 24 which provides clearance for a cone 25 fitting onto said reduced portion. This groove is provided owing to the fact that a reduction in diameter as commonly made creates an abrupt shoulder which would prevent the proper adjustment of the cone 25 on the spindle. Said cone is seated against the adjacent counterbore or beveled seat 18 of the spindle-case, so that the spindle is supported only at the ends of the spindle-case.

In order that the spindles of the head-stock may be securely held in said stock, the outer end of each spindle is further reduced in diameter and externally threaded and on such ends a jam-nut 26 is threaded which bears against the outer face of the cone, forcing the latter against its seat and drawing the spindle outward to properly seat the conical face of the collar 21 against its seat. It is apparent from the foregoing, that the annular groove 24 provides the necessary clearance space to enable the cone 25 to be tightened against its seat while drawing the spindle outward. Within the inner ends of the spindles are fitted the centering pins 12 which form part of the spindles and are so to be considered when reference is made broadly to the spindles. Each centering pin has the usual conical outer end which is to be forced into the work-piece. Obviously the centering pin or "terminal" as it may also be called, may be in piece with the main portion of the spindle; or, a chuck or other appliance may be attached to the spindle which may hold or in which may be fitted suitable parts to hold the work-piece; or, in lieu of the centering-pin any other form of centering element or terminal may be used.

The spindles of the foot-stock may be constructed in any common manner, and by means of hand wheels 27 they may be drawn into the spindles proper or spindle-case, as the case may be, to release the work-pieces.

The spindles 8, 9, of the head-stock have face-plates 28 rotatably mounted on their enlarged inner ends, each face plate having an integral gear 29 which is in mesh with a pinion 30 secured to the inner end of a shaft 31 suitably journaled in the spindle-case and having a pulley 32 secured to its outer end around which passes a belt 33 for driving said shaft, but any other approved method of rotating said shaft may be resorted to. The shaft 31 is arranged parallel with the spindles and through the intervention of said pinion and the gears 29 causes said face-plates to rotate in unison in the same direction.

Projecting from each face-plate is a pin 34 which engage dogs 35 secured to the adjacent ends of the work-pieces, said pins entering forked portions 36 in the dogs and transmitting the rotary motion of said face-plates to the work-pieces.

The spindle-case of the head-stock as well as that of the foot-stock is adjustable on the main or body portion of the stock for the purpose of adjusting the spindles vertically, the purpose and advantages of which will appear hereinafter. This is accomplished by cutting into the main portion of each stock a guide and retainer groove 37 which is arranged at an angle to the base of the main or body portion of the stock, or at an angle to the spindles, and fitting into such groove is a tongue or extension 38 of the spindle-case having guide edges 39 fitting the guiding walls of said groove, said tongue or extension having its guide edges at a corresponding angle. Adjusting screws 40 are provided which pass through parts of the main or body-portion of the stock and take into parts of the spindle-case so that upon manipulation of said screws, the spindle-case can be moved lengthwise on the co-operating main or body-portion with a complementary upward or downward movement, depending on the lengthwise direction the spindle-case is moved. The adjusting screws are not depended upon to retain the spindle-cases in proper position, as considerable pressure is exerted on the cases during the grinding action and the adjusting screws must work comparatively easy. For such purpose I provide securing screws 41 which pass through the main or body-portions of the stocks and take into the spindle-cases. In this manner absolute security is assured after having adjusted the spindle-cases to desired positions.

The head and foot-stocks are positioned on the work table A at the front of the frame or body 1 of the machine, and at the rear a carriage 42 is longitudinally movable and rests upon a plane faced track 43 and a V-shaped groove 44, it having co-operating guide-portions 45, 46, respectively, and also a gear track 47 with which meshes a pinion 48 secured to a transverse shaft 49 journaled in the frame or body 1 and having at its front end a hand wheel 50 for manually rotating said shaft and primarily for positioning the carriage for the commencement of operations. On said shaft 49 is secured a bevel gear 51 which meshes with a bevel gear 52 secured to a longitudinally-disposed shaft 53 journaled in the frame or body 1, and where it projects from the end of the frame or body it has a cone-pulley 54 secured thereto around which passes a

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belt 55 for rotating said longitudinally-disposed shaft, which, through the intervention of the bevel-gears 51, 52, and shaft 49 cause the carriage 42 to be moved lengthwise on the frame or body at the desired speed.

To those skilled in the art to which this invention appertains it will be clear, when I state the carriage 42 carries the grinding element to be presently described, that said carriage reciprocates on the frame or body and that by means of a countershaft, commonly employed with machines of this type, the operator may reverse the movement of the carriage at will or stop the same if desired, or automatic reversal may be provided for.

56 designates a carrier or base which is guided for transverse movement on the carriage 42, said movement being at right-angles to that of the carriage and therefore toward and from the work-pieces. This carrier is adjusted in any well known manner and has a pintle 57 journaled therein, on which is secured an emery-wheel or other grinding device. Said spindle has also a pulley 58 secured thereto, around which is passed a belt 59 for driving said emery-wheel. The emery-wheel is moved in contact with the work-piece when the carrier 56 is properly adjusted.

The vertical adjustment of the spindles on the head and foot-stocks facilitates alining or locating the work-supporting centers properly relative to the emery-wheel spindle, and this feature is of decided advantage when it is desired to grind one work-piece to a larger finished size than the other; for example,—assuming that the work-pieces to be ground are of equal size when placed in the grinding machine and their centers are exactly the same distances above and beneath a plane passing horizontally through the axis of the grinding-wheel, the two work-pieces will be ground to exactly equal size; now assuming, the spindle to be adjusted vertically so as to bring the center of the upper work-piece one-sixteenth of an inch farther from a plane passing horizontally through the axis of the grinding-wheel than the lower, the lower work-piece will be acted upon after the upper work-piece is ground to its proper size, therefore, grinding the work pieces to different finished sizes, the lower being ground to smaller size. Or, if the centers of the lower work-piece is farther from said plane than the upper, said upper work-piece will be ground to smaller size. It is apparent therefore, that by the use of my invention, a plurality of work pieces can be ground simultaneously to the same or different sizes. In grinding tapered work it is only necessary to adjust the work table A on its pivot *a* as before indicated, to secure the angle desired. In grinding shafts having opposite ends of different diameters, the two pairs of the spindles 8, 10 and 9, 11, respectively, may be adjusted relative to the grinding wheel center so that both ends of the shafts may be ground without adjusting or readjusting the spindles. For example, two shafts eighteen inches in length, each to be ground to a diameter of one inch from one end to its center and to a diameter of one and one-half inch from its other end to its center, would be supported at the ends by two pairs of spindles, the shafts being reversed, end for end. Now, assuming the upper shaft to be acted upon to a finish of one and one-half inch and the lower to a finish of one inch, the spindle casings would have to be adjusted to bring the upper pair of spindles a distance above the horizontal center of the grinding wheel to finish the upper work-piece to a diameter of one and one-half inch while the lower is adjusted with the upper and is brought the proper distance closer to said horizontal center to assure its finish to a diameter of one-inch. When this is completed and the shafts are ground to a finish, they are removed from the work-supporting centers of the spindles and replaced one for the other and at the same time reversed end for end, thus the underground portions of the shafts can be ground to proper size without resorting to the fine adjustment required by the spindles. It is of course understood that when grinding shafts under such conditions, the grinding-wheel is moved lengthwise on the body or frame only the distance the shafts are to be ground at one operation. After being once adjusted, the spindles need not again be moved until another job is to be ground under different conditions or requirements. The construction of the spindles as above described is also of prime importance, as it is almost impossible to accurately bore the spindle bores in the head and tail-stocks so that when said stocks are placed on the frames or body 1 they will be in perfect alinement. Therefore, when the spindles are placed in their respective bores and it is found that the distance between centers of the spindles of one stock do not correspond with the distance between centers of those of the other, or when the spindles of one stock are not in the same vertical plane as those of the other, it is simply necessary to scrape or grind the counterbore or counterbores of the headstock at the proper place or places to make the center of both stocks correspond in every way.

It is apparent from the foregoing that an operator at a machine constructed according to my invention can produce nearly as much work, as two operators at two machines of the ordinary type.

As the illustrations and the description of my invention above given are merely of a

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representative form of a grinding machine embodying my invention, it is clear that minor changes in the details of construction or arrangement of parts may be resorted to without departing from the spirit of my invention or sacrificing any of the advantages thereof, and I therefore hold myself at liberty to make such changes in construction and arrangement as fairly fall within the scope of the subjoined claims which are to be given the broadest interpretation permissible by the prior art.

Having thus described my invention, what I claim is,—

1. A grinding machine comprising a plurality of pairs of work-supporting spindles and a single rotary circular grinding element positioned relatively to said spindles to simultaneously act upon a plurality of work-pieces supported by the respective spindles, the axes of said work-supporting spindles and grinding element being in parallel planes.

2. A grinding machine comprising means for rotatably supporting a plurality of work-pieces and a rotary circular grinding device adapted to simultaneously act upon said work-pieces, the axes of said work-supporting spindles and grinding element being in parallel planes.

3. A grinding machine comprising means for rotatably supporting a plurality of work-pieces and a grinding device arranged to simultaneously act upon said work-pieces, said supporting means and grinding device being relatively movable to permit of grinding said work-pieces to the same or different diameters.

4. A grinding machine comprising a plurality of pairs of work-supporting spindles and a rotatable circular grinding device arranged to be operatively positioned in different relationship to the several pairs of work-supporting spindles, whereby it is adapted to act against a plurality of work-pieces supported by said spindles to grind said work-pieces to different diameters.

5. A grinding machine comprising a plurality of pairs of work-supporting spindles and a grinding-wheel coöperating with said pairs of spindles to simultaneously act against a plurality of work-pieces supported by said spindles, the axes of said spindles and said grinding-wheel being movable relatively to bring the axis of the grinding-wheel closer to one of said work-pieces than the other or others.

6. A grinding machine comprising a plurality of pairs of work-supporting spindles and a rotatable grinding device coöperating with said pairs of spindles to simultaneously act upon a plurality of work-pieces supported by said spindles, said spindles being adjustable vertically to cause one pair to be a greater distance from a horizontal plane passing through the axis of said grinding device than the other.

7. A grinding machine comprising a plurality of pairs of work-supporting spindles and a grinding-wheel coöperating with said pairs of spindles to simultaneously act upon a plurality of work-pieces supported by said spindles, said spindles being adjustable in one plane and said grinding-wheel being adjustable in a plane at a right angle to the line of adjustment of said spindles.

8. A grinding machine comprising a plurality of pairs of work-supporting spindles and a grinding-wheel coöperating with said pairs of spindles to simultaneously act upon a plurality of work-pieces supported by said spindles, said spindles being adjustable vertically and said grinding-wheel being adjustable horizontally toward and from said spindles.

9. A grinding machine comprising a frame or body, a work-table swiveled on said frame or body, head and foot-stocks on said work table, said stocks having spindle casings adjustable thereon, and work-supporting spindles within said spindle casings.

10. A grinding machine comprising a frame or body, a work table, head and foot-stocks on said work table, each stock having two parts, one of which is adjustable on the other, and work supporting spindles in said adjustable part.

11. A grinding machine comprising a frame or body, head and foot-stocks on said frame or body including adjustable parts, and a plurality of work-supporting spindles in the adjustable part of each stock.

12. A grinding machine comprising a frame or body, head and foot-stocks on said frame or body, and a plurality of pairs of work-supporting spindles in each stock, at least one of said stocks having an adjustable part in which its work-supporting spindles are located.

13. A grinding machine comprising a frame or body, head and foot-stocks on said frame or body, at least one of said stocks being adjustable lengthwise on said fame or body, and work-supporting spindles in said stocks, at least one of said stocks having a vertically adjustable part in which its work-supporting spindle or spindles are located.

14. A grinding machine comprising a frame or body, head and foot-stocks on said frame or body, each stock comprising a main or body portion and a spindle-casing adjustable lengthwise on said main or body portion with a complementary vertical adjustment, and work-supporting spindles in said spindle-casings.

15. A grinding machine comprising a frame or body, head and foot-stocks on said frame or body, each stock comprising a main or body portion and a spindle-casing adjust-

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able on said main or body portion in an inclined plane, and work-supporting spindles in said spindle-casings.

16. A grinding machine comprising a frame or body, stocks on said frame or body having spindle bores therein, and spindles in said bores, said spindle bores being made to readily change the axis of one spindle to bring the same in alinement with that of the other.

17. In a grinding machine, a spindle stock having a spindle bore therein counterbored at opposite ends, and a spindle in said bore having conical enlarged parts fitting the counterbored ends of said bore.

18. In a grinding machine, a spindle stock having a spindle bore therein with counterbored ends, a spindle fitting in said bore and having a conical enlargement fitting one of counterbored ends of said bore, and a cone secured to said spindle and fitting the other counterbored end of said bore.

19. In a grinding machine, a spindle stock having a spindle bore therein with counterbored ends, a spindle fitting in said bore and having a conical enlargement near one end fitting one of the counterbored ends of said bore and having also an annular groove near its other end, said spindle being reduced in diameter adjacent said groove, a cone on the reduced portion of said spindle fitting the other counterbored end of said bore, and a nut threaded onto the outer extremity of said spindle and bearing against said cone.

20. A grinding machine comprising a frame, a work table swiveled on said frame, means for adjusting and securing said table on its pivot, a head-stock and a foot-stock on said work-table, each of said stocks being provided with a plurality of work holding devices, and the grinding wheel mounted to act upon a plurality of work pieces held by said work holding devices, substantially as set forth.

21. A grinding machine comprising a frame, a work-table swiveled on said frame, a head-stock and a foot-stock mounted on said work-table, each of said stocks being provided with a plurality of work holding devices, means for adjusting and securing said table, a grinding wheel, and means for adjusting and driving said grinding wheel to act upon the separate pieces of work mounted in said several work-holding devices, substantially as set forth.

22. A grinding machine comprising a frame, a work table swiveled on said frame, a plurality of sets of work holding devices on said table adapted to support several separate pieces of work, means for adjusting and securing said table on its pivot, and a grinding wheel mounted to operate upon the several pieces of work simultaneously, substantially as set forth.

In witness whereof, I have hereunto set my hand and seal at Waynesboro, Franklin co., Pennsylvania, this thirteenth day of April, A. D. nineteen hundred and twelve.

ULRICH STEINER. [L. S.]

Witnesses:
WATSON R. DARSIN,
JOSEPHINE ROLLMAN.